Forest Quality Improvement and Efficiency Enhancement Demonstration Project of Hunan Province with Loan from European Investment Bank

Environment Impact Assessments

Forestry Department of Hunan Province

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Content

0 Abstract

Forest Quality Improvement and Efficiency Enhancement Demonstration Project of Hunan Province is to explore and demonstrate models and methods of forest quality improvement and multifunctional forest utilization to make a typical example for promotion of sustainable development, popularisation and application of forestry of Hunan Province through adjustment of forest structure and improve forest quality. The project areas are distributed in 55 forest farms and forest parks from 25 counties (county-level cities and districts) of 9 cities (prefectures). This project includes 7 construction contents, which are forest quality improvement (improved cultivation of rare tree species, artificial promotion of natural formation of woods, valuable and rate arbour and shrub mixed afforestation, precious and high-value tree species afforestation, cultivation of large-diameter timber, and middle-aged forest and young forest tending), forest land compound operation, forest protection, auxiliary works and equipment, technical support system of project, project monitoring system, as well as carbon sink product development and forest certification demonstration.

The environment impact assessments in this report only focus on main construction contents, and two most influence contents forest quality improvement and forest land compound operation.

The state-owned forest farms and forest parks in Human province are generally located in mountain area or far from cities, and mostly are typical rural environment, which surrounded by heavily forested, and no mines or factories. Most pollutants (waste water, waste gas, and waster residue) in the project site are contributed by local residents. The project area has well ecosystem and beautiful landscape, in which environment factors, such as atmosphere, water, and sound reached national standards.

The majority of project implementation units did not utilise any chemicals, even if only a little usage, and chemicals that used is legitimate in China, mainly are decis,

diflubenzuron, *Beauveria bassiana* (biological agent), bifenthrin, imidacloprid, and glyphosate.

During the project construction period, adverse effects mostly caused by package derelict from afforestation and underwood planting, a few waste gas produced by transportation vehicles, and a little household waste water. Afforestation during soil preparation, and forest road construction may result in soil erosion. Soil disinfectant utilised during afforestation may cause groundwater pollution. In addition, pollution also come from package derelict, pesticide chemical fertilizer pollution and sewage when the project is implemented.

Pollution can be slow down or prevent through selecting appropriate land areas, reasonable operation ways, reducing the quantity of chemicals, maintenance of native vegetation, managing abandoned materials and domestic wastewater in time, strengthen environmental factors monitoring, provision of public participation and so on.

The project complies with national industrial policies as this project is to the benefit of adopted to improve forest structure, improve forest quality, enhance the stability, stress resistance, and environmental comprehensive function of the forest's ecological system. Additionally, this project also can improve comprehensive value of forest land and forests, promote sustainable development of compound economics of forests and forest land. As the consequence, this project has significant positive environmental benefits. The management measures of (three wastes) that proposed in this project is effective in ecological protection, and economical feasible. In terms of environment perspective in "three measurements at the same time", proposed project site is feasibility, as the project site has s a good quality of environmental status, and there is no significant environmental factors that restrict the construction of this project.

1 Basic Information of Project

1.1 Project Construction Objectives

The aim of this project is to explore and demonstrate models and methods of forest quality improvement and multifunctional forest utilization to make a typical example for promotion of sustainable development, popularisation and application of forestry of Hunan Province through adjustment of forest structure and improve forest quality.

1.2 The Location of Project

1.2.1 Principle of Selection of Project Site

(1) The project construction units focus on forest farms and forest parks.

(2) Project construction units shall have certain forest operation scale and forest resources and land resources suitable for project constructions with clear and undisputed land ownership.

(3) People's governments in counties (cities and districts) in project areas and project construction units have high initiative for construction of this project with relatively strong project organization and implementation capacity.

(4) People's governments of each county (city and district) agree to provide capital and issue supporting policies benefiting project construction. Besides, the development organization has guaranteed self-raised capital channels or sufficient self-owned capital.

(5) Project approval sticks to the procedures of "from bottom to top, voluntary application, and comprehensive preferential selection".

1.2.2 Project Site

The project construction site is located in 55 forest farms and forest parks from 25 counties (county-level cities and districts) of 9 cities (prefectures), including Zhuzhou County and Chaling County of Zhuzhou City, Leiyang City and Changning City of Hengyang City, Yueyang County, Huarong County, Miluo City and Linxiang City of Yueyang City, Li County and Linli County of Changde City, Guiyang County, Yizhang County, Linwu County, Guidong County and Zixing City of Chenzhou City, Shuangpai County, Jiangyong County and Jindong Management District of Yongzhou City, Xupu County, Mayang Miao Autonomous County and Jingzhou Miao & Dong Autonomous County of Huaihua City, Lengshuijiang City of Loudi City, and Luxi County, Guzhang County and Longshan County of Tujia-Miao Autonomous Prefecture of Xiangxi. Details of project sites can be seen in Table 1-1, and the Layout Map of Hunan Provincial Forest Quality and Efficiency Improvement

Demonstration Project under the Loan of the European Investment Bank in Figure 1.

Construction Site of Project

Table 1-1

Name of County	Name of Project Implementation Subject
Zhuzhou County	Fenghuang Mountain State-Owned Forest Farm, Changlv State-Owned Forest Farm, Junshan State-Owned Forest Farm, Zhuzhou County Hengyuan Agriculture and Forestry Development Co., Ltd., Zhuzhou Baiyijia Agriculture and Forestry Comprehensive Development Co., Ltd.
Chaling County	Yunyang State-Owned Forest Farm, Erpu Nursery, Zhuzhou Xinsheng Forestry Development Co., Ltd.
Leiyang City	Wufengxian State-Owned Forest Farm, Hunan Cailun Bamboo Sea Forest Park
Changning City	Hunan Tiantang Mountain Forest Park
Yueyang County	Dayun Mountain State-Owned Forest Farm, Xiangsi Mountain State-Owned Forest Farm
Huarong County	Tashi State-Owned Forest Farm, Shengfeng State-Owned Forest Farm
Miluo City	Yuchi State-Owned Forest Farm, Taolin State-Owned Forest Farm, Miluo Experimental State-Owned Forest Farm, Baishui Nursery
Linxiang City	Wujian Mountain State-Owned Forest Farm, Jingzhu Mountain State-Owned Forest Farm, Baishiyuan State-Owned Forest Farm
Li County	Tiangong Mountain Forest Farm
Linli County	Taifu Mountain State-Owned Forest Park
Guiyang County	Taihe State-Owned Forest Farm, Douyu Joint Operation Forest Farm
Yizhang County	Qitian State-Owned Forest Farm
Linwu County	Xishan State-Owned Forest Farm
Guidong County	QiYunfeng State-Owned Forest Park
Zixing City	Tian'e Mountain State-Owned Forest Farm, Chukou State-Owned Forest Farm, Zixing Xiangnan Botanical Garden
Shuangpai County	Shuangpai Sengong State-Owned Forest Farm、Shuangpo State-Owned Forest Farm、Daguping State-Owned Forest Farm, Wuxingling State-Owned Forest Farm
Jiangyong County	Gaozeyuan State-Owned Forest Farm
Jindong Management District	Jindong State-Owned Forest Farm
Xupu County	Rangjiaxi State-Owned Forest Farm, Xiaohenglong State-Owned Forest Farm, Xupu Forest Park
Mayang County	Xihuang Mountain State-Owned Forest Farm, Yangliu Mountain Sengong Cutting and Planting Farm, Wenming Mountain Forest Park
Jingzhou County	Paiya Mountain State-Owned Forest Farm
Lengshuijiang City	Maoyi State-Owned Forest Farm
Luxi County	Juntingjie State-Owned Forest Farm, Juntingjie State-Owned Forest Farm, Yemao'ao Forest Farm
Guzhang County	Gaowangjie State-Owned Forest Farm, Gaofeng Town, Hongshilin Town, Guyang Town
Longshan County	Shazipo State-Owned Forest Farm, Zengjiajie State-Owned Forest Farm

Hunan Provincial Forest Quality and Efficiency Improvement Demonstration Project under the Loan of the European Investment Bank

Layout Map

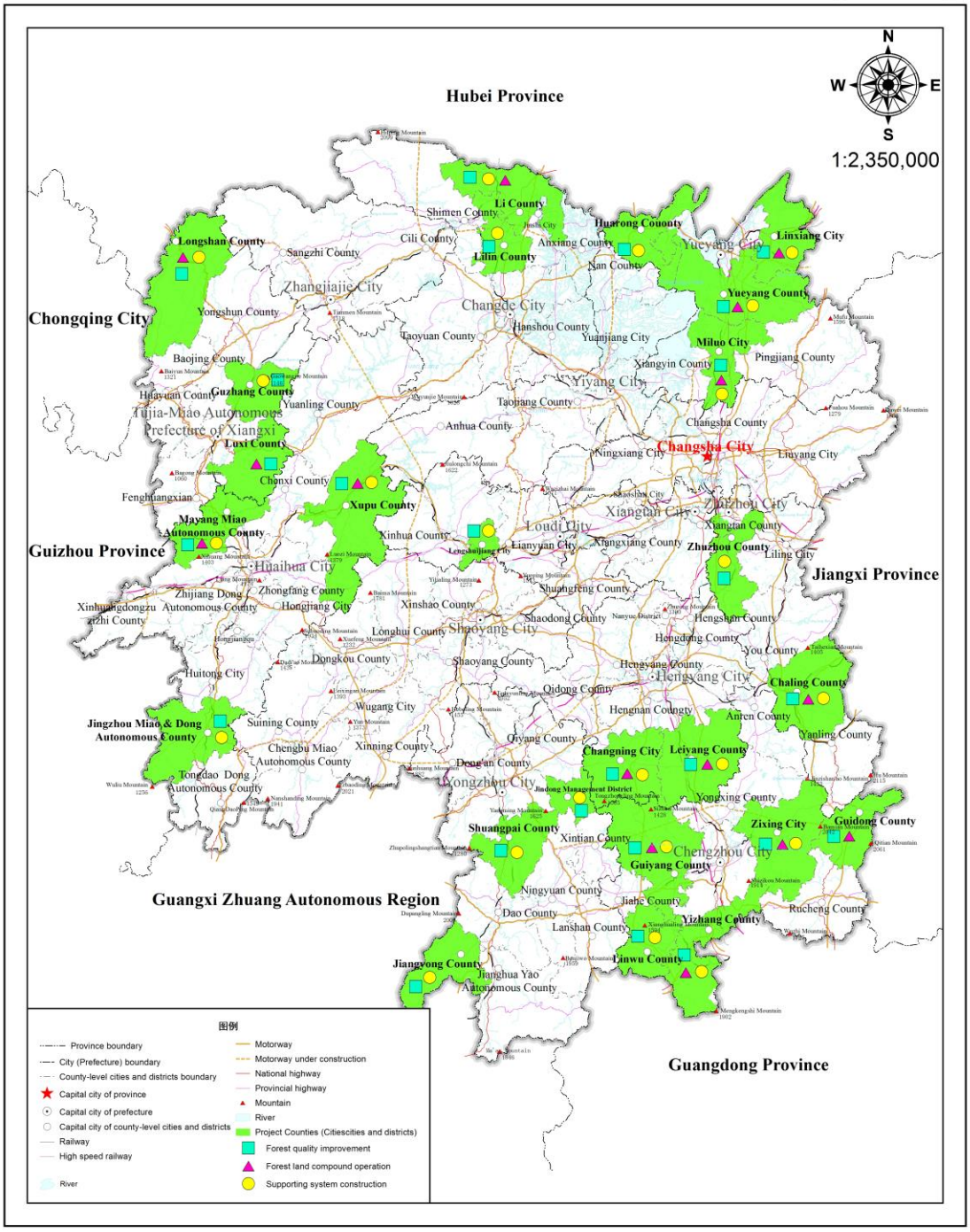


Fig. 1-1 Layout Map of Hunan Provincial Forest Quality and Efficiency Improvement Demonstration Project under the Loan of the European Investment Bank

1.3 Project Construction Contents and Scale

(1) Forest Quality Improvement

The forest quality improvement involves an area of 46,805.5ha. including 19,149.2ha. of improved cultivation of rare tree species, 4,285.5ha. of artificial promotion of natural formation of woods, 1,247.6ha. of valuable and rate arbour and shrub mixed afforestation, 4,188.6ha. of precious and high-value tree species afforestation, 1,319.4ha. of cultivation of large-diameter timber and 16,615.2ha. of middle-aged forest and young forest tending.

(2) Forest Land Compound Operation

Area of forest land compound operation (underwood planting) reaches 368.7 hectares.

(3) Forest Protection

Construct 7,080m^2 of protection and management rooms (118 places), 30 fire towers, 218 forest protection signboards, 108 forest ecological culture and natural scientific knowledge Publicity boards (Monuments), 227.8km of forest road (work road), 75.0km of protective fences, 4,436.0m simple skidding ropeway, 6.0km fire forest belt, as well as construct protection facilities for 60.6ha. of extremely tiny communities, 8.9ha. of old trees and famous wood species, and 55.4ha. of special habitats in the active area of afforestation.

(4) Auxiliary Works and Equipment

Add 27 sets of office equipment including computers, cameras and video cameras, 250 sets of production tools including chain saws and work safety clothes, and 50 sets of skidding tools.

(5) Technical Support System of Project

①Launch research work on aspects having an influence on ecosystem of the forest, including afforestation production activities, existing forest improved cultivation and forest tending, mixing of tree species in afforestation, and climate.

②Launch project management skill training for 750 man-days and professional skill training of 9,000 man-days, compile 500 sets of teaching materials, offer foreign short-term training of 50 person-times, and organize domestic learning and technical communication and visit of 300 person-times.

(6) Project Monitoring System

Launch management monitoring, stand quality monitoring and implementation effect monitoring and carry out staged evaluation of project execution condition, efficiency, effect

and influence.

(7) Carbon Sink Product Development and Forest Certification Demonstration

It is planned to select 5 counties (cities and districts), i.e. Zhuzhou County of Zhuzhou City, Yueyang County of Yueyang City, Zixing of Chenzhou City, Jindong Management District of Yongzhou City, and Longshan County of Tujia-Miao Autonomous Prefecture of Xiangxi, for carbon sink product department. The project products involve native tree species, rare tree species, etc.; forest certification work is comprehensively launched in project implementation areas within 25 project counties (cities and districts) including forest farm, forest park, nursery, botanical garden, county (town) and company.

1.5 Forest Protection Measures

1.5.1 Forest Fire Protection

The project area has relatively completed forest fire insurance prediction systems, fire observation monitoring systems, fire barrier systems, forest fire information and command systems, and forest fire fighting teams and equipment. This project will take full use of the existing fire prevention conditions, and carry out the policy of “prevention foremost, eliminated actively”. A large area of afforestation plots will be built along the main ridge of the main ridge to prevent the spread of forest fire.

In order to find out the forest fire in time, and make measures effectively, the forest fire prevention among project areas will be brought into the local firm protection system, fire prevention organization that set up by afforestation entity, formulate rules and regulations, as well as, strengthening forest fire monitoring,

1.5.2 Forestry Pest Monitoring and Prevention

① The project insists on forest health concept, emphasized on the popularization and application of local tree species and build mixed forest, in the meantime, strengthen on transformation of the existing ecological low pure artificial forests, and inferior quality and low efficiency forest. In order to increase the capability of stress resistance for forest ecological system, this project also has to improve stand quality monitoring, as well protect forest biodiversity, and clear forestry that influenced by pest and burned badly. In addition, we

also have to build a professional and technical team to improve prevention and treatment of pests of forestry.

② When transport grow seedlings and nursery stock, this project will put emphasises on prevention of harmful foreign forestry biological invasion, and strengthen inspection and quarantine. As results, we should have strict introduction approve, and establish a risk assessment system for harmful foreign forestry biological invasion, and in order to prevent introduction of harmful organisms, quarantine inspection and supervision of forest planting seedlings should be strengthened.

③ The prevention and treatment of forest pests and diseases will be emphasised on biological methods, and chemical methods that utilised should be long-term and low toxicityi, which is in accordance with the world health organization's regulations.

2 General Information of Natural and Social Condition

2.1 General Information of Natural Condition

2.1.1 Geological Location

Hunan Province is located in the middle reaches of the Yangtze River, most of the province is in the south of Dongting Lake, so called Hunan, and Xiangjiang River runs through the Province from south to north, so called Xiang. Hunan Province located at east longitude of 108°47’~114°15’ and north latitude of 24°38’~30°08’ which neighbours with Jiangxi Province via Mufu Mountain System and Mugong Mountain System on the east; the province is connected to Guizhou Province on the west via eastern edge of the Yunnan-Guizhou Plateau; the province adjoins Chongqing on the northwest with Wuling Mountain Range; the province rests head on Nanling Mountain Range on the south to connect with Guangdong Province and Guangxi Zhuang Autonomous Region; the province borders on Hubei Province via Binhu Plain on the north. The border position in the east is Huanglianping of Guidong County, to the west reaches Jiucaitang of Xinhuang Dong Autonomous County, from the south to the north, Hunan Province peak to Gupo Mountain of Jianghua Yao Autonomous County and Huping Mountain of Shimen County. The province is 667km wide

from east to west and 774m long from south to north. The total land area of Hunan Province reaches 21,183,500ha.

2.1.2 Geology and Landform

Hunan Province is located in a transitional belt between the Yunnan-Guizhou Plateau and Jiangnan Hill as well as Nanling Mountainous Region and Jianghan Plain. In line with national terrain, Hunan located on the eastern of Yungui Plateau and southern of southeast massif, which belongs to stair lower from west to east. The province neighbours with Jiangxi Province via Mufu Mountain Range, Lianyun Mountain Range, Jiuling Mountain Range Mugong Mountain Range, Wanyang Mountain Range, and Zhuguang Mountain Range on the east. The altitude of mountains is mostly above 1,000m, which echelon from north east to southwest. In the south of the province is Five Ridges Mountain Range (Nanling Mountain Range), including Dageng, Qitian, Mengzhu, Dupang, and Yuechng, which presents a northeast-southwest direction, and the altitude of mountains is mostly above 1,000m, which lines from east to west. In the west of the province is Xuefeng Mountain Range with southwest-northeast direction, which is wide and magnificent, and become an important natural landscape in Hunan. The altitude of the northern section is 500~1,000m, and the altitude of the southern section is 1000m~1500m. The highest peak of this mountain range is Huping Mountain of Shimen County with altitude of 2,099m. The altitude of the middle of Hunan is 500m, mostly is the discontinued red rock basin, limestone basin, hills and terraces. Due to the Doting Lake Plain, the lowest altitude is in the northern section, which is generally below 50m, where the Huaguzhou of Linxiang County is only 23m that is the lowest position in Hunan Province. Therefore, the province is surrounded by mountains at east, south and west. The middle of the province presents a chain of undulating hills. Lakes and plains are distributed in the north. The province presents an asymmetric horseshoe contour.

Hunan Province has large variety of landforms, including half high mountains, low mountains, hills, posts, basins and plains. Generally speaking, the province can be divided into six different landform, namely, erosion hill area in the east, corrosion hill area in the south, erosion of mountain in the west, erosion of coteaux in the northwest, alluvial plains in

the north, and denudation of hills. The majority of landform in Hunan Province is mountain and hills, the mountain land of the province covers an area of 10,849,000ha., taking up 51.22% (including 1.66% of mountain plateau) of total area; the hilly land covers an area of 3,262,700ha., taking up 15.4% of total area; the mound land covers an area of 2,938,000ha., taking up 13.87% of total area; the plain area reaches 2,779,000ha., taking up 13.12% of total area; the water area reaches 1,353,300ha., taking up 6.39% of total area.

2.1.3 Climate

Hunan Province is 400km away from ocean, which belongs to a mid-subtropical monsoon moist climate, and is highly influenced by the East Asian monsoon circulation. This climate has three features, firstly, this province has abundant light, heat, and water, and these three resources are basically synchronised. From April to October total radiation and rainfall took up 70~76% and 68~84% of total annual radiation and rainfall respectively. Secondly, climate changed dramatically during the year and between years, where is frigid in winter and severe heat in summer, and in spring, the climate is changeable, and climate sharp drop in fall. Overall, climate in spring and summer is rainy, and in fall and winter is drought. As mentioned before, the climate also changeable between years, and the difference value between maximum and minimum is 1.29 times larger than the mean value, and the annual rainfall between maximum and minimum is 1460mm. Thirdly, most obvious vertical changed area is the place that is ringed on three sides by mountains, especially in the west and south of Hunan. The number of sunshine hours is 1300 ~ 1800h annually, the longest sunshine hours is Dongting Lake, and in Yueyang city, the index can be reach 1849h. Hunan Province has abundant thermal energy. The province has high temperature annually, where the average temperature is between 16~18℃. The cold air is easily to influence Hunan Province, as the province is effected by winter monsoon, and mountains are surrounded by three orientations, only the north orientation is geomorphic opened. Therefore, in January, the average temperature is 4~8℃, and frostless period can be lasts 260～310d, most area of this province can be reach 280～300d. Additionally, Hunan Province has abundant rainfall, which can be considered as the one of largest rainfall province, the annual rainfall reaches 1,200-1,700mm.

2.1.4 River Systems

Hunan Province has rich river system, which is densely covered with rivers, where has the national second largest freshwater lake, Dongting Lake, which has four major rivers, namely Xiang, Zi, Yuan, and Li. The total length of rivers in Hunan is 99,300 km, there are 5341 rivers that are over 5 km, and there are 17 rivers that has more than 5,000 km^2 basin areas. Except some of the river systems in south and east of Hunan Province belong to Pearl River system, and the Ganjiang River system, most of big and small branches are belongs to the abovementioned four major rivers. Based on the terrain of Hunan, rivers in Hunan is from south to north and then enter the Yangtze River via Chenglingji, thus forming a relatively complete sectored water system. The total annual runoff volume of all water system is 208.5 billion m^3, among which the annual runoff volume of all water systems in the province is 162.3 billion m^3, the extraneous water is 45.55 billion m^3, and the groundwater is 9.65 billion m^3. The total amount of natural water resources in the Hunan Province is 1998.2 billion m^3, of which the total amount of surface water resources is 156.52 billion m^3, and the underground (shallow) amount of water is 43.3 billion m^3.

2.1.5 Vegetation and Biodiversity

Statistical Annual Report of Forest Resources of Hunan Province in 2016 indicated that the forest land area of the whole province reached 13,006,100ha. taking up 61.40% of total land area, and the coverage rate of forests reached 59.64%. During the period of *"12th Five-year"*, the closed forest land area of the whole province was increased from 10,036,000ha. to 11,022,800ha.. The total value of ecological benefits of forest carbon sequestration, oxygen production, energy storage, water impounding, and earth and fertilizer maintenance reached RMB 101,000,000,000 Yuan. The wetland area (except paddy fields) was stabilized at 1,020,000ha. The number of national wetland parks was increased from 9 to 60. The protection rate of wetland reached 72%. As a result, biodiversity was effectively protected. There were 191 natural reserves built in the whole province, covering a total area of 1,368,400ha., there were 126 forest parks, covering a total area of 494,200ha. and there were 60 national wetland parks, covering a total area of 215,700ha., taking up 6.46%, 2.30% and

1.02% respectively.

Hunan Province is located mid-subtropical evergreen broad-leaved forest belt in the east of China with a variety of vegetation types and abnormally abundant plant resources. There are about 5,000 types of spermatophytes, ranking the seventh place of China, including 2,470 species from 478 categories of 103 families of ligneous plants as well as more than 1,000 wild economic plants and more than 800 medicinal plants. The province has 59 valuable and rare wild plants under national special protection, taking up 23% of total species of valuable and rare plants under national protection (254 species in total). Hunan Province has 12 species of wild plants under national level-I special protection including *Cathaya argyrophylla, Metasequoia, Davidia involucrate, Bretschneidera sinensis, taxus mairei, Chinese cypress, Abies ziyuanensis, Ranalisma rostratum, Primulina tabacum, Brasenia schreberi, Davidia involucrata var. vilmoriniana* and *Isoetes sinensis* as well as 45 species of wild plants under national level-II special protection including *Alsophila denticulata, Spinulose tree fern, Cephalotaxus oliveri, Fokienia hodginsii, Pinus kwangtungensis (Guangdong pine), Pseudolarix, Douglas fir, Chinese torreya, Cercidiphyllum japonicum, wild rice, camphor tree, tulip tree, Mangnolia officinalis, Magnolia biloba, Tsoongiodendron odorum, Zelkova schneideriana* and 2 species of plants under level-III protection and 44 species of plants under provincial protection.

Abundant plant resources have provided unique conditions for survival and reproduction of animals. Currently, 897 species of vertebrate are discovered in Hunan Province at present and they are subordinate to 146 families from 44 orders of 5 classes, including 91 species of mammal from 28 families of 9 orders, 448 species of bird from 71 families of 19 orders, 92 species of reptile from 15 families of 3 orders, 64 species of amphibian from 9 families of 2 orders, and 202 species of fish from 23 families of 11 orders. To be specific, there are 18 species under national level-I protection including South China Tiger (*Panthera tigris amoyensis*), Clouded Leopard (*Neofelis nebulosa*), Siberian Crane (*Grus leucogeranus*) and Yangtze River Dolphin (*Lipotes vexillifer*) and 69 species under national level-II protection including Macaque (*Macaca mulatta*), Stump-Tailed Macaque (*Macaca arctoides*), Chinese

Pangolin (Manis pentadactyla), Chinese Giant Salamander (*Andrias davidianus*) and Yangtze Finless Porpoise (*Neophocaena asiaorientalis asiaorientalis*) as well as 216 unique species of China and 16 unique species in Hunan Province. There are a variety of birds in Hunan Province, including 22 rare birds under national protection, taking up 44% of total number of birds under national protection. Class-1 rare birds include Hooded Crane (*Grus monacha*), White-naped Crane (*Grus vipio*),Cabot's Tragopan (*Tragopan caboti*), Siberian Crane (*Grus leucogeranus*), Black Stork (*Ciconia nigra*), Reeves's Pheasant (*Syrmaticus reevesii*) and Scaly-sided Merganser (*Mergus squamatus*); class-2 rare birds include Golden Pheasant (*Chrysolophus pictus*),Lady Amherst's Pheasant (*Chrvsolophus amherstiae*), Whooper Swan (*Cygnus cygnus*), Tundra Swan (*Cygnus columbianus*), Mandarin Duck (*Aix galericulata*), etc..

2.2 General Information of Social Condition

(1) Administrative Division and Population

Hunan Province administers 13 prefecture-level cities and 1 autonomous prefecture; 122 county-level administrative units including 16 county-level cities, 72 counties (including 7 autonomous counties), and 34 municipal districts are established. At the end of 2016, the total population of the whole province reached 68,220,000, including 35,986,000 of urban population and 32,234,000 of rural population.

(2) Transportation and Communication

The total mileage of roads and highways of Hunan Province open to traffic reaches 236,886km, including 6,080km of mileage in highways open to traffic. The province has basically formed a highway network with "five longitudinal and six horizontal" highways as backbone and realized connection of cement (asphalt) roads to 100% of townships and qualified administrative villages as well as opening of passenger regular buses to 100% of townships and 94.51% of administrative villages. Currently, the province has 373 navigable rivers with total mileage of 11,968km, taking up approximately one tenth of mileage of inland rivers of China open to traffic and ranking the 3rd time of China only after Jiangsu Province and Zhejiang Province. The railway traffic of the province is relatively developed. It has 7 major trunk railways including Beijing-Guangzhou Railway, Shanghai-Kunming Railway, Hunan-Guangxi Railway, Shimen-Changsha Railway, Luoyang-Zhanjiang Railway,

Jiaozuo-Liuzhou Railway and Chongqing-Huaihua Railway and several branches including Liling-Chaling Railway, Wayuan-Songbai Railway, Shaoshan Railway, Ji'an-Hengyang Railway, Loudi-Shaoyang Railway and Changsha-Zhuzhou-Xiangtan Intercity Railway as well as two major trunk highways including Beijing-Guangzhou Dedicated Passenger Line and Shanghai-Kunming Dedicated Passenger Line. Furthermore, the construction of several new railway projects including Huaihua-Shaoyang-Hengyang Railway and Qianjiang-Zhangjiajie-Changde Railway are currently accelerated. The province has 2 international airports, i.e. Changsha Huanghua International Airport and Zhangjiajie Hehua International Airport as well as 5 domestic airports including Changde Taohuayuan Airport, Yongzhou Lingling Airport, Huaihua Zhijiang Airport, Hengyang Nanyue Airport and Shaoyang Wugang Airport. Yueyang Airport and Xiangxi Airport are currently under construction and Shaoyang Shaodong Airport, Chenzhou Airport and Loudi Airport have been planned. The transportation infrastructure becomes increasingly perfect to provide vigorous transportation guarantee for economic and social development of Hunan Province.

(3) Economic Development Conditions

Data of *Statistical Bulletin of National Economic and Social Development of Hunan Province in 2016* indicated that the regional GDP of the whole province reached RMB 3,124,470,000,000 Yuan in 2016, up by 7.9% compared with previous year. To be specific, the added value of the primary industry reached RMB 357,840,000,000 Yuan, up by 3.3%; the added value of the secondary industry reached RMB 1,318,100,000,000 Yuan, up by 6.6%; the added value of the tertiary industry reached RMB 1,448,530,000,000 Yuan, up by 10.5%. If calculated as per resident population, GDP per capita reached RMB 45,931.00 Yuan, up by 7.3%. The general public budget income of the whole province reached RMB 425,210,000,000 Yuan, up by 6.0%. The fixed-asset investment of the whole province reached RMB 2,768,850,000,000 Yuan, up by 13.8% compared with previous year. The urban per capita disposal income of the whole province reached RMB 29,064.00 Yuan and the rural per capita pure income reached RMB 11,930.00 Yuan.

2.3 Current Environment Quality of Project Sites

2.3.1 Comprehensive Overview

The state-owned forest farms and forest parks in Human province are generally located in mountain area or far from cities, and mostly are typical rural environment, which surrounded

by heavily forested, and no mines or factories. Most pollutants (waste water, waste gas, and waster residue) in the project site are contributed by local residents. The project area has well ecosystem and beautiful landscape, in which environment factors, such as atmosphere, water, and sound reached national standards.

◆ Xishan State-owned Forest Farm of Linwu County (environmental monitoring centre of Linwu County, 2017/4/6~2017/4/8)

— Air Quality

The results of SO_2, NO_2, and TSP on four sample sites can be shown on Table 2-1-a. the level of air quality in the project is level-I, and ambient air quality is superior.

Monitoring Results of Air Quality of Xishan State-owned Forest Farm of Linwu County

Table 2-1-a Units：mg/m^3

Results / Sample Sites	SO_2		NO_2		TSP
	Mean Rang/Hour	Mean Rang/Day	Mean Rang/Hour	Mean Rang/Day	Mean Rang/Day
Gufutang	0.01L	0.0050-0.0054	0.01L	0.0054-0.0062	0.012-0.018
Forest Farm Feild	0.01L	0.0036-0.0044	0.01L	0.0048-0.0054	0.016-0.020
Fenshui'ao	0.01L	0.0034-0.0042	0.01L	0.0042-0.0060	0.014-0.020
Dahebian	0.01L	0.0026-0.0035	0.01L	0.0054-0.0062	0.012-0.016

— Surface Water Quality

The Table 2-1-b has demonstrated evaluation results of 14 monitoring indexes in three sections of forest farm, which in line with class-I water quality standards (GHZB-GB3838-2002)

Results of Surface Water Quality of Xishan State-owned Forest Farm of Linwu County

Table 2-1-b Units：mg/m^3

NO.	Indexes	Upstream of Wushui River		Downstream of Wushui River		Dahebian	
		Monitoring Range	Over-limit Ratio	Monitoring Range	Over-limit Ratio	Monitoring Range	Over-limit Ratio
1	pH	7.10-7.22	0%	7.50-7.68	0%	6.57-7.01	0%
2	COD_{Mn}	0.60-1.20	0%	0.80-1.50	0%	0.80-1.40	0%
3	BOD_5	2.0L	0%	2.0-2.4	0%	2.0L	0%
4	Phosphorus	0.01L	0%	0.01L	0%	0.01L	0%
5	Nitrogen	0.05-0.08	0%	0.05-0.10	0%	0.05-0.12	0%

Results of Surface Water Quality of Xishan State-owned Forest Farm of Linwu County

Table 2-1-b Units：mg/m^3

NO.	Indexes	Upstream of Wushui River		Downstream of Wushui River		Dahebian	
		Monitoring Range	Over-limit Ratio	Monitoring Range	Over-limit Ratio	Monitoring Range	Over-limit Ratio
6	Petroleum	0.01L	0%	0.01L	0%	0.01L	0%
7	LAS	0.05L	0%	0.05-0.08	0%	0.05-0.10	0%
8	Hg	0.00005L	0%	0.00005L	0%	0.00005L	0%
9	Cr VI	0.004L	0%	0.004L	0%	0.004L	0%
10	Cu	0.001L	0%	0.001L	0%	0.001L	0%
11	Pb	0.01L	0%	0.01L	0%	0.01L	0%
12	zinc Zn	0.05L	0%	0.05L	0%	0.05L	0%
13	Cd	0.001L	0%	0.001L	0%	0.001L	0%
14	As	0.007L	0%	0.007L	0%	0.007L	0%

— Acoustic Environment Quality

The below table shows results of 4 spots of Acoustic Environment Quality of Xishan State-owned Forest Farm of Linwu County, which reached class-I standard.

Results of 4 Spots of Acoustic Environment Quality of Xishan State-Owned Forest Farm of Linwu County

Table 2-1-c

Spots Name	Measurement Range dB(A)		Over-limit Ratio
	Daytime	Night-time	
Gufutang 1#	40.0-43.6	30.0	0%
Gufutang 2#	38.1-43.2	30.0	0%
Forest Farm Feild 1#	45.0-45.6	30.0-35.4	0%
Forest Farm Feild 2#	40.6-42.2	30.0-31.0	0%
Fenshui'ao1#	40.3-41.4	30.0	0%
Fenshui'ao1#2#	42.5-44.3	30.0	0%
Dahebian1#	40.7-41.2	30.0	0%
Dahebian 2#	41.6-43.6	30.0	0%

◆ Jindong State-owned Forest Farm in Jindong Management District of Yongzhou City

— **Air Quality**

Air Quality accords with Class-I (GB3095-1996) in Ambient Air Quality Standard (AAQS)

Table 2-2-a AAQS (class-I) Limit table

Items	Mean value/Hour	Mean value/Day
SO_2	O.15mg / m^3	0.05 mg / m^3
NO_2	0.12mg / m^3	0.08 mg / m^3
TSP	/	O.12 mg / m^3

— **Surface Water Quality**

Surface Water Quality comply with class-III water quality standards (GHZB- GB3838-2002)

Table 2-2-b Evaluation Criteria of Surface Water Quality (Class-III) Limit table

Monitoring Items	Evaluation Criterion	Monitoring Items	Evaluation Criterion
pH(dimensionless)	9th June	Cr VI	0.05mg / L
COD	20mg / L	Cu	1.0mg / L
BOD5	4mg / L	Pb	0.05mg / L
Phosphorus	0.2mg / L	zinc Zn	I. 0mg / L
Nitrogen	1.0mg / L	Cd	0.005mg/L
Petroleum	0,05mg / L	As	O.05mg / L
LAS	0.2mg / L	Cr VI	0.0001mg / L

— **Acoustic Environment Quality**

Acoustic Environment Quality Reached Class-I Standard.

Table 2-2-c Evaluation Criteria of Acoustic Environment Quality (class-I) Limit table

Items	Daytime	Night-time
Level-A in Equivalent Continuous	55dB(A)	45dB(A)

◆ Tashi State-owned Forest Farm of Huarong County

— **Water Quality Monitoring**

The environment monitoring station of Huarong County has set up two conventional monitoring sections, namely, Shishan Mountain and Lijia River section. Based on the analysis

of monitoring data, during the rain season, Shishan mountain section has exceed in permanganate index, chemical oxygen demand (cod), and ammonia nitrogen, and the rests of monitoring items has reached class-II water quality (GHZB -GB3838-2002); however, in the dry season, except chemical oxygen demand (cod) has exceed the standard, the other monitoring items reached class-II water quality (GHZB -GB3838-2002). For the Lijia River section, in rain season, this section has exceed in permanganate index, chemical oxygen demand (cod), and the rests of monitoring items has reached class-III water quality (GHZB -GB3838-2002); however, in the dry season, except chemical oxygen demand (cod) has exceed the standard, the other monitoring items reached class- III water quality (GHZB -GB3838-2002).

— Acoustic Environment Monitoring

The environment monitoring centre of Yueyang City is located in Sanfeng City of Hurong County, which has monitored the noise of surroundings.

In the monitoring point, the measured value of daytime and night-time are 42.6-47.52dB(A), and 35.7-41.72dB(A), which accorded with class-I standard in Criteria of Acoustic Environment Quality (GB3096-2008). Generally speaking, the acoustic environment quality is preferably.

— Atmospheric Environment Monitoring

Based on the annual environment monitoring report of Hurong Conuty, the atmospheric environment quality is favourable, in which PM10, SO_2 and NO_2 has reached class-II based on (AAQS -GB3095-1996).

◆ Ziyun Mountain Forest Park and Maoyi State-owned Forest Farm of Lengshuijiang City in Hunan Province

There is no noise pollution in above mentioned sites; there has some SO_2 and NO_2 in the air where have ironworks and zinc hypoxide works nearby; the surface water has badly influenced by fly ash in power plant; in addition, soil also influenced by residuum of herbicide. As there is a little pesticide residue in forest park and forest farm that influenced soil, and waste discharge of human and animal is treated by septic tank, the environment of project sites will not badly influenced.

2.3.2 The Average Chemical Usage in Recent Three Years

The assessment project team adopted questionnaires to collect the quantity and category of chemicals that utilised in project sites currently.

The results of the average chemical usage in project sites in recent three years have shown in Table 2-3. The table has indicated that most of the implementation units have not utilised chemicals, only a few implementation units have taken use of chemicals in the recent past three years.

The Table 2-4 has demonstrated all the chemicals that used in project sits, all of them are legally in China, namely:

- Insecticide: Decis, Diflubenzuron, *Beauveria bassiana* (biological agent), Bifenthrin, Imidacloprid.
- Herbicide: Glyphosate

Table 2-3 The Results of Questionnaire of the Annual Use age of Chemicals

Project Counties (Cities)	Project Units	Fertilizer				Herbicide						Insecticide						Notes
		Organic Fertilizer		Chemical Fertilizer		Name 1		Name 2		Name 3		Name 1		Name 2		Name 3		
		Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	
Total																		
Chaning County		200000	750	30000	300	300	6	25	9	25	1.8	250	0.45	250		250		Here presents the total data of three project units, as there is no individual data for each project unit.
	Yunyang Forest State-owned Farm																	
	Erpu Nursery																	
	Zhuzhou Xinsheng Forestry Development Co., Ltd.																	
Changning City																		No questionnaire was submit.
Guzhang County		N/A		N/A		N/A						N/A						
	Damian Mountain Forest Farm																	
	Forestry Institute in County																	
	Sanbagu in Guyang Town																	
	Gaowangjie State-owned Forest Farm																	

Table 2-3 The Results of Questionnaire of the Annual Use age of Chemicals

Project Counties (Cities)	Project Units	Fertilizer				Herbicide						Insecticide						Notes
		Organic Fertilizer		Chemical Fertilizer		Name 1		Name 2		Name 3		Name 1		Name 2		Name 3		
		Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	
Guiyang County		N/A		N/A		N/A						N/A						
	Taihe State-owned Forest Farm																	
	Douyu Joint Operation Forest Farm																	
Hurong County																		
	Shengfeng State-owned Forest Farm	N/A		N/A		N/A						N/A						
	Tashi Forest State-owned Farm	N/A		N/A		N/A						N/A						
Jiangyong County	Gaozeyuan State-owned Forest Farm	N/A		N/A		N/A						N/A						
Jindong Management District	Jindong State-owned Forest Farm			622800	451.3													
Jingzhou County	Paiya Mountain State-owned Forest Farm	N/A		N/A		N/A						N/A						
Leiyang City																		
	Wufengxian State-owned Forest Farm	N/A		N/A		N/A						N/A						

Table 2-3 The Results of Questionnaire of the Annual Use age of Chemicals

Project Counties (Cities)	Project Units	Fertilizer				Herbicide						Insecticide						Notes
		Organic Fertilizer		Chemical Fertilizer		Name 1		Name 2		Name 3		Name 1		Name 2		Name 3		
		Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	
	Hunan Cailun Bamboo Sea Forest Park	N/A		N/A		N/A						N/A						
Lengshuijiang City	Ziyun Mountain Forest Park and Maoyi State-owned Forest Farm of Lengshuijiang City in Hunan Province	6000		22500		1800						3200	16					
Li County	Tiangong Mountain Forest Farm	N/A		N/A		N/A						N/A						
Linli County	Taifu Mountain Forest Park	506200	398.6			635	7.5											
Linwu County	Xishan State-owned Forest Farm	N/A		N/A		N/A						N/A						
Linxiang City																		
	Baishiyuan State-owned Forest Farm	N/A		N/A		N/A						N/A						
	Jingzhu Mountain State-owned Forest Farm	N/A		N/A		N/A						N/A						

Table 2-3 The Results of Questionnaire of the Annual Use age of Chemicals

Project Counties (Cities)	Project Units	Fertilizer				Herbicide						Insecticide						Notes
		Organic Fertilizer		Chemical Fertilizer		Name 1		Name 2		Name 3		Name 1		Name 2		Name 3		
		Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	
	Wujian Mountain State-owned Forest Farm	N/A		N/A		N/A						N/A						
Luxi County																		
	Badou Mountain State-owned Forest Farm	3000	3000									1.5	1.5					
	Juntingjie State-owned Forest Farm			2160	80	40	15					4.05	0.15					
	Yemao'ao Forest Farm	3000	3000									1.5	1.5					
Mayang County																		
	Wenming Mountain Forest Park	N/A		N/A		N/A						N/A						
	Yangliu Mountain Sengong Cutting and Planting Farm	N/A		N/A		N/A						N/A						
	Xihuang Mountain Forest Farm	N/A		N/A		N/A						N/A						

Table 2-3 The Results of Questionnaire of the Annual Use age of Chemicals

Project Counties (Cities)	Project Units	Fertilizer				Herbicide						Insecticide						Notes
		Organic Fertilizer		Chemical Fertilizer		Name 1		Name 2		Name 3		Name 1		Name 2		Name 3		
		Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	
Miluo City	Joint Operation Forest Farm (Taolin State-owned Forest Farm, Yuchi State-owned Forest Farm, Baishui Nursery, Lanjiadong Experimental Forest Farm)	817300	1000	331006	405	7355.7	9					16346	20					
Shuangpai County																		
	Shuangpo State-owned Forest Farm	N/A		N/A		N/A						N/A						
	Daguping State-owned Forest Farm	N/A		N/A		N/A						N/A						
	Forestry Development Co., Ltd. (Sengong Forest Farm)			108108	360													
	Wuxingling State-owned Forest Farm	N/A		N/A		N/A						N/A						

Table 2-3 The Results of Questionnaire of the Annual Use age of Chemicals

Project Counties (Cities)	Project Units	Fertilizer				Herbicide						Insecticide						Notes
		Organic Fertilizer		Chemical Fertilizer		Name 1		Name 2		Name 3		Name 1		Name 2		Name 3		
		Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	
Xupu County																		
	Rangjiaxi State-owned Forest Farm	N/A		N/A		N/A						N/A						
	Hunan Xuefeng Mountain Eco-culture Travel	N/A		N/A		N/A						N/A						
	Xiaohenglong State-owned Forest Farm	N/A		N/A		N/A						N/A						
Yizhang County	Qitian State-owned Forest Farm	N/A		N/A		N/A						N/A						
Yueyang County																		
	Dayun Mountain State-owned Forest Farm																	
	Xiangsi Mountain State-owned Forest Farm																	
Zhuzhou County	Fenghuang Mountain State-owned Forest Farm																	

Table 2-3 The Results of Questionnaire of the Annual Use age of Chemicals

Project Counties (Cities)	Project Units	Fertilizer				Herbicide						Insecticide						Notes
		Organic Fertilizer		Chemical Fertilizer		Name 1		Name 2		Name 3		Name 1		Name 2		Name 3		
		Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	Total Volume (kg)	kg/ha	
Zixing City																		
	Zixing Xiangnan Botanical Garden			121.45	0.347							15750	45					
	Chukou State-owned Forest Farm			286.8	0.347							37197	45					
	Tian'e Mountain State-owned Forest Farm			386	0.347													
Guidong County																		No questionnaire was submit.
Longshan County																		No questionnaire was submit.

Table 2-4 The List of Herbicide and Insecticide

Project Counties (Cities)	Project Units	NO.	Common Name / Commerce Name / Product	Chemical Component	Application (Aims, Tree species、Plantation type)	Classification of WHO	Chinese Ratification NO	EU Registration ID	CAS NO. (Optional)
Lengshuijiang City	Maoyi Forest Farm								
		Insecticide							
		Name 1	Decis		Nursery stock				
		Herbicide							
		Name 1	Glyphosate		New afforestation, Young growth				
Linli County	Forestry Bureau of Linli Couty (Taifu Mountain Forest Park)								
		Herbicide							
		Name 1	Glyphosate		New Afforestation、Existing improved cultivation, Fostering				
Luxi County	Badou Mountain Forest Farm	**Insecticide**							
		Name 1	Decis		Prevent red spider and Pear psylla	Light poison	L973110198		
	Juntingjie State-owned Forest Farm	**Insecticide**							

Table 2-4 The List of Herbicide and Insecticide

Project Counties (Cities)	Project Units	NO.	Common Name / Commerce Name / Product	Chemical Component	Application (Aims, Tree species、Plantation type)	Classification of WHO	Chinese Ratification NO	EU Registration ID	CAS NO. (Optional)
		Name 1	Diflubenzuron	C14H9CIF2N2O2	Prevent lepidoptera pests, and other plants	Light poison	PD2015690		NO:35367-38-5
		Herbicide							
		Name 1	Glyphosate	C3H81VO5P	Prevent variety of weed	Light poison	HNP32059-A9533		1071-83-6
	Yemao'ao Forest Farm	**Insecticide**							
		Name 1	Decis		Prevent red spider and Pear psylla	Light poison	L973110198		
Miluo City	Joint Operation Forest Farm (Taolin State-owned Forest Farm, Yuchi State-owned Forest Farm, Baishui Nursery, Lanjiadong Experimental Forest Farm)	**Insecticide**							
		Name 1	*Beauveria bassiana*		Cedarwood				
		Herbicide							
		Glyphosate	Glyphosate		Weeding in forest land				
Zixing City	Zixing Xiangnan Botanical Garden	**Insecticide**							

Table 2-4 The List of Herbicide and Insecticide

Project Counties (Cities)	Project Units	NO.	Common Name / Commerce Name / Product	Chemical Component	Application (Aims, Tree species、Plantation type)	Classification of WHO	Chinese Ratification NO	EU Registration ID	CAS NO. (Optional)
		Name 1	Bifenthrin		Prevent termite				
		Name 2	Imidacloprid		Prevent termite				
		Name 3	*Beauveria bassiana*	Entomogenous fungi	Prevent pine moth				
	Chukou Forest Farm	**Insecticide**							
		Name 1	*Beauveria bassiana*	Entomogenous fungi	Prevent pine moth				

3 Foundation of Assessment

Based on the relevant legislation and regulations of the People's Republic of China (PRC), and the technical documents of European Banks, the following documents will be used in this report.

3.1 Relevant Legislation and Regulations of the PRC

(1) *Law of Environmental Protection of the People's Republic of China*, 2014

(2) *Forestry Law of the People's Republic of China*, 2009

(3) *Law of the People's Republic of China on the Protection of Wildlife*, 2016

(4) *Water Law of the People's Republic of China*, 2002

(5) *Water Pollution Prevention and Control Law of the People's Republic of China*, 2008 (Revised in 2017, Implemented on 1st of January, 2008)

(6) *Law of the People's Republic of China on Water and Soil Conservation*, 2010

(7) *Law of the People's Republic of China on Environmental Impact Assessment*, 2016

(8) *Regulations of the People's Republic of China on Nature Reserves*, No. 167 of the State Council, 1994

(9) *Regulations of the People's Republic of China on Wild Plants*, No. 204 of the State Council, 1996

(10) *Regulations on the Administration of Construction Project Environmental Protection*, No. 682 of the State Council, 2017 (Implemented on 1st of October, 2017)

(11) *Essentials of Protection Plan for Ecologically Vulnerable Zones*, Ministry of Environmental Protection, 2008

(12) *Notification on Strengthening Environmental Impact Construction Project Assessment Management of the International Financial Organization Loan*, NO. 324, 1993, National Environment Protection Bureau and other four Bureaus

(13) *Regulations of the People's Republic of China on Wild Plants on controlling of forest pest and diseases,* No. 46 of the State Council, 1996, 1989

(14) *Regulations of Hunan Province on the Administration of Forest Park*, the 11th Standing Committee of People's Congress of Hunan Province, 2010

3.2 Requirements of European Investment Bank

Handbook of Environmental and Social Practices in European Investment Bank, European Investment Bank of Environment and social Affairs Office, 2010

3.3 Technical Specification

(1) *General and Overall Principle of Environmental Impact Assessment Technology* (HJ2.1－2016)

(2) *Technique Guideline of Environmental Impact Assessment-Atmospheric Environment,* (HJ 2.2-2008)

(3) *Technique Guideline of Environmental Impact Assessment-Acoustic Environment* (HJ 2.4-2009)

(4) *Technique Guideline of Environmental Impact Assessment-Surface Water Affects* (HJ/T2.3－93)

(5) *Technique Guideline of Environmental Impact Assessment-Ecological Influence,* (HJ 19－2011)

(6) *Guideline of Environmental Impact of Construction Projects Impact Assessment* (HJ616-2011)

(7) *Technical Regulation of Comprehensive Treatment on Conservation of Water and Soil* (GB/T16453.1-16453.6-2008)

(8) *Technical Regulation of the Development and construction project on Conservation of Water and Soil* (GB50433-2008)

3.4 Applicable Standard

Environmental Quality Standards	1. Acoustic environmental quality executes Class-I Standard (GB3096-2008). 2. Air quality executes Ambient Air Quality Standard (AAQS) Class-II Standard (GB3095-2012). 3. Surface water executes Class-III Standard (GHZB- GB3838-2002). 4. Soil environment executes Class-I Standard (GB15618-1995).
Pollutant Emission Standards	1. Wastewater emission executes the national Class-I standard of integrated wastewater emission (GB8978-1996). 2. Emission of waste gas executes Class-II Standard of The Integrated Emission Standard of Air Pollutants (GB16297-1996)
Index of Total Quantity Control	There is no need to apply index of total quantity control, as there is project belongs afforestation, and no industrial pollution involved, in other word, no total factors in "13th Five-year".

3.5 Related Documents of Construction Project

Feasibility Study Report of Forest Quality Improvement and Efficiency Enhancement Demonstration Project of Hunan Province with Loan from European Investment Bank (Hunan Prospecting Designing & Research General Institute for Agriculture, Forestry & Industry, 2017)

4 Assessment Purpose

(1) To investigate, evaluate and analyse the environment quality of nature, ecology and society in this project.

(2) To analyse depth and range of the influences of surrounding ecological environment during the period of project implement, young afforested land cultivation, and forest land cultivation.

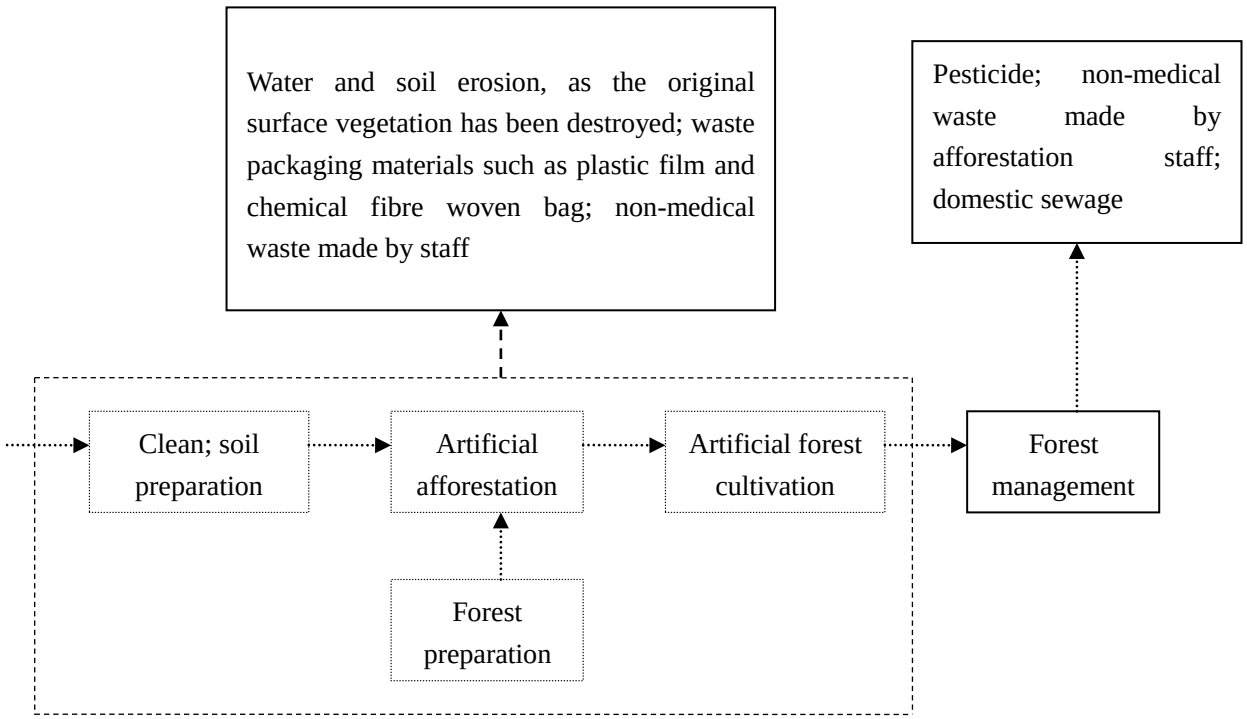
(3) To offer practicable measures that can eliminate, slowdown, and improve the environment quality of the ecological protection, based on the analysis of the

influence of afforestation. In other words, this report provide scientific decision basis on project environmental management to improve ecological environment protection and sustainable development in project sites, as decision making of this project has evaluated the feasibility, feasibility, scientificity, and rationality on ecological protection perspective.

5 The Analysis of Pollutant of Project

5.1Flow Chat and the Main Pollution Steps

5.1.1 Afforestation and Reforestation

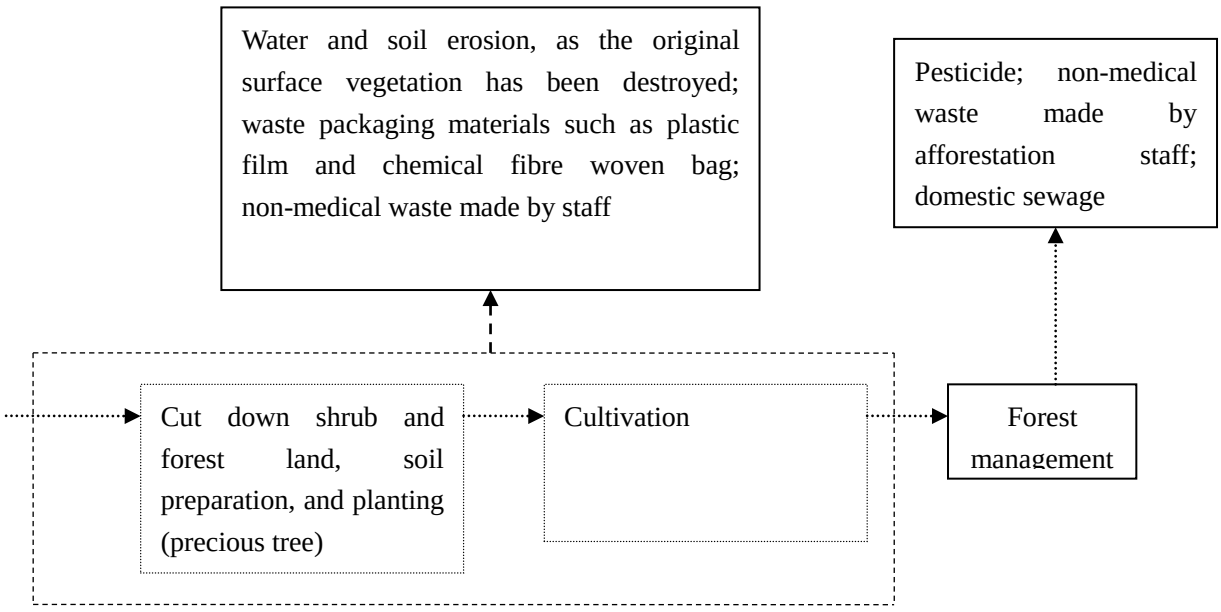


Flow Chat 5-1 the Main Pollution Steps of Afforestation and Reforestation

Description of flow chart: soil cleaning aims to improve site conditions of forest land and the management of soil preparation, planting and cultivation, in order to provide good conditions for newly young forest, in other word, soil cleaning is a technique before afforestation, which is mainly to clean up weeds and bushes on the ground. After soil cleaning

is soil preparation. The cave-shaped soil preparation is generally adopted, and usually in fall and winter, when it is before afforestation. If afforestation in the mountain land, it should be line with contour line. In order to preserve soil and water, all kinds of soil preparation should be careful with cleaning stone, tree root and other sundries, make sure the weir is strong enough, and the land should higher in the external side, and lower in the internal side. Afforestation seedlings can be purchased from nearby nurseries. In order to avoid dehydration of seedlings' root during transportation, seedlings should be with soil, plastic film and chemical fibre woven bags. Management of artificial forest cultivation is mainly including digging, weeding, fertilizing, irrigation, pruning, etc., it is only need doing daily patrol and strengthen the management of plant diseases and insect pests, and no need to use chemical fertilizers when artificial forest grow up.

5.1.2 Improvement and Reconstruction, and Forest Cultivation



Flow Chat 5-2 the Techniques Improvement and Reconstruction, and Forest Cultivation, and the Main Pollution Steps

Description of flow chart: improvement and reconstruction is to cut down shrub and forest land, soil preparation, and planting (precious tree) for the existing forest, in order to improve and reconstruct natural regeneration of forest land quality

5.1.3 Compound Management of Forest Land

Compound management of forest land is a newly business model, which refers to plant medicinal materials, vegetables, fungus, and other seedling cultivation under the existing forest land. This business model can improve and enhance productivity of forest land.

The main pollution sites: water and soil erosion, as the original surface vegetation has been destroyed; waste packaging materials such as plastic film and chemical fibre woven bag; non-medical waste made by staff.

5.1.4 Construction of Supporting Resource Protection Facilities

The construction of supporting resource protection facilities is including construction of forest resources management and protection facilities (such as management tent) and forest roads (work roads). The main pollution sites: water and soil erosion, as the original surface vegetation has been destroyed; oil contamination and noisy made by small-sized construction facilities; non-medical waste and sewage made by staff.

5.2Main Pollution Process

5.2.1 Pollution Places and Category of Pollutants during Construction

The main influences of pollution during construction are displayed as follows:

1. Water and Soil Loss

To some extent, it is necessary to doing clearing of forest land, such as weed and shrub during project implementation of improved cultivation of rare tree species (GP I), artificial promotion of natural formation of woods (GP II), valuable and rate arbour and shrub mixed afforestation (XZ I), precious and high-value tree species afforestation (XZ II), cultivation of large-diameter timber (FY I), middle-aged forest and young forest tending (FY II), forest land compound operation (JY), and other infrastructure construction. Therefore, it is unavoidable the original ground vegetation will be destroyed, and cause water and soil loss to some extent.

2. Use of Fertilizer

Forest fertilisation means people put some organic or inorganic nutrition in the soil or spray on the plants consciously, which result in improving nutriture of forest and plants under

forest and accelerating the growth of forest, as well as to realising high quality, high output, high efficiency and low cost on forest culture and management. The purpose of reasonable fertilisation is to improving output of timer, and in the meantime increasing fertile of cultivated soil which is an important measure of forest culture and management. Therefore, fertilisation can realise the combination of use and cultivation, and in the sometime to satisfy the social demand on wood products. Nutrition is a material basis of forest growth, and volume and output of forest tree growth and have close related to nutrition element concentration of trees, which is a theoretical basis of tree fertilization and nutrition diagnosis.

(1) Types of Fertilisers and Methods of Fertilisation

Different kinds of fertilisers have obvious effect on output of timer, in which the total volume of fertilisers has seriously influenced output of timer. Therefore, it is should seriously considered nutrient content, solubility, pH value, stability, mobility of soil, speed of fertilizer, the level of effect, and side effect which are highly related to fertilisers.

- The organic fertilisers have comprehensive nutrition, late in effect, long in after effect, which able to improve fertilisers of soil, and mainly used as fundamental fertilisers. However, chemical fertilisers is totally opposite to organic fertilisers, which has high concentration, the component is simple, effect is quick and short, thus, it easily to adjust different kinds of nutrition to crop, and mainly used as topdressing.

- Ammonium-nitrogen fertiliser should be put a particular emphasis on cover the soil deeply, and reduce the loss of nutrition, as ammonium bicarbonate is chemical instability, and easy to volatilization.

- Due to high mobility of nitrate fertilizer that should avoid broad irrigation, and unable to utilise as fundamental fertilisers. However, when take use of phosphate as fundamental fertilisers which should be in soil layer with concentrated root due to the low mobility. Currently, chemical fertiliser is widely used, in order to adapt extensive mountain forest operation, fertilisers have been gradually tend into

compound and high concentration fertiliser.

◆ Biological fertiliser is to use the modern high-tech to filtrate and separate microorganism from wild and cultivated leguminous plants, and made it rejuvenation through mutagenesis, then through industrial fermentation to make biologicals that has high quantity of high bacteria and take high-quality peat or lignite as the carrier. Based on the efficiency of microorganisms in Biological fertiliser which can be divided into rhizobium fertiliser, nitrogen-fixing bacteria fertiliser, fungal inoculant, dephosphorisation microbial fertiliser, silicate bacterial fertiliser, EM fertiliser, etc. In addition, the element of rare earth also applied in forest fertilisation

(2) Fertiliser Methods

This project adopts quantitative method as guidance to fertilise, which can be called as metering method. The significant meaning of this method is to obtain best economic benefits based on the scientific fertilisation techniques, which is including three objective benefits, namely, measurement method of forest fertilisation, improve output of forest of fertiliser techniques, and fertiliser in a scientific way.

(3) Fertiliser in the Early Stage of Afforestation

Forest fertilisers is based on the requirements of nutrient element and the capability of supplying nutrition for soil according to physiology activity of forest to replenish nutrition for the growth of forest, which is able to maximum the output and quality of forest and without pollution to environment. The benefits of forest fertilisers are to improve growth of forest, shorten the time for forest establishment, accelerate solidly of forest, shorten period of tending of young and middle aged forests, accelerate canopy closure of young forest, improve quality of the wood, and increase output of under forest plants products.

① Ensure the Quantity of Forest Fertilisers

The quantity of mixed fertilisers of the newly afforestation is 200kg/ha, which means 60kg of nitrogen (N), 20kg of phosphorus (P_2O_5), and 10kg of potassium (K_2O). The total

volume of mixed fertilisers for this project annually is 1087.24 tons.

② Methods and Period of Fertiliser

There are two methods of forest fertilisers, namely, artificial fertilisation and ground mechanical fertilisation, which high accord with labour conditions in China as these two methods have high efficiencies and preferable effects. During the early stage of afforestation can adopt artificial fertilisation, such as furrowing or holing, and radial fertilisation also can be utilised. There is no need to fertilise when forest establishment, and effects are generally result in three years later.

The best season for forest fertilisers is before high growth period, therefore, the best seasons for fertilisers of young growth are in spring and early in summer.

③ Effects of Forest Fertilisers

The effects of forest fertilisers are limited by technology, as above mentioned, output and quality of forest can be improved by fertilisers, for instance, fertilisers are able be shorten rotation, and quickly increased forest coverage.

The effects of forest fertilisers are quite obvious, and along with improvement of fertiliser theories and technologies, the judgements of effect of fertilisers are only focus on the growth of forest growing stock, but also the improvement of quality characteristics of forest, which including physical and chemical characteristics, such as the width, density, internode, compressive strength, and the length and width of fibre of growth ring.

3. Influences of the Usage of Pesticide on Pest Control

The prevention of pest should be taken sustainable control as purpose, ecological management as fundamental, and artificial control as principal. To commence with, it is important to increase disease resistance, insect resistance, and tolerance to insects of forest, and then in order to control pest, it is reasonable to match varieties of trees as selection instinct of insects. As pest is induced into the smallest space, which can be quickly precision stroked and lower population density, and also has less influence on ecological environment.

The aims of sustainable development in low input, high control effect and pest without plague can be realised.

It is significant to avoid utilise pesticide during the project implement, in order to reduce the influence of environment, pesticide that used should be low poison, low residual, and pollution-free if need. In addition, it is also need to pay attention to the quantity, time, and methods of sprinkle pesticide, and in order to avoid waste and lose of pesticide which should avoid of over dose. It is also should not use pesticide during rainy season, especially before downpour. Besides, it is also vital to pay attention to the place for pesticide containers cleaning, which should keep away from drinking water resource of wild animals and human animals. Thus, the adverse impacts on environment of utilise pesticide can be minimised.

4. **Influences of Plastic Film and Chemical Fibre Woven Bags during Nursery Stock Preparation**

Afforestation seedlings and nursery stock (planting materials) under forest can be purchased from nearby nurseries. In order to avoid dehydration of seedlings' root during transportation, seedlings should be with soil, plastic film and chemical fibre woven bags. Those plastic film and chemical fibre woven bags should be collecting and recycling.

5. **Domestic Garbage and Wastewater Resulting from the Operation and Management Staff**

Domestic wastewater can be collected from latrine, and used for forest irrigation, to a large extent, the environmental impact can be minimised that cased by domestic garbage and wastewater.

In addition, negative effects on afforestation effect and ecological environment also can be caused by inappropriate in configuration of tree species, collection of under tree plants, and planting density, which can be avoid by a combination of appropriate configuration of tree species and planting density, and ensure the effectiveness of afforestation, and ecological environment will be improved.

5.2.2 Pollution Places and Category of Pollutants during Operation

It is only need doing daily patrol and strengthen the management of plant diseases and insect pests, and no need to use chemical fertilizers when artificial forest grow up. Therefore, possible pollution impacts during operational period mainly include:

1. Effects of Pesticide on Pest Control

The prevention of pest should be taken sustainable control as purpose, ecological management as fundamental, and artificial control as principal. There is no big influence on pesticide as it is not utilised, and its effectiveness will not take into consideration.

2. Domestic Garbage and Wastewater Resulting from the Administrative Staff

There is no need to consider domestic garbage and wastewater rustling form administrative staff as their offices are located in the existing administration station, and no staff is added.

6 Main Pollutants and Estimate Emission Situations

6.1 The Analysis of Main Pollutants' Factors

Items / Types	Emission Source (NO.)	Pollutants	Concentration and Volume before Dispose (Units)	Concentration and Emission of Dispose (Units)
Air Pollutants	Construction	Exhaust gas from vehicle and chain saw and fuel	Small volume and dispersed	The environmental quality of construction areas is favourable, low gas emission
	Operation	Vehicle exhaust	Small volume and dispersed	No obvious influence
Water Pollutants	Construction	Domestic wastewater	24m^3/d, collected from latrine, and used for forest irrigation	
		Pesticide residue	It is controllable as reasonable in choosing pesticide, controlling the volume of pesticide, and appropriate time for pesticide.	
	Operation	Pesticide residue	It is controllable as reasonable in choosing pesticide, controlling the volume of pesticide, and appropriate time for pesticide.	
Solid Waste	Construction	If possible, trying to recycling all kinds of pollutants, such as plastic film and chemical fibre woven bags that during seedling preparation, as well as domestic garbage resulting from administrative staff (200kg/d in peak		

Items / Types	Emission Source (NO.)	Pollutants	Concentration and Volume before Dispose (Units)	Concentration and Emission of Dispose (Units)
		time), and for the unrecyclable pollutants will be filled in in situ. Additionally, for the packaging containers of pesticides and fertilisers will be collected and disposed unify.		
	Operation	Pollutants can be collected and disposed unify, such as domestic garbage resulting from administrative staff (200kg/d in peak time), and the packaging containers of pesticides and fertilisers as pollutants are in small volume and dispersed.		
Noise	The noise is low to count, and project sites are far away from city centre.			

6.2 Main Ecological Influences

This project improves productivity of forest land and enhances forest benefits through afforestation, forest improvement, forest tending, and compound management of forest land, which are results in increasing variety of afforestation and the amount of plant, as well as enhancing biodiversity and effects of forest landscape. Therefore, ecological benefits of this project are quite obvious.

However, during construction and operation, the following negative ecological effects can be avoid.

1. Choice of Location

(1) Inappropriate choice of afforestation place might result in destroy natural vegetation of the ecologically fragile area;

(2) Seriously water and soil erosion is possibility caused by the gradient of afforestation place is large than 35°;

(3) The environment of wild animal habitats and routes for them migration will be influenced by unreasonable layout.

2. Choice of Varieties of Trees and Layout

Inappropriate choice of varieties of trees is able to lower ecological stability and stress resistance of existing forest.

3. Clearing of Forest Land and Soil Preparation

(1) Water and soil loss, and destroy natural vegetation of the ecologically fragile area result from inappropriate methods of cleaning of forest land.

(2) Water and soil loss results from inappropriate methods for soil preparation in hillside.

4. Forest Tending

Water and soil loss caused by forest tending, which destroyed vegetation and soil on the surface, therefore, the environment of project sites and surrounding will be influenced by

5. Forest Fire Prevention

(1) The construction fire forest belt and watch tower will lead water and soil loss.

(2) Insufficient fire protection agency and unprofessional fire extinction will have side effect on environment.

6. The Use of Pesticides and Fertilisers

(1) Inappropriate usage of pesticides might be killed the natural enemy of pests which results in reducing biodiversity and imbalance in existing species;

(2) Inappropriate methods to use pesticides and fertilisers probably cause water pollution;

(3) The physical properties of the soil will be changed by long-term use of chemical fertiliser, which will be results in soil hardening, soil deterioration, and declined in soil fertility.

(4) Inappropriate ways for washing and disposing of pesticide container will affect water and soil.

7. Wood Felling and Skidding

(1) Unreasonable ways of wood felling is harm for the remaining stumpage and vegetation under trees which result in soil nutrition loss.

(2) Large amount of wood felling will decline the overall function of forest ecosystem.

(3) Inappropriate ways of skidding might destroy nearby forest and natural river system.

(4) The routes of skidding and loading bay will lead serious water and soil loss.

8. Forest Land Compound Operation (Under Forest Planting)

(1) Inappropriate combination of under forest planting and the existing forest might results in non-indigenous organisms' invasion, and lower ecological adaptability and stability of existing forest.

(2) The biodiversity will be decreased in some area.

(3) The increasingly human activity have potential risk in destroy the existing forest.

7 The Analysis of Environmental Impacts

7.1 The Analysis of Positive Environmental Impacts on Project Construction

When the project is implemented where formation forest ecological system that is well stability and high stress resistance, which will improve productivity of forest land and enhance forest benefits. In the meantime, the favourable forest habitats will lead people to advocate natural and pursue healthy green life, as well as encourage people to take participate in afforestation and protect the green homeland that people depend on.

1. Water Conservation, Conserve Water and Soil, Increase Carbon Sinks and Improve Soil Land

The forest area of project sites will increase 5436.2 ha after constructed. There are lots of benefits can be gathered from biological physical effect of canopy layer, litter layer, and soil of forest, such as minimising erosion force of rainfall, improving soil structure, enhancing resistance of soil. In addition, in order to improve soil permeability, increase the period of runoff, reduce the volume and speed of runoff, enhance water conservation, avoid soil erosion, conserve water and soil, and purify water quality, which will intercept, permeate, and evaporate of rainwater after the project implemented.

The greenhouse effect can be effectively reduce due to photosynthesis can fixing carbon dioxide and releasing oxygen. Accordingly, in average, 1 ha of forest can release 10.7 tons of oxygen per year, and absorb 13 tons of carbon dioxide. As this project main focuses on afforestation, which estimated that will release 582,000 tons pf oxygen, and 707,000 tons of fixed carbon dioxide.

2. Improve Stand Structure and Increase Biodiversity

This project will format a forest ecological system that is well stability and high stress resistance though present forest improvement and transformation, forest tending, and the application of precious tree species afforestation, which are able to improve existing ecological environment, create well conditions for species to survival and reproduction, increase diversity of plants and animals, enlarge vegetation coverage, and more importantly, animal diversity will be enhanced, as project areas will introduce some birds and small animals to habitat and reproduce.

3. Improve effect of Forest Landscape

Due to the biological characteristics of different kinds of trees, this project will mix with deciduous trees, evergreen trees, and broad-leaved trees to afforest, which is able to formulate a forest with multiple layer, and forest landscape that is seasonally.

7.2 The Analysis of Negative Environmental Impacts on Project Construction and Mitigation Measures

It is obvious that negative influences along with the construction and operation of project. Based on the different stages and characteristics of project, this report will analyse mitigation measures in construction and operation stages.

7.2.1 Environmental Impacts Analysis on Construction Stage

1. Environmental Impacts of Choice of Location

(1) Impacts Analysis

① Inappropriate choice of afforestation place might result in destroy natural

vegetation of the ecologically fragile area;

② Seriously water and soil erosion is possibility caused by the gradient of afforestation place is large than 35°;

③ The environment of wild animal habitats and routes for them migration will be influenced by unreasonable layout.

(2) Mitigation Measures

It is obvious to avoid important ecological place, ecological situation is fragile, or ecological problems are seriously when planning the project. The following aspects should be noticed:

① The gradient of forest land should be below 35°, and the main quality of forest land is in class-II and class-III, and natural forest and natural secondary forest with canopy density that is larger than 0.2 and are not used for reforestation.

② It is not permitted to take use of public welfare forest with protection class in I and II, as well as the "ecological recreation area" of forest park as project sites.

③ The project arears will divided into forest subcomparment reasonably, and the scale of afforestation should controlled, which should not large than 30hm^2.

2. Environmental Impacts of Choice of Varieties of Trees and Layout

(1) Impacts Analysis

Varieties of afforestation trees in this project mainly focus on local tree species, as the invasion of non-indigenous tree may cause introduction of harmful organisms. In addition, forest landscape and biodiversity will be affected if there is only has single kind of artificial forest, which means, the forest structure is simple, and genetic gene will be minimised. In the meantime, the ability of self-inhibition is largely weakened, and increase risk plant diseases and insect pests.

(2) Mitigation Measures

① Varieties of afforestation trees in this project mainly focus on local tree species, and the scale of afforestation should controlled.

② It is important to control varieties of trees, which should get the allowance by local authorization, and any biology that is in the list of pest, and plants might have harmful impacts are not permitted to introduce.

③ It is recommended to use multiple tree species to build block-shaped mixed forest in terms of configuration of tree species which is a combination of existing forest and natural vegetation.

④ At the early stage of this project, designers should pay lots attention to the choice of place and configuration of tree species in a scientific way, such as varieties of trees, seed source, gene type and age of trees. The choice of varieties of trees should be superior in seeds or fine clone, which can enhance ability to resist the disease and insect pests, as well as decrease the risk of disease and insect pests.

⑤ It is vital to take use of wildlife corridors to protect native tree species, the use of river to protect corridors when design the layout of project, which can enhance the protection, recovery and retention of natural plant communities as the pattern of natural forest landscape is imitated by the mix of different ages of trees and native trees.

3. Environmental Impacts of Clearing of Forest Land and Soil Preparation

(1) Impacts Analysis

Clearing of forest land refers the loss of surface soil and nutrition that destroyed existing vegetation, which have the permanent or temporary interference on vegetation and plant resources. Controlled burning, in particular, where the original vegetation is almost completely destroyed, and the influence of the loss of surface soil and nutrition is more seriously. Water and soil loss results from inappropriate methods for soil preparation in hillside.

(2) Mitigation Measures

①Controlled burning (a way of clearing of forest land) is totally forbidden.

②The way of remove clumps or bands of a ruderal weed is to deposit them in the intercropping holes, and made them decompose naturally.

③It is not allowed to chop down vegetation that is on steep hill, top of slope, cleugh, and river side.

④ The ways of break up the ground are depending on size the slope when afforestation, where the soil area is controlled at 20-25%.

⑤. The width between the edge of afforestation and the farmland is 10 metres, which can be regarded as vegetation protection zone.

⑥ It is important to cover the dead branches and leaves after soil preparation, in order to avoid surface soil exposed.

4. Environmental Impacts on Management Measure of Forest Land Cultivation

(1) Impacts Analysis

Due to forest land cultivation destroyed vegetation, and disturbed surface soil which lead new water and soil loss, where has negative influences on project sites and surroundings.

(2) Mitigation Measures

① It is important to preserve the natural vegetation of young forest, and adopted partly cultivation method; The remaining vegetation after weeding should be kept as field covering.

② In order to increase the ability of water conservation and fertility of soil, the collecting of dry branches and fallen leaves is forbidden.

5. Environmental Impacts on the Construction of Forest Road and Mitigation Measures

(1) Impacts Analysis

The potential influences of construction of forest road can be shown as followed:

① To some extent, vegetation is destroyed.

② It is quite obvious that loose soil and a certain slope are formed when the roadbed has been excavated, as a results, water and soil loss might be occurred during implemented if there is no protective measures adopted.

③ The exposed slope formed by the forest roads will transform into natural landscape.

(2) Mitigation Measures

① It is important to take full use of the existing road, as far as possible to combine with the construction of rural road, and along to fire line or forest subcomparment line, which can seriously reduce water and soil loss.

② the damage to the vegetation can be reduced when Forest Roads designed scientifically, and make reasonable choices of road materials, borrow pits, and waste banks location.

③ Borrow pits and waste banks should be cleaned and planted trees when the project completed, which have to recover vegetation, and no open ground is permitted.

6. Forest Land Compound Operation (Under Forest Planting)

(1) Impacts Analysis

Inappropriate combination of under forest planting and the existing forest might results in non-indigenous organisms' invasion, and lower ecological adaptability and stability of existing forest; The biodiversity will be decreased in some area; The increasingly human activity have potential risk in destroy the existing

(2) Mitigation Measures

① In order to avoid non-indigenous plants, it is important to adopt local matured technology and popularise the varieties of under forest planting.

② Put strict control on the acreage of single species, and distance between the same

species is not less than 100 metres.

③ Put strict control on the areas of human activities, and it is not allowed to enter into the area of non-under forest planting.

7.2.2 Environmental Impacts Analysis on Operation Stage

1. Environmental Impacts on Forest Fire Prevention Measures

(1) Impacts Analysis

① Construction of fire prevention forest belt and road, as well as fire protection observatory will be caused water and soil loss.

② Inadequate fire prevention organisations and unprofessional methods to extinguish fire are also brought bad influence on environment.

(2) Mitigation Measures

① Strictly follow the standard regulates to build the forest belt and road.

② In order to realise forest fire prevention and protect forest effectively, it is significant to establish a perfect forest fire prevention agency, strengthen the construction of forest fire prevention team, as well as to formulate a detailed and individual responsibility forest fire prevention system based on the relevant laws and regulations.

2. Environmental Impacts on the Usage of Pesticides and Fertiliser

The impacts on this aspect mainly focus on forest quality improvement and under forest planting.

(1) Impacts Analysis

① The use of insecticides will be increased during forest disease and insect pest control. The usage of pesticides to insect pest will also kill beneficial insects that are natural enemy of pest result in loss in biodiversity and imbalance in species. Additionally, pesticides are harmful to wildlife directly.

② The nearby water quality and soil will be influenced by inappropriate use of

pesticides.

③ Inappropriate use of pesticides, splash directly on the surface, for instance, results in reduce nearby water quality will, such as fertilizer loss and water pollution.

④ Long-term use of chemical fertiliser caused physical and chemical properties transformation of soil, in other words, the soil will be surface knot, soil degradation, and fertility loss.

⑤ The quality of water and soil will be badly influenced by inappropriate ways of cleaning and disposing of pesticide containers

(2) Mitigation Measures

① The choice of seedlings should be no quarantine objects and superior in seeds or fine clone, and as far as possible to minimise the usage of pesticides, mainly depending on prevention and biological control methods to enhance forest culture and management, and improve disease resistance of the forest.

② It is only permitted to use chemical insecticides in type II and type III, regulated by the world health organization (who), which only has effects on a particular pest, and to the non-target organisms are low toxicity. In addition, it is not permitted to use first insecticides that in first and second of type I in WTO.

③ All the workers and forest farmers who are going to use pesticides have to undertake professional training for the safety management, storage and use of chemical pesticides before use them, which can avoid direct influence on human beings, or pollute water and food. The packaging containers of pesticides and fertilisers will be collected and processed together.

④ To adopt scientific and reasonable fertilisation' methods, and also promote to take use of organic fertiliser, green manure, and forest inter-planting nitrogen fixing plants. The use of inorganic fertiliser must strict accordance with the requirements of afforestation design, which means to fertilise in holes or strips, and cover the surface immediately, besides, it is not

permitted to splash on the ground.

⑤ It is prohibited to wash pesticide containers in the water source, as well as waster that used for breed and raise livestock, only can use water that for agricultural irrigation to clean them.

3. Environmental Impacts on Wood Felling and Skidding

(1) Impacts Analysis

① Unreasonable ways of wood felling is harm for the remaining stumpage and vegetation under trees which result in soil nutrition loss;

② Large amount of wood felling will decline the overall function of forest ecosystem;

③ Inappropriate ways of skidding might destroy nearby forest and natural river system;

④ The routes of skidding and loading bay will lead serious water and soil loss.

(2) Mitigation Measures

① It is prohibited for clear cutting, but selective cutting is permitted. It is important to pay attention to protect under forest vegetation while felling, and forest regeneration should be adopted in the following year of felling.

② It is vital to take use of forest paths for skidding road, if necessary, the width of newly built forest paths should be less than 1 metre.

③ To utilise log-length logging as far as possible, but minimise the use of tree-length logging.

4. Environmental Impacts on Under Forest Planting, Product Acquisition, and Transportation,

(1) Impacts Analysis

① Operational measures in a particular period might cause adversely affect on

environment.

② A large number of human activities during operation brought various pollutants;

③ Pollutants are result from product collection, and transportation of mechanical equipment.

(2) Mitigation Measures

① Followed the standard regulations for under forest planting strictly.

② Collecting production and domestic waste produced by operators in time, and bringing them to the off-site for disposal.

③ Adopt equipment that reach standard for emission.

8 Proposed to Prevention Measures and Expected Measurement Effects of the Project

8.1 Environmental Factor Control Measures and the Expected Measurement Effects

Items / Types	Emission Source (NO.)	Pollutants	Concentration and Volume before Dispose (Units)	Concentration and Emission of Dispose (Units)
Air Pollutants	Construction	Exhaust gas from chain saw vehicle	Adopted equipment and vehicles that exhaust of gas reached standards.	Gas of fuel oil reached standard
	Operation	Domestic wastewater	Latrine, forest irrigation	No discharge of surface water
Water Pollutants	Construction	Pesticide and chemical fertiliser	Avoid use of pesticides and chemical fertiliser, but to use organic fertiliser and farmyard manure.	No discharge of surface water
		Domestic wastewater	Latrine, forest irrigation	No discharge of surface water
	Operation	Pesticide	Avoid to use	No discharge of surface water
Solid Waste	Construction	If possible, trying to recycling all kinds of pollutants, such as plastic film and chemical fibre woven bags that during seedling preparation, as well as domestic garbage resulting from administrative staff, and for the unrecyclable pollutants will be		

Items / Types	Emission Source (NO.)	Pollutants	Concentration and Volume before Dispose (Units)	Concentration and Emission of Dispose (Units)
		filled in in situ. Packaging containers of pesticides and fertilisers will be collected and disposed unify.		
	Operation	Pollutants can be collected and disposed unify, such as domestic garbage resulting from administrative staff. Packaging containers of pesticides and fertilisers as pollutants are in small volume and dispersed.		
Noise	The noise is low to count, and project sites are far away from city centre.			

8.2 Ecological Protection Measures and Expected Effects

It is important to implement and guarantee ecological benefits of the project, the following measures can protect and control adverse effects that might be occurred.

1. The Choice of Tree Species

In order to prevent large amount of pure forest, avoid harmful organisms that influence the stability of forest structure and poor visual effect of landscape, it is best to choice local tree species with high survival rate, and also important to consider the diversity of tree species.

2. Rationally in Planting Density

A reasonable density of planting is able to ensure foraging space of forest canopy, which avoid inhibition of the growth of shrubs and herbaceous plants in high-density woodland. On the other side, it should be as far as possible to shorten period of canopy density reasonably, which enhance the protective effect.

3. Enhance Soil Erosion Prevention

In order to keep native vegetation area on the mountain peak, the mountainside, the mountain foot, the reasonable way is to use hole for soil preparation, and also avoid operate in rainy season.

4. Pest Control Main Focus on Prevention

In the pest control perspective, it is important to take sustainable control as purpose, ecological management as the fundamental, and artificial control as principal. It is significant to avoid utilise pesticide during the project implement, in order to reduce the influence of environment, pesticide that used should be low poison, low residual, and pollution-free if need. It is also important to notice the volume, time, and method of the use of pesticides, and avoid excessively utilise pesticides in one time which result in waste of pesticides, and some of them may affect environment. In addition, It is also should not use pesticide during rainy season, especially before downpour. Besides, it is also vital to pay attention to the place for pesticide containers cleaning, which should keep away from drinking water resource of wild animals and human animals. Thus, the adverse impacts on environment of utilise pesticide can be minimised.

5. Reasonable utilise Chemical Fertilisers

It is important to pay attention on the volume, time, and methods of use of chemical fertilisers, and also promote to take use of organic fertiliser, green manure, and forest inter-planting nitrogen fixing plants. The use of inorganic fertiliser must strict accordance with the requirements of afforestation design, which means to fertilise in holes or strips, and cover the surface immediately, besides, it is not permitted to splash on the ground.

9 Analysis of Alternatives

9.1 Analysis of Project “Zero”

Project “Zero” refers to “maintain the current development trends” or “not do this project”, in other words, the possible development trend without implemented this project. Whether doing or not doing this project, the direct and indirect effects of the project on the ecological environment are significant. The comparative analysis on environment effects of

project “Zero” has shown below, see Table 9-1.

Table 9-1 Environment Impact Analysis of Project “Zero”

Environment Impacts	DO	NOT DO
Direct Impacts	① There has large amount of multi-tree species in project sites which increase the acreage of forest, reduce soil erosion, improve water and soil conservation, increase biodiversity, and enhance carbon sink. However, inappropriate choice of place and tree species for afforestation, and unreasonable choice of afforestation technology and cultivation measures will also adversely influence ecological environment. ② Cultivate the existing forest stand, refers to thinning, re-planting valuable local broad-leaved tree, and tending the current forest stand, which result in lots of benefits, such as increase the volume of tree species, improve forest quality, optimise forest structure, increase under forest vegetation, enhance forest ecological function, and increase biodiversity. However, the adverse ecological impacts and risk will be increased when choose inappropriate forest land and tree species, as well as unreasonable forest cultivation measures. ③Under forest planting can enhance forest products, but might influence the current forest stand.	① If the project not implement, low utilisation rate occurred in suitable land for forest, non-timber forest land and open forest land, which gradually weakened the ability of land anti-erosion. In addition, soli barren, serious soil erosion, decline in ecological function, and frequent natural disasters also associated without this project. ② There have big challenges for sustainable management of forest as the coverage rate of forest reduced year by year, single forest structure, forest degradation, forest diseases and insect pests increased, ecological function declined, comprehensive benefits of forest gradually decreased. ③ Even though there is on influence on the existing forest stand, the variety of forest product is single.
Indirect Impacts	① This project is able to increase forest coverage rate, enhance the appreciation effect of forest landscape, increase habitats for wild animals, form migration channels, which benefits biodiversity conservation. ②This project can adjust climate, improve ecological environment, increase forest carbon sink, and improve forest landscape effect. ③The project can improve production conditions of forest areas, advance utilization rate of land, increase forest effects, and enhance farmers' awareness of environmental protection.	Without this project, wildlife resources will be decrease, which is not benefits in biodiversity conservation. The degradation of ecological environment and cannot be contained and improved. The environment of local community will also delinked, and defence capability of natural disaster in forest area is poor.
Conclusion	Recommend	Not recommend

9.2 The Comparative Analysis of Afforestation between this Project

and Alternatives

The following tables show comparative analysis between mixed multiple tree afforestation with local species, which is adopted in this project and traditional artificial afforestation, which mainly focus on the different between choice of tree species and afforestation models, see in Table 9-2 and Table 9-3.

1、Choice of Tree Species

Table 9-2 Analysis of Choice of Tree Species

Project Scheme	Traditional Scheme
(1) In this scheme, the choice of tree species emphasis on rare and precious local tree species, not only focus on the wood production, but also pay more attention on their market value. (2) Strengthening biodiversity conservation. During the period of afforestation design and implement, in order to enhance the protection, recovery and retention of natural plant communities, it is important to utilise the existing local tree species and shrub, associated with native tree species to imitate the nature forest landscape. (3) The layout of afforestation is mixed with multiple species, and strict control the volume of single species. Among the model of reconstruction of forest land, the number of dominant tree species cannot over 70% than the total amount of afforestation. (4) The existing wildlife corridor should be kept, in general, the width is between 50~100 metres while design the layout of afforestation.	(1) In this traditional scheme, the choice of tree species emphasis on fast growth, high output, preferable quality, which focus on the wood production. (2) The choice of tree species is relevantly single, such as *Pinus elliottii*, *Pinus massoniana, Cunninghamia Populus* sp. and *Eucalyptus* sp., which are fast-growing timber species, and some species that have low diversity, such as *Phyllostachys edulis* and fruit trees.
Conclusion: Recommend	Not Recommend

2、Choice of Afforestation Model

Table 9-3 Analysis of Environmental Impacts of Afforestation Model

Measures	Project Scheme	Traditional Scheme
Clearing of Forest Land	The way of clearing of forest land utilised in this project is to cut grass in block or in strip, and controlled burning is forbidden, which can preserve the native vegetation,	The traditional way of clearing of forest land to adopt completely clearing or controlled burning to clear weed, which easily to cause soil erosion and loss of soil nutrition, and it

Measures	Project Scheme	Traditional Scheme
	reduce the possibility of soil erosion, it is beneficial to biodiversity conservation.	is not beneficial to biodiversity conservation.
Soil Preparation	Different soil preparation methods adopt for different places, for example, when the slope land is above 15 degrees have to utilise hole or strip preparation, and stairs preparation also can be utilised; when the slope land is above 25 degrees, hole preparation should be used. To sum up, soil preparation methods adopted in this project can maintain the native grass belt, and reduce destroy of soil surface as much as possible, the area should be less than 25% of total acreage, and take effective measures for water protection.	The tradition ways of soil preparation is to adopt complete and strip preparation, destroy soil surface 30-100%, which will completely and partly destroy vegetation, and cause seriously soil erosion.
Density of Afforestation	The density of afforestation in this project is 30% less than the traditional way, which has high transmittance of crown canopy, and shrub and grass that under the forest are growth well, therefore, it is beneficial in formulate healthy canopy, and improve ability of forest stress resistance.	In a traditional way, the density of afforestation is large, which has low transmittance of crown canopy, which affect the growth of a single tree, there is almost no shrub or grass under forest, and ability of forest stress resistance is low.
Young Forest Tending	This project adopts partly trending, and surrounding the young trees to enlarge hole, loosen the soil, and weeding, and try to retain the natural vegetation, the remaining vegetation after weeding should be kept as field covering, which can maintain water and soil, increase soil fertility.	The traditional way of tending Mainly utilised total tending, and clear all the weed, which is not good for soil and water conservation
Fertilisation	Choose organic fertilizer as far as possible; When utilise chemical fertiliser, that should be in holes or strips, and cover the surface immediately, besides, it is not permitted to splash on the ground.	The traditional way of fertiliser is lack of pertinence, easily caused soil hardening, and waste of fertiliser while sprinkle it.
Conclusion	Recommend	Not Recommend

9.3 The Comparative Analysis of Improvement and Transformation of Existing Artificial Forest and Traditional Scheme

The following table show comparative analysis between improvement and transformation of existing artificial forest and traditional scheme, which mainly focus on the analysis of

difference of target trees, transformation, and cultivation, see in Table 9-4.

Table 9-4 Analysis of Improvement and Transformation of Existing Artificial Forest and Traditional Scheme

	Project Scheme	Traditional Scheme
Forest Improvement and Transformation	(1) This project improve quality of forest and beautify forest landscape through adjust the forest structure by apply theory and practical experience of natural forest management. (2) Based on the existing situation of forest, to plant the precious tree species or promote natural regeneration, and to formulate multiple tree species.	The traditional way of forest improvement and transformation is to pruning, thinning and woodland management that made the forest structure more reasonable, tree body more healthy, and vigorous growth, which improved production and quality of wood.
Conclusion	Recommend	Not Recommend

10 Environmental Management and Monitoring Programmes

To formulate environmental management and monitoring programmes benefits the relevant department and project units to supervise and guarantee the implementation of this project. Environmental management and monitoring programmes specified the responsibilities of each unit in implementation, development, and monitoring activities during project design, implementation/construction, and operation.

Even through lots of environmental issues associated with the project, as long as the crucial environmental problems have been monitored and controlled, the influences of the project on the local environment can be effectively managed. This project belongs an ecological project which mainly focus on the monitoring of soil erosion, soil fertility, surface water, etc.

10.1 Environmental Management of Project Units and Responsibilities

The environmental management of the project is organised and implemented by the project implementation units under the supervision of the Environmental Protection Department of Hunan Province, the Forestry Department of Hunan Province, as well as the local environmental protection bureaus.

The Forestry Department of Hunan Province is responsible for the environmental protection and coordination management of impacted areas of this project, while the Environmental Protection Department of Hunan Province (provincial environment monitoring station) provides guidance for environmental management and monitoring techniques. The project offices at the county-level are responsible for daily inspection and monitoring of afforestation on the environmental aspects directly depended on the scale of the project to equip with an appropriate number of full-time environmental staffs. The monitoring of physical factors on surface water and soil fertility of this project are completed by county-level environmental monitoring station, and monitoring of ecological factor is competed by organisations that qualified.

The following two diagrams displayed environmental management and organisational structure of implementation and operation, see in Diagram 10-1 and Diagram 10-2.

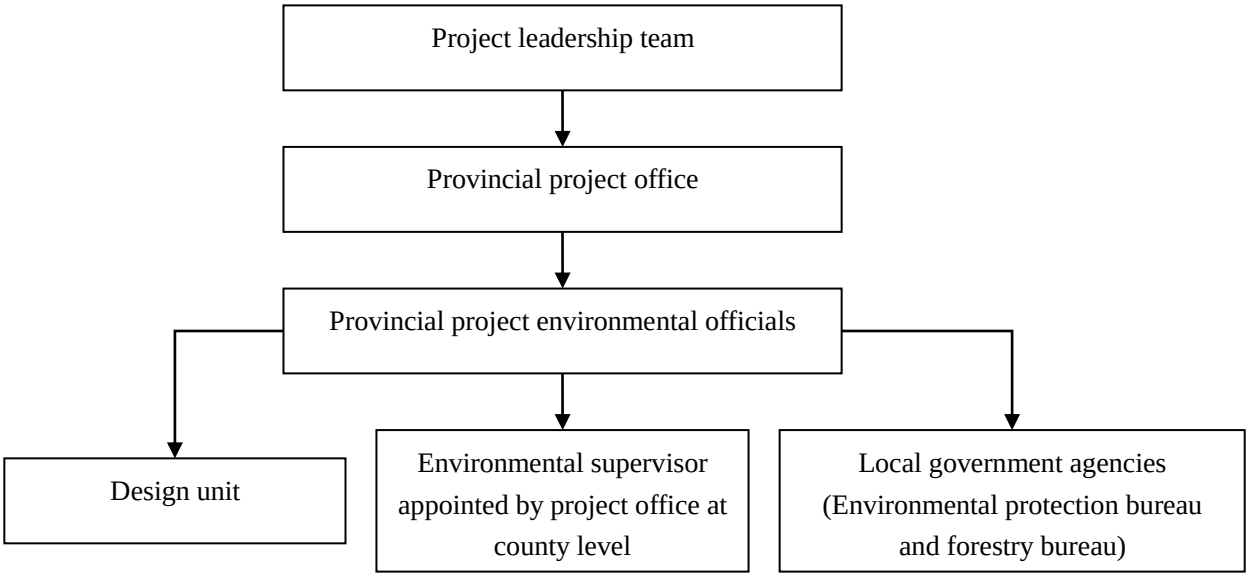


Diagram 10-1 Organisational Structure of Implementation

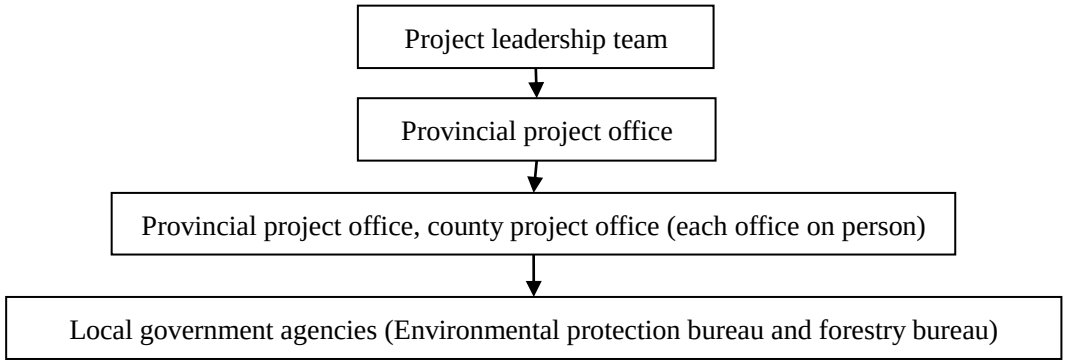


图 10-2　Organisational Structure of Operation

10.2 Environmental Monitoring Plan

Classification of environmental monitoring: based on objectives of environmental monitoring which can be divided into three categories.

- Monitoring of implementation: to determine whether the progress of implementation is consistent with project design (the number of implement of afforestation and management plan, the number of completed project activities). The degrees of completion policies, procedures, procedures, or other management commitments can be assessed by this type of monitoring.

- Monitoring of consistency: to compare the performance of the project with the stated environmental standards, regulations, allowable conditions, and commitments made in the project plan. The result of this type of monitoring is to determine the penalty or punishment for the fault, or reward for good performance.

- Monitoring of effectiveness: to determine the relationship between the environmental impact of project activities and long-term goals of project. If such monitoring is measured by time series, the measurement can also be used to determine the trend of the environment. The choice of this type of monitoring is to determinate the relevant “index”, and establish a baseline to observe environmental situation regularly, in the meantime to form a comparative assessment with the established environmental situation, which determinate whether environmental management measures is effectiveness in achieve project goals.

Objectives of Environmental Monitoring Plan:

- Ensure that all mitigation measures specified in the environmental impact assessment are implemented;

- Evaluate the monitoring values to determine whether the recommended environmental protection measures are fully functional (including design phases, implementation phases and operational phases) if not, indicate the improvement measures is necessary;

- Ensure sustainable utilisation of natural resources such as soil and water resources

The three most important potential environmental impacts related to afforestation:

- Choice of location, especially focuses on potential changes to important natural ecosystems;
- Specific technical measures for project construction, such as the selection of genetic material and species diversity in terms of project design, soil conservation measures, etc.;
- Pest control.

10.2.1 Monitoring Contents and Indicators

To carry on environmental monitoring on project activities new afforestation, change existing forest culture and under forest planting which able to master functions of project construction in soil and water conservation and increase plant diversity and coverage, and dynamic changes when forest diseases and insect pests and degrees of harm occurred. Monitoring contents and indicators are as shown follows:

(1) Monitoring of Soil Erosion

- Soil erosion
- Surface runoff

(2) Monitoring of the Occurrence of Pests and Diseases and Degrees of Harm

- Species of pests and diseases
- Occurrence rate and degree of harm

(3) Monitoring of Vegetation Coverage and Plant Diversity

- Species, strains and canopy density of arbour
- Species and density of shrub
- Species and density herbaceous plant

10.2.2 Monitoring Methods

Depending on various environmental monitoring activities, monitoring of soil erosion is conducted in the first, third, and fifth year of the project, which carried out once a year; monitoring of pests is conducted twice or three time a year; monitoring of vegetation coverage and plant diversity is conducted in the first, third, and fifth year of the project, which carried out once a year.

(1) Monitoring Methods of Soil Erosion

To build different construction contents in each soil erosion monitoring point, and select a typical area that slope surface is flat to establish three runoff plots (runoff field). Among them, two runoff plots were built on project forest land as repetition, the rest of runoff plots was built on non-project forest land as a control plot. The structure of each runoff plot is designed and established based on the unified standard, including the boundary wall, header tank, gutter, flow pool, and drainage ditch built outside the upper margin of the runoff plot and protective belts on both sides of the runoff plot. The monitoring contents are including rainfall, rainfall duration, rainfall intensity, surface runoff, and soil loss, which should be monitored after the annual rainfall.

(2) Monitoring Methods of Diseases and Insect Pests

To set up different fixed monitoring stations in new afforestation, present forest improvement and transformation, forest tending, and under forest planting within the project and also set up stations in the contrast forest land where without project, adopt appropriate mechanical sampling method to define 20~30 strains of trees as standard trees, and marked as fixed monitoring standard trees. To investigate situation of plant diseases and insect pests of the standard trees on an annual regular basis, which includes types of plant diseases and insect pests, occurrence rate and the degree of harm, and in the meantime to record prevention measures and frequency.

(3) Monitoring Methods of Plants Diversity

To select representative areas and forest stand within the project activities and without

project activities, among which to set up three fixed monitoring sample area, and located on the upside, middle and downside of the mountain respectively, the acreage for each sample area is 30×30m^2. To investigate arbours, shrubs, and herbaceous plants within the fixed monitoring sample areas when during an annual monitoring period of July to August.

① Arbour: To investigate every trees of each species of arbour, which include the species of arbour, and the height of the number of strains of arbour that are high than 1 metre and less than 1 metre.

② Shrubs: Set up 5 sample areas on the four corners and central of the sample with the acreage for each sample area is 5×5 m^2, in order to investigate species and degree of coverage of shrubs.

③ Herbaceous plants: Set up five sample areas nearby the sample of herbaceous plant with the acreage for each area is 2×2 m^2, in order to investigate species and degree of coverage herbaceous plant.

10.2.3 Implementation of Monitoring

Provincial project office is responsible for organising the implementation of the monitoring plan, which required to hire qualified institutions to monitoring soil erosion, surface runoff, coverage of vegetation, and plant diversity, in the meantime, who have to guide project offices of forest protection stations at country-level to monitoring occurrence of forest diseases and insect pests and the degree of harm of counties.

10.2.4 Reporting System

At the end of each monitoring year, every environmental monitoring units should be carefully collecting, analysing, and reporting the results of monitoring data, and summarise and evaluate each monitoring data respectively, which should be as the part of implementation progress report of the monitoring project submitted to provincial project office, and formulated an integrated implementation progress report submitting to the World Bank.

11 Public Participation

11.1 The Step of Public Participation

It is obvious that the implementation of the project negatively influenced surrounding natural and social environment, which directly affected the development of social economy and the vital interests of the public. The purpose of public participation is to make the project can be fully accepted by the public, leading decision makers to take fully consideration on the interests and requirements of public when making decision on project construction, which avoid one-sidedness, reduce blindness, and made the design of project more perfect and more reasonable, and also improved environmental and economic benefits of the project.

Public participation should be covered the whole progress of the project construction, which includes from project design (feasibility, overall design, and preliminary design) to project construction (implementation), and then project operation after project completed.

11.2 Approach of Public Participation

11.2.1 Environmental Information Disclosure

The project construction units should release printed materials of relevant information through public media such as local TV stations, newspapers and other kinds of media which are easily got by the public. Information should be included project brief, possible impacts on environments, proposed prevention or mitigated measures for adverse environmental impacts, public access to the environment impact assessments, and ways and times of public opinion.

11.2.2 Environmental Information Survey

Public participation approaches including a combination of questionnaire, individual interview, and expert consultation though residents meetings of village, collective interviews, symposia, which mainly focus on investigating existing forest land, the usage of pesticide and fertiliser, standard of living status, and their opinions and attitudes towards the project, as well as the suggestions for the construction of this project, especially focus on recognition of environmental impact factors, the possible impacts on the environment, and some further advices.

11.3 Information Offered (Feedback) and Appeals

When public (stakeholders) found out some environmental issues, such as construction of the project does not meet the design requirements, a particular technique (ways of operation) has potential risk to environmental safety, pollutions already appeared can offer information and appeal to the local forestry bureaus (project offices) and environmental protection bureaus at county-level, if they do not have any feedbacks, public (stakeholders) can appeal to the Forestry Department of Hunan Province and Environmental Protection Department of Hunan Province.

12 Conclusions and Suggestions

12.1 Analysis and Conclusions

12.1.1 Single Factor Analysis

1. Necessity of Project Construction

Hunan Province is located in the middle reaches of the Yangtze River, and its river system is the main branch and main water source of Yangtze River. The construction of this project is an important approach to transform development model of forestry in China, which is a vital step that transformed from quantity orientation to quality orientation. It is necessity for improving the ecological environment, maintaining ecological balance, and construction of the Yangtze River ecological barrier, and this project also owns significant meanings on promoting and stimulating the development of local agriculture, ecological tourism, hydroelectric industry and local economic development, advancing construction of new socialist countryside, and accelerating the construction of a harmonious society and a well-off society.

2. Conformance of Project Industrial Policies and Plan

Requirement for “promoting construction of forest quality accurate improvement project” have also been clearly put forward in No. 1 Document of the central government in 2017, i.e. *Several Opinions of the Central Committee of the Communist Party of China and the State Council on Deeply Promoting Structure Reform at Supply Side of Agriculture and*

Accelerating the Cultivation of New Energies for Rural Development of Agriculture.

"13th Five-year" Planning of national forestry development indicates "ecological conservation belt Yangtze River", "increase the intensity of forest management, increase operational investment, reforming inefficient and degraded forest actively, and improve the quality of forest and forest land output", "to develop three-dimensional composite operation of forest land, develop comprehensive development of the forest collection, under forest plant breeding under the premise of meeting the target of forest management".

"13th Five-year" Planning of Forestry Development of Hunan Province proposes that to implement "the construction of forest quality improvement", "focuses on the state-owned forest farm to develop multi-channel and multi-form of precious tree planting, strengthen the reasonable operation of existing precious tree species resources, increase the intensity of rare tree species of artificial afforestation, enlarge growing area constantly, improve the proportion of precious tree species in the existing forest resources gradually, increase forest land productivity", "develop ecological tourism industry, increase construction intensity of ecological experience zone of the state-owned forest farms, forest parks, wetland parks, natural reserve, and botanical garden", "accelerate the development of under forest economy, and develop under forest operation in forest medicine, forest mushroom, forest cereals, forest fruit, forest grass, forest tea, forest vegetable, forest flower, forest birds, forest livestock, forest bee, forest frog, rosin, and other industrial raw materials".

3. Conclusions of Environmental Quality Assessment

The project implementation subjects are state-owned forest farms and forest parks, and implementation places are located the operational areas of state-owned forest farms and forest parks, where atmospheric and acoustic environment are favourable based on the monitoring results in different area.

4. Conclusions of Environmental Impact Assessment

This project form a concept of natural forest management to improve forest structure, accelerate forest quality, as well as enhance the stability and stress resistance of forest

ecosystem, and comprehensive environmental functions through the construction of present forest improvement and transformation, new afforestation, and forest tending, which is an effective way and method to adapt to climate change in the modern society. The comprehensive ecological benefits of forests are enhanced. A compound management model that is innovative and creative has been developed in a suitable area of the project, where carried out under forest ecological planting, such as forest medicine, forest vegetable, forest mushroom, and forest seed., which accurate comprehensive value of forest land and forest, promote sustainable development of the composite economy of forest and forest land.

This report has analysed types of pollutants, stages of pollution, the volume of pollution, and pollution objectives within the construction and operation of the project, where the volume of pollution is small and dispersed, and the degree of pollution objective is little and controllable.

5. Analysis of Prevention, Mitigation Measures, and Effectiveness of Environmental Impacts

(1) The domestic wastewater made by administrative staff during the construction and operation of the project is used for latrine and forest irrigation, and no discharged of surface water.

(2) If possible, trying to recycling all kinds of pollutants, such as plastic film and chemical fibre woven bags that during seedling preparation, as well as domestic garbage resulting from administrative staff, and for the unrecyclable pollutants will be filled in in situ.

(3) The use of pesticides are low poison, low residual, and pollution-free if need. It is also noticed the volume, time, and method of the use of pesticides, and avoid excessively utilise pesticides in one time which result in waste of pesticides, and some of them may affect environment. In addition, It is also should not use pesticide during rainy season, especially before downpour. Besides, it is also have paid attention to the place for pesticide containers cleaning, which should keep away from drinking water resource of wild animals and human animals. Thus, the adverse impacts on environment of utilise pesticide can be minimised.

(4) The choice of tree species is reasonable, which is grow vigorously, has high market value, and local rare tree species that has strong resistance, and it is not allowed to introduction of exotic species, Tree species are diversified that avoided high volume of single species, which can effectively avoid harmful biological outbreak and spread, and also avoid the influence of the stability of forest structure, and consequence of bad effect on forest landscape.

(5) The choice of planting density should be reasonable which on the one hand have to avoid high density to influence canopy of forest stand that associated with low nutritious, and restrained the growth of under forest shrubs and herbaceous plant result in low prevention function. On the other hand, the low density result in slow growth of forest where forest stand cannot be closed in a long time which also result in low prevention function.

(6) To utilise holes for soil preparation for new afforestation, and forest improvement and transformation, and should be strict controlled the continuous area of under forest planting, and as far as possible to minimise water and soil erosion, and avoid implemented in rainy seasons.

(7) Strengthen promotion and management of forest fire prevention, and strictly against occurrence of forest fire.

To sum up, the environmental impact prevention and mitigation measures in this assessment is feasibility.

12.1.2 Comprehensive Conclusion of Environment Impact Assessments

Forest Quality Improvement and Efficiency Enhancement Demonstration Project of Hunan Province with Loan from European Investment Bank accords with national industrial policy, which is necessary to implement this project, which is an effective way and method to adapt to climate change in the modern society as it improve forest structure, accelerate forest quality, as well as enhance the stability and stress resistance of forest ecosystem, and comprehensive environmental functions. The comprehensive ecological benefits of forests are enhanced. A compound management model that is developed in the project sites, where

carried out under forest ecological planting, such as forest medicine, forest vegetable, forest mushroom, and forest seed, which accurate comprehensive value of forest land and forest, promote sustainable development of the composite economy of forest and forest land. The project also has significant positive environmental impact. The management measures of (three wastes) that proposed in this project is effective in ecological protection, and economical feasible. Additionally, the project site that proposed has s a good quality of environmental status, and there is no significant environmental factors that restrict the construction of this project.

Based on the above analysis, in terms of environment perspective in “three measurements at the same time”, the choice of project sites are feasibility on the environmental protection perspective.

12.2 Suggestions

1. It is encouraged to take use of organic fertiliser, green manure, and forest inter-planting nitrogen fixing plants, and ensure the supply of nutritious for young seeding and tree species, which accelerated the speed of forest establishment
2. Take prevention as priority while pest control, in order to realise sustainable governance associated with low input, high effective, and with pests but no disaster.
3. In order to ensure the progress of the project is scientifically, reasonably, and orderly, provide training for employees is important.
4. When apple overall planning for the project county, it is important to utilise different kinds promotion methods to collect environmental protection opinions toward public (stakeholders).