

TECHNICAL ASSESSMENT

**FOREST ECOSYSTEM IMPROVEMENT IN THE UPPER REACHES OF YANGTZE
RIVER BASIN PROGRAM**

(P164047)

**September 2019
The World Bank**

ABBREVIATIONS AND ACRONYMS

CDM	Clean Development Mechanism
CCER	Chinese Certified Emission Reduction
CO ₂	Carbon Dioxide
CPC	The Communist Party of China
DLIs	Disbursement-Linked Indicators
DRC	Development and Reform Commission
ETS	Emission Trade Scheme
FYP	Five-year Plan
FMP	Forest Management Plan
GoC	Government of China
GoS	Government of Sichuan
GPS	Global Positioning System
LSGS	Large-Scale Greening Sichuan Program
LTNFM	Long Term National Forest Management Program
M&E	Monitoring and Evaluation
MOF	Ministry of Finance
NDC	National Determined Commitment
NFPP	National Forest Protection Project
NFMP	National Forest Management Plan
O&M	Operation & Management
PforR	Program for Results
PDO	Program Development Objective
QER	Quality Enhancement Review
SFA	State Forestry Administration
NFGA	National Forestry and Grasslands Administration
UN	United Nations
US\$	United States Dollars

TABLES OF CONTENTS

I.	INTRUDUCTION.....	1
II.	PROGRAM STRATEGEC RELEVANCE	1
A.	National Context.....	1
B.	Provincial Context.....	2
III.	PROGRAM DISCRIPTION AND TECHNICAL SOUNDNESS.....	4
A.	Government Program Description	4
B.	Program for Result.....	6
C.	Technical Soundness of the Proposed Program.....	9
D.	Supporting System Assessment.....	18
E.	Institutional Arrangements and M&E System	22
IV.	PROGRAM EXPENDITURES FRAMEWORK ANALYSIS.....	31
V.	DESCRIPTION OF PRGRAM RESULTS FRAMEWORK AND PROTOCAL.....	33
A.	The proposed Program Development Objective (PDO)	33
B.	Proposed Program Results Chain and Result Areas	33
C.	Result Framework and Protocol	42
D.	Program Economic Evaluation	54
ANNEX 1: PROGRAM ACTION PLAN		58
ANNEX 2: LIST WITH TECHNICAL CHARACTERISTICS OF RARE AND PRECIOUS TREE SPECIES IN SICHUAN.....		60
ANNEX 3: TYPICAL TECHNICAL MODELS FOR FOREST DEVELOPMENT AND MANAGEMENT .		65

I. INTRODUCTION

1. This technical assessment has been carried out as part of the preparation of Forest Ecosystem Improvement in Upper Reaches of Yangtze River Basin Program for Results (the Program). The Program development objective (PDO) is to improve sustainable forest ecosystem management in support of Large-Scale Greening Sichuan Program. To realize the PDO, the Program will create the institutional capacity to enable Sichuan taking the lead in planning and implementing sustainable forest management and financing, and in scaling up best practice. Support would include the improvement to forest ecosystem management through the support of Sichuan government forestry program with focus on afforestation, degraded forest restoration and quality improvement, contributing to carbon sequestration and forestry ecological functions; long-term forest resources management planning; development of incentive-based ecological compensation mechanisms, including the institutional framework and technical support system for market-based inclusive forest carbon marketing; and upgrading human resources capacity through training and technical assistance. These activities will help to bring about an enduring change of theory to forestry development and long-term forest ecosystem management in Sichuan Province.

II. PROGRAM STRATEGIC RELEVANCE

A. National Context

2. China's environmental conservation and climate change challenges are unique in terms of their scale and complexity; they are also of global importance. It has been estimated that pollution and environmental degradation in China are reducing the country's gross domestic product by about 9 percent—one of the highest rates in the world.¹ China is also the world's largest emitter of greenhouse gas, accounting for almost 30 percent of total global emissions. This is due in part to its rapid economic growth in recent decades, and its heavy dependence on coal as an energy source. Recognizing the negative consequences of pollution and environmental degradation, the Government of China (GoC) has taken bold steps to address the situation. Through its Nationally Determined Contribution (NDC) agreed to under the United Nations Framework Convention on Climate Change (UNFCCC), produced at the Paris Climate Change Conference, the GoC committed to reducing its carbon emissions by 40 to 45 percent by 2020 relative to 2005 levels, and by 60 to 65 percent by 2030. Forests have been recognized as a potentially important way of achieving these targets, especially through the sequestration potential of its large areas of planted forests, and its rapidly growing forest biomass. China's forest stock is the largest in the world, which stores around 8.4 billion tons of carbon, and sequesters around 500 million tons of carbon dioxide (CO₂) each year, or the equivalent of 11 percent of the country's annual greenhouse gas emissions. Given the potential of forests to mitigate or offset the country's carbon emissions, the GoC is putting in place policy measures to encourage afforestation, including a commitment to increase its forest stock volume by 4.5 billion cubic meters by 2030 over 2005 levels.

3. In addition to increasing pollution, China's rapid economic growth has been coupled with the degradation of its natural resources including forest ecosystems. Forest ecosystems are the largest of

¹ World Bank estimates. Of the 9 percent, pollution-related health costs account for about 6.8 percent, natural capital and ecosystem degradation account for about 1.1 percent, and direct losses to agriculture and industry account for about 1.1 percent.

China's terrestrial ecosystems and provide essential environmental services such as the protection of soil and water resources, atmospheric pollution reduction, wildlife habitat conservation, and climate change mitigation. Their role in conserving water (intercepting rainfall, regulating runoff, improving groundwater storage, purifying water, and reducing flooding) is also of strategic importance in the context of China's water deficit situation. Forests also make an important contribution to economic growth and social wellbeing by providing around 45 million jobs, most of which are located in poor rural areas where job opportunities are limited. They are also important sources of forest products such as paper, timber, fuelwood, poles, and a wide range of non-wood forest products such as traditional medicines, herbs, and food products.

4. In recent decades, the GoC has launched a number of important forestry development programs which have resulted in a significant increase in forest cover. In the 1970s, forests covered 12.7 percent of China's land area, but by 2018, this had increased to 22.96 percent. Despite this substantial increase in area, forest cover in China remains low at 0.14 hectare per capita, or less than 25 percent of the world average. In addition, forest quality is poor, with an average mean annual increment in forest volume of only 4.23 cubic meters per hectare per year, around 56 percent below the global average. An overdependence on monocultures has also resulted in an increase in pests and diseases. China's limited forest resources and poor forest quality have impaired forest ecological function, and as a result, around 30 percent of the country's land (2.95 million square kilometers) is affected by erosion, with the loss of around 5 billion tons of soil per year. In addition, desertified land covers 1.87 million square kilometers (19 percent of the land area), and this is having a deleterious impact to the lives of about 400 million people. To realize the full potential which forests, have to protect the environment and deliver environmental services, forest cover needs to be expanded and forest quality needs to be improved.

5. Research and project experience worldwide has shown that mixed-species silviculture and improved forest practices can not only increase tree growth by 20 to 40 percent, but also improve the ecological functions of forests (reducing soil erosion, increasing soil microbial activity, reducing runoff, improving water quality, increasing biodiversity), strengthen their resistance to pest attacks and extreme weather events (ice storms), and increase their capacity to sequester and store carbon.

6. Recognizing that the poor quality of its forests will have a detrimental effect on their capacity to mitigate climate change and support sustainable and socially inclusive development, the GoC has assigned the highest priority to improving sustainable natural resources management and environmental protection. The future direction for forestry is clearly articulated in China's first long-term National Forest Management Plan (NFMP 2016–2050) issued by the National Forestry and Grassland Administration in June 2016. The NFMP clarifies the role of forests vis-à-vis the GoC's "ecological civilization" concept and calls for a shift from intensively managed monoculture plantations for timber production to multifunction forest ecosystem restoration and protection. To help facilitate this change in direction, the NFMP also calls for expanding the existing two categories of forestland use (public welfare forests, which are strictly protected) and commercial forests (for production) to three by including a third land-use category, multifunction forests. Such a move is intended to better balance the ecological, economic, and climate change benefits obtainable from forest management.

B. Provincial Context

7. Sichuan Province is a global biodiversity hotspot² covering half of the upstream area of the Yangtze River Basin. Around 1,780 kilometers of the Yangtze River flows through Sichuan, or around 28.2 percent of the length of Yangtze River; with around 470,000 square kilometers of the water catchment of Yangtze River Basin (26.1 percent) are located in Sichuan, and around one-third of the surface water flowing into the Yangtze River originates in the province. Sichuan is therefore strategically important to maintaining the ecological and hydrological stability in the Yangtze River Basin; the province also plays a crucial role in protecting China's ecological safety network. However, ecological conditions in Sichuan Province are fragile, and intense pressure on its natural resources has resulted in around 156,500 square kilometers, or 32 percent of the province, being adversely affected by erosion and flash flooding.

8. Forestland covers 17.5 million hectares in Sichuan, or around 36 percent of its land area. Due to the important protective function that they perform in the Yangtze River Basin, 71.2 percent of forestland has been classified as ecological forests, where the primary objective is environmental protection; the remaining 28.8 percent comprises commercial forests. Recognizing the key role forests play in provincial sustainable development and in the protection of vitally important ecosystem in the Yangtze River Basin, the GoC and the Sichuan provincial government have assigned the highest priority to sustainable forest management and conservation. The management strategy for the area is set out in the "*Ecological Environmental Protection Plan of Yangtze River Economic Belt*" issued by the GoC in 2017. The plan aims at improving forest ecosystem functions to enhance water holding capacity, soil conservation, biodiversity conservation, and carbon sequestration by increasing forest cover and improving forest quality.

9. To help realize these aims, Sichuan Province has implemented several ecologically focused forestry projects in recent years, including the Protective Forests on the Yangtze River, Protection of Natural Forests, Conversion of Cropland to Forests, Management of Rocky Desertification, Grassland Rehabilitation, and Soil and Water Conservation and Greening in Urban and Rural Areas. These projects succeeded in increasing forest cover from 19.2 percent to 36 percent between 1989 and 2015.

10. Despite the considerable progress which has been made to increase forest cover in the past, tree growth in large-scale plantations in Sichuan has been below expectations due to poor species and site selection, inadequate tending, and the extensive use of monocultures. Provincial data indicate that the stand volume in most plantations is only 52.27 cubic meters per hectare, substantially below the national average of 85 cubic meters per hectare, and global average of 108 cubic meters per hectare. Furthermore, monocultures have provided limited environmental protection in terms of erosion control, water retention and storage, and biodiversity conservation. Many monoculture plantations have also become susceptible to pest and disease attacks.

11. Sichuan's 13th Forestry Five-year Plan (FYP), issued in 2016, intensified efforts to strengthen sustainable forest management in the province, and to improve the resilience of forest ecosystems in critically important areas. The main thrust of the FYP is to restore and conserve natural ecosystems, improve ecological stability, and increase the output of environmental services, including carbon sequestration. To achieve these aims, the FYP created an additional 2 million hectares of plantations and provided for the enrichment planting of around 1.67 million hectares of existing degraded and low productivity forests. The plan also aims at increasing forest cover from 36 percent to 40 percent,

² "A biodiversity hotspot is a biogeographic region with significant levels of biodiversity that is threatened by human habitation" (https://en.wikipedia.org/wiki/Biodiversity_hotspot).

raising forest standing volume from 1.73 billion cubic meters to 1.80 billion cubic meters, and increasing areas under desertification control programs by 9 percent.

12. Further support for ecological forests is provided for under the State Council Resolution titled "*The Establishment of Sound and Comprehensive Mechanisms for Ecological Conservation Compensation*," and the 19th Communist Party of China (CPC) National Congress proclamation on poverty reduction in China. Both policy statements support the expansion of multiple use, ecological forestry programs (including carbon capture) by including pilot operations to scale up ecological compensation mechanisms, intensifying forest carbon trading, and increasing poor farmer participation in tree planting. The "*Action Plan for Establishment of Market Based and Ecological Conservation Compensation Mechanisms*," issued to provincial governments by the central government in January 2019, provides guidelines on how to operationalize the recommendations of the State Council Resolution. The plan provides for the establishment of market-based ecological conservation compensation mechanisms involving the public and private sectors under the guidance of provincial governments, the aim of which is to stimulate private investment in forest carbon trading and ecological conservation. The action plan assigns high priority to including private voluntary investments in forest carbon trading programs supportive of ecological restoration and conservation in poverty-afflicted rural areas. These initiatives serve to demonstrate the high level of political support that exists for the expansion of forest carbon trading and ecological restoration initiatives. They also highlight opportunities that exist for innovation, especially those related to identifying alternative financing mechanisms for carbon sequestration and forestry ecosystem restoration.

13. Recent policy developments at the national level provide considerable scope to expand mixed-species afforestation for the provision of public goods and services, including forest carbon trading in Sichuan. They also open the door to industries wishing to meet their emissions obligations under the Emissions Trading System to be introduced in China in 2020; and provide opportunities for those who wish to meet their voluntary carbon emission reduction commitments which, in turn, will help Sichuan contribute to China's NDC under the UNCCCF Paris Agreement.

14. To operationalize the FYP, several forestry programs have been launched, the most significant of which is the Large-Scale Greening Sichuan Program, which approved by the Sichuan Government for implementation in 2016 with arms to improve natural ecosystem by afforestation and other landscape restoration interventions. However, current technical regulations and guidelines focus mainly on conventional forestry practice with monocultures. Experience with the establishment and management of more ecologically stable mixed-species planting is limited in Sichuan, and few proven planting models exist to cater for the wide range of silvicultural conditions in the province. To improve the effectiveness of forestry programs under the 13th FYP and the "*Ecological Environmental Protection Plan of Yangtze River Economic Belt*," the Sichuan provincial government has requested the World Bank to provide national and international expertise to guide the transition from conventional monoculture forest management to sustainable, large-scale, multifunction forest ecosystem restoration and conservation.

III. PROGRAM DISRIPTION AND TECHNICAL SOUNDNESS

A. Government Program Description

15. The Large-Scale Greening Sichuan Program (LSGS) was launched in 2016 to spearhead greening activities in the province under the 13th Five-Year Plan (2016–2021). The objectives of the LSGS are to improve forest ecosystem functions by increasing forest coverage, improving forest quality, and promoting forest resilience and stability, with the goal of substantially improving the ecosystem functions of forests, grasslands, wetlands, and deserts to establish a fully-fledged ecological safety

system in one of the most important upstream areas of the Yangtze River.

16. Nine tasks are to be undertaken over the program period: afforestation and reforestation, planting in the upper reaches of the Yangtze River and improving water resources management, enhancing forest quality, restoration of ecologically vulnerable areas, roadside greening, the ecological rehabilitation of grasslands, rural homeland greening, urban tree planting, and strengthening the protection of conservation areas. The LSGS plans to establish 0.9 million hectares of plantations (including 200,000 hectares of planting on land suitable for afforestation and 700,000 hectares on land unsuitable for farming), 1.1 million hectares of mountain closure (including 250,000 hectares of planting in understocked forestlands, 520,000 hectares of planting in shrublands in closed mountain areas, and the management and maintenance of 293,000 hectares of closed immature forestlands); restore 1.6 million hectares of ecological and wetland areas; improve 660,000 hectares of ecologically vulnerable areas; rehabilitate 2 million hectares of ecological conservation areas and grasslands; and improve the quality of 1.3 million hectares of degraded forests. The LSGS activities will focus in 21 prefectures/cities.

17. Specifics on the nine activities include:

- (a) The afforestation and reforestation subprogram aimed at afforesting/reforesting barren hills, slopes, and beaches, and planting steep slope land, which is unsuitable for farming but is suitable for forests and vegetation restoration. The intention is to gradually increase the forest area and accelerate the greening process. Around 740,000 hectares of new forests will be created, and 886,000 hectares will be closed for protection and recovery.
- (b) The planting along the upper reaches of the Yangtze River and water system protection subprogram prioritizes afforestation activities along the Yangtze River corridor. It aims at establishing 20,000 kilometers of green ecological corridor to protect water catchments and protecting 1.67 million hectares of wetlands and 60 wetland parks.
- (c) The forest quality improvement subprogram aims at improving the quality of degraded forests by intensifying thinning and tending. In addition, enrichment planting will be undertaken to improve the species mix of existing monoculture plantations. Under the subprogram, the quality of 800,000 hectares of medium-quality and young forests will be improved, together with 533,000 hectares of low-quality forests (including degraded forests).
- (d) The restoration of ecologically vulnerable areas subprogram comprises interventions for desertification control, karst area management, and arid and semi-arid land management for ecological restoration. It covers 404,000 hectares of decertified land; 242,000 hectares of karst landscape; and 20,000 hectares of arid and semi-arid land, mainly on grassland; and the restoration of areas that have been disturbed by both natural disasters and industry.
- (e) The roadside and railway side planting subprogram will aim to improve scenic quality through planting 40,000 kilometers along roadsides and 1,800 kilometers along railways.
- (f) The ecological restoration of grasslands subprogram will restore degraded grasslands through reseeding and natural regeneration. 1.8 million hectares of grassland will be improved, comprising 1 million hectares of new grass planting, 400,000 hectares of grassland improvement, 200,000 hectares of planted grassland, and the seeding of 200,000 hectares of barren wasteland.

- (g) The rural homeland greening subprogram will enhance green cover in 93,000 hectares of rural settlements and towns.
- (h) The urban tree planting subprogram will increase the green area in cities, villages, and towns, by establishing new forest parks, and tree planting in urban areas. In total, 10,000 hectares of urban park green space will be vegetated, and 2,000 hectares of trees will be planted.
- (i) The protected areas conservation subprogram aims to expand areas under protection. This will involve creating 500 natural protection sites (including 200 forest parks) and forest reserves covering at least 23.6 million hectares with a standing volume of 1.8 billion cubic meters of wood.

B. Program for Result

18. The Program would be embedded in the LSGS and would seek to improve the quality and effectiveness of selected forestry operations in the LSGS (and subsequent renewals thereof) by establishing the required institutional capacity in program related areas, supporting innovative new planting techniques and forest management practices, mainstreaming international and national best practices into provincial operations, and improving the sustainability and efficiency of forest financial mechanisms. It will operate within the framework of the provincial 13th Forestry FYP and county-level plans. To avoid spreading Program activities too thinly on the ground, its activities will focus on subprograms in the LSGS that aim at restoring forest ecosystems, improving the delivery of public goods and services, and increasing carbon capture. To maximize the impact of the Program, an Environmental and Social Systems Screening and Assessment exercise was used to refine the Program boundaries, which are:

- (a) Promoting afforestation/reforestation: Will include all activities linked to afforestation or reforestation where the primary objective is not commercial-scale timber production;
- (b) Improving the quality of forests: Will cover all activities linked to improving poor-quality forests where the primary objective is not commercial-scale timber production. These activities include but are not limited to tending and enrichment tree planting;
- (c) Promoting natural forest regeneration to restore the forest ecosystem at the landscape level, particularly on steep mountainsides and rocky areas.

19. Almost all field interventions would comprise the establishment and rehabilitation of multifunction forests with a mixture of mainly indigenous broadleaf tree species, including rare and precious species.³ The overall aim would be to restore sustainable productivity, enhance forest ecological functions, and strengthen resilience to stress associated with climate change and extreme weather events. Managing the shift from monoculture forests for wood production to mixed-species forests for environmental and climate change mitigation is challenging; it requires a change of institutional mindset and culture, together with the development of new silvicultural technical models, new skills in nursery management, demanding species-site-matching techniques, more complex

³ Rare species are endangered species or species with limited natural distributions; valuable species are characterized by hard wood, long-life, and climax community. All such species are core communities contributing to the biodiversity and stability of a forest ecosystem.

systems of forest management, and different approaches to impact evaluation. In addition, it requires a better understanding of species growth rates, site requirements, shade tolerance, and species interaction and compatibility. The Program inputs will play a key role in ensuring that these skills are put in place to ensure that these new challenges are adequately prepared for.

20. Activities 1, 2, and 3 of the LSGS fall within the Program boundary and can be grouped thematically into afforestation/reforestation, rehabilitating degraded forest ecosystems, and assisted natural regeneration on mountain slopes. Specifically, they include the afforestation of 175,000 hectares, forest quality improvement through enrichment planting and forest management of over 475,000 hectares. In total, the activities would cover 650,000 hectares in 35 counties of Sichuan province under LSGS (2016–2021), these having been included because of their declared commitment to and interest in undertaking mixed-species silviculture with multifunction objectives. They are also strategically located in the most important tributaries of the Yangtze River in Sichuan Province, have large areas of degraded monoculture plantations, contain areas rich in biodiversity, and are highly vulnerable to erosion.

21. From 2016 to 2018, around 433,000 hectares afforestation and degraded forest restoration have been completed and around 217,000 hectares of afforestation (around 50,000 hectares) and degraded forest restoration including natural regeneration (around 167,000 hectares) remained in the 35 Program counties. The Program will mainly finance those greening activities. Even though the LSGS does not prescribe the adoption of mixed-species planting, the Sichuan Provincial Forest Management Plan (2016–2050) specifies that mixed-species planting must comprise 14.3 percent of all tree planting by 2021. To help accelerate the incorporation of rare and precious species under the proposed Program, the Sichuan Provincial Forestry and Grassland Bureau (SFGB) has increased its target of mixed-species plantation forests from 14.3 percent to 60 percent through afforestation and the restoration/rehabilitation of degraded and monoculture forest in the Program areas (35 counties) by 2021.

22. The Program would run for five years starting in 2019, with afforestation and forest management being concentrated in the first three years (2019 to 2021), and institution building, monitoring and evaluation, and the scaling up of Program activities outside the program area using domestic resources being carried out during the entire Program period until the end of 2023. A provincial budgetary and expenditure assessment carried out by the World Bank confirmed that the funding provisions for forestry in recent years have been stable and adequate at the national, provincial, and local government levels. Under the Program, Bank financing will be used to support around 130,000 hectares of mixed-species plantation established through afforestation and restoration of degraded forests, accounting for around 60 percent of the LSGS target in 35 counties.

23. To ensure that adequate capacity exists to undertake the Program, and to ensure the ability to scale up best practice, the Program will include an extensive training program and technical assistance for forestry sector capacity building. This will serve to improve the quality of Sichuan's 14th Forestry FYP (2021–2025) and help facilitate the shift from monoculture forest management to mixed species, multifunction forest management with a strong focus on the provision of public goods and sustainability.

24. To optimize the effectiveness of the LSGS in forest ecosystem management, innovative mixed-species-planting models and a long-term forest management regime and financing mechanisms will be introduced under the Program.

25. The scope of the proposed Program relative to the LSGS is shown in figure1 and table1.

Figure 1. Scope of the Proposed Program

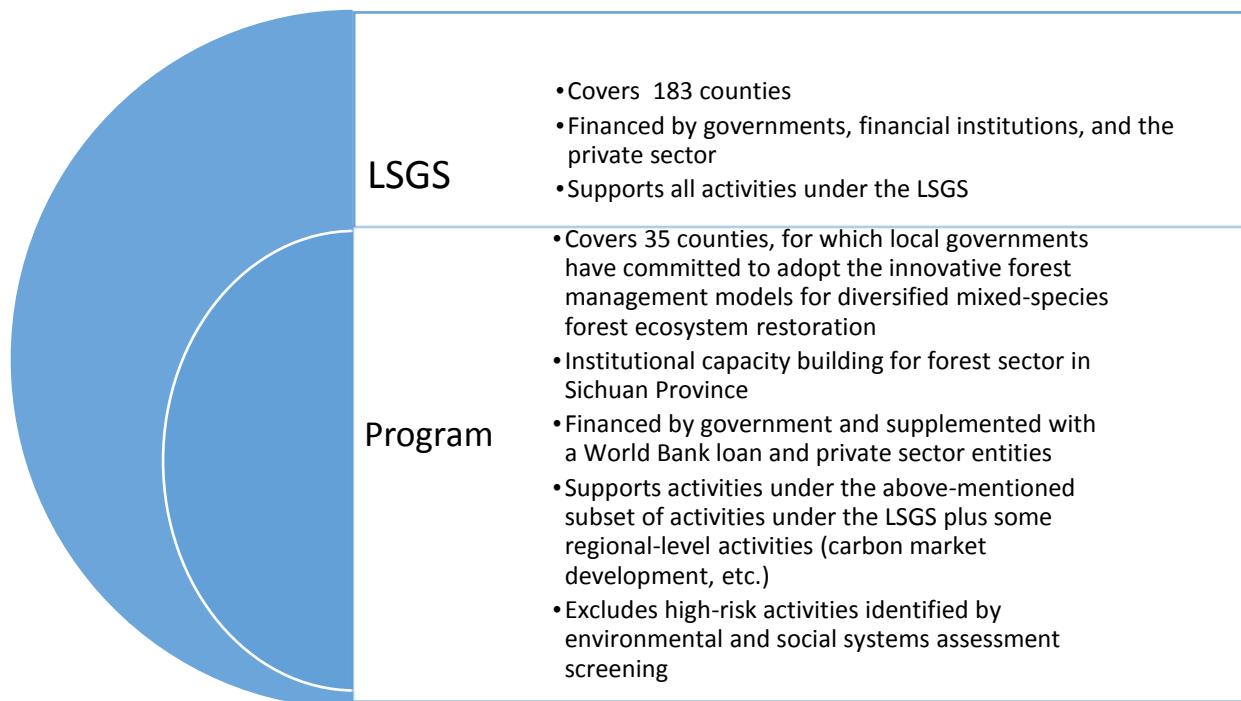


Table 1. Program Counties

No.	Counties	No.	Counties	No.	Counties
1	Jianyang	13	Wutongqiao	25	Qianwei
2	Youxian	14	Jinkouhe	26	Shawan
3	Anzhou	15	Jiajiang	27	Muchuan
4	Jiangyou	16	Ebian Yi	28	Nanjiang
5	Yanting	17	Mabian Yi	29	Jingyan
6	Zitong	18	Longquanyi	30	Shizhong
7	Chaotian	19	Pingchang	31	Cuiping
8	Jiange	20	Yingshan	32	Tongjiang
9	Wangcang	21	Xingwen	33	Yucheng
10	Qingchuan	22	Junlian	34	MingShan
11	Jintang	23	Tianquan	35	Xuzhou
12	Pengxi	24	Nanxi		
Total					35 counties

C. Technical Soundness of the Proposed Program

Results Area 1: Promoting Best Practice for Forest Ecosystem Management

Strategic Relevance

26. As one of the hotspot regions for global biodiversity conservation, Sichuan Province is located in the upper reaches of the Yangtze River Basin, which covers half of its total upstream area and functions as a major player in the ecological barrier on the upper reaches of the Yangtze River, performing an important role in the national ecological safety pattern. The Government of Sichuan Province has been attaching a great importance to forest resources management. In 1989, it made a major decision on “Greening the whole Sichuan,” and since then the province has implemented a number of afforestation and forest management programs, such as the programs of Protective Forest Plantation along Yangtze River, Natural Forest Resources Conservation, Green for Grain, Stone Desertification Control, Giving up Grazing for Grass Growing, Soil and Water Conservation, and Urban and Rural Greenery, in an endeavor to plant trees and grass for ecological restoration and rehabilitation. As a result, remarkable progress has been made in the improvement of the urban and rural eco-environment.

27. However, the forest resources are not enough to protect the important ecological landscape in Sichuan, particularly the watersheds along the upstream and midstream of the Yangtze River Basin, including large catchment areas in large number of its tributaries, and forest quality is poor, with low growth and ecological functions. The forest inventory and surveys indicate that in the province there are still 600,000 hectares of barren forestland that need to be planted.

28. Large areas of degraded low-quality forests are also resulting in poor functions, which significantly prevents the ecological functions of forest ecosystems in the watershed landscape. In Sichuan, young and middle-aged forests cover 7.1 million hectares, making up 40.7 percent of the total forest area of the province, of which low-quality forest comprises more than 40 percent, or around 2.7 million hectares. In Sichuan, on average, the forest stock volume is 52.3 cubic meters (m^3) per hectare of forest stands, which is lower than the national average of 85 cm^3 per hectare and far below the international level of 108 m^3 per hectare (48 percent of the international average). It is estimated that in China, the value of main ecological services per hectare is around US\$4,000, which is only 40 percent of developed countries like Japan, and the capacity of forest carbon sequestration is around 91.7 tons per hectare, which is much lower than the international level of 157.8 tons per hectare, on average, in mid- and high-latitude zone areas (similar areas to China). Poor forest quality is due, in part, to the overlogging and appropriate forest management, and because the monoculture conifer plantations cover large areas (more than 90 percent of the plantation in Sichuan are monoculture forests), which resulted in a reduction in land productivity and low forest functions and made the forests vulnerable to natural disasters such as snow storms and pest outbreaks. Therefore, strengthening forest management can largely improve the forest ecosystem functions, resilience, and carbon sequestration capacity.

29. The Communist Party of China (CPC) Central Committee and the State Council promulgated “Recommendations for Accelerating Ecological Civilization Progress” in 2014. Accordingly, the Sichuan CPC Provincial Committee and the Provincial government transmitted “the Plan for Implementation of the Recommendations for Accelerating Ecological Civilization Progress,” making afforestation a priority and the vehicle of ecological civilization progress. In 2015, the Sichuan Provincial CPC Committee at its 7th plenary session of the Provincial Congress made an important decision on initiating the “Large-Scale Greening in Sichuan Province” Program. Greening Sichuan on a large scale will help create greater eco-environmental capacity and resources-carrying capacity for the fulfillment

of green development through enlarged areas of forest cover and increased forest stock volume. It will also promote green transformation of the economic development pattern through use of forest resources to energize carbon emission mitigation and green economic development.

Technical Soundness of the Proposed Program

30. Assessment on Technical Design: The assessment on the system of afforestation and forest management technical management was undertaken and it present that the design and implementation of the LSGS is based on a number of technical guidelines and regulations, including those for seed and seedling production, afforestation field practice, forest management and protection, together with well-established technical and quality control procedures needed for forest monitoring and evaluation. Key regulations are included in the following table 2.

Table 2. Key Technical Regulations and Norms Relevant to the Program

Activity	Title	Reference number	Description
Afforestation and forest management	1.Afforestation Technical Regulations	GB/T15776-2016	Technical regulations cover afforestation, forest tending, and thinning, degraded forest rehabilitation, and include detailed technical guidance and procedures to be followed for afforestation and forest management, including seedling preparation, site preparation, planting, forest tending, thinning, enrichment planting, natural regeneration promotion and forest rehabilitation, and forest harvesting. Regulations for Forest Inventory provide detailed technical guidance on how to collect compile and store data on the growing stock. They are an extremely useful for the monitoring and verification process.
	2.Forest Management Technical Regulations	LYT 1646-2005	
	3.Forest Management Technical Procedures	GB/T 15163-2004	
	4.Forest Tending and Thinning Technical Procedures	LY/T 1898-2010	
	5.Techical Regulations for Degraded Protection Forest Rehabilitation	DB51/T1807-2014	
	6.Technical procedures for Low Quality Forest Improvement	LY/T 2083-2013	
	7.National Technical Regulations for Inventory and Forest Management Planning and Design	GB/T 15781-2015	
Forest Verification	8.Technical Regulation for National Afforestation Verification	LY/T 1690—2017	Technical Regulations for Afforestation and forest management verification set out the technical procedures to be followed when the quality of planting and management is being assessed, for example, seedling use, land preparation, tree planting, forest tending, thinning and harvesting.
	9.Technical Regulations for Forest Management Verification	Forestry (Forest Management) [2014] No. 140	
	10.Technical Regulations for Afforestation undertaken with subsidies from the National Budget	Forestry (Afforestation) [2012] No. 9	
Seedling and Nursery Management	11.Seedling Quality Grading for Main Tree Species		These Technical Regulations ensure that the necessary standards are being applied for the production and use of good quality tree seeds and seedlings.
	12.Seedling Quality Grading for Main Tree Species in Sichuan	GB6000-1999	
	13.Seeds Quality Grading for Main Tree Species in Sichuan	DB51/T705-2007	
	14.Nursery Techniques for Container Seedlings Production	DB51/T706-2007	
	15.Nursery Techniques for Tree Species	LY/T 1000-2013	

31. The relevant Regulations for Afforestation and Forest Management provide detailed guidance and instructions for afforestation and forest management design, including tree species selection, seedling production, soil preparation, seedling planting, planting density, enrichment planting, forest tending, thinning, natural regeneration, the rehabilitation of degraded forest land, environmental protection, and quality control.

32. Technical Directives cover all aspects of forest management, including the planning and management of field operations, all of which aim to ensure that acceptable standards are achieved in the field. However, they do suffer the deficiency of lacking detailed technical prescriptions for mixed species plantation management, and the management of specific tree species, especially rare and valuable tree species. If the quality of government forestry programs is to be improved, this deficiency will need to be addressed. For instance, the "*regulation for afforestation*" suffers such a deficiency in that it provides detailed techniques for seedling production, soil preparation, and seedling planting, but it does not include clear guidelines for the management of multi-function forests. The establishment of mixed-species forests is mentioned, without providing the necessary practical technical details on how to do it. Similarly, the "*Technical standard of transformation of low-quality Inefficient forests*" includes the technical principles for enrichment planting, however, the guidance on site-species matching and appropriate model development and selection are missing, which are crucial for good forest growth.

33. The afforestation and reforestation subprograms aim at afforesting/reforesting barren hills and watersheds and planting steep slopes of land that are not suitable for agricultural activities. The afforestation along the upper reaches of the Yangtze River Basin focuses on the establishment of the ecological corridor protection forest system based on the water systems of the Yangtze River and its key tributaries, the Dadu River, Fujiang River, Jialing River, Jinsha River, Minjiang River, Qujiang River, Tuojiang River, and Yalong River. The protections developed under the Program are functioning primarily for the purposes of soil and water conservation, forest ecosystem resilience improvement and integrated watershed management, which would be carried out to restore and protect river catchment ecosystem to maintain ecological safety of this important system.

34. However, the technical regulations and guidance focus on conventional afforestation and forest management activities with majority of the plantations are established as monoculture conifer stands and large areas have been degraded by long-term inappropriate human intervention, instead of promoting forest ecological restoration at the landscape level; the technical regulations are also lack of technical prescriptions for long-term forest management and protection, and the use of broadleaves tree species and appropriately match those species especially rare and precious tree species to site conditions. Therefore, the large-scale and poorly managed monoculture plantations, poor species-site matching and lack of long-term sustainable forest management planning with balancing ecological protection and local community development are the main reasons why Sichuan's forests are of low quality and have less than optimal ecological functions.

35. The proposed Program aims to improve the forest ecosystem management by helping the Sichuan government facilitating the move away from monocultures to well managed multi-functions, diversified species planting with promoting close-to-nature forest management approach. This will ensure that forest management is more sustainable, and ecosystem focussed, with their outputs comprising a balance of public services and private benefits. To successfully achieve this, a number of technical improvements are required, namely, an increase in the use of seedlings of native, rare and valuable species; the provision of technical directives, guidelines and training on how to establish and manage such plantations; and the

long-term forest landscape planning and stainability. The knowledge gained, and lessons learnt from the Program will be extended to elsewhere in China as well as in other countries. The improved technical models are discussed and agreed, which is detailed in Annex 3.

36. Key technical innovations of the design are described in the following paragraphs.

(A) Promoting New Concepts

37. The Program will bring international and national best practices to promote the use of multifunction and mixed-species forest structures (the close-to-nature approach) to improve forest ecosystem stability and vitality with a balance of public and private benefits. More specifically, the program would promote a shift from traditional intensive-style monoculture management to the close-to-nature forest management concept with a focus on forest ecosystem/landscape restoration and multi-function management. This would be achieved by:

- (a) Promoting the use of diversified tree species mixtures in forest management. Studies on natural forest formations show that tree species comprise a complex web of elements and forest ecosystem functions, with the physiology of different tree species performing different functions in the forest ecosystem. The aim of multifunction forest management would be to support these functions so that the target trees would be able to fulfill their natural roles in the forest ecosystem more efficiently. To date, China has made limited use of this concept, with most planting comprising a single species.
- (b) Promote improvements to forest structure and stability. A multistory forest structure with mixed species, large-diameter trees, and vigorous growth is synonymous with a healthy and ecologically rich forest; these are also the essential characteristics of multifunctional forest management.
- (c) Promote improvements to forest ecosystem vitality. The vitality of a forest ecosystem can be assessed by the health of its growth and stands. The productivity of a healthy mixed-species stand is superior to that of a degraded monoculture stand under stress. A healthy mixed-species stand also has greater capacity to adjust and adapt to stress, natural disasters, and human interventions and, as a result, can provide more stable economic and ecological functions. In contrast, the productivity of degraded monocultures is low due to physiological stress.
- (d) Promote multi-function forest. Forestland and forest owners are more likely to protect their forestlands if they benefit from its management. Multi-function forest management will seek to achieve this by strengthening the sense of ownership among farmers by allowing them to harvest limited quantities of produce from their areas and the use of precious species with contributing to both biodiversity conservation and high value products to land owners.

(B) Proposed Technical Models

38. Nineteen technical models have been developed with the detailed prescriptions on promoting mixed-species plantation, the planting and protection of a wider range of rare and precious tree species; and the full-cycle management planning for sustainable forest management and resilience forest ecosystem restoration. Of the nineteen models, eight are for afforestation/reforestation, ten are for degraded forest

rehabilitation and monoculture transfer, and one are for natural regeneration promotion. Those models will be used under the Program operation and will be scaled up under the long-term forest management planning in whole provinces as well as in China, including other provinces and counties along the Yangtze River Basin with similar natural conditions.

Results Area 2: Strengthening Institutional Capacity in Support of Sustainability

Strategic Relevance

39. This results area would focus on the promotion of long-term forest management incentive mechanisms through long-term forest resources management planning and creating financing incentive for forest management and income generation to land owners including individual farmers and communities, and the institutional capacity building to create enable conditions for long-term sustainable forest management and financing in Sichuan. It will address those aspects in improving the technical standards and regulations, training to local forest staff and planting and forest management entities including individual farmers.

40. Lack of sustainable forest financing is one of key issues identified in China forest management. Large number of ecological forest planting and forest management activities have been subsidized by the Government, however the level of payments does not reflect the value of the environmental services being generated. Ecological services have not been fully compensated. The limited funding and long-term financing mechanisms is largely responsible for the lack of private interest in ecological forestry and the existence of large tracts of poorly maintained forest stands in China. Therefore, one key consideration giving to the Program design is the support of sustainability of forest ecosystem management.

Technical Soundness of the Design

41. Long-term forest management planning. The Program would support long-term provincial and county forest management planning within the framework of the National Forest Management Plan (NFMP) (2016 to 2050) issued in 2016 by the former State Forestry Administration (now called the National Forestry and Grassland Administration). The NFMP establishes the principles to be followed and provides guidance for the preparation and implementation of the long-term integrated forest resources management plan aimed at improving forest ecosystem conservation and resilience by balancing the economic, social, and ecological functions of forests. The NFMP supports the Government of China's ecological civilization concept by initiating the shift from traditional intensively managed monocultures for timber production to ecologically oriented multifunction forest management for ecosystem protection as primary purpose.

42. The NFMPs advocate for forest ecosystem restoration and protection through the promotion of diversified species and multiple-function forests, where the primary aim is to improve the sustainable ecological functions of forests. More specifically, the NFMP emphasizes the "three-categories" concept of forest classification and management, to add the multifunction management forests between the original dual categories—(a) public welfare forests, and (b) commercial forests—in which, the first part is strictly protected, and the second part is intensively managed. This proposed new classification is based on international practice, which aims to create links between these two forest categories with the promotion of multifunction forest management strategies. This new policy framework will strengthen the move toward implementing multiuse forests to balance forest public services and economic and social benefits and provide incentives for the development of more sustainable ways of financing forest management,

including attracting the private sector to invest in forest management and ecological landscape restoration.

43. The Program would support technical assistance to help the forestry sector in Sichuan move in this direction through the preparation of coherent and effective best practice provincial and county level forest management plans. These plans will incorporate international best practice and cost-effective planting models and provide opportunities for the development of alternative sources of financing. By building a robust and effective triple-level forest management planning system (national, provincial, and county), conditions will be created to roll out a sustainable ecological forestry agenda throughout the province. As the NFGA considers the Program as its pilot for the implementation of NFMP, the best practice on long-term sustainable forest management planning and landscape restoration learned from the Program will be disseminated nationwide.

44. Forest carbon trading framework and technical system development. It was shown that during 2001–2010, forest resources offset about 11.3 percent of China’s greenhouse gas emissions, and the forest resources are expected to play a significant role in the country’s commitment to address climate change risk. To achieve this objective, China’s first Nationally Determined Contribution (NDC) commits to an increase of 4.5 billion cubic meters of forest carbon stock by 2030 over 2005 levels. The experience of forest carbon projects implemented with the support of the Clean Development Mechanism and voluntary domestic action through pilot emission trading systems highlights the scope of forest carbon trading as a key source of financing for sustainable forest management.

45. The potential for forest carbon trading in Sichuan is significant. During the last three decades, the government has implemented several major forestry projects such as the Grain-for-Green Project and the Yangzi River Basin Shelterbelt Project. A significant percentage of forests created under these projects is the planted forests that have a potential capacity for carbon sequestration. In addition, about 600,000 hectares of barren land are available for afforestation for sequestering carbon, and the improvements in forest quality will also largely increase the carbon sequestration capacity of forests to facilitate the achievement of China’s NDC forestry targets.

46. However, the experience to date with forest carbon trade in China under the Clean Development Mechanism, the China Certified Emission Reduction credit scheme, and other voluntary standards (Verra, and Gold Standard) have shown that the time and costs needed to design, implement, validate, and verify forest carbon projects are substantial and constrain China’s mitigation and forest trading potential. The recommendations of the State Council on “Establishment of Sound and Comprehensive Mechanisms for Ecological Conservation Compensation” under the 19th CPC National Congress provide opportunities for the Program to address this issue by designing and piloting market-based and diversified ecological compensation mechanisms in support of forest carbon offsets and trade.

47. The recently published “Action Plan for the Establishment of Market Based and Ecological Conservation Compensation Mechanisms” issued by the central government to provincial governments provides guidance on how to stimulate large-scale participation of public and private sector enterprises and stakeholders in ecological conservation. It emphasizes the importance of promoting voluntary forest carbon sequestration projects to harness ecological, social, and economic benefits, and aims at attracting private investment to enable carbon markets to play a more significant role in ecological restoration and conservation, with priority being given to forest carbon sequestration projects in areas with high poverty rates.

48. Inclusive and market-based approaches can help reduce transaction costs by simplifying the carbon trade process. Taking account of the multiple benefits forests yield through poverty reduction, environmental conservation, social and economic development, and carbon sequestration, inclusive forest carbon trading approach can help in sharing costs and promoting more cost-effective forest carbon offsets. The Program will help create an institutional framework supportive of regional carbon sequestration and trading by piloting an innovative inclusive and market-based approach under the national Emissions Trading System to achieve ecological conservation, climate change mitigation, and poverty reduction, and by catalyzing private sector participation in forest resources management and conservation under the developed incentive mechanism. The Program will also help generate and scale up the knowledge of and experience in inclusive and market approaches for cost-effective forest resources management and conservation.

49. More specifically, an institutional framework and technical support system will be developed under the proposed national Emissions Trading System, as well as under the voluntary commitments facility for use by public and private agencies for ecological restoration. The outputs are (a) assessment of forest carbon potential in Sichuan Province under forest management interventions; (b) a proposal on inclusive forest carbon trading mechanisms and operational procedures for implementation; (c) methodologies on forest carbon trading with a focus on inclusive forest management and afforestation and reforestation activities; (d) development of technical capacity through training, knowledge products, and dissemination of forest carbon offsets and trade; and (e) verification of the readiness and technical capacity to implement inclusive forest carbon trading mechanism.

50. Payments for environmental services (PES) for hydrological and biodiversity conservation. The ecological forests provide important benefits to society by preserving valuable hydrological services (such as regulating water flows, thus reducing the risk of wet season floods and dry season shortages; reducing sediment delivery; and improving water quality) and conserving biodiversity. Therefore, in addition to the forest carbon market development under the PES framework, the Program will include preparation of a proposal for appropriate incentives to induce the sustainable establishment and maintenance of ecological forests. This will allow the exploration of additional opportunities to provide incentives for long-term sustainable forest ecological management and community development.

51. This work will include (a) identification of critical areas that would be especially important to protect or restore in order to safeguard hydrological services and/or biodiversity conservation, (b) assessment of alternative land uses within the ecological forests classification to determine the degree to which they would generate various ecosystem services and their cost of establishment and maintenance; (c) identification of the main landholder types encountered in these critical areas (for example, households, communities, farmer cooperatives, forest farms); (d) assessment of the short- and long-term costs and benefits of ecological forests and of alternative land uses for the landholders themselves, to allow the minimum compensation to be identified; and (e) a review of current incentive instruments to determine to what extent they meet or fall short of the minimum requirements. Analyses (b)–(d) should be conducted separately for each area to allow differences in conditions in different parts of the province to be identified.

52. Technical assistance and training. An assessment of technical assistance and training needs confirmed that Sichuan Province has a strong forestry culture and well-developed and competent forestry institutions. The assessment of its technical capacity concluded that institutional capacity and experience

at the provincial and county levels was adequate to successfully implement the Large-Scale Greening Sichuan Program. In addition, a well-established system of forestry education, research, and extension also exists.

53. However, under the Program, innovative practices and new technologies will be needed to facilitate the shift from traditional monoculture forest management to cost-effective, mixed-species silviculture and forest management directed at conservation and the production of environmental services, including carbon sequestration and trading. The Program will have a crucial role in shepherding this shift toward a new paradigm, and new know-how and skills will be needed to achieve this shift, and to consolidate this shift beyond the period of the Program.

54. At present, little training material exists on ecological and multifunctional forest management, and local staff lack the competence to apply its principles in the field. The Program will therefore support technical assistance and training in such themes as site management, site classification, species-site matching, mixed-species afforestation and management, underplanting, the tending of natural regeneration, environmental accounting, participative planning, and gender equality.

55. The training program has been designed to improve the capacity of both local farmers and forestry staff in these areas and to help them better understand and undertake the innovative forestry practices needed to make the move from monoculture plantation forests to multiuse, mixed-species forests for ecological protection and environmental services. It will also help client agencies build institutional capacity to carry out long-term forest management planning, pilot sustainable financing mechanisms, adopt better nursery management, apply new planting models, ensure better compliance with social and environmental safeguards, and apply policies relative to procurement and financial management. In addition, the gender-specific trainings will be implemented based on women's needs with aim to improving women's technical know-how on forest management in particular the new technologies adaptation; and to building up women's capacities for broadening job opportunities and skills for income generation activities. Broad agreements have been obtained on the scope of the training plan, but a detailed plan will be prepared by the SFGB for approval by the Bank during the first year of Program implementation.

56. In addition to training, the Program will support technical assistance to prepare five silvicultural technical prescriptions/standards covering rare species and mixed forest species management, guidance on rare and precious tree species botany, the ecological characteristics, silvicultural technologies, and technical regulations applicable to multifunction, mixed-species afforestation, and mixed-species forest management. A provincial forest germplasm resources survey will also be undertaken, together with a survey of a broader range of forest species (in particular, the local broadleaf species and rare species).

57. Strengthening government internal financial management. This effort aims to strengthen management and internal controls of the Sichuan Provincial Forestry Department by preparing related manuals and guidance and enhancing the completion rate of the annual audit program, mainly on internal audit, public fund inspection, and budget performance management. The main objective of this support will be to improve budget performance management systems by standardizing and improving related procedures and regulations in the provincial SFGB. The Program will support (a) developing a framework for fully implementing budget performance management in the SFGB; (b) preparing a manual for comprehensive budget performance management, including developing a detailed assessment indicator system; and (c) preparing an annual internal audit work plan and having the plan approved by the SFGB

and reported to the provincial audit office for reference, and internal auditors be able to execute 80 percent of the approved annual plan in 2020, increasing to 100 percent in 2022, an increase of 10 percent annually.

58. In recent years, the national government has focused more attention on budget performance management to ensure that the public funds could be used efficiently. In 2016, the Ministry of Finance and the National Forestry and Grassland Administration jointly issued regulations on budget performance management for the forestry reform and development funds. However, such regulations only aimed at certain special budget funds, as the overall budget performance management system had not been established. Following recent institutional reform in the Sichuan Provincial Forestry Bureau, it was decided that the financial division of the provincial forestry bureau will assume the responsibility of budget performance management. To standardize related procedures and requirements, a series of decrees and regulations will be prepared and issued by the provincial forestry bureau to enhance its capacity on managing budget performance. It is expected that the manual and guidance for budget performance management will be prepared and issued by the provincial forestry bureau during 2020.

D. Supporting System Assessment

59. Seedling Production and Supply: The Sichuan Provincial Forestry Seed and Seedling Station is responsible for tree seedling production and supply, it has 63 forest seedling management offices and 43 seedlings quality inspection stations. The institution has 300 full-time management personnel, nearly 1,500 forest seed inspectors, and is capable of meeting the provincial demand for quality seeds and seedlings for existing programs. The regulatory framework is extremely strict with production being controlled under the Seed Law of the People's Republic of China, Regulations on the Management of Sichuan Province's Forest Tree Seeds, Administrative Measures on the Licensing of Forest Tree Seed Production, Administrative Measures for the Promotion and the Use of Forest Trees, Forest seed collection management regulations, Forest seed quality management methods, Sichuan Province Woody Grain and Seedlings Management Methods, and the Method for the Main Tree Species in Sichuan Province. Furthermore, there are 23 state-level or provincial technical regulations designed to provide technical support for seedling production. The producers of the main tree seedlings are obliged to comply with the conditions of their Production and Business Licenses.

60. Most seeds are obtained from 93 tree seed orchards covering an area of 5,600 hectares. The number of nurseries of various sizes totals 6,732, and their combined annual production capacity is between 900,000 and 1.2 million kilograms of seed, and between 800 million and 1 billion of tree seedlings, but output varies depending on demand. In 2012, seed production was diversified through 6 newly established tree breeding and demonstration bases for rare tree and valuable species. Existing nursery capacity is adequate for provincial afforestation needs which is adequate to meet next year's planting needs, including that for the proposed Program. At present, around 80 species are available for afforestation in Sichuan, of which 40 can be considered 'rare' under "rare tree species list in Sichuan Province".

61. Assessment on Seed and Seedling Supply System: The supply of seeds and seedlings is adequate to meet the afforestation needs of the province with most nurseries are confident that a wider range of local broadleaf species, in particular valuable and rare species, can be made available to meet increased demand for them under the LSGS, including that for the next year's planting. Detailed assessment has been conducted by SFGB based on the seedling demand for the designed technical afforestation and

enrichment planting models for the next two years, it is confirmed that the seedlings will be available for the Program.

62. An assessment of current nursery management capacity, seed production and seedling output confirmed that adequate capacity exists to meet the needs of the Program. Currently, each county has a central nursery, and this would be complemented by several smaller nurseries nearer to the planting sites to reduce transport and handling costs. Staff and workers at central nurseries usually have several years of managerial experience, and have the necessary technical capacity, infrastructure, and capital to produce adequate numbers of high-quality seedlings. Because of this, central nurseries will provide the necessary technical assistance and training to smaller nurseries. All seedlings for the Program would need to conform to the minimum quality requirements (height, collar diameter, and root size and root-shoot ratio) set by the Program.

63. With adequate notice, the demand for a broader range of broadleaf, native species can be met, but advanced notice is required to prepare for species for various needs. For example, sowing time, root pruning, grafting, tissue culture etc. However, the specific technologies for each species are well understood. Seedlings would be purchased through competitive bidding and through the self-procurement model. Under this program, the species selected will be based on the agreed planting and forest enhancement models. Considering the impact of transport distance and keep high survival rate, seedling enterprises will use light matrix container seedling technology to provide container seedlings for rare and precious species.

64. Forestry Education. Forestry education in Sichuan began in 1911 with the establishment of the Sichuan Public Higher Agricultural School. Following the establishment of the New China in 1949, forestry education developed rapidly to certificate and degree levels, so that today a very robust system of training is in place. However, at both graduate and under graduate levels, training in plantation forestry is still very much focused on monocultures, and very little instruction is available on mixed species and multiple use planting, training on the use of rare and valuable species is also missing. To help accelerate the move towards mixed species use, multiple use forestry, and to help underpin the LSGS, a forestry curriculum review is needed at graduate and under graduate levels with the aim of strengthening its content on mixed species and multiple use forestry.

65. Forestry Research and Technology Extension Support System. Sichuan Province has one provincial forestry research institute and 13 prefecture-level forestry research institutes; it also has one provincial forestry science and technology extension station, 20 at prefecture-level and 159 at county-level. These research and extension agencies satisfy the investigative and technology transfer needs of the province.

66. Forestry research activities in the province include the collection and preservation of tree germplasm, selective tree breeding, intensive forest management, forest product processing, ecological restoration, wildlife protection, and the impact evaluation of ecological restoration. The forestry research institute in Sichuan is a highly competent institution, having delivered 274 scientific and technological innovations in forestry, all of which were recommended for inclusion in the national forestry science and technology achievement data base. It has also succeeded in developing more than 300 new forestry practices, including new varieties and planting models for walnuts, peppers, olives, camellia, eucalyptus and other tree species. It has also created over 400 demonstration sites covering more than 16,650 hectares and has trained more than 2,000 forestry technical experts (local experts).

67. Given the formidable track record, it can be concluded that research and extension capacity in Sichuan is adequate for its needs, and, with modest upgrading in some areas, is capable of accommodating the needs of the LSGS and proposed Program.

Overall Assessment Conclusions

68. Sichuan has over a century of experience in forestry, and a strong forestry culture exists in the province. Based on an assessment of the technical supporting system in the LSGS, it is concluded that the existing institutional capacity is adequate, that the system is working well, and that adequate experience, expertise and capacity exists in the province to implement the proposed forestry Program. Capacity at provincial and county levels is robust, with this being supported by a sound legal and regulatory framework at all levels. In addition, a well-established system of forestry education, research and extension has been put in place with the capacity to address challenges, and to explore and promote innovation. A sound policy and sectoral development framework is also in place (the LSGS and Sichuan Forestry 13th Five-year Plan) which provides a clear and stable direction for forestry development. Additional support is provided at national level through the National Forestry and Grasslands Administration's (NFGA) National Forest Management Program (NFMP), which call for the landscape forest management planning, long-term forest resources management and resilience diversified forest ecosystem restoration. One of the lessons learnt from Bank supported forestry projects in China is that coherence between a project's development objectives and government policies greatly increases a project's chances of success.

69. Though the forestry management system is well developed in Sichuan, as majority of plantations have been developed as monoculture forests, which limited ecological benefits such as conservation of soil and biodiversity and proven the increased vulnerability to pests and diseases (the problem that may become more serious with climate change) which is likely to exacerbate the situation; the lack of appropriate forest management results poor quality in large areas of forests, which reduced forests' both ecological and economic benefits including carbon storage capacity; and the lack of long-term forest management development planning and financing mechanism that can balance well the ecological and economic benefits and promote landscape integrated management have provided less incentive to sustainable forest management and financing. The proposed Program will help Sichuan Government to address those identified challenges, as well as to build the institutional capacities for long-term suitable forest ecosystem management.

Recommendations for Improving LSGS Implementation Through the Program

70. The main aim of the Program is to improve the quality and effectiveness of the government's investment under the LSGS by promoting the most cost-effective ways and adopting mixed species afforestation and forest management initiatives, the long-term forest landscape planning, integrated forest resources management in support of the forest ecosystem restoration aims of the government program. The shift from traditional cultivated plantation establishment towards stable forest ecosystem restoration with focus on combining multiple use and mixed species afforestation, natural regeneration promotion and long-term forest stand management as part of a broader landscape management approach under the LSGS represents a fundamental conceptual change in how afforestation is to be undertaken in Sichuan. It also presents forestry practitioners in the province with new challenges. The Program will also support the development of forest carbon trade market—carbon emission trade scheme (ETS) in Sichuan and forest carbon financing program, which will provide sustainable financing as kind of

ecological compensation to forest land owners for long-term sustainable forest resources management and financing.

71. The prospects for success can be enhanced by drawing on the Bank and other international and national experience in developing, implementing, and evaluating the ecologically focused forestry programs. The innovative technical and institutional interventions have been elaborated in the section of Technical Soundness of Design.

Rationale for Bank Involvement Through a Program

72. The Program is fully consistent with the World Bank Group (WBG) Country Partnership Framework (CPF) for China (Report 117875-CN) (FY2020–2025), discussed by the Board of Executive Directors on December 6, 2019, especially the objectives of strengthening sustainable natural resource management set out under the engagement area, “Promoting Greener Growth.” The program is also consistent with the reorientation of the WBGs support to a more strategic and selective engagement and the World Bank Group capital package policy commitments. It will promote innovative forest management practice and viable funding mechanisms to enhance forestry's contribution to ecosystem restoration and carbon sequestration, the latter being important for the achievement of China's NDC. The Program would also improve the ecological resilience of provincial forests and establish additional funding sources to promote and expand multi-function forest management. These achievements would not only have global benefits but would also serve to improve the hydrology, water security, and ecology of the strategically important Yangtze River Economic Belt. In addition, program activities would be supportive of the National Ecological Conservation and Water Management Strategies for China and help to strengthen the effectiveness of provincial initiatives aimed at intensifying forest ecological protection and restoration under the 13th Forestry FYP.

73. The long-term value added by the Program would be to develop the appropriate skills and institutional capacity to undertake sustainable forest management operations and to foster the creation of viable financial mechanisms for sustainable development. The Program would also improve efficiency by developing the most cost-effective silvicultural models and field practices appropriate to sustainable forest management, with the medium-term objective of promoting and scaling up best practice elsewhere in the province. The Program approach would be to use mixtures of native tree species and the near-to-nature forest management concept to restore and enhance ecological conditions on denuded land and in degraded monoculture forests. Thereafter, the principle of continuous forest cover with multiple use management would be applied to optimize ecosystem vigor and improve carbon capture. The main benefits accruing to this would be improved carbon capture, reduced soil erosion, better water quality, less flooding, increased levels of biodiversity, higher resilience to climate change, and increased outputs of non-wood forest products and services (traditional medicines, food products, traditional building materials, ecotourism). Where site conditions permit, planting models will include enrichment planting of rare and protected native tree species, to create sustainable, diversified species stand structure, and multifunction forests capable of yielding a broad range of products and services, and those with improved resilience to climate change. The gender dimensions have been taken into account for the Program design to address the gender gaps in the areas of knowledge and services access, equal decision making and income generation opportunity.

74. To realize these aims, the Program will create the institutional capacity to enable Sichuan to take the lead in planning and implementing sustainable and multifunction forest management and financing,

and in scaling up best practice. This would include long-term forest resources management planning; the development of incentive-based ecological compensation mechanisms, including the institutional framework and technical support system for market-based inclusive forest trade marketing under the national Emissions Trading System for sustainable forestry financing and catalyzing private sector participation in forest resources management; strengthening management and internal financial controls of the provincial forestry administration; and training and technical assistance. These activities will help to bring about an enduring change of theory to the development and implementation of the 14th FYP of Forestry Development in Sichuan. As the Program focuses on institutional capacity building, changes in sector-wide of forest management regime, and the scaling-up of best practice for long-term sustainability, the Program for Results Financing is considered the most appropriate instrument to be used.

75. The program's significant contribution to global public goods will be through carbon sequestration in the newly established mixed-species plantations and the restoration and rehabilitation of degraded forests. Vegetation and soils are widely recognized as carbon storage sinks, and the sequestration of carbon in terrestrial ecosystems offers a cost-effective way mitigating climate change. This will be achieved by increasing carbon sequestration and storage in newly planted areas and improving forest productivity in degraded plantations, both of which will contribute to China's NDC. The use of innovative technical models such as diversified species planting, mixed forest structures, and natural forest regeneration and landscape protection will also strengthen the resilience of forest ecosystems to natural disasters associated with climate change. With the Program, it is estimated that around 23.53 million tons of net carbon dioxide equivalent will be sequestered over a 30-year period.

76. The Program will play a key role in improving the effectiveness of the Sichuan Provincial Government Large-Scale Greening Sichuan Program by developing and promoting best practice and sustainability in multi-function forest management and having these scaled up throughout the province. It will also make an important contribution to the conservation objectives of the Yangtze River Economic Belt ecological civilization program by applying the lessons learned under the Program to other areas in the Yangtze River Basin where conditions are comparable with those in Sichuan. It is also expected that Program experience will make a positive contribution to the three-province investment program in Anhui, Jiangxi, and Sichuan provinces which aims at improving forest ecosystems in the Yangtze River Economic Belt, with the programs in Anhui and Jiangxi being financed by a EUR 200 million loan from the European Investment Bank (EIB). The objectives and design of the EIB program are closely aligned with those of the Program, and close collaboration and knowledge sharing will be maintained between both programs during implementation and beyond.

E. Institutional Arrangements and M&E System

The Institutional Framework

77. The Bank's institutional capacity assessment concluded that adequate capacity and commitment was in place to implement the Program and that the Program would therefore use existing implementation, monitoring, and evaluation mechanisms available under the LSGS. Government forestry institutions at all levels in Sichuan would be responsible for implementing the LSGS in the province, with Sichuan provincial institutions being responsible for leading and guiding implementation. At the operational level, line agencies would coordinate and organize Program development, budget allocation, project implementation, technical support, and monitoring.

78. The provincial greening/afforestation committee would coordinate overall Program design and implementation on behalf of the Sichuan provincial government, and would also coordinate the activities of line agencies, including matters such as fund mobilization, fund allocations from central and provincial levels, overseeing Program implementation, and tracking its progress. The provincial Development and Reform Commission and Finance Department will be responsible for budget allocation, fund management, and expenditure monitoring; the SFGB will be responsible for all forestry-related matters, including specific subproject review and approval, technical standards and guidance, and afforestation and forest management quality monitoring; and the Sichuan Provincial Forestry Academy, the County Forestry Extension Center, and the Seed and Seedling Supply Stations would provide technical services and training to Program entities as well as seed supply and seedling production.

79. County governments will be responsible for implementing Program activities in the field, including their planning and execution. County Forestry Bureaus will be the agencies responsible for field execution, detailed activity planning, activity implementation, technical assistance, training, and Program monitoring and verification. The county finance bureaus will be responsible for Program budget planning and fund allocation to the planning entities and expenditure supervision, and the county auditing bureau will be responsible for Program auditing. The network of technical and seedling support systems at the county level will also provide technical assistance and seedling production at the ground level.

80. The NFGA would be the agency responsible for providing technical guidance to provincial and county level implementation agencies, for supervising and monitoring implementation, and for sharing knowledge and lessons learned from the Bank and other international and government agencies supported forestry projects. This includes the collaboration between this Program and the European Investment Bank-supported Yangtze River Basin Forest Protection Program, both of which are developed under the same framework to jointly support ecosystem protection in Yangtze River Economic Belt. The NFGA will also contribute to mainstreaming and disseminating to the nation-wide the best practice being gained from the Program.

81. Individual farmers; communities, including collective forest farms; and collaborative farmers' associations and state-owned forest farms would be the implementation entities under Program operation.

Monitoring and Evaluation System

82. The Program's DLIs define the minimum quantitative and qualitative parameters and values that need to be achieved to trigger disbursements. The monitoring and evaluation system being used for forestry activities in the LSGS is similar to the ones already used in several Bank-supported forestry projects in China. The system has proved to be robust and effective at measuring progress and at monitoring and evaluating the qualitative achievements and impacts of a wide range of ecological afforestation and management activities. It has also been effective at ensuring that only outputs of the required quality are submitted to the Bank for disbursement. This system (see below) will therefore be used for the Program.

83. The verification protocol is based on the Government Technical Regulations for the National Afforestation Integrated Verification, Technical Regulations for Forest Management Verification, and Technical Regulations for Afforestation Subsidized by National Budget, (see Annex 3 for details). As mentioned, the current government verification system includes two levels of inspection and

acceptance—one at the county level and one at the provincial level. County forestry bureaus will organize the forest investigation and planning technical team check each of sites under Program and the SFGB will conduct selective random sample inspections for the county checked and accepted work, through the third-party verification agencies (TPVAs) contracted by the SFGB to confirm that DLI requirements have been met.

84. Bank-approved TPVAs will be contracted by the SFGB at the time of Program startup. Details of Program verification procedures, technical approaches, and implementation arrangements are detailed in the relevant government regulations, which have been reviewed by the Bank team. Specific verification protocols are detailed in Annex 3.

85. A further level of verification will be provided by the Sichuan Audit Office, which carries out financial verifications through its annual financial audit, when county implementation reports are cross-checked with expenditure categories and reporting frequencies set out in provincial guidelines.

86. In addition to the verifications provided to the outputs of DLIs, a broader Program of monitoring and evaluation will be included. Under the Program, a computerized monitoring and information platform will be developed with the capacity to monitor and evaluate overall Program performance and impacts, and to disseminate the use of improved technical models and other innovative technologies developed under the Program, including new technical standards and regulations, and developments on the carbon trade market and PES activities. The Program monitoring plan has been developed and will be implemented during Program implementation.

1. The SFGB will prepare and submit Program semi-annual progress reports to the Bank on February 28 and August 31 of each year. In addition, SFGB will submit to the Bank: (a) an annual project work and budget plan for the next calendar year by December 15 of each year commencing December 15, 2019; (b) a mid-term review report on September 30, 2021; and (c) a Program Implementation Completion and Result Report (ICR) by December 31, 2023. The Program monitoring report should be submitted to the Bank once a year and it will be part of mid-term review report and ICR.

87.

The Bank Loan Disbursement Arrangements

88. To ensure consistency, accountability, and transparency in disbursing funds against DLIs, the following procedures will be applied: (a) DLI verification protocols will be carried out by a single or limited number of TPVAs to ensure consistency of approach, (b) the SFGB will prepare ToRs for the TPVAs and submit them to the Bank for review and approval, and (c) the TPVA selected by the SFGB must be approved by the Bank.

89. Verification reports will be prepared by Program counties that will submit them to the TPVA for scrutiny, cross-checking, and verification. Thereafter, the TPVA will submit approved disbursement requests to the SFGB for review. Based on the findings of the TPVA's verification reports, the SFGB will periodically prepare and submit disbursement request applications to the Bank for work satisfactorily completed and verified by the TPVAs. The actual disbursed amount will depend on results verified. The SFGB may apply for disbursements as soon as targets are met by providing the necessary documentation to the Bank. Once it is fully satisfied with the evidence of Program achievements, the Bank will inform the client accordingly and authorize the disbursement of the appropriate amount of funding. The SFGB may

also request reimbursement for verified results achieved in advance of the indicative annual target up to the total value of the respective DLI in the Program. Bank disbursements will be in Euro and will be deposited in a Bank account designated by the borrower and acceptable to the Bank. Detailed disbursement arrangements are included in below Table 3.

90. The Sichuan provincial government has indicated its intention to apply for 30 percent payment (US\$45 million) of the IBRD loan for advance and payment for prior results under the Program. The justification for this is that the cost of seeds and seedling production is needed in advance of the annual planting programs implemented. In addition, the cost of long-term forest management planning, forest carbon trading technical support system development and other technical support is also needed in the early stages of the Program. The Bank has examined the relevant proposal and recognizes that such an advance of IBRD loan funds would help speed up implementation and the achievement of Program results. In addition, certain activities under Program have been completed and among those funds, around US\$ 7.5 million will be used to the payment for prior results that completed after April 1, 2019. See Table 4.

Table 3. Matrix of Annual Disbursement-Linked Indicators (DLIs)

	Total DLI Achievement	Total Allocated Amount (US\$, millions)	As Percent of Total Financing Amount	DLI Base-line	Indicative timeline for DLI achievement				
					2019 (US\$, millions)	2020 (US\$, millions)	2021 (US\$, millions)	2022 (US\$, millions)	2023 (US\$, millions)
DLI 1: Number of hectares of improved plantations of mixed species having a survival rate of 85 percent at the end of the first year after planting	30,000 hectares of mixed-species plantation established and verified one year after planting	—	—	--	6,000 hectares of mixed-species plantation established and verified one year after planting	15,000 hectares of mixed-species plantation established and verified one year after planting	9,000 hectares of mixed-species plantation established and verified one year after planting		
Allocated amount:		37	24.7%		7.4	18.5	11.1		
DLI 2: Number of hectares of degraded and monoculture forests restored using a diversified forest structure	100,000 hectares of degraded and monoculture forest restored with diversified forest structure developed	—	—	--	18,660 hectares of degraded and monoculture forest restored with diversified forest structure developed and 1,330 hectares of promoted	46,670 hectares of degraded and monoculture forest restored with diversified forest structure developed and 3,340 hectares of promoted natural	28,000 hectares of degraded and monoculture forest restored with diversified forest structure developed and 2,000 hectares of promoted natural		

	Total DLI Achievement	Total Allocated Amount (US\$, millions)	As Percent of Total Financing Amount	DLI Base-line	Indicative timeline for DLI achievement				
					2019 (US\$, millions)	2020 (US\$, millions)	2021 (US\$, millions)	2022 (US\$, millions)	2023 (US\$, millions)
					natural regeneration verified	regeneration verified	regeneration verified		
Allocated amount:		76	50.7%		15.2	38	22.8		
DLI 3: Number of provincial, county, and forest farms long-term forest management plans developed	Sichuan Provincial and 30 county long-term forest management plans and 50 forest farm forest management plans developed	—	—		1 Sichuan Provincial forest management plan developed	20 county long-term forest management plans and 10 forest farm forest management plans developed	15 county long-term forest management plans and 15 forest farm forest management plans developed	25 forest farm forest management plans developed	
Allocated amount:		17	11.3%		4	4.6	4.6	3.8	
DLI 4: Forest carbon trading institutional framework developed and technical support system in place	Forest carbon trading support system developed and ready for operation in Sichuan Province	—	—	--	Assessment of forest carbon potential in Sichuan Province under forest management	Proposal on inclusive forest carbon trading scheme and operational procedures for implementation	Methodologies on forest carbon offsets with focus on inclusive forest management and		

	Total DLI Achievement	Total Allocated Amount (US\$, millions)	As Percent of Total Financing Amount	DLI Base-line	Indicative timeline for DLI achievement				
					2019 (US\$, millions)	2020 (US\$, millions)	2021 (US\$, millions)	2022 (US\$, millions)	2023 (US\$, millions)
					interventions developed and issued	developed and issued	afforestation and reforestation activities developed and published		
Allocated amount:		14	9.3%				14		
DLI 5: Financial management and internal controls of the Provincial Forestry and Grassland Bureau strengthened	DLR 5-1: (a) annual audit plan approved and the completion rate under each annual audit plan reached at least: (i) 80 percent for FY 2020, (ii) 90 percent for FY 2021, and (iii) 100 percent for FY 2022. DLR 5-2: (a) a framework for implementing				(a) Annual audit program plan approved, and internal auditing executed for least 80 percent of the approved programs; (b) Manual for inspection of public funds is prepared and issued by SFGB	(a) Internal auditing executed for at least 90 percent of the approved programs; (b) Guidance for public budget performance management prepared and issued by SFGB	Internal auditors can execute 100 percent of the approved program		

	Total DLI Achievement	Total Allocated Amount (US\$, millions)	As Percent of Total Financing Amount	DLI Base-line	Indicative timeline for DLI achievement				
					2019 (US\$, millions)	2020 (US\$, millions)	2021 (US\$, millions)	2022 (US\$, millions)	2023 (US\$, millions)
	budget performance management; and (b) a manual for comprehensive budget performance management including a detailed assessment indicator system adopted by SFGB.								
Allocated amount:		6	4%		2.5	2.5	1		
Total		150	100%		29.1	63.6	53.5	3.8	

Table 4. Indicative DLI Targets Identified for Prior Results and Advance

DLI	Target of the Prior Results	Target of the advance	Value (US\$ Mission)
DLI 1: Number of hectares of Improved Mixed-species Plantations having a survival rate of 85 percent at the end of the first year after planting (ha).	Around 1670 hectares plantations were established in 2019	Advance to seedlings purchases, community consultations and planting operation design for planting (15,000 ha) in 2020	8.8
DLI 2: Number of hectares of degraded and monoculture forests restored using a diversified forest structure (hectares)	Around 6,670 hectares degraded, and monoculture plantations converted to mixed forests in 2019	Advance to seedlings purchases, community consultations and planting operation design for degraded forest restoration including interplanting (46,670 ha) in 2020	21.7
DLI 3: Number of provincial, county, and forest farms long-term forest management plans developed (No.)	Sichuan provincial long-term forest management plan developed	Advance to long-term forest management plan developed for 20 counties and 10 forest farms	11
DLI 4: Development of a forest carbon trading institutional framework and technical support system(Set)		Advance to carrying out the assessment on forest carbon potential in Sichuan province and the development of inclusive forest carbon trading scheme and operational procedures for implementation.	2.0
DLI 5-2: (a) a framework for implementing budget performance management; and (b) a manual for comprehensive budget performance management including a detailed assessment indicator system adopted by SFGB.	A framework for implementing budget performance management will be issued and implemented by SFGB by December 31, 2019.	A manual for comprehensive budget performance management including a detailed assessment indicator system prepared by SFGB.	1.5
Total			45

IV. PROGRAM EXPENDITURES FRAMEWORK ANALYSIS

91. The Program mainly involves two categories of activities: general afforestation (including reforestation and natural regeneration promotion) and forest quality improvement (including tending of forests and upgrading of low-quality forests). Sichuan has estimated the total overall expenditure for these activities at RMB 2.77 billion, which includes RMB 0.62 billion for direct government subsidies (see table 5).

Table 5. Program Overall Estimates of Expenditure

Program Activities		2019–2023					
	Activity Target (mu)	Expenditure per Unit (RMB) per mu	Total expenditure (RMB) 10,000	Fiscal Subsidy per Unit (RMB) per mu	Total Fiscal Subsidy (RMB) 10,000	Percent of Fiscal Subsidy	
General Afforestation	Artificial Afforestation	450,000	1,540	69,300	300	13,500	19.48
	Natural regeneration promotion	100,000	325	3,247	100	1,000	30.80
Forest Quality Improvement	Degraded Forest Rehabilitation	1,700,000	2,810	204,733	310	47,200	23.05
Total				277,280	—	61,700	22.25

Note: 1 mu = 0.067 hectares;

— = not available.

No provision is included for indirect expenditure. Source: SFGB.

92. Government expenditures on the Program will be mainly incurred at the prefecture/county level. However, according to China's current intergovernmental revenue sharing system, most of the tax revenue goes to the central and provincial governments, so the prefecture-/county-level governments rely heavily on the grants from upper-level governments for most of their fiscal expenditures. In the case of the Program, the fiscal funding mainly comes from the earmarked grants from central and provincial governments. These grants not only cover the direct fiscal subsidies for the Program activities, but also the capacity building expenditures that indirectly support the Program, though their uses are specified at the time of budget allocation. In addition, the prefecture/county governments that join the Program will arrange budget funding from the forest revegetation fee, which is collected from enterprises that occupy forestlands for various construction projects. The forest revegetation fee can cover either direct or indirect expenditures for the Program, and the specific uses can be determined by the local governments.

93. The detailed budget expenditure items at various government levels in 35 counties, which have committed to participate in Program, are presented in table 6.

Table 6. Program Budget Expenditure Items at Various Government Levels, 35 Counties

(RMB 10,000)

Item	2016	2017	2018	2016–2018 Average	2019–2023 Projection
Direct Program Expenditure	15,718	23,108	27,225	22,017	110,085
General Afforestation	9,174	12,262	15,080	12,172	60,860
Central funding	4,834	5,891	6,322	5,682	28,412
Provincial funding	4,340	6,371	8,758	6,490	32,448
Forest Quality Improvement	6,544	10,846	12,145	9,845	49,225
Central funding	6,274	10,426	11,465	9,388	46,942
Provincial funding	270	420	680	457	2,283
Indirect Program Expenditure	25,679	29,764	28,082	27,842	139,208
Capacity building	25,679	29,764	28,082	27,842	139,208
Central funding	20,929	25,221	22,930	23,027	115,133
Provincial funding	4,750	4,543	5,152	4,815	24,075
General Expenditure	7,355	27,607	30,792	21,918	109,590
Provincial	639	2,881	3,834	2,451	12,257
Prefecture/county	6,716	24,726	26,958	19,467	97,333
Total	48,752	80,479	86,099	71,777	358,883

Source: SFGB.*Note:* “General expenditure” means the funds can be used freely for the Program activities.

94. As illustrated in table 8, over the previous three years, the budget allocation at both the central and provincial level regarding the direct Program expenditures has been steadily increasing. Although the budget allocation regarding the indirect Program expenditures at the central level dropped slightly, and the allocation at the provincial level has remained stable, considering the rapid growth of the general expenditures financed by the forest revegetation fee at the subnational levels, the overall indirect expenditures should have kept rising during the past three years, as well. However, our projection for 2019–2023 assumes the annual expenditure for each item is the same as the 2016–2018 average level. Therefore, the results are modest and reliable. The overall direct budget expenditure during 2019–2023 (about RMB 3.59 billion; table 8) is much higher than the planned total direct fiscal subsidy.

95. **Program Expenditure compared to Government Budget Expenditure.** As the budgetary allocations for the Program are sufficient to the estimated total expenditure for the Program, as indicated above, it is reasonable to conclude that the budgetary allocations in Sichuan are adequate for the Program (table 7).

Table 7. Budget Expenditure compared to Total Planned Expenditure for the Program
(RMB billions)

	Overall Government Budget Expenditure for the Program (1)	Overall Planned Expenditure for the Program (2)	Budget/Plan
			(1)/(2)
35 counties	3.59	2.77	1.30

Source: SFGB.

96. **Fiscal Sustainability and Resource Predictability.** The Program is unlikely to cause significant risk to fiscal sustainability, as budgetary allocations under the Program constitute only a small share of overall

budget expenditure, which is less than 1 percent of the total Sichuan government budget.

V. DESCRIPTION OF PROGRAM RESULTS FRAMEWORK AND PROTOCOL

A. The proposed Program Development Objective (PDO)

97. The PDO would be to improve sustainable forest ecosystem management in support of Large-Scale Greening Sichuan Program.

98. The PDO-level indicators would be:

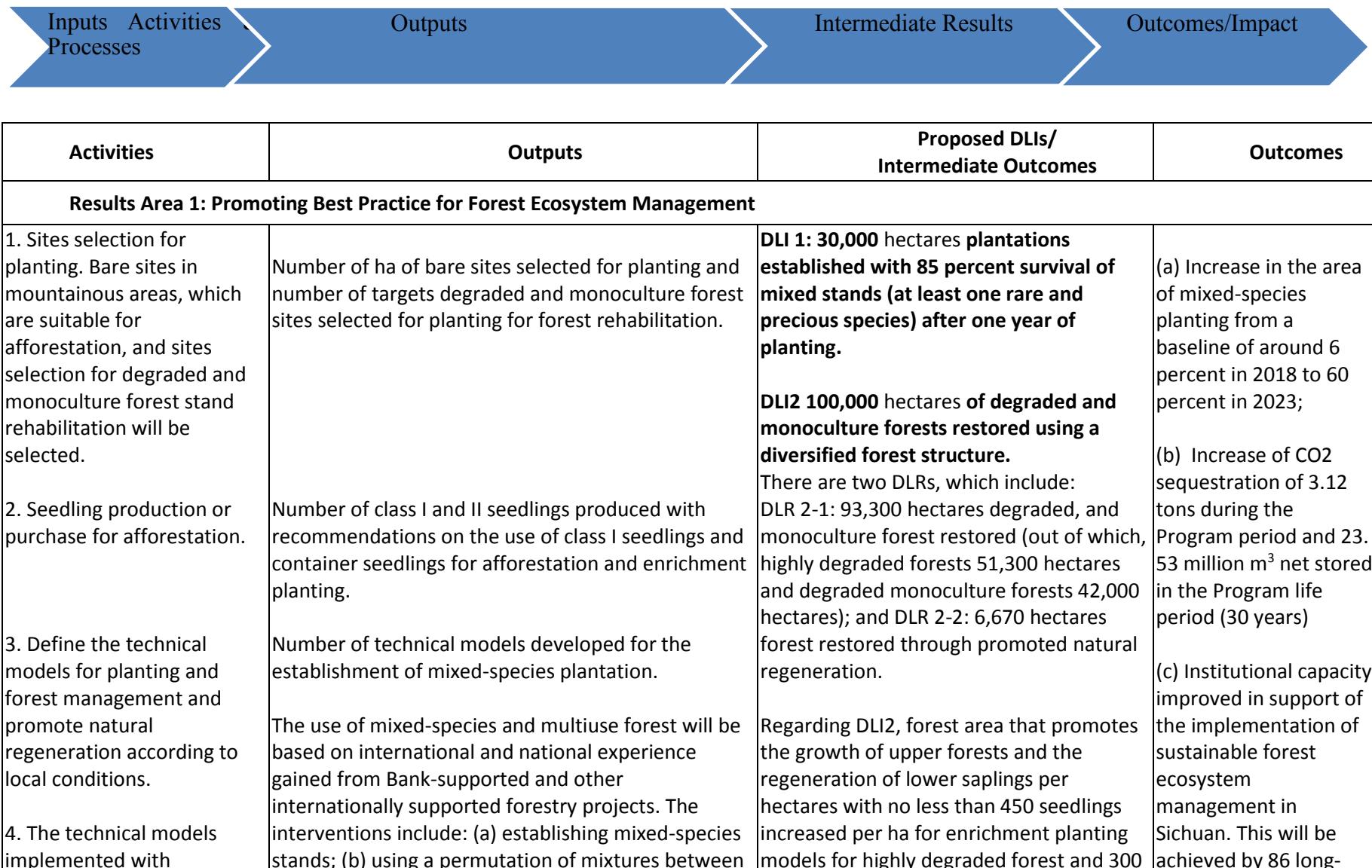
- (a) Increase in the area of mixed-species planting from a baseline of around 6 percent in 2018 to 60 percent in 2023 in the Program area; this change would result in a marked improvement in forest structure, productivity, resilience, and ecology;
- (b) Increase in CO₂ sequestration of 3.12 million tons during Program period (total 23.53 million tons CO₂ sequestered over the Program's lifetime (30 years);
- (c) Institutional capacity improved in support of the implementation of sustainable forest ecosystem management in Sichuan. This would be measured by 86 long-term forest resources management plans developed and adopted, and the institutional framework in place and technical support system developed for forest carbon trading;
- (d) Budget performance management system in Sichuan Forestry and Grassland Sector standardized and improved. This will be measured by a framework for implementing budget performance management and a manual for comprehensive budget performance management including an assessment indicator system adopted by SFGB.

99. **Beneficiaries.** Beneficiaries would include rural individual households, cooperative farmers, villages and communities, and state forest farms that engage in and benefit from the afforestation/reforestation and degraded forest management activities. The Program will also generate employment opportunities for local households through seedling production, site preparation, planting, and forest tending and management. Indirect beneficiaries would include residents living around the government LSGS areas, and the residents who live in the areas along the Yangtze River Basin who will benefit from improved water security, reduced risks from flooding, climate change mitigation impacts of tree planting, and improved biodiversity conservation. In addition, the beneficiaries also include the Sichuan provincial government and participating county government agencies, which will have improved technical and institutional capacity for the sustainable forest management and financing, and apply the lessons learned from this operation to broader areas provincial-wide.

B. Proposed Program Results Chain and Result Areas

(a) Program Results Chain

Table 8. Results Chain for Afforestation, Forest Management and Institutional Capacity Building



<p>multifunction plantation establishment, degraded forest rehabilitated, and monoculture transferred, and natural regeneration promoted.</p> <p>5. Trainings and technical assistance.</p> <p>6. Development of results-based payment mechanism.</p> <p>7. Pest management and fire control.</p> <p>8. Monitoring and evaluation.</p>	<p>species, such as mixtures between rows, mixtures between strips, and/or mixtures between clusters; and (c) refining the system of site classification to ensure that species are well adjusted to site conditions.</p> <p>As a result, mixed-species forests increased through planting and forest rehabilitation and promoted natural regeneration.</p> <p>Number of local staff and farmers trained, with training materials developed.</p> <p>A results-based payment mechanism developed: one payment will be processed one year after planting and other technical interventions based on the third-party verification.</p> <p>Pest management and fire control carried out through well set system at provincial and county levels.</p> <p>Clear and effective technical regulations for afforestation inspection and verification are developed. Quality check by county forest authority for all sites, and random verification by a TPVA based on technical models and verification stipulate and procedures.</p>	<p>seedlings increased per hectares for tending of degraded monoculture forests models and also for natural generation promotion models. The tree species should be increased from 1 to at least 3 to 5 at each site.</p> <p>Multifunction with significant ecological benefit-target forest management design adopted (the improved technical models under Program applied) for afforestation, forest management and enrichment-planting, and natural regeneration promotion.</p>	<p>term forest management plans developed putting into use, and the institutional framework in place and technical support in system developed for forest carbon trading.</p>
--	---	--	---

Results Area 2: Strengthening Institutional Capacity in Support of Sustainability

<p>1. Long-term forest management planning, through the development and implementation of</p>	<p>Long-term provincial and county forest management plans developed under the framework of the NFMP (2016–2050), which establishes the principles to be followed and provides guidance for the preparation</p>	<p>DLI 3: Provincial, county, and forest farms long-term forest management plans developed</p>	
---	---	---	--

<p>Sichuan provincial and county long-term forest management plans (2019–2050).</p> <p>2. Development of forest carbon trading institutional framework and technical system. The efforts aim to establish an inclusive forest carbon trading system by developing the technical supporting system and institutional framework as a long-term incentive forest financing mechanism.</p> <p>3. Strengthening management and internal</p>	<p>and implementation of the long-term integrated forest resources management aimed at improving forest ecosystem conservation and resilience by balancing the economic, social, and ecological functions of forests. The Bank will help the forestry sector in Sichuan move in that direction through the preparation of coherent and effective provincial- and county-level forest management plans by incorporating international best practice and cost-effective planting models and providing opportunities for the development of alternative sources of financing.</p> <p>The outputs under this effort includes putting in place institutional framework and technical support system for forest carbon trading operation in Sichuan.</p> <p>This effort is intended to improve the overall budget performance management system by standardizing and improving related procedures and regulations to</p>	<p>One Sichuan provincial and 35 county-level forest management plans and 50 forest management plans for relevant state-owned forest farms developed for implementation.</p> <p>DLI4: Forest carbon trading institutional framework developed and technical support system in place, to enable implementing an inclusive approach to Sichuan provincial forest carbon trading. The main deliverables include (a) DLR4-1: a forest carbon potential under forest management interventions assessed in Sichuan; (b) DLR4-2: proposal and operational procedures for implementing inclusive forest carbon trading mechanism be in place; (c) DLR4-3: methodologies for inclusive forest carbon trading developed; and (d) implementation capacity developed through training and knowledge products on forest carbon trading published.</p> <p>DLI5: Financial management and internal controls of the Provincial Forestry and</p>	
--	--	---	--

<p>controls of Sichuan Provincial Forestry Bureau.</p>	<p>enhance the capacity on managing SFGB budget performance. It is expected that the manual/guidance for budget performance management will be prepared and issued by the SFGB.</p>	<p>Grassland Bureau strengthened. This DLIs will be filled by the following DLRs:</p> <p>DLR5-1: (a) annual audit plan approved and (b) a completion rate under each annual audit plan reached at least: (i) 80 percent for FY 2020, (ii) 90 percent for FY 2021, and (iii) 100 percent for FY 2022 by SFGB.</p>	
<p>4. Strengthening technical assistance (TA) to build institutional capacity to focus on new know-how and skills that will be needed to shepherd the forest management shift toward a new paradigm within and beyond the period of the Program. The TA includes a support provision with farmers and local forest staff receiving training on the improved technical models, new technologies, and other initiatives brought to project implementation</p>	<p>The training program received by farmers and local forestry staff to help them better understand and undertake the innovative forestry practices needed for moving from monoculture plantation forestry to multiuse, mixed-species forestry for ecological protection and environmental services. It will also help client agencies build institutional capacity to carry out long-term forest management planning, pilot sustainable financing mechanisms, adopt better nursery management, apply new planting models, ensure better compliance with social and environmental safeguards, and the apply the policies relative to procurement and financial management.</p> <p>Other technical assistance will be provided including five silvicultural technical prescriptions/standards covering rare species and mixed-species forest management developed, and a provincial forest germplasm resources survey conducted, with a</p>	<p>The following TAs are included in the Program design to build institutional capacity:</p> <p>Around 14,000 farmers and county staff trained, of which around 6,300 are female; five silvicultural technical prescriptions/standards are issued; a forest germplasm resources survey conducted in Sichuan Province, with a broader range of forest species identified for diversifying the forest ecosystem; and a proposal on improvement of the forestry PES system at the national- and Sichuan provincial-level developed.</p>	

	<p>broader range of forest species (in particular, the local broadleaf species and rare species) identified for diversified forest ecosystem restoration.</p> <p>In addition to developing the forest carbon market, under the payments for environmental services (PES) framework, a proposal will be developed for appropriate incentives to induce communities and the private sector to invest in the establishment and maintenance of sustainable ecological forests.</p>		
--	--	--	--

(b) Results Areas and Disbursement Linked Indicators

100. Five DLIs will be used to verify results and trigger disbursements against achievements. The DLIs to be used in each Results Area are described in the following paragraphs. Annex 2 provides further details on DLIs, disbursement arrangements, and Verification Protocols.

Results Area 1 – Promoting Best Practice for Forest Ecosystem Management

101. Results Area 1 aims to improve the ecological functions and multifunction capacity of new plantations, existing degraded plantations, and degraded mountain slopes. The DLIs will be as follows.

102. **DLI 1:** Number of hectares of Improved Mixed-species Plantations having a survival rate of 85 percent at the end of the first year after planting. More specifically, around 30,000 hectares of mixed plantation established (including rare and precious species) based on the technical models developed under the Program, with a survival rate of 85 percent one year after planting.

103. **DLI 2:** Number of hectares of degraded and monoculture forests restored using a diversified forest structure. More specifically, around 100,000 hectares of mixed forests to be developed through the restoration of degraded forests, the conversion of monoculture forests to mixed-species forests, and the promotion of natural regeneration. DLI2 would comprise the following two DLRs:

- i. **DLR 2-1:** Number of hectares of degraded and monoculture forests restored using a diversified forest structure. More specifically, Program planting models will be used to improve around 93,300 hectares of forests through the supplementary planting of native species (including rare and precious species), the result of the intervention will be that additional young seedlings will be present in the stand thereafter. In addition, the number of broadleaf seedlings in monoculture forests would be increased after having been thinned and tended to promote the growth of native species in the understory. Disbursements will be made against the number of hectares of mixed forests created through (i) forest quality enhancement of highly degraded plantation forests where no less than 450 additional new native species seedlings or young trees are present per hectare one year after forest tending and supplementary planting, (ii) at least 300 additional broadleaf tree seedlings or young trees present per hectare one year after forest tending and thinning in degraded monoculture plantation forests, and (iii) technical models checked to ensure compliance with technical specifications of models promoted by the Program.
- ii. **DLR 2-2:** Number of hectares of degraded and monoculture forests restored by promoting Natural Regeneration. More specifically, around 6,700 hectares of degraded forestland should be demarcated and tended to make space for natural regeneration; where natural regeneration is sparse, the area will be seeded, in accordance with technical model prescriptions. Disbursements will be triggered when at least 300 additional surviving young seedlings are present per hectare one year after the Program intervention.

104. **Verification Protocol:** Two levels of inspection and acceptance will be carried out according to the “*National Afforestation and Forest Management Comprehensive Verification Technical Regulation (LY/T2083-2013)*,” and the “*Forest Management Verification Technical Regulation (Forestry 2014 – No. 140)*” For all afforestation and forest restoration activities under SLGS. The Program verification will be based on county-level forest management checks carried out for all sites by local forestry bureaus. The

Program verification will be the responsibility of the independent third-party verification agency (TPVA) that will review all the competed activities with carrying out random field surveys covering not less than 5 percent of the county's reported qualified areas, which will, in turn, cover at least 15 percent of the total reported counties. Verification procedures will be as follows.

- i. Verification procedures for afforestation will confirm the accuracy of areas planted, quality (size) of seedlings planted and their survival rates, tree species, and other technical parameters established in technical models. More specifically, (i) area verification involves a desk review of the area recorded as planted, followed by random spot inspections in the field. Desk reviews serve to check consistency between the afforestation plots listed in documents and those in the contracts and Program design; (ii) seedling survival checks examine both survival and quality/height. Survival rates are measured one growth season after planting when at least 85 percent of seedlings must have survived one year after planting; and (iii) planting will be checked to ensure compliance with the technical specifications of models promoted by the Program.
- ii. Verification procedures for the restoration of degraded and monoculture forests. The following parameters will be used to verify improvements in forest quality: (i) for enrichment planting, field sampling will be used to confirm that field operations have reached the required standards. This will include the species planted, the number of seedlings planted, the layout of planting points, and survival rates; (ii) thinning intensity; (iii) weeding intensity to verify that bushes and weeds that might affect the growth of the target trees have been removed, and whether rare and precious tree seedlings, saplings, and young trees with growth potential are being protected; and (iv) natural regeneration enhancement to check the growth of seedlings and young trees, and the percentage of target trees present against the percent required.

Disbursements will be made against the number of hectares of mixed forests developed through (i) forest quality enhancement with no less than 450 additional new seedlings or young trees present per hectare one year after forest tending and supplementary planting; and (ii) at least 300 additional seedlings or young trees per hectare present one year after forest tending and thinning.

- iii. For verification of promoted natural regeneration, quality checks will be based on measurements and areas delineated on maps. Maps (scale 1:25,000), together with field survey or Global Positioning System (GPS) readings, will be used to verify areas, with field surveys being used to verify the number of seedlings regenerated and planted. Disbursement will be made against the number of hectares of demarcated with at least 300 additional young live trees present per hectare one year after technical intervention and regeneration treatment and compliance with technical specifications in models promoted by the Program.

Results Area 2 – Strengthening Institutional Capacity in Support of Sustainability

105. Results Area 2 aims to create the institutional capacity essential to ensuring the quality, accountability, transparency, and long-term sustainability of the LSGS. The DLIs would be as follows:

106. **DLI 3:** Number of provincial, county, and forest farms long-term forest management plans developed. To fulfill this DLI, one long-term forest management plan will be prepared for Sichuan province, together with 35 county level forest management plans and 50 state-owned forest farms forest

management plans prepared. All plans will be developed in accordance with the guidance and prescriptions provided by the National Forestry and Grassland Administration for such plans. These plans will help shape the Sichuan 14th Forestry FYP by scaling up new mixed-species forest management regimes for the restoration of forest ecosystems and the application of multiuse forest management.

107. **Verification Protocol:** Disbursements will be made against the delivery of forestry management plans at the provincial, county, and state forest farm levels. An independent TPVA will verify the deliverables against the National Forestry and Grassland Administration's "*Guidance on Forest Management Planning at Provincial Level*," and "*Guidance on Forest Management Planning at County Level*."

108. **DLI4:** Development of a forest carbon trading institutional framework and technical support system. This DLI will require that forest carbon trading mechanism and support system developed to enable forestry carbon trade in Sichuan. The outputs include (a) DLR4-1: the potential for forest carbon trading in Sichuan under different forest management interventions assessed; (b) DLR4-2: an inclusive forest carbon trading scheme with procedures and institutional framework developed; (c) DLR4-3: methodologies for forest carbon trading using inclusive forest management and afforestation activities developed; and (d) training and information on forest carbon trading received by forestry staff and farmers, which enables them to implement forest carbon trades.

109. **Verification Protocol:** Disbursements will be made against the readiness of the institutional framework and technical support system for forest carbon trading, which will be developed and ready for operation in Sichuan, with this being part of a regional forest carbon trading platform under the proposed national Emissions Trading System. The developed methodologies for forest carbon trading using inclusive forest management and afforestation activities should be approved by Sichuan Provincial Quality Bureau as a provincial standard. This will be verified by an independent TPVA.

110. More Specifically, the disbursement will be triggered against the submission of a set of the following deliverables: (a) a technical assessment of the potential for forest carbon trading offsets in Sichuan province undertaken to guide forest carbon financing practice; (b) a policy and institutional framework developed to support inclusive forest carbon trade, together with procedures for implementation; and (c) methodologies to support forest carbon trading developed, targeting inclusive forest management and afforestation/reforestation activities.

111. **DLI 5:** Financial management and internal controls of SFGB strengthened. This will be fulfilled by achieving the following two DLIs:

- i. **DLR5-1:** Approved annual audit plan and percentage increase of completion rate of activities in each plan. More specifically, Sichuan's finance bureau has: (a) approved an annual audit plan; and (b) has reached a completion rate under each plan of at least: (i) 80 percent for Fiscal Year 2020, (ii) 90 percent for Fiscal Year 2021, and (iii) 100 percent for Fiscal Year 2022.
- ii. **DLR5-2:** Framework for implementing budget performance management and a manual for comprehensive budget performance management including a detailed assessment indicator system adopted.
- iii. **Verification Protocol:** Disbursements will be made against (a) an annual audit plan approved

by SFGB; and (b) a completion rate reached under each plan of at least: (i) 80 percent for Fiscal Year 2020, (ii) 90 percent for Fiscal Year 2021, and (iii) 100 percent for Fiscal Year 2022. The plan comprises a number of tasks which could include the financial audit or accountability audit conducted in the various of divisions within SFGB and its subordinate bodies. Disbursements will be made also against a framework for implementing budget performance management and a manual for comprehensive budget performance management including a detailed assessment indicator system adopted by SFGB. The delivery of these documents will be verified by an Independent TPVA (external auditors). The document should be prepared in line with related regulations/standards issued by MOF and the line ministries and issued in the name of SFGB.

C. Result Framework and Protocol

112. These have proven to be sound instruments to monitor and evaluate afforestation and forest quality and are used to inspect all types of afforestation and forest management activities to ensure that only outputs of the required quality are submitted to the Bank for reimbursement. The verification protocol is based on the government's Technical Regulations for the National Afforestation Integrated Verification; Technical Regulations for Forest Management Verification; and Technical Regulations for Afforestation subsidized by National Budget.

113. **Verification Protocol:** Two levels of inspection and acceptance will be carried out according to the "*National Afforestation and Forest Management Comprehensive Verification Technical Regulation (LY/T2083-2013)*," and the "*Forest Management Verification Technical Regulation (Forestry 2014 – No. 140)*" *For all afforestation and forest restoration activities under SLGS*. The Program verification will be based on county-level forest management checks carried out for all sites by local forestry bureaus. The Program verification will be the responsibility of the independent third-party verification agency (TPVA) that will carry out the review for all the completed activities with random field surveys covering not less than 5 percent of the county's reported qualified areas, which will, in turn, cover at least 15 percent of the total reported counties. Verification procedures will be as follows.

114. The Program Framework and Protocol are summarized in the following table 9 to 11.

Table 9. Results Framework

Program Development Objective(s)

To improve sustainable forest ecosystem management in support of Large-Scale Greening Sichuan Program.

Program Development Objective Indicators by Objectives/Outcomes

Indicator Name	DLI	Baseline	End Target
Results Area: Promoting Best Practice for Forest Ecosystem Management			
Increase in the areas of mixed-species in the Program areas in Sichuan (Percentage)		6.00	60.00
Increase of CO ₂ sequestration by the program (Metric ton)		0.00	3,120,000
Results Area: Strengthening Institutional Capacity in Support of Sustainability			
Institutional capacity improved with enabling conditions for scaling up sustainable forest ecosystem management (Yes/No)		No	Yes
Budget performance management system in Sichuan Forestry and Grassland Sector standardized and improved (Yes/No)		No	Yes

Note: (a) The increase of CO₂ sequestration by the Program from Result Area 1 (afforestation and reforestation and rehabilitation of degraded forests) over 30 -year Program life time is estimated at 23.52 million tCO₂eq at an annual average of 0.78 million tCO₂eq. Considering the 5 year duration of Program, the GHG removals by sinks attributable to the program period are estimated at 3.12 million tCO₂eq;

(b) The Institutional capacity improved will be measured by 86 provincial, county, and forest farms long-term forest management plans developed for use; Putting in place the institutional framework and technical support system for forest trade marketing; and a training and technical system for scaling up of sustainable forest ecosystem management as measured by 14,000 of people trained and 5 mixed forest management technical standards developed and put into use.

Intermediate Results Indicator by Results Areas

Indicator Name	DLI	Baseline	End Target
Results Area 1: Promoting Best Practice for Forest Ecosystem Management			
Number of hectares of Improved Mixed-species Plantations having a survival rate of 85 percent at the end of the first year after planting (Hectare(Ha))	DLI 1	0.00	30,000.00
Number of hectares of degraded and monoculture forests restored using a diversified forest structure (Hectare(Ha))	DLI 2	0.00	100,000.00
Results Area 2: Strengthening Institutional Capacity in Support of Sustainability			
Number of provincial, county and forest farms long-term forest management plans developed (Number)	DLI 3	0.00	86.00
Development of a forest carbon trading institutional framework and technical support system (Number)	DLI 4	0.00	1.00
Financial management and internal controls of the Sichuan Provincial Forestry Bureaus strengthened (Number)	DLI 5	0.00	2.00
Number of farmers and county-level staff received Trainings (Days)		0.00	14,000.00

Indicator Name	DLI	Baseline	End Target
Of which, trainings received by women (Days)		0.00	6,300.00
Number of sylvicultural technical standards/regulations for rare species and mixed forest management developed and in use (Number)		0.00	5.00
Provincial forest germplasm resources survey report delivered with Sichuan forest species list developed (Number)		0.00	1.00
Computerized monitoring and information system established (Yes/No)		No	Yes
A proposal developed for the improvement of the forestry payments for environmental services (PES) system at the national level and in Sichuan Province (Number)		0.00	1.00
Increase in women applying for government subsidized afforestation and forest management programs (percentage)		30	45.0

Note: Increase in women applying for government subsidized afforestation and forest management programs will be measured by the increased rate of women applying subsidized afforestation and forest management programs supported by the Program, compared with total households applied the Program.

Table 10. Disbursement Linked Indicators Matrix

DLI 1	Number of hectares of improved plantations of mixed species having a survival rate of 85 percent at the end of the first year after planting			
Type of DLI	Scalability	Unit of Measure	Total Allocated Amount (USD)	As percent of Total Financing Amount
Intermediate Outcome	Yes	Hectare(Ha)	37,080,000.00	24.70
Period	Value		Allocated Amount (USD)	Formula
Baseline	0.00			
2020-2024	30,000.00		37,080,000.00	US\$1,236 per hectare mixed-species planting.

DLI 2	Number of hectares of degraded and monoculture forests restored using a diversified forest structure.			
Type of DLI	Scalability	Unit of Measure	Total Allocated Amount (USD)	As percent of Total Financing Amount
Intermediate Outcome	Yes	Hectare(Ha)	76,296,700.00	50.90
Period	Value		Allocated Amount (USD)	Formula
Baseline	0.00			

2020-2024	100,000.00	76,296,700.00	See the following notes for formula
-----------	------------	---------------	-------------------------------------

DLI 3 Number of provincial, county and forest farm long-term forest management plans developed.				
Type of DLI	Scalability	Unit of Measure	Total Allocated Amount (USD)	As percent of Total Financing Amount
Intermediate Outcome	Yes	Number	17,005,000.00	11.30
Period	Value		Allocated Amount (USD)	Formula
Baseline	0.00			
2020-2024	86.00		17,005,000.00	See the following notes for formula

DLI 4 Development of a forest carbon trading institutional framework and technical support system.				
Type of DLI	Scalability	Unit of Measure	Total Allocated Amount (USD)	As percent of Total Financing Amount
Intermediate Outcome	Yes	Number	14,000,000.00	9.30
Period	Value		Allocated Amount (USD)	Formula
Baseline	0.00			

2020-2024	1	14,000,000.00	A forest carbon trading institutional framework and support system developed.
-----------	---	---------------	---

DLI 5 Financial management and internal controls of the Provincial Forestry Forestry Bureau strengthened.				
Type of DLI	Scalability	Unit of Measure	Total Allocated Amount (USD)	As Percent of Total Financing Amount
Intermediate Outcome	Yes	Number	5,618,300.00	3.8
Period	Value		Allocated Amount (USD)	Formula
Baseline	2			
2020-2024	6,000,000.00		5,618,300.00	See Footnote for formula

- a) Note of DLI2 Formula: For DLR 2-1, US\$783 per hectare for 93,300 hectare degraded and monoculture forest restoration; and for DLR 2-2, US\$484 per hectare for 6,700 hectare promoted natural regeneration.
- b) Note for DLI3 Formula: US\$ 3,953,000 for one provincial long -term forest management plan developed, and US\$153,554 for per forest management plan developed at county and forest farm levels.
- c) Note for DLI 4 Formula: This includes US\$5 million for assessment of forest carbon offset potential on trading in Sichuan; US\$5 million for an inclusive forest carbon trading scheme with procedure developed; and US\$ 4 million for methodologies of forest carbon trading using inclusive forest management and afforestation activities developed, including relevant training and technical assistance.
- d) Note for DLI 5 Formula: The standard internal audit system developed with US\$1 million per audit Program implementation rate increased for 10 percent; and US\$3 million for a framework of public funding management and a manual for public budget performance management, including a relevant indicator system, developed and issued for implementation, of which, US\$ 1 million for the framework for implementing budget performance management, and US\$ 1.62 million for the manual for comprehensive budget performance management including a detailed assessment indicator system issued for implementation.

Table 11. Verification Protocol Table: Disbursement Linked Indicators

DLI 1	Number of hectares of improved plantations of mixed species having a survival rate of 85 percent at the end of the first year after planting
Description	This DLI is defined as 30,000 hectares of mixed-species plantation established with a survival rate of 85 percent one growth season after planting. The technical prescriptions should be met for all established plantations, based on the improved technical models, which were developed under the Program, to extend forest areas with forest species increased and structure adjusted for enhancing forest environmental functions and restoring resilient forest ecosystems.
Data source/ Agency	SFGB
Verification Entity	TPVA
Procedure	<p>Two levels of inspection and acceptance will be carried out according to the “<i>National Afforestation and Forest Management Comprehensive Verification Technical Regulation (LY/T2083-2013)</i>,” and the “<i>Forest Management Verification Technical Regulation (Forestry 2014 – No. 140)</i>” For all afforestation and forest restoration activities under SLGS. The Program verification will be based on county-level forest management checks carried out for all sites by local forestry bureaus. The Program verification will be the responsibility of the independent third-party verification agency (TPVA) that will carry out quality check for all the activiteis completed with random field surveys covering not less than 5 percent of the county’s reported qualified areas, which will, in turn, cover at least 15 percent of the total reported counties.</p> <p>Verification procedures for afforestation will confirm the accuracy of areas planted, quality (size) of seedlings planted and their survival rates, tree species, and other technical parameters established in technical models. More specifically, (i) area verification involves a desk review of the area recorded as planted, followed by random spot inspections in the field. Desk reviews serve to check consistency between the afforestation plots listed in documents and those in the contracts and project design, with special care being taken to ensure that no overlap exists with afforestation projects funded by central and provincial governments; (ii) seedling survival checks examine both survival and quality/height. Survival rates are measured one growth season after planting when at least 85 percent of seedlings must have survived one year after planting; and (iii) planting will be checked to ensure compliance with the technical specifications of models promoted by the Program.</p>

DLI 2	Number of hectares of degraded and monoculture forests restored using a diversified forest structure.
Description	The DLI is defined as 100,000 hectares of mixed forests developed through the restoration of degraded forests, the conversion of monoculture forests to mixed-species forests, and the promotion of natural regeneration. This would comprise the following two DLRs: (a) DLR 2-1: Number of hectares of degraded and monoculture forests restored by adopting mixed-species forest structure. More specifically, Program planting models will be used to improve around 93,300 hectares of forests through the supplementary planting of native species (including rare and precious species), the result of the intervention will be that additional young seedlings will be present in the stand thereafter. In addition, the number of broadleaf seedlings in monoculture forests would be increased after having been thinned and tended to promote the growth of native species in the understory. (b) DLR 2-2: Number of hectares of natural regeneration promoted with increased numbers of young seedlings present. More specifically, around 6,700 hectares of degraded forestland should be demarcated and tended to make space for natural regeneration; where natural regeneration is sparse, the area will be seeded, in accordance with technical model prescriptions. The technical prescriptions should be met for all improved forests by enrichment planting of local broadleaf seedling, tending, and thinning, based on the set of improved technical models to formulate good growth, diversified species, and stable forest structure, enhancing forest environmental functions and rehabilitating degraded forest resilience forest ecosystems. The improved technical models have been developed for this purpose.
Data source/ Agency	SFGB
Verification Entity	TPVA
Procedure	Similar to DLI1, two levels of inspection and acceptance will be carried out according to the " <i>National Afforestation and Forest Management Comprehensive Verification Technical Regulation (LY/T2083-2013)</i> ," and the " <i>Forest Management Verification Technical Regulation (Forestry 2014 – No. 140)</i> " For all afforestation and forest restoration activities under SLGS. The Program verification will be based on county-level forest management checks carried out for all sites by local forestry bureaus. The Program verification will be the responsibility of the independent third-party verification agency (TPVA) that will carry out quality check for all the activities completed with random field surveys covering not less than 5 percent of the county's reported qualified areas, which will, in turn, cover at least 15 percent of the total reported counties.

	<p>Verification procedures for the restoration of degraded and monoculture forests. The following parameters will be used to verify improvements in forest quality: (i) for enrichment planting, field sampling will be used to confirm that field operations have reached the required standards. This will include the species planted, the number of seedlings planted, the layout of planting points, and survival rates; (ii) thinning intensity; (iii) weeding intensity to verify that bushes and weeds that might affect the growth of the target trees have been removed, and whether rare and precious tree seedlings, saplings, and young trees with growth potential are being protected; and (iv) natural regeneration enhancement to check the growth of seedlings and young trees, and the percentage of target trees present against the percentage required.</p> <p>Disbursements will be made against the number of hectares of mixed forests developed through (i) forest quality enhancement with no less than 450 additional new seedlings or young trees present per hectare one year after forest tending and supplementary planting for the highly degraded forests; and (ii) at least 300 additional seedlings or young trees per hectare present one year after forest tending and thinning for the degraded monoculture forests, which will be compliance with technical specifications in afforestation and forest management models promoted by the Program.</p> <p>For verification of promoted natural regeneration, quality checks will be based on measurements and areas delineated on maps. Maps (scale 1:25,000), together with field survey or Global Positioning System (GPS) readings, will be used to verify areas, with field surveys being used to verify the number of seedlings regenerated and planted. Disbursement will be made against the number of hectares of land demarcated with at least 300 additional young live trees present per hectare one year after technical intervention and regeneration treatment and compliance with technical specifications in models promoted by the Program.</p>
--	---

DLI 3	Number of provincial, county and forest farm long-term forest management plans developed.
Description	This DLI is defined as number of long-term provincial, county, and forest farm forest management plans developed. To fulfill this DLI, one long-term forest management plan will be prepared for Sichuan province, together with 35 county level forest management plans, and 50 state-owned forest farms forest management plans prepared. All plans will be developed in accordance with the guidance and prescriptions provided by the National Forestry and Grassland Administration for such plans. These plans will help shape the Sichuan 14th Forestry FYP by scaling up new mixed-species forest management regimes for the restoration of forest ecosystems and the application of multiuse forest management.
Data source/ Agency	SFGB and County Forestry Bureaus

Verification Entity	TPVA
Procedure	Disbursements will be made against the number of delivered Sichuan provincial and county forest management plans. The TPVA will verify the deliverable based on the National Forestry and Grassland Administration issued on “ <i>Guidance on Forest Management Planning at Provincial Level</i> ” and “ <i>Guidance on Forest Management Planning at County Level</i> .”
DLI 4	Development of a forest carbon trading institutional framework and technical support system.
Description	This DLI is defined as a forest carbon trading institutional framework in place and technical support system developed. This DLI will require that forest carbon trading mechanism and support system developed to enable forest carbon offset trading in Sichuan. The outputs include (a) the potential for forest carbon offset trading in Sichuan under different forest management interventions assessed; (b) an inclusive forest carbon offset and trading scheme with procedures and institutional framework developed; (c) methodologies for forest carbon trading using inclusive forest management and afforestation activities developed; and (d) training and information on forest carbon trading received by forestry staff and farmers, which enables them to implement forest carbon tradings. The TORs for the work will be approved by the Bank. The methodologies for forest carbon trading will be approved by Sichuan Provincial Quality Bureau as a regional standard.
Data source/ Agency	SFGB
Verification Entity	TPVA
Procedure	The Disbursements will be made against the readiness of the institutional framework and technical support system for forest carbon trading, which will be developed and ready for operation in Sichuan, with this being part of a regional forest carbon offset platform under the proposed national Emissions Trading System. This will be verified by an independent TPVA. More specifically, the disbursement will be triggered against the submission of a set of the following deliverables: (a) a technical assessment of the potential for forest carbon trading offsets in Sichuan province undertaken to guide forest carbon financing practice; (b) a policy and institutional framework developed to support inclusive forest carbon offset trading, together with procedures for implementation; and (c) methodologies to support forest carbon offset trading developed, targeting inclusive forest management and afforestation/reforestation activities.

DLI 5	Financial management and internal controls of SFGB strengthened.
Description	DLR 5-1: Approved annual audit plan and percentage increase of completion rate of activities in each plan; DLR 5-2: Framework for implementing budget performance management and a manual for comprehensive budget performance management including a detailed assessment indicator system adopted.
Data source/ Agency	SFGB
Verification Entity	TPVA
Procedure	Disbursements for DLR1 will be made against (a) approved an annual audit plan; and (b) reached a completion rate under each annual audit plan of at least: (i) 80 percent for FY 2020, (ii) 90 percent for FY 2021, and (iii) 100 percent for FY 2022 by SFGB. The plan comprises a number of tasks which could include the financial audit or accountability audit conducted in the various of divisions within SFGB and its subordinate bodies; the disbursements for DLR2 will be made also against a framework for implementing budget performance management; and (b) a manual for comprehensive budget performance management including a detailed assessment indicator system adopted by SFGB. The document should be prepared in line with related regulations/standards issued by MOF and the line ministries and will be issued by the SFGB. The delivery of these documents will be verified by an Independent TPVA (external auditors).

D. Program Economic Evaluation

115. **Rationale for public sector financing:** Public sector financing is justified because of the expected positive externalities. The proposed Program will generate a wide range of important environmental benefits from protecting against soil and water erosion, reducing atmospheric pollution, promoting carbon sequestration, and providing habitat for plant and animal species. The Program will develop the improved technical models to promote multifunction and mixed forest management (the close-to-nature forest management approach). While the efforts will help shift forest management away from monocultures toward forest ecosystem restoration, to ensure that forestry development is focused on improving forest ecosystem stability and vitality, the multiuse-orientated forest management approach will also help balance the public and private benefits. This will improve the prospects for sustainability and address the need to improve the quality and ecological functions of degraded forest plantations, and the need to provide farmers with income generation, including long-term forest financing.

116. **Program Benefits:** The main aim of the Program is to improve the quality and effectiveness of the government's investment in the LSGS by promoting the most cost-effective ways of adopting mixed-species afforestation and forest management initiatives, long-term forest landscape planning, and integrated forest resources management in support of the forest ecosystem restoration aims of the government program. The shift from traditional cultivated plantation establishment toward stable forest ecosystem restoration with a focus on combining multiuse and mixed-species afforestation, natural regeneration promotion, and long-term forest stand management as part of a broader landscape management approach under the LSGS represents a fundamental conceptual change in how afforestation is to be undertaken in Sichuan.

117. The expected benefits from the Program would be both local and global. At the local level, significant increases in biodiversity and vegetative cover can be expected, together with a significant decrease in soil erosion in degraded forests. In addition, significant global benefits will result from the carbon sequestration potential of the newly established mixed-species plantations. Vegetation and soils are widely recognized as carbon storage sinks, and the sequestration of carbon in terrestrial ecosystems offers a low-cost means of reducing carbon emissions. The Kyoto Protocol makes provisions for direct human-induced land use change and vegetation-recovering activities to be considered in relation to each country's commitment to reduce greenhouse gas emissions.

118. **Methodologies for Economic Assessment:** The evaluation of the proposed Program would be based on what the Program is expected to achieve relative to a counterfactual situation, that is, a comparison is drawn between the with and without Program situations. The baseline scenario is the LSGS without Program support. Against the baseline scenario, the Program will strengthen the quality and impact by ensuring the adoption of good technical models to diversify forest systems in afforestation and forest management processes. It has been proved that forests with more diversified locally adapted species and a long-term forest management regime would contribute to significantly enhancing forest ecosystem resilience to natural disasters and climate variability and its environmental functions, as well as forestland productivity.

119. A cost-benefit approach will be adopted to gauge the economic internal rate of *return* of the proposed Program. The incremental costs and benefits (on a 1-hectare basis) are derived from the recommended technical models in comparison with the ongoing LSGS. The costs will include both establishment costs and operations and maintenance costs, while the benefits cover (a) carbon

sequestration, (b) reduced soil erosion, (c) increased water conservation, and (d) reduced losses due to improved pest control.

120. In addition, the Program will generate other significant but not readily quantifiable benefits including improved biodiversity, institutional capacity building, and forest development strategies, in connection with DLIs. Results Area 2 (Strengthening Forest Programs in Support of Sustainability) would focus on long-term forest resources management planning and financing incentives for forest management and income generation to landowners, including individual farmers and communities, and the institutional capacity building to create conditions for long-term sustainable forest management and financing in Sichuan. It will address those aspects in improving the technical standards and regulations, and in training for local forest staff and forest management entities, including individual farmers.

121. **Assumptions:** The major assumptions adopted for the analysis are as follows:

- (a) Economic prices: It is assumed that the prevailing market prices net of taxes are a sufficiently accurate representation of the economic value. Given the status of market liberalization in the country, no major bias can be observed that would require the calculation of world market reference prices. Therefore, market prices of the inputs and labor are taken as economic prices. The shadow price of carbon has been set at the lowest level of US\$40 per ton of CO₂ per the Bank's guidelines.⁴ The shadow prices of water conserved (3 yuan/m³) and soil erosion reduced (84 yuan/ton) are based on the estimation of ecological evaluation adopted for many years by the Sichuan Provincial Forestry Ecological Benefit Assessment Center.⁵ As such, the shadow prices of carbon, water, and soil are at the lowest limits of calculation.
- (b) Ecological benefits begin to accrue five years after the Program interventions.
- (c) Program life is set at 30 years, which is conservative in view of the economic life of ecological forestry.
- (d) Cash flows are used to estimate the economic rate of return and net present value for major plantation/rehabilitation activities.

122. **Analytical Models:** Based on the major Program interventions, the models (on a per hectare basis) for cost-benefit analysis have been developed as follows, with detailed technical descriptions contained in the technical report:

Model 1: Afforestation/Reforestation (30,000 hectares): To encourage households, farmer cooperatives, afforestation companies, forest farms, and other eligible entities to engage in mixed species, multifunction afforestation and management. A full cycle forest management regime will be adopted to provide technical guidance and incentives to beneficiaries, encouraging them to plant and manage mixed stands of a wider range of rare, precious tree

⁴ Guidance note on the shadow price of carbon in economic analysis (November 12, 2017).

⁵ Annual Report on Forestry Ecological Benefit Monitoring Report in Sichuan Province (2018).

species and native trees, and to adopt the close-to-nature concept for creating and managing mixed species, multilayered, unevenly aged stands.

Model 2: Rehabilitation of Degraded Forests (93,300 hectares): To improve the quality, vitality, structure, diversity, and ecological functions of the stands. The close-to-nature concept will be used to guide tending of the upper-story level and supplementary planting at the understory level. These operations will bring both short- and long-term benefits by creating a mixed, multilayered, and unevenly aged forest stand.

Model 3: Promotion of Natural Regeneration Promotion (6,700 hectares): To establish forest stands in which the number of viable, naturally regenerating seedlings or trees reaches at least 300 per hectare. This will be achieved by adjusting and improving the structure and quality of the forest stands through the selection and marking of viable seedlings and young trees suitable for regeneration, together with supplementary underplanting.

123. **Quantification of Program benefits and data sources:**

(a) **Carbon sequestration:** The greenhouse gas (GHG) emissions were calculated in tCO₂eq using the Food and Agriculture Organization (FAO) EX-ACT GHG accounting Excel tool. The Ex-Ante Carbon-balance Tool (EX-ACT) is an appraisal system developed by FAO providing estimates of the impact of agriculture and forestry development projects, programs, and policies on the carbon balance. The carbon balance is defined as the net balance from all GHGs expressed in CO₂ equivalent that were emitted or sequestered due to Program implementation compared to a “without Program” scenario. EX-ACT is a land-based accounting system, estimating carbon stock changes (that is, emissions or sinks of CO₂), as well as GHG emissions per unit of land, expressed in equivalent tons of CO₂ per hectare per year.

(b) **Water conservation, and soil and losses reduction:** The Sichuan Provincial Forestry Ecological Benefit Assessment Center (the Center) has been tasked with the evaluation of the province-wide forestry ecological benefits for the past 20 years and maintains a large data set on various replanting and rehabilitation models from both field surveys and experimental stations. In fact, the methodologies adopted by the Center for measuring the quantities of water conserved, soil erosion reduced, and losses avoided are based on the guidelines of the National Forestry and Grassland Administration. Baseline scenarios are drawn from an existing data bank in the Center, while the “with Program situation” projections are based on the estimates reached by the Center and the forest specialists involved in the government LSGS.

124. **Results and Conclusions of the Assessment:** The initial results that total area under all three models will generate the incremental environmental benefits shown in tables A14 and A15 during the economic life of the Program.

Table 12. Incremental Aggregate Environmental Benefits

Carbon Sequestration (Million tCO₂eq)	Water Conservation (Million m³)	Soil Retention (Million ton)
23.52	910.14	8.14

Table 3. Results of Economic Assessment

	Model 1: Afforestation/ Reforestation	Model 2: Rehabilitation of Degraded Forests	Model 3: Promotion of Natural Regeneration and Tending
Economic rate of return	17.46 percent	18.35 percent	24.11 percent
Net present value (Opportunity cost of capital at 8 percent in RMB)	13,480	15,538	18,882

125. The results show that all technical models to be adopted by the Program (including afforestation, reforestation, and habitation) are economically viable, with ERRs all noticeably above 8 percent (economic cost of capital). The overall Program therefore is economically viable.

126. **Sensitivity analysis.** In the economic assessment, the shadow prices of carbon, water conserved, and soil erosion reduced are based on the lowest limits of estimations. As such, the ERRs are conservative estimates, thus rendering the sensitivity test not applicable.

ANNEX 1: PROGRAM ACTION PLAN

Action Description	Source	DLI#	Responsibility	Timing		Completion Measurement
1.Prepare training program for farmers and local forestry staff focuses on the adoption of new technologies of multifunction mixed-species forest management and other innovative interventions promoted by the Program, as well as to meet the women focused capacity building needs.	Technical		SFGB	Due Date	31-Dec-2019	The training program will be submitted to the Bank by the SFGB for review and approval. The implementation of the training program will be reported to the Bank in a semiannual progress report.
2.Prepare and implement a Community Participation Manual	Technical		SFGB	Due Date	31-Dec-2019	Manual issued by the SFGB.
3. Conduct an assessment and prepare a proposal to improve or establish a forestry-related PES system aimed at inducing the private sector to adopt sustainable management of ecological forests.	Technical		SFGB	Due Date	31-Dec-2021	Proposal submitted to Sichuan government and relevant national agencies for consideration and decision.
4. Conduct a provincial forest germplasm resources survey together with a Survey Report that includes a broader range of forest species (in particular, the local broadleaf	Technical		SFGB	Due Date	31-Dec-2020	A list of local broadleaf species including rare species, with their provenance, issued by SFGB and in use in Sichuan.

species and rare species) together with their provenance.						
5. Develop a computerized monitoring and information platform to monitor and evaluate Program performance and impacts, and to disseminate the improved technical models and other technical innovations promoted by the Program.	Technical	SFGB	Due Date	30-Jun-2020	The computerized monitoring and information system developed and put into operation.	
6. Promptly inform the Bank of any credible and material allegations of fraud and/or corruption regarding the Program, and ensuring that persons or entities debarred or suspended by the Bank are not awarded contracts.	Fiduciary Systems	SFGB	Due Date	31-Jan-2020	Issuance of letter to relevant agencies by Sichuan Province to comply with the Bank's Anti-Corruption Guidelines, including compliance with the list of debarred and suspended firms and individual reporting through semi-annual Program reports.	
7. The financial audit of the Program operation should be further defined.	Fiduciary Systems	SFGB	Due Date	31-Mar-2020	Develop ToR for the financial audit of the Program operation and the verification of DLIs related to DLR 5-1.	

ANNEX 2: LIST WITH TECHNICAL CHARACTERISTICS OF RARE AND PRECIOUS TREE SPECIES IN SICHUAN

No	Tree Species (in Chinese)	Family	Latin Names	Bio-ecological Characteristics		
				Ecological Characteristics	Adaptability	Growth Speed
1	珙桐	Tupelo	<i>Davidia involucrata</i> Baill.	Shade Tolerant	Growing in wet ever-green broad and fallen leaved mixed forests at 1500-2200 m; commonly seen in dark sites, suitable for neutral soil or slightly acidic soil with thick layer of humus.	Slow
2	银杏	Ginkgoaceae	<i>Ginkgo biloba</i> L.	Photophilous	Suitable for warm and wet sites at below 1000m; growing well at sites with thick and fertile soil layer and good drainage.	Medium
3	桢楠	Lauraceae	<i>Phoebe zhennan</i> S. Lee	Shade Tolerant	Strict with site conditions; growing well on shady slope or at the foot of sunny slope; preferring sites with thick soil layer with high content of humus, loose and wet soil, neutral soil, slightly acidic soil or sandy loam with high organic content	Medium
4	红椿	Meliaceae	<i>Toona ciliata</i> Roem.	Photophilous	Wide adaptability, growing at 300-2600m, without strict requirements on soil; normally growing on dry, barren hillsides. Preferring thick, fertile, moist, well-drained acidic or calcareous soils, especially growing well in mountainous sites with moist and fertile yellow soil or yellow-brown soil, or in wet lands along mountain streams.	Fast
5	鹅掌楸	Magnoliaceae	<i>Liriodendron chinense</i> (Hemsl.) Sargent.	Photophilous	Suitable in thermophilic and humid climate, commonly seen in mountain forests or forest edges at 900-1 000 m, with a certain degree of cold resistance, favors thick, fertile, wet and well-drained acidic or slightly acidic soils (pH 4.5-6.5), fails to grow well in dry land	Medium
6	峨眉含笑	Magnoliaceae	<i>Michelia wilsonii</i> Finet et Gagn.	Shade Tolerant	Preferring thick, loose, fertile, well-drained acidic to slightly alkaline soils	Medium
7	杜仲	Eucommiaceae	<i>Eucommia ulmoides</i> Oliver	Photophilous	Suitable for warm and humid conditions; can grow in infertile red soil, or on rock cliffs	Medium
8	黄檗	Rutaceae	<i>Phellodendron amurense</i> Rupr.	Light Demanding	Adaptable to soils, suitable for thick, moist, well-ventilated, humus-rich neutral or slightly acidic loamy soils	Medium
9	厚朴	Magnoliaceae	<i>Magnolia officinalis</i> Rehd. et Wils.	Day neutral	Growing in the mountainous forest between 300-1500 m, in need of shade during the young age; preferring cool, humid, cloudy and foggy climate with higher relative humidity; Growing well in thick, fertile, loose, humus rich, well-drained slightly acidic or neutral soils.	Medium

					Often mixed in deciduous broad-leaved forest, or growing in evergreen broad-leaved forest edge	
10	德昌杉	Taxodiaceae	<i>Cunninghamia unica</i>	Photophilous	Mainly located in Anning river basin and Yalong river basin of Sichuan, main production areas are in Dechang and Miyi counties; growing in valleys at 1300m-3000 m; aridity tolerant, fast growing.	Fast
11	水杉	Taxodiaceae	<i>Metasequoia glyptostroboides</i> Hu & W. C. Cheng	Photophilous	Preferring warm and humid climate; commonly seen growing in a valley or at the foot of a hill, at places that is flat, moist, with thick soil, or slightly waterlogged; with strong coldness and waterlogging resistance; can grow in slightly saline-alkali lands, but not resistant to infertile and arid conditions	Fast
12	四川红杉	Pinaceae	<i>Larix mastersiana</i> Rehder & E. H. Wilson	Photophilous	Growing at sites at 2300-3500 m ; tolerant to alpine and cold conditions, as well as infertile soil	Slow
13	香樟	Lauraceae	<i>Cinnamomum camphora</i> (L.) Presl.	Shade Tolerant	Preferring warm and humid climate, not strict with soil conditions, strong resistance to moisture, but without strong resistance to coldness, drought, or infertile or saline soils	Medium
14	黄连木	Anacardiaceae	<i>Pistacia chinensis</i> Bunge	Photophilous	Preferring warmth to coldness, resistant to drought and infertile soil. Not strict with soil conditions, adaptable to slightly acidic, neutral and slightly alkaline sandy soil and clay soil; most suitable sites are in fertile, moist and well-drained limestone mountainous land; with shade tolerance when young.	Slow
15	香椿	Meliaceae	<i>Toona sinensis</i> (A. Juss.) Roem.	Photophilous	Widely adaptable, growing in mountainous areas below 1500m and in vast plain areas; more resistant to moisture and suitable in fertile, wet soil along riversides and around houses.	Fast
16	润楠	Lauraceae	<i>Machilus yunnanensis</i> Lec.	Shade Tolerant	Growing in evergreen broad-leaved forests in the mountainous areas at 1650m-2000m; preferring humid and fertile soil on the slopes; being a deep-rooted tree species	Medium
17	银木	Lauraceae	<i>Cinnamomum septentrionale</i> Hand.-Mazz	Photophilous, Slightly Shade Tolerant	Preferring warm and wet climate, growing in valleys or mountain slopes at 600-1000m; deep-rooted, with strong germination capability	Medium
18	丝栗栲	Fagaceae	<i>Castanopsis fargesii</i> Franch	Shade Tolerant	Preferring moist and fertile soils, distributed in coniferous, broad-leaved forest at 1600~2200 m.	Medium
19	青冈栎	Fagaceae	<i>Cyclobalanopsis glauca</i> (Thunb.) Oerst.	Shade Tolerant	Growing on mountain slopes or valleys at 60-2600m, forming mixed forests of evergreen broad-leaved type, or evergreen broad and fallen leaved type, or broad-leaved type; strong adaptability, seen growing in acidic to alkali bed rock areas	Medium

20	水青冈	Fagaceae	<i>Fagus longipetiolata</i> Seem.	Photophilous	Growing in the mountain mixed forests at 300m-2400 m ; more commonly seen in sunny slopes, mixed with evergreen or deciduous trees; often seen as upper layer tree species	Medium
21	麻栎	Fagaceae	<i>Quercus acutissima</i> Carruth.	Photophilous	Preferring humid climate; resistant to coldness, drought and infertile soils, but not resistant to waterlogging and salinity. Most suitable for moist, fertile, well-drained neutral to slightly acidic sandy loam, not suitable for poorly drained or waterlogged sites; slightly shade tolerant when young.	Medium
22	檫木	Lauraceae	<i>Sassafras tzumu</i> (Hemsl.) Hemsl.	Photophilous, slightly shade tolerant	Preferring warm, humid sites with abundant rainfall, generally distributed on sunny slopes below 800m , suitable for deep, well-ventilated, well-drained acidic soil	Medium
23	油樟	Lauraceae	<i>Cinnamomum longepaniculatum</i> (Gamble) N. Chao ex H. W. Li	Shade Tolerant	Preferring warm, humid climate, growing in evergreen broad- leaved forests at 600-2000 m, suitable for acidic or slightly acidic soils	Medium
24	南方红豆杉	Taxaceae	<i>Taxus wallichiana</i> Zucc var. <i>mairei</i> mairei mairei (Lemée et H. Lév.) L. K. Fu et Nan Li	Shade Tolerant	Growing in acidic soils with rich humus in valleys, along streams or on gentle hillslopes at below 1000m ; can grow in yellow and yellow brown soils, neutral soil and calcareous soil with high fertility. Tolerant to drought, infertility soil, but not tolerant to waterlogging in low-lying area	Slow
25	川柏	Cupressaceae	<i>Cupressus funebris</i> Endl.	Photophilous	Suitable for all types of soils in warm and moist areas, with a wide soil adaptability; able to grow in neutral, slightly acidic and calcium soils. Tolerant to aridity, infertile soil and coldness, slightly tolerant to waterlogging.	Medium
26	塔枝圆柏	Cupressaceae	<i>Juniperus komarovii</i> Florin	Photophilous	Growing in alpine areas at 3200-4000m at the upper reaches of Minjiang river basin and Daduhe river basin; tolerant to alpine coldness and aridity, extremely tolerant to infertile soil	Slow
27	云杉	Pinaceae	<i>Picea purpurea</i> Mast.	Shade Tolerant	Requiring loose, fertile and air permeable acidic soil, preferring moist and cool climate, but with certain resistance to aridity and slightly alkaline soil	Medium
28	三角枫	Aceraceae	<i>Acer buergerianum</i> Miq.	Limited light demanding, Slightly Shade Tolerant	Preferring warm and moist sites, as well as neutral to acidic soils. Cold tolerant, relatively tolerant to waterlogging; with strong germination capability, trimming endurance, well-developed branches.	
29	元宝枫	Aceraceae	<i>Acer truncatum</i> Bunge	Limited light demanding,	Preferring temperate and moist climate, with strong cold tolerance; not strict with soil condition, able to grow in acidic, neutral and lime soils, and grow best in moist, fertile and thick soils.	

				medium shade tolerant		
30	喜树	Tupelo	Camptotheca Acuminata	Photophilous	Growing at the edge of forests or along streams at below 1000 m ; preferring warm and moist climate, not tolerant to extreme coldness or aridity; able to grow in acidic, neutral, slightly alkaline soils, and grow well in limestone saprolite soil and alluvial soil.	Fast
31	岩桂	Laraceae	Cinnamomum pauciflorum	Photophilous	Growing in mountainous areas at 400-2200m; seen in sparse forests in valleys, sandstone hilly areas, limestone areas and dense forests	Medium
32	枫杨	Juglandaceae	Pterocarya stenoptera C. DC	Photophilous, Slightly Shade Tolerant	Growing in forests on the shoals along the streams and on overcast hillsides at below 1500m.	Fast
33	刺楸	Araliaceae	Kalopanax septemlobus (Thunb.) Koidz.	Photophilous	Highly adaptable, preferring sunny and moist environment, slightly shade-tolerant, cold tolerant, suitable for neutral or slightly acidic soils that are rich in humus, thick, loose and well-drained	Medium
34	毛豹皮樟	Lauraceae	Litsea coreana var. lanuginosa	Shade Tolerant	Growing in sparse forests on hill slopes at 1900—2300m.	Medium
35	桂花	Oleaceae	Osmanthus fragrans (Thunb.) Lour.	Netural	Widely adaptable, preferring warm and moist climate, with strong stress resistance, tolerant to high temperature and coldness	
36	五角枫	Aceraceae	Acer pictum Thunb. subsp. mono (Maxim.) Ohashi	Slightly Shade Tolerant	Preferring moist and fertile soils, able to grow in acidic, neutral and carboniferous soils	Medium
37	红桦	Betulaceae	Betula albosinensis Burk.	Photophilous	Often seen growing in mixed forests on slopes at 1000-3400m and on slopes at 1600-2700m, and often forming mixed forests with Bashan Mountain fir and Picea wilsonii and etc.	Medium
38	光皮桦	Betulaceae	Betula luminifera H. Winkl.	Photophilous	Suitable for acidic soil, not strict with soil fertility, tolerant to infertility	Fast
39	桤木	Betulaceae	Alnus cremastogyne Burk	Photophilous	Preferring warm and moist climate, suitable for hilly, plain and mountainous areas with annual average temperature 15~18°C and precipitation of 900~1400 mm; strong adaptability to soil types	Fast
40	柰树	Sapindacease	Koelreuteria paniculata Laxm.	Photophilous, Slightly Shade Tolerant	Growing in hill and plain areas at below 1500m, with strong environmental adaptability, preferring limestone soils, resistant to salinity and short period waterlogging	Medium

41	漆树	Anacardiaceae	<i>Toxicodendron vernicifluum</i> (Stokes) F. A. Barkl.	Neutral	Growing in forests on sunny slopes at 800-2800 (-3800) m.	
42	木荷	Theaceae	<i>Schima superba</i> Gardn et Champ.	Photophilous	Suitable for subtropical climate, distributed in areas with annual precipitation of 1200~2000 mm, annual average temperature of 15~22°C; highly adaptable to soil conditions, able to grow in red soil, red-yellow soil, yellow soil and other acidic soils, especially in thick, moist, loose sandy soil	Medium
43	华山松	Pinaceae	<i>Pinus armandii</i> Franch.	Light demanding	Growing in temperate and moist areas, in acidic yellow soil, yellow-brown loam soil or calcium soil	Medium
44	广玉兰	Magnoliaceae	<i>Magnolia Grandiflora</i> Linn	Photophilous	Widely adaptable, suitable for dry, fertile, moist and well-drained slightly acidic soils or neutral soil; slightly shade tolerant when young	Medium
47	刺槐	Leguminosae	<i>Robinia pseudoacacia</i> L.	Photophilous	Preferring thick, fertile, loose and moist loam, sandy loam, sandy soil or sticky loam; able to grow in neutral soil, acidic soil and salinity soil with salinity content below 0.3 percent; slightly shade tolerant when young	Medium
45	板栗	Fagaceae	<i>Castanea mollissima</i> BL.	Photophilous	Growing in areas at 370—2800m; mostly seen in mountainous areas	Medium
46	核桃	Juglandaceae	<i>Juglans regia</i>	Light demanding	Preferring dry climate, cold tolerant, shade intolerant; preferably planted in valleys exposed to sunshine and with thick, loose and well-drained soil	Medium
47	油桐	Euphorbiaceae	<i>Vernicia fordii</i> (Hemsl.) Airy Shaw	Photophilous	Preferring warm and humid climate, with intolerance of severe cold; growing on hills and mountains at below 1 000 m; more suitable to grow in sunny, thick, loose, fertile, rich in humus content and well-drained sub acidic sandy loam.	Fast
48	山桐子	Flacourtiaceae	<i>Idesia polycarpa</i> Maxim.	Shade Tolerant	Growing in mixed forests of fallen –and- broad -leaved trees, and of coniferous-broad leaved trees on slope and valleys of hills at 400-2500m.	Medium
49	紫薇	Loosestrife	<i>Lagerstroemia indica</i> L.	Photophilous, Slightly Shade Tolerant	Preferring warm and moist climate and fertile soils, especially thick, fertile sandy soil, aridity tolerant	
50	红叶石楠	Rosaceae	<i>Photinia x fraseri</i> Dress	Photophilous	Preferring warm and moist climate, not strict with soil conditions, suitable for slightly acidic soil, especially sandy soil	

Notes: This list mainly refers to “National Forest Management Plan (2016-2050)”, “Afforestation Zoning and Main Tree Species for Planting in China (2013)”.

ANNEX 3: TYPICAL TECHNICAL MODELS FOR FOREST DEVELOPMENT AND MANAGEMENT

Table 3- 1 Afforestation /Reforestation

No.	Multi-functional Forest Development and Management Models	Eligible Sites and Current Status	Afforestation Method	Forms of Mixing	Tree Species Applicable for Mixing	Main Operation	Classification of Seedlings	Land Preparation Method	Method to Promote Regeneration	Operations for Forest Stands	Ecological Function Positioning	Targets		Expected Forest Form
												Survival Rate after Year 1 (%)	Expected Canopy Density	
1	Cunninghamia lanceolata (Lamb.) + Phoebe zhennan S. Lee + Quercus	Barren mountainous land and young afforested land, and etc.	Manual planting	Mixing in strips and clusters	<i>Cinnamomum camphora</i> (L.) Presl. (<i>innamomum longepaniculatum</i> (Gamble) N. Chao ex H. W. Li, <i>Cinnamomum septentrionale</i> Hand.-Mazz.) , <i>Phoebe zhennan</i> (<i>Machilus yunnanensis</i> lec.), maple(incl.broad-leaved maple), <i>Sassafras tzumu</i> , <i>Liriodendron chinense</i> (Hemsl.) Sargent. and etc.	Afforestation	Strong Seedlings , Class- I & II seedlings	not to apply overall reclamation	Young forest tending	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	85	0.7	Mixed Coniferous-Broad Leaved Forest Stands of Precious and Rare Tree Species
2	Metasequoia glyptostroboides Hu & W. C. Cheng + Phoebe zhennan S. Lee + Acer	Barren mountainous land and young afforested land, and etc.	Manual planting	Mixing in strips and clusters	<i>Michelia wilsonii</i> , <i>Gingko</i> , <i>Koelreuteria paniculata</i> Laxm, <i>Camptotheca Acuminata</i> , <i>Erythrina indica</i> , <i>Osmanthus fragrans</i> Lor and etc.	Afforestation	Strong Seedlings , Class- I & II seedlings	not to apply overall reclamation	Young forest tending	Focus on bio-diversity and habitat protection measures	Ecological forests with multiple functions	85	0.7	Mixed Coniferous-Broad Leaved Forest Stands of Precious and Rare Landscaping Tree Species
3	Pine + Fagus + Sassafras tzumu (Hemsl.) Hemsl.	Barren mountainous land and young	Manual planting	Mixing in strips and clusters	<i>Pinus yunnanensis</i> , <i>Dahurian larch</i> , <i>Larix mastersiana</i> Rehder & E. H. Wilson, <i>Castanopsis</i>	Afforestation	Strong Seedlings , Class- I	not to apply overall	Young forest tending	Goal tree management, cluster selective	Ecological forests with	85	0.7	Mixed Coniferous-Broad Leaved Forest Stands of

		afforested land, and etc.			fargesii Franch, Schima superba, Michelia wilsonii and etc.		& II seedlings	reclamation		cutting for regeneration	multiple functions			Precious and Rare Tree Species
4	Abies+Birch+Castanopsis	Barren mountainous land and young afforested land, and etc.	Manual planting	Mixing in strips and clusters	Picea asperata, Dahurian larch, Quercus and etc.	Afforestation	Strong Seedlings , Class- I & II seedlings	not to apply overall reclamation	Young forest tending	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	85	0.7	Mixed Coniferous-Broad Leaved Forest Stands of Precious and Rare Tree Species
5	Phoebe zhennan+Camphor+ChineseToon	Barren mountainous land and young afforested land, and etc.	Manual planting	Mixing in strips and clusters	Cinnamomum camphora (L.) Presl. (Cinnamomum longepaniculatum (Gamble) N. Chao ex H. W. Li, Cinnamomum septentrionale Hand.-Mazz, Phoebe zhennan (Machilus yunnanensis lec.), maple(incl.broad-leaved maple), Sassafras tzumu、Liriodendron chinense (Hemsl.) Sargent.,Robinia pseudoacacia, alder and etc.	Afforestation	Strong Seedlings , Class- I & II seedlings	not to apply overall reclamation	Young forest tending	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	85	0.7	Mixed Coniferous-Broad Leaved Forest Stands of Precious and Rare Tree Species
6	Phoebe zhennan+Taxus chinesis+Tee	Barren mountainous land and young afforested land, and etc.	Manual planting	Mixing in strips and clusters (intercropping with trees and tea)	Phoebe zhennan (Machilus yunnanensis lec.), maple(incl.broad-leaved maple), Sassafras tzumu、Liriodendron chinense (Hemsl.) Sargent., Osmanthus fragrans Lour., Gingko and etc.	Afforestation	Strong Seedlings , Class- I & II seedlings	not to apply overall reclamation	Young forest tending	Goal tree management, collection and utilization	Ecological forests with multiple functions	85	0.7	Mixed Coniferous-Broad Leaved, Multi-layered Forest Stands with Precious and Rare Tree Species

7	Juglans regia +Castanea mollissima BL.+ Pine	Barren mountainous land and young afforested land, and etc.	Manual planting	Mixing in strips and clusters	Acer mono Maxim., Metasequoia glyptostroboides Hu & W. C. Cheng, , Dahurian larch, Metasequoia glyptostroboides Hu & W. C. Cheng and etc.	Afforestation	Strong Seedlings , Class- I & II seedlings	not to apply overall reclamation	Young forest tending	Goal tree management, collection and utilization	Ecological forests with multiple functions	85	0.7	Mixed Coniferous-Broad Leaved Multi-layered Forest Stands with Precious and Rare Tree Species
8	Bamboo	Barren mountainous land and young afforested land, and etc.	Manual planting	Mixing in strips and clusters	Phyllostachys pubescens, hybrid bamboo	Afforestation	Strong Seedlings , Class- I & II seedlings	not to apply overall reclamation	Young forest tending	Collection for Utilization, Bamboo Forest Improvement	Ecological forests with multiple functions	85	0.7	Highly Effective Use of Bamboo Forests

Table 3- 2 Monoculture Forest Transfer to mixed Species Forest Models

No.	Multi-functional Forest Development and Management Model	Eligible Sites and the Current Status	Main Operations	Designed Thinning Intensity	Tending Methods to Promote Regeneration	Operations Planed for the Forest Stands	Ecological Function Positioning	Expected Forest Form	Other
1	Tending of Taxodiaceae (Cryptomeia fortune, Pins massoniana and etc.)	Young, immature Taxodiaceae (Cryptomeia fortune) forests, with initial planting density of above 2000 plants/hm ² , lacking tending operation, canopy density at above 0.9, pure, singly layer forest	Intermediate cuttings, increment felling, interlucation felling, necessary supplementary planting or dibble and broadcast seeding	No. of trees reaching 20-40% 2-3 operations of intermediate cutting)	Preserving broad-leaved goal trees	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	Mixed coniferous-broad leaved forest stands with Rational Density	Supplemented /renewed trees should be no less than 300 per hectares

2	Tending of Cupressus Trees	Slow growth forest stands with canopy density at above 0.9	Intermediate cuttings while maintaining trunks, Intermediate cuttings, necessary supplementary planting or dibble and broadcast seeding	No. of trees reaching 40%	Preserving broad-leaved goal trees	Goal trees' management and selective cutting	Ecological forests with multiple functions	Mixed coniferous-broad leaved forest stands with Rational Density	Supplemented /renewed trees should be no less than 300 per hectares
3	Tending of Broad-leaved Pure Forests of Alpine Ash and Poplar Trees	Forest stands' density reaching 2000-2500 plants/hm ² , with canopy density of above 0.8	Intermediate cuttings, increment felling, interlucation felling, necessary supplementary planting or dibble and broadcast seeding	No. of trees reaching 20-40% (2-3 operations of intermediate cutting)	Preserving ecological goal trees	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	Mixed forest stands with Rational Density	Supplemented /renewed trees should be no less than 300 per hectares
4	Supplementary Rare Species to mixed with Existing Tea Plantation	Tea plantations with density of 2500-3000 stump/ha	Phoebe zhennan (<i>Machilus yunnanensis</i> LeC.), <i>Liriodendron chinense</i> (Hemsl.), <i>Ginkgo biloba</i> L, <i>Taxus wallichiana</i> Zucc var. <i>mairei</i> , etc.	Thinning for less than 20%	Supplementing with rare and precious broad-leaf tree species for 300 stump/ha	Goal trees' management and selective cutting	Multiple functions	Mixed stands	Supplemented seedlings: no less than 300 per hectares

Table 3- 3 Degraded Forest Restoration Models

No.	Multi-functional Forest Development and Management Model	Eligible Sites and the Current Status	Method for Supplementary Planting	Form of Mixing	Tree Species Applicable for Mixing	Main Operations	Designed Thinning Density	Classification of Seedlings	Land Preparation Requirement	Tending Methods to Promote Regeneration	Operations for Forest Stands	Ecological Function Positioning	Expected Forest Form		Target Forest Stands
													Survival Rate after Year 1	Expected Canopy Density	
1	Enhancement of pure coniferous forests of Cupressus /Pinaceae/Taxodiaceae through supplementary planting	Low efficiency forests with canopy density below 0.4	Manual planting (300-900 seedlings/hectares)	Mixing in clusters as appropriate	Quercus, Fagus, Nanmu, Cinnamomum, Acer mono Maxim, Koelreuteria paniculata Laxm, Schima superba Gardn et Champ, Liriodendron chinense (Hemsl.) Sargent., Robinia pseudoacacia L., Alnus cremastogyne Burk, Castanea mollissima BL and etc.	Supplementing with rare and precious broad-leaf tree species	Strong Seedlings, Class- I & II seedlings	Plant pits formed	Manual supplementary planting to facilitate regeneration	Goal tree management, selective cutting for utilization	Ecological forests with multiple functions	85			Mixed ,uneven-aged ,multi-layered forests of Cupressus/ Pinaceae,/ Taxodiacea e with rare and precious broad-leaved trees
2	Enhancement of pure broad-leaved forests of Cinnamomum/ Quercus/ Sassafras tzumu through supplementary planting	Low efficiency forests with canopy density below 0.4	Manual planting (300-900 seedlings/hectares)	Mixing in clusters as appropriate	Pinus massoniana, Taxodiaceae, Cryptomeria, Pinus yunnanensis, Quercus, Fagus, Nanmu, Cinnamomum, Acer mono Maxim, Koelreuteria paniculata Laxm, Schima superba Gardn et Champ, Liriodendron chinense	Supplementing with coniferous, broad-leaf tree species	Strong Seedlings , Class- I & II seedlings	Plant pits formed	Manual supplementary planting to facilitate regeneration	Goal tree management, selective cutting for utilization	Ecological forests with multiple functions	85			Mixed ,uneven-aged ,multi-layered forests of rare and precious broad-leaved trees

					(Hemsl.) Sargent., Robinia pseudoacacia L.,Alnus cremastogyne Burk , Castanea mollissima BL and etc.										
3	Upgrading and restoration of pure broad-leaved forests of Cinnamomum, Quercus, Sassafras tzumu and Schima superba Gardn et Champ. and etc.	Slow growth and poor forest forms resulted from improper operations, with vegetation coverage beneath trees <0.6	Manual planting (300-900 seedlings/hectares)	Mixing in clusters as appropriate	Taxodiaceae,Cryptomeria, Pinus yunnanensis and etc.	Restructuring by reducing coniferous trees while preserving broad-leaf trees and conducting goal tree management	Within 25% of cross-section area of the stand, or within 40% of total number of trees	Strong Seedlings , Class- I & II seedlings	Plant pits formed	Manual coniferous tree supplementary planting to facilitate the regeneration	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	85		Mixed ,uneven-aged ,multi-layered coniferous and broad-leaved forests with rare and precious broad-leaved trees
4	Upgrading and restoration of pure coniferous forests of Pinaceae, Taxodiaceae, Cupressus	Slow growth and poor forest forms resulted from improper operations, with vegetation coverage beneath trees <0.6	Manual planting (300-900 seedlings/ha)	Mixing in clusters as appropriate	Quercus, Fagus, Nanmu, Cinnamomum, Acer mono Maxim, Koelreuteria paniculata Laxm, Schima superba Gardn et Champ, Liriodendron chinense (Hemsl.) Sargent., Robinia pseudoacacia L.,Alnus cremastogyne Burk , Castanea mollissima BL and etc.	Restructuring by cutting coniferous trees and supplementing with broad-leaf trees, and conducting goal tree management	Within 25% of cross-section area of the stand, or within 40% of total number of trees	Strong Seedlings , Class- I & II seedlings	Plant pits formed	Manual broad-leaved tree supplementary planting to facilitate the regeneration	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	85		Mixed, uneven-aged, multi-layered coniferous-broad leaved forests

5	Upgrading and restoration of mixed coniferous and broad-leaved forests of Cunninghamia (Cryptomeria fortune) +Sassafras tzumu, or Pinus massoniana+F agus	Slow growth and poor forest forms resulted from improper operations, with vegetation coverage beneath trees <0.6	Manual planting (300-900 seedlings/h a)	Mixing in clusters as appropriate	Quercus, Fagus, Nanmu, Cinnamomum, Acer mono Maxim, Koelreuteria paniculata Laxm, Schima superba Gardn et Champ, Liriodendron chinense (Hemsl.) Sargent., Robinia pseudoacacia L., Alnus cremastogyne Burk, Castanea mollissima BL and etc.	Restructuring by thinning coniferous trees and supplementing with broad-leaf trees, and conducting goal tree management	Within 25% of cross-section area of the stand, or within 40% of total number of trees	Strong Seedlings , Class- I & II seedlings	Plant pits formed	Manual broad-leaved tree supplementary planting to facilitate the regeneration	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	85		Mixed, uneven aged, multi-layered forests of Cunninghamia/Pinus + Rare and precious broad-leaved trees
6	Replacement and enhancement of pure forests of poplar, eucalyptus and bamboo	Seriously degraded artificial, commercial pure forest	Manual planting (300-900 seedlings/h a)	Mixing in strips and clusters	Pinus yunnanensis, Dahurian larch, Larix mastersiana Rehder & E. H. Wilson, Cunninghamia, Cryptomeria fortune, Cinnamomum septentrionale Hand.-Mazz , Phoebe zhennan S. Lee., Sassafras tzumu,Liriodendron chinense (Hemsl.) Sargent., Robinia pseudoacacia L.,Alnus cremastogyne Burk and etc.	Gradual cutting for enhancement	No. of trees planted in the year limited within 50% of the total	Strong Seedlings , Class- I & II seedlings	Plant pits formed	Tending of young trees	Goal tree management, cluster selective cutting for regeneration	Ecological forests with multiple functions	85	0.7	Mixed forests of coniferous plus broad leaved trees, or of broad-leaved trees, both including rare and precious tree species.

Table 3- 4 Natural Regeneration Promotion

No.	Multi-functional Forest Development and Management Model	Eligible Sites and the Current Status	No. of Additional Young Trees /Seedlings (No. of plants/hm ²)	Main Operations	Operations for the Forest Stands	Ecological Function Positioning	Expected Forest Form	Others
1	Natural Regeneration Promotion	Forest land , sparse forests, and shrub lands with natural regeneration capability and etc.	>300/hm ²	Tending and protection; Setting up sign boards and marks; Selecting and marking seedlings/young trees for natural regeneration; Irrigating; Raking soil; Conducting necessary supplementary planting or dibble or broadcast seeding	Focus on bio-diversity and habitat protection measures	For protection and landscaping , recreation and other functions	Multi-layered Forest Stands with Rational Density	