

**Stora Enso (Guangxi) Forest, Pulp Paper
Company Ltd. 900000T/a of Pulp, 900000T/a of
Paper and Paper Board Project**

Raw Material Forest Base

**Environmental Impact
Assessment**

Chinese Research Academy of Environmental Sciences

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Beijing

Note; The document is a translation of the Chinese EIA report submitted for application for the environmental approval for the project according to Chinese regulations. The approval process took place in 2008.

Stora Enso has edited the translated report for the purpose of public disclosure. Certain financial information and technical details of the planned investment have been removed from the text.

ABBREVIATIONS

CIFOR	Center for International Forestry Research	国际林业研究中心
CRAES	Chinese Research Academy of Environmental Sciences	中国环境科学研究院
EIA	Environmental Impact Assessment	环境影响评估报告
GDOF	Guangxi Department of Finance	广西区财政厅
GDRC	Guangxi Development and Reform Commission	广西发改委
GFB	Guangxi Forestry Bureau	广西区林业局
MOF	Ministry of Finance	国家财政部
NDRC	National Development and Reform Commission	国家发改委
SEASIA	Stora Enso (Asia)	斯道拉恩索浆纸亚洲有限公司
SEGX	Stora Enso (Guangxi)	斯道拉恩索（广西）林浆纸有限公司
SEPA	State Environment Protection Administration	国家环保总局

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1 General

1.1 Background of Project

In order to implement the national strategy for forest, pulp and paper integrative development, fully exert the unique natural and resources advantages of Guangxi, cultivate forest, pulp and paper industry as the pillar industry of Guangxi and promote the social and economic sustainable development, Guangxi Development and Reform Commission has organized the compilation of *Master Development Planning for Forest, Pulp and Paper Integrative Industry in Guangxi during 2005-2015*. The CPC and the People's Government of Guangxi Zhuang Autonomous Region decide to utilize foreign investment to construct a large-scale forest, pulp and paper integrative project in the coastal areas of Guangxi, including Qinzhou and Beihai. For this, Guangxi has issued a number of supporting documents, preferential policy and stimulating mechanism to promote the development of forest, pulp and paper industry and encourage the integrative project using foreign investment.

Stora Enso (Guangxi) Forest, Pulp Paper Company Ltd. (SEGX) is a Sino-Foreign joint-venture enterprise comprising of Guangxi Gaofeng Forest, Pulp and Paper Industrial (Group) Company Ltd. (Gaofeng Group) and Stora Enso Asia Company Ltd. (SEASIA). The total registered capital of the company is RMB 8800 million. The company plans to construct a forest, pulp and paper integrative production base in Beihai city of Guangxi Zhuang Autonomous Region.

Parallel to the construction of the pulp mill, the joint-venture company intends to utilize a total area of 160,000 hm² (2.40 million mu) of land to construct the pulp material forest base. These places are distributed in the eight state-owned forest farms of Gaofeng Group and the 15 counties (cities and districts) in the southwest Guangxi under the municipality of 4 cities, respectively Beihai, Fangchenggang, Yulin and Chongzuo.

Construction of this project conforms to the national industrial policy and the national planning for forest, pulp and paper integrative development. It also conforms to the strategy of the West Development of the State and the local forestry development planning of Guangxi. It will be of great significance in promoting the construction of forest, pulp and paper integrative development of Guangxi, expediting the economic development, increasing job opportunities, adding to the local financial revenue and farmers' income and stimulating the development of relevant industries, showing remarkable social and economic benefits.

According to the regulations and rules as stipulated in *List of Classified Management for Environmental Protection for Construction Projects* issued by State Environment Protection Administration (SEPA), the pulp material forest base belongs to Category-I project, which requires compilation of *Environmental Impact Assessment (EIA)* and submit it to SEPA for approval.

In February 2007, SEGX entrusted Chinese Research Academy of Environmental Sciences (CRAES) to undertake the environmental impact assessment on the ecological environment of the project of 160,000hm² pulp forest base of the company.

As the basis for preparing this EIA, technical guidance of the code and comments of the environmental specialists were adopted. Other documentary materials and results were also referred, such as the forestry and ecological information collected from the project area, interpretation of the satellite pictures and data, engineering characteristics of the forest base, as well as the results of the ecological impact analysis of all links relating to land preparation, afforestation and construction of access roads etc. In addition, public participation was also designed and implemented. Accordingly, this *Subject Report of Environmental Impact Assessment of 160,000hm² Pulp Material Forest Base is prepared herein.*

1.2 Objectives of Assessment

According to the information provided by the *Application Report on Pulp Material Forest Base Project of 900000T/a of Pulp, 900000T/a of Paper and Paper Board Project* of SEGX, and on the basis of the engineering analysis and the present situation of the natural resources of the project area, the EIA analyzes scope, distribution, operational mode and whole process of the relevant activities of the pulp forest base, with the objectives of (i) investigating the eco-environmental conditions of the pulp forest base and the neighboring places, and the major existing environmental problems; (ii) predicting and evaluating the impacts on the eco-environment brought by the pulp forest base; (iii) recommending the measures for mitigating the negative environmental impacts brought by the construction of the pulp forest base; (iv) proposing the environment management plan (EMP) to minimize the negative impacts on the resources and environment of the project area and effectively protect the sensitive area and targets; and (v) ensuring the environmental reasonability and feasibility of the construction scheme of the pulp forest base.

1.3 Basis for Compilation

1.3.1 Relevant national and local laws and regulations

- (1) *Environment Protection Law of the People's Republic of China* (December 26, 1998)
- (2) *The Environment Impact Assessment Law of the People's Republic of China* (September 1, 2003)
- (3) *Land Administration Law of the People's Republic of China* (August 29, 1998).
- (4) *Law of the People's Republic of China on Water and Soil Conservation* (June 29, 1991)
- (5) *Forest Law of the People's Republic of China* (October 29, 1998)
- (6) *Flood Control Law of P.R. China* (January 1, 1998) ;
- (7) *Water Pollution Prevention Law of the People's Republic of China* , 1995;
- (8) *Air Pollution Prevention Law of the People's Republic of China* (, September 1, 2000) ;
- (9) *Law of the People's Republic of China on Prevention of Environmental Pollution Caused by Solid Waste*, (April 1, 1996);
- (10) *Law of the People's Republic of China on Prevention of Environment Noise*

Pollution (August 29, 1998);

(2) *Regulations on the Administration of Construction Project Environmental Protection*, Decree No.253 of the State Council (98);

(12) *Ordinance for Protection of Basic Farmland* (December 27, 1998);

(13) *Regulations of People's Republic of China on Protection of Natural Conservation Area* (December 1, 1994);

(14) *Regulations of People's Republic of China on Wild Plants Protection* (September 30, 1996);

(15) *Classified Management for Environmental Protection for Construction Projects* (July 19, 2002)

(16) *The National Programme for Ecological Environment Protection* (Issued by the State Council, November 26, 2000);

(17) *Circular of the State Council on Printing and Issuing National Plan of Eco-environment Conservation of China*, Ref. GF[1998]36;

(18) *Decisions of the State Council on Expediting Forestry Development* (June 5, 2003).

(23) *Special Planning for Whole Country Forest Paper Integrative Project during "Ten Five-Year Plan" and 2010*, (State Development and Reform Commission, January 2004);

(25) *Circular of Issuing and Distributing the Opinions of State Planning Commission, Ministry of Finance and State Forestry Administration Regarding Several Opinions on Expediting Construction of Raw Material Forest Base for Paper-Making Industry*, (Ref. JB[2001]141).

(26) *"Tenth Five-Year Plan" of Forestry Development Planning for 2015 of the State Forestry Administration*;

(27) *Master Engineering Plan of State Forestry Administration Regarding Construction of Fast-Growing Forest Base in Key Places*, December 2000;

(28) *Approval of the State Planning Commission for Engineering Planning for Construction of Fast-growing and High-Yield Timber Forest Base in Some Key Places* (Ref. JNJ[2002]1037).

(29) *Decisions of the State Council on Expediting Forestry Development* (June 2003).

(30) *Master Development Planning for Forest, Pulp and Paper Integrative Industry in Guangxi during 2005-2015*, (Guangxi Development and Reform Commission, November 2004);

(31) *Circular the People's Government of Guangxi Zhuang Autonomous Region on Approval and Transmission of the Opinions of Guangxi Planning Commission and Guangxi Forestry Bureau on Expediting the Development of Fast-growing and High-yield Forest in Guangxi*, Ref. GZF[2002]22.

(32) *Some Suggestions of the People's Government of Guangxi Zhuang Autonomous Region on Expediting the Construction of Coastal Forest, Pulp and Paper Raw Material*

Forest Base, Ref. GZF[2004]66.

(33) *The “Eleventh Five-Year Plan” of Forestry and Development Planning of Guangxi for 2020*, Guangxi Forestry Bureau, 2006;

(34) *The “Eleventh Five-Year Plan” of Fast-growing and High-Yield Forest and Development Planning for 2020*, Guangxi Forestry Bureau, 2006.

(35) *The “Eleventh Five-Year Plan” of Forestry Industry and Development Planning of Guangxi for 2020*, Guangxi Forestry Bureau, 2006.

(36) *Ecological Function Regionalization of Guangxi Zhuang Autonomous Region*, 2004

1.3.2 National Technical Specifications

Environment Impact Assessment Technology Guidelines (HJ/T2.1-2.3-93)

(2) *The Non-Pollution Ecological Impacts, the Environment Impact Assessment Technology Guidelines*, (HJ/T19-97)

(3) *The Acoustic Environment, the Environment Impact Assessment Technology Guidelines*, HJ/T2.4-1995

(4) *EIA of the Special Planning for Whole Country Forest Paper Integrative Project during “Ten Five-Year Plan” and 2010*, December 2004.

1.3.3 Direct References

(1) *Letter of Entrust for EIA Compilation for Pulp Material Forest Base Project of 900000T/a of Pulp, 900000T/a of Paper and Paper Board Project of SEGX*, SEGX;

(2) *Project Application Report on Pulp Material Forest Base Project of 900000T/a of Pulp, 900000T/a of Paper and Paper Board Project of SEGX*, Guangxi Forestry Survey and Design Institute, September 2006.

(3) *Environmental And Social Impact Analysis Stora Enso Plantation Project In Guangxi*, UNDP;

(4) *Outline of EIA for Pulp Material Forest Base Project of 900000T/a of Pulp, 900000T/a of Paper and Paper Board Project of SEGX*, Guangxi Environmental Protection Research Institute, October 2006.

(5) *Consultancy Reviews on EIA Outlines for Pulp Material Forest Base Project of 900000T/a of Pulp, 900000T/a of Paper and Paper Board Project of SEGX*, Ref. GHPGG[2006]81, Technical Engineering Evaluation Center of State Environment Administration, December 2006.

1.4 Bio-Diversity and Objectives of Eco-Environment Protection

The proposed pulp forest base is located in the 15 counties (cities and districts) that are under the jurisdiction of 4 cities, respectively Beihai, Fangchenggang, Yulin and Chongzuo. Based on the ecological characteristics of the topography, landform, climate and vegetation etc. of the project area, the objectives of eco-environment protection under this project shall be classified into the following four aspects in this EIA.

1.4.1 Avoid the disturbance to the rare or endangered animals and plants within the project area.

The evaluated area is located in the north tropical and south subtropical zones. The distribution of zonal vegetations is featured by the alternation of different vegetation types with the rise of latitude and decrease of temperature. Normally the rate of vegetation coverage is over 60%, and the forest covering rate is 42.02% (excluding shrubs). The biological diversity of Guangxi is only next to Yunnan and Sichuan provinces. It is estimated that wild vascular plants comprise of 8,354 species, inclusive of 48 species are gymnosperm and 7,406 species are angiosperm. So far, 916 species of terrestrial vertebrates have been recorded, of which 516 are birds, 166 mammals, 157 reptiles and 84 amphibians. Among these species, the species that are under the national and provincial level protection include *Alsophila spinulosa*, *C. nitidissima*, *Cathaya*, dugong, salamanders, white-headed black leaf monkey etc. Considering the wide range of the pulp forest base and its impacts, it is suggested to avoid endangering the living conditions of these species during site selection and project construction.

1.4.2 Prevent the damages done to the environmental sensitive areas such as natural reserve.

Within the project area, there are distributed a number of national and provincial level natural reserves and natural landscapes such as forest park. And thus, the distribution planning of the pulp forest base should strictly conform to the national laws and regulations on growing pulp forest and avoid disturbance to these sensitive areas.

1.4.3 Maintain the biological diversity of the forest land.

In this connection, the use of pulp forestland should be controlled. The pulp forest base covered by the plan of using fast-growing and high-yield forestland should be strictly controlled within the range of the commercial forestland. Occupation of the land proposed for natural forest, ecological forest and non-commercial forest etc. should be prohibited. In addition, it is required to prevent the regional single-species vegetation caused by the plantation of single tree species. Large-area plantation of conifer trees should be also avoided for the purpose of preventing the damages of forest disease and pest thereof and protecting the neighboring ecological and non-commercial forest.

1.4.4 Water and soil erosion control and surface source pollution.

The project area is situated in the south of Guangxi featured primarily by hills and plains and next to hill hills. The pulp forests are mostly planted on the gentle slopes. During the process of land preparation, tree tendering and felling, it is specially required to avoid new soil erosion. In addition, in tree tendering management like cultivation and fertilization, some elements such as N and P of the soil may enter the water body along with the runoff, and thus scientific and environmental measures should be adopted for the construction of the pulp forest base. Especially, the plantation gradient and the forest management measures should conform to the relevant requirements of the forestry departments of the State, and thus minimize the soil erosion and area-sources pollution.

1.5 Class of Assessment and Range of Assessment

1.5.1 Job class of assessment.

Based on the technical guidance for environmental assessment, and according to the

degree and range of environmental impacts that may be brought by the project of pulp forest base, as well as characteristics of the biological community, nature, regional environment and the indicators of water and soil, the class of the environmental impact assessment of this project shall belong to Class-I.

1.5.2 Range of assessment

The places that are directly under the impacts of the pulp forest base.

1.6 Contents and Focus of Assessment

1.6.1 Assessment Contents

The contents for assessment are determined as the follows based on the characteristics of the project and the identification of the environmental problems.

(1) According to the characteristics of the project, the field survey will focus on the investigation of existing ecological conditions and the environmental quality of the areas impacted by the project. The survey of the existing ecological conditions shall focus on collecting materials. Based on these, it is to evaluate the environmental quality.

(2) According to the ecological environment and the characteristics of the operation and management of the raw material forest base, it is to analyze the eco-environmental impacts that may be caused by plantation, management and cutting, especially the negative impacts in the aspects of soil erosion, site condition, as well as control of pest, disease and freeze injury etc.

(3) According to the quality control target for the impacted project area and the requirement of environmental management, it is to analyze and propose mitigating measures and schemes.

(4) The technical justification of the feasibility and economic indicators of the environmental measures.

(6) Design the framework plans for environmental management, monitoring and training.

(7) Organize public participation and survey.

1.6.2 Focus of Assessment

Focuses of assessment for this project are determined according to the engineering characteristics of the project and the environmental characteristics of the impacted areas as the follows.

The eco-environmental impacts during construction and operation periods shall be analyzed according to the patterns of plantation and operation of the base, and accordingly, preventive and mitigating measures shall be proposed.

1.7 Ecological Sensitive Objects

The major ecologically sensitive objects within the raw material forest base are the natural reserve, key soil erosion area, sand-desertified area and sources protection area for drinking water. According to the statistics, within the four project areas and the eight forestry farms, there are totally 17 natural reserves of national or provincial protection levels. Details are shown in Table 1.7-1 and Figure 1-1.

The key soil erosion areas within the project area are mainly distributed in the coastal

area of Beihai city and scattered in Yulin city, Xingye county, Bobai county and Beiliu county. The stony desertified areas are mainly distributed in Chongzuo city and Fushui county, while the sand desertified areas are in the coastal areas. Details are shown in Figure 3-9 and Figure 3-11.

Based on the list and distribution map of sources protection areas for drinking water of Guangxi, the analytical screening shows that, in the cities covered by the project area, there are totally 53 sources protection areas for urban drinking water. Details are shown in Table 1.7-2.

From this table, it can be found that the sources protection area for drinking water within the project area have three types, respectively lake-reservior type, river type and deep-ground extracting type.

The distribution of sources protection areas for urban drinking water of Guangxi is shown in Figure 1-2.

Table 1.7-1 Summary of Natural Reserves Covered by Project Area (September 2006)

SL.	Name of Natural Reserve	Location	Area (hm ²)	Major Protection Targets	Type	Level	Year Established	Administrative Dept.
1	Fangcheng Golden Camellia Nature Reserve	Fangcheng District, Fangchenggang City	9195	Golden camellia & its eco-system	Wild plants	National	1994.04	EPB
2	Hepu Dugong Natural Reserve	Hepu County, Beihai	35000	Dugong, Chinese white dolphin & the eco-system	Wild animals	National	1992.10	EPB
3	Nonggang Natural Reserve	Longzhou and Ningming counties, Chongzuo City	10080	Limestone monsoon rainforest eco-system, white-headed leaf-monkey, francois monkey etc.	Forest ecosystem	National	1980	Forestry
4	Damingshan Natural Reserve	Wuming, Mashan, Shanglin and Binyang counties of Nanning City	16994	Monsoon evergreenn broad-leaf forest, water-conservation forest and natural landscape.	Forest ecosystem	National	1982.06	Forestry
5	Siwan Mountain Natural Reserve	Shangsi and Fangcheng of Fangchenggang city	58277	Monsoon evergreenn broad-leaf forest, water-conservation forest	Forest ecosystem	National	1982.06	Forestry
6	Chongzuo White-headed Leaf Monkey Natural Reserve	Jiangzhou district & Fusui county of Chongzuo City	35148	White-headed leaf monkey, macaque, francois monkey	Wild animals	Provincial	1982.06	Forestry
7	West Damingshan Natural Reserve	Jiangzhou, Fusui and Daxin of	60100	Monsoon evergreenn broad-leaf forest,	Forest ecosystem	Provincial	1982.06	Forestry

SL.	Name of Natural Reserve	Location	Area (hm ²)	Major Protection Targets	Type	Level	Year Established	Administrative Dept.
		Chongzuo city, Long'an of Nanning city		water-conservation forest				
8	Shanglin Longshan Natural Reserve	Shanglin County, Nanning	10749	Monsoon evergreen broad-leaf forest, water-conservation forest	Forest ecosystem	Provincial	2003.11	Forestry
9	Weizhou Island Natural Reserve	Beihai city	2600	Various migratory birds and passing birds	Wild animals	Provincial	1982.06	Forestry
10	Nalin Natural Reserve	Bobai County, Yulin City	19900	Monsoon evergreen broad-leaf forest, water-conservation forest	Forest ecosystem	Provincial	1982.06	Forestry
11	Sanshiliunong Yilingjun Natural Reserve	Wuming county, Nanning city	12822	Limestone eco-system, rare plants and animals featured with cycas and forset musk deer, natural habitats.	Forest ecosystem	Provincial	2004.11	Forestry
12	Daqingshan Natural Reserve	Pingxiang City	4092.3	north tropical and south subtropical zones, evergreen broad-leaf forest eco-system	Forest ecosystem	Provincial	2001	Forestry
13	Zuojiang River Lamprotula & Mansuyi Natural Reserve	Jiangzhou district & Longzhou county of Chongzuo City	417.4	Freshwater mussels and habitats for lamprotula mansuyi	Wild animals	Provincial	2005.09	Aquatic
14	Geological Standard Profile of Devonian Period Beiliu	Beiliu, Yulin city	8	Geological profile of Devonian period	Geological relics	Provincial	1983	Land resources

SL.	Name of Natural Reserve	Location	Area (hm ²)	Major Protection Targets	Type	Level	Year Established	Administrative Dept.
	Damengmen							
15	Shankou mangrove natural reserve	Hepu County, Beihai	8000	Mangrove community ecosystem	Marine and marine eco-system	National	1990	Ocean
16	Beilunhe River Mouth Marine Natural Reserve	Dongxing, Fangchenggang City	3000	Mangrove community ecosystem	Marine and marine eco-system	National	2000.04	Ocean
17	Maoweihei mangrove natural reserve	Qinzhou city	2784	Typical island-group and rocky beach mangrove eco-system	Marine and marine eco-system	Provincial	2005.01	Forestry

* Combined in March 2005 from two former Fusui Bapen Wild Animal Protection Zone and Chongzuo Banli Wild Animal Protection Zone.

Table 1.7-2 Summary of Sources Protection Areas for Urban Drinking Water in Project Area

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
Nanning							27.90	96.89				21.00	514.51				
Nanning	Yongjiang river drinking water source area	H03450101000S1	Trunk streams of Zuojiang & Yujiang rivers	Yongjiang River	River	Large	15.40	6.02		1km upstream of Sanjin waterworks	300m downstream of Henan waterworks	21.00	12.00		Area other than the protected zone, from join of Zuojiang and Youjiang to 300m downstream of Henan waterworks		
Nanning	Tianbao reservoir water source area	H03450101000R1	Trunk streams of Zuojiang & Yujiang rivers	Kelijiang (Sanbaojiang)	Reservoir	Medium		0.98		Water area under 95.83m normal storage level (Pearl River datum)			6.44		Area other than protected zone, including water-catchment area below the mountain ridges around the reservoir.	Without resettlement isobath	
Nanning	Longtan reservoir water source area	H03450101000R2	Trunk streams of Zuojiang & Yujiang rivers	Longtanhe, tributary of Yongjiang river	Reservoir	Medium		1.73		Areas belong the reservoir resettlement line			14.84		Area other than protected zone, including water-catchment area below the mountain ridges around the reservoir.		
Nanning	Shicunhe reservoir water source area	H03450101000R3	Trunk streams of Zuojiang & Yujiang rivers	Shicunhe river	Reservoir	Small		1.20		Area below max. flood level of reservoir			/	/	/	N/A	
Nanning	Yongning Qingshuiquan spring water source area	H03450101000G1	Trunk streams of Zuojiang & Yujiang	Bachijiang	ground water	Medium		0.02		Area within 80m from the spring extracting point			22.00		From the underground water replenishing zone to the spring extracting point		

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area				Quasi-Protected Area					Remarks	
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream		Downstream
			rivers														
Nanning	Liangqing Nama spring water source area	H03450101000G2	Trunk streams of Zuojiang & Yujiang rivers	Bachijiang	ground water	Medium		0.02		Area within 80m from the spring extracting point		12.00		Area other than protected area, including the area from underground river replenishing zone to the spring extracting point.			
Nanning	Dawangtan reservoir reserved water source area	H03450101000R4	Trunk streams of Zuojiang & Yujiang rivers	Bachijiang	Reservoir	Large		41.60		Area below the 105m resettlement line		249.60		Area other than protected zone, including water-catchment area below the mountain ridges around the reservoir.			
Nanning	Fengtinghe Tunliu reserved water resoureces area	H03450101000R5	Trunk streams of Zuojiang & Yujiang rivers	Fengtinghe	Reservoir	Large		43.93		Area below resettlement line (Fengtinghe 17m, F=23.23km ² ; Tunliu 147.5m, F=20.7km ²)		148.22		Area other than protected zone, including water-catchment area below the mountain ridges around the reservoir.			
Wuming County	Wuming county Lingshui water source area	H03450122000G1	Youjiang	Wuminghe	ground water	Medium		0.10		Area within 500m in length and 200m in width, extracting point centered.		49.40		Area other than protected area, including the area from underground river replenishing zone to the spring extracting point.			
Shanglin County	Shanglin Beicanghe water reserouces area	H02450125000S1	Hongshuihe	Qingshuihe	River	Small	12.50	0.50		From origin located at south ridge of Longtoushan peak of Damingshan Mountain to Damingshan tea farm, totally 12.5km in length and 20-50m in width.		/	/	/	/	Single function zone, N/A	

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area				Quasi-Protected Area				Remarks		
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target		Protected Area	
										Upstream	Downstream					Upstream	Downstream
Shanglin County	Shanglin Mumian reservoir water source area	H02450125000R1	Hongshuihe	Qingshuihe	Reservoir	Small		0.80		Area below max. flood level of reservoir			/	/	/	/	N/A
Beihai city							3.20	184.49			3.00	341.34					
Beihai city	Hepu reservoir water source area	H09450501000R1	Coastal rivers in southern Guangxi	Xiaojiang, Wangshengjiang, Zalijiang	Reservoir	Large		98.80		Xiaojiang reservoir: 68km ² below 58.5m rettlement line (Pearl River Datum); Wangshengjiang reseroir: 24.5km ² below 49m resettlement line; Zakou reservoir: 1.3km ² below 16.3m normal high level, and areas below the both dyke top level of canal.			167.00		Area other than the protected zone, including the places from the boundary of the protected zone to the areas below the mountain ridge lines around Xiaojiang, Wangsheng and Zakou reservoirs.		Incl. Xiaojiang reservoir, Wangsheng reservoir, Zakou reservoir and water-delivering canal.
Beihai city	Niuweiling reservoir water source area	H09450501000R2	Coastal rivers in southern Guangxi	Sanhekoujiang	Reservoir	Medium		4.70	II	4.2km ² below 29.2m (Pearl River datum) of resettlement line; area below the both dyke top level of Niuweiling channel.			14.70		Area other than the protected zone, including those sourrounded by the mountain ridge lines of the reservoir		F=24.48km ²
Beihai city	Qingshui reservoir water source area	H09450521000R2	Coastal rivers in southern Guangxi	Qingshuijiang, tributary of Nanliujiang river	Reservoir	Medium		7.73		Area of 7.73km ² below 29.3m (Pearl River datum) of the resettlement line			26.56		Area other than the protected zone, including those sourrounded by the mountain ridge lines of the reservoir		F=52km ²
Beihai city	Longtan village ground water source area	H09450501000G1	Coastal rivers in southern Guangxi		ground water	Large		0.50		Water-extracting well	50m from well		/	/	/	/	Deep groud water, N/A

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
Beihai city	Hetang village ground water source area	H09450501000G2	Coastal rivers in southern Guangxi		ground water	Medium		0.30		Water-extracting well	50m from well		/	/	/	/	
Beihai city	Ground water source areas of Haicheng District, Gaoyang village and Houtang village	H09450501000G3	Coastal rivers in southern Guangxi		ground water	Small		0.20		Water-extracting well	50m from well		/	/	/	/	
Hepu county	Hepu Hongcaojiang reservoir water source area	H09450521000R1	Coastal rivers in southern Guangxi	Hongcaojiang	Reservoir	Large		70.80		Area of 69.8km ² below 28.5m (Pearl River datum) of the resettlement line; water delivery channel			131.68		Area other than the protected zone, including those sourrounded by the mountain ridge lines of the reservoir		F=400km ²
Hepu county	Water source area of Zongjiang section of Nanliujiang river of Hepu	H09450521000S1	Coastal rivers in southern Guangxi	Nanliujiang river	River	Small	3.20	0.96		2km upstream of water-taking point; dyke top	100m downstream of Zongjiang bridge gate	3.00	0.90		3km of upstream river course, including the area below both dyke top level.	2km upstream of water-taking point; dyke top	The water-taking point is 1.1km from Zongjiang bridge gate
Hepu county	Other ground water source areas of Hepu county	H09450521000G1	Coastal rivers in southern Guangxi		ground water	Small		0.50		Water-extracting well	50m from well		0.50		50m from well	100m outside the protected zone	

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
Fangchenggang city							28.00	62.22				16.00	174.09				
Fangchenggang city	Mutoutan water source area of Fangchenghe river	H09450603000S1	Coastal rivers in southern Guangxi	Fangchenghe	River	Medium	15.00	3.00		Area below P=10% flood, within 15km from Mutoutan river dam – upstream Tanxi.		8.00	1.60		River section of Fangchenghe river at 8km upstream of Tanxi, including the range of 500m inland area.		
Fangchenggang city	Xiao reservoir water source area	H09450603000R1	Coastal rivers in southern Guangxi	Fangchenghe	Reservoir	Large		6.27		Area below 183m resettlement line of Xiaofeng reservoir.			38.59		Area from the resettlement line upto the mountain ridge line around the reservoir.		F=54.5km ²
Fangchenggang city	Sanbo reservoir water source area	H09450602000R2	Coastal rivers in southern Guangxi	Shatangjiang, tributary of Fangchenghe river	Reservoir	Medium		2.20		Area below 18m resettlement line of Sanbo reservoir			5.68		Area from the reseroir's mountain ridge lines to the boundaries of protected zone		F=9.3km ²
Fangchenggang city	Guanshanliao reservoir water source area	H09450602000R3	Coastal rivers in southern Guangxi	Fangchenghe	Reservoir	Small		0.70		Area below max. flood level of reservoir			/	/	/	/	Small reseroir, N/A; F=3.029km ²
Shangsi County	Shangsi Naban reservoir water source area	H03450621000R1	Pearl river	Mingjiang	Reservoir	Large		40.70		Area below the resettlement ment line, 223.57m			96.00		Area from the reseroir's mountain ridge lines to the boundaries of protected zone		
Dongxing County	Dongxing Beilunhe water source area	H09450681000S1	Coastal rivers in southern Guangxi	Beilunhe river	River	Small	13.00	1.30		Jiangna village	Join entry of Baiheling reservoir	8.00	1.60		8km upstream river section of Beilunhe river, including the range of 500m inland area.		
Dongxing County	Dongxing Huangtangshui reservoir water	H09450681000R1	Coastal rivers in southern	Zupaijiang / Jiangpingjiang	Reservoir	Medium		8.05		Area below 30m resettlement line of Huangtangshui reservoir			30.63		Area from the reseroir's mountain ridge lines to the boundaries of		F=69.3km ²

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
	source area		Guangxi												protected zone		
Qinzhou city							39.00	76.63				38.00	123.86				
Qinzhou city	Qinzhou Qinjiang Youth Watergate water source area	H09450701000S1	Coastal rivers in southern Guangxi	Qinjiang	River	Medium	8.00	9.35		(i) Area below P=10% flood level along the 8km river section from Youth Watergate of Qinjiang river to Gaoying Ferry of Jiulong town; (ii) Area below both dyke top levels along the 7.5km water delivery channel from west head of trunk channel of Youth Watergate to the waterworks.	9.00	10.35		Area below the P=10% flood level along the 9km river section from Gaoying ferry of Jiulong town to Dingmeng ferry of Qinjiang river.	The length excludes the water-delivery channel. Only length of river course applicable.		
Qinzhou city	Dafengjiang river Dongchang water source area	H09450701000S2	Coastal rivers in southern Guangxi	Dafengjiang	River	Medium	16.00	18.40		Area below P=10% flood level along the 16km river section of Dafengjiang river, from the tide-resisting gate of Dongchang town to Pinggen bridge of Shabu town.	12.00	13.80		Area below P=10% flood level along the 12km of river section of Dafengjiang river from Pinggen bridge of Shabu town to Youbu power station.	under construction		
Qinzhou city	Qinzhou Jinwo reservoir water source area	H09450701000R1	Coastal rivers in southern Guangxi	Jinwojiang, small tributary independently into sea	Reservoir	Medium		10.72		Area below 20m resettlement line of reservoir		13.91		Area from the reseroir's mountain ridge lines to the boundaries of protected zone	F=24.63km ²		
Qinzhou city	Qinzhou Duiqinlong reservoir water source area	H09450701000R2	Coastal rivers in southern Guangxi	Small tributary independently into sea	Reservoir	Small		0.78		Area below max. flood level of reservoir					N/A		

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
Qinzhou city	Qinzhou Qinshan reservoir water source area	H09450701000R3	Coastal rivers in southern Guangxi	Small tributary independently into sea	Reservoir	Small		1.30		Area below max. flood level of reservoir							N/A
Qinzhou city	Maolingjiang river Milongwan water source area of Qinzhou	H09450701000S3	Coastal rivers in southern Guangxi	Maolingjiang	River	Medium	10.00	11.50		Area below P=10% flood level along the 10km river section of Maolingjiang river from Milongwan to Jiaqi.		10.00	11.50		Area below P=10% flood level along the 10km river section of Maolingjiang river from Jiaqi to Niupi power station.		
Qinzhou city	Qinzhou Dama'an reservoir water source area	H09450701000R4	Coastal rivers in southern Guangxi	Small tributary independently into sea	Reservoir	Medium		1.68		Area below 22.08m resettlement line of reservoir			6.32		Area from the reseroir's mountain ridge lines to the boundaries of protected zone		F=8km ²
Qinzhou city	Shapinghe drinking water source area of Yujiang water-diversion system of Qinzhou	H09450721000S4	Trunk streams of Zuojiang & Yujiang rivers	Shapinghe, tributary of Xijin reservoir area	Reservoir	Large		6.60		Area below P=10% flood level along the 6km of river section of Shapinghe river, within the range of 3000m both to the upstream and downstream of water-releasing tower of the water-diversion system at Qishi village of Shaping town.			6.60		Area below the P=10% flood level, for a section of 3km of Shapinghe river, located at the 3km-6km upstream of the water-releasing tower of the water-diversion system at Qishi village; Area within the range of 3km of river section, located at the 3km-6km downstream of water-releasing tower, or a range of 500m inland area. The water-taking point belongs to the		planned water source area

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
															backwater area of Xijin reservoir, and the water direction may be positive or negative in different seasons.		
Lingshan County	Qinjiang Dabujiang bridge water source area	H09450721000S1	Coastal rivers in southern Guangxi	Qinjiang	River	Small	5.00	5.50		Area below the P=10% flood level along the 5km river section from the pumping station of Lingshan Fertilizer factory to Dabujiang dam.		7.00	7.70		Area below P=10% flood level along the 7km river section from Dabujiang dam to Lingdong reservoir dam.		
Lingshan County	Lingdong reservoir water source area	H09450721000R1	Coastal rivers in southern Guangxi	Qinjiang	Reservoir	Large		10.80		Area below the 98m resettlement line of reservoir (Pearl River Datum)			53.68		Area from the reseroir's mountain ridge lines to the boundaries of protected zone		F=145km ²
Yulin city							6.20	12.20				6.00	72.39				
Yulin city	Yulin Suyan reservoir water source area	H09450900000R1	Coastal rivers in southern Guangxi	Dengjiang, sub-tributary of Qingwan tributary of Nanliujiang river	Reservoir	Medium		2.65		Area below 140.2m resettlement line of Suyan reservoir; area below 396m of resettlement line of Darongshan reservoir resettlement line; area below the max. flood level of Sanhe reservoir.			27.58		Area other than the protected zone, including places below the mountain ridge lines of Suyan and Darongshan reservoirs.		
Yulin city	Nanliujiang water source area	H09450900000S1	Coastal rivers in southern Guangxi	Nanliujiang river	River	Small	3.10	0.30		3km upstream of water-taking point	100km downstream of water-taking point	3.00	0.36		6km upstream of water-taking point	3km upstream of water-taking point	

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
Yulin city	Yulin Jiangkou reservoir water source area	H09450900000R2	Rivers in southern Guangxi	Pingwenjiang, tributary of Nanliujiang river	Reservoir	Medium		1.99		Area below the 115m resettlement line.			17.01		Area other than the protected zone, including places below the mountain ridge lines of reservoir.		F=36km ²
Luchuan County	Luchuan Fenghuangtian reservoir water source area	H09450922000R1	Coastal rivers in southern Guangxi	Shahuhe	Reservoir	Small		0.31		Area below max. flood level of reservoir							N/A
Luchuan County	Luchuan Sanhe reservoir water source area	H09450922000R2	Coastal rivers in southern Guangxi	Shahuhe	Reservoir	Small		0.32		Area below max. flood level of reservoir							
Luchuan County	Luchuan Shichan reservoir water source area	H09450922000R3	Coastal rivers in southern Guangxi	Xilihe, tributary of Jiuzhoujiang river	Reservoir	Small		0.14		Area below max. flood level of reservoir							
Bobai County	Bobai Chongsu reservoir water source area	H09450923000R1	Coastal rivers in southern Guangxi	Luzhujiang, tributary of Nanliujiang river	Reservoir	Medium		5.38		Area below the 123.5 m resettlement line.			26.90		Area other than the protected zone, including places below the mountain ridge lines of reservoir.		F=174.8km ²
Xingye County	Xingye Fuyang reservoir water source area	H09450924000R1	Coastal rivers in southern Guangxi	Shibijiang	Reservoir	Small		0.15		Area below max. flood level of reservoir							N/A
Xingye County	Xingye Changhao reservoir water source area	H09450924000R2	Coastal rivers in southern Guangxi	Changhaojiang	Reservoir	Small		0.15		Area below max. flood level of reservoir							

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
Xingye County	Xingye Sanlian reservoir water source area	H09450924000R3	Coastal rivers in southern Guangxi	Liangchongjiang	Reservoir	Small		0.36		Area below max. flood level of reservoir							
Beiliu city	Beiliuhe river water source area	H04450981000S1	Qianxunjiang and Xijiang (after Wuzhou)	Beiliuhe	River	Small	3.10	0.45		3 km upstream of water-taking point	100 m downstream of water-taking point	3.00	0.54		6km upstream of water-taking point	3km upstream of water-taking point	
Chongzuo city							40.00	18.88				0.00	0.00				
Chongzuo city	Chongzuo Zuojiang Mupai village water source area	H03451400000S1	Trunk streams of Zuojiang & Yujiang rivers	Zuojiang	River	Small	20.00	10.00		Area at the range of 20km in length and 0.5km in width from dam of Zuojiang power station to Chongzuo hydrology station							
Fusui County	Zuojiang Dajiangkou water source area of Fushui county	H03451421000S1	Trunk streams of Zuojiang & Yujiang rivers	Zuojiang	River	Small	5.00	2.50		Area within the range of 5km in length and 0.5km in width, from Yunhe to Chaliu of Fushui county							Single function zone, N/A
Ningming county	Ningming Mingjiang water source area	H03451422000S1	Trunk streams of Zuojiang & Yujiang rivers	Mingjiang	River	Small	10.00	4.00		Area within the range of 10km in length and 0.4km in width from Dong'an to the county town							
Pingxiang City	Pingxiang Daxiang reservoir water source area	H03451481000R1	Trunk streams of Zuojiang & Yujiang rivers	Pingxianghe	Reservoir	Small		0.88		Area below max. flood level							N/A

City	Name of Water source area	SL. Of Water source area	Water System	River	Type ¹	Scale ²	Protected Area					Quasi-Protected Area					Remarks
							Length (km)	Area (km ²)	Quality Target	Protected Area		Length (km)	Area (km ²)	Quality Target	Protected Area		
										Upstream	Downstream				Upstream	Downstream	
Pingxiang City	Pingxiang Pingerhe drinking water source area	H03451481000S1	Trunk streams of Zuojiang & Yujiang rivers	Pingerhe	River	Small	5.00	1.50		Area within the range of 5km in length and 0.3km in width, from Pinger village to Tuolitun village of Youyi town							

Notes: The types of water source areas are described as river, reservoir, lake, ground water.

2. Scale: (i) The water-storage facilities are classified according to total storage capacity as: Large ≥ 100 million m^3 ; 100 million m^3 > Medium ≥ 10 million m^3 ; 10 million m^3 > Small ≥ 0.1 million m^3 ; Pond dam < 0.1 million m^3 , which excluding fish pond, lotus-root pond and the low-land for non-irrigation purpose. (ii) The water-delivering, water-pumping and water-diverting facilities are classified according to the construction scale as: Large $\geq 30m^3/s$, $30m^3/s$ > Medium $\geq 10m^3/s$, small < $10m^3/s$. (iii) Ground water facilities are classified as: Large ≥ 50000 t/d, 50000 t/d > Medium ≥ 10000 t/d, small < 10000 t/d.

2 Engineering Analysis of the Raw Material Forest Base

2.1 Profile of Raw Material Forest Base

Name of Project: Construction Project of Pulp Forest Base of 160,000hm² for 900000T/a of Pulp, 900000T/a of Paper and Paperboard, Stora Enso (Guangxi) Forest, Pulp Paper Company Ltd.

Total Construction Scale: 160,000hm² of raw material forest base by 2011 (2.4 million mu).

Distribution of Pulp Forest Base: Total 160,000 hm² (2.40 million mu) of land distributed in the eight state-owned forest farms of Gaofeng Group and the 15 counties (cities and districts) in the southwest Guangxi under the jurisdiction of 4 cities, respectively Beihai, Fangchenggang, Yulin and Chongzuo. The distribution of the base is shown in the Figure 2-1.

Design Cutting Rotation: 6-7 years

Output Rate: 82.86% for six-year eucalyptus; 83.99% for seven-year eucalyptus; 75% for acacia.

Construction Period: 6 years for the pulp forest base, i.e. 2006 – 2011. The plantation will be completed during 2006-2009, then continuous nourishing for 3 years, and cutting will be conducted in the 6th year after nursing.

Project Investment: [removed]

2.2 Land Selection for Pulp Material Forest

2.2.1 Principle of forest land selection

(1) Strictly follow the principle for classified and categorized operation of forest. This is to distribute the base in the commercial forest land approved by the local government based on the achievements in classified forest operation approved by all counties (cities and districts). And the forest base cannot be overlapped with sensitive area, such as natural protection area or public benefit forest area.

(2) Overlapping with ecological sensitive areas shall not be allowed, such as natural reserve and non-commercial forest etc.

(3) The afforesting land within the range of 50m and 20m from both banks respectively for the trunk river and tributary Rivers (incl. Nanlijiang river, Beilijiang river, Zuojiang river and Maolingjiang river) cannot be included into the forest base.

(4) All the land proposed for afforestation shall be located in commercial forestland of gentle slope and without soil erosion.

(5) The boundaries are clear, without disputes and interference in land entitlements. The formalities for leasing forestland are valid and complete.

(6) The forestland must have convenient transportation and relatively concentrated in continuous patch.

(7) Before commencing afforestation, it is required to sign leasing agreement or

cooperation contract, handle necessary formalities regarding to forest management. Especially for the improvement of low-yield forest, no afforestation will be done without the approval from the administrative department.

2.2.2 Site conditions of the project forestland.

Among the forestland in the project area, there are 953954.4hm² of commercial forestland, accounting for 64.5%. Among the commercial forestland, in terms of the grading of site quality, they are: Class-I site quality 218190.0hm², accounting for 22.87% ; Class-II quality 554764.7hm², accounting for 58.16% ; Class-III quality, 180999.7hm², accounting 18.97%. Details are shown in Table 2.2 –1.

Table 2.2-1 Classification of Site Quality of Forestland in Project Area

Types	Group of Sites	Type of Sites		Natural Characteristics			Suitable Tree Species
		Name	Code	Landform & Small Climate	Soil Characteristics	Vegetation Characteristics	
Low hill	Magmatic rock, Sandshale, Mud shale and siliceous rock.	Down slope, medium humus, thick soil.	-1	Down slope of low hill, valley land. Wind avoiding. Cool and humid.	Latosolic red soil, with over 15cm-thickness surface soil and over 80cm earth thickness. High soil fertility. Below 15% of gravels.	Lespedeza bicolor, litsea cubeba, ouercus acutissima carruth, quercus fabri hance, rhus chinensis, evodia lepta, wendlandia scabra , S. octophylla, mallotus apelta, melastoma candidum, miscanthus floxidulus, heteropogon contrtus and pteridium aquilinum.	Masson pine, eucalyptus and tufty bamboo.
		Down slope, medium humus, thick soil.	-2		Latosolic red soil, with over 10cm-thickness surface soil and over 80cm earth thickness. Middle soil fertility. Below 30% of gravels.	Hairy chestnut, liquidamber formosana, loropetal, lespedeza bicolor, azalea, rhodomyrtus tomentosa bush, melastoma candidum, miscanthus floxidulus, dicranopteris linearis, cymbopogon tortilis, ischaemum indicum etc.	Masson pine etc.
		Up-slope, ridge thin humus, thin (medium) soil layer	-3	Upper slope of low hill and ridge. Wide open, strong sunshine and comparative dry.	Latosolic red soil and mountain red soil, with below 10cm-thickness surface soil and below 50cm earth thickness. Poor soil fertility. Over 30% of gravels.	Hairy chestnut, liquidamber formosana, loropetal, offorange, cratoxylon ligustrinum, azalea, eulalia speciosa (Debeaux) Kuntze, arundinella hirta, miscanthus floxidulus, dicranopteris linearis, ischaemum indicum, etc.	
Hill	Sandshale, Mud shale and siliceous rock.	Down slope, medium humus, thick soil.	-1	Down slope, small climate, humid.	Latosolic red soil, with over 15cm-thickness surface soil and over 80cm earth thickness. High soil fertility. Below 15% of gravels.	Blastus cochinchinensis lour, rhodomyrtus tomentosa bush, rhus chinensis, mallotus apelta, liquidamber formosana, baeckea fruticscens, evodia lepta, miscanthus floxidulus, dicranopteris linearis, heteropogon contrtus, Rubus alceaefolius, chiloe strawberry etc.	Masson pine, eucalyptus and tufty bamboo.

Types	Group of Sites	Type of Sites		Natural Characteristics			Suitable Tree Species
		Name	Code	Landform & Small Climate	Soil Characteristics	Vegetation Characteristics	
		Down slope, medium humus, thick soil.	-2	Middle and down slopes of hills. Relatively strong sunshine. Small climate and humid.	Latosolic red soil, with over 10cm-thickness surface soil and over 80cm earth thickness. Middle soil fertility. Below 30% of gravels.	Rhodomertus tomentosa bush, Baeckea fruticscens,, offorange, saussurea amara, helicteres angustifolia, dicranopteris linearis, <i>miscanthus floxidulus</i> , ischaemum indicum etc.	
		Up-slope, ridge thin humus, thin (medium) soil layer	-3	Upper slope of hill, ridge. Strong sunshine, comparatively dry.	Latosolic red soil, with below 10cm-thickness surface soil and below 50cm earth thickness. Over 30% of gravels.	Rhodomertus tomentosa bush, Baeckea fruticscens,, offorange, saussurea amara, helicteres angustifolia, dicranopteris linearis, <i>miscanthus floxidulus</i> , ischaemum indicum etc.	
							Pinus massoniana
Plain, tableland	Quaternary red earth, mud rock, sandshale, granite.	Medium humus; thick soil.	-1	Full slope of low hill and tableland; strong sunshine.	Latosolic red soil, lateritic soil. With over 10cm-thickness surface soil and over 80cm earth thickness. High soil fertility. Below 15% of gravels.	Mallotus apelta, melastoma candidium, Evodia lepta, geum aleppicum jacq, cratoxylon ligustrinum, rhodomertus tomentosa bush, lantana camara, eragrostis pilosa, heteropogon contrtus, ischaemum indicum, dicranopteris linearis, eriachne etc.	Eucalyptus, tufty bamboo.
		Thin humus, middle (thick) soil thickness	-2	Full slope of low hill and tableland; strong sunshine. Comparative drought.	Latosolic red soil, lateritic soil. With below 10cm-thickness surface soil and below 50cm earth thickness. Medium soil fertility. Below 30% of gravels.	Rhodomertus tomentosa bush, melastoma candidium, clerodendron cyrtophyllus, Helicteres angustifolia, eragrostis pilosa, pteris vittata Linn, eriachne, arundinella hirta, heteropogon contrtus, eicranopteris linearis, cymbopogon tortilis etc.	

Types	Group of Sites	Type of Sites		Natural Characteristics			Suitable Tree Species
		Name	Code	Landform & Small Climate	Soil Characteristics	Vegetation Characteristics	
		Thin humus, thin (medium) soil thickness.	-3	Full slope of low hill and tableland; strong sunshine. Comparative drought.	Latosolic red soil, lateritic soil. With below 5cm-thickness surface soil and below 50cm earth thickness. Over 30% of gravels.	Phyllanthus emblica, rhodomyrtus tomentosa bush, baeckea frutescens, helicteres angustifolia, evodia lepta, mallotus apelta, melastoma candidum, dicranopteris linearis, heteropogon, eriaachne, cymbopogon tortilis, ischaemum indicum , arundinella hirta etc.	

2.2.3 Options of Forest Resources

In the project area, among the total forestland of 1479.3 thousand hm², the commercial forest takes up 953.8 thousand hm², accounting for 64.5%; the ecological non-commercial forest takes up 525.3 thousand hm², accounting for 35.5%.

In terms of the requirements on land for afforestation, the site should be commercial forestland of below 500m elevation and with gentle slope and above-average site quality. As such, in the project area, the total commercial forestland of below 500m elevation and 30 gradient and above-average site quality that are suitable for growing quick-growth and high-yield eucalyptus 664960.5.4hm². After deducting economic forest, bamboo, shrubs in rock mountains, un-mature forest, natural regeneration forest and nursery, the actual area suitable for afforestation is 500338.4.3hm². Among which, the land suitable for growing fast-growing and high-yield eucalyptus is 321748.0hm². Details are shown Table 2.2-2.

The construction scale of the pulp forest base is 160000.0hm², which only accounts for 50.3% of the total land suitable for growing quick-growth and high-yield eucalyptus. Therefore, it can be seen that the forestlands suitable for growing quick-growth and high-yield eucalyptus are adequate for the construction of the pulp forest base in the project area.

Table 2.2-2 Statistics of Forestland Resources Suitable for Developing Quick-Growth and High-Yield Eucalyptus In Project Area During 2006-2010

Items	Total	Chongzuo city	Yulin city	Beihai city	Fangchenggang city	Gaofeng Group
Total	321748.0	29484.1	87978.2	37301.1	93539.3	73445.3
1. Cutting Blank	10659.5	1295.2	2047.2	1551.1	946.6	4819.2
2. Burned area	9380.3	161.1	4374.4	2095.7	936.8	1812.3
3. Prepared forest land	7759.3	1029.5	3702.4	135.4	1513.9	1378.1
4. Planned forest land	32511.6	4111.2	9055.7	1667.6	6952.7	10724.4
5. Open forest land	4466.7	361.8	16942	465.3	1680.4	265
6. Shrub land	45298.3	3444.9	35165	5.3	34820.2	3511.4
7. Low-yield forest land planned to be renovated during 2006-2010	155999.1	15099.3	50269.3	28097.0	38628.3	23905.2
8. Forest land planned for cutting as industrial raw materials during 2006-2010	55673.2	3981.1	13318.5	3283.5	8060.4	27029.7

2.2.4 Planning and Implementation of the Distribution of Pulp Forest Base

2.2.4.1 Site Planning

The pulp forest base of 160,000hm² of this project will select the site according to the regulations specified in *Some Suggestions of the People's Government of Guangxi Zhuang Autonomous Region on Expediting the Construction of Coastal Forest, Pulp and Paper Raw Material Forest Base* (Ref. GZF[2004]66). Considering the transporting

diameter, the 160,000hm² of pulp forest base shall be distributed in 15 counties (under the jurisdiction of Beihai, Fangchenggang, Yulin and Chongzuo cities) and 8 state-owned farms of Gaofeng Group. Details of planning distribution are shown in Table 2.2-3.

Table 2.2 –3 Distribution of Project Construction

City / Farm	Location (County, District, Forestry Farm)	Nos.
Beihai city	Hepu county, Tieshangang district, Yinhai district	3
Fangchenggang city	Gangkou district, Fangcheng district, Dongxing city, Shangsi county	4
Yulin city	Bobai county, Luchuan county, Beiliu county, Fumian district, Yuzhou district, Xingye county	6
Chongzuo city	Jiangzhou district, Fusui county	2
Gaofeng Group	Gaofeng, Qipo, Bobai, Liuwan, Qinlian, Dongmen, Paiyangshan and Liangfengjiang	8

2.2.4.2 Distribution of Forestland and Rationality Analysis

1. Distribution of forestland

According to the statistics of the available sub-compartments, the distribution of the pulp forestland is shown in Table 2.2-4.

At present, the total area of the selected sub-compartments of the project is 143287.5hm², accounting for 89.6% of the planned pulp forest area.

Among the determined forestlands, the sources are mainly from three aspects.

(i) Through cooperation with Gaofeng Group, Gaofeng Group supplies 97342.3hm² of collective forestland from its eight state-owned farms, accounting for 60.8% of the planned area of the pulp forest base. Among which, there are 87787.1hm² of pure or mixed forest, 6323hm² of for forestland without stands and of other 2506.3hm² forestlands.

(ii) SEGX acquires a total area of 5946.2hm² of forestland through leasing from Fangchenggang, Yulin, Qinzhou and some branch farms, accounting for 3.7% of the planned area of the pulp forest base. Among which, 2802.93hm² from Bobai and Bobai forest farm, 394.76hm² from Fangchenggang city, 1384.45hm² from Yulin city, 696.37hm² from Qinzhou city, and 667.69hm² from Liuwan Forest Farm (Guiping city). In this connection, there are 5787.12hm² of eucalyptus and eucalyptus mixed forest area.

(iii) Beihai Forestry Investment Development Co. Ltd. leases a total area of 39999hm² from Beihai city, accounting for 25% of the planned pulp forest base area, of which, 30370.7hm² from Hepu county, 5571.1hm² from Tieshangang District and 4057.2hm² from Yinhai District. The total area of existing eucalyptus forest is 25041.3hm².

Table 2.2-4 Distribution of Pulp Forest Base

Unit: hm² [removed]

2. Rationality analysis for selection of forestlands.

The selected forestlands are filtered according to the sub-compartment information and the environmental requirements (nature, gradient and the relative location the forestland with ecological sensitive targets etc.). The results are:

(1) The selected forestlands that fail to satisfy the requirements of timber commercial forest are:

Soil and water conservation forest, wind protection and sand bind forests in Tieshangang District of Beihai City, totally 190.0ha.;

Water source conservation forest, water and soil conservation forest, wind protection and sand-bind forest, farmland and grassland protection forest, special-purpose forest in Yinhai District, totally 668.4ha.;

Various kinds of protection forests, special-purpose forest, firewood and economic forest in Hepu county, totally 783.3ha.;

Agricultural land in Hepu county, Qinzhou city and Paiyangshan forest farm, respectively 2059ha, 694.32ha, 0.9ha.

Subtotal of the above: 4396ha.

(2) Forestland of over 35 gradient.

Among the proposed forestland in Beihai city and Hepu county, there are 195.7ha. of forestland with over 35 slope gradient.

(3) The forestlands that are near to or even interrelated with the ecological sensitive objects such as natural reserves are:

Yufei Branch Farm of Bobai Forest Farm is near to Nalin Natural Reserve. There are about 108.2ha. of land located within 1km from the boundary of the natural reserve, which cannot be used as the pulp forest base.

Xiangyang Branch Farm of Dongmen Forest Farm is interrelated with Chongzuo White-headed Leaf Monkey Protection Zone, totally 2000ha. that cannot be treated as the pulp forest base.

Wanpeng Branch Farm of Gaofeng Forest Farm is near to Longshan Natural Reserve. There are about 820.2 ha. of land located within 1km from the boundary of the natural reserve, which cannot be used as the pulp forest base.

Beishan Branch of Paiyangshan Forest Farm is near to Daqingshan Natural Reserve. There are about 20.1 ha. of land located within 1km from the boundary of the natural reserve, which cannot be used as the pulp forest base.

Subtotal of the above: 2860 ha.

After deducting 7452ha. of forestland as mentioned above, among the proposed forestland for the base, there are 135,800ha. of land conforming to the requirements (equivalent to 2.037 million mu), accounting for 84.9% of the planned area for plantation.

The project plans a total area of 160,000ha. forestland. So far, 84. 9% of which has been decided. With the efforts from all parties, the short portion will be obtained.

2.2.5 Rationality Analysis for Site Selection of Raw Material Forest Base

2.2.5.1 Compliance with Industrial Planning for Forest and Paper Integration

(1) Conformity analysis with *Engineering Planning of State Forestry Administration Regarding Construction of Fast-Growing Timbre Forest Base in Key Places*.

In 2001, the State Forestry Administration issued *Engineering Planning of State Forestry Administration Regarding Construction of Fast-Growing Timbre Forest Base in Key Places* to encourage the national development of fast-growing and high-yield forest, with a view to fundamentally solve the conflicts between supply and demand after implementing the project of protecting natural forest in China.

The planning of the base is made on the basis of: "According to the principle of forest classification, and on the basis of the construction of the existing fast-growing and high-yield timbre forest base, the priority should be given to places to the east of 400mm isopluvial line, especially to those to the east of 600mm isopluvial line, that have good natural and site conditions (over 14 site index, in principle). These places should be the tropical or sub-tropical areas that have flattish relief and good capacity against soil erosion and ecological impacts, such as Guangdong, Guangxi, Hainan, Fujian, north sub-tropical middle / lower Yangtze regions, temperate middle / lower Yellow regions (including Huaihe River and Haihe River), cool temperate Northeast and Inner Mongolia regions."

"Among these places, Guangdong, Guangxi, Hainan, Fujian regions have favorable natural conditions, with over 1000mm annual precipitation and over 16 annual average temperature, satisfying the requirements for growing fast-growing and high-yield tree species". "The coastal hills and tablelands of these places are especially suitable for developing pulp forest base that is mainly featured by planting eucalyptus and acacia. The low hills thereof are suitable for developing the forest base for the raw materials of paper pulp or artificial board (mainly planting mason pine, pinus caribaea and slash pine etc.), and developing the forest base for high-value large-size timbre forest base (mainly planting tectona grandis, swietenia macrophylla king, betula alnoides etc.)".

In the planned construction range thereof, 73 districts, counties and forest farms of Guangxi that are suitable for growing fast-growing and high-yield timbre forest base are listed. The pulp forest base of this project is located in the 15 counties (cities and districts) of 4 cities (Beihai, Fangchenggang, Yulin and Chongzuo) and 8 state-owned forest farms of Gaofeng Group in southern Guangxi. These proposed places of this project are basically within the said planned range, and thus the distribution of pulp forest base giving priority to eucalyptus conforms to the national planning for construction fast-growing and high-yield timber forest.

In the Guangdong, Guangxi, Hainan, Fujian regions, "the construction scope during 2001-2015 is 1.987 million hectares, accounting for 15% of the total scope", of which, the pulp forest base is "to supply the raw materials mainly for staple fiber and supplementary for long fiber bleached pulp paper. The tree species should be focus on eucalyptus (eucalyptus urophylla, eucalyptus camaldulensis, eucalyptus ABL12, eucalyptus Leizhou No.1), acacia (acacia mangium, acacia crassicaarpa, acacia coufusa), pinus caribaea and pinus massoniana etc.". The tree species of pulp forest base of this project is eucalyptus,

which is consistent with the planned fast-growing and high-yield trees for Guangdong, Guangxi, Hainan, Fujian regions.

(2) Conformity analysis with *Special Planning for Whole Country Forest Paper Integrative Project during “Tenth Five-Year Plan” and 2010*.

NDRC issued the *Special Planning for Whole Country Forest Paper Integrative Project during “Tenth Five-Year Plan” and 2010* (hereinafter called as the Special Planning) in 2003, providing the guidance in the distribution, scope, structure and environmental protection of forest pulp paper project throughout China.

In this Special Planning, the overall countrywide distribution of forest paper integrative projects are set in the places to the east of 500mm isohyet according to the conditions of climate, rainfall, opto-thermal resources, water resources, water environment, forestland resources, industrial foundation for paper making, transportation, energy, as well as the natural growth of forest etc..

The “Special Planning” gives priority to the southeast coastal areas, covering Guangdong, Guangxi, Hainan and Fujian. These places belong to the tropical and sub-tropical humid climates that have adequate heat resources, being as the regions of the richest rainfall and water resources in China. The pulp forest base of this project is located in the south of Guangxi, having the typical features of tropical and sub-tropical climates. The annual average precipitation is 1500mm, indicating rich water resources and large water environmental capacity. The water and heat conditions thereof can satisfy the requirements of development forest and paper integrative project.

“These regions are the key places of China for developing forest paper integrated project. At the same time of strengthening the existing large and medium size forest paper integrated project, it is proposed, in Guangdong, Guangxi, Hainan and Fujian, to construct 3-4 large-scale forest paper integrated project of or above 500,000T/a chemical wood pulp.”

This project plans to construct a base of 900,000T/a of pulp, 900,000T/a of paper and paperboard and a area of 160,000hm² eucalyptus pulp forest base. The proposed pulp forest base is located in the key places stipulated by the Special Planning. The construction scale and the selected tree species of the project conform to the requirements of the Special Planning for growing fast-growing and high-yield forest and the local water and heat conditions.

(3) Relationship with the industrial planning for forest paper integration of Guangxi.

As indicated in the *Circular of the People’s Government of Guangxi Zhuang Autonomous Region on Approval and Issuance of the Opinions of Guangxi Planning Commission and Guangxi Forestry Bureau on Expediting the Development of Fast-growing and High-yield Forest in Guangxi* issued by the GDRC, GDOF and GFB, “the eastern and southern parts of Guangxi will focus on developing industrial raw material timber forest featured by growing fast-growing eucalyptus, fast-growing acacia and improved pines”.

According to the *Master Development Planning for Forest, Pulp and Paper Integrative Industry in Guangxi during 2005-2015* issued by GDRC in 2004, during the “Eleventh

Five-Year Plan”, the planned additional plantation area will be 0.67 million hm² (0.1 million hm² of bamboo). By end of “Eleventh Five-Year Plan”, “there will be a total area of 2 million hm² of fast-growing and high-yield timber forest, of which, there will be 1 million hm² of paper pulp forest base (0.13 million of bamboo) , producing 5 million m³ of paper pulp timber and 3.20 million T of fresh bamboo each year. By the year of 2015, the planned area of fast-growing and high-yield forest will be 2.53 million hm², of which, there will be 1.33 million hm² of paper pulp forest base (0.23 million hm² of bamboo), producing 12 million m³ of paper pulp timber and 5.5 million T of fresh bamboo. ”

“The distribution of paper pulp forest base shall focus on the site selection of the project, reasonably make use of the lands returning from the farmlands and sugar-growing land. It is also to make the best use of the forestland resources and afforestation capacity of state-owned forest farms, and, within the reasonable range, it is to select the places that are comparative gentle and continuous as the base for growing pulp forest.” “In this connection, as for the the Sino-foreign joint-venture (cooperative) 600,000T/a. pulp project of Beihai, the distribution of pulp forest base thereof shall be centralized with Beihai city, distributing to: (i) Hepu county, Tieshangang district and Yin Hai district of Beihai city; (ii) Bobai county, Luchuan county, Beiliu city, Xingye county, Fumian district and Yuzhou district of Yulin city; (iii) Fangcheng district, Shangsi county, port district and Dongxing city of Fangchenggang city; (iv) Jiangzhou district and Fushui county of Chongzuo city.” “Within the planned range for pulp forest base of the project, there are 0.84 million hm² of land suitable for growing pulp forest, and thus the first-phase will plant 0.16 million hm² of fast-growing pulp forest.”

The pulp forest base of this project is within the planned range. The construction sites are located in the range of Beihai city, Yulin city, Fangchenggang city and Chongzuo city, conforming to the requirement of distribution. In addition, the proposed tree species is eucalyptus, conforming to the category of fast-growing pulp forest.

(4) Compliance with *Development Planning for Quick-growth and High-Yield Forest in the “Eleventh Five-Year Plan” and for 2020*.

The distributions of the four major raw forest bases stipulated in the *Development Planning for Quick-growth and High-Yield Forest in the “Eleventh Five-Year Plan” and for 2020* are shown in Table 2.2-5, while the regional distribution is shown in Figure 2-2.

Table 2.2-5 Distribution of Bases for Quick-Growth and High-Yield Forest of Guangxi in “Eleventh Five-Year Plan and by 2020

SL.	Name of Bases	Distribution Range	Nos. of Counties (Districts, Cities, Farms)	Key Components of Construction

1	Coastal Forest Pulp Paper Raw Material Forest Base	<p>Qinnan, Qinbei, Pubei, Lingshan, Hepu, Tieshangang, Yin Hai, Gangkou, Fangcheng, Shangsi, Dongxing, Yuzhou, Fumian, Beiliu, Xingye, Bobai, Luchuan, Rongxian, Gangnan, Gangbei, Qintang, Guiping, Pingnan, Long'an, Mashan, Binyang, Shanglin, Hengxian, Wuming, Yongning, Liangqing, Jiangnan, Xingning, Xixiangtang, Qinxu, Jiangzhou, Ningming, Fushui, Qinlian farm, Liuwan farm, Bobai farm, Dongmen farm, Paiyangshan farm, Qipo farm, Gaofeng farm, Nanning Liangfengjiang National Forest Park.</p>	46	Emphasis on growing short-rotation forest, such as eucalyptus and acacia.
2	Woodboard, Forest, Pulp and Paper Industrial Raw Material Forest Base in east Guangxi	<p>Cenxi, Tengxian, Cangwu, Mengshan, Babu, Zhaoping, Zhongshan, Fuchuan, Lipu, Pingle, Gongcheng, Yangsuo and Daguishan farm</p>	13	Emphasis on growing the short-rotation woods for fiberboard, pulp and paper, such as griffithii, mason pine and eucalyptus; giving due consideration to growing large-size timbre, such as mason pine and castanopsis hystrix etc.
3	Large-size Timbre Forest and woodboard, forest, paper and pulp industrial raw material forest base in west Guangxi	<p>Zuojiang, Qingxi, Debao, Napo, Pingguo, Tiandong, Tianyang, Tianlin, Lingyun, Leye, Longlin, Xiling, Dahua, Du'an, Bama, Donglan, Fengshan, Yizhou, Hechi, Nandan, Tian'e, Tiandeng, Daxin, Longzhou, Pingxiang and Yachang farm</p>	26	Emphasis on large-size timbre, such as mason pine, fir, betula alnoides, Zenia insignis Chun, toona sinensis roem etc.; giving due consideration to growing short-rotation industrial raw material forest, such as mason pine,

				eucalyptus and tufty bamboo etc.
4	Wood-bamboo pulp paper industrial raw material base in north and mid Guangxi	Yongfu, Lingui, Yanshan, Lingchuan, Guanyang, Xing'an, Quanzhou, Longsheng, Ziyuan, Rongshui, Rong'an, Sanjiang, Liujiang, Liucheng, Luzhai, Luocheng, Huangjiang, Xingbin, Heshan, Xincheng, Wuxuan, Xiangzhou, Jinxiu, and Weidu farm, Huangmian farm and Sanmengjiang farm.	26	Emphasis on growing pulp-paper raw material forest, such as tufty bamboo (hybrid bamboo, minor McClure, pervariabilis McClure etc.), phyllostachys pubescens, mason pine and eucalyptus; giving due consideration to growing large-size timbre, such as pine, fir, Betula alnoides, schima superba, liquidamber formosana, zenia insignis chun, toona sinensis roem etc.

Notes: The underlined districts and counties in the table are covered by the project area.

The above table and Figure 2-2 indicate that, all the forest bases in the districts and counties covered by the project area are within the planned coastal forest bases, and thus conforming to the distribution planning.

(5) Coordination with the *Planning Outline for Ecological Construction in Guangxi*.

The raw material forest base of this project also includes four cities, respectively Yulin, Beihai, Fangchenggang and Chongzuo, and 8 forestry farms of Gaofeng Group. These cities are respectively located in the hilly ecological area of southeast Guangxi, tableland ecological zone of south Guangxi and karst mountain ecological zone of southwest Guangxi that are specified in the *Planning Outline for Ecological Construction in Guangxi*. The outline states the characteristics and development orientation of the above three ecological zones as the follows:

(I) Hilly ecological zone in southeast Guangxi

1. Major characteristics

The leading ecological function of this zone is “water source protection, conservation

of water and soil, flood control and water storage". The existing major environmental problems are: (i) The area of natural forest is small and scattered, showing inferior forest quality, deteriorated ecological service function and reduced biological species; (ii) Mining of mineral and stone causes serious problems of ecological destruction and soil erosion; (iii) Pollution caused by urban domestic sewage, agricultural source pollutants and animal breeding etc. endangers the security of water source; (iv) Excessive ground water extraction in some places causes ground sinking; and (v) Flood occurs frequently.

2. Development orientation and key components for protection and construction

This ecological zone emphasizes the development of "high-efficiency modern agriculture and the complex agricultural, forestry and animal husbandry". The emphasis for ecological protection and construction will be: (i) Restore and increase the area of natural broad-leaf forest through "closing hill for afforestation" and improving the artificial forest, and thus to improve the forest function of water conservation. (ii) Construct the key ecological protection zones, such as Daguishan, Darongshan, Liuwandashan etc.. (iii) Strengthen the treatment of soil erosion in small basin and the ecological re-construction of the mining areas. (iv) Promote the standard and ecological agricultural production, thus to reduce the agricultural source pollution and attend to the pollution control of animal breeding. (vi) Expedite the biogas construction in rural area. (vii) Expedite the infrastructure construction in urban area and give special attention to the comprehensive treatment of Nanliujiang river. (viii) Enhance the protection and reasonable utilization of ground water, and thus further to implement the trans-basin water supplementation program and solve the problem of water deficiency in Yulin city.

3. Conformity between the forest base and ecological zone

Yulin city, Liuwan forestry farm and Bobai forestry farm involved by the forest base of this project belong to this ecological zone. Planting eucalyptus forest in the existing planned range for artificial forest conforms generally to the key development orientation of the ecological zone – "complex-type agriculture, forestry and animal husbandry". The forestland has avoided the natural forest and the key eco-functional protection zone. In addition, the afforesting methodology of the project will hardly cause soil and fertilizer erosion, and thus will not deteriorate the ecological problems. So, it conforms to the requirements of ecological protection and construction in this zone.

(II) Tableland ecological zone in south Guangxi

1. Major characteristics

The leading ecological functions of this zone are protection of water source, conservation of water and soil, wind-breaking and sand fixation, as well as protection of biological diversities. The existing major environmental problems are: (i) Relatively large area of artificial pure forest and inefficient system of various protection forests result in inferior ecological function and local land desertification, threatening the biological diversities. (ii) Excessive development of hilly areas cause serious soil erosion. (iii) Uncontrolled discharge of urban domestic and industrial pollutants seriously affect the river water quality such asf Yongjiang river and Qinjiang river. (iv) Excessive extraction of

ground water in some coastal areas lead to the back flow of sea water, causing coastal storm tides.

2. Development orientation and key components for protection and construction

This ecological zone emphasizes the development of featured agriculture and forestry such as “tropical and subtropical fruits, flowers, quick-growing and high-yield forest and economic forest etc.”. The key components for ecological protection and construction are: (i) Protect and restore the natural vegetation of the key ecological functional zones such as Shiwan Mountains, thus further to enhance its ecological service function. (ii) Strengthen the construction and management of the natural reserves and promote the construction of the system of coastal protection forests. (iii) Continue to implement the program of “sloping cropland conversion, closing hills for afforestation”, enhance the treatment of soil erosion and sand-decertified land, especially the treatment of soil erosion and pollution control round the large reservoirs. (iii) Develop the resources of coastal tidal flats and bays in a reasonable way; (iv) Strictly control the extraction of ground water in coastal area, expedite the construction of water-storing, water-diverting and water-supplying facilities, and thus to keep the balance of water resources in coastal area. (v) Strengthen the improvement of the medium and low-yield farmland, and promote the standard and ecological agricultural production. (vi) Expedite the construction of the environmental infrastructure of the urban and coastal industrial parks, make comprehensive treatment of the land-source pollution, and thus substantially reduce the volume of pollutants to sea. (vii) Expedite the pollution comprehensive treatment and control for the key rivers such as Yongjiang river and Qinjiang river. (viii) Strengthen the approach of preventing environmental risks of the coastal heavy and chemical industries, and thus to protect the marine environment.

3. Conformity between the forest base and ecological zone

Beihai city, Fangchenggang city, Gaofeng forestry farm, Liangfengjiang forestry farm, Qipo forestry farm and Qinlian forestry farm involved by the forest base of this project belong to the tableland ecological zone in south Guangxi. Such conforms to the key development orientation of growing “quick-growing and high-yield forest” of this zone. The selected forestlands have no involvement of the natural reserves and protection forests and have avoided the key areas of soil erosion, having no conflict with the ecological protection and key construction of this zone.

A general historical problem in this area is the large proportion of artificial pure forest. In the last 50's or 60's, some other tree species were also planted to resist wind and solidify sand, but these species seemed dying out or in bad condition. However, the eucalyptuses that were introduced later seemed in good condition under proper forest management measures such as fertilizing. This project will improve the existing artificial forest and will not deteriorate the existing problem of pure forest in this ecological zone.

(III) Karst mountain ecological zone in southwest Guangxi

1. Major characteristics

The leading ecological functions of this zone are water and soil conservation and

protection of biological diversities. The existing major environmental problems are: (i) The natural forests, especially the vegetation in rocky areas, have been damaged seriously, leading to local stone desertification. (ii) The habitats are scattered, and the invasion of exotic species like eupatorium odoratum is serious, endangering the biological diversities. (iii) Cultivation on steep slopes and uncontrolled mining in some places have caused serious ecological destruction and soil erosion. (iv) Drought occurs frequently.

2. Development orientation and key components for protection and construction

This ecological zone emphasizes the development of featured industries such as growing sugar cane, subtropical fruits, anti-season vegetables, flue-cured tobacco, quick-growing and high-yield forest, as well as herbivorous animals and livestock etc. The key components for ecological protection and construction are: (i) Establish the ecological protection zone in southwest Guangxi for conservation of water and soil in karst mountainous areas. (ii) Implement the program of “closing hills for afforestation”, and expedite the development of water source protection forest and water conservation forest. (iii) Continue to implement the comprehensive measures for treatment of stone desertification, such as “returning farmland to forest and grass”, comprehensive treatment of small basin and construction of ecological energy sources in rural areas etc. (iv) Strengthen the management of the natural reserves, construct the ecological corridor, protect the natural ecological system and important habitats, as well as control the invasion of exotic species. (v) Implement the soil fertilization project to upgrade the soil fertility and solve the drought problem through adopting engineering measures and water-saving technology. (vi) Restore and reconstruct the ecological environment in mining areas, as well as prevent and control the industrial and domestic pollution.

3. Conformity between the forest base and ecological zone

Chongzuo city and Dongmen forestry farm covered by the forest base are located in the karst mountainous areas of southwest Guangxi, belonging to the key development of “quick-growing and high-yield forest”. The EIA has proposed to cross out partial forestlands that are interrelated with the White-headed Leaf Monkey National Nature Reserve, the forestlands that are within the range of 1km and the forestlands on both sides of the rivers. Such will not involve the stone desertified areas, and thus conform to the key development strategy of this zone to “protect the natural ecological system and the key habitats”. At the same time, since eucalyptus has been introduced to Guangxi for many years, and such exists the impacts of invasion of exotic species.

Generally speaking, construction of this forest base conforms to the requirements of the outline, and it will not deteriorate the existing major ecological problems of this area if with proper afforestation measures.

2.2.5.2 Relativeness with Existing Neighboring Forest Paper Pulp Forest Base

At present, the existing major paper pulp forest base in the neighboring areas is the integration project of Sino-foreign Joint-venture Jingui Pulp & Paper Company Ltd..

In the *Some Suggestions of the People's Government of Guangxi Zhuang Autonomous Region on Expediting the Construction of Coastal Forest, Pulp and Paper Raw Material Forest Base*, in order to expedite the construction of pulp forest base and ensure the smooth implementation of the coastal forest, pulp and paper integration project, the provincial government of Guangxi made the following proposals: (i) Construction of pulp forest base should be combined with the construction of the coastal pulp mills; (ii) "Develop the forestland resources as led by the owner of the coastal pulp mills." (iii) According to the production scales proposed by the two project owners of the coastal large-scale pulp mills, a supporting pulp forest base shall be constructed, respectively 9 million mu for Qinzhou project and 5 million mu for Beihai project". (iv) "For orderly development of forestland resources, according to the distribution of the two pulp mills, the 38 counties (city, district) of Beihai, Qinzhou, Fangchenggang, Yulin, Guigang, Nanning and Chongzuo are divided into Qinzhou and Beihai two project areas, which are respectively corresponding to Qinzhou pulp mill and Beihai pulp mill." These proposals have defined the range of the pulp forest base for this project. As such, this project will have selectable forestland, without competing with other enterprise for land.

2.3 Pulp Forest Base Construction Project

2.3.1 Major Technical Economic Indicators.

The technical and economic indicators of the pulp forest base are shown in Table 2.3-1.

Table 2.3-1 Summary of Major Economic Indicators of Pulp Forest Base Project
[removed]

2.3.2 Construction Contents

(1) Regulate and protect the existing forest.

(2) During 2006-2011, afforest 123056.0hm² of raw material forest (incl. Afforestation by Forestry Company, entrusted growing and buying from social forest). All of them belong to eucalyptus, with the components of planting, nourishing, fertilizing, regulating and protecting.

(3) Construct and repair the forest access roads. Such includes constructing 940.0km and repairing 258.0km of access roads.

2.3.3 Construction Period and Schedule

From 2006 to 2009, it is to complete afforestation the tasks respectively of 26000.0hm², 38237.0hm², 32805.0hm² and 26014.0hm², then consecutively fostering for three years; to construct forest access roads respectively of 200.0km, 290.0km, 250.0km, 200.0km and 258.0km, which will be completed in 2006. Of which:

- Breeding seedlings and land preparing in winter of 2005;

- Starting afforestation in January 2006, and fostering and protection of trees, construction of access roads and repair of access roads will be conducted at the same time.

- Felling in 2009-20015, re-planting with new seedlings after felling.

The schedule is shown in Table 2.3-2.

Table 2.3-2 Project Implementation Schedule

SL.	Items	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	Breeding seedlings											
2	Land preparing and applying basal fertilizer											
3	Transplanting (hm ²)		26000	38237	32805	26014						
4	Purchasing social forest (m ²)		13955	19993	15481	3773						
Incl.	1-year forest		139	4716								
	2-year forest		8775	12177	11410	3773						
	3-year forest		5041	3100	4071							
5	Earth loosening, fostering and top dressing											
6	Nursery											
7	Forest road construction (km)		200	290	250	200						

8	Forest road repair (kkm)		258									
9	Regulating and protection of existing forest (hm ²)	36944										
10	Felling and regeneration					23082	27678	26295	25327	25126	23300	9193

2.3.4 Technical Scheme for Seedling Production

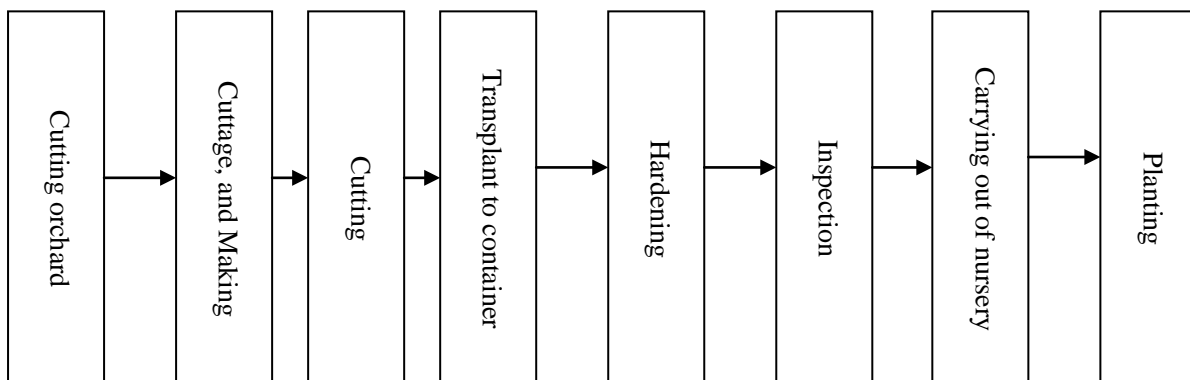
2.3.4.1 Production scheme for seedling production

The production scheme for seedling production of the project is: The seedlings shall be produced and supplied by the seedling nursery center of the Joint Venture Company. In case of short supply of seedlings, the shortage can be satisfied through expanding the capacity of the nursery garden and through procurement from other breeding centers (Mainly from breeding centers of Dongmen, Bobai, Gaofeng, Qinlian forestry farms under Gaofeng Group, as well as from Guangxi Forestry Breeding Demonstrative Base, Good Stock Breeding Base of Guangxi Academy of Forestry Science and Zhanjiang Nursery Center of Chinese Academy of Forestry).

Seedling breeding technology: micro cutting technique and the new-type container nursery method. All the seedlings for the afforestation will adopt the qualified cottage seedlings.

2.3.4.2 Seedling Production Process

The production process for eucalyptus cutting seedlings is:



(1) Establish the cutting orchard for fine varieties to provide high-quality cuttings. The maternal plant for cuttings will be renewed every two years when new eucalyptus will be introduced to increase the genetic diversity of eucalyptus.

(2) Adopt container seedling pot (such as the products of Lanne and BCC), which will help to reduce the pest propagation and improve the root development and thus increase the efficiency of the nursery.

(3) Adopt the light substrate production technique, such as mixing sugar cane bagasse and pine bark or coconut bran with perlite and chaff.

(4) Adopt shade shelter and automatic spraying system to control the root development environment and increase the stocking percentage of the cutting pieces.

(5) The seedling hardening field is equipped with spraying facilities and overhead seedbed to control root growing through air root-cutting for the purpose of producing the seedlings with strong lateral roots.

(6) Apply reasonable fertilizing and improve the sanitary conditions of the nursery.

(7) The Management Manual will be combined with the operating guidance to provide with training for the technical workers of the nursery so that they can master all the production process and culture seedlings all round the year.

2.3.4.3 Construction of Nursery

In 2004, the Forestry Company rent the existing nursery of Shankou Forestry Farm of Hepu county construct the nursery. The construction scope of the nursery was 5.05hm² (incl. 1.5hm² with cutting orchard).

By now, the nursery of Shankou forest farm has built 11 shade shelters of totally 2600m² that are equipped spraying facilities to control the humidity and the cutting temperature. There is one large net shade of total area of 2100m², one seedling hardening field of 10500m² that is equipped with overhead seedbed and spraying facilities. In addition, it is equipped with electric transformer, one diesel electric generator to ensure the power supply, four wells to ensure water supply. Other facilities include newly-constructed access roads, working shelter and other items such as office, laboratory, substrate fermentation field etc.

Major equipments of the nursery are: one drum screen and delivery belt, one substrate crushing machine, working platform with delivery belt for cutting, one mixing machine for blending substrate, seedling transport frame and four-wheel cart for carrying seedlings etc. The production of seedlings has realized semi-mechanical operation.

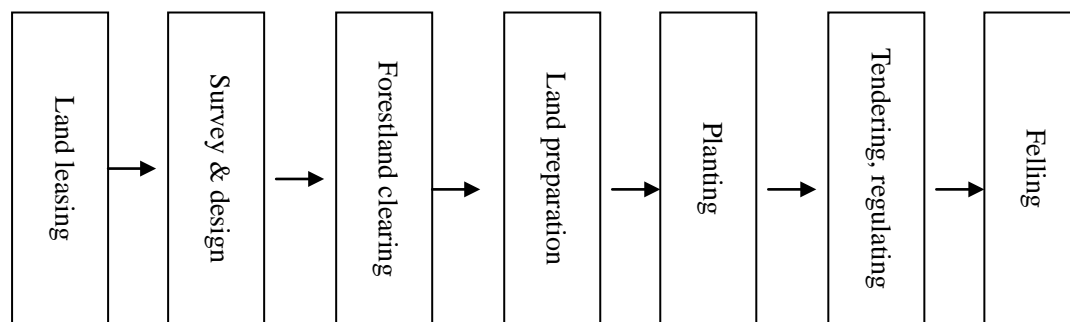
Working staff: 1 manager, 2 assistant manager, 2 technician, 2 electrician and 50 workers.

The production capacity: 4 million pieces in 2005; 8 million in 2006; 2007 onward 10-12 million pieces.

At present, the production capacities of the breeding centers for cutting seedlings of Dongmen, Bobai, Gaofeng and Qinlian forestry farms are respectively 10 million pcs/year, 8 million pcs/year, 4 million pcs/year and 10 million pcs/year, while that of nursery of

Guangxi Academy of Forestry Science, Guangxi Forestry Breeding Demonstrative Base and Zhanjiang Nursery Center of Chinese Academy of Forestry are respectively 25 million pcs/year, 10 pcs/year and 8 million pcs/year. Total production capacity for cutting seedlings of the central nursery of the Joint Venture Company and the eight breeding center / nurseries has reached 87 million pieces per year, while the maximum demand for eucalyptus seedling is 55 million pieces a year. Therefore, the supply of seedlings can be ensured, satisfying the seedling requirements of the pulp forest base of the joint-venture company and the social groups or individuals.

2.3.5 Production Process for the Base



2.3.6 Afforestation Scheme

2.3.6.1 Selection of tree species

The main tree species of the pulp forest base of this project is eucalyptus.

The improved eucalyptus varieties bred by the Sino-Australia cooperation project and Guangxi Academy of Forestry Science and authenticated by Guangxi Committee for Examination and Approval of Improved Varieties of Forest Tree will be adopted. These varieties are: (i) the hybrid improved clonal eucalyptus series of Dongmen eucalyptus grabdix; (ii) the improved clonal eucalyptus series of Brazil eucalyptus grabdix; (iii) the hybrid clonal eucalyptus series of Dongmen eucalyptus grabdix; (iv) the hybrid clonal eucalyptus series of Dongmen eucalyptus tereticornis; (v) the hybrid clonal eucalyptus series of Dongmen eucalyptus camaldulensis; (vi) the improved varieties of clonal seedling garden for eucalyptus urophylla of Dongmen Forestry Farm; (vii) the improved varieties of seedling seed orchard of eucalyptus urophylla of Dongmen Forestry Farm; (viii) Seeds of seed stands of eucalyptus urophylla of Dongmen Forestry Farm; (ix) GL 5 eucalyptus grabdix; (x) GL 9 of eucalyptus grabdix; and (xi) GL 4 of eucalyptus urophylla.

In the costal plain area, it is to select the improved varieties with strong capacity against typhoon and forest pests, such as eucalyptus grabdix, the hybrid clonal eucalyptus series, eucalyptus urophylla, eucalyptus grabdix, eucalyptus tereticornis etc.. In the hilly

areas with relatively higher elevation, it is to select the improved varieties of hybrid clonal series with strong capacity against drought, frost and typhoon, such as eucalyptus Gxtereticornis, eucalyptus camaldulensis, eucalyptus terreticomis etc.

2.3.6.2 Land for Afforestation

The distribution of the proposed land for afforestation will use the commercial forestlands that are below the elevation of 500m, of gentle slope and above-average site quality. The priority will be given to the hills and tablelands that are in continuity and thick soil.

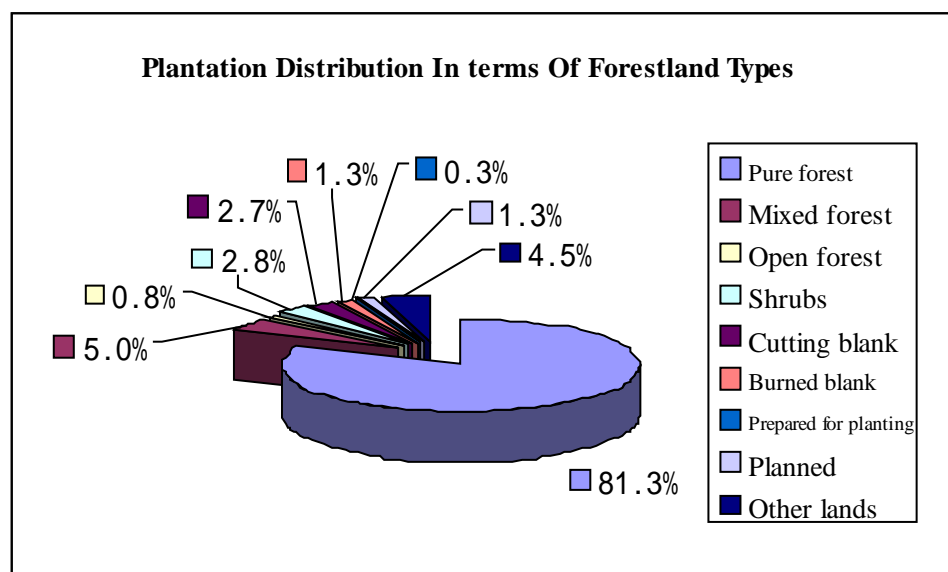
In the project area, the lands available for new plantations are: the lands through tendering and improving the existing eucalyptus and low-yield forest; open forestland, land suitable for plantation etc.

The principle for selecting forestland is: make the best use of the existing land suitable for plantation and open forestland, and giving priority to the improved existing low-yield forestland. In addition, through scientific planning and design, the scattered patches of open forestland, barren land and those lands suitable for plantation shall be integrated as a continuous scope to enable the convenient management.

Currently in the project area, there are 101204.9hm² of open forestland. The pulp forest base of this project will use 10547.31hm² of open forestland and land suitable for plantation, which includes 1151.41hm² of open forestland, 3805.3hm² of cutting blank, 1856.2hm² of burned area, 2308hm² of conserved plantation land, and 1422.4hm² of other lands suitable for plantation.

The current total area of pure forest and mixed forest of the project area is 0.9859 million hm², of which, about 0.1237 million hm² shall be planned for the new plantation of the base, accounting for 12.5% of the total area of the existing pure and mixed forests.

In this project, among the 0.1433 million hm² of plantation land, the proportions of various land types are shown in the following chart.



2.3.6.3 Afforestation Schedule

The construction period of the raw material forest base is 6 years, i.e. 2006-2011. The afforestation will be completed during 2006-2009, then continuous nourishing for 3 years, and felling will be conducted in the 6th year after regulating and protecting.

Construction progress: From 2006 to 2009, it is to complete afforestation the tasks respectively of 26000.0hm², 38237.0hm², 32805.0hm² and 26014.0hm²; to construct forest access roads respectively of 200.0km, 290.0km, 250.0km, 200.0km and 258.0km. Road construction will be completed in 2006. The construction schedule is showed in Table 2.3-3.

Table 2.3-3 Construction Schedule of Pulp Forest Base

Cities (Counties, Farms)		Total Scale	Existing forest	Planned Annual Afforestation Area				
				Total	2006	2007	2008	2009
Total of Project Area		160,000	36,944	123,056	26,000	38,237	32,805	26,014
Beihai city	Total	40,510	7,191	33,319	14,971	9,667	5,667	3,014
	Hepu county	39,414	7,150	32,264	13,916	9,667	5,667	3,014
	Tieshangang district	799		799	799			
	Yinhai district	297	41	256	256			
Yulin city	Total	6,058	1,058	5,000		1,000	500	3,500
	Beiliu city	500		500		500		
	Bobai County	1,981	481	1,500				1,500
	Luchuan County	1,562	562	1,000				1,000
	Xingye County	500		500		500		
	Yuzhou district	500		500			500	
	Fumian District	1,016	16	1,000			0	1,000
Fangchenggang city	Total	7,073	241	6,832		1,000	1,832	4,000
	Fangcheng district	2,903	71	2,832			832	2,000
	Shangsi County	2,000		2,000				2,000
	Port district	1,170	170	1,000		500	500	
	Dongxing County	1,000		1,000		500	500	
Chongzuo city	Total	5,000		5,000		500	2,000	2,500
	Jiangzhou County	2,000		2,000		500	500	1,000
	Fusui County	3,000		3,000			1,500	1,500
State Farms	Total	100,666	27,761	72,905	11,029	26,070	22,806	13,000
	Gaofeng forest farm	14,667		14,667		4,667	5,000	5,000
	Liangfengjiang forestry farm	1,000		1,000		1,000		
	Qipo forest farm	9,999		9,999		3,333	3,333	3,333
	Paiyangshan forestry farm	9,333		9,333		3,333	3,333	2,667
	Dongmen Forestry Farm	10,666	3,623	7,043	797	3,079	3,167	0
	Liuwan forestry farm	6,667	1,467	5,200	1,333	1,867	2,000	0
	Bobai forestry farm	21,333	4,507	16,826	5,358	6,134	3,335	2,000
	Qinlian forestry farm	27,001	18,165	8,836	3,541	2,656	2,638	0
Others	Total	692	692					
	Qinnan district	692	692					

2.3.6.4 Technology and Method for Afforestation

(1) Forestland clear-up

Adopt the belt-type or patch-type clearing. In principle, overall clean-up is not recommended for hill afforestation. In addition, the slope crest, gully and slope toe must be well protected, and no vegetation along rivers are allowed to be cut. As to the forestland below 15 gradient, if without much shrubs and butts, the land preparing can be conducted mechanically.

(2) Land preparing and dibbing

Two methods respectively of manual and mechanical land preparing will be adopted.

(i) Where forest land of $\geq 16^\circ$, local land preparing shall be adopted, including manual dibbing, manual belt preparing and mechanical dibbing. The hole surface size will be 50×50cm, while the bottom size will be 40×40cm, depth will be 30cm.

(ii) Where the gentle slope at 6-15 gradient shall adopt mechanical land preparing. The method is: use soil ripper (or duck-foot plough) to make furrow along the contour line at a depth of 60-90cm, with only loosening the earth but not damaging the top soil. The inter-belt places of the mechanical-plough shall retain the original vegetation.

(iii) Where the gentle slope at 0-5 gradient shall adopt mechanical land preparing. The method is: to directly use plough to loose the soil in a back-and-forth and parallel way, at a depth of 30-50cm.

(iv) The land preparing shall be completed 1-1.5 months prior to planting seedlings.

(3) Application of basal fertilizer

(i) Application of basal fertilizer will be usually conducted in line with hole back-filling before planting.

(ii) The types of fertilizer shall use special compound fertilizer and fused calcium magnesium phosphate for eucalyptus, each hole with 250g, respectively 100g of special compound fertilizer and 150g of fused calcium magnesium phosphate. In order to satisfy the nutrition demand of eucalyptus at different fast-growing stages, the application of fertilizer shall be conducted in a scientific way. This is to determine the optimal proportions of N, P and K according to the soil conditions and the eucalyptus growing status.

(iii) The utensils such as cup or bowl shall be used during fertilizing. After the fertilizer is put into the tree hole, the clumpy blocks must be broken up and then spray some top soil and fully blend it.

(iv) Back-filling. The top soil must be back-filled first, then the loosed earth to the full. The back-filled earth must be broken up with maximum diameter of 2cm. In order to avoid fertilizer erosion, after fertilizing, back-filling must be conducted immediately. At the same time, all the weeds within a diameter of 50cm from the tree hole must be removed.

(4) Planting.

(i) Time of planting. March – April is the optimal period for planting. The container seedlings can be planted throughout the year.

(ii) Planting density. The density of planting shall be determined according to the site conditions, objective and management level. Normally, the primary planting density will be

1250-1667 trees per hm². For gentle low hills and tableland, the primary density will be 1250 trees/hm², with row spacing of 2x4m. For hills of high gradient, the density will be 1390-1667 trees/hm², with row spacing of 4x1.8m, 4x1.5m or 3x2m. In addition, small-patch multiple series of clonal varieties shall be adopted for planting in an interactive mode to reduce the ecological risk such as forest pests.

(iii) Requirement of planting. The seedlings must be delivered to the nearby places in advance, and before planting, the seedlings must be wetted with spraying water.

(iv) Before planting, it is first to remove the seedling container, then put the seedling into the tree hole, put it straight and back-fill the earth. The soil around the seedling must be compacted to enable the root system in full contact with the soil. On the surface, one layer of loose soil shall be applied. The depth of planting shall be 2-3cm deeper than the earth-mark of the original seedling container.

(v) Where the tree planting characterized by mechanical operation, the basal fertilizer and the container seedlings shall be delivered by the conveyor belt to the planting furrow, then the workers shall then homogenize the fertilizer with small hoes following the machine, and then plant the container seedlings.

(vi) According to the site conditions of the forestland, the company will gradually use tree planter to conduct mechanical or semi-mechanical tree planting. Tree planter has three functions: transplanting, fertilizing and water-spraying. These three procedures will be completed at a time, of which, the water-spraying (including water retention agent) will normally reach 150g/pcs. Compared with the planting methods of the medium-level management in Guangxi, the planting method of the Company has added the procedure of water-spraying that can timely replenish the water content to the seedlings, expedite the dissolution of the chemical fertilizer into the neighboring soils, and thus will obviously increase the survival rate.

(vii) Inspection of survival rate and replanting. Based on the experiences from Brazil, prompt replanting will effectively increase the growth of the trees. Therefore, the system of "prompt inspection and prompt replanting" will be implemented. The quality-supervising department of the Company will inspect the survival rate within half a month after the planting. When the survival rate is lower than 95%, the strong seedlings must be used for replanting.

(5) Fertilizer top dressing

(i) Type of fertilizer. Special compound fertilizer for eucalyptus.

(ii) Quantity of application. The first top dressing shall be applied within 1-2 month after the planting, at the quantity of 300g/tree. The second time shall be conducted within 7-8 months after planting, at a quantity of 500g/tree. The necessity for further top dressing shall be determined in the third year after soil diagnosis and fertilizing experiment.

(iii) Method for fertilizing. It is mainly to adopt the groove fertilization method, while locally with mechanical fertilization method. The method is: to dig grooves on both sides at the distance of 20cm to the tree, put in fertilizer, blend with soil and back-fill with soil. Soil loosening and weed removing must be conducted at the same time with top dressing.

(iv) The Joint Venture Company will cooperate with relevant research organization of

Brazil to conduct full experiments on the growing characteristics of eucalyptus and conduct comprehensive analysis of the soil nutrient for the purpose of knowing about the nutrient status of soil and the demand of eucalyptus. Based on the N, P and K fertilizers and the materials with trace elements purchased from the markets, the Joint Venture Company has developed, according to the experiment design and analytical results, the special compound fertilizer for eucalyptus for scientific fertilizing. Compared with the compound fertilizer sold in the market, the special eucalyptus compound fertilizers prepared by the Joint Venture Company have the following characteristics: (a) High effectiveness. The contents of N, P and K are optimally proportionate while other nutrient trace elements such as B, Cu and Zn etc. are also used. (b) Strong adaptability. The selection of materials and proportions are more scientific and rational, which will accordingly increase the efficiency of fertilizers that are applied in a proper time and quantity according to different site conditions and trees.

In addition, the Company also attaches importance to the land utilization and maintenance, i.e. the dropped dead leaves and the cutting remains are left on the forest land each year. Therefore, the nutrients of the dropped leaves and branches in the nutrition system of the forest land are not lost, and the site quality can be well maintained.

(6) Stands fostering

Weeds control. Where of mechanical land preparing, normally one weed removing manually or with chemical weed killer shall be conducted in the same year when the tree is planted. Where of tree-hole land preparing, the weeds will be more, and thus weed removing will be conducted for consecutive three years, of which, two times in the first year and respectively one time in the second and the third year.

Soil loosening. In the first year, hole-expanding and belt-type soil loosening will be conducted, at the belt width of 1.2-1.5m.

Stand fostering is an important measure to improve the stand growing environment and increase the growth of eucalyptus. Through weeding removing and fostering of the stands, especially the young stands, it is to reduce or eradicate the shading on young trees and the competition for fertilizer and water. Through hole-expanding and soil loosening, it is to reduce the loss of water and nutrients, promote the absorption of nutrients by root system and thus ensure the growth of the stands. Addition, through stand fostering, it is to reduce the occurrence of forest pests.

The technical model for afforestation technology is shown in Table 2.3-4.

Table 2.3 – 4 Technical Model for Afforestation

Tree species		Eucalyptus (New Plantation, Tendering)	
Tendering Goals		Pulp paper timber	
Site index or site type		Above average	
Seedlings		Source	Nursery.
		Grade of seedlings	Qualified cuttage seedlings
Afforestation measures	Forest land clear-up	Method for clearing	Belt-type or patch-type, cutting the grasses
	Site preparation	Slope ≥ 16 gradient	manual dibbing, manual belt preparing and mechanical dibbing, hole size: 50×50×50 cm
		Slope 6 – 15 gradient	Mechanical stripping, use soil ripper to make furrow along the contour line at a depth of 60-90cm,
		Slope 0 – 5 gradient	Total mechanical tillage, parallel loosening, at the depth of 30 – 50 cm.
Basal fertilizer	250g/ hole	Special fertilizer for eucalyptus	100 g/ hole
		Calcium magnesium phosphate	150 g/ hole
Primary plantation density		Gentle low hills and tableland	1250 tree / hm², row spacing 2 m×4 m
		Hills of high gradient	1390~1667 tree / hm² Row spacing: 4x1.8m ,4x1.5m ,3x2m
Fertilizer top dressing	Special compound fertilizer for eucalyptus	1st top dressing	1 –2 months after planting, 300 g/tree
		2nd top dressing	7 – 8 months after planting, 500 g/tree
		The necessity for further top dressing shall be determined in the third year after soil diagnosis and fertilizing experiment.	
	Method for top dressing	Mainly adopt the groove fertilization method, while locally with mechanical fertilization method.	
Stands fostering	Weed Control.	Weed removing manually or with chemical weed killer	
	Soil loosening	In the first year, hole-expanding and belt-type soil loosening will be conducted, at the belt width of 1.2-1.5m.	

(7) Forest pest control

The pests endangering eucalyptus are mainly of bacterial wilt, termite, cricket and tung-tree cankerworm etc. The bacterial wilt of eucalyptus shall be prevented via selecting improved varieties and clonal series. The termite and cricket can be prevented through soaking the roots in termite-killer liquid. Tumble bug can be killed or lured to be killed

through blending dipterex with fried bran. In addition, eucalyptus are also susceptible to physiological diseases that are caused by the lack of some nutrients or trace elements which can be cured through applying fertilizer and trace elements.

2.3.6.5 Regulating, Protecting and Cutting Rotation

(1) The management of protection of the forest will be conducted by the qualified afforesting company through entrusting, such as state-owned forestry farm, to ensure the security of the forest.

(2) Cutting rotation. The cutting of eucalyptus shall be 6-7 years. The cutting methods will follow the *Management Rules of Felling and Regeneration of Forest issued by the State*. After cutting, all places will be replanted

2.3.7 Scheme for Equipments

Planting, fostering and felling of the Project will require some ordinary facilities and special equipments, mainly including: (i) Cultivating equipments are plough, hook, hoe, measurement stick (rope) etc.; (ii) Cutting equipments are large-scale felling machine and buncher, chain saw, knife and axe etc.

Since the construction activities of afforestation of this Project are contracted by professional teams, these equipments will be purchased by the contractors or use the existing equipments. If using mechanical operation during felling, large-scale felling machine and buncher should be procured.

2.3.8 Access Road Construction Scheme

Based on the existing traffic conditions of the forest land and the requirement of construction of raw material forest base in the project area, the forest access road for the new planting area shall be planned as per 8m/hm², and totally 940km. The specifications of the forest access roads are: pavement width 2.0-3.0m; subgrade width 3.0-4.0m; maximum longitudinal gradient 13%. The earth road shall be improved. Currently, the highway and access roads to the existing tree stands are complete, and thus no additional access roads will be planned. It is only required to undertake repair on the existing access road, which, as per 6m/hm², will total to 285m.

2.4 Operational Mode and Management of Pulp Forest Base

2.4.1 Operation Mode of Pulp Forest Base

The operation modes of the base construction are slightly different before and after the establishment of the joint-venture company, including leasing operation and cooperating operation.

1. Operation mode before establishment of Joint-venture Company.

At present, the operational mode of the base adopts two types, respectively leasing operation and leasing before joint-stock.

(1) Leasing operation. The Joint Venture Company will acquire the right to the use of the forestland of the rural collective ownership, forestry farmers and forestry farms through land leasing. In this mode, the operational mechanism of “enjoy benefits and assume risks, profits and losses alone” shall be implemented. The Joint Venture will make

full investment on the base. All forest products belong to the Company, and the owners of the rights to the use of the forestland will get fixed benefits (land rentals). In this mode, there are three operational methods.

(i) Forestry Company conducts afforestation. The company will directly rent and implement management of the lands for afforestation from the rural collective ownership or from the forestry farmers.

(ii) Entrusted land leasing (or afforestation). A special department under Beihai Forestry Bureau is responsible for renting the land to the Forestry Company that will conduct afforestation, or renting the land and handing over to the Company for management after conducting afforestation.

(iii) Purchase the standing volume. The Company purchases the young forest (as it is called “green hill”) from the entities or individuals at the latest market prices, and leases the rights to the use of these forestlands.

(2) Lease before joint-stock. Guangxi Gaofeng Forest, Pulp and Paper Industrial (Group) Company Ltd. (Gaofeng Group) shall rent out some forestlands to GXSE for afforesting. Upon the establishment of the joint-venture company, the right to the use of forestland shall be appraised and incorporated as the capital contribution of the Chinese counterpart.

2. Operation mode after establishment of Joint-venture Company.

After establishment of the joint-venture company, Gaofeng Group shall pool its right to the use of state-owned forestland and the state-owned forest assets as the shares of the joint-venture company. Stora Enso Group shall mobilize funds and be responsible for the construction, operation and management of the base. The company will implement a mechanism of cooperative operation, and both parties will take the benefits according to the proportions mutually agreed.

This mode is mainly applied to the state-owned forest land. According to the *Letter of Intent for Joint Venture* entered between Gaofeng Group and Stora Enso Asian Company Ltd., Gaofeng Group will pool its rights to the use of 96666.7hm² of commercial forest land and the forest assets as shares, and the Joint Venture Company will be responsible for the operation and management of the raw material forest base.

2.4.2 Operation Management of Pulp Forest Base

In order to ensure the smooth implementation of the project, it is required to enhance the management of the project.

(1) Planning management. In order to ensure that all kinds of works relevant to the project construction can be conducted smoothly and fruitfully, it is required to emphasize the planning management of three links, respectively prior guidance, on-going inspection and post-acceptance. The corresponding functional department of the Company will work out various plans such as annual afforestation plan, afforestation costs and charges plan, materials procurement and supply plans and technical training plan etc. ,

(2) Design management. The annual working design will be made according to the annual afforestation plan. and the construction and acceptance must be conducted according to the design and standards.

(3) Construction management. This is to strengthen the management of working procedures. All works including forest land clearing, planting, earth back-filling, replanting and fostering etc. must be conducted under the guidance and supervision of the construction supervisors or technical staff. Any non-conforming works must be stopped, and the whole process of afforestation must be under quality management and control.

(4) Regulating and protecting of forest. This is to enhance the fostering and protection of the newly afforested land. The fostering works, such as hole expanding, soil filling, weeds and shrub removing, fertilizing etc. must be conducted in a timely manner. It is also required to set up the forest protection organization with the local forestry administrative department to be responsible for the protection of forest. In this regard, the protection measures, staff, funds and responsibilities must be clearly defined and mobilized.

(5) Engineering management. The project will adopt the construction supervising system. The Forest Production Dept. or the engaged qualified construction supervisors will be responsible for the quality supervision of the whole afforestation process to ensure that all afforestation have been conducted as per the design and every afforestation link conforms to the design requirements. In addition, the project inspection and acceptance system will be implemented, including annual inspection, interim acceptance inspection and completion acceptance inspection.

(6) Scientific management. On the basis of the existing scientific strength, the project will enhance the cooperation and exchange with the international and domestic forestry research institutions and jointly establish the backup system for scientific popularization. This is to promote the application of the home and abroad advanced and practical technology. As such, the special scientific research fees must be covered by the budget. The research will target at settling the key technical issues relevant to the production of eucalyptus quick-growth and high-yield forest, such as introduction of improved varieties and clonal series, improvement and breeding, scientific recipe and dosage of chemical fertilizer, comprehensive forest disease and pest control, maintenance of soil fertility, conservation of water and soil, as well as protection of biological diversity etc. All these will scientifically facilitate the development of eucalyptus quick-growth and high-yield forest.

(5) Information archives management. This is to actively apply the “3S” technology, establish or perfect the project information management system and the forestland information management system so to improve the management level and efficiency.

2.5 Analysis of Equilibrium of Supply and Demand of Woods Raw Material for Pulp Mill

2.5.1 Scheme of Demand for Wood Raw Materials of Pulp Mill

The annual production capacity of pulp-making factory corresponding to this project is 900,000T of chemical pulp. It will start commissioning from 2009 with 90% of production load. Full production will be achieved in 2010. Based on the technological requirement of the pulp factory, eucalyptus shall be used as the raw material wood (with some quantity of acacia in the year of commissioning). One ton of chemical pulp will require 4.1546m³ of eucalyptus / acacia woods (with 6% of bark, equivalent to 3.77453m³ without bark). As such, by 2009, the annual requirement on raw material wood of pulp factory will be 2.7177

million m³ (barked, hereinafter the same). 2010 onward, the annual requirement will be 3.3971 million m³.

2.5.2 Supply Plan of Wood Raw Materials of the Base

Based on the construction and cutting plans of the raw material forest base, the annual volume of supply of woods of the forest base are shown in Table 2.5-1.

Table 2.5-1 Annual Supply Plan of Wood Raw Materials of the Base Unit:
10000m³

Year	2009	2010	2011	2012	2013	2014	2015	2016 onward
Eucalyptus	214.76	350.92	351.28	350.37	357.16	347.06	362.65	≥362.99
Acacia	67.35	-	-	-	-	-	-	-
Total	282.11	350.92	351.28	350.37	357.16	347.06	362.65	≥362.99

2.5.3 Equilibrium Analysis of Wood Supply and Demand

According to the forest classification of Guangxi in 2001, the total forestland was 13584824.0 ha. (excluding those of the non-forestry system and partial natural reserves, hereinafter the same), of which, the area of commercial forestland was 7806683.6 ha., accounting for 57.5% of the total; the area of non-commercial forestland was 5778140.4 ha., accounting for 42.5%. Among the commercial forestland, there were 4590382 ha. of forestland of above-moderate fertility and site conditions that were located below 800m altitude and 30 gradient, accounting for 58.8% of the total figure. Forestland resources are rich.

In addition, the *Development Planning for Quick-growth and High-Yield Forest in the "Eleventh Five-Year Plan" and for 2020* prepared by Guangxi Forestry Bureau in December 2005 has planned four forest bases for industrial raw materials, respectively: Coastal forest pulp paper raw material forest base; Woodboard, Forest, pulp and paper industrial raw material forest base in east Guangxi; Large-size timbre forest and woodboard, forest, paper and pulp industrial raw material forest base in west Guangxi; Wood-bamboo pulp paper industrial raw material base in north and mid Guangxi.

Coastal forest pulp paper raw material forest base. The forest base has involvement of 7 cities of 38 counties (cities and districts) and 8 provincial state-owned forestry farms, including Qinzhou, Beihai, Fangchenggang, Yulin, Guigang, Nanning and Chongzuo cities. It will, as for the two large-scale forest pulp paper integration projects in Qinzhou and Beihai, construct a short-rotation paper-pulp forest base featured by growing eucalyptus and acacia.

Woodboard, forest, pulp and paper industrial raw material forest base in east Guangxi. This forest base has involvement of 3 cities of 12 counties (cities and districts) and 1 provincial state-owned forestry farm (Daguishan farm). It will, focusing on the enterprises of woodboard, pulp and paper in Wuzhou, Hezhou and Cenxi etc., emphasize the construction of the short-rotation woodboard and paper pulp raw material base in the low hills, such as castanopsis fissa, masson pine and eucalyptus. In addition, it will also plant large-size trees, such masson pine and castanopsis hystrix.

Large-size timbre forest and woodboard, forest, paper and pulp industrial raw material forest base in west Guangxi. This forest base has involvement of 3 cities of 25

counties (cities and districts) and 1 provincial state-owned forestry farm (Yachang farm). It will, focusing on the enterprises of paper pulp and woodboard of Baise and Hechi cities, grow large-size timbre in the low hills, such as masson pine, fir and betula alnoides etc. In addition, it will also supplement with constructing short-rotation forest base, such as masson pine, griffithi and eucalyptus etc.. In the karst areas, it will construct the timbre forest base featured by zenia insignis chun, toona sinensis roem etc., and the paper-pulp forest base featured by tufty bamboo.

Wood-bamboo pulp paper industrial raw material base in north and mid Guangxi. This forest base has involvement of 4 cities of 23 counties (cities and districts) and 3 state-owned forestry farms, respectively Guilin, Liuzhou, Hechi, Laibin, Weidu farm, Huangmian farm and Sanmenjiang farm. Centralized at the enterprises of paper pulp and woodboard in Liuzhou and Guilin, the it will develop a raw material base that are featured by tufty bamboo (hybrid bamboo, minor McClure, pervariabilis McClure etc.), phyllostachys pubescens, masson pine and eucalyptus. In addition, it will supplement with large-size timbre, such as pine, fir, Betula alnoides, schima superba, liquidamber formosana etc. In the karst rocky areas, it will construct bamboo pulp base featured by growing tufty bamboo and large-size timbre base featured by growing zenia insignis chun and toona sinensis roem.

The *Development Planning* has clarified the distribution, species and industrial types of various quick-growing and high-yield forest bases. This project belongs to the coastal forest paper pulp raw material forest base, conforming to the requirement of site selection, and thus no competition will exist with other processing industries of fiberboard and timbres within the project area.

According to the *Survey Report on Balance of Demand and Supply of Raw Material Woods in Preliminary Stage of 900000T/a of Pulp, 900000T/a of Paper and Paper Board Project of Stora Enso (Guangxi) Forest, Pulp Paper Company Ltd.*, the carrying capacity of forestland was concluded as: "Except that the forestland resources of Liuzhou bamboo pulp planned forest base fails to satisfy the required plantation area, the forestland resources of other forest bases (including Beihai project of Stora Enso) can satisfy the requirement on plantation area". Also, the carrying capacity of forest resources was concluded as: "During the '11th Five-Year Plan', the newly-added industrial forest bases, whichever in the proportions of 80% of eucalyptus and 20% of pine or in the proportions of 70% of eucalyptus and 30% of pine, can satisfy the total requirements of 20.37 million m³ of wood by 2010, respectively, 2.5 million tons of wood pulp by paper-making enterprises and 6 million m³/a of timbres by wood processing enterprises". However, during the "12th Five-Year Plan", the newly-added industrial forest bases cannot satisfy the total requirement of 35.05 million m³ of wood by 2015, respectively, 5 million tons of wood pulp by paper-making enterprises and 8 million m³/a of timbres by wood processing enterprises. As such, the gaps respectively of 0.87 million tons or 1.38 million tons of pulp will exist, and thus the scope of wood pulp production or the proportion of forest types needs to be re-adjusted or increased.

The annual equilibrium of supply and demand of the pulp factory are shown in Table

2.5-2.

From the table, it can be seen that, during 2009 – 2015 and under normal conditions, the timber output can satisfy the demand for raw material woods of the pulp mill.

Viewing from the preparation of the project, it is more likely to start operation in 2010. The production load will be 80% in the first year after operation and 100% in the second year. Based on the technological requirement of the pulp factory, eucalyptus shall be used as the raw material wood. One ton of chemical pulp will require 4.02m³ of eucalyptus (with 6% of bark, equivalent to 3.77m³ without bark). As such, by 2010, the annual requirement on raw material wood of pulp factory will be 2.7177 million m³ (barked, hereinafter the same). 2011 onward, the annual requirement will be 3.3971 million m³. According to the construction of raw material forest base and the felling plan, the raw material base will supply wood volume of 2.1476 million m³. From 2010 to 2014, the annual wood supply volume will exceed 3.45 million m³. In 2015 onward, wood supply volume will exceed 3.62 million m³. The annual wood production of raw material forest base exceeds the demand of pulp factory on raw material wood. Wood supply from the individuals in project area is unnecessary. Therefore, under normal conditions, the timber output can satisfy the demand for raw material woods of the 900,000T/a chemical pulp project when the base reaches the designed growth volume and output rate.

Table 2.5-2 Equilibrium of Demand and Supply of Woods in Preparatory Stage of Pulp Mill of SEGX [removed]

2.5.4 Wood Consumption of Other Wood Enterprise Users of the Project Area

According to *Industrial Structure and Wood Demand Analysis for Wood Processing Industry in Guangxi* (2005) prepared by CIFOR, within the project area, there are totally 119 wood processing enterprises, the annual total production capacities are: 1.0183 million m³ of artificial board; 0.437 million tons of paper, paper pulp and wood chips. The annual total volume of wood raw materials are: commercial wood 1.4198 million m³; 0.9714 million tons of remains and firewood. Among the consumption of commercial wood, there are: 0.7688 million m³ of eucalyptus (incl. 0.5602 million m³ eucalyptus chips), accounting for 54.1%; other woods 0.6510 million m³, accounting for 45.9%.

In terms of the sources of raw materials for the existing wood-processing enterprises, some enterprises have their own forest base through leasing the forestland, some others directly buy woods from the society.

The structure of consumption of wood raw materials are:

1. In terms of administrative jurisdiction of wood-processing enterprises: Beihai city 0.3104 million m³, accounting for 13.0%; Yulin city 1.2976 million m³, accounting for 54.3%; Fangchenggang city 0.1222 million m³, accounting for 5.1%; Chongzuo city 0.6610 million m³, accounting for 27.6%. In this regard, the wood-processing enterprises of the provincial state-owned forest farms are listed to the city level.

2. In terms of the types of wood-processing enterprises, they are: 0.1575 million m³ for paper and paper pulp, accounting for 6.6%; 1.152 million m³ for medium and high-density fiberboard, accounting for 48.2%; 0.2028 million m³ for polywood, accounting for 8.5%; 0.6552 million m³, accounting for 27.4%; 0.1045 million m³ for sawn wood, accounting for 4.4%; 15000 m³ for flake board, accounting for 0.6%; 4500 m³ for lumber-core board, accounting for 0.2%; 99800m³ of other wood products, accounting for 4.2%.

Viewing from the survey of the wood-processing enterprises of the project area, Yulin has the greatest number of wood-processing enterprises, having the highest wood consumption. Viewing from the types of processing enterprises, the producers of medium and high-density fiberboards are the “big consumers” of wood materials. Eucalyptus woods are mainly used by polywood and wood chips processing factories. Because of the high price of eucalyptus, and the small scope and backward technology of the paper pulp mill of the project area, the demand for eucalyptus of the project area is relatively small. The results of the survey for the wood-processing enterprises within the wood-supply area are shown in attached Table 1. .

According to the spirit of the document Ref. GZF[2004]66 issued by the People's Government of Guangxi Zhuang Autonomous Region, “the investment competent administrative department and forestry administrative department of the Autonomous Region should work out the layouts of wood consuming processing enterprises within raw material forest bases in Qinzhou and Beihai. They should also restrict the development of small-scale wood processing enterprises with high consumption of wood and low benefits. Any non-conforming afforestation project and wood-processing project to Guangxi Development Planning and Layout should not be approved.” In the project area, establishment of new wood-processing enterprises will not be considered. Also, according

to *Circular on Further Strengthening the Supervision and Management of Wood Operation (Processing)* Ref. [2006]6 issued by GFB, “GFB decides to check up and rectify wood operation (processing) units, further strengthen the supervision over wood operation (processing). Any units or individuals engaging wood purchase, sales and processing should re-register. All illegal wood operation (processing) units should be closed and banned.” It is less possible that the existing wood processing enterprises would expand their production capacity. Therefore, comparing with present wood consumption, the annual consumption of wood raw materials of wood processing enterprises during the “Twelfth Five-Year Plan” period will not greatly increase but decrease instead.

2.6 Scope Matching Analysis for Raw Material Forest Base and Pulp Mill

2.6.1 Rationality Analysis of Wood Growth in Engineering Design

2.6.1.1 Basis of Design Growth Volumm

Based on the survey on the eucalyptus growth of the sample forestland, as well as considering the forest management measures of Stora Enso, the design wood growth is 2.2 m³/mu per year.

Table 2.6-1 shows the statistical summary of the wood growth on the sample forestland of the social forest and state-owned forest. From this table, it can be seen that, among the surveyed samples, the annual average growth of eucalyptus forest is more than 2.0 m³/mu per year.

Table 2.6 –1 Statistics of Eucalyptus Growth on Sample Forestland

Unit: mu / pieces / cm / m / year / m³

City (farm)	Town (Branch Farm)	Sub-compartment	Area	Time of Afforesting	Time of Survey	Nos.	Average DBH	Average height	Age	Unit Stock	Annual average growth	Remarks
Gaofeng	Jiebei	16	161	2002.4	2007.2	78	14.1	17.7	4.8	12.62	2.63	Social forest
Qipo	Longlou		5493	2002.4	2006.9				4.3	9.81	2.28	
Beihai	Changle		420	2003.6	2007.3	148	11.0	14.5	3.8	10.10	2.69	
Dongmen	Momang	105016507	137	2002-5-15	2007-1-25	87	15.0	22.2	4.7	12.47	2.65	Raw material base of SEGX
Dongmen	Momang	105014802	214	2002-5-15	2007-1-30	81	14.8	19.9	4.7	10.91	2.31	
Dongmen	Momang	105014803	89	2002-5-15	2007-1-30	109	13.0	18.8	4.7	11.76	2.49	
Dongmen	Momang	105015004	388	2002-5-15	2007-1-29	86	14.0	20.4	4.7	11.37	2.41	
Dongmen	Momang	105017004	45	2001-5-15	2007-1-31	87	15.8	23.4	5.7	15.03	2.63	
Dongmen	Momang	105017822	250	2001-5-15	2007-1-31	93	14.1	22.5	5.7	13.82	2.42	
Dongmen	Xiangyang	106011802	45	2001-5-15	2007-2-2	117	13.1	20.1	4.7	12.30	2.60	
Dongmen	Xiangyang	106012519	63	2002-5-15	2007-2-2	107	12.3	20.1	4.7	10.51	2.22	
Dongmen	Xiangyang	106016409	85	2001-5-15	2007-2-3	96	13.8	22.1	5.7	13.22	2.31	
Dongmen	Xiangyang	106016415	66	2000-5-15	2007-2-3	113	13.9	20.8	6.7	14.83	2.21	
Qinlian	Nali	308070612	50	2003-6-15	2006-8-11	100	12.3	15.3	3.2	8.09	2.56	
Qinlian	Wujia	304040202	228	2001-6-15	2007-1-10	110	13.8	20.3	5.6	13.11	2.35	
Qinzhou	Dafanpo	205010108	209	2003-5-23	2006-11-13	80	12.2	15.3	3.5	7.40	2.11	
Beihai	Zhakou	332040120	48	2003-5-15	2006-7-25	150	10.1	12.3	3.2	6.41	2.01	
Beihai	Shankou	301040203	211	2001-4-15	2007-1-2	107	12.8	17.2	5.7	11.57	2.02	

2.6.1.2 Silviculture Measures to Ensure the Increase of the Growth Volume in Forest Base

SEGX has worked out the management measures to ensure the increase of wood growth of the pulp forest base as the follows:

Selection of species

Guangxi has rich improved eucalyptus varieties. However, different varieties have different ecological and biological characteristics such as adaptability to the environment, growth and wood properties etc. Based on the years of experimental plantation and popularization of eucalyptus in different places of Guangxi, a great number of improved eucalyptus varieties adaptable to different places have been developed. The project area is located in the south coastal areas of Guangxi, and the selected varieties should be the improved eucalyptus that should have the characteristics of fast-growing, strong capacity against typhoon and forest pests, such as the hybrid Clonal series of eucalyptus *ruophylla* × *grandis*, eucalyptus *grandis* × *urophylla*, and eucalyptus *grandis* × *umbellata* etc.

Methods for land preparation

Many experiments have proved that different methods of land preparation would have great impacts on the eucalyptus growth. For example, machinery tillage would result in higher wood growth than that of manual digging. This is because that machinery tillage provides with an environment of loose soil and good permeability that are good for weed control and fertilizing. At the same time, the methods of machinery tillage are also changing. Currently, the common method is to use soil ripper (or duck-foot plough) to make furrow along the contour line, with only loosening the earth but not damaging the top soil. The inter-belt places of the machine-tillage shall retain the original vegetation. Such has changed the traditional high-strength land-preparation method of “three plowings + three harrowings”, and thus reduce the damage to vegetation and soil structure of the forestland and promote the wood growth.

However, machine tillage is only applicable to the plain and tableland area of ≤15 gradient. In Guangxi, most of the forestlands are above 16 gradients, which only manual land preparation shall be applied. Similarly, different specifications and methods of manual land preparation would also have different impacts on the wood growth. Currently, according to different gradients, there are two major methods of manual land preparation. (i) In the hills of gradient between 15 ~ 20°, the site preparation can be conducted along the contour line through scooping up or digging big holes, then applying basal fertilizer for planting. After planting, the loosening and fostering shall be conducted along the rows. (ii) In the hills of gradient of above 20°, the site preparation shall be conducted through digging big holes along the contour line to a size of 40-60cm in width, 40cm in depth, and 30-40cm in bottom width. After planting, the earth-loosening and fostering shall be conducted along the belt rows to form a belt. Such has changed the past method of small hole digging in site preparation, hole-expanding or full-loosening in fostering, and thus facilitate the wood growth.

Planting density

Reasonable planting density would be more beneficial for fully using the soil fertility

and sunshine, initiating the growth potential of trees and improving the growth and quality of forest stands. The planting density of Guangxi also experienced a process of changing with time. Before 1995, the planting density of *eucalyptus exserta* and *eucalyptus citriodora* was 2000 – 5000 tree /hm². During 1995 – 1999, the planting density of some improved varieties such as *eucalyptus urophylla* was 1666 – 1960 tree /hm². Since 2000, the planting density of improved *eucalyptus* is mostly of 1250 – 1666 tree/hm², while that in some places growing large-size timber is 833 – 1250 tree /hm². The time changes of *eucalyptus* planting density are related to the increase of growth of forest stands in an organic way. With the decreasing of planting density, the growth gradually increases. This indicates that reasonable planting density would have remarkable impacts on the increase of forest growth.

After years of experiments on planting density of *eucalyptus*, the reasonable density has been defined. In terms of short-period pulp forest, the planting densities should be: (i) 1250 tree /hm² for the forestland of good site conditions and plain landform, at row spacing of 2m x 4m; (ii) 1666 tree / hm² for the places middle site conditions and higher gradient, at row spacing of 2m x 3m or 1.5m x 4m; (iii) 833 –1250 tree /hm² for planting medium or large-size stands, at row spacing of 2m x 4m, 3m x 4m. The primary planting density currently adopted by the Joint-venture company is 1250 tree /hm², at row spacing of 2m x 4m.

Scientific fertilizing

Forest fertilizing is one of the effective means to increase the soil nutrients, improve the situation of nutrition, expedite the growth of woods, reduce the growing period and accordingly increase the operational benefits. Fast-growing of *eucalyptus* will consume great quantity of nutrients, and application of fertilizer will have remarkable influence on the increase of output. In the past, *eucalyptus* fertilizing of Guangxi focused on single-element fertilizer or two-element compound fertilizer. According to the fertilizing experiments on *eucalyptus urophylla*, the stock of the 2-year-old *eucalyptus urophylla* with fertilizer application is 56.5% more than that without. At the same time, application of N, P, K compound fertilizer would have much better results than applying two-element or single-element fertilizer. According to the balance fertilizing method (soil-fertility maintenance method), the optimal quantity of fertilizer application can be defined. Such would be of great significance in improving the growth of the forest stands. Since different forestlands have different nutrient contents, it necessary to adopt scientific method to measure the nutrient contents of soil and determine the reasonable fertilizing quantity for different forestlands. Many practices have proved that, *eucalyptus* fertilizing should use the full-nutrient fertilizer containing N, P, K. Such include the basal fertilizer and top fertilizer dressing. Other trace elements shall be also added according to the needs of forestlands. The Joint Venture Company will cooperate with relevant research organization of Brazil to conduct full experiments on the growing characteristics of *eucalyptus* and conduct comprehensive analysis of the soil nutrient for the purpose of knowing about the nutrient status of soil and the demand of *eucalyptus*. In addition, based on the experimental design and analytical results, a special compound fertilizer exclusively for the company will be produced. Whatsoever, scientific fertilizing for *eucalyptus* plantation will promote the growth of *eucalyptus* to great extent.

2.6.1.3 SEGX's methodology and contents of sub-compartment inventory sampling

All Eucalyptus sub-compartments are sampled between 2 and 3 years of age in order to evaluate its performance, then they can be projected to the harvesting age and SEGX is able to plan for its actual future volumes.

(1) Sub-compartment sampling methodology

(i) Acquire basic information from database (GPS maps of the sub-compartment, area, clone numbers, planting time and so on);

(ii) Fix on the inventory itinerary according to the GPS maps in office;

(iii) Find out the coordinate of the sampling plots in the GPS maps;

(iv) Find the corresponding location in the field according to the coordinates of the designed sampling plots;

(v) Adopt round sampling plots, the distance between the plots is generally 100 meters;

(vi) The principle of the plots distributing is trying best to make the plots cover all the sub-compartment;

(vii) The number of the sampling plots is decided according to the area of the sub-compartment, if the area is less than 1 ha, 1 or 2 plots, if the area is 1 to 5 ha, 2 to 3 plots will be designed.

Volume equation: $V = 1.774597E - 02 - 4.299255E - 03 \times D + 2.008136E - 04 \times D^2 + 4.94599E - 04 \times D \times H + 1.125969E - 05 \times D^2 \times H - 1.782894E - 03 \times H$

(2) Inventory team

Guangxi Stora Enso Forestry Inventory and Design Team has 11 technicians right now. Among the team members, 2 are senior engineers, 1 is engineer, 1 is assistant engineer and 7 are technicians. In 2007, the team was expanded to 8 groups, and there are 24 technicians.

(3) Equipment in use.

The SEGX inventory team has advanced and complete set of equipments, including computer, printers specialized in maps making, GIS software and GPS, as well as a number of necessary tools for inventory, such as compass, height measurer, measuring ropes, tripods, calipers, measuring tapes, steel rulers for trees measuring etc.

2.6.1.4 Results of eucalyptus growth survey of the forest base

(1) Plantation practice of SEGX in 2002-2004

From the 205 sub-compartments of completed survey, the projected 7-year growth is $MAI > 2.2 \text{ m}^3/\mu$ ($33 \text{ m}^3/\text{ha.}$). These sub-compartments are distributed in the places of SEGX of different site conditions.

From the existing 20166 μ (1344.4 ha.) of stands, the projected 7-year growth is

MAI >2.2 m³/mu. The data of survey are shown in Table 2.6-2 and Table 2.6-3.

- Self plantation and bought forests in 2002-2004.
- The annual average growth of 14% of the self-plantation forest of SEGX reaches >2.2 m³/mu.
- The annual average growth of 5% of the bought forest of SEGX reaches >2.2 m³/mu.

Table 2.6-2 Investigated Data for Eucalyptus Growth

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Table 2.6-3 Statistical Results of Sample Plot Survey

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(2) Since 2007, SEGX started to launch a program of new afforestation targeting to increase 30% of eucalyptus growth as the follows:

- New clonal species (by emphasizing the “air-dried pulp production, i.e AD t/mu: Annual average growth * pulping rate * survival rate);
- New practice of fertilization.
- New fertilizer formula (applying scientific fertilizing according to the soil test).
- Conduct nutrition monitoring for the 18-month stands (soil and leaf sampling).
- Improve the method of site preparation in hilly areas.
- Apply regulating and weeding during the period of 1-3 years, ensuring no competition from grasses in this special growth period.
- Implement the management system.
- After felling, the barks, branches and litter should be retained in the forestland.

(3) Growth and yield models for eucalyptus

On the basis of actual inventory sampling, Stora Enso, at the level of macrostands (sub-compartment strata with same specie, age class, growth condition, ownership, and potential productivity) and according to the Law of Large Numbers, the growth and yield of fully stocked eucalyptus plantations is described by the following logistic function:

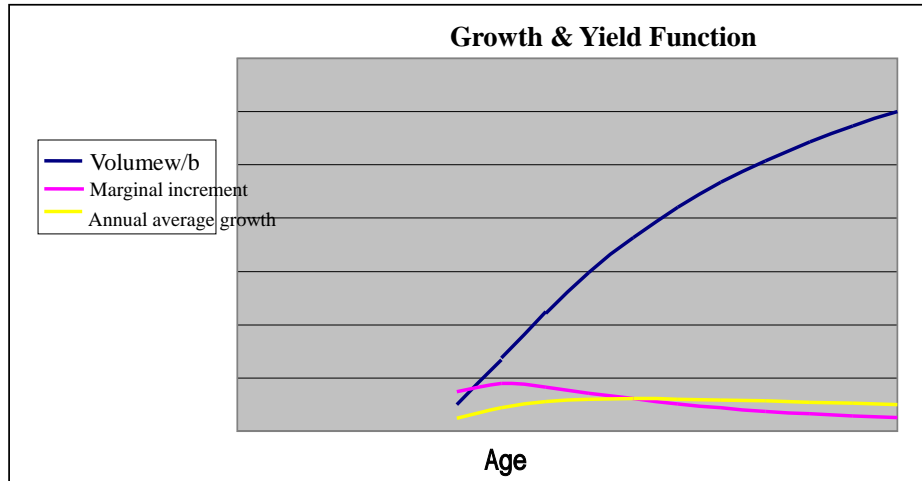
$$V = e^{a + \frac{b}{t}} \quad t^3 \quad 2$$

Where: V – volume outside bark (in m³ / ha.)

t – plantation age in years from planting

a, b – parameters that depend on productivity capacity class

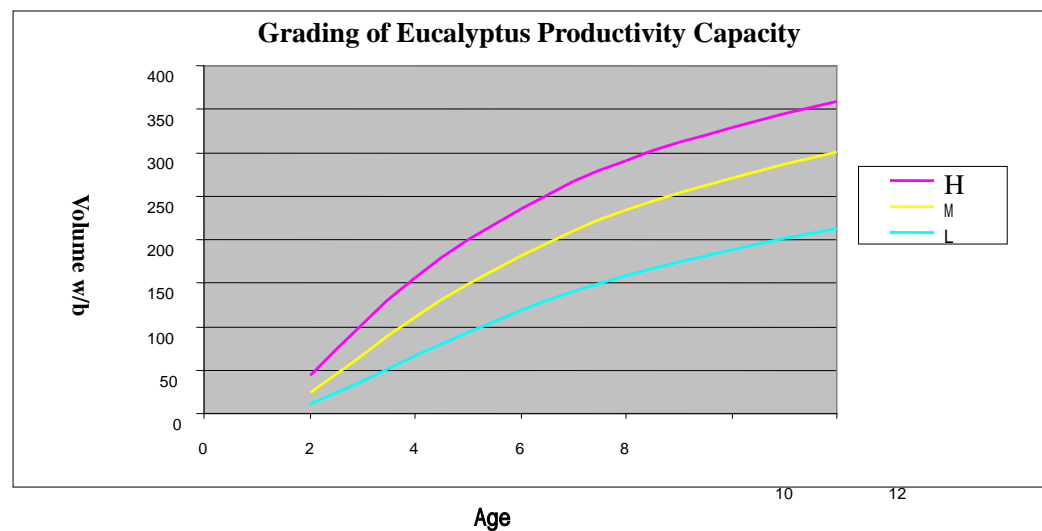
The general form of the growth & yield function is:



SEGX areas are classified accordingly to its productivity capacity class for the best-known economically efficient silviculture on the land of interest. Using these estimates and the inventory data we classified the forestland in three groups:

Productivity capacity class					
Tree species	Productivity Capacity Class		MAI7	b	a
Acacia	L	Low	4.00	-16.00	5.62
	M	Medium	12.00	-12.00	6.15
	H	High	20.00	-8.00	6.08
Eucalyptus	L	Low	20.00	-7.00	5.94
	M	Medium	30.00	-6.00	6.20
	H	High	38.00	-5.00	6.30
Mixed species	L	Low	12.00	-11.50	6.07
	M	Medium	21.00	-9.00	6.28
	H	High	29.00	-6.50	6.24

For eucalyptus, the corresponding yield classes are:



It can be seen that, the eucalyptus of medium productivity capacity can reach a stand of 210 m³/ha (2.0 m³/mu.a) at the seventh year, while that of high capacity eucalyptus can reach 266 m³/ha (2.53 m³/mu.a). According to the experiences, Stora Enso holds the view that the designed growth of the forest base is 2.2 m³/mu.a is feasible.

2.6.2 Scope Matching Analysis for Pulp Forest Base and Pulp Mill

According to the production scope of pulp mill, the annual requirement of wood raw material upon full production shall be 3.3971 million m³, demanding a total volume of standing growing stock of 4.5295 million m³ at 75% of output rate.

The total area of the raw material base is 2.4 million mu. Assuming the cutting rotation is 6 years (i.e. 0.4 million mu per year), and the growing stock is 11.32 m³/mu (annual average growth is 1.89m³/mu), the output can meet with the requirement on wood raw material of the pulp mill. In the engineering design, when the growth of eucalyptus reaches 2.20 m³/mu, the pulp forest base can satisfy the wood requirement of the pulp mill.

From the results of sample field survey, the average annual growth of the existing fast-growing and high-yield eucalyptus of Guangxi is 1.50-1.60m³/mu. In some state-owned forest farms with better management, the annual average growth has reached 1.90-2.00 m³/mu. This is to say that, the annual average stock of the forest stands under good management has exceeded the minimum requirement of the pulp mill on stock growth.

The EIA has doubts on the productivity capacity of 2.2 m³/mu.a of the forest base. Nevertheless, taking 2.4 million mu of eucalyptus plantation of this project as a whole, the annual average growth of 1.6 m³/mu.a can satisfy 85% of the production demand of paper pulp mill of 900000T/a capacity.

Based on the analysis of the sample field, under the existing forestry management capacity, the annual growth of eucalyptus stand in Guangxi has reached 1.6m³/mu. As for this project, the pulp forest base is located in the places that have relatively better conditions of water and heat. The growth of eucalyptus is higher than the nationwide average level. In terms of forestry management, 60% of the forest base of this project are of state-owned forestland, of which, the annual average growth of eucalyptus stand have already reached as high as 1.90-2.00 m³/mu. After implementation of this project, Stora Enso will adopt unified management measures and anticipate to further increase the growth of forest stands.

Therefore, the proposed 2.4 million mu of raw material forest base can basically satisfy the requirement of raw materials by the paper & pulp mill of 900,000T/a., and thus the construction scope of the pulp forest base can match with the planned scale of the paper & pulp mill.

2.6.3 Risk analysis on increasing wood stocks through social purchases

The basic principle of the forest, pulp and paper integration project of Stora Enso is self-sufficiency in supply of wood raw materials, i.e. through adopting scientific management to increase the growth of the plantation. However, in case of insufficiency in supply of raw materials to the pulp mill that is temporarily caused by forest fire, typhoon or

frost damages, or in case of short supply of wood caused by the proportion of plantation of mixed forests, the project may consider to supplement the volume through purchasing wood from the society.

Stora Enso has worked out an efficient monitoring and management system for purchasing social wood stock. The system for monitoring and management is:

Stora Enso actively works to combat illegal logging wherever the Group operates. It has a tracing system for all the woods purchased. The whole process from the forestland / forest base to the pulp mill is under monitoring and documented, including the purchase agreement, source of wood, internal audit and external audit (ISO, FSC China etc.). Any purchases from illegal logging identified shall be ceased.

When signing purchase agreement, Stora Enso requires to have copies of all necessary documentation that can certify that the woods are from legal sources. The agreement also stipulates the terms and conditions for sustainability. In addition, the logging point will be recorded in the GIS database of Stora Enso to enable the traceability of wood purchased. This system serves for the internal audit and can be used in passing audit of ISO, FSC chain of custody, FSC wood control and other similar certifications.

To promote sustainable forestry practices, Stora Enso also participates in developing forestry certification, and certifies its own forestry operations. In China, SEGX's plantations are a pilot site for China's national forest certification scheme, and the company actively participates in the development of FSC China.

Under this management model, the risks of supplementary social purchases can be minimized.

3 Survey and Assessment of Existing Conditions of Ecological Environment

3.1 Brief introduction to the Natural Environment

3.1.1 Geographical location

Guangxi is located in the southern area of China neighboring the Yungui Plateau to the west, hilly areas of the Five Ridges to the north and facing to the Beibu Gulf to the south. It is the unique autonomous minority region that has the advantages of adjoining sea, river and border.

The project area is located in the south of Guangxi, covering 15 countries (cities and districts) of such 4 cities as Beihai, Fangchenggang, Yulin and Chongzuo as well as the eight state-owned forestry farms of Gaofeng Group. Geographically, it is located in 106°38'~110°40'E and 21°24'~24°03'N, neighboring with Wuzhou City and Zhanjiang City of Guangdong Province to the east, Daxin and Ningming counties of Chongzuo City to the west, the Beibu Gulf to the south and Nanning City and Liuzhou City to the north. The geographical location is shown in Figure 3-1.

3.1.2 Landforms

The project area is situated in the south of Guangxi featured primarily by hills and plains and next to hill hills.

As a whole, the landform slants from the north to the south and surrounded by mountains from three sides and facing to the sea in the south. The peak mountain in this area is Shuliang Ridge of Shangsi county of Fangchenggang City if 1462.0m above the sea. Generally the elevation of the project area is 300-500, while the elevations of Beihai and Fangchenggang city is below 300m. The gradients of the forest land are normally at 10-25 degree providing with gentle topography that is suitable for eucalyptus intensive operation.

The topographical and geographical characteristics of the project area are respectively shown in Figure 3-2 and Figure 3-3.

3.1.3 Meteorological Conditions

The project area is located to the south of the Tropic Cancer belonging to the monsoon climate in the south subtropical zone and north tropic zone where long summer and short winter, abundant heat and rainfall. Rainfall and heat are in the same season. The annual average temperature is 20.8~22.9 , with coldest month in January at average temperature of 12 and hottest month in July at average temperature of 28 . The extreme minimum and maximum temperatures are respectively -2.3 and 39.2 . The annual active accumulated temperature of ≥ 10 are 7500~8100 and the annual average sunshine hours are 1600 hours. The annual average precipitation is 1150~2820mm, evaporation is 1130~1700mm, relative humidity 75-85% and frost-free period 350-363 days. This area is the most suitable area for growing eucalyptus in Guangxi.

The change tendency ratio of the average temperature series of Guangxi during 1961 – 2005 is 0.01196 /year, i.e. every 10 years increasing 0.1 , indicating a rising tendency. The actual changes are shown in Figure 3-4.

Figure 3-4 Average Temperature Variation Curve of Guangxi ()

Guangxi has obvious characteristics of subtropical monsoon circulation. The spring and summer are mainly controlled by the current from sea, with prevailing south wind; the autumn and winter are affected by the north current from inland, with prevailing north wind. The project are is centralized at Beihai City, facing the sea to the south. The climate is regulated by the sea, forming a local day-night changing air current – sea-land breeze. The sea-land breeze frequency and average wind speed of all seasons are shown in Table 3.1-1.

Table 3.1 –1 Statistics of Frequency of Sea-Land Breeze and Average Wind Speed of All Seasons

Category		Winter (Jan.)	Spring (April)	Summer (July)	Autumn (Oct.)
Sea wind SW ~ SE	Climate frequency (%)	14	28	70	15
	Average wind speed (m*s ⁻¹)	1.5	2.6	3.4	1.7
Inland wind NW ~ NE	Climate frequency (%)	68	40	8	62
	Average wind speed (m*s ⁻¹)	3.1	3.0	2.5	3.3

3.1.4 Hydrology and Water Resources

The project area has abundant surface water resources for production, irrigation and domestic living. There are Zuojiang river, Yongjiang River, Yujiang River, Nanliujiang river, Datongjiang River, Jiuzhoujiang River, Rongjiang River, Beilunhe River, Jiangpingjiang River, Fangchengjiang River, Mingjiang River and Maolingjiang River, with total catchments area of 65270km². These rivers belong to the Pearl River System and river valleys of rivers located in the coastal areas of south Guangxi.

Among them, Nanliujiang, Wulijiang, Qinjiang and Maolingjiang rivers of Yulin city, as well as Beilunhe river of Fangcheng District belong to the river valleys of coastal rivers of southern Guangxi and finally enter the Beibu Gulf. Other rivers of the project are belongs to the Pearl River System.

The water system distribution of the project is shown in Figure 3-5.

3.1.5 Current water quality of the project area

1. Results of routine monitoring of water quality

The routine monitoring results of water quality for 2007 within the project area

respectively in high-water period, low-water period and ordinary period are shown in Table 3.1-2 – 5. From the data, it can be seen that, the water quality of the river sections in the project area under routine monitoring can conform to the requirement respectively. Most of them conform to the Class-III quality (with exception to Hengfeng section of Qinjiang river, where the ammonia nitrogen exceeds class-III but conforms to class-IV). Such indicates that the surface water of the project area is in good condition.

The monitoring results for centralized drinking water sources of the project area are shown in Table 3.1-6. Due to the adjacency to the urban areas and impacts of human activities, some indices exceed the standards. The water quality of Beihai city is affected by geological factors. All of them fail to conform to the standard.

2. Water quality monitoring results in raw material forest bases

With the help of Hepu Forestry Bureau, on April 11, 2008, Beihai Environmental Monitoring Central Station conducted quality monitoring for the ground water and surface water of the forest bases of the project area. Two points for surface water, respectively in Kenkou pond (reservoir) of Chenwu village of Gongguan town and Wulijiang river; six points for ground water (human drinking wells), respectively in Shankou farm, Yangjiatun village of Gongguan town, Quzhang police station, Bainiupo village, Pailou village, Taiping village of Shikang town. These points are located within the forest bases. The monitoring results are shown in Table 3.1-7, Table 3.1-8 (average value). In Beihai area, except the pH value is slightly exceeding due to geographical structure, other parameters of water quality conform to the standards.

3.1.6 Soil

3.1.6.1 Distribution of Soil Types

The zonal soil of the project area is mainly of latosolic red soil, while the southern areas of Beihai city and the coastal areas of Fangchenggang City belong to lateritic soil. In the hills and plains, the soils of forestland are latosolic red soil and lateritic soil. In the low hill areas of 500-800 m of elevation are mountain red soil, with partial local mountain red soil. All the latosolic red soil, lateritic soil and mountain red soil belong to acid soil with pH value between 4.5 – 6.5. The latosolic red soil is thin in thickness and has low fertility. Lateritic soil has moderate thickness of soil, with intermediate level of fertility. Mountain red soil is thick and has above-average fertility. In addition, in some local places are distributed with little quantity of purple soil.

The distribution of soil types of the project area is shown in Figure 3-6.

Table 3.1-2 Annual Average Monitoring Results of Surface Water Quality in Routine Sections of Project Area in 2007

SL.	Stations	Rivers	Sections	Class of Quality	pH	Permanganate Index	BOD ₅	NH ₃ -N	Nitrates	Phenols
1	Yulin city	Beiliujiang	Ziliang Ferry	III	7.37	2.03	1.71	0.443		0.002
2	Chongzuo city	Guichunhe	Detian	I	8.22	0.98	1	0.091		0.001
3	Chongzuo city	Xialeihe	Na'an	III	8.08	0.96	1.38	0.72		0.001
4	Chongzuo city	Heishuihe	Xinli	II	7.89	0.99	1	0.143		0.001
5	Chongzuo city	Shuikouhe	Bajiao power station	II	8.01	1.13	1	0.135		0.001
6	Chongzuo city	Pingerhe	Ping'erguan	II	8.04	1.72	1	0.127		0.001
7	Chongzuo city	Mingjiang	Nanong	II	7.1	3.06	1.14	0.234		0.001
8	Chongzuo city	Zuojiang	Quduo	II	7.86	1.47	1	0.103		0.001
9	Nanning city	Zuojiang	Shangzhong	II	7.88	1.69	1	0.12		0.0009
10	Nanning city	Youjiang	Yanjiang	III	7.8	2.66	1	0.444		0.0009
11	Nanning city	Yongjiang	Laokou	II	7.92	1.99	1	0.191		0.0009
12	Nanning city	Yongjiang	Shuitangjiang river	III	7.87	2.36	1	0.592		0.0008
13	Nanning city	Yongjiang	Pumiao	IV	7.89	2.6	1	0.558		0.0009
14	Nanning city	Yujiang	Nan'an	III	7.78	2.61	1	0.254		0.0008
15	Yulin city	Nanliujiang	Liusi bridge	III	7.21	3.54	1.94	0.864		0.002
16	Yulin city	Nanliujiang	Hengtang	III	7.35	2.72	1.79	0.442		0.0021
17	Beihai city	Nanliujiang	Jiangkou bridge	II	7.54	3.63	1.6	0.268		0.0011
18	Beihai city	Nanliujiang	Nanyu	II	7.35	3.46	1.96	0.36		0.0011
19	Beihai city	Nanliujiang	Yaqiao bridge	II	7.46	3.34	1.99	0.358		0.0015

20	Beihai city	Wulijiang	Dongbianyong	II	7.38	3.23	1.74	0.313		0.0014
21	Yulin city	Jiuzhoujiang	Wenche bridge	III	6.81	2	1.87	0.913		0.0021
22	Fangchenggang city	Beilunhe	Dongxing paper mill	IV	6.94	2.73	1.63	0.913		0.001
23	Fangchenggang city	Fangchengjiang	Santan	III	7.01	2.71	1.38	0.541		0.001
24	Qinzhou city	Qinjiang	Youth watergate	II	7.31	2.16	1	0.412	0.04	0.001
25	Qinzhou city	Qinjiang	Hengfeng	IV	7.15	4.07	1.28	1.074	0.02	0.001
	Standards	(GB3838-2002)		III	6—9	6	4	1		0.005

Table 3.1-3 Monitoring Results of Surface Water Quality in Routine Sections in High-Water Period of Project Area in 2007

SL.	Stations	Rivers	Sections	Class of Quality	pH	Permanganate Index	BOD ₅	NH ₃ -N	Nitrates	Phenols
1	Yulin city	Beiliujiang	Ziliang Ferry	III	7.52	2.14	1.61	0.6		0.002
2	Chongzuo city	Guichunhe	Detian	I	8.11	1.08	1	0.064		0.001
3	Chongzuo city	Xialeihe	Na'an	III	8.01	1.08	1	0.904		0.001
4	Chongzuo city	Heishuihe	Xinli	I	8.01	0.98	1	0.134		0.001
5	Chongzuo city	Shuikouhe	Bajiao power station	II	8.09	1.08	1	0.056		0.001
6	Chongzuo city	Pingerhe	Ping'erguan	II	8.01	1.65	1	0.037		0.001
7	Chongzuo city	Mingjiang	Nanong	III	6.9	3.55	1.25	0.284		0.001
8	Chongzuo city	Zuojiang	Quduo	I	7.84	1.54	1	0.086		0.001
9	Nanning city	Zuojiang	Shangzhong	II	7.87	1.84	1	0.13		0.0008
10	Nanning city	Youjiang	Yanjiang	IV	7.79	2.82	1	0.409		0.0008
11	Nanning city	Yongjiang	Laokou	II	7.92	1.97	1	0.146		0.0007
12	Nanning city	Yongjiang	Shuitangjiang river	III	7.93	2.56	1	0.345		0.0007
13	Nanning city	Yongjiang	Pumiao	IV	7.92	2.9	1	0.372		0.0008
14	Nanning city	Yujiang	Nan'an	IV	7.66	2.73	1	0.106		0.0006
15	Yulin city	Nanliujiang	Liusi bridge	III	7.36	3.01	1.71	0.69		0.002
16	Yulin city	Nanliujiang	Hengtang	III	7.36	2.65	1.74	0.408		0.002
17	Beihai city	Nanliujiang	Jiangkou bridge	III	7.5	3.15	2.05	0.311		0.0013
18	Beihai city	Nanliujiang	Nanyu	III	7.39	3.22	2.46	0.388		0.001
19	Beihai city	Nanliujiang	Yaqiao bridge	III	7.45	3.08	2.53	0.384		0.0018
20	Beihai city	Wulijiang	Dongbianyong	III	7.28	3.29	2.55	0.438		0.0015
21	Yulin city	Jiuzhoujiang	Wenche bridge	III	6.8	1.56	1.68	0.919		0.0023
22	Fangchenggang city	Beilunhe	Dongxing paper mill	IV	6.87	2.51	2	0.943		0.001

23	Fangchenggang city	Fangchengjiang	Santan	III	6.75	2.73	1.13	0.368		0.001
24	Qinzhou city	Qinjiang	Youth watergate	III	7.08	2.29	1	0.322	0.08	0.001
25	Qinzhou city	Qinjiang	Hengfeng	IV	7.04	3.75	1.08	0.993	0.04	0.001
	Standards	(GB3838-2002)		III	6—9	6	4	1		0.005

Table 3.1-4 Monitoring Results of Surface Water Quality in Routine Sections in Low-Water Period of Project Area in 2007

SL.	Stations	Rivers	Sections	Class of Quality	pH	Permanganate Index	BOD ₅	NH ₃ -N	Nitrates	Phenols
1	Yulin city	Beiliujiang	Ziliang Ferry	III	7.24	1.29	1.76	0.359		0.002
2	Chongzuo city	Guichunhe	Detian	I	8.31	0.93	1	0.1		0.001
3	Chongzuo city	Xialeihe	Na'an	II	8.14	0.75	1.25	0.485		0.001
4	Chongzuo city	Heishuihe	Xinli	II	7.89	0.93	1	0.173		0.001
5	Chongzuo city	Shuikouhe	Bajiao power station	I	8	1.03	1	0.093		0.001
6	Chongzuo city	Pingerhe	Ping'erguan	II	8.05	1.78	1	0.097		0.001
7	Chongzuo city	Mingjiang	Nanong	II	7.25	2.36	1	0.174		0.001
8	Chongzuo city	Zuojiang	Quduo	II	7.87	1.31	1	0.114		0.001
9	Nanning city	Zuojiang	Shangzhong	II	7.94	1.54	1	0.101		0.001
10	Nanning city	Youjiang	Yanjiang	II	7.9	2.23	1	0.451		0.001
11	Nanning city	Yongjiang	Laokou	II	7.96	1.88	1	0.229		0.001
12	Nanning city	Yongjiang	Shuitangjiang river	III	7.9	2.22	1	0.726		0.001
13	Nanning city	Yongjiang	Pumiao	III	7.92	2.54	1	0.693		0.001
14	Nanning city	Yujiang	Nan'an	II	7.93	2.53	1	0.419		0.001
15	Yulin city	Nanliujiang	Liusi bridge	III	6.94	3.32	1.89	0.911		0.002
16	Yulin city	Nanliujiang	Hengtang	III	7.52	2.3	1.8	0.336		0.0023
17	Beihai city	Nanliujiang	Jiangkou bridge	III	7.63	4.48	1.35	0.299		0.001
18	Beihai city	Nanliujiang	Nanyu	II	7.44	3.73	1.75	0.394		0.0013

19	Beihai city	Nanliujiang	Yaqiao bridge	II	7.56	3.63	1.82	0.448		0.0013
20	Beihai city	Wulijiang	Dongbianyong	II	7.53	3.1	1.13	0.322		0.0013
21	Yulin city	Jiuzhoujiang	Wenche bridge	III	6.78	2.03	1.84	0.916		0.002
22	Fangchenggang city	Beilunhe	Dongxing paper mill	IV	7.05	3.13	1.5	0.94		0.001
23	Fangchenggang city	Fangchengjiang	Santan	III	7.17	2.75	1.75	0.761		0.001
24	Qinzhou city	Qinjiang	Youth watergate	III	7.48	1.8	1	0.511	0.03	0.001
25	Qinzhou city	Qinjiang	Hengfeng	IV	7.35	3.56	1	1.357	0.01	0.001
	Standards	(GB3838-2002)		III	6—9	6	4	1		0.005

Table 3.1-5 Monitoring Results of Surface Water Quality in Routine Sections in Ordinary Water Period of Project Area in 2007

SL.	Stations	Rivers	Sections	Class of Quality	pH	Permanganate Index	BOD ₅	NH ₃ -N	Nitrates	Phenols
1	Yulin city	Beiliujiang	Ziliang Ferry	III	7.35	2.67	1.75	0.37		0.002
2	Chongzuo city	Guichunhe	Detian	I	8.24	0.94	1	0.106		0.001
3	Chongzuo city	Xialeihe	Na'an	III	8.08	1.04	1.8	0.761		0.001
4	Chongzuo city	Heishuihe	Xinli	I	7.81	1.06	1	0.126		0.001
5	Chongzuo city	Shuikouhe	Bajiao power station	II	7.96	1.26	1	0.232		0.001
6	Chongzuo city	Pingerhe	Ping'erguan	II	8.07	1.74	1	0.223		0.001
7	Chongzuo city	Mingjiang	Nanong	III	7.15	3.28	1.17	0.243		0.001
8	Chongzuo city	Zuojiang	Quduo	II	7.88	1.55	1	0.109		0.001
9	Nanning city	Zuojiang	Shangzhong	II	7.83	1.7	1	0.129		0.0009
10	Nanning city	Youjiang	Yanjiang	IV	7.7	2.93	1	0.47		0.0009
11	Nanning city	Yongjiang	Laokou	III	7.87	2.13	1	0.198		0.0009
12	Nanning city	Yongjiang	Shuitangjiang river	III	7.79	2.3	1	0.705		0.0008
13	Nanning city	Yongjiang	Pumiao	IV	7.83	2.37	1	0.608		0.0008
14	Nanning city	Yujiang	Nan'an	III	7.76	2.58	1	0.237		0.0008
15	Yulin city	Nanliujiang	Liusi bridge	IV	7.34	4.3	2.21	0.991		0.002
16	Yulin city	Nanliujiang	Hengtang	III	7.16	3.2	1.83	0.581		0.002
17	Beihai city	Nanliujiang	Jiangkou bridge	II	7.5	3.27	1.41	0.194		0.001
18	Beihai city	Nanliujiang	Nanyu	II	7.16	3.41	1.52	0.266		0.0009
19	Beihai city	Nanliujiang	Yaqiao bridge	II	7.34	3.3	1.54	0.219		0.0014

20	Beihai city	Wulijiang	Dongbianyong	II	7.32	3.3	1.53	0.179		0.0015
21	Yulin city	Jiuzhoujiang	Wenche bridge	III	6.87	2.43	2.1	0.905		0.002
22	Fangchenggang city	Beilunhe	Dongxing paper mill	IV	6.92	2.54	1.38	0.856		0.001
23	Fangchenggang city	Fangchengjiang	Santan	II	7.13	2.66	1.25	0.495		0.001
24	Qinzhou city	Qinjiang	Youth watergate	II	7.37	2.39	1	0.404		0.001
25	Qinzhou city	Qinjiang	Hengfeng	IV	7.08	4.9	1.75	0.872		0.001
	Standards	(GB3838-2002)		III	6—9	6	4	1		0.005

Table 3.1-6 Monitoring Results of Centralized (Urban) Drinking Water Source Quality of Project Area

City	Names of Water Sources	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
Nanning city	Sanjin water works	√	√	√	√	√	√	√	√	√	√	√	√
	Chencun water works	√	√	√	√	√	√	√	Excessive	√	√	√	√
	Xijiao water works	√	√	√	√	√	√	√	√	√	√	√	√
	Zhongyao water works	√	√	√	√	√	√	√	Excessive	√	√	√	√
	Henan water works	√	√	√	√	√	√	√	√	√	√	√	√
	Qingshuiquan spring	Excessive	Excessive	Excessive	Excessive	Excessive	√	Excessive	Excessive	Excessive	Excessive	Excessive	Excessive
Beihai city	Haicheng District water works	○	○	○	○	○	○	-	○	○	○	○	○
	Houtang water works (ground water source)	○	○	○	○	○	○	○	○	○	○	○	○

	Hetang water works (ground water source)	○	○	○	○	○	○	○	○	○	○	○	○
	Houtang water works (ground water source)	○	○	○	○	○	○	○	○	○	○	○	○
Fangchenggang city	Mutoutang	√	√	√	√	√	√	√	√	√	√	√	√
Qinzhou city	Youth watergate	√	Excessive	√	√	√	√	√	√	√	√	√	√
Yulin city	Suyan Reservoir	√	√	√	√	√	√	√	√	√	√	√	√
	Wanjiao	√	√	√	√	√	√	√	Excessive	√	√	√	√
Chongzuo city	Chongzuo water works	√	√	√	√	√	√	√	√	√	√	√	√

Notes: “√” stands for “satisfying standard”; “Excessive” stands for “exceeding the standard”. The water quality of Beihai City cannot satisfy the standards due to the geological reasons, marking as “○”.

Table 3.1-7 Monitoring Results for Ground Water Quality (Average)					Unit: mg/l, except for pH			
Name of Location	Longitude & Latitude	Distance to Forestland	pH	COD _{Mn}	Total Nitrogen	Total P	NH ₃ -N	
Office campus of Shankou forestry farm	21°34.786N 109°42.704E	50m to eucalyptus, well depth 60m	4.0	0.5 L	4.33	0.01L	0.025 L	
Yangjiatun village of Gongguan town	21°47.066N 109°33.809E	50m to eucalyptus, well depth 4 m	7.1	0.6	0.19	0.01	0.107	
Quzhang police station	21°51.087N 109°33.675E	50m to eucalyptus, well depth 60 m	4.9	0.5	0.28	0.03	0.171	
Bainiupo village	20°49.328N 109°27.683E	60m to eucalyptus, well depth 7 m	6.1	0.7	12.72	0.01L	0.107	
Pailou village	21°52.110N 109°19.161E	40 m to eucalyptus, well depth 9 m	4.4	0.5	8.60	0.01	0.040	
Taiping village	21°46.410N 109°20.282E	150 m to eucalyptus, well depth 8 m	6.5	0.5	1.45	0.14	0.140	
Class-III, GB/T14848-93			6.5 ~ 8.5	≤3.0	-	-	≤0.2	
Comments			pH value of ground water in Beihai is meta acid due to the geological structure	Satisfying standard			Satisfying standard	

Table 3.1-8 Monitoring Results for Surface Water Quality (Average)								Unit: mg/l, except		
			for pH							
Name of Location			Longitude Latitude	& Distance Forestland	to pH	COD _{Mn}	Total Nitrogen	Total P	NH ₃ -N	DO
Kenkou pond of Chenwu village of Gongguan town			21°47.043N 109°33.541E	Eucalyptus around the pond	7.1	2.9	0.86	0.01	0.219	7 . 7
Wulijiang river			21°52.732N 109°18.238E	Eucalyptus along riversides	7.1	2.9	0.92	0.06	0.700	7 . 1
Class-III, GB3838-2002					6 ~ 9	≤6	≤1.0	≤0.2 (lake, reservoir 0.05)	≤1.0	≥5
Comments					Satisfying standard	Satisfying standard	Satisfying standard	Satisfying standard	Satisfying standard	Satisfying standard

3.1.6.2 Soil Quality of Forestland

The quality of soil is an important factor that determines the functions of water preservation, water induction, nutrient keeping, nutrient supplying, temperature keeping and temperature conducting etc. The main factor that affects the soil quality is the physical clay content of soil that increases the stickiness of soil, whilst the clay content of soil is closely related to the soil-forming rock. Different soil-forming rocks will result in different types of soils, and, consequently in different soil quality.

According to *Guangxi Soil* and the analysis of the site survey results for the forestland of the project area, the soil formed by laterite parent material of the Quaternary Period, shale and the parent material of limestone efflorescence is more sticky. The soil quality formed by the parent materials of sandstone and river alluvium is moderate. The soil formed by the parent materials of sandstone, granite and shallow sea sediments etc. is comparatively lighter.

Viewing from the distribution of the soil-forming rocks, Jiangzhou district, Fusui county, Qipo farm, Dongmen farm, Gaofeng farm and Liangfengjiang farm are featured by larger area of distribution of laterite parent material of the the Quaternary Period and limestone, with larger proportion of clay loam and clay. Yulin city and Fangchenggang city are featured by large area of granite, while Beihai city is featured with large area of shallow-sea sediments. The clay contents of the zonal soils tend to gradually, in general, increase from the south to the north and from the high to the low.

The correlation between the soil quality and types of parent materials are shown in Table 3.1-9.

Table 3.1-9 Correlation Between Soil Quality And Types Of Parent Materials

Type of parent materials	Physical cosmid ($\zeta < 0.01\text{mm} =$; content (%)		Soil quality
	Amplitude	Average value	
Laterite soile	48.0 ~ 85.0	55.5	heavy-soil to medium clay
Sandstone	16.2 ~ 29.9	21.8	sand soil – light soil
Sandshale,	28.2 ~ 65.0	50.9	light soil – light clay
Shale	60.9 ~ 77.5	70.5	light clay – medium clay
Granite	14.1 ~ 58.8	37.1	sand soil – heavy soil
Limestone	57.7 ~ 72.0	55.4	heavy-soil – light clay
Purple sandstone	12.5 ~ 27.0	20.5	sand soil – light soil
Purple sandshale	30.4 ~ 53.7	45.2	medium soil – heavy soil
Purple shale	62.0 ~ 86.8	75.5	light clay – heavy clay
River alluvial	17.1 ~ 64.1	40.6	sand soil – light clay
Neritic deposits	18.6 ~ 36.0	27.3	sand soil – light soil

3.1.6.3 Soil Nutrients of Forestland

Based on the experimental results of the 56 soil samples taken from the existing forest land of the project area, due to the different sources, soil quality and site conditions, the nutrient contents are different to great extent. However, in general, the soil of the forest land of the project area are in acid state, with pH values of 4.02-5.30. The content of organic matter is moderate, at 15.0-30.0g/kg. The content of N is medium, with quick N of 60.0-90.0mg/kg. The content of P is insufficient, being less than 3.0mg/kg. The content of K is medium, with less content of quick-acting K, normally at 10.0-30.0mg/kg. The trace elements such as Cu, Zn and B are lack. Amplitude of variation of soil nutrients of existing forestland of project area is shown in Table 3.1-10.

Table 3.1-10 Amplitude of Variation of Soil Nutrients of Existing Forestland of Project Area

City (farm)	pH	Organic matter (g/kg)	Whole N (g/kg)	Whole P (g/kg)	Whole K (g/kg)	Quick-acting N (mg/kg)	Quick-acting P (mg/kg)	Quick-acting K (mg/kg)	Effective Cu (mg/kg)	Effective Zn (mg/kg)	Effective B (mg/kg)
Chongzuo city	4.21 ~4.59	18.78 ~34.91	0.75 ~1.21	0.56 ~1.40	1.69 ~6.09	54.0 ~86.1	0.6 ~0.7	7.2 ~21.6	0.75 ~1.15	0.55 ~0.90	0.05 ~0.28
Fangchenggang city	4.02 ~4.36	10.99 ~19.80	0.39 ~0.88	0.32 ~0.39	17.38 ~30.77	40.2 ~64.0	0.3 ~0.5	15.6 ~27.6	0.65 ~0.80	0.65 ~0.90	0.07 ~0.16
Beihai city	4.07 ~4.75	4.39 ~72.59	0.22 ~2.25	0.23 ~1.40	1.41 ~40.99	20.2 ~137.3	0.1 ~23.9	3.6 ~74.4	0.20 ~1.15	0.30 ~1.90	0.04 ~0.33
Qinlian forestry farm	4.07 ~5.30	16.83 ~43.63	0.63 ~1.72	0.24 ~0.58	6.28 ~36.43	48.1 ~137.3	0.4 ~2.6	10.8 ~88.8	0.35 ~0.90	0.55 ~1.65	0.05 ~0.33
Yulin city	4.02 ~4.35	16.10 ~30.95	0.71 ~1.23	0.26 ~0.75	1.60 ~40.99	58.0 ~104.6	0.1 ~1.3	7.2 ~22.8	0.20 ~1.05	0.65 ~1.45	0.04 ~0.30

Notes: Qinlian forestry farm in this Table mainly refers to the forest land in Qinzhou city, while the balance land are added to city it belongs to.

3.2 Conditions of Socio-Economic Environment

3.2.1 Socio-economic situation

In 2005, the GDP of Guangxi was RMB 407.575 billion (current year price, hereafter the same), of which, the GDP of the primary industry was RMB 91.25 billion, that of secondary industry was RMB 151.068 billion, that of the tertiary industry was RMB 165.257 billion, respectively accounting for 22.4%, 37.1% and 40.5%.

The average per-capita GDP of Guangxi was RMB 8788. The towners' per-capita average disposable income was RMB 8917. The average per-capita income of rural residents was RMB 2495.

The project area includes 15 counties (cities and districts) of 4 cities and 8 state-owned forestry farms, covering 241 towns, 2365 administrative villages, 78 sub-forestry farm and 214 timbre stations. By the end of 2005, the total population was 8.806 million, including 1.249 million of non-agricultural population and 7.557 million of agricultural population. There was totally 4.170 million of labor force. In 2005, the GDP of this area was RMB72.34 billion, increasing by 13.8% than that of the previous year; and financial revenue was RMB6.12 billion, increasing by 16.8% than that of the previous year. The average per-capita GDP was RMB8240, increasing 13.3% than that of the previous year; the average per-capita financial revenue was RMB695, increasing 16.7% than that of the previous year; the average per-capita farmer's net income was RMB2722, increasing by 12.9% than that of the previous year.

3.2.2 Communication & Transportation

Water and inland transportation are convenient in the project area. Railway runs through in all direction and has covered most of the places. By now, there are a number of serviceable trunk railways such as Xiang-Gui railway, Li-Zhang railway, Nan-Fang railway and Qin-Bei railway. Expressways, highways and country roads have formed transport network. All countries are connected by Class-II or above highways, while all towns are connect by Class-III or above highways. Major navigable waterways are Zuojiang river, Yongjiang river, Yujiang river and Nanliujiang river. In addition, Fangcheng Port and Beihai Port have become the major ports in the South China Sea. All these favorable transportation conditions have provided with great convenience for the construction and logistics of the materials and products for the raw material forest base.

3.2.3 Tele-Communication Conditions

The tele-communication facilities of the project area are available. Line and mobile telephones have covered all towns and villages, and thus providing favorable conditions for the information exchange for the base construction.

In order to strengthen the forest fire prevention, the forestry institutions of all cities (counties), towns, forestry farms and branch farms are equipped with wireless paging system such as interphone. The telecommunication network has covered the whole project area.

3.2.4 Agricultural Production

Guangxi is actively adjusting and optimizing the agricultural structure and developing

the ecological agriculture, giving great efforts to the agricultural integrative development in the areas of grain and sugar production and 10000-yuan field. In 2005, the gross output value of farming, forestry, animal husbandry and fishery of Guangxi was RMB 144.8 billion, of which, RMB 71.189 billion of agriculture, RMB 6.168 billion of forestry, RMB 51.16 billion of animal husbandry, RMB 14.361 billion of fishery and RMB 1.959 billion of service thereof. The total grain production was 15.1629 million tons, oil production 0.6318 million tons, sugar production 51.5469 million tons, cassava production 1.7361 million tons, fruit production 5.7158 million tons, tea production 0.0262 million tons, meat production 4.1860 million tons, and aquatic products 2.8419 million tons.

Guangxi is one of the good places in China that has good combination conditions of water, soil and heat resources that bring about rich varieties of products. Major products are sub-tropical fruits, vegetables, sugar cane, crude-fiber crops, silkworm, medicinal crop, aromatic crop, rosin, tung oil, Sanhuang chicken, milk buffalo and aquatic products etc. By now, the total fruit growing area of Guangxi is over 1.1333 million hm^2 , producing orange, shaddock, banana, lichee, longan and mango etc. Vegetation production focus on growing autumn and winter vegetables, of which the total area is over one million hm^2 . The total area of sugar cane plantation is about 0.6 million hm^2 . More than 866.7 thousand hm^2 of water area are suitable for aquatic cultivation, and the characteristic products of prawn, java tilapia, peal and oyster etc. have occupied a good share in the domestic and international markets.

3.2.5 Labor Resources Conditions

In the project area, there are 4.170 million rural labor force, including 2.148 million of male labors and 2.022 million of female labors. However, the rural average per-capita farmland is only 0.71mu, which only requires a total of 622 thousand labors each year. The surplus labors in rural area would reach 3.548 million people. Therefore, the labor resources are sufficient.

In all, the advantageous location and the unique natural resources in the project area have constituted it as a most suitable place for growing fast-growth and high-yield eucalyptus. At the same, favorable social and economic conditions, adequate labor force and convenient transportation of the project area have endowed with it basic conditions for constructing a large-scale raw material forest base.

3.3 Land Utilization and Soil Erosion

3.3.1 Survey and Assessment of Existing Conditions of Land Utilization

(1) Survey of land use situation

According to the results of the planning and design survey of the forestry resources of Guangxi (2000), the classified forestry operation area (2001), the supplementary survey for forest cutting quota (2005), as well as planning and design statistical results of state-owned forestry farms (2005), the total land area of the 15 counties (cities and districts) and the 8 state-owned farms is 2745171.2hm^2 , including 2667790.9hm^2 of land area, accounting for 97.2%; 77380.3hm^2 of water area, accounting for 2.8%. Among the inland area, there are 1479257.3hm^2 of forest land, accounting for 55.5%; wasteland 5384.0hm^2 , accounting for 0.2%; agricultural land 931462.7hm^2 , accounting for 34.9%; hard-to-use land 79564.8hm^2 , accounting for 3.0%; and other land 172122.1hm^2 ,

accounting for 6.4%. Details are shown Figure 3-7.

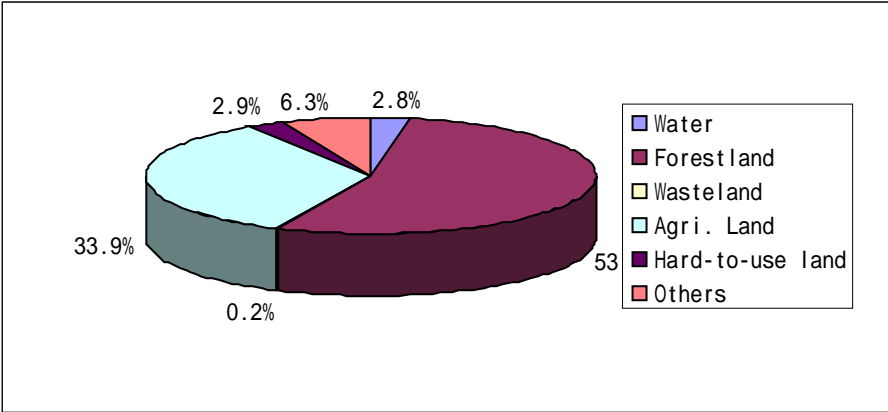


Figure 3-7 Statistics of Land Use Types of Project Area

(2) Assessment of land use situation

The land-use situation assessment herein adopts the 30m spatial resolution multi-spectral image and 15m spatial resolution full-color image of ETM Stateline of the U.S of 1999-2000. According to the relevant documentations, the assessment made interpreting analysis of the existing land-use situation of the pulp forest base, covering 15 counties of the project area and the places where the 8 state-owned forest farms of Gaofeng Group are located (Nanning city, Binyang county, Shanglin county, Wuming county, Yongning county, Ningming county, Pingxiang city, Qinzhou city, Lingshan county and Pubei county). The interpreted land-use existing situation of the project area is shown in Figure 3-8, while the interpreted analytical data are shown in Table 3.3-1.

Table 3.3-1 Present Situation of Land Use in Project Area (Unit: hm²)

Name	Total area	Grassland	Forest Land	Agricultural land	Water catchment	Residential Area	Orchard land	Land use for transportation	Unused Land
Hepu county	3626.42	26.07	1090.87	1695.59	413.55	377.70	1.66	10.91	10.07
Tieshangang district									
Yinhai district									
Fangcheng district	3168.94	266.24	2229.05	444.72	141.69	79.56	2.03	2.39	3.26
Port district									
Dongxing County									
Shangsi County	2819.43	124.04	2168.34	428.62	63.25	30.95	3.86	0	0.37
Beiliu city	2453.84	79.21	1695.83	577.20	16.25	81.57	1.83	1.87	0.08
Bobai County	3820.16	205.50	2713.94	751.99	91.26	53.39	1.10	0	2.98
Luchuan County	1558.06	69.34	1070.77	366.51	23.90	25.63	1.91	0	0.0024
Xingye County	1462.91	45.56	801.08	553.81	12.67	48.57	0	1.22	0
Yulin city (Yuzhou district, Fumian District)	1264.76	25.72	574.46	543.20	19.32	94.61	4.85	2.60	0
Chongzuo city (Jiangzhou district)	2901.35	215.20	1646.31	911.67	44.16	82.49	1.52	0	0
Fusui County	2828.84	281.36	1410.13	990.34	41.53	104.74	0.74	0	0
Nanning	1798.12	120.36	796.05	614.61	81.49	182.22	2.20	1.19	0
Binyang County	2309.67	105.21	926.98	1084.71	65.41	121.58	1.25	3.09	1.44
Shanglin County	1868.44	162.92	1040.31	576.10	36.72	51.58	0.81	0	0
Wuming County	3373.32	145.83	1755.60	1265.33	83.91	121.35	1.30	0	0
Yongning County	4658.15	287.97	2381.60	1742.26	129.58	104.49	1.62	10.63	0
Ningming county	3713.93	259.05	2673.94	664.32	35.56	78.29	1.20	0	1.57
Pingxiang City	646.44	59.39	520.38	48.50	2.01	14.21	0.64	0	1.31
Qinzhou city	4682.82	137.72	2342.81	1749.74	301.23	139.20	1.80	9.13	1.19
Lingshan County	3547.94	264.71	1778.63	1336.40	56.80	110.99	0.41	0	0
Pubei County	2521.35	101.00	1937.38	418.01	35.95	27.66	1.20	0	0.15

Project Area	55024.89	2982.40	31554.46	16763.63	1696.24	1930.78	31.93	43.03	22.42
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The project covers 15 districts and counties, as well as 10 districts and counties under the 8 state-owned forest farms of Gaofeng Group. The total area of these places is 55024.89hm², of which, there are 31554.46 hm² land with forest, accounting for 57.3% of the total area; 2982.40 hm² grassland, accounting for 5.4% ; 16763.63 hm² of agricultural land, accounting for 30.5% ; 1930.78 hm² of residential area for rural, urban and factory, accounting for 3.5% ; 1696.24 hm² of water area, accounting for 3.08%.

3.3.2 Survey and Assessment on the Existing Conditions of Soil Erosion

(1) Rating standards for soil erosion.

In this regard, the rating is made according to soil erosion strength standards of the second nationwide remote-sensing survey, as shown in Table 3.3-2.

Table 3.3-2 Standards for Rating of Soil Erosion

Rating of soil erosion		Relevant Grading Indicators for Surface Erosion	
Rating	Erosion modulus (t/km ² ·a)	Slope Gradients	Vegetation Coverage (%)
Low erosion	<200 , 500 , 1000	<5°	>75
Light erosion	200 , 500 , 1000~2500	5°~8°	60~75
Moderate erosion	2500~5000	8°~15°	45~60
High erosion	5000~8000	15°~25°	30~45
Very high erosion	8000~15000	25°~35°	<30
Severe erosion	>15000	>35°	<10

(2) Survey and analysis of the reasons causing soil erosion in the project area

The project area is located in the coastal area of south Guangxi belonging to the north tropical and south subtropical monsoon climate zones where with frequent disastrous weather such as drought, typhoon and storm etc. Severe typhoon will cause serious damages to the dyke, salt field, marine aquatic farm, agriculture and forestry etc.. With the moving soil particles, the wind erosion may occur. However, the plenty of rainfall along with typhoon will form heavy rain, and subsequently causing soil erosion or collapsing (water eroding). At the same time, the unreasonable construction and human activities, such as large quantity of reclaimed land, cultivation on the slopes and continuous destruction of forest vegetation resulting in exposure of top soil, constructions such as mining and road building without taking measures of soil and water conservation, random dumping of surplus earth that causes intense erosion under the wash of storm water, etc. have added to the soil erosion.

According to the site survey and data collection, the soil erosion of the project area is featured by water erosion. In addition to the factors of geological conditions, landform and climate, unreasonable development and production activities of human being are also the major reasons for the soil erosion.

(3) Survey and assessment on the situation of soil erosion of the project area.

Based on survey, the distribution map of soil erosion of the project area is shown in Figure 3-9. Currently, the total area of land with soil erosion in Guangxi is 2.81 million hm^2 , accounting for 12% of the total area of Guangxi.

Through overlaying analysis with distribution of the pulp forest base and the distribution map of soil erosion of Guangxi, it can be seen that, the total area of land of the project area is 2.7452 million hm^2 , of which, an area of 2.5784 million hm^2 is without soil erosion, accounting for 93.92%; an area of 0.1667 million hm^2 has water and soil erosion, accounting for 6.07% of the total, being less than the average rate of Guangxi.

In the area with soil erosion, an area of 78.7 thousand hm^2 is of slight erosion, 49.3 thousand hm^2 of moderate erosion, 12.20 thousand hm^2 of high erosion, 9.3 thousand hm^2 of serious erosion, and 17.2 thousand hm^2 of especially severe erosion, respectively accounting for 2.87%, 1.80%, 0.44%, 0.34% and 0.63% of the total area, which also account for 47.21%, 29.57%, 7.32%, 5.56% and 10.34% of the area with soil erosion. The erosion modulus of the soil of the project area is $3553.9\text{t}/\text{km}^2\cdot\text{a}$, and the annual volume of eroded soil is $592.53\times 10^4\text{t}/\text{a}$. The proportions of soil erosion situation are shown in Figure 3-10, while the situation of erosion are shown in Table 3.3-3.

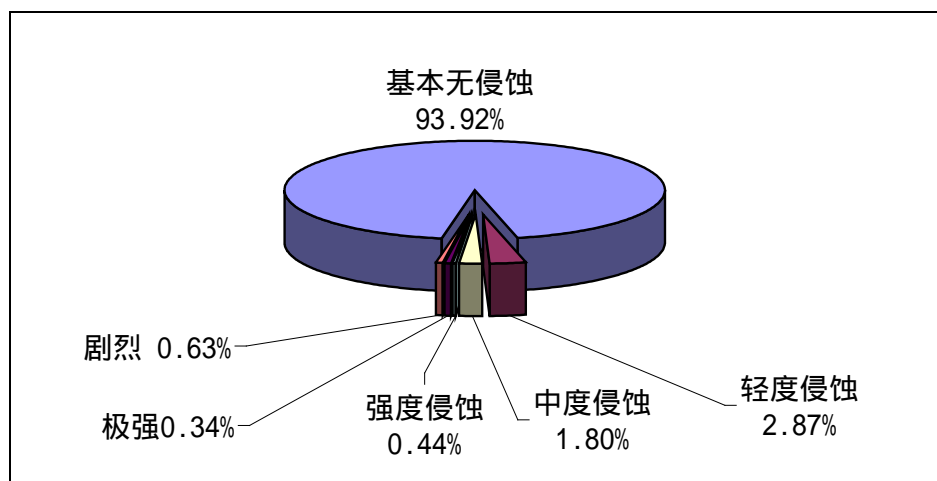


Figure 3-10 Statistics of Types of Soil Erosion of Project Area

Table 3.3–3 Statistical Table for Survey of Present Situation of Soil Erosion

Name	Erosion intensity	Total land area (hm²)	Percentage in total land area (%)	Eroded volume (t/a)	Percentage in total eroded volume (%)
Project Area	Total	27451.71	100.00	592.53	100.00
	Basically without erosion	25784.43	93.92		
	Light erosion	787.18	2.87	137.76	23.25
	Moderate erosion	492.99	1.80	184.87	31.20
	High erosion	122.10	0.44	67.16	11.33
	Serious erosion	92.63	0.34	64.84	10.94
	Especially severe erosion	172.38	0.63	137.90	23.27
Beihai city	Subtotal	3404.45	100.00	151.46	100.00
	Basically without erosion	3172.56	93.19		
	Light erosion	13.23	0.39	2.32	1.53
	Moderate erosion	60.66	1.78	22.75	15.02
	Especially severe erosion	158.00	4.64	126.40	83.45
Fangchenggang city	Subtotal	6004.45	100.00	27.30	100.00
	Basically without erosion	5874.67	97.84		
	Light erosion	106.86	1.78	18.70	68.51
	Moderate erosion	22.92	0.38	8.60	31.49
Yulin city	Subtotal	9955.95	100.00	395.05	100.00
	Basically without erosion	8751.90	87.91		
	Light erosion	570.27	5.73	99.80	25.26
	Moderate erosion	404.67	4.06	151.75	38.41
	High erosion	122.10	1.23	67.16	17.00
	Serious erosion	92.63	0.93	64.84	16.41
	Especially severe erosion	14.38	0.14	11.50	2.91
Chongzuo city	Subtotal	5372.64	100.00	10.77	100.00
	Basically without erosion	5311.12	98.85		
	Light erosion	61.52	1.15	10.77	100.00
Gaofeng Group	Subtotal	2714.22	100.00	7.96	100.00
	Basically without erosion	2674.18	98.52		
	Light erosion	35.30	1.31	6.18	77.66
	Moderate erosion	4.74	0.17	1.78	22.34

According to the investigation, the type of soil erosion in the project area belongs to light erosion, followed by moderate erosion, high erosion, serious erosion and especially severe erosion.

From the above information, it can be seen that, most of the land within the project area are without soil erosion, while among those with soil erosion, the total area with light erosion has accounted for nearly a half. The places with especially severe erosion are mainly distributed in the southern coastal areas of Beihai City that are vulnerable to typhoon and where the soil erosion is caused by the combined force of wind and water erosion. The places with serious erosion are mainly distributed in Xingye county of Yulin city.

3.3.3 Survey and Assessment on Existing Conditions of Land Degradation

The land degradation in Guangxi are mainly represented by stone desertification and land desertification.

(1) Survey and analysis of the reasons causing land degradation.

Currently, Guangxi has a total area of 2.30 million hm² of stone desertified land that are distributed in the karst regions of northwest Guangxi, such as Hechi, Baise, Nanning, Liuzhou and Guilin. Soil formation process of these regions is very slow. Thin soil thickness, plus the steep landform, soil erosion may easily occur under rainfall, and the vegetation would be difficult to restore once it is damaged. The major reasons for such stone desertification are unreasonable development.

The sand desertified lands of Guangxi are mainly distributed in the southern coastal area, i.e. southern areas east from Shankou and Gongguan of Hepu county of Beihai city, west to Dongxing town of Dongxing city. The reasons for sand desertification and development are mainly caused by two reasons, natural and artificial: (i) Sand earths of marine sediment and estuarine deposit become sand-desertified under the long storm washing and wind disturbance; (ii) After vegetation damage by human activities, the soil erosion become deteriorated and formed a new sand-desertified earth under the joint impacts of rainfall and typhoon.

(2) Analysis of the present situation of land degradation of project area.

Through overlaying analysis with distribution of the pulp forest base and the distribution map of stone and sand desertification of Guangxi,

it can be seen that, the pulp forest base of this project is mainly distributed in southern Guangxi, most of which are out of the stony area. Only Jiangzhou and Fusui county of Chongzuo city have some stone-desertified land. According to the statistics, among the total area of 27.452 million hm² of land of the project area, there are only 50400 hm² belonging to stony area (Jiangzhou 38600hm², Fusui county 11800hm²), accounting for 1.8% of the total area.

The total area of 241.9 thousand hm² of sand-desertified land of Guangxi are mainly distributed in the southern coastal areas including Fangchenggang city, Qinzhou city and Beihai city. In this regard, this project only covers Fangchenggang city and Beihai city. From the overlaying map, it can be seen that, except Qinzhou has some desertified land,

most of the desertified land of Guangxi coastal area are distributed in the places covered by the raw material forest base of this project. According to the statistics, among the total area of 27.452 million hm² of land of the project area, there are only 212.5 thousand hm² belonging to desertified land, accounting for 7.7%. However, the total area of the desertified land of the project area has accounted for over 87.8% of the total desertified land of Guangxi.

3.4 Survey of Existing Terrestrial Ecological Conditions

3.4.1 Animal and Plant Resources :

3.4.1.1 Animal and Plant Resources

The total forestland area of Guangxi is 13.6622 million hm², accounting for 57.7% of the total area of Guangxi. The total area of various grassland is 8.699 million hm², accounting for 36.8% of the total thereof.

Guangxi is one of the richest provinces (autonomous regions) in plant resources in China. So far, there are found over 280 families, over 1670 genera and nearly 8000 species of plants, comprising of over 700 plantation series. Among them, trees have 120 families, over 480 genera and 1800 species. There are 113 threatened plants, of which, 3 plants belong to class-I protection, 47 plants belong to grade-II protection and 63 plants of grade-III protection. *Cathaya argyrophylla*, an ancient plant having the name of “plant panda” was found earliest in Guangxi. Other treasure trees are Jianmu of Longzhou, *Abies nephrolepis* of Ziyuan, *Shorea chinensis* of Napo, south hemlock of Mao’ershan mountain, *Hopea chinensis* of Shiwan Mountains, *Alsophila spinulosa* of Guangxi and golden camellia etc. Guangxi has over 600 timber species rich in the production of woods of fir, pine, eucalyptus, oak and other treasure trees. It is also the main production base of famous economic forest, including aniseed, *Cinnamomum cassia*, tung and shellac etc., accounting for 2/3 of the total production volume of China.

In addition, Guangxi also has rich resources of wild animals, totally reaching 944 kinds, including 74 amphibians, 157 reptiles, 526 birds and 163 beasts. Among these wild animals, there are 26 animals under national grade-I protection, 123 animals under national grade-II protection and 146 animals of Guangxi provincial level key protection.

3.4.1.2 Types of Vegetation Community of Project Area

The project area is located in the north tropical and south subtropical zones. The distribution of zonal vegetations is featured by the alternation of different vegetation types with the rise of latitude and decrease of temperature.

According to the Vegetation Distribution Map of Guangxi and Distribution Map for Vegetation Types of Guangxi (Figure 3-12, Figure 3-13), there are three natural vegetation distribution areas in the project area.

- Hill and mountain monsoon forest area in southeast Guangxi, including: Hepu county, Tieshangang district, Yin Hai district, Bobai county, Luchuan county, south of Beiliu county, Fumian district, south of Yuzhou district, south of Xingye county, Fangcheng district, Dongxing city, as well as Qinlian farm, Bobai farm and Liuwan farm etc..

- Stone mountain monsoon forest area in southwest Guangxi, including: Shangsi

county, Jiangzhou district, Fusui county, south of Gaofeng farm, Liangfengjiang, Qipo farm, Dongmen farm and Paiyang farm etc..

· Stone mountain evergreen, deciduous broad-leaf forest and mixed forest in mid Guangxi, mainly including: the north of Beiliu county, north of Yuzhou district, north of Xingye county and north of Liuwan farm, as well as north of Gaofeng forest farm etc.

Viewing from the types of vegetation community, due to human activities, the vegetation types have no longer any traces of natural native vegetation. Most of them have been succeeded by the tropical monsoon forest, evergreen broad-leaf forest or artificial forest. Only some remains of ravine forest are locally found in the micro-environment in valleys. The commonly seen vegetation types are: tropical monsoon forest, monsoon evergreen broad-leaf forest, coniferous forest, theropencedrymion, thin tree low-shrubs, artificial forest, cultivated land vegetation and mangrove, totally eight categories.

Due to the good conditions of climate, water and heat, the vegetation groups grow in good conditions, with over 60% of vegetation coverage.

3.4.2 Eco-Sensitive Areas and Species of Key Protection

The ecological sensitive areas of the project area include natural reserve, soil erosion area, sand desertification area, stone desertification area. The natural reserves consist of wild animals and plants protection zone, forest eco-system protection zone, geological relics protection zone, marine and marine eco-system protection zone.

Among them, there are 7 natural reserves of national level, respectively Fangcheng golden camellia, Hepu Dugong, Nonggang, Damingshan, Shiwan Mountains, Shankou mangrove and Beilunhe marine protection zones. In addition, there are 10 natural reserves of provincial level, respectively Chongzuo white-headed leaf monkey, West Damingshan Mountain, Shanglin Longshan, Weizhou island, Nalin, Sanshiliunong Longkun, Zuojiang river lamprotula mansuyi, Beiliu Dafengmen geological profile of Devonian period, and Maoweihei mangrove natural reserves.

These eco-sensitive places are mainly distributed in Beihai, Fangchenggang, Yulin and Chongzuo, as well in the 8 state-owned forest farm of Gaofeng Group. Details are shown in Map 1-1.

1. Fangcheng Shangyue Golden Camellia Nature Reserve

This natural reserve was established in 1986, and approved by the State Council as the national natural reserve in 1994. It has a total area of 9195 hm², with the major protection targets of golden camellia and forest eco-system.

The protection zone is located within Fangcheng county in the south Guangxi, situating in the Lanshan ridges of the Shiwan Mountains and belonging to the landforms of low hills and coastal tableland. The elevation is 20-1000m, with the peak elevation of 1400m. The annual average temperature is 22.5 . The annual precipitation is 2500-2800mm, locally reaching 3200mm. The rainfall is mainly concentrated in June-September. Soils are red soil, yellow soil and black yellow soil, showing high fertility.

The protection area is the central distribution area for common golden camellia and

Camellia euphlebia. It is also the sole distribution area for Dongxing yellow camellia. Within a small area has concentrated three kinds of golden camellia. In addition, the communities of these three camellia are complete, a rare scene in the world camellia production areas. In addition, the protection zone has rich vegetation resources. There are over 100 kinds of treasure plants. The vegetation belongs to monsoon rainforest and secondary forest of valley rainforest. Such kind of secondary forest comprise of lauraceae, theaceae, moraceae, leguminosae, hamamelidaceae, araliaceae, sapotaceae and fagaceae totally ten species shrubs and trees. The major trees are: liquidamber formosana, octophylla, Machilus chinensis, Chinese redbud, Ixonanthes Chinensis Champ, Hainan fig, ficus altissima, Caesalpiniaceae Erythrophleum fordii, tsoongiodendron odorum, **Altingia chinensis**, Cleidiocarpon cavaleriei, lingmushu, Vietnam theaceae etc. There are over 20 plants under the national level protection. In addition to the three camellia, there are: grade-I protection comprising of alsophila spinulosa, grade-II protection comprising of Chinese redbud, allotypa musaenda pubescens, tsoongiodendron odorum, hopea chinensis, Erythrophleum fordii; grade-III protection comprising of Amentotaxus Yunnanensis, Rhizophoraceae, Ixonanthes Chinensis Champ, *Aquilaria sinensis*, Cleidiocarpon cavaleriei, Dysosma pleiantha, Verbenaceae, Artocarpus hypargyreae Hance, Xerospermum bonii Radlk, Reevesia rotundifolia Chun and Heliciopsis terminalis Sleum etc. The grade-I protection animals of the protection zone is leopard. Those of grade-II protection are short-tail monkey, macaque, pangolin, black bear, sambar, viverricula indica and hornbill etc.

2. Hepu Dugong Natural Reserve

Guangxi Hepu Dugong Natural Reserve was established in 1996. It is located within Hepu county of Beihai city, east from Yingluo port of Shankou town and west to the sea area of Shatian town, totally 43km of coastal line. The total area is 350km², including 132km² core area, 110km² of buffer area and 108km² of experimental area.

It is the sole natural protection zone for dugong protection in China. The protecting targets are: national grade-I protection, including dugong and Chinese white dolphin; national grade-II protection, including owfish, sea turtle, tachypleus tridentatus. In addition, this zone has the large-area and good-growing seaweed eco-system that has the important ecological function. The biological diversity is rich.

3. Nonggang Natural Reserve

This protection zone is located 30km to the northeast of Longzhou county town, covering Longzhou and Ningming counties. It was approved as the national level protection zone in 1980, comprising three parts respectively Longhu, Nonggang and Longshan. The total area is 8000 hm², with the peak of 597m. The temperature of the protection is temperate. The annual average temperature is 22 . The forest eco-system is well protected, showing rich biological resources. There are 1282 kinds of vegetation, 123 kinds of animals and 439 kinds of insects. In the mountain, a lot of unique karst caves are formed naturally under the natural erosion. There are a lot underground rivers. This place has become the best place of typical karst topography protection to the north line of tropical belt of China.

So far, among the collected plants are the treasure special trees in karst areas,

including golden camellia, *Burretiodendron hsienmu*, *Burretiodendron hsienmu*, *Cephalomappa sinensis* Kosterm, and *Deutzianthus tonkinensis* Gagnep etc. *Burretiodendron hsienmu* is a special tree in the tropical limestone area. Its hardness and weight can be ranked the top among all trees. In this protection zone, there is a *burretiodendrono hsienmu* of 1000 years old, with 48.8 in height and nearly 3m in diameter. The stem stock has 107m³. It was found in 1977. *Shorea chinensis*, a new tree species only growing in Guangxi, has good hardness and beautiful grain. The stem can reach as high as 50-60m. The developed buttress root has 2-3m in height. It is the representative plant in the South Asian subtropical rainforest along with *parashorea chinensis* of *Hsishuangbanna*, both of *dipteroarpaceae*. The evergreen shrub *camellia* growing on the forest and road sides was a treasure plant found in the early 60's. Golden *camellia* belongs to *theaceae* plant. It is the only one plant among its category with yellow blooming. Because the golden flower of the axil is the germ resource for breeding new varieties, it is also called "queen of *theaceae*". It is also one of the famous ornamental plants in the world.

The protection zone has over 120 kinds of birds and beasts. The most rarely-seen is white-headed leaf-monkey, a special animal of China. It is only distributed in the south of Zuojiang river and east of Mingjiang river, in some limestone mountains of Longzhou, Ningming, Chongzuo and Fusui counties. It is comparatively concentrated in Nonggang. The white-headed leaf-monkey has a long tail and lives in the high-density forest or shrubs. Currently, it is rare in numbers, belonging to the national key protection rare animals along with *francois monkey*, *bradicebus tardigradus*, *clouded leopard viverricula indica*, *jungle fowl* etc.

4. Damingshan Natural Reserve

Damingshan Natural Reserve was established in 1981, and approved as the national level protection zone in July 2002. It is located in the boundary areas of Wuming, Shanglin, Mashan and Binyang counties of Nanning city in the mid by south Guangxi. It shapes irregular rectangle, with 21km from north to south, 19km from east to west. Most of the mountains are at 1200m elevation. The peak is located at the border of Wuming and Shanglin counties, with 1760.4m above sea level and 1563m of relative altitude, being as the highest peak in mid Guangxi. The total area of the protection is 16994hm². The protection objects are: diversity mountain mixed forest system, rare and endangered plants and animal resources, as well as the water-conservation forest for the mid Guangxi.

The protection zone has the typical features of a national level forest eco-system in that its monsoon evergreen broad-leaf forest eco-system has the outstanding nationwide representation or in the aspect of bio-geography.

So far, the known vascular bundle plants in Damingshan Mountain are 209 families, 764 genera and 2023 species. Wild terrestrial vertebrates have 31 orders, 90 families, 208 genera and 294 species. The known species of animals and plants of Damingshan has accounted over 30% of the know species of Guangxi, forming a small area with high-density of biological diversity. It is a converging place of different plant series. The characteristics of animal series show obvious transition features.

Among the wild plants of Damingshan Mountain, there are 16 kinds of plants under

the national level protection, such as *Bretschneidera sinensis* and *Alsophila spinulosa*. *Pseudotaxus chienii*, a very rarely seen plant in other places of China, has also formed a comparatively dominant community. In terms of wild vertebrates, there are 37 kinds under the national level protection, such as Francois monkey and black bear. Especially, the habitat of Francois monkey is at the place of 1500m altitude. Such phenomena is rarely seen in Guangxi, and which has very high value of scientific research value.

5. Shiwan Mountain Natural Reserve

Shiwan Natural Reserve was approved and established by the People's Government of Guangxi Zhuang Autonomous in 1982. It was promoted to the national level protection zone in 2003, serving as a natural protection zone targeting to protect the north tropical monsoon rainforest and hill evergreen broad-leaf eco-system. This protection zone is located in the border area between Shangsi county and Fangcheng district of Fangchenggang city. It is the core of Shiwan Mountain, with 74.4km from east to west, and maximum 45km from south to north. The total area is 0.874 million mu.

Shiwan Mountain is located in the coastal area of southern China. It is also the highest place in south Guangxi, belonging to the north tropical monsoon rainforest belt. It is also the border area between China and Vietnam, having a peculiar geographical characteristic. Shiwan Mountain is characterized by its huge body, old stratum and complicated topography. It is mainly of medium mountains. There are totally 82 mountains with over 1000m in altitude. Within the protection zone, the places below 700-900m belong to the monsoon rainforest belt – the zonal vegetation of these areas. The places of 900-1100m altitude are mainly of mountain evergreen broad-leaf forest. The places below 400m of altitude belong to the humid and hot valley belt, with typical non-belt-type valley rainforest represented by *Hopea chinensis* and *Horsfieldia hainanensis*.

So far, the found vascular bundle plants are 2233 kinds, among them: 2 kinds are under the national grade-I protection, respectively *Hopea chinensis* and *Cycas* of Shiwan Mountain; 13 kinds are under the national grade-II protection, including *Fokienia hodginsii*, Chinese redbud, *Cycas*, fern etc.. There are found 397 kinds of terrestrial vertebrates, among them: 4 kinds are under the national grade-I protection, respectively clouded leopard, leopard, lizard, Indian python; 45 kinds are under national grade-II protection, including macaque, short-tail monkey, pangolin, Chinese three-striped box turtle, *Geoemyda spengleri* etc.. There are found 129 macrofungi and 789 kinds of insects. This protection zone is also the source origins of 65 rivers, including Fangchenghe river, Beilunhe river and Mingjiang river, serving as an important water-conservation forestland in the south Guangxi.

6. Shankou mangrove natural reserve

This protection zone was approved by the State Council for establishment in 1990. The total area is 8000 hm². It is located on both east and west sides of Shatian peninsula in the southeast Hepu county, comprising of the sea area, land area and all beaches thereof. The total length of the coastal line is 50km. The east part is the west sea area of Moluo port, while the west part is Dandou gulf.

The surface layer of the protected coast belongs to sea sludge. It is of sandy sludge, locally of basaltis. Inland soil of Xinxu Beijie village belongs to latosol of basaltis that is

thick and fertile. Most of the rest belong to latosol of sediments of shallow sea that is thick but with little organic matter and poor fertility. The coastal belt belongs to sandy area. The inter-tidal belt belongs to salted sludge, with semi sand and earth, or full earth. The climate characteristics are: rich sunshine, plentiful rainfall. The annual average temperature is 22.9 , with extremely high temperature of 37.4 . There is no frost throughout the years. The annual average precipitation is 1663mm, with relative humidity of 82%. The annual average wind speed is 3.4m/s, with frequent typhoon or gust of 7-10 grades.

Mangrove forest is the special vegetation in the tropical and subtropical coastal areas and the river-mouth inter-tidal belts, comprising of the mangrove family plants or other vegetations of modal and ecological similarities. The mangrove ecosystem is one of marine ecological systems that has the richest diversity and highest productivity. In the protection area, there are currently 700 hm² of mangrove and 3000 hm² of beach suitable for afforestation. Mangrove has 3 families with 5 species, respectively: rhizophoraceae, comprising of rhizophora stylosa, bruguiera gymnorhiza, kandelial candell; myrsinaceae, comprising of parmentiera cerifera seem; verbenaceae, comprising of avicennia marina. Among them, rhizophora stylosa accounting for 50%; bruguiera gymnorhiza for 8%; kandelial candell for 2%; parmentiera cerifera seem for 37%; avicennia marina for 3%. From interior to exterior, the mangrove community is arranged in the order of bruguiera gymnorhiza, kandelial candell, rhizophora stylosa, to the outer beach area of parmentiera cerifera seem and avicennia marina. The rhizophora stylosa is distributed in the deep-sludge beach on both east and west banks. The exterior surface of the community is green, with total coverage of 80%. It is normally in 2-3m in height, maximally 6m. Among the species, the rhizophora stylosa has the absolute dominance. Its main stem has receded, with highly developed root system. The kandelial candell and parmentiera cerifera seem are distributed in the gentle beach, of which, the soil belongs to heavy clay loam. The surface community distribution is in two upper and lower layers, with parmentiera cerifera seem at the bottom and kandelial candell at the top. The parmentiera cerifera seem is distributed in belt or patches in the ditches of the beaches, with soft sludge as the top soil. The community structure is simple, sometimes accompanied by avicennia marina and bruguiera gymnorhiza.

Bruguiera gymnorhiza is mostly distributed nearby the dyke, normally forming a belt of different width. There are also some patches of forest. It is mostly growing in the higher places of the beach where the high tide can reach. The soil belongs to heavy clay loam. When tide rises, the mangrove is soaked in the sea water.

In addition to the coastal mangrove, there are over 600 hm² of inland plantations, with 16883m³ of wood stock, of which, the eucalyptus exserta takes up 16203m³. The existence of these forests has great function for the protection of mangrove. Mangrove enjoys the name of "sea forest", serving as the unique geographical landscape in the tropical coastline, which brings about a different beauty compared with other coastal scenes.

In the inland area, there are still remained little quantity of tropical rainforest tree species, such as malay arrowpoison and carallia diplopetala, as well as the shrubs, such

as woad, phoenix hanceana, pandanus tectorius solms, seaside clerodendron, pongamia pinnata and excoecaria etc. In addition, there are some artificial plantation of acacia coufusa, eucalyptus exserta, Casuarina equisetifolia, pinus elliottii, as well as those in the villages, such as bead tree, hibiscus tiliaceus, ficus microcarpa, wrightia pubescens, longan and jackfruit etc.

Within the environmental zone, the marine biological resources are rich. The fishes are perch, mullet, silver mullet, walking goby, odontamblyopus rubicundus, tiger fish, sea otter, cornu ammonis, eel and anguilla japonica etc. Shrimps have banana prawn, prawn penaeus penicillatas, ridgipail prawn, zhoushan shrimp, and solenocera crassicornis etc. Crabs have scylla serrata and fiddler crab. Shells have oyster, saccostrea cucullata, glauconomechinensis, reptile, bloody clam etc. The mud under the mangrove have lobworm, helminth, siphon-worm etc. Those living outside the mangrove is dugong, the world rare marine mammal. Within the mangrove, there are birds of eagle, anthus hodgsoni yunnanensis, grus leucogeranus etc.

7. Beilunhe River Mouth Marine Natural Reserve

Beilunhe protection zone is located in Fangcheng district and Dongxing of Fangchenggang city, situated in 108°02'-108°16' E and 21°28'-21°37'N. The total area is 3000 hm². It was approved and established by the People's Government of the former Fangcheng county in 1985, and later promoted to the provincial level protection zone in 1990. In 2000, it was approved as the national level, serving as a natural protection zone targeting to protect the mangrove ecological system.

This area is located in the southwest coastal belt of Fangchenggang city. The total length of the coastline is 87km, having the landforms of river-mouth coast, wide-open coast and sea-type coast and belonging to the subtropical monsoon climate. Within the protection zone, there are large-area and continuous-growing mangrove. The mangrove plant has 10 families with 13 species, forming 12 mangrove communities. Among them, the continuous patch of pure bruguiera gymnorrhiza and large-area of acanthus ilicifolius communities are rarely seen in China. This area has rich sea beach and fishery resources. There are 27 kinds of fish and 84 kinds of large phylums. Because this protection area is located in the converging area for two routes of bird migration, coastal area of east Asia and Central Siberian – mid China, it has become an important breeding place and rest place for migratory birds. The observed birds are 128 kinds, respectively belonging to 15 orders 34 families, of which, 13 birds belong to the national grade-II protection animals.

List of the birds in the mangrove and beach protection areas are shown in the following table.

I. Insectivora		II. Egretta Garzetta Garzetta	
Ardeidae		Hirundinidae	
苍鹭	Ardea cinerea	家燕	Hirundo rustica
草鹭	A. purpurea	鹳科	
绿鹭	Butorides striatus	灰鹳	Motacilla cinerea
池鹭	Ardeola bacchus	白鹳	M. alba
牛背鹭	Bubulcus ibis	树鹳	Anthus hodgsoni

大白鹭	Egretta alba	田鸻	A. novaeseelandiae
白鹭	E. garzetta	山椒鸟科	
黄嘴白鹭	E. eulophotes	暗灰鹡鸰	Coracina melaschistos
中白鹭	E. intermedia	鹡鸰科	
夜鹭	Nycticorax nycticorax	红耳鹩	Pycnonotus jocosus
黄苇开	Lxobrychus sinensis	白头鹩	P. sinensis
栗苇开	L. cinnamomeus	红臀鹩	P. aurigaster
黑开	L. flavicollis	Laniidae	
紫背苇开	L. eurhythmus	红尾伯劳	Lanius cristatus
大麻开	Botaurus stellaris	棕背伯劳	L. schach
鸻科		黄鹡鸰科	
白琵鹭	Platalea leucorodia	黑枕黄鹡鸰	Oriolus chinensis
黑脸琵鹭	P. minor	卷尾科	
III. Charadriiformes		黑卷尾	Dicrurus macrocercus
雉鹑科		发冠卷尾	D. hottentottus
水雉	Hydrophasianus chirurgus	Sturnidae	
彩鹡鸰科		丝光椋鸟	Sturnus sericeus
彩鹡鸰	Rostratula benghalensis	黑领椋鸟	S. nigricollis
鸻科		鹡鸰科	
凤头麦鸡	Vanellus vanellus	蓝喉歌鸲	Luscinia svecica
灰头麦鸡	V. cinereus	红胁蓝尾鸲	Tarsiger sylvanus
灰斑鸻	Pluvialis squatarola	黑喉石鵒	Saxicola torquata
金鸻	P. dominica	蓝矶鸫	Monticola solitaria
剑鸻	Charadrius hiaticula	乌灰鸫	Turdus cardis
金眶鸻	C. dubius	褐柳莺	Phylloscopus fuscatus
环颈鸻	C. alexandrinus	黄腰柳莺	P. proregulus
蒙古沙鸻	C. mongolus	极北柳莺	P. borealis
铁嘴沙鸻	C. leschenaultii	黄眉柳莺	P. inornatus
红胸鸻	C. asiaticus	乌鹡鸰	Muscicapa sibirica
Columbidae		褐胸鹡鸰	M. nuttallii
黑尾膝鹡鸰	Limosa limosa	北灰鹡鸰	M. latirostris
鹧鸪	Tringa erythropus	Paridae	
红脚鹧鸪	T. tatarus	大山雀	Parus major
泽鹧鸪	T. stagnatilis	绣眼鸟科	
青脚鹧鸪	T. nebularia	暗绿绣眼鸟	Zosterops japonica
白腰草鹧鸪	T. ochropus	文鸟科	
林鹧鸪	T. glareola	树麻雀	Passer montanus
矶鹧鸪	T. hypoleucos	白腰文鸟	Lonchura striata
翘嘴鹧鸪	Xenus cinereus	雀科	
针尾沙锥	Gallinago stenura	栗鹨	Emberiza rutila
扇尾沙锥	G. gallinago	黄胸鹨	E. aureola
丘鹨	Scolopax rusticola	黄喉鹨	E. elegans
红胸滨鹨	Calidris ruficollis	灰头鹨	E. spodocephala
青脚滨鹨	C. temminckii	小鹨	E. pusilla
黑腹滨鹨	C. aplina	凤头鹨	Melophus lathami
弯嘴滨鹨	C. ferruginea	四、鸥形目	
Recurvirostridae		Gulls	
黑翅长脚鹨	Himantopus himantopus	海鸥	Larus canus
燕鸻科		银鸥	L. argentatus

普通燕鸥	Glareola maldivarum	红嘴鸥	L. ridibundus
V. Anseriformes		VI. Falconiformes	
Anatidae		Accipitridae	
针尾鸭	Anas acuta	凤头鹰	Accipiter trivirgatus
绿翅鸭	Anas crecca	雀鹰	A. nisus
花脸鸭	A. formosa	松雀鹰	A. virgatus
鸭纹鸭	A. falcata	灰脸鵟鹰	Butastur indicus
绿头鸭	A. platyrhynchos	隼科	
斑嘴鸭	A. poecilorhynchos	燕隼	Falco subbuteo
赤颈鸭	A. penelope	红脚隼	F. vespertinus
白眉鸭	A. querquedula	红隼	F. tinnunculus
VII. Gruiformes		VIII. Cuculiformes	
Rallidae		Cuculidae	
普通秧鸡	Rallus aquaticus	红翅凤头鹑	Slanmator cormoandus
蓝胸秧鸡	R. striatus	鹰鹑	Cuculus sparveroides
白喉斑秧鸡	Rallina eurizonoides	噪鹑	Eudynamys scolopacea
小田鸡	Porzana pusilla	小鸦鹑	Centropus toulou
红胸田鸡	P. fusca	IX. Columbiformes	
白胸苦恶鸡	Amaurornis phoenicurus	Viperidae	
董鸡	Gallicres cinerea	山斑鸠	Streptopelia orientalis
黑水鸡	G. chloropus	珠颈斑鸠	S. chinensis
骨顶鸡	Fulica atra	火斑鸠	Oenopoelia tranquebarica
X. Podicipediformes		XI. Apociformes	
Podicedidae		Apodidae	
小鸊鷉	Tochybaptus ruficollis	小白腰雨燕	Apus affinis
XII. Piciformes		XIII. Caprimulgiformes	
Picidae		Caprimulgidae	
鸺鹠	Jynx gorquilla	普通夜鹰	Caprimulgus indicus
XIV. Coraciiformes		XV. Strigiformes	
Alcedinidae		Strigidae	
普通翠鸟	Alcedo atthis	红角鸮	Otus scops
白胸翡翠	Halcyon smyrnensis	鹰鸮	Ninox scutulata
蓝翡翠	H. pileata		

8. Chongzuo White-headed Leaf Monkey Natural Reserve

This protection zone was established in 1982. In 2005, upon approval of the provincial government, Bapen natural reserve and Banli natural reserve were combined as Chongzuo white-headed leaf monkey natural reserve. It is located in Jiangzhou district of Chongzuo City and within Fushui County, with a total area 35148hm² and protection targets of wild animals. In this protection zone, the mountains are steep and beautiful, serving as one of the best-protected areas of typical subtropical karst landform and natural resources in China. Currently, it is applying for the national level natural reserve.

This protection zone is the unique provenance base for white-headed leaf monkey in china, and one of the 13 heat places of international significances for terrestrial biological diversity. It is also a rare and important biological gene base in the southwest China. It remains some monsoon rainforest sections and representative tree species thereof. The existing vegetation has 4 vegetation groups, covering 5 vegetation types and 32

community series. Within the protection zone, there are over 60 kinds of mammals, over 100 kinds of birds, over 30 kinds of reptiles, over 20 kinds of amphibians, as well as nearly 1000 kinds of plants that can offer more than 100 kinds for medical use. Among the mammals, the white-headed leaf monkey of national grade-I protection has 18 groups with more than 240 monkeys. In addition to the animals that are under the national grade-I and grade-II protection, such as white-headed leaf monkey, clouded leopard, forest musk deer, Indian python, macaque etc., there are still some wild plants under the key national protection, such as *cycas splniformis*, *burretiodendron hsienmu* and golden camellia etc.

9. West Damingshan Mountain Natural Reserve

West Damingshan Mountain water source conservation protection zone is located in the boundary areas of Fushui, Long'an, Danxin and Chongzuo four counties, situating in 22°40'-22°58'N and 107°17'-107°46'E, comprising of Fenghuang mountain, West Damingshan Mountain and Xiaomingshan Mountain. The total area is 601km². It was approved by the People's Government of Guangxi Zhuang Autonomous Region in 1982. The management station is established on the basis of the state-owned Fenghuangshan Forest Farm who is also responsible for the management. The major protection objects are the water source conservation forest and the rare plants and animals in the zone, such as golden camellia and *viverricula indica*.

This protection zone is located in the north edge of the north tropical belt, belonging to the zonal vegetation of monsoon rainforest. However, due to the human damage, in the valleys are only with the remains of some tropical monsoon rainforest including *caesalpiniaceae erythrophleum fordii*, *mischocarpus sundaicus*, *dysoxylum hongkongense*, *horsfieldia hainanensis*. In the places of 800-1700m altitude, there remains so mountainous evergreen broad-leaf forest represented by *castanopsis fabri*, *Gastanopsis carlesii* and *machilus nakao*. Most of the places have been replaced by the secondary forest. Below the altitude of 800m are the secondary forest with dominant trees of *schima wallichii choisy*, *albizzia chinensis* and *liquidamber formosana* etc., and artificial mason pine trees. In the valleys, there are some *choerospondias axillaries*, *cesalpiniaceae Erythrophleum fordii* etc. The underwoods are large area of golden camellia. The protection zone has now a total forest area of 230km², with forest covering rate of 38.2% and the forest stock of 0.91 million m³.

The biological resources of the protection zone are rich. In terms of plant resources, the national grade-I protection rare plant includes golden camellia. The national grade-II protection plants are *eythrophleum fordii* and *tsoongiodendron odorum*. The national grade-III plants are *auilaria sinensis* etc. In addition, other commonly seen plants are *pas chinensis*, *amomun* fruit, *ardisia gigantifolia stapf*, *mucuna birdwoodiana tutch* etc. In terms of animal resources, national grade-I protection animal has spotted deer, those of grade-II protection are *viverricula indica*, pangolin, otter, hornbill, *viverra zibetha* etc. Other economic animals are *sus scrofa*, *suncus murinus* and civet cat etc.

Within the protection zone, there are 16 small rivers that serve respectively as the source origins of Longchuanhe river, Lanyuhe river, Lujinghe river, Zuo Zhouhe river and Xin'an reservoir. They are closely connected to the downstream 200,000 people, 300km² cultivated land, 43 reservoirs, 72 power stations and 7 irrigation pumping stations.

However, before establishing the protection zone, due to the long-period forest cutting and the mining of crystal, lead and zinc, the water conservation capacity of the forest has declined and thus caused soil erosion, riverbed and reservoir silting. For example, Xin'an reservoir has been silted for 40%, the flow of dry-water season of Lujinghe River has decreased from the previous 0.3m³/s to 0.15m³/s. Such has seriously affected the agricultural irrigation.

10. Shanglin Longshan Natural Reserve

The protection zone was approved for establishment in November 2003 by the people's government of Guangxi Zhuang Autonomous Region. It is located in Shanglin county of Nanning city, connecting with Damingshan Mountain Natural Reserve to the north. The total area is 10749 hm². The major protection targets of the protection zone are evergreen broad-leaf forest and water-conservation forest.

11. Weizhou Island Natural Reserve

Weizhou Island birds protection zone is located in the mid Beihu Gulf of the south Beihai city, situating 20°54' - 21°05'N and 109°05' - 109°13'E, comprising of two islands, respectively Weizhou and Xieyang. The total area is 26.3km², of which, Weizhou island has 24.4km² and Xieyang island 1.9km². These two islands are the important midway rest places for migratory birds heading for Indonesia, the Xisha Islands and Indo-China Peninsula. The protection station was approved in 1982 by the people's government of Guangxi, and the bird banding point was set up in Weizhou island in 1985. The major protection objects are migratory birds.

(I) Plant resources

The original vegetation of the two islands no longer exist, and the secondary natural vegetation are the scattered small-patch shrubs. The commonly seen shrubs are *atalantia buxifolia*, *phoenix hanceana*, *opuntia dillenii*, *fructus bruceae*, *desmos chinensis* lour, *lxora chinensis*, *capparis* sp, *grewia biloba*, *miscanthus floxoidulus*, Indian stringbush root, *rhodomyrtus tomentosa* bush, *litsea glutinosa*, *lannea grandis*, *myrsine linearis*, *ficus microcarpa*, *ficus gibbosa* etc. The liana plants are *streptocaulon griffithii*, *tetracera asiatica*, *vitis pentagona*, *cassytha filiformis* etc. The forest species of the islands are simple. The indigenous trees are mainly of bead tree, mulberry, *ficus virens* ait var *sublanceolata* corner, *cinnamomum camphora* etc. The newly introduced tree species are *casuarinaceae*, *acacia confusa*, *leucaena glauca* and *eucalyptus* etc. The current forest area is 4.31km², most of the protection forest of *casuarinaceae* and *acacia confusa*.

(II) Animal resources

The coastal areas are rich in fish and shrimps that serve as the rich food sources for birds. There are totally 17 families 37 species of birds, respectively: *anseriformes* with *anatidae*; *pelecaniformes* with *pelecanidae*; *insectivora* with *ardeidae* and *ciconiidae*; *lariformes* with gulls; *charadriiformes* with *jacaniidae*, *rostratulidae*, *charadriidae* and *tringae*; *gruiformes* with *turnicidae*, *rallidae* etc. In addition, others are *columbiformes* with *viperidae*; *strigiformes* with *strigidae*; *cuculiformes* with *cuculidae*; *coraciiformes* with *alcedinidae*, *coraciidae*; *falconiformes* with *accipitridae*, *palconidae*; *egretta* with *laniidae*, *oriolidae*, *dicruridae*, *fringillidae*, *timaliidae* etc.

12. Nalin Natural Reserve

Nalin water source forest plant and animal protection zone is located in the west of Bobai county of Guangxi, comprising of 2 towns, Nalin and Jiangning, 23 administrative villages and county-owned Jianglu forest farm. The geological formation is old, showing complicate topography. The mountains are high and large. It belongs to the hill of the offshoot of Shiwan Mountains. It is low in the southwest and high in the northeast. The altitude is mostly above 600m. The peaks of over 800m altitude are Jiguanzhang, Shangliufeng, Liutangjing, Tiemaotou and Yunfeizhang etc. The main peak, Shangliufeng, is 918m in altitude, serving as the highest peak of Bobai county. This zone belongs to the transitional monsoon climate from south subtropical to tropical belt. The sunshine is adequate and the temperature is high. The rainfall is rich, with normal annual precipitation of 2000mm. The average temperature is 21.2 , with high humidity and long non-frost period.

It was approved by the people's government of Guangxi Zhuang Autonomous Region in 1982. The total area is 0.521 million mu, of which, the forest area is 0.398 million mu. The zone has rich animal and plant resources being regarded as a big gene base for species. It is also one of the major water-conservation area for the largest Hepu reservoir of Guangxi. The evergreen and broad-leaf tree species are abundant and the vegetation types are in great diversity. The forest covering rate is 68%. There are 309 kinds of wild plants and 10 kinds of terrestrial vertebrates. Among them, there are 4 kinds of plants under the national grade-II protection, one animal under the grade-I protection, 4 animals under the grade-II protection and 13 animals under the provincial key protection. In the shrubs and stone caves, there frequently appear some rare animals, such monkey, Muntjac, hedgehog, sus scrofa, pangolin, civet cat, lizard, Indian python, partridge, cuckoo, thrush, starling, howl, eagle, blackcock etc. In the foothills are rich in mixed forest of fir, pine, machilus nanmu, eucalyptus, *toona ciliata*, Caesalpiniaceae *Erythrophleum fordii*, *aquilaria sinensis*, theaceae. Major local products are tea, camellia oleifera, aniseed, bamboo paper, lichi, longan, pine apple, canarium album, canarium pimela, wampee, rhodomyrtus tomentosa, 牛柑子, bamboo seeds, 檀蒙子 and herba cistanches etc. In addition, there are numerous bamboo in this area that the local live on. It is famous for the bamboo shoots and dried shoots, bamboo paper etc.

Due to the large area of water-conservation forest in the protection zone, rain can be stored in rainy season and water can come out in dry sea. The average water-conserving volume is over 700m³ /mu. Jinzhenhe river, Nalinjiang river, Jiangninghe river, Daogenjiang river, Longjingjiang river and Xiajiejiang river are originated from this zone, among them, Jinzhenhe river and Jiangninghe river has a total length of more than 70km. The rivers of all sizes of the protection zone converge in Daogeng and Hepang of Jiangning town, then enter Hepu reservoir, accounting for 60% of the total 1.1 billion m³ storage.

13. Sanshiliunong-Longjun Natural Reserve

This protection zone is a provincial natural reserve established in 2004. It is located in the southwest Wuming county, situating at 107°50'36" -108°08'44"E and 23°04'27"-23°19'11"N. The total area is 12822 hm². It belongs to the typical karst low-hill

landforms and the south subtropical climate. The annual rainfall is plentiful and sunshine is adequate. It has obvious biological diversity, typicalness and rareness. The vegetation has strong representative features, showing good ecological quality.

The protection zone has complete ecological system and comparatively rich vegetation types. Within the protection zone, there are 1041 kinds of vascular bundle plants. Among them, cycadaceae belongs to the wild plant under the national grade-I protection. *Zenia insignis* chun, *burretiodendron hsienmu* and *Hainania trichosperma* etc. ten plants are listed as the wild plants under the national grade-II protection. Other wild plants that have been listed in the national category of protection are *C.flavida* Chang, *Garcinia paucinervis* Chun et How, *Pteroceltis tatarinowii* Maxim, *C. sappan* L., *A crocarpus fraxinifolius* Arr ex Wight, *Dendrocide urentissima* Chew etc. Many others are listed in the arethusa appendix of *Convention on International Trade of Endangered Species of Wild Fauna and Flora*. There are 190 kinds of terrestrial vertebrates. Among them, there are 2 kinds under the national grade-I protection, respectively forset musk deer and indian python; 20 kinds under the national grade-II protection, such as macaque, tokay, *viverra zibetha*, sambar, spotted linsang; 55 kinds under key protection of Guangxi.

In the protection zone, there remains a large area of north tropical and south subtropical evergreen broad-leaf ecological system. There are numerous wild animals and plants that are under the key national protection, such as *burretiodendron hsienmu*, which is the largest continuous plot in Guangxi.

14. Daqingshan Natural Reserve

This protection zone was established in 2001. It is located in Pingxiang city. The total area is 4092.3 hm². The major protection objects are the north tropical, south subtropical and evergreen broad-leaf ecological system, scientific pilot forest.

15. Zuojiang River Lamprotula Mansuyi Natural Reserve

This protection zone was approved for establishment by the People's government of Guangxi Zhuang Autonomous Region in 2005. It is located in river valley of Zuojiang river in Jiangzhou district and Longzhou county of Chongzuo city. The total area is 417.4 hm². The major protection objects are the fresh water shells such as *lamprotula mansuyi* and their habitats.

16. Geological Standard Profile of Devonian Period Beiliu Damengmen Protection Zone

This protection zone is located in Beiliu county of Yulin city. The total area is 8hm². It was approved as the provincial level protection zone in 1983, with the major protection object of the geological standard profile of the Devonian Period. This protection zone is the important evidence for the study of the marine faces in the remote ancient times. The quantity and distribution of brachiopoda alcyonarian fossil coenosis are unique and rarely seen in China. It is of great significance in studying the paleo-geography and paleo-climate of south China devoian period and the evolution of the sedimentary basins.

17. Maowehai Mangrove Natural Reserve

Guangxi Maowehai Mangrove Natural Reserve is located at Qinzhou Gulf in the

north or Beibu Gulf, the coastal south of Guangxi, being at N21°33'15" ~ 21°54'40" and E108°28'33" ~ 108°55'53". It was approved by the People's Government of Guangxi to be a provincial natural reserve in January 2005. The natural reserve is distributed with the largest and most typical island-group and rocky beech mangrove in China, which belongs to subtropical river-mouth, coast and tidal flat etc. wetland ecological system. The natural reserve covers 2784hm², among which 1892.7hm² are covered with natural mangrove in the original state (accounting for 100% of the mangrove area in the project area). The mangrove has 11 families with 16 species. Semi-mangrove has 3 families with 3 species. The accompanied plants of mangrove has 3 families with 4 species, accounting for 43.2% of mangrove species in China, mainly dominated by *Kandelia candel*, *Parmentiera cerifera* Seem and *Aricennia marina*, followed by *Bruguiera gymnorhiza*, *Rhizophora stylosa* G, *Acrostichum aureum*, *Excoecaria*, *Acanthus ilicifolius*, *Hibiscus tiliaceus* (among which, *Acanthus ilicifolius*, *Bruguiera gymnorhiza* and *Parmentiera cerifera* Seem are precious endangered mangrove). The natural reserve is featured with biodiversity with 444 species of animals, 48 species of migratory birds, among which 33 species belong to the protected birds by Sino-Macao and Sino Japan Association as well as *Inhabit Environment Agreement*. At the same time, this protection zone is also one of the major breeding places for natural oyster in China, accompanied with a lot special aquatic products such as crabs, grouper and prawns etc.

In the above 17 natural reserves, the major species of animals and plants under protection are shown in Table 3.4-1.

Table 3.4 – 1 Natural Reserves and Major Species Under Protection in Project Area

Name of Natural Reserves	Geographical location	Level	Area (hm ²)	Major animals under protection		Major plants under protection	
				National Grade-I	National Grade – II	National Grade-I	National Grade – II
Fangcheng Shangyue Golden Cammellia	Within Fangcheng county	National	9195	leopard	short-tail monkey, macaque, pangolin, black bear, sambar, viverricula indica, hornbill.	3 kinds of golden camellia, alsophila spinulosa	Chinese redbud, allototype mussaenda pubescens, tsoongiodendron odorum, hopea chinensis, Erythrophleum fordii.
Hepu dugong	Hepu County, Beihai	National	35000	Dugong, Chinese white dolphin	cowfish, sea turtle, tachyplesus tridentatus etc.	-	-
Nonggang	Notheast of Longzhou county, covering Longzhou and Ningming counties	National	8000	White-headed leaf monkey, clouded leopard.	francois monkey, bradicebus tardigradus, viverricula indica, jungle fowl.	Golden camellia	
Damingshan	Wuming, Mashan, Shanglin and Binyang counties of Nanning City	National	16994	-	francois monkey, black bear	Bretschneidera sinensis hemsl, alsophila spinulosa, Pseudotaxus chienii etc.	
Shiwan Mountain	Boundary areas of Shangsi county and Fangcheng district	National	58270	clouded leopard, leopard, lizard, indian python	macaque, short-tail monkey, pangolin, Chinese three-striped box turtle, geoemyda spengleri etc., totally 45 species.	Hopea chinensis, cycas of Shiwan Mountain	Fokienia hodginsii, Chinese redbud, cycas, fern etc., totally 13 varieties.
Chongzuo white-headed leaf monkey	Jiangzhou district & Fusui county of Chongzuo City	Provincial	35148	White-headed leaf monkey, clouded leopard, indian python, forset musk deer.	macaque etc.	Cycas splniformis, golden camellia	Burretiodendron hsienmu etc.
Western Damingshan	Boundary areas of Fushui, Long'an, Daxin Chongzuo,	Provincial	60100	Spotted deer	viverricula indica, pangolin, otter, hornbill, Viverra zibetha etc.	Golden camellia	erythrophloeum fordii, tsoongiodendron odorum
Nalin	West Bobai county, incl. Nalin, Jiangning towns	Provincial	34730	1 kinds	4 kinds	-	4 kinds
Sanshiliunong Longjun	Southwest of Wuming	Provincial	12822	Forset musk deer, indian python	macaque, tokay, viverra zibetha, sambar, spotted linsang etc., totally 20 varieties	Stone hill cycas	Zenia insignis chun, burretiodendron hsienmu and Hainania trichosperma etc. ten plants

3.4.3 Tourism Resources.

Guangxi is rich in tourism resources. The project area has three tourism areas, respectively Nanning tourism area featured by subtropical landscape and border beauty, southeast Guangxi tourism area featured by famous mountains, unique water and caves, and coastal tourism area represented by Beihai Silver Beach. The tourism resources within the project area mainly include: Shiwan Mountain National Forest Park and Liangfengjiang National Forest Park (Nanning); Darongshan Mountain, Laohuling Ridge (Nanning), Sanshiliuqu (Qinzhou), Shimen (Nanning), Wuxiangling Ridge (Nanning) etc. provincial-level forest parks; Huashan National Resort; Provincial level landscapes such as Shuiyue Cave – Longzhu Lake, Xielu Villa, Goulou Cave, Nanwan – Weizhou Island, Jiangshan Peninsula, Yanshishan Mountain, Longquan Cave, Liufengshan – Sanhai Cave (Lingchuan county of Qinzhou city), and Qingxiushan Mountain etc.

There are a lot of cultural relics in the project area, including 4 historical and cultural relics under state protection (Dashi Pavilion of Hepu, ancient tombs of Han Dynasty in Hepu, neoteric architecture of Beihai, Liancheng camp of Beihai, Youyiguan Pass), 2 in Gaofeng Group (Huashan Mountain cliff paintings, Shidingshan relics of Yongning county), and a number of cultural relics under provincial and city level protection.

Shiwan Mountain National Forst Park is located in the southeast of Shangsi county on the north ridge of Shiwan Mountain. It is located at 107°48'40" ~ 107°56'15"E and 21°50'05" ~ 21°55'30"N, having a total forest area of 8810 hm². In the park, there is a patch of tropical rainforest that is basically in a primitive state. High-rise ancient trees, endless forest, scattered ditches, flowing streams and continuous mountains are very impressive. It has rich rare animal and plant resources and the tourism resources, serving as a good place for recreation, scientific education, commercial conference etc.

Liangfengjiang National Forest Park is located south outskirts of Nanning city, being 14.5km away of the downtown. In the park, the running Liangfengjiang river, prosperous river-bank trees, scattered pavilions and blooming flowers would linger the visitors. The park has 122 families with 1294 species of the subtropical tree species and the endangered tree species in Guangxi, which includes 85 species under the national key protection.

The park is the earliest national forest park in Guangxi approved by the Ministry of Forestry. It has a total area of over 70000mu. Beautiful mountains and water, blooming flowers and busy singing birds have composed a pretty natural beauty. In addition, the largest gene base of golden camellia in south China is in the park. The park has high air anion content, enjoying the name of forest bathroom. In Puti Villa, there is a unique linden tree that combines Yin and Yang. It is said that it can emit Buddha's halo. Whoever touches it will get rid of all diseases. It thus attracts numerous visitors.

3.5 Survey and Assessment of Existing Conditions of Ecological Landscape of Project Area

3.5.1 Ecological type of landscape of project area

According to the categorizing principle for ecological landscape types, the ecological landscapes of the project area are divided into two categories. Details are shown in Table 3.5-1.

Table 3.5-1 Ecological Categorization of Landscape of Project Area

Sl.	Category-I Landscape	Category-II Landscape	Landscape Characteristics
1	Forest Land		Land growing tree, bamboo, shrub and mangrove etc., excluding residential greening land and the road and bank protection forest of railway, highway, river and canals etc.
		Land with Forest	Natural forest and artificial plantation of canopy density > 30%, including continuous forestland with timber forest, economic forest, protection forest etc.
		Shrubs	Low forestland and shrub forestland with shade density >40% and below 2m in height.
		Open Forest Land	Open forestland with 10%-30% shade density.
		Other forestland	Un-matured forestland, blanks, nursery etc.
2	Cultivated land		Land for cultivating crops, including the newly-reclaimed land, idle land, in-turn use land, grass in-turn land; the land mainly growing crops but scattered with fruit trees, mulberry or other trees; shoal and sea beach lands that have been cultivated for over 3 years. The cultivated lands include the ditch, canal, road and field banks of <1.0m in the south and <2.0m in the north in width.
3	Grassland		Various grassland mainly growing grasses, with 50% of coverage, including shrub grass and the open grassland below 10% of shade density.
4	Orchard land		The lands growing wood or grass crops under intensive management for collection of fruits, leaves and roots, with shade density of >50%, or the density is higher than 70% of the reasonable numbers per mu, including fruit seedling nursery.
5	Lands of residents and factories / mines		The lands of enterprises and institutions, such as factory, mines, national defense, historical relics etc., other than those for residential area in rural and urban areas, including internal transportation and greening land.
6	Land use for transportation		Lands used for various roads, attached facilities and civil airports that are outside the residential area, including the road-protection forest.
7	Water area		Refer to the lands for inland water area and water conservation facilities, excluding the flood-retarding area, the shoal land of three-year cultivation, the farmland, forestland, residential land and roads in the sea beaches.
8	Unused Land		Lands that have not been used, including the land difficult to use, such as rock and stony lands; the lands of surface rock or gravels, with coverage of >5%.

3.5.2 Ecological Assessment Method for Landscape

Landscape comprises of patch, corridor and matrix. The matrix is the background of

the landscape serving as the most important landscape element. To a great extent, it plays a leading role in determining the landscape quality and dynamics. Ecologically speaking, the key element in judging the quality of a landscape lies in the judgment of the matrix to see whether it has the components of the surface features that can strongly adjust the eco-environmental quality.

There are three standards in judging the matrix, i.e. large relative area, high connectivity and having the function of dynamics control. In the traditional ecology, the calculation of the dominance of a patch in the landscape is also called value of dominance degree. In this assessment, the standard values dominance degree are used to judge the matrix. Dominance degree value is determined by three parameters: Density (R_d), Frequency (R_f) and Proportion (L_p).

These three indicators can well reflect the two matrix judging standards, large area and high connectivity. It is less expressive for the dynamic control function. However, from the judging process of the landscape matrix, and when the two standards are clear in judgment, it can be regarded that that matrix which has high connectivity and large area is the right one that we need.

The formula for computing dominance degree is:

$$R_d = \frac{\text{Nos of patch } i}{\text{Total Nos. of Patch}} \times 100\%$$

$R_f = \frac{\text{Nos of sample plot of patch } i}{\text{Total nos of sample plots}} \times 100\%$; the size of sample plot is 1km×1km. Take full covering sampling, and use Merrington Maxine “t – distribution point” method to check.

$$\text{Landscape Proportion } L_p(\%) = \frac{\text{Area of patch } i}{\text{Area of total sample plots}} \times 100\%$$

$$D_o = \frac{(R_d + R_f) / 2 + L_p}{2} \times 100\%.$$

At the same time, the landscape ecological pattern of the assessment area shall be evaluated by using landscape fragmentation. In a landscape ecological system, the richer the landscape elements are, the higher fragmentation degree it will be, and the information content and system stability will be higher. The expressive formula for landscape fragmentation is:

$$\text{Fragmentation degree} = \text{nos. of fragments per unit area (n/km}^2 \text{ or n/hm}^2 \text{)}$$

3.5.3 Survey Results and Assessment

The landscape ecological assessment herein adopts the image data of ETM Stateline of the U.S of 1999-2000, plus the relevant documentations and research results, GPS positioning and field survey. As such, the assessment is made to interpret the existing landscape situation of the pulp forest base, covering 15 counties of the project area and the places where the 8 state-owned forest farms of Gaofeng Group are located (Nanning city, Binyang county, Shanglin county, Wuming county, Yongning county, Ningming county, Pingxiang city, Qinzhou city, Lingshan county and Pubei county).

As the interpreting results, the present situation of forest coverage of the project area is shown in Figure 3-14. The assessment has covered totally 55024.89km² of landscape

area, including 31554.46 km² of forestry landscape, 2982.40km² of grazing landscape, 16763.63km² of agricultural landscape and 1930.78km² of artificial structure landscape. The statistical area of all types of landscapes are shown in Figure 3-15.

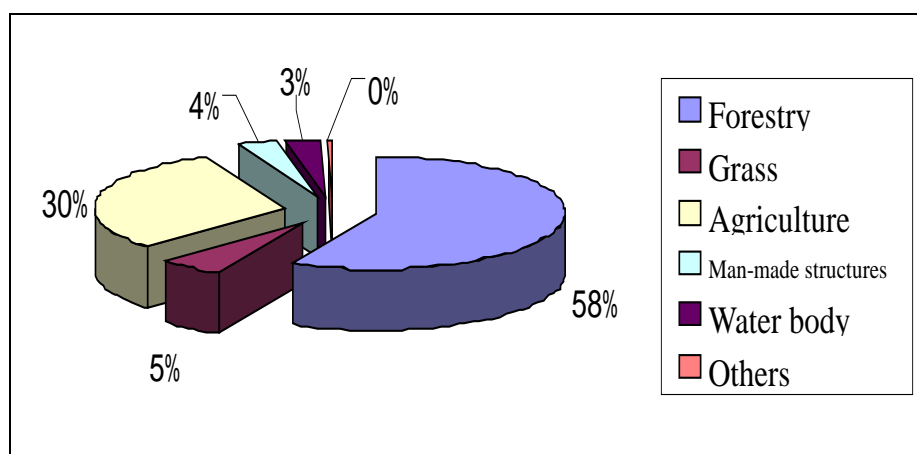


Figure 3-15 Statistics of Landscape Types of Project Area

As per the appraising methods of landscape ecology, the degree of fragmentation and degree of dominance were computed respectively for the Category-II forest landscape and Category-I of other types within the project area. The results are shown in Table 3.5-2.

From the table, it can be seen that, among the 8 categories and 11 types of landscape groups, the landscape dominance degree of forestland reached as high as 66.44%. The distributing area is also the largest, reaching 57.17, with high degree of connectivity. If plus the shrubs and bush lands, the dominance degree shall take the absolute position. Therefore, the sum of these three types of environmental resource patches constitutes to the matrix of the appraisal area.

In the forestland, forest (land with stand) is the element type with high metastability among the environmental resource patches that has the strongest controlling capacity against the eco-environmental quality. It has relatively high dominance degree, reaching 40.71%. The distributing area accounts for 38.25%, and the connectivity is also high (Rd 5.37%, Rf 80.97%). Next to this is the open forestland, having 13.09% of landscape dominance degree. The landscape dominance degrees of other shrubs and forestlands are relatively lower.

In addition to forest landscape, other landscapes with high dominance degrees include agriculture landscape, having 42.60% of landscape dominance degree, 30.37% of distributing area and high connectivity (Rd33.28% , Rf76.39%). Due to the warm and humid climate of the project area, the time of growing vegetation on farmland is relatively longer, which will also have some capacity of regulating the eco-environmental quality of the project area.

In all, the present landscape eco-environment quality of the project area is comparatively good.

Table 3.5-2 Degree of Landscape Fragmentation and Degree of Dominance of All Patches of the Project Area

Landscape Type	Nos of Fragments	Area of Fragments (km²)	Degree of Landscape Fragments (n/km²)	Landscape Proportion L_P(%)	Density Rd(%)	Frequency Rf(%)	Dominant Degree – D_o(%)
Forest landscape	2296	21113.71	0.109	38.25	5.37	80.97	40.71
Shrub landscape	2166	3433.36	0.631	6.22	5.06	14.73	8.06
Open forest landscape	3977	5414.25	0.735	9.81	9.30	23.44	13.09
Other forest landscape	2000	1593.64	1.255	2.89	4.67	7.86	4.58
Grassland Landscape.	4880	2982.40	1.636	5.40	11.41	15.83	9.51
Agricultural landscape	14239	16763.63	0.849	30.37	33.28	76.39	42.60
Water body landscape	2797	1696.24	1.649	3.08	6.54	9.28	5.50
Urban and rural residential landscape	10244	1930.78	5.306	3.50	23.94	19.26	12.55
Orchard landscape.	68	31.93	2.130	0.06	0.16	0.19	0.12
Transportation construction landscape	25	43.03	0.581	0.08	0.06	1.68	0.48
Bare rock and stone landscape	91	22.42	4.059	0.04	0.21	0.19	0.12

3.6 Existing Conditions of Forestland Resources

3.6.1 Structure of Forestland

According to the results of the planning and design survey of the forestry resources of Guangxi (2000), the classified forestry operation area (2001), the supplementary survey for forest cutting quota (2005), as well as planning and design statistical results of state-owned forestry farms (2005), the total land area of the project area (15 counties in Beihai, Fangchenggang, Chongzuo, Yulin and 8 stated owned forest farms) is 1.4793hm².

In terms of structure, the forestland can be classified into: land with forest 1159.8 thousand hm², accounting for 78.4%; open woodland 8.72 thousand hm², accounting for 0.6% ;shrub woodland 217.86 thousand hm², accounting for 14.7% ;young-afforested land 18.7 thousand hm², accounting for 1.3% ; non-timbre forest land 73.7 thousand hm², accounting for 5.0 % ; nursery land 0.04 hm².

In terms of entitlements, the forestland can be classified as: state-owned forest land 263.86 thousand hm², accounting for 17.8% ; collective forest land 115.97 thousand hm², accounting for 78.4%; other forest land 55.9hm², accounting for 3.8%.

The structure of the forestland of the project area is shown in Table 3.6-1.

3.6.2 Structure of Forestry Management

In terms of type of use, among the total forestland of 1479.3 thousand hm², commercial forest takes up 953.9 thousand hm², accounting for 64.5%; while ecological public welfare forest takes up 525.3 thousand hm², accounting for 35.5%. The structure of the forestland management of the project area is shown in Table 3.6-2. Among the land with forest of the project area, the proportions of commercial and non-commercial forest are shown in Figure 3-16.

Table 3.6-1 Statistical Table of Forestland Structure of Project Area (Unit: hm²)

Units	Land Entitlements	Total land area	Forestry Land Area						
			Total	Land with Forest	Open Forest Land	Shrub Land	Young Afforested Land	Land without Forest	Plant Nursery
Project Area	Total	274.5	147.93	115.98	0.87	21.78	1.87	7.37	0.039
	State-owned	37.6	26.37	17.92	0.21	4.27	1.23	2.73	0.013
	Collective	230.63	115.95	92.66	0.66	17.50	0.61	4.50	0.024
	Others	6.28	5.60	5.40	0.003	0.02	0.03	0.14	0.002
Chongzuo city	Total	53.73	21.19	10.0	0.04	10.42	0.21	0.51	0.002
	State-owned	4.60	2.63	1.97	0.008	0.34	0.10	0.21	0.001
	Collective	49.13	18.56	8.03	0.034	10.08	0.11	0.30	0.001
Yulin city	Total	99.56	58.64	52.29	0.37	2.79	0.45	2.74	0.009
	State-owned	1.60	1.52	1.21	0.03	0.05	0.11	0.12	
	Collective	95.17	5.43	48.29	0.34	2.74	0.34	2.62	0.009
	Others	2.79	27857.5	2.79					
Beihai city	Total	34.04	10.26	9.29	0.065	0.18	0.099	0.81	0.014
	Collective	32.60	9.71	8.73	0.062	0.16	0.065	0.68	0.012
	Others	1.44	0.75	0.56	0.003	0.02	0.034	0.13	0.002
Fangchenggang city	Total	60.04	38.26	30.21	0.29	5.95	0.15	1.66	0.0012
	State-owned	5.71	4.30	2.0	0.06	1.4	0.06	0.75	0.0002
	Collective	53.72	33.35	27.60	0.23	4.51	0.09	0.91.2	0.001
	Others	0.61	0.61	0.61					
Gaofeng Group	Total	27.14	19.38	14.19	0.11	2.44	0.96	1.66	0.012
	State-owned	25.69	17.93	12.75	0.11	2.44	0.96	1.66	0.012
	Others	1.45	1.45	1.44					

3.6.3 Category of Forest

The project area has 1479257.3hm² of land with forest, including 1159823.9hm² with woods, 8702.2hm² of open woodland, 217839.6hm² of shrub land, 92502.7hm² of non-stand forestland and 388.9hm² of nursery land. In terms of forest category, the forestland can be classified as: 495301.3hm² of coniferous forest, accounting for 33.5%; 392046.3hm² of broad-leaf forest, accounting for 26.5%; 98505.2hm² of coniferous broad-leaf mixed forest, accounting for 6.66%; 173970hm² of economic forest, accounting for 11.8%; 32170.5hm² of cutting blank and burned area, accounting for 2.17% ; 55598.5hm² of un-mature, reserved and planned forestland, accounting for 3.76%. The structure of forest species are shown in Table 3.6-3.

Table 3.6-2 Statistical Table of Forestland Categorized Management of Project Area (Unit: hm²)

Units	Land Entitlements	Total land area	Total	Area of Ecological Non-commercial Forest	Area of Commercial Forestland
Project Area	Total	274.5	147.93	52.53	95.38
	State-owned	37.6	26.37	7.19	19.18
	Collective	230.63	115.95	44.11	71.83
	Others	6.28	5.60	1.23	4.37
Chongzuocity	Total	53.73	21.19	11.56	9.63
	State-owned	4.60	2.63	0.77	1.86
	Collective	49.13	18.56	10.79	7.77
Yulin city	Total	99.56	58.64	19.16	39.48
	State-owned	1.60	1.52	0.44	1.08
	Collective	95.17	5.43	18.0	36.34
	Others	2.79	27857.5	0.72	2.06
Beihai city	Total	34.04	10.26	2.05	8.41
	Collective	32.60	9.71	1.88	7.83
	Others	1.44	0.75	0.17	0.58
Fangchenggang city	Total	60.04	38.26	15.05	23.20
	State-owned	5.71	4.30	1.36	2.94
	Collective	53.72	33.35	13.44	19.90
	Others	0.61	0.61	0.25	0.36
Gaofeng Group	Total	27.14	19.38	4.70	14.68
	State-owned	25.69	17.93	4.61	13.32
	Others	1.45	1.45	0.09	1.36

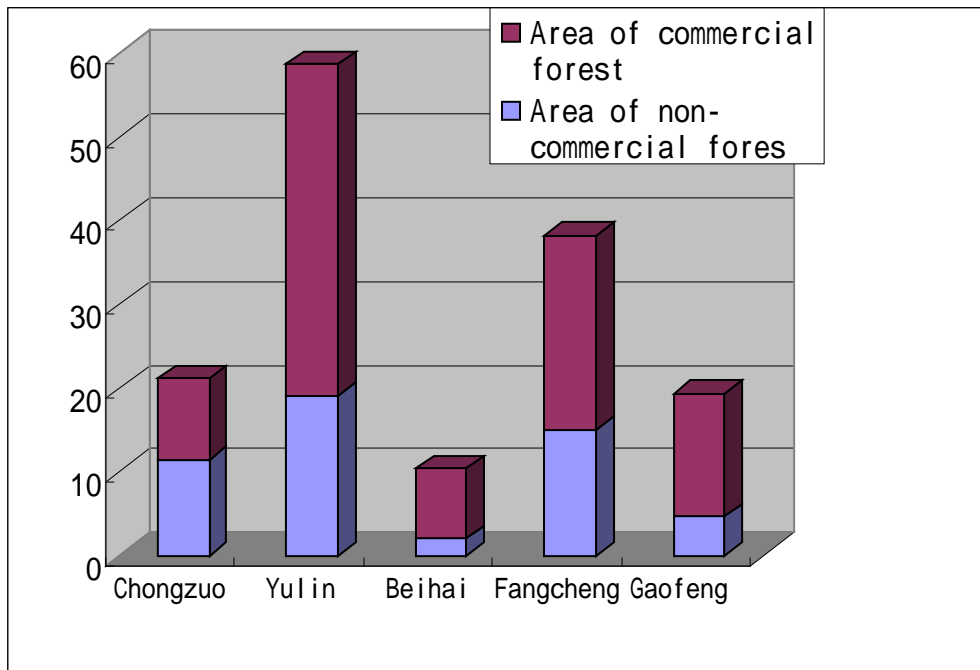


Figure 3-16 Proportions of Non-Commercial Forest and Commercial Forest in Project Areas

Table 3.6-3 Statistical Table of Forest Tree Species of Project Area (Unit: hm2)

Units	Total Forest Land	Forest						Open Forest Land	Shrubs	Forest Land without Standing Trees							Plant Nursery
		Total	Coniferous forest	Broad-leaf forest	Coniferous-Broad mixed forest	Economic forest	Bamboo			Total	Cutting blank	Burned blank	Unmatured land	Natural regeneration	Prepared land	Planned land	
Total of Project Area	1479257.3	1159823.9	495301.3	392046.3	98505.2	173970.0	1.1	8702.2	217839.6	92502.7	17179.5	14991.0	18724.7	4733.7	14680.8	22193.0	388.9
Chongzuo city	211869.2	99986.4	33665.7	42785.4	8494.6	15040.7	0.0	426.3	104192.8	7244.7	1536.5	223.5	2159.0	171.7	1110.8	2043.2	19.0
Jiangzhou County	116877.6	46177.2	15278.2	20359.2	3959.7	6580.1	0.0	328.6	67351.6	3007.9	733.7	80.4	455.6	83.8	28.5	1625.9	12.3
Fusui County	94991.6	53809.2	18387.5	22426.2	4534.9	8460.6	0.0	97.7	36841.2	4236.8	802.8	143.1	1703.4	87.9	1082.3	417.3	6.7
Yulin city	586445.2	522911.9	261949.3	116850.5	43071.4	101039.6	1.1	3684.6	27927.8	31828.7	4418.2	6907.6	4468.5	3789.9	6184.3	6060.2	92.2
Yuzhou district	13049.2	11747.8	5478.1	1070.1	727.6	4472.0	0.0	19.5	1087.7	186.6	0.0	25.7	33.3	50.1	56.7	20.8	7.6
Fumian District	34962.7	27603.4	12171.7	4202.0	1819.1	9410.6	0.0	308.3	4830.7	2161.1	175.9	34.5	492.4	28.9	913.1	516.3	59.2
Beiliu city	148894.8	126535.2	58230.5	19880.2	8677.6	39746.9	0.0	819.1	14985.1	6546.7	419.0	674.0	537.1	1896.3	1531.7	1488.6	8.7
Bobai County	209367.8	192537.3	96215.3	66760.2	18100.8	11461.0	0.0	1273.8	1445.1	14107.9	2017.5	4841.8	1010.1	1218.9	2937.2	2082.4	3.7
Luchuan County	96251.0	87910.2	53206.0	16147.4	8698.5	9858.3	0.0	740.6	1299.4	6292.0	1435.5	1020.5	2180.9	284.8	463.6	906.7	8.8
Xingye County	83919.7	76578.0	36647.7	8790.6	5047.8	26090.8	1.1	523.3	4279.8	2534.4	370.3	311.1	214.7	310.9	282.0	1045.4	4.2
Beihai city	104601.4	92876.9	23867.3	56516.8	7875.9	4616.9	0.0	654.4	1792.0	9134.9	2620.6	4532.1	990.0	173.5	300.5	518.2	143.2
Tieshangang district	11301.0	11000.9	9.7	9703.4	23.7	1264.1		8.6	44.8	242.5	125.2	0.0	81.3	0.0	0.0	36.0	4.2
Yinhai district	8125.3	7403.9	258.9	5242.6	611.2	1291.2	0.0	14.6	403.2	256.2	98.2	6.4	116.0	0.0	4.7	30.9	47.4
Hepu county	85175.1	74472.1	23598.7	41570.8	7241.0	2061.6	0.0	631.2	1344.0	8636.2	2397.2	4525.7	792.7	173.5	295.8	451.3	91.6
Fangchenggang city	382565.5	302099.3	138571.9	98381.6	26312.5	38833.3	0.0	2879.1	59478.3	18096.1	2418.1	1306.7	1477.2	64.0	4599.5	8230.6	12.7
Port district	15139.1	12948.7	8049.8	3489.9	1282.2	126.8		134.8	1617.9	437.7	0.0	194.3	9.6	0.0	0.0	233.8	0.0
Fangcheng district	157389.6	142503.8	46614.7	54552.7	11233.0	30103.4	0.0	765.4	6487.1	7622.5	299.0	280.4	972.7	0.0	1885.6	4184.8	10.8
Dongxing County	27085.3	23242.2	11450.1	6974.8	2044.8	2772.5		358.7	1869.8	1614.6	0.0	1.1	1.5	0.0	596.8	1015.2	0.0

Units	Total Forest Land	Forest						Open Forest Land	Shrubs	Forest Land without Standing Trees							Plant Nursery
		Total	Coniferous forest	Broad-leaf forest	Coniferous-Broad mixed forest	Economic forest	Bamboo			Total	Cutting blank	Burned blank	Unmatured land	Natural regeneration	Prepared land	Planned land	
Shangsi County	182951.5	123404.6	72457.3	33364.2	11752.5	5830.6	0.0	1620.2	49503.5	8421.3	2119.1	830.9	493.4	64.0	2117.1	2796.8	1.9
Provincial forest farm	193776.0	141949.4	37247.1	77512.0	12750.8	14439.5	0.0	1057.8	24448.7	26198.3	6186.1	2021.1	9630.0	534.6	2485.7	5340.8	121.8
Bobai forestry farm	28195.3	23117.5	6878.2	13252.4	2236.7	750.2	0.0	233.2	1943.9	2898.2	1498.3	58.2	1286.7	0.0	47.2	7.8	2.5
Dongmen Forestry Farm	14287.5	11544.6	1847.3	7852.2	1077.7	767.4	0.0	9.2	574.0	2143.5	354.8	0.0	982.9	130.6	405.9	269.3	16.2
Gaofeng forest farm	38405.6	27975.6	3986.3	15617.4	2181.4	6190.5	0.0	172.1	7174.9	3040.7	1238.3	6.6	1408.5	0.0	69.6	317.7	42.3
Liuwan forestry farm	14478.2	11469.3	1879.8	5740.9	846.8	3001.8	0.0	20.8	2737.2	244.4	236.3	4.0	1.1	0.0	3.0	0.0	6.5
Paiyangshan forestry farm	25681.9	21361.3	8660.1	10568.0	2133.2	0.0	0.0	47.5	2077.2	2188.5	865.5	39.4	1010.5	0.0	224.3	48.8	7.4
Qipo forest farm	17489.5	10169.5	6899.9	1775.7	963.8	530.1	0.0	15.6	4603.1	2691.1	470.9	26.5	1106.6	15.1	523.4	548.6	10.2
Qinlian forestry farm	50550.9	32552.5	5262.7	21168.0	2936.7	3185.1	0.0	518.6	4911.7	12544.2	1446.3	1886.4	3683.1	388.9	1015.7	4123.8	23.9
Liangfengjiang forestry farm	4687.1	3759.1	1832.8	1537.4	374.5	14.4	0.0	40.8	426.7	447.7	75.7	0.0	150.6	0.0	196.6	24.8	12.8

3.6.4 Age of Forest Stand

Among the 985.9 thousand hm² of land with forest in the project area, there are 284.4 thousand hm² of ecological public welfare forest stand, accounting for 28.9%; 701.4 thousand hm² of commercial forest stand, accounting for 71.1%.

In the commercial forest stand, if classified as per the age groups, they are: young forest 247.4 thousand hm², accounting for 35.3% ; middle-age forest 190.4 thousand hm², accounting for 27.1% ; near-mature forest 126.35 thousand hm², accounting for 18.0% ; mature forest 88.9 thousand hm², accounting for 12.7% ; over-matured forest 48.4 thousand hm², accounting for 6.9%. Details are shown in Table 3.6-4.

Table 3.6-4 Age Structure of Forest of Project Area (Unit: 10000hm²)

Units	Type of Forest	Woods					
		Total	Sapling forest	Middle-age forest	Near-mature forest	Mature forest	Over-mature forest
Project Area	Total	98.59	37.41	28.15	17.00	11.16	4.86
	Non-commercial forest	28.44	12.67	9.11	4.38	2.27	0.02
	Commercial forest	70.14	24.74	19.04	12.63	8.89	4.84
Chongzuo city	Total	8.49	3.66	2.29	1.22	0.79	0.53
	Non-commercial forest	1.92	1.61	0.29	0.02	0.004	
	Commercial forest	6.57	2.05	2.00	1.20	0.79	0.53
Yulin city	Total	42.19	16.55	11.84	6.61	5.54	1.65
	Non-commercial forest	12.19	5.84	4.46	1.55	0.34	0.01
	Commercial forest	30.00	10.71	7.38	5.06	5.20	1.65
Beihai city	Total	8.83	4.43	2.86	0.94	0.21	0.39
	Non-commercial forest	1.36	0.76	0.35	0.25	0.007	0.001
	Commercial forest	7.46	3.67	2.51	0.69	0.20	0.39
Fangchenggang city	Total	26.33	9.46	7.74	5.58	2.69	0.85
	Non-commercial forest	10.67	3.68	3.27	2.07	1.63	0.007
	Commercial forest	15.66	5.78	4.47	3.51	1.06	0.85
Gaofeng Group	Total	12.75	3.31	3.42	2.65	1.92	1.44
	Non-commercial forest	2.30	0.78	0.74	0.49	0.28	0.004
	Commercial forest	10.45	2.53	2.68	2.17	1.64	1.43

3.6.5 Site Conditions and Optional Forestland of Project Area

3.6.5.1 Grading of Site Quality

Among the 953.9 thousand hm² of commercial forest stand of the project area, if being classified as per the site quality, they are: Class-I site quality 218.2 thousand hm², accounting for 22.87% ; Class-II quality 554.87 thousand hm², accounting for 58.16% ; Class-III quality 181 thousand hm², accounting 18.97%. Details are shown in Table 3.6-5.

Table 3.6-5 Statistical Table of Forestland Site Quality In Terms of Land Types
(Unit: hm²)

Units	Quality / Grade of Forestland	Total Area	Forest Land				
			Land with Forest	Open Forest Land	Shrubs	Forest Land without Standing Trees	Plant Nursery
Project Area	Total	953954.4	815648.6	6732.3	62150.1	69096.8	326.6
	Class 1	218190.0	191370.6	1381.8	9229.7	16143.9	64.0
	Class 2	554764.7	466080.5	4121.6	43986.2	40359.1	217.3
	Class 3	180999.7	158197.5	1228.9	8934.2	12593.8	45.3
Chongzuo city	Total	96263.3	77427.7	420.4	11909.1	6487.1	19.0
	Class 1	25883.1	20818.6	113.1	3202.1	1744.2	5.1
	Class 2	55215.4	44411.6	241.1	6830.9	3720.9	10.9
	Class 3	15164.8	12197.5	66.2	1876.1	1022.0	3.0
Yulin city	Total	394814.1	367474.3	2499.6	2693.5	22074.9	71.8
	Class 1	129484.2	120517.8	819.8	883.4	7239.7	23.5
	Class 2	155948.4	145149.4	987.3	1063.9	8719.4	28.4
	Class 3	109381.5	101807.1	692.5	746.2	6115.8	19.9
Beihai city	Total	84120.4	78321.2	485.0	5.0	5187.0	122.2
	Class 1	6470.1	6024.0	37.3	0.4	399.0	9.4
	Class 2	74440.0	69308.2	429.2	4.4	4590.1	108.1
	Class 3	3210.3	2989.0	18.5	0.2	197.9	4.7
Fangcheng gang city	Total	232017.6	175886.2	2577.6	41599.4	11943.5	10.9
	Class 1	20616.9	15629.1	229.0	3696.5	1061.3	1.0
	Class 2	181462.4	137561.7	2016.0	32535.1	9341.1	8.5
	Class 3	29938.3	22695.4	332.6	5367.8	1541.1	1.4
Gaofeng Group	Total	146739.0	116539.2	749.7	5943.1	23404.3	102.7
	Class 1	35735.7	28381.1	182.6	1447.3	5699.7	25.0
	Class 2	87698.5	69649.6	448.0	3551.9	13987.6	61.4
	Class 3	23304.8	18508.5	119.1	943.9	3717.0	16.3

3.6.5.2 Optional Forestland Resources

According to the survey, the total commercial forest land within the project area is 953,900hm², of which, there are 665,000hm² of forest land of below 500m elevation and 30 gradient and above-average site quality that are suitable for growing quick-growth and high-yield eucalyptus (excluding 500,300hm² of land suitable for afforestation such as economic forest, bamboo, shrubs in rock mountains, un-mature forest land, natural renewing forest land and nursery). Details are shown in Table 3.6-6.

Table 3.6-5 Statistical Table for Various Forestland Below 500m Elevation and 30 Gradient And Above-Average Site Quality in Commercial Forest Area

		Total of Project Area	Chongzuo city	Yulin city	Beihai city	Fangchenggang city	Gaofeng Group
Land with forest	Subtotal	551115	59149	219158.2	49731.5	133973.7	89102.6
	Coniferous forest	194685.8	18360.5	82293.9	11965.8	57036.3	25029.3
	Broad-leaf forest	167286.1	22638.2	32498.6	31375.2	37530.7	43243.4
	Coniferous-Broad mixed forest	40694.7	4637.9	13254.5	3743.3	10103.3	8955.7
	Economic forest	138220.7	13412.8	83822.8	1851.9	28781.7	10351.5
	Bamboo	10227.7	99.6	7288.4	795.3	521.7	1522.7
Open Forest Land		4466.7	361.8	1694.2	465.3	1680.4	265
Shrubs	47246.8	4414.6	3520.3	5.3	35788.7	3517.9	
	1948.5	969.7	3.8		968.5	6.5	
Forest Land without Standing Trees	61840.3	7086.9	19774.8	5668.9	8049.5	21260.2	
	11157.4	1909.3	2043	692.7	399.8	6112.6	
Plant Nursery		291.7	18.7	60.7	122.2	10.9	79.2
Total Forestland		664960.5	71031	244208.2	55993.2	179503.2	114224.9

3.7 Survey on impacts of eucalyptus plantation

By now, no survey exclusively on environmental impacts of eucalyptus plantation is conducted in Guangxi. The assessment is presented herein with the citation from the survey report written by Professor Wen Yuanguang of Forestry College of Guangxi University, *Monitoring and Research of Impacts on Main Environmental Factors Caused by Planting Short-Rotation Eucalyptus and Acacia Forests* (hereinafter referred as the *Survey Report*).

The experimental area of the *Survey Report* is selected in the demonstrative base for improved tree species of Gaofeng Forestry Farm. Before the experiment, the vegetation was artificial fir forest. After full-felling and ground burning, this place was divided into three basin plots respectively growing vegetation of eucalyptus grandis, acacia crassiparva and naturally-restored grasses. The growth, soil erosion, micro-climatic effect, soil physical properties, soil water dynamics, undergrowth diversities and undergrowth

biomass of the three sample plots during the period of 2002-2006 were investigated. The results are as follows:

(I) Patterns of soil erosion

1. Impacts on surface runoff

As for the annual average surface runoff, the result is that: acacia crassicaarpa (39.60 t/hm²) < eucalyptus grandis(45.03t/hm²) < grasses slope(64.30 t/hm²). As for the annual surface runoff ratio, the result is that: acacia crassicaarpa (0.0032) < eucalyptus grandis (0.0036) < grasses slope (0.0052) . The annual variations of surface runoff seem obviously decreasing with the ages of vegetation restoration and can be divided into three runoff periods, i.e. high runoff period (year of plantation), slow-down runoff period (2nd-3rd period after plantation) and steady runoff period (4th-5th year after plantation).

The seasonal variations of surface runoff of the three kinds of vegetation are shown in Figure 3-17. According to the statistics, the performance of these three kinds of vegetation are identical, i.e. high in summer while weak in autumn and winter.

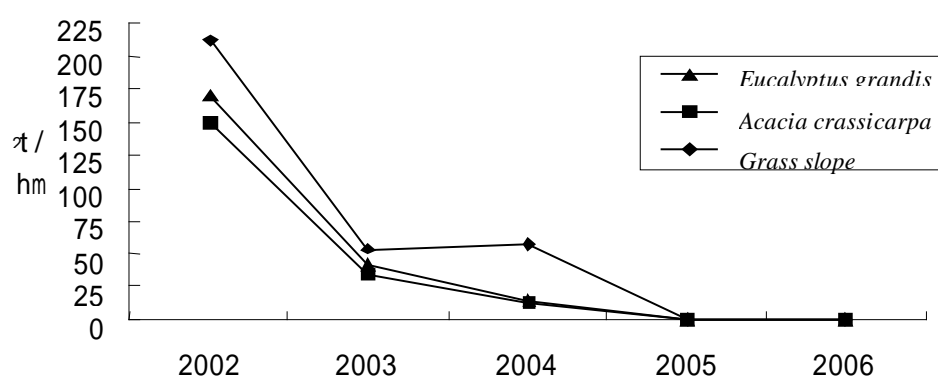


Figure 3-17 Annual Variations of Surface Runoff of Restoration of Three Vegetations

2. Impacts on volume of soil erosion

The annual variations of soil erosion of the three vegetations during the process of restoration are shown in Figure 3-18. As for the annual average volume of soil erosion, the result is that: acacia crassicaarpa (0.26 t/hm²) < eucalyptus grandis(0.29 t/hm²) < grasses slope (0.30 t/hm²) , showing unobvious differences.

It can be seen that, the volume of soil erosion of the woods of the same age (acacia crassicaarpa and eucalyptus grandis) are almost the same. In addition, the volumes of soil erosion of these two vegetation in different years have little difference, i.e. 0.007 t/hm²-0.045 t/hm² . However, the differences between wood land and the grass slope of the same age are quick big.

Viewing from the annual variation of soil erosion, all the three plots reached the maximum volumes in 2002, respectively 1.07t/hm², 1.05t/hm² and 0.82t/hm² for eucalyptus grandis, acacia crassicaarpa and grass slope. In the period of 2003-2004, the volumes of soil erosion of the three plots reduced rapidly to 0.08-0.33t/hm². In 2005-2006,

the variations of soil erosion of the three vegetations are within the range of 0.03-0.09 t/hm², showing little soil erosion.

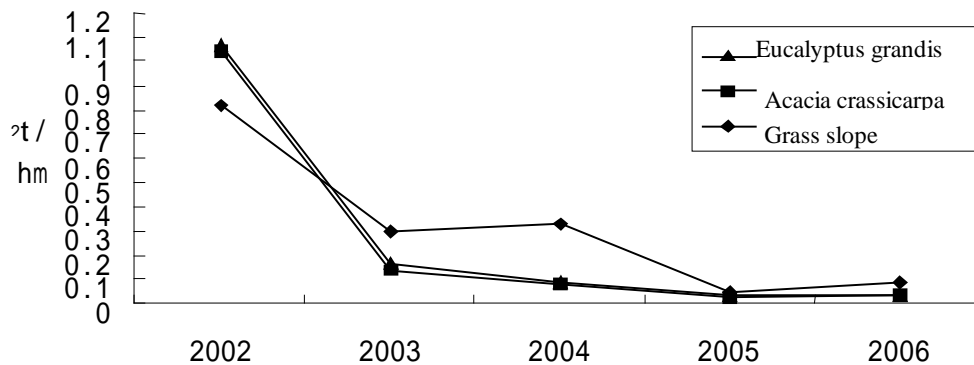


Figure 3-18 Annual Variations of Volumes of Soil Erosion of Three Vegetations in Restoration

In a year, spring and summer are the seasons with the most serious soil erosion, respectively accounting for 48.24% and 48.57% of the total volume. The soil erosion in autumn and winter only accounts for 3.19% of the total figure. In addition to the reason of seasonal rainfall distribution, such big differences are also greatly attributed to the operating activities in these seasons, such as tending, fertilizing, weeding and pit-expanding etc.

3. Impacts on volume of nutrient loss

The annual variations of loss of nutrients of the three vegetations during the process of restoration are shown in Figure 3-19. As for the loss of nutrients during the process of restoration, the result is: acacia crassicaarpa (0.036 kg/hm²) < eucalyptus grandis (0.039 kg/hm²) < grass slope (0.054 kg/hm²) . Of which, those of acacia crassicaarpa and eucalyptus grandis are respectively 33.3% and 27.7% lesser than that of grass slope. Such indicates that, during the process of vegetation restoration, short-rotation wood vegetation is more efficient in reducing the loss of nutrients.

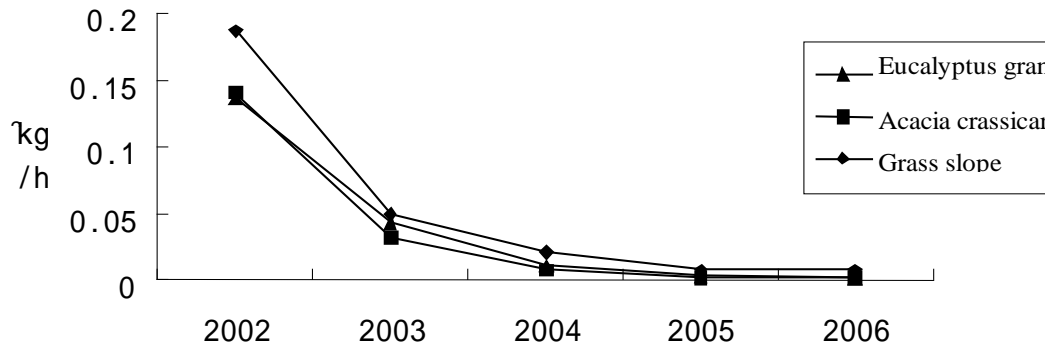


Figure 3-19 Annual Variations of Nutrient Losses in Restoration of Three Vegetations

Similarly, the loss of N, P, K of the three plots also occurred in 2002. In 2003-2004, the loss of nutrients obviously became less, and in 2005-2006, the situation turned to be steady. The variation of nutrient loss is in the same pace with those of surface runoff and volume of soil erosion. Especially in 2002, the loss of nutrients was the most serious. Loss of nutrients is featured by: $N > K > P$, mostly of N.

In all, the soil erosion of the wood land is weak and will quickly decrease along with the age of vegetation restoration.

(II) Micro-climatic effect of artificial forest

The average sunshine intensities of acacia crassica and eucalyptus grandis are smaller than that of grass slope, and which will gradually decrease with the age of restoration, of which, the decrease for acacia crassica is more obvious. Moreover, the temperature reduction and humidity increase within the stand of acacia crassica are more obvious than those of eucalyptus grandis and grass slope.

(III) Changes of soil physical properties

In terms of soil density (1-100cm) of the three kinds of vegetations, the result is: acacia crassica ($1.19-1.33\text{g/cm}^3$) < eucalyptus grandis ($1.21-1.49\text{g/cm}^3$) < grass slope ($1.25-1.65\text{g/cm}^3$). In terms of total porosity, the result is: acacia crassica > eucalyptus grandis > grass slope. The soil densities of various vegetations will decrease along with the age of vegetation restoration.

The vertical variations of the three types of vegetations are shown in Figure 3-20. It is seen that the variation trends are comparatively identical, and will increase along with the depth of soil.

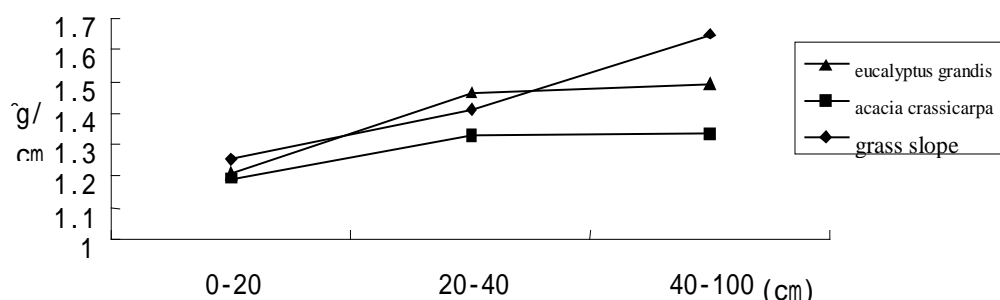


Figure 3-20 Vertical Soil Density Variation in Restoration of Three Vegetations

After five years of restoration of the three types of vegetations, compared with the previous fir forest, the pH value and the contents of organic matter, total N, total P and hydrolysable nitrogen of acacia crassicaarpa forest have obviously increased, indicating improvement of soil fertility. Similarly, the content of soil nutrients of grass slope have increased to some extents compared with those of the previous fir forest, indicating that grass vegetation restoration is also good for nutrient accumulation. However, the main contents of major nutrients of eucalyptus grandis are generally the same with those of the previous fir forest, showing unobvious accumulation of soil nutrients.

(IV) Dynamic variation of soil water content

The water contents respectively of acacia crassicaarpa and eucalyptus grandis at the same soil strata (0-80cm) are lower than that of grass slope. In terms of maximum water-holding volume, soil (0-100cm) water-storing capacity, soil (80cm) average permeation rate, accumulated volume of lithers and maximum water-absorbing capacity after five years of restoration, the result is: acacia crassicaarpa > eucalyptus grandis > grass slope.

(V) Impacts on undergrowth diversities

The numbers of undergrowth species respectively of eucalyptus grandis and acacia crassicaarpa forests are not obvious, which are less than that of the naturally-restored grass slope. The plant abundance indices of naturally-restored shrub and grass layers are the highest, while the diversity indices of shrubs and grasses of acacia crassicaarpa are the best. The undergrowth species of acacia crassicaarpa forest are evenly distributed.

(VI) Impacts on undergrowth biomass

In terms of vegetation biomass of the three restored vegetations, the result is: grass slope > eucalyptus grandis > acacia crassicaarpa. In the mean time, the composition of the undergrowth biomass are also quite different. The grass slope and acacia crassicaarpa are featured by undergrowth grass, while eucalyptus grandis is featured by shrubs.

4 The significance of developing eucalyptus forest

4.1 Guarantee the raw material supply for paper making industry

According to *China Paper*, the annual growth of consumption of paper and paperboard in China during 1990-1999 was 10.4%, while that of recent years kept at approximately 8.0% each year. Great consumption potential has greatly stimulated the rapid development of paper making industry. By now, China has become one of the leading countries in paper production, consumption and importation. However, the fiber raw materials for paper making in China depend mostly on grass pulp, while the utilization of wood pulp only accounts for 21.0%, which is far less behind the 90% of wood pulp in the international modern paper making industry. What is more, most of the wood pulp used in paper making industry in China depends on import, accounting for over 80% of the total volume of wood fiber. It is noted that the price fluctuation of paper pulp in the international market will have great impacts on the paper making industry of China. As such, the use of non-wood pulp for paper making has not only restricted the scale development of paper-making enterprises of China but also caused a series of problems such as inferior quality, low grade and serious environmental pollution.

Taking into consideration of the limited capacity in supplying raw materials to the paper pulp, paper and wood product industry and the pressure from the import from the world markets, as well as the participation in the international competition of China's paper-making industry, market demand for paper products and environmental protection etc., Chinese Government has proposed the strategic decision in the *Tenth Five-Year Plan for National Economic and Social Development* that, "great efforts must be made to develop the wood pulp, high-grade paper and paperboard" and "strengthen the ecological construction, expedite the afforestation of quick-growth and high-yield forest and industrial raw material forest".

This Project will plant eucalyptus forest of 2.4 million mu as raw material forest base for pulp and paper project, which will solve the problem in raw material supply and conform with the strategic policies of our nation.

4.2 Conform to the State's principle for classified and categorized operation of forest

Like other plantations, eucalyptus plantation performs the same ecological function and brings about the same benefits such as water and soil conservation, climate regulation and environmental upgrading etc.

The ecological performance and position of eucalyptus forest can be viewed from the State's strategic forestry development and the principles for classified and categorized operation of forest.

In recent years, all countries have made greater efforts to protect the environment, especially the natural forests in tropical areas. As a result, the contradiction between the supply and demand of woods and forestry products becomes increasingly outstanding in the world. Therefore, to actively initiate commercial forest and direct breeding, follow a way of combination of forestry and processing, substitute artificial quick growth timber and

small sized timber for natural forest and large sized timber has become the development tendency of the world forestry and the cultivation of forest resources. Only by solving the aforesaid contradiction, can we protect the natural forest in a more effective way.

In recent years, China has made greater efforts in the construction of “Six Key Forestry Projects” through the implementation of classified and categorized operation of forest and the strategy of “treatment in the west, expansion in the east, rest in the north, use in the south” for forestry development. Guangxi is located in tropical and subtropical areas rich in water, heat, light and woodland resources, being the key region for developing commercial forest. Therefore, the development of quick growth and high yield timber forest such as eucalyptus, pine trees and firs and other species has become a key forestry construction project. Eucalyptus featured with quick growth and high yield and benefited from advanced technical achievements will surely become an important species for the construction of quick growth and high yield forest base and integrated industry of forest, pulp and paper.

In addition, the construction of forestry ecosystem and the construction of industrial system are interdependent and supplementary to each other. Thus, to develop eucalyptus forest shares the same objectives with ecosystem construction and conforms to the State’s principle of classified and categorized operation of forest.

4.3 Provide more forestry products and reduce the pressure on natural forest

The ecological benefits of artificial forest can be viewed from the facts that eucalyptus forest replaces natural forest and provides more forestry products for human beings.

Protection of natural forest and biodiversity is a dynamic and developing balance and needs abundant materials, say, forest resources as basis. China has forest of approximately 1.748 billion hectares, accounting for 5% of the global forest area. Its forest resource per capita is only 1/4 of the world average level. Therefore, China is in great shortage of forest resources. In 2004, China imported timber and sawn wood respectively of 26.24 million m³ and 6 million m³; pulp, waste paper and paper products of 24.51 million tons (equivalent to timber of 0.1 billion m³), showing outstanding contradiction between timber supply and demand. The construction of commercial forest base aims at replacing natural forest and producing more timber and forestry products at faster speed and with less woodland. In this way, a vast area of natural forest and ecological non-commercial forest will be protected at the cost of small-sized artificial forest.

The quick growth and high yield eucalyptus can increase forest resources at rapid speed and satisfy the demand for development. Thus, it is an effective way to protect natural forest, ecological non-commercial forest and biodiversity.

5 Bio-Diversity and Objectives of Eco-Environment

Protection

5.1 Biodiversity

Biodiversity refers to the richness of animals, plants, organism and other species on earth. It includes two dimensions: firstly, it refers to the richness of species in specific regions, which is called regional biodiversity; Secondly, it refers to uniformity coefficient of species distribution in terms of bionomics, which is called biodiversity or species diversity of plant communities. (Ref. Jiang Zhigang, 1997) Biodiversity is an objective indicator to measure the richness of living resources in specific region.

Guangxi started planting eucalyptus in 1956 and has a history of over 50 years in introducing and planting eucalyptus. In 1980s, Guangxi cooperated with Australia to develop the improved varieties for Guangxi and the neighboring areas. By the end of 2006, Guangxi had artificial eucalyptus forest of 600,000 hm².

This Project plans to develop raw material forest within the artificial forest. The existing forestland includes eucalyptus, pine and acacia or mixed forest as well as partial open forestland, shrub forest, cutting blank and burned area etc. These forestlands are in low elevation and gentle slopes where human disturbance is frequent. There are no primary forest and natural secondary forest.

This Project adopts eucalyptus, which has been introduced and planted for many years. The eucalyptus plantation is concentrated in artificial forestland. Thus, eucalyptus plantation will not damage primary forest and natural secondary forest. Therefore, the project construction will not have any adverse impacts on regional biodiversity.

Viewing from uniformity coefficient of species distribution, the project construction will increase eucalyptus forest of 129200 hm², which accounts for 13.5% of total area of commercial forest in project area. After the project implementation, the plantation proportion of conifer will drop from 33.5% to 23.5% whilst that of eucalyptus will increase from 10.1% to 18.9%. However, the uniformity coefficient of species distribution in the south of Guangxi will be affected by the additional 2.4 million mu of artificial eucalyptus forest, showing single species distribution.

5.2 The relation between raw material forest base and ecological public-good forest

5.2.1 The relation between raw material forest base and ecological public-good and protection forest

The supportive projects include construction project of protection forest of Zuojiang River catchments, the subproject of *construction project of Guangxi for protection forest system in the Pearl River Catchments*, construction project of protection forest in Guangxi coastal area (including protection forest in inter-tidal zone, on coastline, on land, by farmland and villages). The superposition of *Distribution Map of Project Raw Material Forest Base* and *Distribution Map of Public Non-commercial Forest* is shown in table 2-1.

All these protection forests are mainly distributed in water source head, riverbanks,

nature reserves and boundaryline. According to categories of forestry business, ecological forest belongs to public welfare forest.

The raw material forest base of this Project aims to plant fast-growing commercial forest used for pulp and paper production. According to the statistics of the available sup-compartments, the site for raw material forest base is in commercial forest plantation area, except Beihai has some raw material forest outside commercial forest plantation area, which include:

Soil and water conservation forest, wind protection and sand bind forests in Tieshangang District of Beihai City, totally 190.0ha.;

Water source conservation forest, water and soil conservation forest, wind protection and sand-bind forest, farmland and grassland protection forest, special-purpose forest in Yinhai District, totally 668.4ha.;

Various kinds of protection forests, special-purpose forest, firewood and economic forest in Hepu county, totally 783.3ha.;

The above-mentioned forestland shall be deleted from raw material forest base as required by EA. The other selected sites have excluded ecological protection forest and public non-commercial forest such as water resources protection forest, soil and water conservation forest, sand fixation forest etc. Despite that some selected sites are interrelated with ecological forest and public non-commercial forest, no public non-commercial forest and ecological forest will be used for pulp and paper production.

5.2.2 Analysis on the impacts of raw material forest base on natural reserves and forest park

The raw material forest base covers 15 counties and 8 state-owned forest farms where there are 15 natural reserves of national and provincial levels; 7 forest parks of national and provincial levels and numerous holiday resorts. The relation between the proposed raw material forest base and the eco-environmentally sensitive targets is shown in table 5.2-1 and map 2-1.

Table 5.2-1 The relation between raw material forest base and nature reserve and forest park

Protection Type	Name	Relation with project area	Relation with selected raw material forest base
The existing nature reserve;	Fangcheng Golden Camellia Nature Reserve (National)	Within Facheng district	Far from forestland
	Hepu Dugong Natural Reserve (National)	In project area within Beihai city and coastal area	Far from forestland
	Nonggang Natural Reserve (National)	In project area in the west of Chongzuo district, the north of Paiyangshan forestry farm, keeping long distance	Far from forestland
	Damingshan Natural Reserve (National)	North of Wanpen Branch of Gaofeng forest farm, separated by Longshan natural reserve, keeping long distance	Far from forestland
	Siwan Mountain Natural Reserve (National)	Located in Fangchenggang city at the boundary area of Shangsi county and Fangcheng District of the project area.	Far from forestland
	Shankou mangrove natural reserve (National)	In project area within Beihai city and coastal area	The sites are selected within the forestry farm; the nature reserve is more than 2km from territory of Shankou forestry farm to the west.
	Beilunhe River Mouth Marine Natural Reserve (National)	Within Dongxing territory of Fangchenggang city; the coastal area	Far from forestland
	Chongzuo White-headed Leaf Monkey Natural Reserve (Provincial)	In Jiangzhou district of Chongzuo city and within Fushui county; The west nature reserve is interrelated with Xiangyang Branch of Dongmen forestry farm, being over 1km from Buman Branch; The west nature reserve is over 1km from Leika Branch.	The west nature reserve is interrelated with Xiangyang Branch of Dongmen forestry farm, being over 1km from Buman Branch; The west nature reserve is over 1km from Leika Branch.
	West Damingshan Natural Reserve (Provincial)	The southern protection zone is located in the project area.	Far from forestland
	Weizhou Island Natural Reserve (Provincial)	In Beibu Gulf seas, far from project area	Far from forestland
	Zuojiang River Lamprotula Mansuyi Natural Reserve (Provincial)	Partial zone is located in project area along the river.	The shortest distance between Zuojiang bank and the selected site is 500m. Such selected site extends no more than 1km. The other selected sites keep away more than 1km from Zuojiang river bank.

	Shanglin Longshan Natural Reserve (Provincial)	Close to Wanpeng Branch of Gaofeng Forestry farm in the north; with 5km interrelated line.	The south part of natural reserve is close to the selected sites of Wanpeng Branch with 5km interrelated line.
	Nalin Natural Reserve (Provincial)	Within Bobai county, close to Yunfei Branch of Bobai forestry farm with approximately 8km interrelated line.	Between southeast boundary of natural reserve and the selected sites of Yunfei Branch of Bobai forestry farm, there are 8km interrelated line which space is within 1km.
	Sanshiliunong Yilingjun Natural Reserve (Provincial)	Outside the project area, in the northwest of Gaofeng forestry farm, keeping long distance	Far from forestland
	Daqingshan Natural Reserve (Provincial)	Outside the project area, in the west of Beishan Branch of Paiyangshan forestry farm.	The selected site is about 800m from the boundary of the natural reserve.
	Beiliu Dafengmen geological profile of Devonian period (provincial)	Within the project area	Far from forestland
	Maoweihei mangrove natural reserve (Provincial)	Outside project area, coastal area of Qinzhou city, in the south of Pinggen Branch of Qinlian forestry farm.	Far from forestland
The existing forest park	Shiwan Mountain Forest Park of national level	Located in Fangchenggang city at the boundary area of Shangsi county and Fangcheng District of the project area.	Far from forestland
	Liangfengjiang Forest Park of national level (Liangfengjiang tree garden)	Special use forest, public non-commercial forest and protection forest in the northwest section of Liangfengjiang tree garden.	The selected site is about 1km from public non-commercial forest, interrelated with partial protection forest.
	Darongshan Mountain Forest Park (Provincial)	In Darongshan forestry farm in the north of Beiliu city, where most are protection forest with less forestland available for selection.	The selected sites are outside the forestry farm; far from forestland
	Laohuling Ridge Forest Park (Provincial)	12km from the south central part of Nanning city, including Laohuling Reservoir and surrounding forest, overlapping with the north part of Pingpu Branch of Gaofeng forestry farm.	Far away from the selected sites
	Sanshiliuqu Forest Park (Provincial)	In the north suburb of Qinzhou city, far away from the project area and Qinlian forestry farm	far from forestland
	Shimen Forest Park (Provincial)	In the suburb of Nanning city, about 600m from the north part of Ertang Branch of Gaofeng forestry farm.	Far away from the selected sites
	Laohuling Ridge Forest Park (Provincial)	The protection forestland in the north of Liangfengjiang tree garden	About 3.4 km from the selected sites

Notes: Remark: “far away” refers to the linear distance of over 2km from the boundary of project area.

(1) Natural reserves far from the selected forestland

From the overlay map, there are 12 natural reserves being 2km away from the selected site, respectively Fangcheng golden camellia, Hepu Dugong, Nonggang, Damingshan, Shiwan Mountains, Shankou mangrove and Beilunhe marine protection zones, West Damingshan natural reserve, Weizhou natural reserve for birds, Sanshiliunong Longkun, Maowehai mangrove natural reserve and Beiliu Dafengmen geological profile of Devonian period. It can be seen that the selected site is far away from the 12 natural reserves. Therefore, the base construction will not have adverse impacts on the natural reserves.

(2) Natural reserves close to the selected forestland

Yunfei Branch of Bobai forestry farm is close to the southeast boundary of Nalin Natural Reserve with approximately 8km interrelated line. Viewing from the distribution map of the selected forestland, some distribute within 1km from the natural reserve, which covers an area of 108.2 hm².

Wanpeng Branch Farm of Gaofeng Forest Farm is near to Longshan Natural Reserve with interrelated line of 5km. There are about 820.2 hm² of land located within 1km from the boundary of the natural reserve.

Beishan Branch of Paiyangshan Forest Farm is near to Daqingshan Natural Reserve (provincial level). There are about 20.1 hm² of land located within 1km from the boundary of the natural reserve.

However, the selected site is close to the natural reserve and human activities are frequent owing to short rotation of eucalyptus. Therefore, it is possible that the workers may enter the natural reserve, which may disturb the wildlife within the natural reserve. Based on the review of the EIAs, within 1km of the boundary of natural reserve, it is not suitable to plant eucalyptus with short rotation. Therefore, the selected site shall keep at least 1km isolation strip from the natural reserve. According to the requirements of EIAs, the selected sites shall exclude the above-mentioned forestland, totaling 948.5hm².

(3) The natural reserve interrelated with the selected site

Chongzuo White-headed Leaf Monkey Natural Reserve was combined from Bapen natural reserve and Banli natural reserve. The whole natural reserve is made up of dozens of patches of different sizes, scattering in Jiangzhou district of Chongzuo city and Fushui county. This natural reserve is the only germplasm resource base of white-headed leaf monkey.

Dongmen forestry farm, subordinated to Gangfeng Group, is located in this area and interrelated with the natural reserve. Viewing from the distribution map of Dongmen forestry farm, the selected site in Xiangyang Branch is interrelated with the natural reserve.

According to statistics, white-headed leaf monkey is one of the 25 critically endangered Primate species identified by the World Primate Association. It is the subspecies of leaf monkey. On a global scale, white-headed leaf monkeys distribute in Nonggang, Fushui and Chongzuo of Guangxi, approximately totaling 700. They belong to

the animals under first-class state protection. They live in karst mountainous area, eating the leaves, roots, stem and fruits of plants at daytime and resting in caves and the cracks of the cliff at night. They are good at climbing, swinging in the trees and climbing the cliff. They live a community life, having regular activity range, route and fixed habitat. Generally, they rest in cave and cracks of the cliff, eating tender leaves, buds, flowers and fruits.

Partial selected forestland of Xiangyang Branch of Dongmen forestry farm is interrelated with the White-headed Leaf Monkey National Nature Reserve. Considering that the area where white-headed leaf monkeys are distributed is very narrow, the migration and activities of the white-headed leaf monkeys may be interfered by human activities if it is separated by artificial forest. Further more, white-headed leaf monkeys have to live in a narrower area, which will cause degeneration due to inbreeding. Such will further threaten the population continuity.

Therefore, EA requests that the selected site interrelated with white-headed leaf monkey natural reserve and the selected site within 1km of the boundary of the Natural Reserve shall be excluded. Such guarantees that the project construction will not cause any adverse impacts on the activities of white-headed leaf monkeys in Chongzuo White-headed Leaf Monkey Natural Reserve. According to the statistics of sub-compartment, the excluded area of sub-compartment is about 2000hm².

In site selection of the project, the forestland within 1km from the natural reserve and the forestland interrelated with the natural reserve have been excluded. Thus, the project construction will not have any adverse impacts on the eco-environmentally sensitive targets.

5.3 The changing tendency of tree species

5.3.1 Adaptability of tree species

Eucalyptus is of numerous varieties, quick growth, barrenness adaptability, hardiness against climate and natural changes and high economic value. Eucalyptus is of good adaptability to soil and grows well in barren and sandy land. Introduction of Eucalyptus in Guangxi can be traced back to early 1970s. At present, the plantation of artificial eucalyptus amounts to proximately 750,000 hm², which is mainly distributed in Nanning region, and in south and southwest of Nanning. In addition, Liuzhou city, Hechi City and Baise City are the new plantation area of eucalyptus, which extended northward to Guilin region. The major species of eucalyptus include *E. grandis* and *E. urophylla*.

The raw material forest base is the major plantation of artificial eucalyptus forest in Guangxi. The selected tree species are the most popular species in Guangxi these years, being of good adaptability.

5.3.2 The changing tree species and environmental impacts

(1) The changing tree species

The present situation of changing tree species is: It is reported that the commercial forest within project area totals 954000hm², among which the land with forest covers 701400hm², including major tree species: masson pine of 300600 hm², accounting for 31.51% of total commercial forest; pinus yunnanensis franch of 946.5 hm² for 0.10%; exotic pine of 123200 hm² for 12.91%; fir of 40400 hm² for 4.23%; eucalyptus of 148900

hm²for 15.61%; acacia 22400 hm²for 2.35%; broad-leaf tree 65000 hm² for 6.28%.

After the implementation of this Project, the new planted eucalyptus will reach 129200 hm², most of which used to be low-yield coniferous forest, some be broad-leaf forest, barren land, shrubs and grass, felling base and burned area. Within the project area, eucalyptus forest will reach 278100 hm², accounting for 29.2% of commercial forest, an increase of 13.59%. Of the commercial forest, coniferous forest (masson pine, pinus yunnanensis franch exotic pine and fir) will reduce from present 48.76% to around 39.3%.

(2) The changing of tree species and environmental impacts

The existing commercial forestlands no matter artificial eucalyptus forestland or coniferous forestland are managed in accordance with Chinese traditional operation pattern. Especially, the coniferous forestland adopts extensive management owing to its long growing period and long rotation that is generally 15 to 20 years. In spite of lack of fostering measures, the commercial forestland still perform ecological function due to few human disturbance.

However, after the implementation of this Project, afforestation management will be greatly strengthened. Particularly, Stora Enso has rich experience in eucalyptus management in Brazil, which is a kind of plantation management pattern. Such management pattern aims at maximum yielding as the objective for operation and will weaken the ecological function of the forest. Therefore, the implementation of this Project will weaken the ecological function of the selected site.

According to the requirements of categories of forestry business by the State, the purpose of categories of commercial forest is to promote the production of timbers in order to satisfy the demand of timbers for national economic development. In commercial forest, this Project adopts high-investment and high-yield operation that conforms to the requirements of categories of forestry business by the State.

(3) The overseas operation mode of Stora Enso

The operation mode of Stora Enso in Brazil: In terms of tracts of land management, Stora Enso, in accordance with the characteristics of natural environment, marked off the protection area (including wildlife habits, wildlife migration route, the river origins and banks and other ecological targets) and well maintained the area basing on the principle of biodiversity. The retaining land should conform to the local laws and regulations. A certain proportion of indigenous tree species should be guaranteed. In addition, plantation operation of eucalyptus was also adopted in other suitable land, as shown in the picture.



Proportions of fast-growing tree species and indigenous tree species.



The active compensation and protection for the Atlantic rainforest – one of the the endangered ecological systems of the world.

(4) The problem of pure forest & mixed forest after the changing of tree species

Different from land acquisition mode in Brazil, Stora Enso cannot acquire tracts of land. The environmental experts of the Company rationally determine the scope and quantity of artificial eucalyptus forest. At present, the Company has acquired the land of 2.4 million mu for raw material forest plantation in 15 counties and 8 state-owned forestry farms.

In order to prevent large-scale pure forest arising from project implementation, this Project proposes to control the size of the sub-compartment under 20hm² and adopt multiple series of clonal varieties for planting in an interactive mode.

Considering that the selected sites are close to social forestland, the sound operation pattern of raw material forest base will set good example for others to follow in the plantation of artificial eucalyptus forest in Guangxi. As a result, large-scale of pure forest will come into exist. Under such circumstance, large-scale pure forest may appear in raw material forest base and social forestland.

Of the forestland, 67.9% belongs to state-owned forestry farm. In order to avoid large-scale pure forest, it is first to plant indigenous tree species in the selected site within the state-owned forestry farm. In addition, the state-owned forestry farm, as a partner of joint-venture forestry company of this Project, should be responsible for the control of tree species planted in other forestland within the forestry farm. Mixed plantation should be encouraged by planting proper amount of local coniferous forest or other broad-leaf forest.

However, the surrounding social forestland is not under the management of the project forestry company. As a result, within the project area, large-scale pure forest might appear if the other forest farmers imitate to plant eucalyptus. To avoid large-scale pure forest, the local forestry department shall make reasonable distribution of commercial forest plantation and restrict the cutting quota with an aim to keep eucalyptus planting under control.

5.4 Underwood Vegetation

5.4.1 Existing Conditions of Underwood Vegetation of Project Area

1. The dominated type of forestland and underwood vegetation of project area

The broad-leaf forest of the project area includes eucalyptus, acacia and mixed forest, belonging to warm deciduous broad-leaved forest. It is mainly featured by artificial forest that is vastly distributed. Among the existing forest, the underwood vegetation consists of weeds and shrubs, including *Dicranopteris linearis*, *Rhodomyrtus tomentosa* bush, *Melastoma candidum*, *Miscanthus floridulus*, *Baekkea frutescens*, *Rhus chinensis*, fern, 百花草, *Cinnamomum camphora*, *S. octophylla*, *Sapium sebiferum*, *Eriachne* and *Bidens pilosa* etc.

Major conifer trees are mason pine, *Pinus elliottii*, as well as mixed forest, belonging to warm conifer forest. Among them, mason pine and *Pinus elliottii*, is featured by artificial forest that is vastly distributed and of tens of years of old. Most of the *Pinus elliottii* will gradually die out after collecting rosin. These forestlands must be renewed. The underwood vegetation of conifer are *Dicranopteris linearis* grass, *Ilex rotunda*, *Itea oldhamii* Schnerder, *Miscanthus floridulus*, *Cinnamomum porrectum*, *Rhodomyrtus tomentosa* bush, *Liquidamber formosana*, Category etc.

4.4.2 Investigation on the bio-diversity

According to the investigation on the biodiversity of the dominated type of forestland in the project area conducted by Wen Yuanguang, Liang Hongwen and Zhu Hongguang of Forest Institute of Guangxi University in June of 2007 and combining the investigation data made in August 2004 and August 2006, it is to select six vegetation types under

mason pine forest, pinus elliottii forest, eucalyptus forest, acacia forest, mixed forest and shrubbery. Of the selected community types, mark 5 patches with the size of 400 m² as the sample plots for investigation. Then, record the name of the tree species which height is over 4m. At the same time, measure its DBH, height and crown density. Within each sample plot, four sampling sites of 4m×4m are selected, where each plant name, height, number of individuals and covering rate shall be recorded. The species composition of different community types is shown in Appendix 1; Table of investigation on sample plot is referred to Appendix II.

Results are presented below.

Under Masson pine community, the shrub layer has 70 plant species. The dominated species include *Baeckea frutescens*, myrtle, common melastoma and *Cassytha filiformis*; Herb layer has 23 plant species. The dominated species is *D. linearis* followed by *miscanthus floxidulus*, *ischaemum indicum*.

Under *Pinus elliottii* community, the shrub layer has 44 plant species. The dominated species include myrtle, *Baeckea frutescens*, *Litsea glutinosa*, indigowoad, chinaroot greenbier rhizome, *Aporosa chinensis*, *Embelia laeta*, *Cassytha filiformis*; Herb layer has 19 plant species. The dominated species is *D. linearis* followed by *miscanthus floxidulus*, *ischaemum indicum* and *Ischaemum indicum*.

Under eucalyptus community, the shrub layer has 80 plant species. The dominated species is myrtle followed by *Psychotria*, chinaroot greenbier rhizome and *Evodia lepta*; Herb layer has 26 plant species. The dominated species is *D. linearis* followed by *miscanthus floxidulus*, *ischaemum indicum* and *Ischaemum indicum* etc.

Under acacia community, the shrub layer has 42 plant species. The dominated species is myrtle followed by *Evodia lepta*, chinaroot greenbier rhizome, *Baeckea frutescens*, *Rhus chinensis* Mill and *Melastoma candidum*. Herb layer has 19 plant species. The dominated species are *D. linearis* and *miscanthus floxidulus* followed by *Blechnum orientale*, *Belamcanda chinensis*, *P. scrobiculatum* Linn and *Sabina procumbens* etc.

Under mixed forest community, the shrub layer has 44 plant species. The dominated species are *Psychotria* and myrtle followed by 6 species such as *Litsea cubeba*, *Schima wallichii* Choisy, *Symplocos racemosa*, *C.camphora*, *Lygodium japonicum* and *S. octophylla*. Herb layer has 17 plant species. The dominated species is *D. linearis* followed by two species such as *miscanthus floxidulus* and *Blechnum orientale*.

Under shrub community, the shrub layer has 64 plant species. The dominated species is *Baeckea frutescens* followed by myrtle. Herb layer has 27 plant species. The dominated species is *D. linearis* followed by *Blechnum orientale*, *miscanthus floxidulus* and *Ischaemum indicum* etc.

The above-mentioned plant species are the dominated and common species in investigation area. The dominated species under shrub community are very similar to those under forest community. This indicates that artificial forest only change the dominated species of the tree layer whilst the dominated species in shrub and herb layers still remain the same.

With 20 sampling sites of 4m×4m (16m²) , there are over 60 plant species. Under eucalyptus forest, there are 106 plant species, which ranks the top among the five types of forest under investigation. The covering rate of the underwood vegetation is over 80% under different types of artificial forest. Particularly, the covering rate in shrub layer is 21-42% at average. The species composition and covering rate under eucalyptus forest are obviously higher than that of pinus elliottii forest and mixed forest with longer recovery period.

Of the six community types, the richness of species is 60-106 species with average level of 79.5±19.66. The coefficient of variation is 24.74%. The richness of species in shrub layer is 42-80 species with average level of 58±15.59. The coefficient of variation is 26.89%. The richness of species in herb layer is 16-27 species with average level of 22±4.11. The coefficient of variation is 19.13%.

The variation of Shannon-Wiener index of the six communities is 0.688-2.231. The maximum value is produced in eucalyptus forest and the minimum value is produced in pinus elliottii forest. Biodiversity varies greatly at different layers of the communities. Biodiversity of shrub layer is higher than that of herb layer. The biodiversity at shrub layer of different communities is very close with the variation of 1.880-3.614. The coefficient of variation is 42%. The maximum index of biodiversity is produced in eucalyptus forest whilst the minimum value is produced in shrub community. Biodiversity in herb layer is of great variation at 0.2626-1.8930. The coefficient of variation is 61%. The maximum index of biodiversity is produced in herb layer of eucalyptus whilst the minimum index is produced in Pinus elliottii forest.

The average variation of the six communities is 0.164-0.478. Such regularity of variation is similar to the regularity of Shannon-Wiener index.

With masson pine forest as reference criterion, Bio-Integrity of different types of artificial forest is to be analyzed. The index of bio-integrity of Pinus elliottii and acacia forest is 5.32, being Grade II integrity. The index of bio-integrity of eucalyptus forest is 6.71, being Grade I integrity. The index of bio-integrity of mixed forest is 4.83, being at the general standard.

This shows that under similar stand structure, environmental condition and disturbance, the species quantity and biodiversity of underwood vegetation under different tree species are very close. The analysis on similarity of communities also shows that the co-existing species of underwood vegetations account for 40-50%. This means that biodiversity of underwood vegetation under artificial forest depends on stand structure, environmental condition and human disturbance and has nothing to do with tree species.

5.4.2 Conditions of Underwood Vegetation of Artificial Eucalyptus in Neighboring Areas

The geographical and climate conditions of Qinzhou city of Guangxi and Leizhou Peninsula of Guangdong are similar to those of the project area, according to comparison of biological diversities of the underwood vegetation, it can see the follow facts.

Biodiversity of underwood vegetation under eucalyptus forest has something to do with land preparation and soil type of forestland. The covering rate of underwood vegetation under eucalyptus forest adopting manual land preparation is higher than that of

eucalyptus forest adopting mechanical land preparation and plantation. The underwood vegetation is richer and recovers sooner under eucalyptus forest with higher soil fertility.

The richness of underwood vegetation is related to forest stand canopy. The impacts of tree age on biodiversity are also the impacts on stand canopy. At the primary stage of afforestation, the stand canopy is lower. The strong sunlight is unfavorable for the recovery of underwood vegetation. With the growth of trees, stand canopy is expanding and human disturbance is reduced. Underwood vegetation is recovering.

In the soil developed from sediments of shallow sea of Leizhou Peninsula, the differences in richness and biomass of the underwood vegetation in artificial forest are not obvious between different eucalyptus species and other tree species

The bio-diversity of artificial eucalyptus underwood vegetation is comparatively low. The reasons may come both from natural elements but also human factors (incl. improper growing, taking-away litters etc.). However, such is not caused by the eucalyptus species itself, it is a common phenomena of all artificial forests.

5.4.3 Impacts on Underwood Vegetation Caused by Project Construction

(1) As for the forestland now with artificial eucalyptus, construction of the project will not change the properties of the underwood dominant vegetation. However, due to the purpose of increasing growth rate in the construction period, the operational measures will be enhanced, such as use of weed killer and hand weeding. Such will have certain impacts on the underwood vegetation richness in the fostering period for young trees.

(2) As for the forestland now with conifer or other species trees, the underwood vegetation will decrease obviously during renewing, land clearing and preparation. During afforestation, the tree species will be changed, which may also change the properties of the dominant underwood vegetation. After 2-3 years, a new underwood vegetation will form similar to that of the existing eucalyptus forest.

(3) As for the forestland now of shrub land and open land, the existing bio-diversity is comparatively rich, with the composition of shrubs and grasses. After implementation of the project, these places will form the artificial eucalyptus eco-system, and so the richness of underwood vegetation will be decreased considerably. However, the area of this kind of land is very limited in this project, accounting for only a very small portion of the base.

(4) As for the forestland of cutting and burned blanks where the existing vegetations have been damaged, after a period of time when the artificial eucalyptus are planted, due to the strengthened management, the speed of recovery of underwood vegetation is slow. In this regard, the recovered vegetation bio-diversity will be inferior to that without planting artificial forest.

In all, after implementation of this project, the bio-diversity of the underwood vegetation of the forest will be decreased. However, the existing underwood vegetation is not rich because most of the existing forests belong to artificial forest. In addition, the difference in bio-diversities of different tree species is not obvious, and thus constructing the eucalyptus raw material base will not bring about serious impacts on the underwood vegetation.

5.5 Impacts on Wild Animals

5.5.1 Impacts on Wild Animals of Forestland

Among the selected forestland of the base, regardless of the existing artificial eucalyptus forest or the forestland improved from other tree species (slash pine, acacia and fir etc.), all these forestlands are distributed the places below the elevation of 500m and where with active human activities, without covering the local natural forest and secondary forest. Generally speaking, the afforesting management will not deteriorate the disturbance to the wild animals, nor will change the habitats and the migratory corridors of wild animals. The forest access roads of 3.5m in width will basically have no impacts on the activities of wild animals.

However, during the period of cutting and afforesting, strong disturbance will be made to the wild animals that live on the artificial forest. Some animals have to migrate and dispatch, while the cutting activities will block the migrating routes of these animals.

In order to avoid such problems, during afforestation, distribution design, combination of age groups, biological buffer zone etc. should be considered. In this regard, the cutting plan should be reasonably arranged for the purpose of providing mitigating corridor for the wild animals.

5.5.2 Impacts on Wild Animals of Key Protection

This is to take white-headed leaf monkey, the most sensitive animals under national first-class protection, as example to analyze the impacts arising from the construction of raw material forest base. The construction mainly affects the living space of other species.

Within the project area, the wild animals under national Class-I protection are white-headed leaf monkey, leopard, clouded leopard, spotted deer, forest musk deer and Indian python. Brief analysis shall also be made on such animals. Supposed that these sensitive species can survive in project area, then biodiversity can be maintained.

The white-headed leaf monkey lives in the karst area located in the subtropical area of prosperous vegetation in southern Guangxi. The central government and Guangxi have established Nonggang National Natural Reserve of 10080hm² and Chongzuo White-Headed Leaf Monkey Provincial Natural Reserve 35148hm² (combined from Bapen natural reserve and Banli natural reserve) that have provided with certain space for the survival of white-headed leaf monkeys.

Viewing from site selection for raw material forest base of this Project, the forestland within 1km from the natural reserve and the forestland interrelated with the natural reserve have been excluded (that is to avoid the places of karst hills, mainly small amounts of forest distributed in karst hills in Dongmen forestry farm). The places suitable for the activities of white-headed leaf monkey are not within the selected places of the base, and thus will not have direct impacts on its living space.

Other wild animals under national Class-I protection within the project area are leopard, clouded leopard, spotted deer, forest musk deer and Indian python. etc. that are distributed in the high-elevation areas. The suitable living spaces belong to the complex eco-system. Within the project area, natural reserves have been established as the existence environment for them. As a fact, the selected sites of this project belong to the

low hills where the human activities are frequent. Currently, there is hardly emergence of any large wild animals in these places. In addition, during site selection, the project is required to avoid the natural reserves, and therefore the project construction will not have direct negative impacts on the living environment of wild animals.

6 Utilization of Land Resources

6.1 Land Resources

The planned area of the pulp forest base is 160,000hm². According to the statistics of sub-compartment, there are 123,700hm² of existing forestland growing eucalyptus, mason pine, pinus elliottii, acacia and mixed forest. The construction of the pulp forest base will not change the land use type.

In addition, there are 19,600hm² of new afforesting land, which includes the existing low-yield open forest, shrubs, prepared and planned afforesting lands, burned blank, cutting blank and land suitable for plantation etc. As for the additional forestland, the scattered small patch of open land, prepared and planned forestland, barren land suitable for afforesting and cutting blank are integrated as a whole for growing eucalyptus of the base. These changes are only made to the structure and tree species, and the natural of forestland has not been changed.

As the supporting facilities for the construction of the raw material forest base, bio-fireproofing belt and woodland access roads are also constructed.

The bio-fireproofing belt will function mainly through growing local original broad-leaf tree species block the fire. This belt will not change the natural of the original forestland, and thus only belong to the changes of forestland structure and species.

Construction of access roads will occupy land. The total area occupied by road construction will be 282-376hm². This will change the land utilization type, and the impact would be irreversible.

6.2 Impacts on Soil and Site Quality

6.2.1 Impact Analysis for Soil Quality

Soil quality includes two parts of physical structure and chemical composition. During the afforesting period, the impacts on soil quality are mainly from soil loosing, fertilizing, felling and timbre collecting. Among them, land preparation, felling and timbre collection will affect the physical structure of soil, while fertilizing will affect the chemical composition of soil.

Before planting and during fostering period, land preparing and loosing shall be done in workable period (suitable soil humidity). The reasons are: Plough while the soil is too dry will damage soil aggregate, thus to reduce retention capacity of soil. Plough while the soil is too humid will reduce the porosity of soil and increase soil bulk density, which leads to hardening of the soil. The land preparation of this project is selected 1-1.5 months before afforesting, i.e. in winter or early spring. In this period, the soil humidity would be more suitable for land preparing and loosing than other seasons, and which will be also beneficial the improvement of soil quality.

During felling and timbre collection, machine rolling and timbre-collecting activities will reduce the soil porosity and may cause soil hardening. During felling, the mitigating

measures may include covering tree branches and grasses, or the situation may be mitigated via special measures in the next round of land preparation .

In this project, fertilizer application shall be conducted according to the soil nutrients analysis and the nutrient demands of plants, ensuring full absorption by eucalyptus. Therefore, fertilizing will not cause the problem of salinization. However, such will lead to soil hardness that shall be further improved through other reasonable afforesting measures (such soil loosening).

Pesticide will inevitably enter the soil and react with solid, gas and liquid materials, thus to change the chemical constitution of the soil. Some pesticide of high toxicity can even kill some insects and microorganism in the soil, restrict the activities of soil enzyme invertase, and thus will affect the conversion of nutrients substances of soil. Reasonable application of pesticide and adoption of low-toxicity pesticide may help to mitigate such impacts.

6.2.2 Impacts on Soil Fertility of Forestland

The operating mode for artificial forest is intensive operation. In the pure artificial forest, due to the same characteristics in absorption and the same structure of nutrients, some nutrients in the soil will be greatly consumed. Therefore, the decrease of soil fertility and productivity are not uncommon in the artificial forests of most eucalyptus, pine tree, fir and polar.

The experimental results of home and abroad location tests prove that trees absorb nutrients from soil but return most of them to the soil in the form of litters. Under the circumstances without any human interference, the forest ecological system can realize the self-supply of nutrients through its own substance circulation.

The standing volume of the nutrients of litters from artificial eucalyptus is of handsome quantity. In addition, the litters of eucalyptus can be easily dissolved and the nutrients can return to the soil.

According to “ The Study on Nutrient Circulation and Balance of Eco-system of Eucalyptus Forest” by Liao Guanrong and Zhong Jihong, Eucalyptus ABL 5 in Leizhou Peninsula of Guangdong Province through one 5-year felling cycles, the total growing stock of nutrient contents of P, K, Ca and Mg is 753.69kg/hm^2 , including nutrient contents of branches, leaves, barks and roots reach 381.15kg/hm^2 , accounting for 50% of total nutrient stock. During felling, the nutrients shall totally be returned to soil from theoretical point of view. Actually, only 20% nutrients would be returned to soil due to full utilization of eucalyptus or the remains being taken away by the local farmers to use as firewood. This is the main reason causing the decrease of soil fertility of the eucalyptus forestland in China.

In this project, the felling residues and litters of eucalyptus can be retained within the forestland, and thus the biotic circulation of nutrient elements of the eucalyptus forest will not be retarded. The soil nutrients can be basically maintained in the low balance level, and the consumption of soil fertility will be less than the method of full utilization in the existing eucalyptus operation.

This Project also substitutes a large quantity of conifer forestland with eucalyptus

forestland. Thus, this is to make comparative study on nutrient circulation between eucalyptus and conifer (*Pinus elliottii* and mason pine). As for eucalyptus in 5-year felling cycles, the total growing stock of nutrient contents of P, K, Ca and Mg is 753.69kg/hm^2 , including nutrient contents of branches, leaves, barks and roots reach 381.15kg/hm^2 . For *Pinus elliottii* in 12-year felling cycles, the total growing stock of nutrient contents is 1555.66kg/hm^2 , including nutrient contents of branches, leaves, barks and roots reach 878.29kg/hm^2 . For mason pine, the total growing stock of nutrient contents is 771.0kg/hm^2 , including nutrient contents of branches, leaves, barks and roots reach 647.7kg/hm^2 .

The comparative study shows that although *pinus elliottii* and eucalyptus are both artificial quick growth and high yield forests, the total growing stock of nutrient contents and the contents of all components are higher than that of eucalyptus. Especially, the total growing stock is two times as much as that of eucalyptus. The growing stock of branches is 1.8 times as much as that of eucalyptus. The growing stock of eucalyptus in two felling circles is equivalent to that of *pinus elliottii* in one felling circle.

Comparison between artificial quick growth and high yield eucalyptus and indigenous mason pine shows that the total growing stock of eucalyptus forestland in one felling circle is equivalent to that of mason pine whilst the growing stock of branches is obviously higher than that of mason pine.

These data show that eucalyptus nutrients circulate at higher rate and shorter time period comparing with conifer forest. The growing stock of eucalyptus timber is a bit higher than that of *pinus elliottii* and much higher than that of mason pine. When the felling residues and litters of eucalyptus are retained within the forestland, the consumption of soil nutrients by eucalyptus is larger than that of conifer.

After changing the tree species, the soil fertility of the forestland may decrease if without effective measures.

6.2.3 Measures for Maintaining Soil Fertility of Forest Land

The afforestation management of eucalyptus forest shall pay special attention to well handling the relation between land utilization and maintenance and adhere to long term maintenance of soil fertility, which can effectively mitigate the deterioration of soil fertility arising from eucalyptus plantation.

(1) Reasonable fertilizing

According to data analysis, eucalyptus takes away most of quickly available nutrients, which come from fertilizing. Therefore, during afforestation management, analysis shall be made to soil fertility of each patch of forestland and adopt scientific fertilizing in accordance with the soil nutrients and the demand of eucalyptus at different stages.

(2) Retain the residues from cutting.

During cutting, local barking and branch removing shall be conducted. Only the stem wood supplied for pulp factory shall be delivered from the forestland. Other remains after cutting shall be retained at the forestland, thus to return the nutrients to forestland. At the same time, it is to avoid disturbance to forestland and remain the litters at the forestland.

(3) Reasonable afforestation to reduce water and soil erosion in the forestland

The selection of proper time and method of fertilizing can improve the efficiency of chemical fertilizer utilization. Land clearing and preparing is also an important measure to prevent the erosion of water and soil. Therefore, unreasonable afforestation measures shall be avoided to stop the erosion of water and soil.

(4) Try all means to retain the underwood vegetation

Underwood vegetation and proper land clearing will be helpful for the maintenance of soil fertility of the forestland. The research shows that the nutrient contents of underwood shrubs and herbs are considerably higher. Generally, the nutrient contents are herbs > shrubs > trees which will play important role in maintaining the soil fertility of the forestland. The underwood shrubs and herbs are normally of indigenous plants that have formed relative conformity with the soil ecological demands and nature during the long-time soil formation and succession of vegetation communities. Returning the nutrients of underwood vegetation to the soils is also a measure for keeping the soil fertility.

Conduct land clearing for the places with over 70% of coverage of weeds, shrubs and eucalyptus sprouting. After clearing, the underwood places shall retain the undergrowth of 15cm in height, which will not affect the growth of the seedlings.

Such kind of land clearing will retain certain underwood vegetation and accordingly will maintain the fertility of the soil.

(5) Prohibit ground burning

Ground burning seriously damages woodland vegetation and topsoil. The comparative study on non-burning afforestation and traditional burning afforestation shows that under the same afforestation measures, there is just slight difference in eucalyptus growth in the first two years between the two afforestation methods. However, the investment in non-burning afforestation is lower than that in traditional afforestation. Ground burning and land preparing followed by weed removing will damage the topsoil of the forestland, cause water and soil erosion and lead to the decrease of soil fertility. Meanwhile, non-burning afforestation retains humus layer of the original blank, which not only protects the topsoil and soil fertility, reduces water and soil erosion of the forestland, but also reduces ground evaporation, protects the environment of forestland and exerts the ecological benefits. In addition, non-burning afforestation will effectively reduce the fire risk caused by ground burning.

Although it is specified in forestland management guidelines that ground burning is allowed under proper condition, EA prohibits ground burning for forest clearing due to potential risks it may cause.

7 Impact Analysis for Soil Erosion

7.1 Impact Analysis for Soil Erosion

7.1.1 Analysis of Reasons for Soil Erosion

Soil erosion refers to the whole process where soil is eroded, transferred and settled under the force of water. The major reasons for soil erosion are mainly of natural element and artificial element.

Landform, rainfall, soil (surface substance composition) and vegetation etc. are the major factors of natural elements.

(1) Topography: The steeper the slope is, the quicker runoff becomes and the stronger the erosion will be. The longer the slope is, the greater the surface runoff volume is, causing more serious erosion.

(2) Rainfall: Generally it is the rainstorm that causes water and soil erosion. Only when the rainfall intensity exceeds the infiltration rate of the soil, surface runoff (super infiltration) will be formed, causing the washing away and erosion of the surface.

(3) Surface substance composition: They are soft soil with low anti-erosion capacity, easily to be washed away at rainy day. The soils such as yellow earth and silt are easily washed away by water.

(4) Vegetation: The forestry and grass with certain crown density can protect the soil from erosion. The higher the crown density is, the stronger protection capacity it has.

Irrational land utilization, damage on the surface vegetation and landform are the two major factors of human element causing serious soil erosion.

As to this project, during the operation and management of the raw material base, the factor that may cause soil erosion is the change of vegetation of the selected forestland.

7.1.2 Trend of Impacts on Soil Erosion Caused by Project Implementation

In this project, there are 465 thousand mu of eucalyptus forestland, of which, the vegetation type of the forestland is not changed. So the factors that may affect the strength of soil erosion will come from afforesting measures.

In other types of selected lands of the project that are substituted by growing eucalyptus, due to the changes of tree species, the characteristics of vegetation of the forestland will be also changed, and thus the soil erosion will also changed. The major factors of forest vegetation affecting soil erosion are: canopy density, underwood vegetation, coverage of underwood litters and cutting cycle (surface disturbance frequency). The comparison of water and soil erosion between conifer and eucalyptus forest is shown as follows:

Canopy density: The canopy density is affected by planting density, forestland operation and management. The canopy density of the forestland with greater planting density is comparatively higher. So is the forestland under sound management and operation. Generally, the canopy density of conifer is similar to that of eucalyptus. Most conifer forest of this Project for felling and regeneration has been tapped for 2 to 3 years before grown up. Therefore, the canopy density of such conifer forest is obviously lower

than eucalyptus forest.

Underwood vegetation: Underwood weeding during seedling period and short rotation lead to poor underwood vegetation. When conifers are in luxuriant growth, the decayed underwood braches and leaves are acid and inhibit the growth of underwood vegetation. However, when the canopy density of conifer forest is low, the underwood vegetation is in luxuriant growth. The selected conifer forest has richer underwood vegetation than eucalyptus forest.

The coverage of underwood litters: The field survey shows that the coverage of underwood litters in the selected conifer forestland is higher than that of eucalyptus forestland.

Cutting cycle (surface disturbance frequency): The cutting cycle of eucalyptus of this Project is 6-7 years whilst the cutting cycle of conifer is generally 10-20 years, which is much longer than that of eucalyptus. There will be 2 to 3 years from cutting to regeneration when the coverage of forestland is very low. In 20 years, the low coverage period of eucalyptus is 6-8 years whilst the period of conifer is only 3-5 years. It is evident that surface disturbance frequency of eucalyptus forest is higher than that of conifer forest. Therefore, the soil erosion will increase obviously.

The above analysis shows that, after substituting conifer with eucalyptus, the factors of canopy density, underwood vegetation, coverage of underwood litters are subject to different management. However, due to the short rotation of artificial eucalyptus, its disturbance to the surface is obviously higher than that of conifer trees. Therefore, the soil erosion will increase obviously.

7.1.3 Analysis of Soil Erosion Possibly Caused by Operation Mode of the Project

The analysis of soil erosion caused by operation mode of the Project during afforestation is shown as follows:

(1) Selection of forestland

The company should appraise the forestland available and work out different management measures against different types of forestland. Some special lands that are suitable for growing artificial eucalyptus should be protected through growing some indigenous tree species.

(2) Clearing and land preparation of forestland.

Many researches indicate that, the ground-burning (or full clearing) and land preparation are the major reasons leading to soil erosion in afforestation.

According to the regulations of the company, this project will only conduct land clearing for the places with over 70% of coverage of weeds, shrubs and eucalyptus sprouting. After clearing, the underwood places shall retain the undergrowth of 15cm in height. Such kind of land clearing will retain certain coverage of vegetation and accordingly will reduce the soil erosion.

However, in the operation rules of the Company, ground burning is also allowed in some cases. After burning, all the ground vegetation will be burnt out, and the exposed land will easily cause soil erosion. This will obvious deteriorate the soil erosion in the forestland. Therefore, this EIA recommends removing this rule of ground burning. Instead,

the method of manual clearing shall be adopted in some difficult places: use shrub cutting machine or other tools to remove the shrubs and weeds for a width of 1.5-2m along the planting belt and the contour line.

In land preparation, the mechanical and manual methods shall be combined to adapt to the different gradients of lands. This method will minimize the soil erosion.

However, from land preparation to planting seedling will need 1-1.5 months, and thus soil erosion may also occur to the exposed surface if attacked by storms. In this regard, aiming at different gradients of the forestland, necessary measures such as construction discharge outlet, water-retaining wall etc. shall be adopted to retard runoff and reduce soil erosion.

(3) Fostering young trees.

Normally, the company will adopt spraying weed killer for fostering young trees. The use of pesticide in spring and summer when the grass and shrubs are in luxuriant growth will kill the underwood grass and shrubs, thus to reduce underwood biodiversity. However, the dead grass and shrubs still remain underwood and prevent the water and soil erosion of the forestland. Meanwhile, the underwood litters and remains after cutting in the forestland must be kept at certain coverage so as to reduce the water and soil erosion of the forestland.

However, when conducting pit-expanding and soil-loosing during fostering, even with some local disturbance to the ground, the underwood remains can retain the soil erosion therein.

(4) Cutting.

The cutting of this Project shall conform to the *Management Rules of Felling and Regeneration of Forest* by the State.

Technical requirements for cutting: when the slope $<5^\circ$, the clear cutting area $<10\text{hm}^2$; when the slope $<6-15^\circ$, the clear cutting area $<5\text{hm}^2$; when the slope $<16-25^\circ$, the clear cutting area $<3\text{hm}^2$; when the slope $>25^\circ$, strip clear cutting shall be adopted.

During the period of tree felling, it is required to avoid the disturbance to the soil by vehicles. Tree trimming and transportation may turn the wooded area into exposed land. In addition, large-scale human activities will add to the soil disturbance, especially the rolling-log access and mechanical collecting will damage the topsoil vegetation, cause soil hardening and form a new cycle of serious soil erosion.

7.1.4 Analysis of Strength of Soil Erosion During Afforesting.

A percentage of 98% of the selected places for the base belong to little erosion and light erosion, and only 2% belongs to moderate erosion. Generally speaking, under the existing afforesting mode, the soil erosion of the existing eucalyptus forestland will decrease. However, the soil erosion of the renewed forestland from conifer forest will increase considerably, but normally such impact will not increase the original soil erosion modulus.

The total land area of the project area is 2.7452 million hm^2 , of which, the places basically without soil erosion or of light erosion have 2.6571 million hm^2 , accounting for 96.8% of the total figure. Only 3.2% belongs to erosion of moderate or above levels.

In general, the soil erosion can be controlled to the existing level of the forestland, and will not deteriorate the situation.

7.2 Impact Analysis for Land Degradation

7.2.1 Impact Analysis of Stone Desertification

According to the Distribution Map of Stone Desertification and the Landform Type Map of Guangxi, it can be seen that the stone desertification mainly occurs in the landforms of karst high hills and mesorelief low hills, distributed in Chongzuo Jiangzhou district and Fusui county in this project area.

In this project, Jiangzhou district and Fusui county have selected 5000hm² of forestland, plus 10666hm² of Dongmen forest farm, the total area is 15666hm². According to the overlaying analysis of the raw materials distribution map, stone desertification map and landform type map, during site selection in Chongzuo, this project has avoided the area of stone desertification, and tried to avoid the places of karst hills that may be easily desertified.

7.2.2 Impact Analysis for Land Sand Desertification

Among the selected forestland in Beihai has a portion of sand desertified land. According to the experiences of Beihai City in afforesting on sand desertified land, eucalyptus has relatively strong adaptability, and some successful eucalyptus growing experiences on sand desertified land have been obtained. The investigation shows that Shankou Forrest Farm of Beihai has achieved good results in growing artificial eucalyptus on sand desertified land.

Therefore, with reasonable management, growing eucalyptus on sand desertified land can also meet the criteria of fast-growing and high-yield.

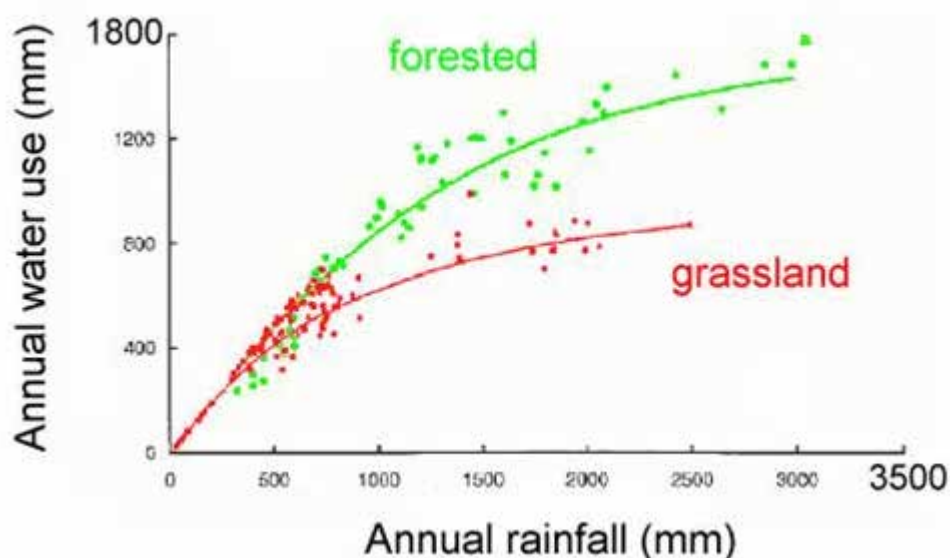
8 Impacts on Water Environment

8.1 Analysis of Impacts on Water Resources by Growing Eucalyptus

8.1.1 Study on the water consumption for eucalyptus growth

8.1.1.1 The relation between rainfall and evaporation in Australian eucalyptus pure forestland and grassland

Holmes and Sinclair (1986) had investigated the relation between rainfall and runoff in 19 large catchments in Victoria State of Australia. The rainfall in 1986 was 500-2500mm and the investigated vegetation includes grassland and eucalyptus forest. The results show that there is great difference in evaporation between grassland and eucalyptus gathering ground. They proposed two curves: The variation trend of evaporation in pace with rainfall gradient (Ref. Picture 3). According to the curve, when the rainfall is respectively 600, 800, 1300, 1500 and 1800mm, the evaporation in eucalyptus gathering ground is bigger than that in grassland gathering ground, which additional amount is respectively 40, 90, 215, 240 and 250mm.



8.1.1.2 Study on the water consumption for eucalyptus growth in China

In 1999, RITF and CFTT financed by ACIAR jointly undertook the research on water balance of eucalyptus in Jijia and Hetou town of Leizhou city of Guangdong Province. They measured water consumption of three or four-year-old *Eucalyptus urophylla* by heat pulse method (the planting density is 3×2.5m in Hetou town and 3×1.5m in Jijia town). The water consumption is 524mm/year in Hetou town and 559mm/year in Jijia town.

(1) Comparing with other tree species in the same region: The annual water consumption of 25 year-old pinus caribaea near Eucalyptus urophylla in Hetou town exceeded 700mm, which was higher than that of Eucalyptus urophylla.

(2) Comparing with water consumption of eucalyptus in other countries:

Mahmood et al (2001) and Jim Morris et al. (1999) measured water consumption of eucalyptus by heat pulse method. The results showed that evapo-transpiration volume in Pacca Anna and Tando Jam in Pakistan was respectively 1100 and 1700mm/year whilst the evapo-transpiration volume in Dong Bung of northern Thailand was 1200mm/year. Such volumes were two times as much as that in Hetou and Jijia of Leizhou city of Guangdong Province.

Water consumption of eucalyptus is mainly related with soil, climate and seasonal water distribution. As for the reasons for low water consumption caused by evapo-transpiration, Tropical Forestry of Chinese Academy of Forestry holds the view that:

(1) Viewing from climate conditions, average solar radiation is about 12 MJ/m²/d in Leizhou; 20MJ/m²/d in Pacca Anna and Tando Jam of Pakistan; 16 MJ/m²/d in Dong Bung in northern Thailand. In summer, Leizhou is very humid. Saturated steam pressure difference is about 0.5-2kPa in Leizhou; 1-4kPa in Pakistan and 1-3kPa in north Thailand. In summer, Leizhou is cloudy and humid, and the solar radiation and energy input are less, and thus the water is more difficult to be transpired from the leaves of eucalyptus than those of other countries of dry climate.

Although the winter in Leizhou is drier than summer, water limitation and low temperature lower the physiological activity of the trees. Thus, evapo-transpiration and water consumption of eucalyptus become less, with daily water consumption of approximately 1mm/d.

(2) Restricted by soil conditions, the leaf area of eucalyptus in south China is comparatively smaller than that of other countries (Xu et al. 2002). In most parts of south China, the leaf area of eucalyptus is 1.5-2.0 whilst the leaf area in other countries is 2-6. Under the same climate conditions, in terms of water consumption caused by evapo-transpiration, the smaller the leaf area is, the lower the water consumption will be.

In south China, evapo-transpiration of eucalyptus is slower than other semiarid regions. Annual water consumption is less than 600mm. The annual evapo-transpiration volume of eucalyptus is most probably between 900 to 1200mm.

8.1.2 Analysis of Impacts on Water Resources by Growing Eucalyptus

On this basis, the water consumption of eucalyptus after implementation of the project can be analogically analyzed.

The selected sites of this project are located in southern Guangxi where the climate conditions are similar to those of Leizhou. Comparing the water consumption of Leizhou Peninsula, for artificial eucalyptus of this project, the annual water evapo-transpiration volume is about 500mm, the crown interception is about 150-200mm. In addition, the annual interception and evapo-transpiration of the underwood vegetation is about 30-100mm. The amplitude of soil evaporation is big, reaching as high as 200-400mm each year. This is related to the soil properties, soil water availability and coverage of surface earth. Therefore, the total evapo-transpiration of artificial eucalyptus of Stora Enso is approximately 880-1200mm each year.

In terms of annual precipitation for the places of raw material base of this project,

Beihai is 1700mm, Fangchenggang is 2000mm, Yulin is 1600mm and Nanning is 1500mm. So, artificial eucalyptus will not have serious impacts on the local water balance.

However in Chongzuo city, the annual precipitation is about 1250mm and the variation is big. In some dry years, the evaporation volume of artificial eucalyptus may approach to the volume of precipitation, which may produce some negative impacts on the local water balance.

Eucalyptus is called “water pumps” because they grow quickly. At the same time unit, the rotation of pine is 20 to 25 years when the eucalyptus has been cut for 3 to 4 times. The eucalyptus seedlings need great quantity of water and yield highly. This is the very reason that eucalyptus consumes so much water.

In addition, the root system of eucalyptus is distributed at very shallow layer of the soil where underground water is not available. Therefore, eucalyptus plantation will not lower the ground water level.

8.2 Analysis of impacts on water quality

According to the *Monitoring and Research of Impacts on Main Environmental Factors Caused by Planting Short-Rotation Eucalyptus and Acacia Forests* written by Professor Wen Yuanguang of Forestry Institute of Guangxi University, the annual average surface runoff of eucalyptus forest is 45.03t/hm², the annual average soil erosion volume is 0.29 t/hm² and the soil nutrient loss is 0.039 kg/hm². The erosion is more serious in the year of plantation. The data also indicates that, the loss of soil nutrients is very limited, and thus the impact on the environment is also limited.

8.3 Analysis of Impacts on Water Conservation of Project Area

In the project area, the natural reserves with the function of water conservation are Shiwan Mountain, West Damingshan Mountain and Nalin natural reserves. The relationship between these natural reserves and the selected species are shown in Table 8.2-1.

Table 8.2-1 Relationship Between Selected Sites and Natural Reserves with Water Conservation Function

Damingshan natural reserve (national level)	North of Wanpen Branch of Gaofeng forest farm, separated by Longshan natural reserve
Shiwan Mountain natural reserve (national level)	Located in Fangchenggang city at the boundary area of Shangsi county and Fangcheng District of the project area, being far from the selected forestland.
West Damingshan Mountain natural reserve (provincial level)	The southern protection zone is located in the project area, being far from the selected forestland.
Shanglin Longshan natural reserve (provincial level)	The shortest distance between north boundary of the natural reserve and the selected forestland in Wanban Branch is about 600m-700m.
Nalin natural reserve (provincial level)	The shortest distance is about 1.6km to Yunfei branch of Bobai forest farm.

From the table, it can be seen that most of selected sites of the project are far from these natural reserves. Only one site is relatively near to Shanglin Longshan Natural, but

the distance is also over 500m. In addition, in the project area, other forestlands that have the functions of water conservation are the protection forest along both banks of rivers. In site selection of the project, the raw material base has avoided the forest of 200m in distance to both banks.

It is evident that eucalyptus forest also has the function of water conservation as other forests do, however, in consideration of the quick growth and the absolute high consumption of water resources, Guangdong has already banned growing artificial eucalyptus in the areas of water conservation. As in this project, the selected places have avoided the areas of water conservation, and thus the project will not affect the water resources of the project area.

8.4 Analysis of the impacts on the drinking water sources of the forest base and nearby places

Through overlaying the distribution map of forest bases with the selected protection zones for urban drinking water sources, the distribution map for urban drinking water source protection zones is shown in Figure 1-2. The overlaying results are shown in Table 8.4-1. From the table, it can be seen that, the selected forest bases of the project area are far away from most of the water source protection zones, approximately more than 2km.

However in Beihai city, the selected forest bases are relatively near to the water source protection zones, involving 4 lake-reservoir type water source protection zone and 1 deep-extracting ground water source protection zone.

Among them, Longtan village is the water source of deep-ground water extracting, and thus the protection zone is set at the range of 50m from the well. No quasi-protection zone is set. This project has 85.9hm² of forestland in Longtang village that is not within the protected zone for water source. In addition, this water source belongs to deep-extracting well, ordinary surface erosion may only affect the shallow ground water, and thus it will not bring about negative impacts on this water source.

The four reservoir-type water sources involved by the selected forest bases of the project are: Hepu reservoir water source of Beihai, Niuweiling reservoir water source of Beihai, Beihai Qingshuijiang reservoir water source and Hepu Hongcaojiang reservoir water source. In views of forest distribution, these selected forests are not within the range of water source protection zone, but within the quasi-protection zone.

According to the *Regulations on Pollution Prevention and Control for Drinking Water Sources Protection Zones*, within the Class-I drinking water source protection zone, “construction and expansion of projects that are apart from water-supply facilities and water source protection shall be prohibited”, and “any activities of plantation, farming and animal breeding etc. shall be prohibited”. This is to say that, the industrial raw material forest cannot be planted in the Class-I protection zone. In the Class-II protection zone and the quasi-protection zone, proper afforesting activities shall be allowed. Therefore, the site selection of this project conforms to the requirements of the *Water Pollution Prevention Law of the People's Republic of China* and the *Regulations on Pollution Prevention and Control for Drinking Water Sources Protection Zones*.

In the *Water Pollution Prevention Law of the People's Republic of China* issued on February 28, 2008, the articles that are related to afforestation are: Article 3, "Give priority to the protection of drinking water source" and "Prevent and Control the agricultural source pollution"; Article 47, "Use of pesticide should conform to the national regulations and standards for safety use of pesticides". The *Regulations on Pollution Prevention and Control for Drinking Water Sources Protection Zones* issued in 1989 has stipulated the requirements on classification and protection of drinking surface water and ground water source protection zones.

According to the *Survey Report* prepared by Professor Wen Yuanguang, the volume of soil erosion and loss of nutrients of eucalyptus forest are very little. In addition, the scientific afforesting measures will be adopted during forest management. Moreover, based on the actual situation of China and Guangxi, Stora Enso has also worked out a series of technical standards, security and health management schemes. Under such forest management, the forest source pollution arising from afforestation activities will be very little, conforming to the *Water Pollution Prevention Law*.

Considering these forests are adjacent to the water source protection zones, it is suggested that, during afforestation of these forest bases, it should properly adjust the plantation patterns, reduce the frequency of tending and fertilizing and properly extend the felling period. Such will help reduce the impacts on the soil erosion and shallow ground water that are caused by forest management. By now, during the forest management, Stora Enso has never applied any pesticides. It is suggested, during future forest management, to avoid using pesticides. Use of high-toxic and high-residue pesticides shall be prohibited.

Table 8.4-1 Relationship between Forest Bases and Drinking Water Source Protection Zones in Project Area

SL.	Name of Water Source Protection Zones	Relation to Forest Bases
1	Yongjiang river drinking water source area	far away
2	Tianbao reservoir water source area	far away
3	Longtan reservoir water source area	far away
4	Shicunhe reservoir water source area	far away
5	Yongning Qingshuiquan spring water source area	far away
6	Liangqing Nama spring water source area	far away
7	Dawangtan reservoir reserved water source area	far away
8	Fengtinghe Tunliu reserved water source area	far away
9	Wuming county Lingshui water source area	far away
10	Shanglin Beicanghe water source area	far away
11	Shanglin Mumian reservoir water source area	far away
12	Hepu reservoir water source area	Outside protected zone, but within quasi-protected zone

SL.	Name of Water Source Protection Zones	Relation to Forest Bases
13	Beihai Niuweiling reservoir water source area	Outside protected zone, but within quasi-protected zone
14	Beihai Qingshuijiang reservoir water source area	Outside protected zone, but within quasi-protected zone
15	Beihai Longtancun ground water source area	Mining of ground water, with 85.9ha. of forest in the village.
16	Beihai Hetangcun ground water source area	Mining of deep-layer ground water, far away
17	Ground water source areas of Haicheng District, Gaoyang village and Houtang village, Beihai	Mining of deep-layer ground water, far away
18	Hepu Hongcaojiang reservoir water source area	Outside protected zone, but within quasi-protected zone
19	Water source area of Zongjiang section of Nanlijiang river of Hepu	far away
20	Other ground water area areas of Hepu county	far away
21	Fangchenggang Mutoutan water source area of Fangchenghe river	far away
22	Fangchenggang Xiaofeng reservoir water source area	far away
3	Fangchenggang Sanbo reservoir water source area	far away
24	Fangchenggang Guanshanliao reservoir water source area	far away
25	Shangsi Naban reservoir water source area	far away
26	Dongxing Beilunhe water source area	far away
27	Dongxing Huangtanshui reservoir water source area	far away
28	Qinzhou Qinjiang Youth Watergate water source area	far away
29	Dafengjiang river Dongchang water source area	far away
30	Qinzhou Jinwo reservoir water source area	far away
31	Qinzhou Duiqinlong reservoir source area	far away
32	Qinzhou Qinshan reservoir water source area	far away
33	Maolingjiang river Milongwan water source area of Qinzhou	far away
34	Qinzhou Dama'an reservoir water source area	far away
35	Shapinghe drinking water source area of Yujiang water-diversion system of Qinzhou	far away

SL.	Name of Water Source Protection Zones	Relation to Forest Bases
36	Lingshan Qinjiang Dabujiang bridge water source area	far away
37	Lingshan Lingdong reservoir water source area	far away
38	Yulin Suyan reservoir water source area	far away
39	Nanlijiang water source area	far away
40	Yulin Jiangkou reservoir water source area	far away
41	Luchuan Fenghuangtian reservoir water source area	far away
42	Luchuan Sanhe reservoir water source area	far away
43	Luchuan Shichan reservoir water source area	far away
44	Bobai Chongsu reservoir water source area	far away
45	Xingye Fuyang reservoir water source area	far away
46	Xingye Changhao reservoir water source area	far away
47	Xingye Sanlian reservoir water source area	far away
48	Beiliu Beiliuhe river water source area	far away
49	Chongzuo Zuojiang Mupai village water source area	far away
50	Zuojiang Dajiangkou water source area of Fushui county	far away
51	Ningming Mingjiang water source area	far away
52	Pingxiang Daxiang reservoir water source area	far away
53	Pingxiang Pingerhe drinking water source area	far away

9 Landscape Impact Analysis

9.1 Evaluation Principle

9.2 Landscape Impact Analysis

Of the selected forestland of 143,300hm², the land with forest covers 123,700 hm², including pure and mixed forest; open forestland covers 1155.41 hm²; shrubbery covers 4003.37 hm². The forestland accounts for 89.9% of total selected area. In addition, cutting blank covers 3805.3 hm²; burned area 1856.2 hm²; conserved plantation land 2308 hm², nursery 13.9 hm². Among the selected forestland, there are some bamboo forest, suitable land for afforestation, barren land, glade and rocky hills and so forth landscape.

After project implementation, the selected blank, suitable land for afforestation, non-stand forestland, glade, rocky hill, nursery and so forth landscape will be turned into forestland, which will add to the proportion of forestland landscape. However, such lands cover small area, which will not cause serious impacts on micro landscape.

Furthermore, during the afforestation in raw material forest base, the cutting, forestland clearing and preparation will temporarily change the forestland landscape. This change is just for a short time. From long-term view, the project implementation will not change the regional landscape components.

According to the principle of the distribution of raw material forest base, after implementation of the project, the project will not change the existing landscape components within the project area. Forest will still be the element type with high metastability that has the strongest controlling capacity against the eco-environmental quality, of which, its dominance degree will still be the highest.

Due to the mono-specific plantation and large-scale continuity of trees, the degree of fragmentation of the landscape of the project area will be reduced. This has not changed the landscape element type, however, it has changed the proportional relation among the forest landscape elements. The project raw material forest base will form a landscape concentrated with large patches of eucalyptus forest, reducing the degree of heterogeneity of the landscape thus to deteriorate the disturbance resisting capacity and recovery capacity of the landscape.

In all, the construction of the project will not produce obvious impacts on the ecological landscape of the project area.

9.3 Measures of Mitigating Impacts on Ecological Landscape

The characteristic of natural forest system is diversity such as multiple species, irregular spacing and forms, multiple structure of tree ages etc. During development of artificial forest, imitation of such diversity can help to get the ecological system similar to that of the natural forest. As to implementation of this project, the following aspects can be considered to increase the bio-diversity of the artificial forest.

(1) Within the plantation range of the raw material forests, design the forest stands of different ages.

(2) Plant or keep local broad-leaf trees (indigenous tree species) or other forest stands around the artificial forest or on an independent patch of land.

(3) Form the corridor for the wild animals of the protected forest in the range of the raw material forest, including construction of the bank buffer zone and the corridor belt that crosses mountain ridge and connects valley.

(4) Retain small patch of forest in the design of the raw material forest base, keeping some individual trees.

10 Environmental Impact Analysis of Application of Pesticide and Fertilizer

10.1 Impact Analysis for Application of Pesticides

10.1.1 Eucalyptus disease and pest control and pesticide utilization

Eucalyptus belongs to exotic tree species and the history of large area of plantation in China is not long. Up to now, no large-scale outbreak of pests is found. However, in recent years, due to the great development of eucalyptus artificial tree, the quantity of harmful insects increases every year, and so the risk of forest pests increases gradually and the potential dangers are also great.

In natural forest, predators and parasites can control the pest number. And, natural biodiversity can reduce the spreading of diseases. At the same time, due to the large-scale utilization of single clonal series, the stands are simple. As such, the narrowness and simplicity of the biological diversity and genetic gene will weaken the self-owned pest control mechanism of the tree, and which will lead to the occurrence of forest pests. Therefore, large-scale development of eucalyptus pure forest will increase the danger of diseases and pests.

The pests endangering eucalyptus are mainly of bacterial wilt, termite, cricket *Suana divisav* and tung-tree cankerworm etc. The pests causing harms to seedlings and saplings include Stem Rot, termites, *Brachytrupes portentosus*, *Agrotis ypsilon* Rottemberg, *Anoraala aupripe* Hope etc. The pests causing harms to eucalyptus include bacterial wilt, *Hypomeces squamosus* Fabricius, *Acanthopsyche subferalbata* Hampson, *Agrotis ypsilon* Rottemberg, and *Strepsicrates coriaHae* Oku. Seedling rot, white hypha, Brown patch, *Septoria motarlensis* Penz.et Sacc and canker are common eucalyptus diseases in Guangdong, Guangxi and Hainan provinces. In recent years, bacterial wilt is commonly found in *E. urophylla*, *E.saligna* and *E.grandis*, causing the death of large number of eucalyptus trees in some seriously affected areas.

At present, no effective prevention measures can be taken for the treatment of bacterial wilt. The cultivation of clonal series and good species with strong capacity against disease. At attack, the leaves and branches of the infected tree should be removed and burnt out promptly. The soil should also be drained and sterilized promptly.

In years' afforestation experience, biological treatment is the major measure to kill termite, assisted with forestry technical measures and chemical prevention. The forestry technical measures to prevent termite mainly include: Afforestation of eucalyptus forest shall avoid fir blank or warm and leeward area; select healthy and strong seedlings; adopt belt-type or patch-type land preparing method; plant mixed forest; avoid the surface feeding peak of the termite; carefully tender the seedlings etc. Other measures include protecting the natural enemies of termite such as spider, ant, dragonfly, numerous birds and animals (such as pangolin, echidna etc.); spraying biotic pesticide, i.e., nematode, *Beauveria* and *Metarrhizium* spp. to prevent termite (further examined). When the forestland seriously suffers from termite, chemical treatment shall be adopted such as using Thiram, Shachongshuang, Chlorpyrifos, Deltamethrin, fiproni etc.

In addition, eucalyptus is also susceptible to physiological diseases that are caused by the lack of some nutrients or trace elements which can be cured through applying fertilizer and trace elements.

Within the project area, there are 4 Forest Pest Control and Quarantine Stations at municipal level and 12 stations at county level; 2 disease and pest monitoring points at national level and 1 point at provincial level. Every town has professional personnel in charge of forest pest monitoring and reporting, which forms a complete network of pest monitoring and reporting from town, county to municipal level. Every county or municipal forest pest control and quarantine station is equipped with computer network. Four municipal and county stations are equipped with special-use vehicles for forest protection. There are totally 118 full-time forest technicians, 1 professional pest control team, 7 senior engineers, 1 widerange spraying machine and 467 automatic knapsack sprayers. When the large-scale forest pests occur, pesticide and instruments will be promptly allocated and delivered from all parts of Guangxi to the affected area. At present, pest control for eucalyptus forest has made achievements, which will benefit the raw material forest base.

10.1.2 The impacts of pesticide and chemicals utilization on environment

1) Prevention first. This is to minimize the use of pesticides and control the source pollution from the beginning.

Stora Enso will adopt the following measures to reduce the occurrence of forest disease and insect: (i) Imported species shall be inspected for sanitary quarantine to avoid introducing disease and insects. (ii) The seedlings from nursery shall be controlled, and any disease and insect identified shall be treated to avoid bringing to the forest. (iii) The eucalyptus forest base shall adopt mixed plot plantation of different clonal species to reduce the occurrence of disease and insect. (iv) Eucalyptus has relatively strong anti-disease capacity, while Stora Enso continues to develop new eucalyptus species of strong anti-disease capacity.

Therefore, by now, the eucalyptus forests under the management of Stora Enso have never occurred any disease and pests. No pesticides have been used. All these indicate that the disease and pest prevention and control of the company is effective.

2) Use of herbicide

During tendering of young trees, in order to avoid overlaying the tree by grasses, the grasses, shrubs and tree stumps must be cleared. The herbicide that the project plans to use include three kinds: glyphosate (N-glycihe), Chaosu (10.8% glyphosate 2.4-drops), paraquat that do not belong to the pesticides of high toxic and high residues. Because weedicide spraying would damage the trees, Stora Enso mostly use manual weeding in forest management, and thus the use of herbicide is very limited.

The herbicide are normally used in the grass quick-growing season and in the weather without rain and wind. After dilution, it will be applied to the leaves of weeds or to the stumps to be removed. With this method of application, the pesticides entering the water body would be very little, and thus have very little impacts on the environment. However, it will reduce the undergrowth abundance.

3) Application of chemicals in nursery

During breeding period in nursery, the chemicals mainly include rootone, sterilizing agent (carbendazol wettable, Sandofan, M-45); pesticides (deitamethrin, fiproni, dimethoate), herbicide (glyphosate) and sterilizing liquid (potassium permanganate, formaldehyde) etc. Among them, dimethoate belongs to high-toxic and high-residue pesticide, and thus the volume of application should be controlled.

Use of these chemicals shall be limited within the nursery. All the wastewater during breeding shall be recovered for use, without entering the water body nearby.

In the course of forest management of the base, it is suggested to learn the experiences and lessons from the neighboring places in disease and pest control, make efforts to conduct disease and pest forecast in the places of the base and promptly prevent the occurring or spreading. In addition, it is also suggested to formulate and implement strict regulations on disease and pest control management plan. The disease and pest control shall focus on comprehensive treatment by giving priority to biological treatment to reduce the application of chemicals. It is required to select the pesticides with low residues and toxicity and increase the efficiency so that the negative impacts on the environment can be minimized.

10.2 Impact Analysis for Application of Fertilizer

10.2.1 Fertilizing Plan

According to SE's afforestation experience in foreign countries, the years' experience of Gaofeng Group and Guangxi forestry system in eucalyptus planting as well as *Technical Code for Afforestation of Eucalyptus Pulp Wood Forest*, this Project decides that during the raw material forest base construction, the fertilizing shall be conducted at land preparing and seedling tendering stages.

After site preparing and digging, put fertilizer into the holes, mainly the special compound fertilizer and fused calcium magnesium phosphate for eucalyptus and respectively 100g of special compound fertilizer and 150g of fused calcium magnesium phosphate per hole. The optimal proportions of N, P and K shall be determined according to the soil conditions and the eucalyptus growing status. The first top dressing shall be applied within 1-2 month after the planting, at the quantity of 300g/tree. The second top dressing shall be applied within 7-8 month after the planting, at the quantity of 500g/tree. The necessity for further top dressing shall be determined in the third year after soil diagnosis and fertilizing experiment.

After land preparing, dig trench of 50x50x30cm and put in fertilizer or dig trench to the depth of 30-50cm or 60-90cm and put in fertilizer, then back-fill with soil. The method for fertilizing seedlings is: to dig grooves on both sides at the distance of 20cm to the tree, put in fertilizer, blend with soil and back-fill with soil.

10.2.2 Analysis of impacts on application of fertilizer

1. Impacts of fertilizing on ordinary environment.

The soil of the project area is acid; the content of organic matter is moderate; the content of quick N, P and K is low, especially quick P is extremely low. The effective trace elements Cu、Zn、B are in great shortage. Therefore, fertilizing is an important technical measure to realize quick growth and high yield of eucalyptus. This project will construct industrial raw material base. In order to increase the growth rate of eucalyptus, it is

necessary to apply fertilizer to the forestland. However, the N and P substances of the fertilizers may enter rivers, lands and reservoirs and lead to eutrophication of water body. Such may be caused by a number of factors such as runoff, penetration, soil erosion and improper fertilizer application.

According to the *Survey of Fertilization and Water Eutrophication for Eucalyptus Forestation Areas in Guangxi* conducted by Nong Bichang and his colleagues, among the sources of eutrophy substances of Guangxi, agriculture (livestock, fertilizer application and production) has taken up a majority percentage. However, with the large-scale development of eucalyptus and large-scale production and application of fertilizer, the total discharge volume of eutrophy substances (especially total N and total P) is on obvious rise.

Investigation had been conducted in June of 2004 in four places, respectively Qinglong working section of Pinggen Branch of Qinlian forestry farm, Liuyou Reservoir of Wuling town of Binyang county, Jingdu working section of Lanchong Branch of Bobai forestry farm and Jian'an Branch of Qingyuan forestry farm of Yizhou county of Qinzhou city. The investigation results are shown in table 10.2-1.

Table 10.2-1 Investigation on fertilizing and the eutrophication of the water body in eucalyptus afforestation area

Investigated forestland		Qingyuan forest farm	Wuling of Binyang county	Qinlian forestry farm	Bobai forestry farm
Eucalyptus species		E.grandis	GL 9 of eucalyptus grabdix	E.grandis	3229
Time of Afforesting		2002-03	2000-04	2000-03	2002-04
Planting density (tree/hm ²)		1665	1560	1665	1395
Fertilizing condition	Basal fertilizer (g/tree)	Calcium magnesium phosphate 250	Organic and inorganic fertilizers 400	Organic and inorganic fertilizers 500	Calcium magnesium phosphate 450
	Top dressing (g/tree)	Compound fertilizer (1:0.5:0.5) 250	Compound fertilizer 300	Compound fertilizer (12-10-8)300	Compound fertilizer (17-5-8)250
Standing growing stock(m ³ /hm ²)		17.07	17.71	89.36	32.41
Contents of eutrophy substances of water body	Samples	Samples from pond	Samples from reservoir	Samples from reservoir	Samples from pond
	pH	4.94	6.90	6.21	5.24
	Total N (mg/L)	3.14	3.75	1.34	0.62
	Total P (mg/L)	mark	mark	0.05	0.16

The investigation shows that the water sample from Qinlian forestry farm and Wuling forestry farm of Binyang county is in oligotrophic state; the water sample from Bobai forestry farm is in mesotrophic state; the water sample from Qingyuan forestry farm of Hechi city is in eutrophic state. The latter adopts total tillage while preparing the forestland and dig shallow trench to put fertilizers in to prevent them from washing away by rainwater. Thus, the nutrients are accumulated and eutrophic water is formed. Eutrophic water is formed in eucalyptus forest is to do with trace element N because fertilizer with trace element N is the primary fertilizer for the growth of eucalyptus.

According to the *Monitoring and Research of Impacts on Main Environmental Factors Caused by Planting Short-Rotation Eucalyptus and Acacia Forests* written by Professor Wen Yuanguang of Forestry Institute of Guangxi University, during the process of vegetation restoration, the nutrients losses of the three types of vegetation are little as: acacia crassiparva (0.036 kg/hm²) < eucalyptus grandis (0.039 kg/hm²) < grass slope (0.054 kg/hm²).

Similarly, the loss of N, P, K of the three sample plots also occurs in the year of plantation. The loss of nutrients in the second and the third years has obvious decreased. In the 4th and the 5th years, such becomes steady. This variation of nutrient loss is in the same pace with those of surface runoff and volume of soil erosion. Loss of nutrients is featured by: N > K > P, mostly of N.

In all, the soil erosion of the wood land is weak and will quickly decrease along with the age of vegetation restoration.

2. Analysis of impacts on environment caused by fertilizing methodology of the project

1) Stora Enso will cooperate with relevant research organization of Brazil to conduct full experiments on the growing characteristics of eucalyptus and conduct comprehensive analysis of the soil nutrient for the purpose of knowing about the nutrient status of soil and the demand of eucalyptus. In addition, based on the experimental design and analytical results, a special compound fertilizer exclusively for the company will be produced. Such will both satisfy the growth of eucalyptus and maintain the soil fertility.

2) The forest management of this project will only apply fertilizer in the periods of plantation and tendering young trees (first 18 months). The types of fertilizers are: limestone, phosphate and NPK compound.

Application of basal fertilizer will be usually conducted in line with hole back-filling before planting. After the fertilizer is put into the tree hole, the clumpy blocks must be broken up and then spray some top soil and fully blend it. In order to avoid fertilizer erosion, after fertilizing, back-filling must be conducted immediately.

The first top dressing shall be applied within 1-2 month after the planting. The necessity for further top dressing shall be determined in the third year after soil diagnosis and fertilizing experiment. Method for fertilizing. It is mainly to adopt the groove fertilization method, while locally with mechanical fertilization method. The method is to dig grooves on both sides at the distance of 20cm to the tree, put in fertilizer, blend with soil and

back-fill with soil.

3) In addition, the felling residues and litters can be retained within the forestland hence to reduce surface runoff and, to some extent, prevent fertilizer from washing away with the runoff.

In all, subject to reasonable times of fertilization in a scientific way, plus adopting scientific management measures better than other eucalyptus forests, the raw material forest base will not produce the problems of polluting surface water due to fertilization, and the impacts on the environment are also little.

11 Environmental Impact Analysis of Other Afforesting

Activities

11.1 Road Construction in Forest Area

This project will construct 940.0km of forest access road by occupying about 2.82-3.76km² of land. Such will permanently change the function of this part of forest land. It is a fact that most of the forestlands are distributed in low hills and ridges. During road construction, the vegetation of the subgrade, earth-borrowing pits and spoil area will be removed or buried. Such will expose the surface and thus will easily cause soil erosion. In addition, cutting, filling and stacking of wastes etc. will change the original landforms, gradients and length and form course surface. This is also a reason that may lead to soil erosion.

In this regard, on the basis of using the existing access roads, necessary adjustment will be made for the base. In the design, the width of access road is 2.0-3.0m, enabling safe traffic and avoiding excessive land occupation and surface exposure; the maximum longitudinal gradient is 13%, reducing the possibility of soil erosion. In addition, the access roads of the forest areas of 2.0-3.0m in width will not have negative impacts on the activities of wild animals.

It is recommended that, road construction should be conducted in dry season. This will help to avoid excessive runoff and erosion. Before the arrival of rainy season, the roads should be compacted. During the construction of access roads, earth cutting and filling should be avoided as much as possible. In case of necessity, earth cutting shall be properly arranged, and the surface should be recovered with vegetation as soon as possible so that the soil can be fixed.

11.2 Impacts of Tree Felling and Log Collecting

In the ecological system, the loss of nutrients may be affected by the cutting system (full cutting or selective cutting), the size of clearance after cutting, type of soil and the proportion of trees being cut (incl. bark and leaf). These factors should be considered as a whole as the composition of the nutrient system. The impacts caused by tree felling and log-collection include the following aspects:

(1) Soil. Large-scale tree felling and rolling-log access will have great impacts on soils, leading to soil hardening, soil erosion and loss of soil fertility. The soil hardening caused by machine rolling will deteriorate the water absorption capacity of soil, which will further lead to soil erosion due to runoff. Whole tree cutting and continuous nutrients extraction from soil may cause loss of soil fertility.

(2) Water. Soil erosion of the log-collecting roads will add to the sediments of rivers, thus will affect the water quality that the aquatic animals and plants depend on.

(3) Wild animals. The impacts on wild animals are mainly reflected by the disturbance to the propagation and nest-building of wild animals. Large-scale full cutting and log-rolling will damage the nets of the wild animals and affect the space of their activities.

(4) Large-scale full cutting will also damage the ground landscape. In this regard, it is required to following the rules of cutting, formulate reasonable plan and attend to protect the surface vegetation.

12 Risk analysis of base construction

12.1 The analysis on potential risk factors and risk degree

The risk factors involving the construction of the raw material base mainly comprise of market risk, natural risk, social risk and policy risk. Based on the risk factors and the risk degrees, the analytical results are shown in the following table.

Table 12-1 Risk Factors and Risk Analysis

SL.	Risk Factors	Risk Degree	Notes
1	Market		
1.1	Product price	Fairly	From the <i>Project Application Report</i> , it can be seen that, with 8% base benefit ratio, the critical point for price decrease of the products of the base is 20.05%. However, viewing from the development trend and the wood supply situation of Chinese and global paper-making industry, the materials for paper-making materials are steadily increasing. The possibility of price decreasing is very little. In addition, this project adopts the average price of the recent years, conforming to the stable pricing strategy.
1.2	Competitiveness	Fairly	Eucalyptus is the good material for paper pulp and fiberboard. So, the project has strong competitiveness. In addition, the products of the project are supplied to fixed consumers. The future wood market will be the seller's market, and the seller is in an advantageous position.
1.3	Market demand	Fairly	The wood raw materials of the project are supplied to the 900,000t/a of pulp and 900,000t/a of paper and paper board project of GXSE, so there will be not any risks in market demand. With the development of global socio-economic and cultural development, the consumption of paper and paper articles is increasing. Especially, China imports pulp and paper articles in great quantity each year.
2	Money risk		
2.1	Funding source break	Fairly	The project construction demands great investment. If any funding sources breaks, the construction progress of raw material forest base will be affected, so will the raw material supply and production of the pulp factory. However, Stora Enso is among the global 500 top enterprises with low assets liabilities ratio and strong financial ability. Therefore, the possibility of fund chain break is slim.
3	Natural environment		
3.1	Fire	Fairly	Eucalyptus forest fire is not likely to happen. In the project area, a complete set of forest fire fighting system has been established. Fire fighting measures have been included into the afforestation design.
3.2	Typhoon	Fairly	The project area is located in coastal area where typhoon frequently happens, which has great impacts on afforestation seeds and sapling trees.
3.3	Disease & Pest	Fairly	In the project area, bacterial wilt and termite are found, but not commonly.
4	Project risk	Fairly	The project points are distributed in the vast area. Consequently, site management proves to be difficult. The project quality and the selection of afforestation tree species sources (clonal species) are the major risks in project construction. However, with the supportive afforestation technical system and mature project management, the risks will be greatly reduced.

5	Social risk	Fairly	Most of afforestation forestland of the base is from forest farms, but partial of the land belongs to collective forestland, whose operation rights are owned by the farmers. Therefore, the project covers a vast area and numerous farmers. To collect the forestland of thousands of households for large-scale operation, project implementing agency will confront with great difficulty. Provided that forestland is not timely leased, the project progress and the investment will be affected. At the same time, proper measures should be taken to prevent farmers quit the forestland leasing, which will hinder the continuous operation of the project.
6	Policy risk	Fairly	The construction raw material forest base will occupy commercial forest and so forth natural resources. The ongoing quick-growth forest project and relevant industries will have great influence on the project area and on the governmental policies on industries.

12.2 Measures to prevent and reduce risks

Catering for the risks in project implementation, the project planning and design have proposed the following measures.

1. Market

(1) Strengthen the management during project construction and operation periods and try to reduce construction investment and operational charges, thus to reduce the production costs;

(2) Strengthen management, improve the operational and technical level, increase the high-technology content, resist and prevent the risks arising from the fluctuation of market prices with high yielding and reinforce the competitiveness of the products.

(3) To plant suitable trees in suitable place to exert the productivity of forestland to the utmost.

(2) Funds

The project owner should mobilize sufficient capital funds to ensure the input in the preliminary stage of the project.

The project owner should mobilize funds from various channels and spare some profits as the supplementary funds to ensure the timely and sufficient in-place of the funds for construction and operation periods, thus to ensure the timely completion and normal operation of the project.

3. Natural and environmental risks.

Strengthen the forecasting system of pest and disease outbreaks by implementing the principle of “prevention first, combining prevention with treatment”. This is to establish the strict epidemic prevention system and the forecasting network for forest disease and pest that can accurately foretell the outbreaks and ensure the forest safety.

Prevention and control of disease and pest such as bacterial wilt etc shall be started from cultivating anti-disease species, varieties and clonal series. Secondly, any varieties suffering disease found in nursery should be discarded immediately so that the fine species and seedlings can be used for afforestation. Thirdly, as for the afforestation measures and in order to improve the forest growing environment, it should improve the land preparation quality, adopt reasonable density, conduct tendering promptly and apply fertilizer scientifically. Pest can be prevented through ahead afforesting and lignifying, as

well spraying chemicals of control. Fourthly, the plant with bacterial wilt should dug out and burnt.

Fully strengthen the existing forest fire prevention system, manpower and material sources, and establish the effective system of Company – Farm – Fire-prevention organs of the base. In addition, it is also to enhance the construction of the forest fire prevention team and develop detail responsible system according to the relevant laws and regulations.

Typhoon prevention can be conducted mainly through breeding the varieties or clonal species of strong wind-resisting capacity for afforestation. At the same time, scientific research on breeding should be enhanced so as to foster the new varieties that have stronger capacity against wind and disease. Such will help increase the volume clonal series and reduce the risk potentials caused by simple clonal series.

Emphasize on the job design, implement the measures proposed by the EIA and avoid large-area continuous eucalyptus growing.

4. Risk of project construction

The afforestation of the project should select mature and fine clonal series to reduce the ecological risk, with at least 10 fine clonal series.

The project management should be conducted strictly according to the national basic construction procedure, implementing *Overall Plan for Afforestation in Wood Forest Base under Intensive Management* (GB/T 15782—1995) and code for construction of high-yield forest. The construction should be undertaken according to the design, and the funds, technical support and management should be in place.

The institutions for design, construction and supervision should be engaged through bidding.

Emphasize on land acquisition and determine the construction schedule.

The system of construction quality supervision should be adopted during the whole process from design to approval. Every process should be under strict quality control.

5. Social risk

Lawful operation. The national laws, regulations and policies should be strictly observed.

Operate with integrity. The land rent and labor charges should be paid on timely basis without squeezing on the price.

With caring heart. The company should assume the social responsibility and gain the social respects, giving necessary help to the vulnerable groups of the project area, such as the solitary elderly, orphans as well as soldier's dependents and martyr's dependents.

Strengthen communication. This is to enhance the communication with the forestry economic entities and farmers and solve the problems through discussion by guarding against possible trouble.

Offer optional operation modes for the farmers.

The land rent shall be calculated in different phases and adjusted according to the

price inflation and land appreciation. The rent should be adjusted for one time every five years, thus to satisfy the requirements of the farmers.

6. Policy risk

Under the guidance of the national industrial policy, it is to attend to the construction of the raw material base and relevant industrial development.

Perfect the construction of the infrastructure of the base, implement the conception of sustainable development, attend to the environmental protection, and increase the operable transparency for social issues, and thus contribution to the construction of a harmonious society in the project area.

In brief, the investors shall not only protect the self-interests, but also ensure the interests of land owners and labors by enabling the residents and local government to be satisfactorily benefited from the project. In addition, the investors shall create a good social image. Such will be beneficial for the implementation of afforestation hence to ensure the project to reach its goals.

13 Preventive Measures for Eco-Environmental Impacts.

Application Report on Raw Material Forest Base Project has proposed the relevant measures to protect the environment during project construction period in order to mitigate the impacts of project construction on environment. Combining the designed environmental protection measures, this EIA report proposes some preventing and protecting measures to mitigate the environmental impact.

13.1 Protection Measures for Biological Diversity

(1) The project shall retain some quantity of non-commercial in the sensitive places of the project area, so that the distribution of forest bases and the public forests can be scientifically interrelated and facilitate sustainable operation. Such will also help mitigate the ecological risks of growing eucalyptus.

(2) EIA requests that the selected site interrelated with white-headed leaf monkey natural reserve and the selected site within 1km of the boundary of the Natural Reserve shall be excluded. The excluded area of sub-compartments is about 2000ha. Such will help ensure that the activities of the white-headed leaf monkey in the protection zone shall not be affected by the project construction.

(3) Exclude the selected forestland located within the range of 1km from the boundary of the natural reserve, so as to avoid the impacts on the key protected wild plants and animals of the protection zones.

(4) The area of sub-compartment shall be well planned, normally not exceeding 100-200hm² each.

(5) Site preparation shall attend to the protection of the natural broad-leaf trees and shrubs located in the gully and mountain ridges; the natural wetland should be protected.

(6) Retain the vegetation of broad-leaf trees and shrubs in the open forestland or valley to facilitate the protection and restoration of biological diversity.

(7) During clearing forestland and site preparation, burning is prohibited. Site preparation for plantation on slopes shall be conducted according to the site conditions. Total soil tillage can be used in the gentle slopes of below 15° gradient. When total tillage is done for over 200m in length, it is required to retain a horizontal vegetation belt of minimum 3m in width at every 100m interval. Where of 16°-25° gradients should conduct the land preparing with holes or belt type, and the original vegetation should be retained between two horizontal belts. Where of 26°-35° gradients should use holes, and the holes on the hills should be arranged in delta shape.

(8) Adopt multiple series of clonal varieties for plantation in an interactive mode. In the surrounding of selected forestland in state-owned forestry farms, proper amount of local coniferous forest or other broad-leaf forest shall be planted in order to realize mixed plantation.

(9) The local forestry administrative department shall plan the distribution of different tree species in the commercial forestland, restrict the harvesting quota, provide with guidance to other forest farmers in selecting and planting suitable tree species. Such will

help avoid large-scale plantation and formation of pure eucalyptus forest in the project area.

(10) Promote the comprehensive control of forest pests, enhance the forest protection management and minimize the use of chemicals.

(11) Large-area application of herbicide shall be prohibited. Herbicide shall be used in spring and summer when the weeds are in luxuriant growth.

(12) During afforestation, distribution design, combination of age groups, the cutting plan etc. should be considered. In this regard, biological buffer zone should be reasonably arranged for the purpose of providing mitigating corridor for the wild animals.

(13) The participants at all levels must receive the education relevant to environmental protection for the purpose of strengthen their consciousness of environmental protection and consciously protect the wild animals and vegetation. Any hunting of the wild animals in the protection area shall be prohibited.

13.2 Measures for Maintaining Soil Fertility of Forestland

(1) Try to avoid the land preparation when it is drought or after raining so that the soil physical properties can be maintained to the most extent.

(2) Implement scientific fertilization. Before planting and top dressing, it is required to analyze physicochemical properties and nutrients of soil, based on which, recipe scientific fertilizing shall be applied to maintain the balance of nutrient elements in soil.

The selection of proper time and method of fertilizing can improve the efficiency of chemical fertilizer utilization. Land clearing and preparing is also an important measure to prevent the erosion of water and soil. Therefore, unreasonable afforestation measures shall be avoided to stop the erosion of water and soil.

(4) Protect the dropped branches, leaves and vegetation within the forestland. Collection of dropped branches and leaves and taking away of grass ashes shall be prohibited, conduct land clearing for the places with over 70% of coverage of weeds, shrubs and eucalyptus sprouting.

(5) After cutting, local barking and branch-removing shall be conducted. The residues and remains, such as leaves, bark and branches, shall be returned to the forestland.

(6) Prohibit ground burning for forest clearing, protect humus layer of the original cutting-blank, mitigate water and soil erosion in the forestland, reduce ground evaporation.

13.3 Soil Conservation Measures

(1) Within the selected site, plant indigenous tree species in the forestland unsuitable for the plantation of quick growth tree species.

(2) Conduct land clearing for the places with over 70% of coverage of weeds, shrubs and eucalyptus sprouting. After clearing, the underwood places shall retain the undergrowth of 15cm in height. No total tillage and ground burning shall be allowed for clearing.

(3) Select suitable time for forestland clearing, and avoid clearing and weeding in rainy season.

(4) Adopt different methods of land preparing according to different gradients of forestlands. Mechanical land preparing can be conducted only in forest land of ≤ 15 gradient and the advanced soil rippers are recommended. Where of 16-25 gradients should conduct the land preparing along the contour line with holes or belt types.

(5) The belt-type land preparing must be conducted along the contour line, with at least 1.m in width of spacing for grass growing; When the length of slope is more than 200m, a spacing of about 3.0m for each 100m must be retained as the grass-growing protection belt.

(6) While land preparing, construction discharge outlet and water-retaining wall etc. at the places of large gradients, which may retard runoff and reduce soil erosion.

(7) When tending the young trees, it must adopt local earth-loosing and weed removing, and the surface vegetation must be retained. The residues and remains of the weeds must be retained in the original places. Large-area application of herbicide shall be prohibited.

(8) Protect the dropped branches and leaves so to increase the water retention capacity and keeping the soil fertility.

(8) The surface vegetation must be retained at most during felling and logging. The density and quantity of rolling-log paths should be reduced, and the *Management Rules of Felling and Regeneration of Forest* must be strictly followed.

(9) Construction of access roads in forest area should preferably be conducted in dry season so as to avoid excessive runoff and erosion. Before the arrival of rainy season, the roads should be compacted and hardened.

(10) During the construction of access roads, earth cutting and filling should be minimized. In case of necessity, earth cutting shall be properly arranged, and the surface should be recovered with vegetation as soon as possible so that the soil can be fixed.

13.4 Measures for controlling source pollution

(1) Site selection for forest base shall avoid the places of water supplementation to drinking water source area. There should be provided with some protection distance on both sides of rivers (50m for trunk river, 20m for tributary). No tree species of long-rotation will be planted.

(2) Encourage soil diagnosis and receipt fertilizing. Abuse of fertilizer shall be prohibited.

(3) The methodology for applying fertilizers of the company should be strictly observed. In the places of high gradients, fertilizer application shall adopt the method of digging holes. After putting in fertilizer, the boles must be back-filled immediately. Spraying of fertilizer is prohibited.

(4) Develop new tree species of strong anti-disease capacity. Adopt multiple series of clonal varieties for plot-type plantation in an interactive mode, so as to reduce the occurrence of forest disease and insects and application of pesticides.

(5) Use of pesticides should be conducted strictly following the guidelines and in the weather without wind and rain, so as to prevent pesticides entering the water body.

13.5 Measures of Mitigating Impacts on Landscape

(1) Within the plantation range of the raw material forests, design the forest stands of different ages.

(2) Grow local broad-leaf trees (indigenous tree species) or other forest stands around the artificial forest or on an independent patch of land, recommended to a proportion of 10% of the total area of raw material forest.

(3) Form the corridor for the wild animals of the protected forest in the range of the raw material forest, including construction of the bank buffer zone and the corridor belt that crosses mountain ridge and connects valley.

(4) Retain small patch of forest in the design of the raw material forest base, keeping some individual trees.

13.6 Measures for Forest Disease and Pest Control

The disease and pest control must follow the principle of “prevention first, combining prevention with treatment”. The major measures are:

(1) Emphasize the quarantine of the species and seedlings to prevent from any diseases and pests.

(2) Emphasize sterilization of the seedling nursery and the nutrient substrate.

(3) Adopt the improved varieties and clonal series that have strong hardness for afforestation, as well adopt multiple clonal series for distribution so as to reduce the ecological risk. It is also to unceasingly breed new clonal series for afforestation that have the characteristics of strong capacity against disease and typhoon and high yielding.

(4) Emphasize scientific afforestation, reasonable fertilizing, suitable planting density and strengthen the capacity of forest stands against disease and pests.

(5) Emphasize the prediction and forecast of forest disease and pest and timely control the breakout and spreading of disease and pests.

(6) Formulate and implement strict regulations on disease and pest control management plan. The disease and pest control shall focus on comprehensive treatment by giving priority to biological treatment to reduce the application of chemicals. It is required to select the pesticides with low residues and toxicity and increase the efficiency so that the negative impacts on the environment can be minimized. .

13.7 Measures for Enhancing Environmental Monitoring of the Base.

(1) The Joint Venture will enhance the technical exchange and cooperation with the environmental monitoring departments within the project area to work out the complete environmental monitoring scheme for the forest land and neighboring places.

(2) Some quantity of monitoring points must be established within the project base. The routine inspection and the regular investigation shall be combined to closely monitor

the changes of all indicators of the forest land and the neighboring places, such as soil erosion, soil fertility, water resources, biological diversity, forest disease and pests etc.. Any abnormalities shall be probed into and be provided with corresponding measures.

(3) Where with precipitation of less than 1200mm should be provided with monitoring of forest water consumption and water quality.

(4) The environmental monitoring database and graphical information for forest land resources should be established to provide necessary services to the project management and sustainable development.

14 Eco-Environment Monitoring and Management Plan

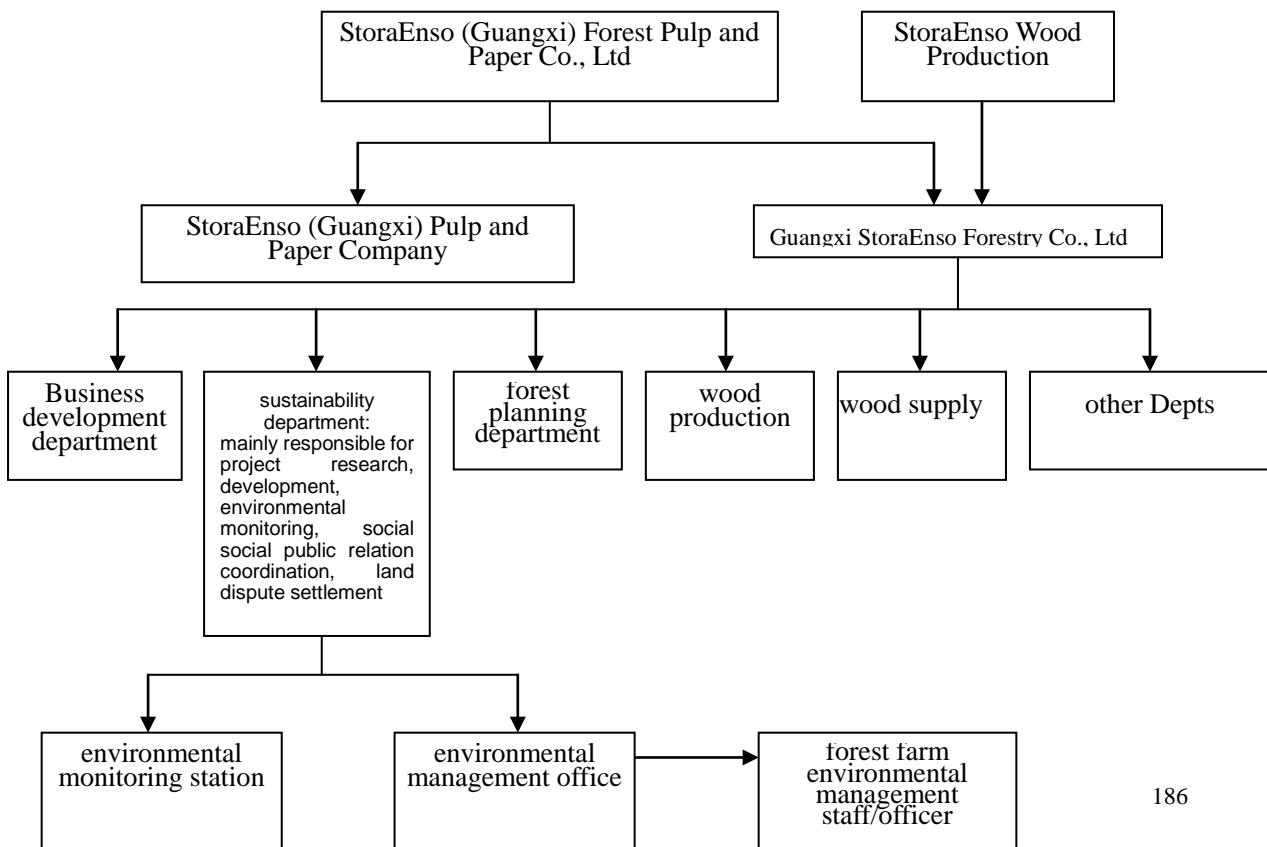
14.1 Eco-Environmental Management Plan

14.1.1 Establishment of Environmental Management Organization

The project owner of this project is Stora Enso (Guangxi) Forest, Pulp and Paper Company Ltd., and thus the environmental management organization and its operation shall be under its leadership.

According to the production characteristics and the demands of environmental protection in raw material forest base, this Project shall establish environmental administration institution. Through the establishment of ISO9001/14001 and OHSAS18001 executive management system, the propose project will step into sound environmental management.

The construction of raw material forest base is the basis for the construction of forest, pulp and paper integrative project. Therefore, the management system of raw material forest base shall prior to the construction of pulp engineering. The raw material forest base adopts and continues the existing operational and management mode of the Forestry Company under the leadership of the Forest and Pulp Company and the direct jurisdiction of Forestry Company. The Forestry Company includes the functional departments of Career Development Dept., Sustainable Development Dept., Forest Planning Dept., Forest Production Dept., Forest Felling Dept., Human Resources Dept., Finance Dept. and Research Dept. Sustainable Development Dept. is mainly responsible for internal environmental management and monitoring. It is suggested that Sustainable Development Dept. consist of environmental monitoring station and full-time environmental management office. All forestry farms shall establish layer management system.



14.1.2 Environment Management in Design Stage

In the stage of preliminary design of the raw material forest base, when each and every compartment is to be finalized to the practical land patches, the professionals of the forestry company shall, as the group member, participate in the site selection. The site selection shall be conducted according to the afforestation requirements, EIA and its comments of reviews.

This process will help to avoid possible negative impacts on the eco-environment at the initial design stage.

14.1.3 Environment Management during Forestland Operation and Management

1. The responsibilities of environment management of Stora Enso (Guangxi) Forest, Pulp and Paper Company Ltd.

(1) Inspect and supervise all the activities of the subordinated forestry companies that are related with guidelines, policies, laws and regulations of the State and the regions and counties where the project is located on environmental protection and forestry management; as well as the local environmental management.

(2) Periodically listen to the reports of the forestry companies on environmental monitoring and inspect the performance of the responsibility of each position.

(3) Coordinate with 15 project regions and counties in Beihai, Yulin, Fangchenggang and Chongzuo city and 8 state-owned forestry farms subordinated to Gaofeng forestry farm in the management of environment.

2. Forestry company and eco-environment administration departments.

(1) Undertake supervision over the afforestation of raw material forest base in accordance with *Technical Code for Afforestation*; send professional personnel to offer periodic training and give guidance and inspection to the forest area during operational period every year.

(2) Promptly take measures to control the disease and pests upon receiving the report of disease of pest and timely popularize the measures in all forest bases through the environmental workers.

(3) Conduct regular monitoring and supervision over the subordinated soil erosion monitoring station, soil fertility monitoring station, water resources monitoring station, biodiversity monitoring station and forest pest monitoring station and receive their annual reports.

(4) Monitor and inspect the nursery, the construction of forestry training center to ensure the orderly development of raw material forest base.

(5) Actively urge the raw material forest bases to implement the engineering protection measures proposed by the design unit and the measures proposed by EA and actively inspect the implementation of the ecological protection measures.

(6) Compile annual work report of the raw material forest base. The contents include:

the operation of forestland, the implementation of environmental protection measures, water and soil erosion, soil fertility, water resources, biodiversity and forest pests etc.

3. Responsibilities of all monitoring stations.

(1) Conscientiously carry out State's rules and regulations on forestry and environmental protection; establish sound regulations and mechanism for the monitoring stations.

(2) Accomplish the assigned monitoring items; supervise over the operation of raw material forest base; ensure the monitoring data to be exact and typical; timely report the monitoring results on water and soil erosion and soil quality in case of huge fluctuation or deterioration; report the causes and corresponding mitigating measure; report the forest disease and pest; timely report the dramatic decrease of water resources and serious pollution of water quality; add monitoring frequency if necessary and report the authorized department of upper level.

(3) Collect, sort out and analyze monitoring data and establish monitoring archives.

(4) Strengthen the maintenance and regular correction of monitoring instrument and facilities and ensure that the monitoring goes on smoothly.

(5) Compile monitoring report on water and soil erosion, soil fertility, water resources, biodiversity and forest disease and pest.

14.2 Environmental Monitoring

Environmental monitoring is the necessary means for environmental protection, which timely informs the discharge of pollutants. Accordingly, related protection measures shall be taken to prevent adverse impacts and minimize the environmental impacts within the allowable laws and regulations.

Environmental monitoring shall comply with the State and local laws on environmental protection; adopt the standard monitoring methods specified by the State and regularly report the results to the competent environmental department.

Eucalyptus is the primary species for fertilizing and afforestation of this Project, including the existing forest and new-planted forest.

14.2.1 Monitoring of soil erosion during operating period.

(1) Distribution of monitoring points

In order to make the monitoring spots to be the representatives of the major afforestation areas and the afforestation tree species, the monitoring spots are selected in different types of forestland and new forestland. Two monitoring points for soil erosion will be established in the 15 project counties where with serious soil erosion.

(2) Monitoring contents

Rainfall, rainfall duration and strength; surface runoff; soil eroding volume; water quality analysis (analyzing N, P, K contents in the eroding water); analysis of earth samples (analyzing the contents of organic matters, total N, total P, total K, quick-effect N, quick-effect P and quick-effect K); recording the activities of afforesting, fostering and stand growth.

(3) Monitoring method and frequency

Establish runoff plot:

On water and soil erosion monitoring spot, select the places with tender slope and typical stand condition to establish three runoff plots. Two runoff plots are in the forestland as the comparative plots under the same or different technical measures for afforestation. One runoff plot is in the non-forestland as the contrast plot. Each runoff plot shall be a rectangular of 20m X 5m with the size of 100m², which long side shall be vertical to contour. The structure of each runoff plot shall conform to the standard, including side wall, water collecting sump, gutter, engrafted tank and drain ditch at the margin of runoff plot and the protection belt at both sides of runoff plot.

Field monitoring method:

(1) Rainfall, rainfall duration and strength: measured by self-recording rain gauge, which be put on the open place near the runoff plot.

(2) Surface runoff: measure once every day (conducted in the afternoon when it rains in daytime; in the morning when it rains at night; more measures in case of continuous raining). Use steel ruler to directly measure the volume of water in the engrafted tank.

(3) Soil erosion: The measure shall depend on two situations. When the tank has sludge, directly measure the sludge volume and compute the weight according to the sludge volume (two times sampling each year to measure the average value). When the tank has little sludge, to compute the soil erosion in accordance with the silt concentration and runoff (three to five times sampling to measure the average value).

Water and soil sample analysis:

(1) Take water and soil sample: three time in the first year, one in heavy rain (daily rainfall 25-50mm) and twice in stormy rain (daily rainfall >50mm), hereinafter, once per year.

(2) Soil sample shall be taken from sludge in the tank. Apply unified index analysis method to analyze contents of organic matters, total N, total P, total K, quick-effect N, quick-effect P and quick-effect K.

(3) Water sample shall be taken from the tank. If timely analysis is impossible, add proper amount of dimethylbenzene into the water sample and put into the refrigerator. Apply unified index analysis method to analyze contents of N, P and K in water sample.

14.2.2 Monitoring of ground water in operating period

(1) Distribution of monitoring points

Set 1-2 points for ground water monitoring at the ground drinking water source and the drinking water well of the hilly area or coastal plain and tableland.

(2) Monitoring contents

Water level, water temperature, pH, chroma, odor, turbidity, potassium permanganate index, BOD₅, nitrates, nitrite nitrogen, ammonia nitrogen, total P, phenols and coliform bacteria group etc.

(3) Monitoring methodology and frequency

Methodology: observe the *Technical Requirements and Test Methods for Drinking Water* (GB5750).

Monitoring frequency: 2 times / year (high-water period, low-water period)

14.2.3 Monitoring of soil fertility of operation period

(1) Distribution of monitoring points

In accordance with different stand type, two monitoring points for soil fertility will be set in the newly-afforested and fostering forests of the 15 project counties.

(2) Monitoring indicators

Soil pH value, soil hydrolytic acidity; contents of soil organic matter, total N, quick N, quick P, quick K, slow K, exchangeable Ca and exchangeable Mg.

(2) Monitoring method and frequency

Every year, take soil sample from the sample forestland to measure the above-mentioned index, to further identify the soil fertility. Before afforestation, take soil sample to make analysis as the background soil fertility. After afforestation, analysis of soil sample shall be conducted from June to August once every year to measure the changes of the above index. Fertilizing and collecting of soil sample in forestland shall follow the same rules and procedure to ensure the scientificness of fertilizing and collecting of soil sample. At the same time, investigation shall be conducted on the growth of trees in the sample forestland.

14.2.4 Monitoring of pest and disease in operation period

(1) Distribution of monitoring points

The project area has currently 2 disease and pest monitoring points at national level and 1 point at provincial level. It is planned to establish 2 additional disease and pest monitoring points in 15 project regions and counties, including each monitoring point respectively in the existing forest and the new planted forest.

(2) Monitoring contents

Varieties of diseases and pests, number (rate) suffered trees, average insect density per tree, degree of damage of stands etc.

(3) Monitoring method

Establish sample forestland and tree for monitoring: When the site condition and the stand type are the representatives, the monitoring spots are selected in new forestland or improved forestland with gentle slope and convenient traffic. On the fixed sample forestland for monitoring, 20 –30 trees shall be selected as standard trees by mechanical sampling according to the different stand type.

Every year, make regular monitoring over the disease and pest of the fixed standard trees in the sample forestland; record the varieties of diseases and pests, the number of suffered trees etc. The field monitoring and indoor identification of the varieties of diseases and pests shall be conducted in accordance with technical requirements and procedures.

(4) Monitoring frequency

Generally, monitoring shall be conducted for three times each year, respectively in early May, early July and early September.

(5) Infrastructure

Special offices, specimen rooms, specimen of major forest pests, laboratories, file cabinets, chemicals and instrument storehouse, spare parts of instrument.

(6) Transportation and telecommunication

Special vehicles for forest inspection and quarantine, computer, fax machine, telephone.

(7) Instrument and equipment

Microscope, anatomical lens, camera, temperature humidity chamber, bacteria killing pan, temperature and humidity recorder, balance, moth-killing lamp, refrigerator, drier, soft X-ray device and formulation device.

14.2.5 Monitoring of biodiversity during operation period

(1) Distribution of monitoring points

This is to establish two investigation sample forestlands in the existing eucalyptus forestland. So is in the transformed eucalyptus forestland from other tree species, shrubbery, planned afforestation land, barren land and so forth new forestlands. The number of sample forestland will depend on the type of land.

(2) Monitoring contents

Plant species, individual number, height, coverage at shrub layer and herb layer.

(3) Monitoring method

Of the selected community types, mark 2 patches with the size of 400 m² as the sample plots for investigation. Then, record the name of the tree species which height is over 4m. At the same time, measure its DBH, height and crown density. Within each sample plot, four sampling sites of 4m×4m are selected, where each plant name, height, number of individuals and covering rate shall be recorded.

To record the time of afforestation in the sampling forestland, which rotation it is in, the type of land before project construction and the change of biodiversity in the base.

(4) Monitoring frequency

Generally, monitoring shall be conducted once in every rotation when the stand canopy is well formed.

14.3 Sustainable Development Plan of Forestry Company

In the design stage of the project, the forestry company has formulated the sustainable development plan according to the characteristics of the project. Such is done for the purpose of (i) protecting the environment, reducing the impacts of soil erosion and land degradation; and (ii) maintaining the production sustainability of the forestland. Main contents of the plan are as follows:

1. Sustainable operation management strategy.

- Approval of the SEGX's sustainable development proposal.
 - SEGX Development Standards
- Implementation of standards.
- ISO 9001/14001 and OHSAS 18001 Environment Management Certification
- Forest Certification / CoC Certification

2 Environmental protection measures

- Preliminary research on impacts on water resources.
- Preliminary research on impacts on soil erosion.
- Reasonable utilization of fertilizer and chemical substances
- Development of monitoring system for artificial eucalyptus
- Operation of environmental monitoring system
- Research on protection of biological diversity. In this regard, the company has established the cooperative relation with UNDP, covering the contents of protection of mangrove, recovery of indigenous species, plantation experiment of indigenous tree species, establishment of arboretum of indigenous tree species.

3. Measures for increase the social benefits.

Including working conditions, regional development, as well as the cooperative relation with forest farms.

4. Establishment of the sustainable supply chain of timbres.

- Determine the timbre demand of contractors.
- Contractors' monitoring system
- Contracted procurement of 100% timbres

Formulate and implement the regulations to be observed by timber suppliers.

5. Dynamic operation of investors.

Formulate the communication plan. Implement the investor commitment strategy. Investigate and ban the improper channels.

15 Public Participation

15.1 Purpose and Principle

15.1.1 Purpose :

The purpose of the public participation is to let the local units, residents and farmer householders and forest farm employees within the project area understand the significant of this project construction and environmental impact by this project (including positive and negative, long term and short term) and the mitigation measures.

It is to reflect the public attitude to the project's social and environmental impact, and collect public comment and feedback.

15.1.2 Principle :

It presents that the public have the right to learn the truth of the consequential events on social development and economic construction, which respects interests of the public and improve the public awareness on participating the environmental protection.

The participants should be representative, and the form of this public participation should be fair and open.

15.2 Working Contents

(1) it is to inform the public in the project area with the project general introduction, projected major positive and negative impact and the mitigation measures.

(2) It is to design the public concerned questions, consult with habitants and units directly affected by the project, and collect their suggestions, comment and feedback on environmental protection.

15.3 Form and Framework of Public Participation

In accordance with the Interim Measure for the Public Participation of Environmental Impact Assessment by Stated Environmental Protection Administration, the public participation and investigation work was carried out by stages.

(1) the first round public participation and public notification

During the beginning stage – compiling the outline, it was decided to choose mass media to expose environmental impact assessment information regarding the StoraEnso (Guangxi) Forest Pulp and Paper Integrated Project and carry out the first round public participation and public notification.

The first public notification: the information was published on the 2nd page of Beihai Daily on September 5, 2007, on Beihai government website for 10 days which is from September 6 to 15, 2007.

(2) the second round public participation and public notification

During the process of assessing the environmental impact , it is to notify the public with the public concerned issues, such as, the general introduction of the 160,000ha raw material forest base of the StoraEnso (Guangxi) Forest Pulp and Paper Integrated Project, its construction activities related to environmental problem, the initial analysis and conclusion of the environmental impact assessment and the adopted measure for mitigating the environmental impact.

This public participation adopted 3 approaches. The first approach was to publish the EIA report in 12th page of Guangxi Daily on July 6, 2007, and also on the Guangxi Environmental Protection Bureau website for 10 days which were from July 6 to 16, 2007. the second approach was to place the EIA report in StoraEnso Guangxi office, management supervision division of Guangxi Environmental Protection Bureau, Guangxi Gaofeng Group and management supervision division of Beihai Environmental Protection Bureau for public review. It was also aiming to collecting feedback and comment from the public. The third approach was to distribute questionnaire to stakeholders. Based on different areas and target groups, 3 types of questionnaire are designed for forest farm employee, forest farmer, and other social individuals. The questionnaire investigation result of is collected.

(3) The Second Time of Public Participation and Investigation for Forest Farms Employees

During the second round of public participation, the result shows that the employees of the 8 forest farms are against the this fiber base project because

they worry about their future employment and livelihood after they hand over the forest land to StoraEnso. After communication and negotiation with the project implementing agency(StoraEnso) and local forestry administrative department, a discussion meeting, aiming at forest farms employees, was held by Guangxi Forestry Bureau on December 10, 2007. on the meeting, Mr Liao Peilai, deputy director of the Guangxi Forestry Bureau, delivered a speech on how to adequately solve the survival and development issue for forest farms employees after hand over the forest land to StoraEnso. As the administrative department, Guangxi Forestry Bureau explained the issues regarding employment resettlement, pension security and forest farms development in the future. 800 copies of questionnaire were distributed to 8 forest farms for once more comment to the fiber base project construction.

15.4 Statistics and Feedback of the Public Participation and Investigation

15.4.1 Statistics of the First Time of Public Participation and Investigation

15.4.1.1 Statistics of Public Participation Questionnaire

During the second round of public participation, 3 types of questionnaire are designed for forest farm employee, forest farmer and other social individuals.

(1) public participation and investigation for state owned forest farm employee

Quantity and scope : 160 copies of questionnaire were distributed and 151 were collected, respectively, Gaofeng FF 20 copies, Liangfengjiang 15 copies, Qipo 18 copies, Dongmen 20 copies, Paiyangshang 20 copies, Qinlian 18 copies, Bobai 15 copies, Liuwan 20 copies.

The scope of respondents include forest farm employees, technicians, silviculture engineers, staff of forest farms sales office, accountant, chief of financial department, assistant economic manager etc.

Among the respondents, there are 111 men , accounting for 73.5% of the total, 40 women ,26.5% of the total. Regarding their education background, 16 persons, 6.6%, are middle school level; 22 persons, 14.6%, are high school level; 65 persons, 43%, are junior college level; 32 persons, 21.2%, are

university or above level. 40 persons, 26.5% of the total, are at the age of 18~30; 54 persons, 35.8%, at 31~40; 45 persons, 29.8%, at 41~50; 8 persons, 5.3%, at the age of 50 or above.

The even distribution of the occupation and age reflect different forest farm employees' attitude to this project.

Questionnaire statistics: see table 15.4-1

Table15.4-1 “public participation” investigation State owned forest farms employee

investigation record				
Do you know StoraEnso (Guangxi) 160,000ha of raw material forest base project?	楚 Yes (72)	hear of it (65)	Do not know (13)	
Is the forest farm which you serve involved in the scope of the forest base ?	Yes (130)	No (2)	not clear about it(17)	
do you like your forest farm to join the forest base project?	Yes (41)	No (89)	indifferent (20)	(1)
What is the main species in you forest farm?	Eucalyptus (140)	pine (33)	acacia (5)	other : (7)
What is the eucalyptus proportion in you forest farm?	10% and below (3)	10%~20% (25)	20%~30% (16)	30% and above (107)
What is the growth volume of the Eucalyptus in your forest farm_ m ³ /mu.y?	1.5 and below (23)	1.5~2.0 (70)	2.0~2.5 (32)	2.5 and above (21)
What is the abundance degree of underwood vegetation in your Eucalyptus forest in your forest farm?	lots of shrub (71)	a few shrub (73)	bare (2)	
Do you use fertilizer for the Eucalyptus in your forest farm?	yes (117)	no (23)	do not know (9)	
Do you use herbicide?	是 yes (83)	否 no (51)	不知道 do not know (6)	
What kind of the site cleaning is adopted in you forest farm?	manual cleaning (34)	site burning (127)	mechanical cleaning (3)	

What is the Eucalyptus rotation in you forest farm?	5-6 年 year			
have you ever seen wild animal in your forest farm ?	yes (129)	no (21)		
Do you think that SE's silviculture measures can increase the Eucalyptus's growth?	能 yes (31)	不能 no (17)	不清楚 not clear about it (100)	
What environmental impact will be if you plant Eucalyptus instead of other tree species?	Most of respondents reply that there is no environmental impact or just very small impact. Partly believe that it has impact to water source, soil, climate, biodiversity and water quality.			
Do you support this project?	yes (55)	no (61)	indifferent (34)	

(2) public participation and investigation for Forest farmer in forest base area

Quality and scope: 100 copies of questionnaire were distributed, 93 copies were collected, respectively, Yulin city 15 copies, Fangchenggang city 15 copies, Beihai city 63 copies.

From the scope of occupation, it covers forest farmer, working staff in forestry station, village cadre, working staff in agriculture service center. Forest farmers were the majority of the respondents, which could reflect the forest farmer's attitude to the forest base project within the project area.

Among the respondents, there were 85 men accounting for 91.4% of the total; 8 women, 8.6% of the total. 8 persons, 8.6% of total are primary school level; 22 persons, 23.7%, are middle school level; 30 persons, 32.3%, are high school level; 11 persons, 11.8%, are secondary technical school level; 9 persons, 9.7%, are junior college level; 10 persons, 10.8%, are university or above level. 10 persons, 10.8%, are at the age of 18~30; 27 persons, 29.7%, at 31~40; 31 persons, 33.3%, at 41~50; 22 persons, 23.7%, at 50 and above.

Questionnaire statistics: see table 15.4-2

(3) public participation and investigation for social individuals

Quantity and scope: 40 copies were distributed, and 30 copies were collected, respectively, 13 copies in Beihai Hepu, 7 copies in Yulin city, 5 copies in Fangchenggang city, 5 copies in Nanning.

From the scope of the occupation, it includes self-employed individual, company employee, worker, village cadre, villager, student and etc. which could widely represent attitude of different social circles.

Among the respondents, there were 11 men, accounting for 36.7% of the total, 19 women, 63.3% of the total. 8 persons, 26.7%, are middle school level; 13 persons, 43.3%, are high school level; 1 person are secondary technical school level; 3 persons are university and above level. 11 persons, 36.7%, are at the age of 18~30; 11 persons, 36.7%, at 30~40; 7 persons, 23.3%, at 40~50; only 1 person is 50 or above.

Questionnaire statistics: see table 15.4-3

Table15.4-2 investigation for forest farmer

investigation record				
do you know the StoraEnso (Guagnxi) Forest Pulp and Paper Co. Ltd. 9000,000T/a of Pul, 900,000T/a of Paper and Paper Board Project ?	yes clear (54)	hear of it (33)	do not know (4)	
Do you know that this project requires 160,000ha of raw material forest base?	yes, clear (49)	hear of it (30)	do not know (9)	
If you have forest land or there is suitable land for the forest base project your village, are you willing to join the business model of company+household? Which cooperation pattern do you think is the best?	yes (75)	no (3)	do not know (9)	
	renting the forest land with once payment only (38)	offer land to company to implement and become shareholder (19)	self running, while the company provides technical guiding. , (33)	其他 others (0)
If you have forest land, when you plant trees, which factor is the first priority for your consideration?	economic benefit (78)	national policy (14)	easy to manage (1)	
what kind of tree are you planting in your forest land ?	Eucalyptus (85)	Pine (5)	Acacia (1)	others (4)
what is your annual investment ? what is your investment mainly for ?	200-600 元/亩 yuan/mu			
	raising seedling (5)	fertilizing (70)	disease and pest control (12)	others (10)
what type of site cleaning do you adopt ?	manual cleaning (39)		burning (44)	
Comparing with manual site cleaning, what do you think of the burning?	labor saving (36)	save money (36)	easy to catch fire (16)	degrade soil fertility (0)
what kind of technical help and support do you need for the operation ?	raising seedling (16)	afforestation (49)	forest tending (32)	others (4)
Does the disease and pest frequently happen to local Eucalyptus? What is the disease?	1 time every 10/>10 years (21)	every 5 years (7)	every 2/3 years (9)	few or none (10)

	name of the disease and pest : bacterial wilt (34) , some people answer: grasshopper, buzura suppressaria, slug caterpillar moyhs, Cylindrocladium			
Based on the local situation, do you believe that the Eucalyptus output can be increased via scientific silviculture management?	Yes (88)	No (0)	do not know (4)	
What is the project impact to your income?	increase (65)	none (16)	decrease (8)	Do not know (2)
do you support implementing this project	yes (87)	no (2)	indifferent (3)	

Table15.4-3 public participation investigation for social individuals

investigation record				
Do you know the StoraEnso (Gguangxi) Forest Pulp and Paper Integrated project?	yes (2)	hear of it (14)	no (14)	
Do you know that this project requires 160,000ha of raw material forest base?	yes (2)	hear of it (17)	do not know (11)	
Do you think the project will benefit local economic development?	yes (23)	no (0)	do not know (7)	
What benefit do you concern about this project?	drive economic development (25)	increase job opportunity (11)	increase wood supply to the market (8)	reduce logging to natural forest (5)
Which environmental impact is greater, mill or forest base?	mill (8)	Forest base (11)	both small (4)	both great (5)
What is the worst social impact by the forest base?	garbage in the forest land (13)	hunting (0)	deforestation out of project forest area (9)	others :
Do people plant Eucalyptus in your village?	yes (22)	no (3)	do not know (5)	
Comparing with manual site cleaning, what do you think of the burning?	labor saving (16)	save money (1)	easy to cause fire (11)	degrade soil fertility (3)
Do you think Eucalyptus plantation is good for the environment?	yes (16)	no (6)	do not know (8)	
Do you think planting Eucalyptus will consume much water resource?	much (10)	not too much (12)	do not know (8)	
Do you think the Eucalyptus plantation will degrade the soil fertility?	yes (7)	no (14)	do not know (9)	
do you support this project?	yes (19)	no(1)	indifferent (10)	

15.4.1.2 Statistical Result Analysis

274 copies of questionnaire were collected, among which, 151 from forest farms, 93 from forest farmers, 30 from social individuals.

(1) investigation result for forest farm employees

Among the forest farm employees, 90% of respondents in forest farm hear of this project. 86% respondents work in the forest farms which belong to the scope of forest base. 27% forest farm employees are willing to join the forest base, 59% of them are not willing to, and 13% of them show indifference.

Among the forest farm employee, 93% of the respondents replied that they plant Eucalyptus in their forest farms; 22% replied that their forest farm plant pine, and some acacia and other species. 71% respondents replied that the area of eucalyptus forest is more than 30% of the total area; 46% answer the eucalyptus growth volume is 1.5~2.0 m³/mu-year, 21% answer 2.0~2.5 m³/mu-year, 15% answer the growth volume is <1.5 m³/mu-year or >2.5 m³/mu-year. The investigation result shows that the within the project area, forest farms plant eucalyptus and the eucalyptus growth volume is high.

47% respondents replied there are many shrubs in eucalyptus plantation, 48% answer there are a few shrub. 77.5% of respondents replied that people use fertilizer for eucalyptus in their forest farms, 15% of them replied “do not use fertilizer”; 55% respondent say they use herbicide; 34% respondents replied “do not use herbicide”. 84% respondents said they adopt burning for site cleaning, 23% adopt manual cleaning. It could be seen from the above result that there lots of underwood vegetation, pesticide, fertilizer and herbicide are used in eucalyptus forest, and most of forest farms adopt burning for site cleaning.

According to the public comment and feedback, the eucalyptus rotation is 5~6years, fewer people said 3~6 years or 5~7 years.

Among the forest farm employees, 85% of respondents saw wild animal, 14% replied they have not seen wild animal before. 21% respondents believed StoraEnso can increase the growth volume via its silviculture measures, 11% replied StoraEnso cannot do that, and the rest replied they did not know.

Regarding the question “what environmental impact will be caused by the eucalyptus planting”, most of the respondents did not answer this questions, parts of respondents answered no impact or just small impact, very few respondents believed it has impact to water source, water quality, soil, climate, and biodiversity. The investigation result shows that most of the forest farms

employees believe eucalyptus has small impact to environment, and a few people still believe big scale area of eucalyptus will have impact to water source, soil and biodiversity.

36.4% of the forest farm employees support this project, 40.4% of the respondents do not support this project, and 22.5% of them are indifferent to this project.

。 The respondents those who do not support this project mainly consider from the point of employee's economic benefit, worry about that their income and job will be affected when the forest farm hand over the land to StoraEnso. It is required to consider to adequately solving the problems of the employees' re-employment, livelihood and wellbeing. Many people believe that the forestland hand over is government act, the wood purchasing price is lower than the market price. They do not agree to hand over the land to a foreign company, however, it is suggested to explore a mutual benefit cooperation model, such as prioritize to supply wood to StoraEnso based on the market price. Some people also worry that this project is impractical if it fails properly coordinate the relationship with local villages. A few people worry that large scales of the eucalyptus will cause negative impact to the environment; therefore, it is recommended to mix with other species. And some people did not give the reason.

(2) investigation result for forest farmer within project area

93% of the forest farmers said that they know or hear of this project; 53% of them know that this project requires 160,000ha of raw material forest base, and 32% of them hear of the forest base.

81% of the forest farmers are willing to join the company + household business model, while only 3 forest farmers are not willing to join it. Among the respondents, 41% believe the renting with only once payment is the best way, and 20% of them would like to become shareholders by offering their land to the company, and have the company to run the business, and believe this is the best model. 35% of forest farmers would like to run the business by themselves while the company provides technical guidance.

84% of respondents consider the “economic refund” as the major factors, while 15% of them think of the national policy when choosing the tree species. 91% of them are planting eucalyptus now, only a few of them plant pine, acacia and other species.

Based on the investigation, the forest farmer’s annual investment to their forest land is about 200~600yuan. The total investment could be different in different forest area. 75% of respondents replied that they mainly put money on fertilizer, 13% of them invest on disease and pest control, and only 5% of them invest on tending. And 11% of them invest on others.

47% of the respondents adopt site burning, 42% of them adopt manual cleaning. Comparing with manual cleaning, 39% of the forest farm believe that burning will help to save labor and money, 17% of them said it is easy to catch fire. 53% of the respondents hope that they could receive some technical help and support on afforestation, 34% of respondents hope to receive technical support on forest tending, and 17% of them prefer support on raising seedling.

Regarding the frequency of the disease and pest, 23% replied “every 10 or >10 years, 7.5% of them answered “every 5 years”, 9.7% of them said “every 2 or 3 years”, 10.8% said “few or none”

According to local condition, 95% of the respondents believe that scientific silviculture and management can help to increase the eucalyptus output; only 4 persons replied “do not know”. 70% of the forest farmers believe the project can help to increase their income, 17% of them believe it has no impact to their income, 8.6% of them believe the project construction will decrease their income, and still 2 person said “not clear about it”.

Among the forest farmer in the project area, 94% of them support this project, 2 persons (2.2%) chose “not support”, 3.2% of them have indifferent attitude.

The reason why the forest farmer do not support this project is the low price for wood purchase and land rental which decrease their income.

(3) investigation result for social individuals

Among the social individuals, 46.7% of the respondents “hear of this

project” , 56.7% of the respondents said they heard of that this project needs 160,000ha of forest base, only 2 persons said they knew this project requires 160,000ha of forest base.

76.7% of the respondents believe that the project construction will benefit local economic development, while the other said “not clear about it”; 83.3% of the respondents pay attention to this project because they believe the project will drive economic development, 36.7% of them replied it would increase the employment opportunity, 26.7% believe it would increase the wood supply in the market”, 16.7% said it would reduce the logging in natural forest. The investigation shows that local people pay more attention to the economic benefit brought by the project.

mill and forest base, which has sound environmental impact”, 36.7% of the respondents replied “the forest base has”, 26.7% replied “pulp mill”, 4 people replied “both mill and forest base just have small impact”, and other 5 persons replied “both have great impact”; 43.3% respondents believe that the worst impact by forest base construction is to bring the garbage into the forest land, 30% of the respondents replied deforestation out of project forest area. 1 person believed “it causes pollution to water quality”. The investigation shows that people worry that the forest base would cause impact the environment. In order to reduce the environmental impact, it requires to strengthen the management for the silviculture operation.

Most of the respondents replied that they eucalyptus in their villages, 5 persons replied “not clear about it”, only 3 persons replied “No”. The investigation result presents that eucalyptus are planted in most of the project area. Comparing with manual site cleaning, 53% of the respondents believed that site burning requires less labor, 37% of the respondents believed that burning is easier to catch fire, and 3 persons replied that site burning is easier to degrade the soil fertility.

53% of respondents believed that Guangxi is suitable for planting eucalyptus, 20% believed eucalyptus is not in favor of the environment, 26.7% replied “not clear about it”; 33% of the respondents believed eucalyptus will consume lots of water, 40% of the respondents believed eucalyptus will not

consume too much of water; 23% believed that eucalyptus plantation will degrade the soil fertility.

63% of the respondent support this project, 33% of them are indifferent to this project, while only 1 person is against this project. The reason is that the project will have negative impact to the environment.

(4) general statistics

274 copies of questionnaire were collected for the first round of questionnaire investigation, 161 persons have positive attitude and support this project which is 59% of the total respondents. 23% and 64 persons are against this project, while the others are indifferent to this project. Those who are against this project mostly are forest farm employees. They worry that the business model adopted by StoraEnso will affect their employment, economic income and wellbeing. They suggest to explore a totally marketization cooperation model like “forest farms run and manage forest land and then supply wood to StoraEnso based on market price.

15.4.1.3 Comment and Feedback

in the forest round of questionnaire investigation, different respondents' comment and feedback are collected as below:

(1) state owned forest farm employee

it is suggested that forest farm employees run the forest land instead of handing over the forest land to StoraEnso. When harvesting the wood, the forest farm will give priority to providing woods to StoraEnso.

forest farm is short of land resource, when handing over the land to StoraEnso, both forest and agriculture farmers will be unsecured without land; adequately solve the problems of re-employment, livelihood and economic income of forest farm employees; sufficiently maximize and utilize the techniques and human resource of the forest farm.

it is suggested that StoraEnso should sufficiently consider the market factor and project the future vision when renting existing eucalyptus forest from forest farm.

it is the government behavior to acquire the forest land, and the common

people have no power to affect it. It is hoped that the problems of re-employment, pension and medical insurance problem can be adequately solved. And a mutual benefit cooperation model should be developed.

the wood purchasing price offered by StoraEnso is quite low. It is suggested to consider the market price, carry out fair and equitable negotiation, take concrete action to safeguard the forest farm employees and contractors' legal interests.

the forest farms' management have great impact to the environment both on social and natural. At present, the forest farms have difficulty in disposing the relationship with local villages, sepecially when the message of handing over forest land to foreign company comes out, illegal logging and occupying land become worse. It will be more serious if all land is under StoraEnso's administration. Once the land being occupied, it is very difficult to retake the land.

it is suggested to acquire bare land, improve the use of land resources, which will benefit the agriculture farmer and increase their income.

it is hoped that StoraEncso can run the business better, return to the society, improve the use of the land resources and finally achieve common prosperity.

it is suggested to consider protecting environment, wild animals and endangered species and maintain the balance of the ecological system.

the company will construct pure eucalyptus plantation, which will have negative impact to the environment and water resources and quality within the planting area, therefore, it is suggested that StoraEnso should adopt mix species planting or plant some native species, protect biodiversity, abandon site burning, reserve water and soil, minimize the pollution to the environment and create sound and effective social and ecological benefit.

○,11 Reinforce forest fire prevention, forest tending, invest more on fertilizer, reach a common consensus with local government in terms of forest resources protection.

(2) comment and feedback from forest farmer within project area

it is suggested to adopt the business model of household+foest base

+company afforestation, or absorb farmer households and make them shareholders.

wood purchasing price offered by StoraEnso is lower than the market price, therefore, it is suggested to raise the wood purchasing price and land rental and adopt the principle of fair, open, just and mutual benefit.

it is suggested the company to purchase young forest, which could help to reduce conflicts and quicken the afforestation.

give priority to hire the villagers who offer land to this project

it must pay attention to environmental protection and ensure not to create negative impact to surrounding environment. Forest tending system should be established for the existing forest.

it is suggested to expand the company's reputation, and provide some workshop on technical guidance.

It is hope that the project can be established as soon as possible, which will help to improve local infrastructure and benefit local people.

(3) social individuals

Reduce the pollution to environment

Increase the investment and employment opportunity

15.4.2 The second time of public participation and investigation statistics for stated forest farm employees

15.4.2.1 public participation and questionnaire investigation

The second questionnaire investigation is aiming at the forest farm employees. 800 copies of questionnaire were delivered to the forest farms, and 662 copies were collected, respectively, 79 from Gangfen, 94 from Liangfengjia, 85 from Qipi, 62 from Dongmen, 96 from Paiyangshan, 90 from Qinlian, 84 from Bobai and 74 from Liuwan.

The scope of respondents cover forest farm employees, technicians, silviculture engineers, staff of forest farms sales office, accountant, chief of financial department, assistant economic manager and police from forest farm police station and etc.

Among the respondents, there were 516 men, accounting for 77.9% of the

total, 146 women ,22.1% of the total. Regarding their education background, 34 persons, 5.1%, are primary school level; 183 persons, 27.6% are middle school level; 72 persons, 10.8%, are high school level; 87 persons, 13.1% are technical secondary school level; 176 persons, 26.6%, are junior college level; 73 persons, 11.0%, are university or above level. 126 persons, 19.0% of the total, are at the age of 18~30; 281 persons, 42.2%, at 31~40; 166 persons, 25.1%, at 41~50; 76 persons, 11.5%, at the age of 50 or above.

The even distribution of the occupation and age reflect different forest farm employees' attitude to this project.

Questionnaire statistics: see table table15.4-4

Table15.4-4 the second time of “public participation” investigation for the state owned forest farms employee

investigation record				
Do you know StoraEnso (Guangxi) 160,000ha of raw material forest base project?	yes (426)	hear of it (214)	do not know (18)	
您所在的林场是否属于原料林基地范围 ? Is the forest farm which you serve belong involved in scope of the forest base ?	是 yes (624)	否 no (9)	不清楚 not clear about it (23)	
Do you like your forest farm to join the forest base project?	yes (597)	no (35)	indifferent (30)	
What is the main species in you forest farm?	Eucalyptus (557)	pine (179)	acacia (29)	others (19)
What is the eucalyptus proportion in you forest farm?	10% and below (19)	10%~20% (127)	20%~30% (129)	30% and above (353)
What is the growth volume of the Eucalyptus in your forest farm____m ³ /mu.y?	1.5 and below 以下 (88)	1.5~2.0 (344)	2.0~2.5 (81)	2.5 and above 以上 (115)
What is the abundance degree of underwood vegetation in your Eucalyptus. forest in your forest farm?	有茂盛的灌木丛 lots of shrub (305)	有少量灌木 a few shrub (333)	光秃秃的 bare (6)	
Do you use fertilizer for the Eucalyptus in your forest farm?	Yes (473)	no (126)	do not know (28)	

Do you use herbicide?	是 yes (270)	否 no (269)	do not know (29)	
What kind of the site cleaning is adopted in you forest farm?	manual cleaning (134)	site burning (514)	mechanical cleaning (9)	
What is the Eucalyptus rotation in you forest farm?	4-7 year 年			
have you ever seen wild animal in your forest farm ?	yes (559)	no (90)		
Do you think that SE's silviculture measures can increase the Eucalyptus's growth?	yes (304)	no (51)	not clear about it (286)	
What environmental impact will be if you plant Eucalyptus instead of other tree species?	<p>Most of respondents replied that there is no environmental impact or just very small impact, 1 worker believed: the land would be useless once it was planted with eucalyptus.</p> <p>11 persons believed it has impact to surface water resource.</p> <p>11 believed it will cause drought.</p> <p>15 persons believed it will degrade the biodiversity.</p> <p>11 persons believed is will deagrade soil fertility.</p>			
Do you support this project?	yes (611)	no (20)	indifferent (31)	

15.4.2.2 Statistical Result Analysis

In the second time of questionnaire investigation for forest farm employees, 97% of the respondent replied they are clear about this project or hear of it, 94% respondents work in the forest farms, which are included in the forest base scope. 90% of the respondents replied they would like to join this forest base, 5% of them replied they are not willing to join the forest base, and the rest of 5% forest farm employees are indifferent to this project.

84% of respondents replied they planted eucalyptus in their forest farms, 27% of the trees are pine, and there are acacia and other species. 53% respondents replied that the eucalyptus plantation area is over 30% in their forest farms; 52% respondent replied that the eucalyptus growth volume is 1.5~2.0 m³/mu·year, 12% replied the growth volume is 2.0~2.5 m³/mu·year,

13% replied their growth volume is lower than 1.5 m³/mu·year, 17% replied the growth volume is higher than 2.5 m³/mu·year. The investigation shows that there are eucalyptus plantations in the forest farms and the eucalyptus grow fast.

46% of the respondents replied that there are many shrubs in the eucalyptus plantation in their forest farm, 50% replied there are a few shrub in the eucalyptus plantation. 71% replied they use pesticide and fertilizer in the plantation, 19% replied “ not use pesticide and fertilizer”; 41% respondents replied they use herbicide for eucalyptus in their forest farm, 40% replied they do not use herbicide. 78% respondents replied they adopt burning for site cleaning, 20% adopt manual cleaning. The above investigation result shows that there are shrubs in the eucalyptus plantation, and the underwood vegetation is abundance. Pesticide, fertilizer and herbicide are used in most of eucalyptus plantations, and burning is adopted for site cleaning in most of forest farms.

According to the public feedback, in the 8 forest farms, the rotation for eucalyptus is 5~6 years, a few people replied 3~6 years or 4~7 years.

84% of respondents replied they saw wild animal in their forest farm, only 14% replied they haven't seen it before. 46% respondent replied they believed StoraEnso can increase the eucalyptus growth volume by adopting its silviculture measure. 7 % replied “No”, while 43% of them replied they are not clear about it.

Regarding the question of “what is the environmental impact if the forest plant eucalyptus instead of other species”, most of the respondents did not answer this question, part of them replied it has little or none impact, only a few people (7%) believed it has impact to “water resource”, “soil”, “climate”, “biodiversity” and “water quality”. The investigation presents that most of the forest farm employees believed it has little impact to the environment if they plant eucalyptus instead of other species, while a few people also believed great scale of eucalyptus has impact to water resources, soil, biodiversity etc.

On the discussion meeting organized by Guangxi Forestry Bureau, many forest farm employees learned that Guangxi government has already

formulated a re-employment resettlement and pension safeguard measures. 92% of the respondents changed their negative attitude to support this project. While there is still 3% of the respondents replied “not support” this project. And the rest 5% of them are indifferent.

The reason of not supporting this project is still as same as that of the first round questionnaire investigation. Forest farm employees worry that the project will affect their income and work opportunity, and worry about their pension, or they are dissatisfied with proposed cooperation model and want to retain their ownership or management right over the forest land.

15.4.2.3 Feedback and comment

During the second time of investigation, most of the comment and suggestions are about the cooperation between forest farms and StoraEnso, and the re-employment, pension and social security. The specific suggestions as below:

(1)由林场经营 ,定量按市场价格提供原材料给斯道公司 ;the forest farms run the forest land, and then provide a fixed quacity of woods to StoraEnso based on the market price;

(2) most of forestry workers will lost job, therefore, the re-employment issue for the forest farms employees must should adequately considered.

(3) it is suggested to cooperate with the forest farms and settle the forest farms employees livelihood.

(4) land rental should be more than 100yuan/mu/year. How to settle the on duty employees (especially at the age of 40~50)? The employee's income should not be less than the existing level.

(5) adequately solve the problems of re-employment, well being and social security problem;

(6) give priority to hiring forest farm employees

(7) It is suggested to compensate the contractor accordingly. Forest farms run the forest base, and then provide woods to StoraEnso based on market price. StoraEnso should be responsible for the employees well being and properly solve the re-employment of the forest farm employees.

Through the 2 times of questionnaire investigation and the discussion meeting with forest farm employees, the EIA institute believes that Guangxi Forestry Bureau and Gaofeng Group should reinforce the re-employment resettlement and pension and social security.

16 Conclusion and Suggestions

16.1 General Suggestions

This is the Raw Material Forest Base Project for 900000T/a of Pulp, 900000T/a of Paper and Paper Board Project of Stora Enso (Guangxi) Forest, Pulp Paper Company Ltd.

The construction scope of raw material forest base covers 160,000 hm² land distributed in the eight state-owned forest farms of Gaofeng Group and the 15 counties (cities and districts) in the southwest Guangxi under the jurisdiction of 4 cities, respectively Beihai, Fangchenggang, Yulin and Chongzuo. According to the statistics of the available sub-compartments, the total area of the selected sub-compartments of the project is 135800hm², accounting for 84.9% of the planned raw material forest base.

Eucalyptus is selected for the forest base afforestation. It is planned to afforest 123056.0hm² of new forest and to tend 36944.0hm² of existing eucalyptus forest. The designed rotation is 6~7 years and the designed output is 3,118,400m³, which can feed the demand of the pulp mill.

The project construction conforms to the demands *Special Planning for Whole Country Forest Paper Integrative Project during "Ten Five-Year Plan" and 2010*. The construction area and the selection of tree species conform to Engineering Planning for Construction of Fast-growth and High-Yield Wood Forest Base in Some Key Places. At present, the production of timbers can satisfy the demands of timbers for pulp mill and the integrated forest-pulp-paper project.

The selected sites of the Project conforms to the *Development Planning for Quick-growth and High-Yield Forest in the "Eleventh Five-Year Plan" and for 2020*. and the ranges specified in Some Suggestions of the People's Government of Guangxi Zhuang Autonomous Region on Expediting the Construction of Coastal Forest, Pulp and Paper Raw Material Forest Base. There will be no problem of competing for land with other paper and pulp projects, construction of this forest base conforms to the requirements of. *Planning Outline for Ecological Construction in Guangxi*.

According to the statistics of the available sub-compartments list, the forest land which may affect the ecological sensitive area were taken out of the forest base. There is no possibility to destroy regional natural forest or second generation natural forest in the selected forest base area. The project construction will not have negative impact to regional biodiversity.

129,000 hm² of new eucalyptus plantation area will be increased by the project construction, which may cause species simplification to the project area.

。It is possible to avoid degrading the biodiversity, soil fertility or causing soil erosion in the forest base area when adopting scientific silviculture measures.

It is required to design monitoring spots to monitor water and soil erosion, soil fertility, disease and pest and biodiversity in the forest base. Sustainable development plan is formulated to reinforce the environmental monitoring and controlling.

The public participation and investigation shows that most of the forest farm employees support this project and are willing to join the business model of forest base after having the discussion meeting, however, the problem of re-employment and livelihood of the forest farms employees should be properly solved. Around 80% of the forest farmers are willing to join the company+farmer household business model. Meanwhile, part of the public concern the environmental impact (to biodiversity, water and soil erosion and etc.) by the great scale of the eucalyptus.

In general, the selected forest base land excludes the ecological sensitive area at the designing stage. Forest resources are rich in the project area, while the project construction still has certain impact to the existing standing forest. It is planned to adopt intensive silviculture measures which will bring more disturbance to the forest land, which will affect the integrity and stability to the ecological system, especially to the integrity of the plant community. If StoraEnso operates in accordance with the silviculture code and carries out the environmental protection measures, the environmental impact is still acceptable.

16.2 Evaluation on Existing Environmental Situation

1、utilization of land

This project covers 15 counties and 8 forest farms under administration of Gaofeng Group which touches upon 10 counties. The total area is 55024.89hm². The existing main land use type are forestry and agriculture land which takes up 88% of the total project area.

2、soil erosion and land degradation

The type of soil erosion in the project area belongs to light erosion, followed by moderate erosion, high erosion, serious erosion and especially severe erosion,

respectively accounting for 2.87%, 1.80%, 0.44%, 0.34%, 0.36% of the total project area (27,451.711 km²). Most of the lands within the project area are without soil erosion, while among those with soil erosion, the total area with light erosion has accounted for nearly a half. The places with especially severe erosion are mainly distributed in the southern coastal areas of Beihai City that are vulnerable to typhoon and where the soil erosion is caused by the combined force of wind and water erosion. The places with especially serious erosion are mainly distributed in Xingye county of Yulin city.

At present, stone desertified land in Guangxi are distributed in the karst regions of northwest Guangxi, such as Hechi, Baise, Nanning, Liuzhou and Guilin. The sand desertified lands of Guangxi are mainly distributed in the southern coastal area, i.e. southern areas east from Shankou and Gongguan of Hepu county of Beihai city, west to Dongxing town of Dongxing city. The reasons for sand desertification and development are mainly caused by two reasons, natural and artificial

3、terrestrial ecology

The forestry use land in Guangxi is 13,662,200 hm² which is accounting for 57.7% of the total area of Guangxi. Plants and animals resources are rich. The project area mainly covers with hilly land in southeast of Guangxi, mountainous monsoon forest, rocky monsoon forest in southwest of Guangxi and evergreen forest and deciduous broad-leaved forest in middle of Guangxi. The origin vegetation has been succeeded by tropical monsoon forest and monsoonized evergreen broad-leaved forest or artificial forest, only small patches of ravine forest is still reserved in the ravine microenvironment.

The sensitive ecological areas cover natural reserves and key erosion controlling area. The natural reserves mainly cover wildlife protection area, forest ecological system protection area, geological vestige protection area and oceanic ecological system protection area. The key protected species are whitehead leaf monkey and golden camellia.

3、ecological landscaping

Forestry landscaping is the main landscaping type, to which the agriculture landscaping is the second within the assessment scope. The total patch of forest, shrub and bush is the model land in the assessment area. Forest will still be the high metastability element that has the strongest controlling capacity against the eco-environmental quality.

4、 forest land resources

In terms of type of use, among the total forestland of 1,479,300 hm², standing forest takes up 1,159,800 hm², accounting for 78.4%. according to the land use classification, commercial forest takes up 953,800 hm², accounting for 64.5%. in the project area, the total commercial forestland of below 500m elevation and 30 gradient and above-average site quality that are suitable for growing fast-growth and high-yield eucalyptus 664960.5.4hm² (excluding 500,338.4 hm² of economic forest, bamboo, shrub in rocky mountain, young standing forest, natural generation forest, nursery and any other forestation suitable land).

16.3 Evaluation on Environmental Impact

16.3.1 Biodiversity

1、 biodiversity

This Project adopts eucalyptus which has been introduced and planted for many years. The eucalyptus plantation is concentrated in artificial forestland. Thus, eucalyptus plantation will not damage primary forest and natural secondary forest. Therefore, the project construction will not have any adverse impacts on regional biodiversity.

The project construction will increase eucalyptus forest of 129200 hm². After the project implementation, the plantation proportion of conifer will drop from 33.5% to 23.5% whilst that of eucalyptus will increase from 10.1% to 18.9%. However, the uniformity coefficient of species distribution in the south of Guangxi will be affected by the additional 2.4 million mu of artificial eucalyptus forest, showing single species distribution.

2、 The relationship between forest base and public benefit forest and natural reserves

The site for raw material forest base is in commercial forest plantation area, except Beihai has some raw material forest outside commercial forest plantation area, which include soil and water conservation forest, wind protection and sand bind forests in Tieshangang District of Beihai City, water source conservation forest, water and soil conservation forest, wind protection and sand-bind forest, farmland and grassland protection forest, special-purpose forest in Yinhai District, and various kinds of protection forests, special-purpose forest, firewood and economic forest in Hepu county, totally 1641.7ha. The above-mentioned forestland shall be deleted from raw material forest base as required by environmental assessment.

3、 The changing tendency of tree species

Introduction of Eucalyptus in Guangxi can be traced back to early 1970s. At present, the plantation of artificial eucalyptus amounts to proximately 750,000 hm², which is mainly distributed in Nanning region, and in south and southwest of Nanning. In addition, Liuzhou city, Hechi City and Baise City are the new plantation area of eucalyptus, which extended northward to Guilin region. The raw material forest base is the major plantation of artificial eucalyptus forest in Guangxi. The selected tree species are the most popular species in Guangxi these years.

After the implementation of this Project, eucalyptus forest will reach 278100 hm², accounting for 29.2% of commercial forest, an increase of 13.59%. Of the commercial forest, coniferous forest (masson pine, pinus yunnanensis franch and exotic pine) will reduce from present 44.52% to around 29.1%.

The existing commercial forestland adopts extensive management owing to its long growing period. In spite of lack of tending measures, the commercial forestland still perform ecological function due to few human disturbance. However, after the implementation of this Project, afforestation management will be greatly strengthened. ecological function of the forest will be weakened. Therefore, the implementation of this Project will weaken the ecological function of the selected site. In commercial forest, this Project adopts high-investment and high-yield operation that conforms to the requirements of categories of forestry business by the State.

There is possibility that large scale of pure forest because of the intensive plantation management model and and the increasing social eucalyptus forest land which is not under the control of the company. The EIA institute suggests that it should plant indigenous tree species and confierours and broad-leaf forest in the selected site within the state-owned forestry farm to realize the mixed forest. it is first to plant indigenous tree species in the selected site within the state-owned forestry farm.

4、 underwood vegetation

Under similar stand structure, environmental condition and disturbance, the species quantity and biodiversity of underwood vegetation under different tree species are very close. The analysis on similarity of communities also shows that the co-existing species of underwood vegetations account for 40-50%. This means that biodiversity of underwood vegetation under artificial forest depends on stand structure, environmental condition and

human disturbance and has nothing to do with tree species.

According to comparison of biological diversities of the underwood vegetation in Qinzhou and Leizhou, it can be seen that the biodiversity of underwood vegetation under eucalyptus forest has something to do with land preparation, soil type of forestland and forest stand canopy (forest age). The bio-diversity of underwood vegetation in eucalyptus plantation is comparatively low. The reasons may come both from natural elements but also human factors (incl. improper growing, taking-away litters etc.). However, such is not caused by the eucalyptus species itself; it is a common phenomenon of all artificial forests.

As for the forestland now with artificial eucalyptus, construction of the project will not change the properties of the underwood dominant vegetation. But since the operational measures will be enhanced, it will have certain impacts on the underwood vegetation richness in the fostering period for young trees. As for the forestland now with conifer or other species trees, the underwood vegetation will decrease obviously during renewing, land clearing and preparation. During afforestation, the tree species will be changed, which may also change the properties of the dominant underwood vegetation. As for the forestland now of shrub land and open land, after implementation of the project, these places will form the artificial eucalyptus eco-system, and so the richness of underwood vegetation will be decreased considerably. However, the area of this kind of land is very limited in this project, accounting for only a very small portion of the base. As for the forestland of cutting and burned blanks where the existing vegetations have been damaged, after a period of time when the artificial eucalyptus are planted, due to the strengthened management, the speed of recovery of underwood vegetation is slow. In this regard, the recovered vegetation bio-diversity will be inferior to that without planting artificial forest. In all, after implementation of this project, the bio-diversity of the underwood vegetation of the forest will be decreased. However, the existing underwood vegetation is not rich because most of the existing forests belong to artificial forest. In addition, the difference in bio-diversities of different tree species is not obvious, and thus constructing the eucalyptus raw material base will not bring about serious impacts on the underwood vegetation.

5、 impact to wild animals

The project area is not covering the local natural forest and secondary forest. Generally speaking, the afforesting management will not deteriorate the disturbance to the wild animals, nor change the habitats and the migratory corridors of wild animals. However, during the period of cutting and afforesting, strong disturbance will be made to the wild animals that live on the artificial forest. During afforestation, distribution design, combination of age groups, biological buffer zone etc. should be considered. In this regard, the harvesting plan should be reasonably arranged for the purpose of providing mitigating

corridor for the wild animals in order to avoid such problems,

White-head leaf monkey is the most sensitive animals in the project area under national first-class protection. There are also some other Class-I protection such as, leopard, clouded leopard, spotted deer, forest musk deer and Indian python. The forestland within 1km from the natural reserve and the forestland interrelated with the natural reserve have been excluded. The places suitable for the activities of white-headed leaf monkey are not within the selected places of the base, and thus will not have direct impacts on its living space. The selected sites of this project belong to the low hills where the human activities are frequent. During site selection, the project is required to avoid the natural reserves, and therefore the project construction will not have direct negative impacts on the living environment of wild animals.

16.3.2 Utilizations of Land Resources

The construction of the pulp forest base mainly use the existing eucalyptus, mason pine, *pinus elliottii*, acacia forest land and mixed forest, and will not change the land use type. The scattered small patch of open land, prepared and planned forestland, barren land suitable for afforesting and cutting blank are integrated as a whole for growing eucalyptus of the base. These changes only happen to the structure and tree species, and the natural of forestland has not been changed.

During the process of the forest base construction, site cleaning, use of chemicals, harvesting and skidding will produce certain impact to the physical structure and chemical component of the soil, which is small and can be mitigated or avoided via rational silviculture measures.

The decrease of soil fertility and productivity are not uncommon in the artificial forests of most eucalyptus, pine tree, fir and polar. Actually, only a few nutrients would be returned to soil due to full utilization of eucalyptus or the remains being taken away by the local farmers to use as firewood. This is the main reason causing the decrease of soil fertility of the eucalyptus forestland in China.

Eucalyptus nutrients circulate at higher rate and shorter time period comparing with conifer forest. The growing stock of eucalyptus timber is a bit higher than that of *pinus elliottii* and much higher than that of mason pine. When the felling residues and litters of eucalyptus are retained within the forestland, the consumption of soil nutrients by

eucalyptus is larger than that of conifer. After changing the tree species, the soil fertility of the forestland may decrease if without effective measures.

16.3.3 Soil Erosion

1、 Soil Erosion

The change of the vegetation is the factor affecting water and soil erosion in forestland during the forest management. After substituting conifer with eucalyptus, the factors of canopy density, underwood vegetation, coverage of underwood litters are subject to different management. However, due to the short rotation of artificial eucalyptus, its disturbance to the surface is obviously higher than that of conifer trees. Therefore, the soil erosion will increase obviously.

A percentage of 98% of the selected places for the base belong to little erosion and light erosion, and only 2% belongs to moderate erosion. Generally speaking, under the existing afforesting mode, the soil erosion of the existing eucalyptus forestland will decrease. However, the soil erosion of the renewed forestland from conifer forest will increase considerably, but normally such impact will not increase the original soil erosion modulus.

2、 Land Degradation

The stone desertification mainly occurs in the landforms of karst high hills and mesorelief low hills, distributed in Chongzuo Jiangzhou district and Fusui county in this project area. During site selection in Chongzuo, this project has avoided the area of stone desertification, and tried to avoid the places of karst hills that may be easily desertified.

Among the selected forestland in Beihai there is a portion of sand desertified land and the soil is leaness. Eucalyptus has relatively strong adaptability, therefore, with reasonable management, the growth of eucalyptus can also meet the requires of fast-growing and high-yield.

16.3.4 Impact to Water Environment

The water demand for the 3-4 year eucalyptus in Leizhou, Guangdong is 550mm/y which is lower than that of caribbean pine, and is half demand of the eucalyptus in Pakistan and Thailand. the total evapo-transpiration of artificial eucalyptus of Stora Enso is approximately 880-1200mm each year. The annual rainfall in Beihai, Fangchenggang, Yulin and Nanning is big, therefore, eucalyptus plantation will not have serious impacts on the local water balance. However, the rainfall in Chongzuo is less and the variation is big.

In some dry years, eucalyptus plantation may produce some negative impacts on the local water balance

Eucalyptus is a fast growing and high yielding species which has short rotation. Young eucalyptus requires great amount of water. These are the reasons that eucalyptus has great water demand. The roots of the eucalyptus is shallow under the ground, which will not lower the water level of the ground water.

In Eucalyptus plantation, the soil nutrient loss is 0.039 kg/hm^2 . The erosion is more serious in the year of plantation. The data also indicates that, the loss of soil nutrients is very limited, and thus the impact on the environment is also limited.

In the project area, Shiwand Mountain, West Damingshan, Nalin and Shanglin Longshan natural reserves are the water conservation function natural reserves. Only Shanglin Longshan natural reserve is close to the forest base, but still 500m away from it. The selected forest base evades the forest land 200m from the river bank, which will not affect the water resources in the project area.

It can be seen that, the selected forest bases of the project area are far away from most of the water source protection zones, approximately more than 2km. However in Beihai city, the selected forest bases are relatively near to the water source protection zones, involving 4 lake-reservoir type water source protection zone and 1 deep-extracting ground water source protection zone.

The site selection of this project conforms to the requirements of the *Water Pollution Prevention Law of the People's Republic of China* and the *Regulations on Pollution Prevention and Control for Drinking Water Sources Protection Zones*.

Considering these forests are adjacent to the water source protection zones, it is suggested that, during afforestation of these forest bases, it should properly adjust the plantation patterns, reduce the frequency of tending and fertilizing and properly extend the felling period. Such will help reduce the impacts on the soil erosion and shallow ground water that are caused by forest management. By now, during the forest management, Stora Enso has never applied any pesticides. It is suggested, during future forest management, to avoid using pesticides. Use of high-toxic and high-residue pesticides shall be prohibited.

16.3.5 Impact to Ecological Landscaping

After implementation of the project, the project will not change the existing landscape components within the project area. Forest will still be the element type with high metastability that has the strongest controlling capacity against the eco-environmental

quality, Due to the mono-specific plantation and large-scale continuity of trees, the degree of fragmentation of the landscape of the project area will be reduced. This has not changed the landscape element type, however, it has changed the proportional relation among the forest landscape elements, which reduce the degree of heterogeneity of the landscape thus to deteriorate the disturbance resisting capacity and recovery capacity of the landscape. In all, the construction of the project will not produce obvious impacts on the ecological landscape of the project area.

16.3.6 Use of Pesticide and Fertilizer

1、 disease and pest control and use of pesticide

Regarding the disease and pest control, it should give top priority to preventing. Disease resistant clones should be selected, and rational silviculture measures should be adopted in order to lower the probability of diseases and pest in the forest. Pesticide should be used when the preventing measures fail to control the disease and pest.

Short residual period and low toxicity chemicals could be used when selecting the pesticide and herbicide. It should develop the chemicals efficient to minimize the negative impact to environment.

2、 use of fertilizer

。 Surface runoff, filtering, water and soil erosion and irrational fertilizing in the forest land shall take away the N and P from the soil and drain into rivers and reservoirs, which shall entrophication to water quality. It will not bring about the fertilizer pollution to the surface water when less frequency of fertilizing according to the technique guideline is adopted, as well as a better silviculture measures is conducted.

16.3.7 Environmental Impact by Other Silviculture Activities

1、 road construction in forest area

Road construction makes uncovered and rough ground, which shall cause water and soil erosion. Once the road is constructed, the land use will be permanently changed. Therefore, road should be constructed in dry season and the road surface should be firmly pressed before rain season. It should to minimize excavation and filling. When it fails to minimize the excavation and filling, the earth should be adequately disposed and the covering vegetation should be restored as soon as possible.

2、harvesting and skidding

Harvesting and skidding operation shall bring soil erosion and losing soil fertility, therefore, the river deposit will be added. Large area of clear cutting and roll skidding shall destroy the den of wild animal, which will affect their activity space. Clear cutting also destroy the landscaping.

16.4 Prevention and Protection Measures

16.4.1 Measures of Mitigating Impact to Biodiversity

(1) 1641.7ha of soil and water conservation forest, water source storage forests, wind prevention and sand bind forest, farmland reclamation forest, firewood+economic forest and special use forest are excluded from the selected forest base land.

(2) at least 1km isolation belt between selected forest and natural protection area should be reserved. It is required that the selected forest base land which is 1km around the natural reserves are excluded. (Yunfei Branch of Bobai forest farm is close to the southeast part of Nalin natural reserve; Gaofeng forest farm Wanpan branch is close to southern boarder of Longshan natural reserves; Beishan branch of Panyangshang forest farm, is close to Daqingshan natural reserves)

(3) 2000hm² of forest base land which is 1km away from the white-head leaf monkey protection area is excluded.

(4) In order to prevent great scale of pure forest, the area of sub-compartment should be controlled in 100-200hm². several clones should be adopted and mixed for the afforestation. Native species should be planted in the forest land near the forest farm plantation in the project area in order to realize the mixed forest. The social forest farm will also plant eucalyptus, which will create great scale of pure forest, therefore, the local forestry departments should make a reasonable plan for commercial forest distribution and adjust harvesting quota to properly control the commercial land.

(5) Underwood vegetation, vegetation between land preparation should be protected. The natural board-leaf and shrubs in valley and ridge of the mountain should be protected too.

16.4.2 Measures of Preventing Soil Fertility Degradation

(1) Implement scientific fertilizer techniques.

(2) Reserve branches, leaves, barks and tree roots on the forest land in order to retain or improve the soil fertility

(3) Rational forest management to prevent losing water or soil fertility.

(4) Try effort to restore or retain the soil covering with the precondition of guaranteeing the seedling grow in normal way.

(5) Site burning is prohibited for site cleaning.

16.4.3 Measures of Mitigating Soil Erosion

(1) 195.7ha of forest land with 35 or more than 35 gradient are excluded forest the selected forest base land.

(2) Prohibit site burning and reserve the origin underwood vegetation so as to prevent water and soil erosion.

(3) Adopt suitable site cleaning measure in accordance with the slope degree. The origin vegetation on top as well as that on ridge and bottom of the mountain must be reserved and cannot be harvested.

(4) It should adopt expanding pit, cutting bushes and ripping for tending young forest so that it could mitigate the destroy to surface land; reserve the weeds on surface of the land in order to prevent soil erosion.

(5) Reserve the branches in the plantation and prevent collecting residuals so as to improve the capability to conserve the water.

(6) It should adopt patch harvesting and protect the underwood vegetation when harvesting. Afforestation must be carried out in the second year after harvesting.

16.4.4 Measures of Mitigating Impact to Landscaping

(1) Within the forest base area, different ages of forest should be planned according to the demand of the pulp mill.

(2) indigenous species and other tree species should be planted around the plantation.

(3) it should create corridor for wild animal within the scope of forest base, such as buffer zone along the river bank. Corridor between the ridges and valley should be created as well.

(4) It is proposed to design to reserve a small patch of forest and standing trees within the forest base.

16.4.5 Measures of Mitigating Environment Pollution

(1) Site selection for forest base shall avoid the places of water supplementation to drinking water source area. There should be provided with some protection distance on both sides of rivers (50m for trunk river, 20m for tributary). No tree species of long-rotation will be planted.

(2) Encourage soil diagnosis and receipt fertilizing. Abuse of fertilizer shall be prohibited. The methodology for applying fertilizers of the company should be strictly observed. In the places of high gradients, fertilizer application shall adopt the method of digging holes. After putting in fertilizer, the boles must be back-filled immediately. Spraying of fertilizer is prohibited..

(3) Develop new tree species of strong anti-disease capacity. Adopt multiple series of clonal varieties for plot-type plantation in an interactive mode, so as to reduce the occurrence of forest disease and insects and application of pesticides.

(4) Use of pesticides should be conducted strictly following the guidelines. Low toxicity pesticide shall be used when there is necessity using the pesticide. Use of extremely toxic and long residue period pesticide is prohibited.

(5) Recycled or paper seedling cup should be used for seedling raising. It is not allowed to used indegradative container.

(6) Fertilizer plastic bags and pesticide containers must be collected from the forest land.

(7) Information warning board regarding forest fire prevent should be wooden made and avoid to using concrete or plastic material.

16.5 Main Suggestions

In order to prevent the great scale of pure forest, it is Yin, Weilong suggested to reserve 10% of mixed indigenous species.

There is possibility that a great scale of pure forest will appear because some social forest may be close to StoraEnso forestland. It is suggested Guangxi Forestry Bureau should plant indigenous coniferous tree and broad leaf tree near the forest land from the forest farms, so that it can realizes the mixed forest, meanwhile, local forestry departments should adopt resasonable

plan on commercial forest quota to prevent the great scale of pure forest.

During the implementation of this project, it should pay attention to re-employment of the forest farms employees and their pension and social security problem. Yin, Weilong