EIB-funded Rare, High-quality Timber Forest Sustainability Project

Non-technical Summary of Environmental Impact Assessment

State Forestry Administration

December 2013

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1. Source of contents

These contents come from the EIB-funded Rare, High-quality Timber Forest Sustainability Project Environmental Impact Statement for Henan Province prepared by Jinhan Environmental Assessment Consulting Co., Ltd, EIB-funded Rare, High-quality Timber Forest Sustainability Project Environmental Impact Statement for Guangxi prepared by Guangxi Environmental Protection Research Institute and EIB-funded Rare, High-quality Timber Forest Sustainability Project Environmental Impact Statement for Hainan prepared by Hainan Environmental Science Research Institute. Preparation of this report began on July 30, 2013 and completed in December 2013.

2. Background information

Rare tree species and timber are strategic resources required for the economic and social development and the defense industry and equipment manufacturing sector in China. Due to excessive harvesting of natural forests, coupled with little attention given to artificial cultivation and management of rare species, the pool of rare tree species and reserved resources have long been seriously insufficient to meet the demand. According to the results of the 7th national forest inventory, 12 main rare tree species including Korean pine, Mongolian scotch pine, cedar, oak, birch, fraxinus mandshurica, Juglans mandshurica, Phellodendron amurense, camphor wood, nanmu, elm and basswood cover a combined land area of 32.9514 million ha and have a combined stock volume of 2382.3091 million cubic meters, accounting for 17.0% and 17.8% of the total respectively. Compared with the results of the sixth national forest inventory, the percentages of the area and stock volume decreased continuously, especially given the fact that the recoverable resources are basically exhausted. Currently, most of rare timber used in China is imported

from abroad, posing a high risk to China's forestry industry. Development of rare, high-quality timber forests is important to increasing the strategic reserve of timbers, addressing the undersupply of rare timber, preserving the forest ecosystem stability and biodiversity, increasing the forecast carbon sink and raising the farmer income.

3. Project objectives

This project will be implemented to restore the forest vegetation, increase forest coverage, provide rate, high-quality timber products, improve the forest ecosystem structure, and functionality, utilize the functions and overall benefits of forests, improve the forest sustainable management practice, increase farmer income and provide a role model for other regions to adopt the sustainable management approach to multifunctional and multi-benefit artificial forests.

4. Project description

4.1 Project site

The project involves 40 counties (cities and districts) and 8 state-owned forest farms, as shown in Table 4-1.

Project site

Table 4-1

Province (region)	Number of counties (cities, districts and state-owned forest farms)	Name of county (city, district or state-owned forest farm)
Henan	26 counties and one forest farm	Song County, Luanchuan County, Luoning County, Xin'an County, Yanshi City, Yiyang County, Xixia County, Xichuan County, Zhenping County, Fangcheng County, Tongbai County, Luoshan County, Shangcheng County, Huangchuan County, Xin County, Guangshan County, Nanwan forest farm, Gongyi City, Dengfeng City, Yuzhou City, Huaiyang County, Linzhou City, Lushi County, Qi County, Kaifeng County, Xiayi County
Guangxi Zhuang	13 counties and 7	Rong'an County, Lingui County, Quanzhou County,

Autonomous Region	forest farms	Xing'an County, Yongfu County, Longsheng County, Leye County, Tianlin County, Xilin County, Babu District, Zhaoping County, Huanjiang County, Yizhou City, Gaofeng forest farm, Qipo forest farm, Liuwan forest farm, Weidu forest farm, Huangmian forest farm, Daguishan forest farm and Yachang forest farm directly under Guangxi Department of Forestry.
Hainan	1	Dongfang City

4.2 Scope of project

The project comprise forestation, management of existing forests, construction of auxiliary facilities, capacity building, project management, monitoring and evaluation.

Forestation： Covers 45184 ha, including 19550 ha in Henan, 21500.0 ha in Guangxi and 4134 ha in Hainan.

Management of existing forests： Covers 29023 ha, including tending of 20090 ha of young and middle-aged forests and reformation of 8933 ha of low-yield forests. 22400 ha of existing forests will be managed in Henan, including tending of 16000 ha of young and middle-aged forests and reformation of 6400 ha of low-yield forests; 4090 ha of existing forests will be managed in Guangxi, which comprises tending of young and middle-aged forests; 2533 ha of existing low-yield forests in Hainan will be reformed and cultivated.

Construction of nurseries： 54 ha of nurseries will be built or renovated, including 14 ha in Guangxi and 40 ha in Hainan.

Construction of auxiliary facilities： Construction of management rooms, pavement of forest roads, construction of firebreaks, installation of billboards, provision of forest protection equipment and tillage implements, and development of management information system.

Capacity building, project management and monitoring and evaluation： Intensified training of forest rangers and project participants, provision of motor vehicles and equipment and technical extension.

4.3 Project lifecycle

This project will span 5 years. The procurement of office equipment, vehicle and other infrastructure will be conducted in the first and second year of the project lifecycle, while forestation activities take place in the first three years. The fourth and fifth years will be a period of reinforcement planting, young forest tending and acceptance check.

4.4 Alternatives

The alternatives to this project include without-project scenario, alternative to forestation plan and alternative to forestation model.

5. Factors affecting the environment

5.1 Positive environmental impacts of the project

The implementation of the project will help make full use of the functions and benefits of forests. In particular, it will remarkably increase the forest areas, improve the forest structure and quality and better the ecological environment in the project areas. This project will produce positive impacts in terms of land utilization efficiency, water conservation, soil conservation, soil improvement, mitigation and containment of desertification, farmland protection, air purification, improvement of living environment and improved biodiversity in the project areas.

5.2 Without-project environmental impact

（1） The resistance to erosion of barren hills and slopes and desertified land will weaken, resulting in thinning and hardening of soil, serious soil erosion, land desertification, fertility loss, degradation of ecological function and frequent occurrence of natural disasters.

（2）The forest coverage will decrease year by year, the stand lack structural diversity, forests deteriorate, biodiversity decrease, forest pest increase, ecological functions deteriorate, overall benefits of forests decrease and sustainable management of forests face daunting challenges.

（3） The wildlife resources will decrease to the detriment of biodiversity conservation; the deterioration of ecological environment can not be contained or improved; the quality of living environment of local communities will deteriorate and the farmland's resistance to natural disasters weakened.

5.3 Potential negative impacts on environment

（1） Impact of forestland clearing and site preparation on ecological environment

In the process of forestland clearing and soil preparation, the existing vegetation will be damaged, resulting in soil loss and decrease in the population of certain species during a certain period.

（2） Impact on soil fertility

During the project implementation, the site preparation and clearing might result in loss of surface soil and nutrients and subsequently produce certain potential impact on the soil fertility of forestlands. Extensive use of inorganic fertilizers might produce potential negative impact on the soil structure, soil fertility and bioactivity.

（3） Impact on ecological balance of pest

Planting single tree specie extensively in commodity forest areas might produce certain potential impact on ecological balance of pest in the project area. Extensive plantation of genetically similar tree species is vulnerable to pests and diseases. The possible negative impacts include:

① The possibility that men and animals enter the project areas will increase and the pest propagation will increase, during the project

implementation, which might result in ecological imbalance of pest.

② The project implementation involves clearing of the vegetation on the lands to be forested, which might cause impact to some beneficial insects and hosts while clearing certain harmful insects and their hosts, thus producing impact on the project areas, especially the ecological balance of pest.

（4）Negative impact of application of agrochemicals on environment

① Application of agrochemicals will kill many enemies of pest while eradicating pests, thus reducing the biodiversity and causing imbalance of species in the forestlands. In addition, application of agrochemicals might directly hurt wildlife.

① The extensive application of agrochemicals might affect the quality of nearby water and contaminate the soil.

② Application of agrochemicals will produce impact on atmosphere.

③ Application of agrochemicals might affect human health directly or indirectly through contaminated water or food.

⑤ Agrochemicals containers, if littered around, will produce impact on environment and might result in accidents.

5.4 Measures to mitigate negative impacts

（1） Measures to mitigate the impact of forestland clearing and soil preparation on ecological environment

Prohibit full-scale soil preparation. Instead, belt-by-belt approach to soil preparation shall be adopted. The belt-shaped soil preparation on hilly lands shall be conducted along the contour line, with secondary vegetation of no less than 1 m in width to be reserved between belts. On hillside lands where local soil loss is serious, soil preparation shall be conducted after soil conservation measures are undertaken. Secondary vegetation belt of more than 10 m in width shall be reserved between the rim of the land lot to be forested and the farmland.

A secondary vegetation belt of 6 m in width shall be reserved on an interval of 100 m along the slope surface of land lots to be forested. After soil preparation, the land surface shall be covered with deadwood and leaves immediately.

（2）Measures to mitigate the impact on soil fertility

Measures shall be undertaken to maintain and improve the soil structure, soil fertility and bioactivity of the land lots to be forested. Where possible, natural methods shall be used to reduce the reliance upon inorganic fertilizers. Where feasible, organic fertilizers, green manure shall be used and nitrogen-fixing plants shall be planted between trees. The application of inorganic fertilizers shall be conducted strictly according to the requirements of forestation plan.

（3）Measures to mitigate the impact on ecological balance of pest

The combination of tree species, source of species, genetic types and tree age in the forestation activities can generally increase the resistance to pest and diseases. Measures shall be taken to prevent or minimize the occurrence of pest and disease, and quarantine measures established to prevent foreign pests, with internal quarantine established inside forest operation unit. The existing vegetation on the valleys and hillsides shall be preserved strictly according to the requirements of forestation plan in order to increase the diversity of insects and natural enemies and improve the capabilities to regulate the ecological balance of pests. Extensive use of chemical pesticides shall be minimized and it shall be confirmed that chemical pesticides are used against a particular pest and are low-toxicity to non-target organisms.

（4）Measures to mitigate the impact of application of agrochemicals

Superior seedlings that are highly resistant to diseases shall be used for forestation and forest management measures shall be intensified to improve the forest’s resistance to diseases. New shelter forests shall be of mixed species

whenever possible in order to effectively mitigate the propagation of pests and diseases.

The overall pest and disease control shall be based on use of bio-pesticides and minimize the use of agrochemicals. Where use of chemical pesticides is necessary, efficient, low-toxicity, low-residue and fast-degrading chemicals shall be used in the form of ultra-low spraying. Measures shall be taken to minimize the pollution caused by use of fertilizers and agrochemicals. Rigorous control shall be exercised over the amount of agrochemicals used and the appropriateness of application method in order to minimize the environmental impact.

6. Environmental monitoring

6.1 Environmental monitoring during implementation

Project implementation activities might produce negative impact on some environmental parameters, such as short-term minor impact on vegetation, soil and biodiversity. An environmental monitoring plan will be prepared for the project. Environmental monitoring shall comprise two parts: 1) routine monitoring: used to determine how much the forestation activities are consistent with the approved project plan and these rules. The most essential part of the routine monitoring is monitoring of the diversity of artificial forests, soil preparation, tending (weed eradication and intermediate cutting, pest and disease control (selection and application of pesticides and safety of farmers). 2) Management monitoring: used to determine the growth of artificial forests, and identify the ecological and social impacts of forestlands and other land lots.

6.2 Environmental monitoring during operation

The potential environmental impacts during the operation phase are soil erosion, related issues resulting from use of agrochemicals and pest and disease

control activities, reduced soil fertility and biodiversity. The environmental monitoring personnel in each project county will monitor the impact of the project on different environmental factors during the project operation. The main objective of the environmental monitoring plan during the operation period is to understand the impact of the project on environment during the operation period. The information obtained will be used to improve the environmental management and monitoring plan and related project activities in order to prevent or reduce the greater negative impact of the project on environment in the next phase.

7. Conclusion

This project fits well into the industry policy and the local site conditions, and the project sitting is feasible. Forestation part of this project will generally use rare timber species and native tree species, which is conducive to increasing the forest resources and forestry carbon sink, restructuring of the forest category and tree species, improving the regional ecological environment and production conditions for forestry, improving the technical expertise of forest workers, facilitating the sustainable management of forest resources and contributing to the construction of national strategic timber reserves. In the meantime, this project will help readjust the agricultural industry structure and socioeconomic structure in the project areas and contribute to the harmony between people, economy, society, ecology and resources. The project implementation will produce certain environmental impacts, and effective engineering and managerial measures will be taken to prevent and mitigate the environmental problems such as soil loss and territorial ecosystem during the project implementation and operation. The effective implementation of the measures described in the environmental impact assessment report will

minimize the negative impacts of the project. The project is environmentally feasible from the perspective of environmental protection.

8. Carbon sink

8.1 Carbon sink measurement

The National Forestry Carbon Sink Measurement and Monitoring Guide prepared by the SFA in 2013 provides that aboveground and underground biomass carbon pools are carbon pools that must be selected. According to the principle of conservationism and cost effectiveness, this project may ignore the carbon pools of deadwood, litter, soil organic carbon and wood products. This project calculates carbon stock using two methods:

The first method involves calculating the carbon stock based on the relation between growing stock, biomass of different dominant tree species (groups) and stock volume as well as the carbon content of each tree species (group) according to the National Forestry Carbon Sink Measurement and Monitoring Guide. This method is adopted in Henan and Hainan provinces, as described in detail below:

The relationship model between biomass of different dominant tree species (groups) and stock volume is as follows:

$Mi = aXi + b$。

Note：Mi is the per unit area biomass of i^{th} tree species (group), Xi is the per unit area stock volume of i^{th} tree species (group). Both a and b are parameters. The regression equation parameters for each main tree species biomass and stock volume are shown in Table 8-1.

Table 8-1 Overall relation parameter values of biomass and stock volume

No.	Tree species	a	b
1	Poplar	0.64550	36.30800
2	Oak, **deciduous broad-leaved tree**	0.85205	13.48525
3	evergreen broad-leaved tree	1.03780	11.40920
4	mixed coniferous broad leaved forest	0.97880	5.37640
5	Chinese pine	0.71060	14.48070
6	mixed broadleaf-conifer forest	0.81360	18.46600

Source: National Forestry Carbon Sink Measurement and Monitoring Guide

Ci＝∑（Mi×Ai×CFi）

Note：Ci is the carbon stock of tree species i, Mi is the per unit area biomass of the tree species (group)i, Ai is the area of the tree species (group) i, and CF is the carbon content of the tree species (group) i. The carbon content of each tree species (group) is shown in Table 8-2.

C=∑Ci

Note：C is the total carbon stock of timber species, and Ci is the carbon stock of tree species (group) i.

Carbon contents of tree species (groups)

Table 8-2

Tree species (group)	**overall carbon content**	**Tree species (group)**	**overall carbon content**	**Tree species (group)**	**overall carbon content**
Chinese pine	0.5184	oak	0.4798	Other soft broad-leaved forest	0.4502
other cedars	0.5185	other hard broad-leaved forest	0.4901	broad-leaved mixed forest	0.4796
Coniferous mixed forest	0.5168	Poplar	0.4502	economic forest	0.4700
coniferous broad-leaved mixed forest	0.4893	Acacia	0.4666		

Source: National Forestry Carbon Sink Measurement and Monitoring Guide

The second method involves calculating the carbon stock using the growing stock, basic wood density, the biomass expansion factor converted

between growing stock and aboveground biomass as well as the root/stem ratio and carbon content. This method is adopted in Guangxi, as described in detail below.

$$C_{AB} = V \cdot D \cdot BEF \cdot CF$$

$$C_{BB} = C_{AB} \cdot R$$

Wherein：

C_{AB} = carbon stock of aboveground biomass， t C ha^{-1}

C_{BB} = carbons stock of underground biomass， t C ha^{-1}

V = growing stock， m^3 ha^{-1}

D = average wood density，t d.m.m^{-3}

BEF = the biomass expansion factor converted between growing stock and aboveground biomass, dimensionless.

CF = carbon content， t C （t d.m)$^{-1}$， IPCC default value = 0.5

R = root-stem ratio, dimensionless.

Wood density, biomass expansion factor and root/stem ratio of the tree species used in this project

Table 8-3

Tree species	Wood density （t. d.m.m^{-3}， growing stock）	BEF	Root/stem ratio
Masson pine	0.380 (43, 0.019)	1.46 (103, 0.47)	0.283 (77, 0.043)
fir	0.307 (54, 0.009)	1.53 (237, 0.27)	0.255 (237, 0.040)
Other species	0.598 (482, 0.012)	1.79 (120, 0.36)	0.217 (94, 0.075)
Sweetgum	0.443 (189, 0.013)	1.54 (21, 0.36)	0.283 (14, 0.088)

Note: 1. Data comes from the 1994 China Forestry Greenhouse Gas Emissions Checklist Report prepared by Forest Ecological Environment Research Institute of Chinese Academy of Forestry. 2. The figures in parenthesis represent the number of samples and standard deviation respectively.

During the 25-year calculation period, the project will increase carbon

stock by 3.6433 million tons, including 2.4471 million tons in Henan, 498700 tons in Guangxi and 687500 tons in Hainan.

8.2 Carbon emission measurement

This estimation employs the applicable formulas described in the Forestry Carbon Sink Measurement and Monitoring Guide.

（1）Application of fertilizer

Calculate the direct N_2O emission based on the types, areas, amount used and nitrogen contents of fertilizers applied each year according to the project plan.

$E_{N\_Fertilizer,t}=[(F_{SN,t}+F_{ON,t})*EF_l]*MW_{N2O}*GWP_{N2O}$

Wherein：$F_{SN,t}$——the amount of nitrogen-containing fertilizer applied in the year t after volatilization of NH_3 and NO_X （$tN.a^{-1}$）；

$F_{ON,t}$——amount of organic fertilizer applied in the year t after volatilization of NH_3 and NO_X （$tN.a^{-1}$）；

EF_l —— NO_2 emission factor of application of nitrogen-contained fertilizer（IPCC reference valeu=0.01 t N_2O-N.$(tN)^{-1}$）；

MW_{N2O}——molecular weights of NO_2 and N （44/28）（t N_2O-N.$(tN)^{-1}$）；

GWP_{N2O}——global warming potential of N_2O （IPCC reference value=310 t CO_2-e.$(tN_2O)^{-1}$）。

The volatilization of urea is set at 20% (based on the master’s degree thesis written by graduate Lin Li from Shandong Agricultural University in 2011 under the title “farmland nitrogen element loss path and water and nitrogen utilization efficiency under different fertilization application practices in high-yield grain-producing areas”). In this project, 256040 tons of fertilizers will be applied (urea or urea equivalent) and 194575 tons of carbon emissions will be produced. For Henan province, only compound fertilizers will be applied in the quantity of 373177 tons, or equivalent to 194052 tons of urea, producing carbon

emissions of 141797 tons. For Guangxi, only urea will be applied in the quantity of 49174 tons, producing 47909 tons of carbon emissions. For Hainan, only compound fertilizers will be applied in the quantity of 12814 tons, or equivalent to urea of 6663 tons, producing 4869 tons of carbon emissions.

（2）Fuel oil

Primary consideration is given to carbon dioxide emissions resulting from combustion of fossil fuel in transport vehicles (i.e., fuel-fired motor vehicles). The calculation is based on the types of motor vehicles used for transport of fertilizers, seedlings and timbers, types of fuel, average distance of transport and per-km fuel consumption, using the following formula.

$$LK_{vehicle,t} = \sum_{f=1}^{n} EF_{CO_2,f} \times NCV_f \times FC_{f,t}$$

Wherein： $LK_{vehicle,t}$—— CO_2 emissions（$tCO_2\text{-}e.a^{-1}$）resulting from transportation off the battery limit of the project in the year t;

$EF_{CO2,f}$—— CO_2 emission factor of type f fuel.（$tCO_2\text{-}e.GJ^{-1}$）;

NCV_f——heat number of type f fuel （$GJ.L^{-1}$）;

$FC_{f,t}$——consumption of type f fuel oil in the year t （L）。

The fuel used in this project is generally diesel oil, whose carbon emission coefficient is set at 2.778Kg. CO_2/L（IPCC data）. A total of 9971.64 tons of diesel oil will be used in this project, resulting in carbon emissions of 27701.20 tons. Of them, 1411.45 tons of diesel will be used in Henan, producing carbon emissions of 3921.00 tons; 8512.43 tons of diesel in Guangxi, producing 23647.52 tons of carbon emissions, and 47.76 tons in Hainan, producing carbon emissions of 132.68 tons.

9. List of agrichemicals

The list of agrochemicals used in Henan, Guangxi and Hainan in this

project is shown in Table 9-1, Table 9-2 and Table 9-3 respectively.

List of agrochemicals used in Henan

Table 9-1

Tree species	Pest and disease	Controls	Bio-pesticides	recommended chemical pesticide	Pesticide classification（WHO）	EC number	Chinese national/industry standard
Poplar	Canker,black spot,leaf rust, Cytospora chrysosperma	1. Forest management measures: use high-quality seedlings and improve tending management for improved resistance to diseases. Reasonable dense planting, timely intermediate cutting and maintenance of good ventilation and exposure to light. 2. Chemical controls: apply 3 or 5 degree lime sulfur mixture or 10% alkaline water to scabs	Lime sulfur；10% alkaline water	Carbendazim	U	234-232-0	GB 10501-2000
				chlorothalonil	U	217-588-1	GB 9551-1999(2004)
	long-horned beetle, Geometridae, Micromelalopha troglodyta, Leucoptera susinella Herrich-Schaffer, Tinea pellionella	1. Forest management measures: planting right trees in the right place, using multiple tree species and planting luring tree species; 2. Physical controls: remove the pest-infested branches for centralized burning in the process of wintertime pruning.	Matrine；Nicotine				
Oak	Ciboria Pseudotuberosa	1. Forest management measures: mixed forest, improve the site conditions and remove deadwoods. 2. Intensify quarantine efforts. 3. Chemical protection: use of low-toxicity, high-efficiency and low-residual-toxicity varieties.		chlorothalonil	U	217-588-1	GB 9551-2004
				thiophanate-methyl	U	245-740-7	GB 24755-2009
				Triadimefon	III	256-103-8	HG 3293-2001
	Fentoniacypete	1. Forest management measures: mixed forest,	Matrine	Chlorbenzuro	III	252-529-3	GB/T5009.135-2003

	Bremer，Laverannisfilipjeri Wehril，Naganoea albibasis	improve site conditions. 2. Mechanical and physical controls: remove clusters of eggs, sex attractant, insecticidal lamp. 3. Biological controls: Trichogramma 4. Chemical controls: spray non-toxicity chemical agents when appropriate.		n			
			azadirachtin	Triflumuron	III	264-980-3	
			Nicotine	diflubenzuron	III	252-529-3	GB/T 009.147-2004
			Bt	Fenoxycarb	U	276-696-7	
Meliaazedarach	Canker, tick bedbug	1. Forest management measures；intensify tending management, conduct intermediate cuttings in time for sufficient ventilation and exposure to light. 2. Intensify quarantine efforts. 3. Chemical controls: spray 3 or 5 degree lime sulfur mixture or apply 10% alkaline water to scabs	Lime sulfur mixture spray, 10% alkaline water	chlorothalonil	U	217-588-1	GB 9551-1999(2004)
	Spider mite, scale insect	1. Forest management measures: build mixed forest, intensify tending efforts, and remove deadwoods. 2. Physical controls: apply lime sulfur mixture to the trunks. 3. Chemical controls: apply non-toxic chemical agents when appropriate.	Azadirachtin, nicotine	Dimethoate	III	200-480-3	GB 15582-1995(2004)
Catalpabungei	Meloidogyne incognita Chitwood Anthracnose	Forest management measures: improve water-mixed manure management and improve the plants' resistance to diseases.					
	Plautia，Basiprionota bisgnata, lymantria monacha，Trachea albidisca (Moore), Psilogramma menephron, Dictyoploca japonica Moore,	1. Forest management measures: improve site conditions, and clear infested leaves and fruits. 2. Mechanical and physical controls: remove clusters of eggs, insecticidal lamps. 3. Biological controls: Bt. 4. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity varies.		diflubenzuron	III	252-529-3	GB/T5009.147-2004
				Imidacloprid	III	428-040-8	GB 28126-2011
			Bt	Lorsban	U	220-864-4	

	omphisa plagialis, Cicadella viridis						
Fir	Anthracnose, leaf blight	1. Forest management measures: build mixed forests, improve site conditions and remove infested leaves and branches. 2. Intensify quarantine efforts. 3. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity varies.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)
				thiophanate-methyl	U	245-740-7	GB 24755-2009
				Triadimefon	III	256-103-8	HG 3293-2001
	Polychrosis cunninghamiacola Liu et Pai	1. Forest management measures: build mixed forests, intensify tending efforts and remove deadwoods. 2. Biological controls ; release parasitic wasps. 3. chemical controls: spray non-toxic chemical agents when appropriate.	Azadirachtin, nicotine Bt	Chlorbenzuron	III	252-529-3	GB/T 5009.135-2003
				Triflumuron	III	264-980-3	
				Fenoxycarb	U	276-696-7	
Masson pine	Sheath Blight 、Pine needle rust	1. Forest management measures: build mixed forests, improve site conditions and remove infested leaves and branches. 2. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity varies when appropriate.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)
				Triadimefon	III	256-103-8	HG 3293-2001
				thiophanate-methyl	U	245-740-7	GB 24755-2009
	Dendrolimus punctatus walker, Dasychira axutha Collenette, Bupalus Piniarius	1. Forest management measures: build mixed forests, and improve site conditions. 2. Mechanical and physical controls： sex attractant, insecticidal lamps. 3. Biological controls: Trichogramma, Bt, and Beauveria bassiana 4. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity varies for spraying.	Matrine Nicotine Bt SNPV	Chlorbenzuron	III	252-529-3	GB/T 5009.135-2003
				diflubenzuron	III	252-529-3	GB/T 5009.147-2003(2004)
				Triflumuron	III	264-980-3	
				Fenoxycarb	U	276-696-7	
Chinese red pine	Damping-off Pine needle rust	1. Forest management measures: build mixed forests, improve site conditions and remove infested leaves and branches. 2. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity varies when appropriate.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)
				Triadimefon	III	256-103-8	HG 3293-2001
				thiophanate-methyl	U	245-740-7	GB 24755-2009
	Dendrolimus punctatus	1. Forest management measures: build mixed forests, and improve site conditions. 2. Mechanical and physical controls： sex attractant,	Matrine, nicotine	Chlorbenzuron	III	252-529-3	GB/T 5009.135-2003
				diflube	III	252-529-3	GB/T 5009.147-2003(20

	Walker, Dasychira axutha Collenette, Bupalus Piniarius	insecticidal lamps. 3. Biological controls: Trichogramma, Bt, and Beauveria bassiana 4. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity varies for spraying.	Bt SNPV	nzuron			04)
				Triflumuron	III	264-980-3	
				Fenoxycarb	U	276-696-7	
Black locust	Helicobasidium mompa Tanaka	1. Forest management measures: build mixed forests, improve site conditions and remove infested leaves and branches. 2. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity varies when appropriate.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)
				Triadimefon	III	256-103-8	HG 3293-2001
				thiophanate-methyl	U	245-740-7	GB 24755-2009
	Napochema robiniae, Bruchophagus philorobiniae Liao	1. Forest management measures: build mixed forests, intensify tending efforts and remove deadwoods. 2. Biological controls ; release parasitic wasps. 3. chemical controls: spray non-toxic chemical agents when appropriate.	Matrine, nicotine	Chlorbenzuron	III	252-529-3	GB/T 5009.135-2003
				Triflumuron	III	264-980-3	
				Fenoxycarb	U	276-696-7	
Walnut	Brown blotch, Anthracnose, shoot blight, canker.	Select and breed disease-resistant varieties, intensify management efforts, apply organic fertilizers and improve the tree vigor and resistance to diseases. Forest management measures: remove infested leaves, fruits and branches, deadwoods and scrape off barks for centralized deep bury or burning. Intensify quarantine efforts. Chemical controls: use of low-toxicity, efficient and low-residual-toxicity varieties.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)
				thiophanate-methyl	U	245-740-7	GB 24755-2009
				Triadimefon	III	256-103-8	HG 3293-2001
	Atrijuglans hetauhei, Agrilus lewisiellus Kere, Eucleidae	1. Forest management measures: improve site conditions and remove infested leaves and branches. 2. Mechanical and physical controls: remove clusters of eggs, use of insecticidal lamps. 3. Intensify quarantine efforts. 3. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity varies.	Matrine, Azadirachtin, nicotine Bt	Chlorbenzuron	III	252-529-3	GB/T 5009.135-2003
				Triflumuron	III	264-980-3	
				Fenoxycarb	U	276-696-7	
				diflubenzuron	III	252-529-3	GB/T 5009.147-2003(2004)
Pistacia chinensis	Damping-off	1. Forest management measures: select right nursery sites, sufficiently ferment organic fertilizers before		Carbofuran	III	216-353-0	
				dexon	III	205-419-4	HG 2317-1992(2009)

Bunge		application, especially manure; seed treatment and soil disinfection. 2. Chemical controls: use of low-toxicity, efficient, low-residual-toxicity germicides when appropriate.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)
	Geometridae, chalcid fly	1. Forest management measures: build mixed forests, intensify tending efforts, remove deadwoods, harvest seeds to the maximum extent to prevent sources of overwintering insects. 2. Biological controls: release trichogramma or raise chicken in forests.		Phoxim	Ⅲ	238-887-3	GB 9556-2008
			Matrine, nicotine	DDVP	Ⅲ	200-547-7	GB 2549-2003(2004)

List of agrochemicals used in Guangxi

Table 9-2

Tree species	Pest and disease	Controls	Bio-pesticides	recommended chemical pesticide	Pesticide classification（WHO）	EC number	Chinese national/industry standard
Betula alnoides	Gummosis	Physical controls: avoid damaging the balks. In case of any damage to balks, apply wax or Vaseline to the woulds.					
	Platypodidae, scarab, moth.	1. Physical controls: use of insecticidal lamps 2. Chemical controls： spray pesticides.		omethoate	Ⅲ	200-480-3	GB 15582-1995(2004)
Machilus pauhoi	Anthracnose	1. Forest management measures: build mixed forests, improve site conditions and remove deadwoods. 2. Intensify quarantine efforts. 3. Chemical controls: use of low-toxicity, efficient and low-residual-toxicity varieties.		Zineb		235-180-1	HG 3289-2000
	Leaf roller	1. Physical controls: remove insect webs and kill adult insects using black light lamps. 2. Forest management measures: intensify tending and management, cultivate strong seedlings, provide reasonable dense planting and prune branches in time.		DDVP	Ⅲ	200-547-7	GB 2549-2003(2004)

		3. Chemical controls: spray pesticides.					
Taiwania flousiana Gaussen（rarely-seen pest）	Blight	1. Forest management measures: plant trees on half shady slopes and shady slopes, build mixed forests, preserve certain vegetation at the time of tending and reduce sunburn. 2. Chemical controls: use of low-toxicity, effective and low-residual-toxicity varieties.		Carbendazim	U	234-232-0	GB 10501-2000
Toona sinensis	Gummosis, leaf rust, Powdery mildew, blight, Helicobasidium mompa, damping-off	1. Physical controls: intensify seedling quarantine efforts, remove infested branches and leaves.		thiophanate-methyl	U	245-740-7	GB 24755-2009
		2. Forest management measures: intensify tending management efforts, prune branches and leaves in time and apply fertilizer reasonably.		omethoate	Ⅲ	200-480-3	GB 15582-1995(2004)
		3. Chemical controls: spray pesticides.		Triadimefon	Ⅲ	256-103-8	HG 3293-2001
	Lycorma delicatula, toon borer moth, 、Batocera horsfieldi, Cnidocampa flavescens Walker	1. Physical controls: remove overwintering cocoons, protect such enemies as Erytomamonemae Ruschka, Trichogramma, braconid and ichneumon fly. Kill adult insects using black light lamps. 2. Forest management measures: intensify tending management, cultivate strong seedlings, reasonable dense planting, timely pruning, improve ventilation and exposure to sunlight, improve the immunity to diseases and reasonable application of fertilizers. 3. Chemical controls: spray pesticides.	Bt	Imidacloprid	Ⅲ	428-040-8	GB 28126-2011
Liriodendron chinensis	Leaf spot, Anthracnose	1. Forest management measures: intensify tending management, timely pruning, and reasonable application of fertilizers. 2. Chemical controls: spray pesticides.		Carbendazim	U	234-232-0	GB 10501-2000
	epidiaspis , leaf	1. Forest management measures: intensify tending and pruning efforts, clear infested branches and leaves.	Bt	omethoate	Ⅲ	200-480-3	GB 15582-1995(2004)

	roller, spider mite.	2. Chemical controls: use of low-toxicity, efficient and low-residual-toxicity varieties.					
Castanopsis hystrix	Leaf blight, root rot.	1. Physical controls: intensify seedling quarantine and remove infested branches and leaves. 2. Chemical controls: spray pesticides		Carbendazim	U	234-232-0	GB 10501-2000
	Curculio davidi Fairm(mainly damage fruits)、leaf roller, stick insects	1. Forest management measures: build mixed forests, tending, pruning and intermediate cuttings. 2. Chemical controls； use of low-toxicity, efficient and low-residual-toxicity varieties.	Bt、Beauveria bassiana	Phoxim emulsifiable concentrate	Ⅲ	238-887-8	GB 9557-2008
Taxus chinensis	leaf blight, taxus blight	1. Forest management measures: build mixed forests and clear affected plants. 2. Chemical controls； use of low-toxicity, efficient and low-residual-toxicity varieties.		Carbendazim	U	234-232-0	GB 10501-2000
	tetranychid mite, aphid, scale insect.	1. Forest management measure：intensify tending and pruning efforts, clear infested branches and leaves.		omethoate	Ⅲ	200-480-3	GB 15582-1995(2004)
		2. Biological controls: protect natural enemies of pests (such as ladybug and 赤小蜂)		DDVP	Ⅲ	200-547-7	GB 2549-2003(2004)
		3. Chemical controls: use of low-toxicity, efficient and low-residual-toxicity varieties.		**deltamethrin**	Ⅲ	258-256-5	GB 28131-2011
Mytilaria laosensis	Angular leaf spot, brown blotch, Anthracnose	1. Forest management measures: build mixed forests and clear infested branches and leaves.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)
		2. Chemical controls: use of low-toxicity, efficient and low-residual-toxicity varieties.		thiophanate-methyl	U	245-740-7	GB 24755-2009
	Mole cricket, cutworm, giant cricket.	1. Forest management measures: deep excavation, soil preparation, tending and clearing of infested plants.		DDVP	Ⅲ	200-547-7	GB 2549-2003(2004)
		2. Chemical controls: use of low-toxicity, efficient and low-residual-toxicity varieties.		omethoate	Ⅲ	200-480-3	GB 15582-1995(2004)
Cinnamomum hupehanum	Powdery mildew, mainly occurring on young seedlings.	1. Forest management measures: thinning for sufficient ventilation, ensure environmental sanitation and timely clearing of infested plants. 2. Chemical controls: spray lime sulfur mixture	Spray 3 or 5 degree lime sulfur mixgure.	Carbendazim	U	234-232-0	GB 10501-2000

	Ceroplastes rubens Maskell, mite, Psychidae, Limacodidae, Orthagaachatina Butler, Mesoneura rufonota Rohwer	1. Forest management measures: remove infested branches and clear overwintering-generation female worms.		omethoate	Ⅲ	200-480-3	GB 15582-1995(2004)
		2. Chemical controls: Use of low-toxicity, efficient and low-residual-toxicity varieties.		DDVP	Ⅲ	200-547-7	GB 2549-2003(2004)
Michelia maccIurei	Root rot, stem rot, Cephaleuros virescens	1. Forest management measures: build mixed forests, timely tending and timely drainage during rainy season.		Carbendazim	U	234-232-0	GB 10501-2000
		2. Chemical controls： spray germicides.					
	Aphid, cricket, long-horned beetle, leaf miner.	1. Forest management measures: improve site conditions and clear infested plants.		DDVP	Ⅲ	200-547-7	GB 2549-2003(2004)
		2. Mechanical and physical controls: remove clusters of eggs and use insecticidal lamps.		Omethoate	Ⅲ	200-480-3	GB 15582-1995(2004)
		3. Chemical controls: Use of low-toxicity, efficient and low-residual-toxicity varieties.					—
Fir	Anthracnose, leaf blight	1. Forest management measures: build mixed forests, improve site conditions and clear infested branches and leaves.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)
		2. Intensify quarantine efforts.		thiophanate-methyl	U	245-740-7	GB 24755-2009
		3. Chemical controls: Use of low-toxicity, efficient and low-residual-toxicity varieties.		Triadimefon	Ⅲ	256-103-8	HG 3293-2001
	Polychrosis cunninghamiacola Liu et Pai, Semanotus bifasciatus	1. Forest management measures； build mixed forests, intensify tending efforts and remove deadwoods.	Azadirachtin,	Chlorbenzuron	Ⅲ	252-529-3	GB/T 5009.135-2003
		2. Biological controls: release parasitic wasps.	Nicotine	Triflumuron	Ⅲ	264-980-3	
		3. Chemical controls: spray non-toxic chemical agents when appropriate.	Bt	Fenoxycarb	U	276-696-7	
Masson pine	damping-off, pine needle rust	1. Forest management measures: build mixed forests, improve site conditions and clear infested branches and leaves.		chlorothalonil	U	217-588-1	GB 9551-1999(2004)

		2. Chemical controls: Use of low-toxicity, efficient and low-residual-toxicity germicides.		Triadimefon	Ⅲ	256-103-8	HG 3293-2001
				thiophanate-methyl	U	245-740-7	GB 24755-2009
	Dendrolimus punctatus walker, Dasychira axutha Collenette, Monochamus alternatus	2. Forest management measures: build mixed forests and improve site conditions.	Matrine	Chlorbenzuron	Ⅲ	252-529-3	GB/T 5009.135-2003
		2. Mechanical and physical controls: sex attractants, insecticidal lamps.	Nicotine	Diflubenzuron	Ⅲ	252-529-3	GB/T 5009.147-2003(2004)
		3. Biological controls: Trichogramma, Bt, and Beauveria bassiana	Bt	Triflumuron	Ⅲ	264-980-3	
		4. Chemical controls: spray low-toxicity, efficient and low-residual-toxicity pesticides.	SNPV	Fenoxycarb	U	276-696-7	

List of agrochemicals used in Hainan

Table 9-3

Tree species	**Pest and disease**	**Controls**	**Bio-pesticides**	**recommended chemical pesticide**	**Pesticide classification（WHO）**	**EC number**	**Chinese national/industry standard**
Rosewood	Anthracnose , tarspot	1. Forest management measure: select and plant high-quality seedlings, intensify tending management efforts for greater immunity against diseases; reasonable dense planting, timely intermediate cutting, maintenance of ventilation and exposure to sunlight; 2. Chemical controls: spray mancozeb or thiophanate-methyl two or three times.	spray mancozeb or thiophanate-methyl two or three times	mancozeb	**U U**	8018-1-7	GB 20700-2006
				thiophanate-methyl	**U**	23564-05-8	GB 24755-2009
	Aristobia hispida Saunders	1. Forest management measures: plant right trees in right places for multi-species forestation,	Spray **trichlorfon and phoxim**	**Trichlorfon**	**Ⅲ Ⅲ Ⅲ**	52-68-6	GB 334-2001

		and plant luring tree species. 2. Physical controls: shake the trees to kill falling aristobia hispida saunders; 3. Chemical controls: spray **trichlorfon and phoxim solution at a ratio of 300-400:1 or inject it into wormholes before sealing with clay.**	**solution at a ratio of 300-400:1 or inject it into wormholes before sealing with clay.**	phoxim	Ⅲ	238-887-3	GB 9556-2008
Chinese eagle wood	Anthracnose	1. Forest management measure: select and plant high-quality seedlings, intensify tending management efforts for greater immunity against diseases; reasonable dense planting, timely intermediate cutting, maintenance of ventilation and exposure to sunlight. 2. Chemical controls: spray 80% thiram (600 or 700:1) or 75% chlorothalonil (400 or 600: 1) two or three times.	Spray 80% thiram (600 or 700:1) or 75% chlorothalonil (400 or 600: 1) two or three times.	thiram	**U** **U** Ⅲ	3586-60-5	
				Chlorothalonil	**U**	217-588-1	GB 9551-1999(2004)
	Leaf roller	1. Forest management measures: plant right trees in right places for multi-species forestation, and plant luring tree species. 2. Chemical controls: spray **80% DDVP (800 or 1000:1) once every five or seven days for two or three consecutive times.**	Spray **80% DDVP (800 or 1000:1) once every five or seven days for two or three consecutive times.**	DDVP	Ⅲ Ⅲ Ⅲ	62-73-7	GB 2548-2008
Hopea hainanensis	Stem rot	1. Forest management measures: select and plant high-quality seedlings, intensify tending management efforts for greater immunity against diseases; reasonable dense planting, timely intermediate cutting, maintenance of ventilation and exposure to sunlight. Chemical controls: before sowing, dilute Carbendazim, thiophanate-methyl or dexon with fine earth at a ratio of 20 or 30 :1	before sowing, dilute Carbendazim, thiophanate-methyl or dexon with fine earth at a ratio of 20 or 30 :1 and scatter the resulting mixture evenly	Carbendazim	**U**	10605-21-7	
				thiophanate-methyl	**U**	23564-05-8	GB 24755-2009
				dexon	Ⅲ	140-56-7	HG 2317-1992(2009)

		and scatter the resulting mixture evenly into the surface soil at a rate of 5 or 10 g per square meter. Or alternatively, apply the resulting mixture in sowing grooves.	into the surface soil at a rate of 5 or 10 g per square meter. Or alternatively, apply the resulting mixture in sowing grooves.				
	Aristobia hispida Saunders	1. Forest management measures: plant right trees in right places for multi-species forestation, and plant luring tree species. 2. Physical controls: shake the trees to kill falling aristobia hispida saunders; 3. Chemical controls: spray **trichlorfon and phoxim solution at a ratio of 300-400:1 or inject it into wormholes before sealing with clay.**	Spray **trichlorfon and phoxim solution at a ratio of 300-400:1 or inject it into wormholes before sealing with clay.**	**Trichlorfon**	**Ⅲ Ⅲ Ⅲ**	52-68-6	GB 334-2001
				phoxim	**Ⅲ**	238-887-3	GB 9556-2008
Jackfruit	Anthracnose , fruit rot	1. Forest management measures: select and plant high-quality seedlings, intensify tending management efforts for greater immunity against diseases; reasonable dense planting, timely intermediate cutting, maintenance of ventilation and exposure to sunlight. 2. Chemical controls: alternately spray 1% boredeaux mixgture and 25% chlorothalonil solution (500 or 800:1)	alternately spray 1% boredeaux mixgture and 25% chlorothalonil solution (500 or 800:1)	Boredeaux Mixture	**U U Ⅲ**	8011-63-0	
				chlorothalonil	**U**	217-588-1	GB 9551-1999(2004)
	Aristobia hispida Saunders	1. Forest management measures: plant right trees in right places for multi-species forestation, and plant luring tree species. 2. Physical controls: shake the trees to kill falling aristobia hispida saunders; 3. Chemical controls:	Spray **trichlorfon and phoxim solution at a ratio of 300-400:1 or inject it into**	**Trichlorfon**	**Ⅲ Ⅲ Ⅲ**	52-68-6	GB 334-2001
				phoxim	**Ⅲ**	238-887-3	GB 9556-2008

		spray **trichlorfon and phoxim solution at a ratio of 300-400:1 or inject it into wormholes before sealing with clay.**	**wormholes before sealing with clay.**				
Acacia	Anthracnose , stem rot	1. Forest management measures: select and plant high-quality seedlings, intensify tending management efforts for greater immunity against diseases; reasonable dense planting, timely intermediate cutting, maintenance of ventilation and exposure to sunlight. 2. Chemical controls: alternately spray 1% boredeaux mixture and 25% chlorothalonil solution (500 or 800:1)	alternately spray 1% boredeaux mixture and 25% chlorothalonil solution (500 or 800:1)	Boredeaux Mixture	**U U Ⅲ**	8011-63-0	
				chlorothalonil	**U**	217-588-1	GB 9551-1999(2004)
	termite	1. Forest management measures: plant right trees in right places for multi-species forestation, and plant luring tree species. 2. Chemical controls: spray silafluofen along the termite path at an interval of 50 to 100 cm.	spray silafluofen along the termite path at an interval of 50 to 100 cm.	Silafluofen	**U**	7361-61-7	
Madhuca hainanensis	Stem rot	1. Forest management measures: select and plant high-quality seedlings, intensify tending management efforts for greater immunity against diseases; reasonable dense planting, timely intermediate cutting, maintenance of ventilation and exposure to sunlight. Chemical controls: before sowing, dilute Carbendazim, thiophanate-methyl or dexon with fine earth at a ratio of 20 or 30 :1 and scatter the resulting mixture evenly into the surface soil at a rate of 5 or 10 g per square meter. Or alternatively, apply the resulting mixture in sowing grooves.	before sowing, dilute Carbendazim, thiophanate-methyl or dexon with fine earth at a ratio of 20 or 30 :1 and scatter the resulting mixture evenly into the surface soil at a rate of 5 or 10 g per square meter. Or alternative	Carbendazim	**U**	10605-21-7	GB 10501-2000
				thiophanate-methyl	**U**	23564-05-8	GB 24755-2009
				dexon	**Ⅲ**	140-56-7	HG 2317-1992(2009)

			ly, apply the resulting mixture in sowing grooves.				
	Aristobia hispida Saunders	1. Forest management measures: plant right trees in right places for multi-species forestation, and plant luring tree species. 2. Physical controls: shake the trees to kill falling aristobia hispida saunders; 3. Chemical controls: spray **trichlorfon and phoxim solution at a ratio of 300-400:1 or inject it into wormholes before sealing with clay.**	Spray **trichlorfon and phoxim solution at a ratio of 300-400:1 or inject it into wormholes before sealing with clay.**	**Trichlorfon**	**Ⅲ Ⅲ Ⅲ**	52-68-6	GB 334-2001
				phoxim	**Ⅲ**	238-887-3	GB 9556-2008