European Investment Bank Loan

No. of project：1203

Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province

Environmental Impact Assessment Report (draft)

Foreign Capital Project Office
Liaoning Provincial Forestry Department

March, 2013 Shenyang

Preface

European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province is planning to use the European investment bank loan to carry out ecological construction project.Purpose of the project is that, in the northwest of Liaoning, building up ecological shelter forest and ecological economic forest to increase the total amount of forest resources and forest coverage, contain land desertification and the move of Horqin sandy land. Meanwhile, improve the soil and water conservation, increase water retention, enhance the ability of fixed carbon dioxide, improve the ecological environment, the economic benefits and living standard of farmers, and promote the regional economic development role.

Project locates in 124 townships of 9 counties (county-level city and district) of Fuxin city and Chaoyang city, which are Fumeng county and Zhangwu county of Fuxin city, and Beipiao county-level city, Kazhuo county, Jianping county, Chaoyang county, Lingyuan county-level city, Longcheng district, Shuangta district of Chaoyang city. Afforestation area is 23726 hm^2, of which difficult site planting area is 13450 hm^2; local poplar big-diameter timber repertory forest area is 1557 hm^2; national poplar big-diameter timber repertory forest area is 4518 hm^2;economic forest of shelter forest is 4202 hm^2. Project construction period is 5 years, from 2013 to 2017.

The project total investment is RMB 480 million, including RMB 240 million yuan from European Investment Bank Loan ($30 million euros, press 1 euro = 8.0 yuan RMB), or 50% of the total investment, and RMB 240 million from Domestic supporting, or 50%.

By Foreign Capital Project Office of Liaoning Provincial Forestry Department entrust, Investigation and Design Institute of Water Resources and Hydropower Liaoning Province took the job of making Environmental Impact Assessment Report of European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province. According to the relevant laws and regulations, guidelines and standards of regulations and re quirements, Investigation and Design

Institute of Water Resources and Hydropower Liaoning Province formulated the work plan, and organized the field survey to Fuxin city and Chaoyang city. After analysis and evaluation of status survy and data collected from the public consultation and environmental impact, Investigation and Design Institute of Water Resources and Hydropower Liaoning Province wored out the report (for examination) in March, 2013, according to the European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province Feasibility Study Report.

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2. Notification on European Investment Bank Forestry Special Framework Loans Alternative Project Plan Issued by National Development and Reform Commission

3. Environmental Impact Assessment Approval Form of European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province

4. Public Consultation Questionnaire of Attorney of European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province

ATTACHMENT Ⅲ:

1. Environmental evaluation standard for instructions of European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province

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1. Reply Environmental assessment standard of European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province

1 Pandect

1.1 Necessity of Project Construction

1.1.1 Background

Liaoning province is located in the northeast of China, between the east longitude 118 ° 53 '- 125 ° 46', north latitude and 38° 43 '- 43 ° 26'; Total administrative area is 148000 km^2, forestry land area is 7.136 million hm^2, the forest coverage rate is 38.2%. In the forestry land area, woodland area is 5.6361 million hm^2, forest area is 4.6442 million hm^2, and non forest land area is 622,100 hm^2. The stocking volume is 244 million m^3.

The forest resources characteristic is as following, quantity is not good enough, the quality is not high, uneven distribution, and forest age structure is not reasonable. forest resources amount of Liaoning province is less in the nation, even not meets the world's average level, and the economic development of Liaoning province is discordant. Now the forest area and volume in the national is 16^{th}, per capita forest area is 0.11 hm^2, accounted for 83.3% of the national averageand; the per capita forest volume is 6.46 m^3, accounted for 67.9% of the national averageand. Forest quality is not good enough, most of the forest is single stand, volume per area is low, forest resources distribution is uneven, and forest age structure is not reasonable.

At present ecological security of Liaoning is a hidden danger, the drought, storm, flood and other natural disasters are still threat to people's living environment and agricultural production activities. The protection of biological diversity is serious, now the desertification and desertification area of Liaoning is 2.595 million hm^2, distribution is in 9 cities and 18 counties (city, area), 203 township (town), soil erosion of the soil loss is 131 million t/a, the average soil erosion modulus is 2834 $t/km^2 \cdot a$, surface soil erosion is 2 mm, soil organic matter is declining. Flow sand and half fixed sand in the west of Liaoning stripped thousands of hectares of farmland, some plots need to sow 2 -3 timesin one year. Drought, wind are also frequent, severely affected on agricultural production. Some endangered and precious plants are endangered, living space of the protection of

wild animals is narrow, quantity is reducing, some ecological system has been in different degree of damage, the wetland area is shrinking.

"Forestry development in Liaoning province '12th five-years' plan" explicitly pointed out that, in the northwest of liaoning region construction is focused on, for the purpose of improving ecological environment, increase the intensity of the afforestation, focus on implementation of hill afforestation and widening border protection forest system in the northwest of Liaoning, and increase of forest vegetation coverage.

In order to realize "Forestry ecological construction development planning outline in Liaoning province" and "Forestry development in Liaoning province 'twelfth five-years' plan", vigorously carry out comprehensive control of soil erosion, desertification, desertification land management project, efforts to increase vegetation, expand the green area, improve forest vegetation coverage, improve the quality of forest stand. Insisted planting combined with engineering measures, combination of shelter forest and economic forest construction, vigorously build shelter forest in reclamation area, meanwhile, positively developing characteristic ecological economic forest base, such as *Z. jujuba*, *A. apricot*, *M. pumila*(Hanfu), etc. to improve the management benefit of forest farmer, increase the operating income of forest farmer, to improve farmers' living standards, promote regional economic development.

1.1.2 The necessity of project construction

Because of the short of national investment on ecological construction, they decided to declare a long term, low interest rate European investment bank loans. Using the European investment bank loan to carry out ecological environment construction, large-scale construction of soil and water conservation forest, shelter forests against wind and for fixing sand to improve the ecological environment, and protect the natural ecological balance; Building large-scale construction of ecological economic forest, which is beneficial to poverty mountainous area people, and accelerate economic development.

Implementation of the project could set up a positive demonstration significance for improving the ecological environment in northwest Liaoning, effectively preventing

horqin sandy land moving. Meanwhile, it is good to increase farmers' income, and improve the project project farmers' living standards. Forest farmers participated in the project will receive funds and technology support, and also will combine the implementation of the project with the collective forest property rights system reform to consolidate the achievement of reform, broaden the scope of foreign investment projects, and improve the forestry construction level.

European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province is a social and public welfare undertakings of the ecological engineering. The project construction is helpful to consolidate and develop the forest resources, protect the natural ecological balance; To encourage poverty mountainous area people's income, and accelerated economic development, and promote liaoning forestry modernization. The project has an important realistic meaning and profound historic significance, huge considerable ecological benefit and social benefit, and remarkable economic benefit, so the project construction is very necessary.

1.2 Assessment Task Origin

According to the law of the People's Republic of China on environmental impact assessment law "and other relevant laws, and the European investment bank the environmental and social practical manual for the relevant requirement of Environmental Impact Assessment, by the environment selection, the report is worked out by the class B project environmental impact assessment. Foreign Capital Project Office of Liaoning provincial forestry department take this project environmental impact work very seriously, entrust Investigation and Design Institute of Water Resources and Hydropower Liaoning Province for prepare European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province Environmental Impact Assessment Report. After accept the work, Investigation and Design Institute of Water Resources and Hydropower Liaoning Province formulated the work plan, and organized the field survey to Fuxin city and Chaoyang city. After analysis and evaluation of status survy and data collected from the public participation and environmental impact,

Investigation and Design Institute of Water Resources and Hydropower Liaoning Province wored out the report (for examination) in November, 2012, according to the European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province feasibility study report.

1.3 Basis of Compilation

1.3.1 Legislation

(1) Environmental Protection Law, P.R. China, 1989

(2) Forest Law, P.R.China, 1998

(3) Wild Animal Protection Law, P.R.China, 2004

(4) Water law, P.R.China, 2002

(5) Water Pollutant Prevention and Control Law, P.R. China, 2008

(6) Soil and Water Conservation Law, P.R. China, 2011

(7) Environmental Impact Assessment Law, P.R. China, 2002

(8) Nature Reserve Regulation, P.R.China, State Council order No. 167, 1994

(9) Wild Plant Protection Regulation , P.R.China, State Council order No. 204, 1996

(10) Notice of Further Strengthening the Administration of Nature Reserve, State Council order No. 111, 1998

(11) Construction Project Environmental Management Regulation, State Environmental Protection Administration, 1998

(12) Notice of Strengthening EIA Management of Projects Financed byLoan of International Financial Organizations, four ministries and commissions of State Environmental Protection Administration etc. SEPA official document [1993] No. 324

(13) Construction Project Environmental Protection Classified Management List, State Environmental Protection Administration, 2008

(14) Forest Pest and Diseases Prevention and Control Regulation , State Council order No. 46, 1989

(15) Forest Plantation Quality Management Provisional Methods, SFA, 2002

1.3.2 Requirements of the European Investment bank

(1) Environmental and Social Practice Handbook(2010.02)

1.3.3 China's technical specifications

(1) The Technical Guideline for Environmental Impact Assessment — General Principles (HJ2.1-2011)

(2) The Technical Guideline for Environmental Impact Assessment — Surface Water Environment (HJ/T2.3-1993)

(3) The Technical Guideline for Environmental Impact Assessment — Ecological Impact (HJ19-2011)

(4) The Technical Guideline for Environmental Impact Assessment — Acoustic Environment (HJ2.4-2009)

(5) The Technical Guideline for Environmental Impact Assessment — Atmospheric Environment (HJ2.2-2008)

(6) Surface Water Environment Quality Standard (GB3838-2002)

(7) Ambient Air Quality Standard (GB3095-1996)

(8) Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011)

(9) Environmental Quality Standard for Noise (GB3096-2008)

(10) Integrated Wastewater Discharge Standard of Liaoning Province (DB21 /1627 -2008)

(11) Integrated Control of Soil and Water Conservation Standard (GB/T16453.1 -16453.6 -1996)

(12) Technical Regulations for Afforestation (GB/T15776-1995)

(13) Mountain (sand) Cultivation Technology Regulations (GB/T15163-2004)

(14) Regulations for Tending of Forest (GB/T15781-1995)

(15) Development and Construction of Soil and Water Conservation Project Technical Specification(GB50433-2008)

1.3.4 Related documents

(1) About Print and Distribute Notice of Liaoning Province Construction Project Interim Measures for Administration of The Environmental Supervision(Liao PEPA [2007] No. 24)

(2) European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province Feasibility Study Report

(3) The Technical Guideline for Environmental Impact Assessment-- Afforestation Project (exposure draft)

(4) Forestry Development 11th Five-Year Plan of Liaoning Province (Liao DRC [2011] No. 1798)

(5) Notification on European Investment Bank Forestry Special Framework Loans Alternative Project Plan Issued by National Development and Reform Commission (Liao DRC [2011] No. 1798)

1.4 Evaluation Scope

Project locate in 9 counties (county-level city and district) of Fuxin city and Chaoyang city, which are Fuxin county and Zhangwu county of Fuxin city, and Beipiao county-level city, Kazhuo county, Jianping county, Chaoyang county, Lingyuan county-level city, Longcheng district, Shuangta district of Chaoyang city(table 1-1).

Table 1-1 Project Construction Area

City	County(County level city, diatrict)	Amount
Fuxin	Fumeng, Zhangwu	2
Chaoyang	Beipiao, Kazuo, Jianping, Chaoyang, Lingyuan, Longcheng, Shuangta	7

The scope of assessment is mainly in the effect of project construction on ecosystem according to the ecological integrity of planting and the surrounding area.

1)Mountainous region

Environmental impact assessment of afforestation in mountainous region take the side slope (ridge and foot) for range line, enlarged 200 m of upstream outside and 1.0 km

of downstream as bounds.

2)Plain

Environmental impact assessment of afforestation in plain take enlarged 200 -300 m of the project fields as bounds.

1.5. Estimation Scale

According to the European investment bank "the environmental and social practice handbook ", this project is B class project, and according to "the technical guideline for environmental impact assessment on the ecological environment" (HJ19-2011), and reference to the evaluation grade classification requirements of "technical guideline for environmental impact assessment on afforestation project" (draft), and combined with the regional environmental characteristics and the features of the project, determine evaluation level by ecological environment, surface water, soil and other environmental factors as follows:

In the project fields, rainfall is 439 mm to 509 mm, less than 800 mm; Topography is mainly low hills, and with some sand and plain; Plant scale is 23726 hm^2 forest, between 10000 to 50000 hm^2; the main tree species for planting are *pinus tabulaeformis, platycladus orientalis, Mongolian scotch pine*, 13450 hm^2 planting area is for main tree species, and the proportion is less than 90%; So the ecological environment, surface water, soil environmental assessment work level is level Ⅱ.

1.6 Priorities of Assessment

According to the assessment grade and features of the project, the project assessment is mainly on surface water, soil environment, social environment, groundwater and biodiversity.

1.7 Purpose of Environmental Protection

According to the project construction and operation characteristics, as well as the status of environment and environment function of the project, develop the purpose of project protection is as following:

(1) Surface water environment

The water quality of main rivers in the project area including Dalinghe river, Xiaolinghe river, Liu river, Mangniuhe river and Xi river are Grade Ⅴor Ⅴ minus exept Raoyanghe river which the water quality is Grade Ⅳ during the dry season; in normal season, the water quality of Dalinghe river is Grade Ⅲ, the water quality of Xiaolinghe river is Grade Ⅳ, the water quality of Raoyanghe river is Grade Ⅴ, the water quality of Liuhe river, Mangniuhe river, Xihe river are Grade Ⅴ minus; in wet season, the water quality of Mangniuhe river is Grade Ⅲ, the water quality of Xiaolinghe river is Grade Ⅳ, the water quality of Raoyanghe river is Grade Ⅴ, the water quality of Liu and Xihe river is Grade Ⅴ minus. Control production waste water discharged directly, kinds and quantity of pesticide application during operation period to reduce the pollution of surface water and avoid water quality deterioration.

(2)Soil environment

The project area is low hills and a small amount of sand and plain, control building forest road construction by over dig, and reduce soil structure damage and soil and water loss during construction period; During the operation, control pesticide dosage, use organic fertilizer, green manure, and prevent harmful substance getting into the soil to decline of land productivity.

(3)Groundwater environment

According to groundwater conditions and characteristics of roots development in the project and local conditions, determine afforestation tree species to reduce the effect of construction on groundwater environment.

(4)Biodiversity

Avoid large pure forest, which lead to the forest biodiversity decrease and genetic narrow, so as to reduce the occurrence of pest and disease risk.

1.8 Evaluation Criterion

The project is to primarily build ecological forest, does not involve any major project construction activities and natural conservation area, also won't destroy natural forest or high biodiversity of shrub/grass, so according to the European investment bank

Environmental Impact Assessment classification principle, the Environmental Impact Assessment classified as class B.

According to the project in the area of environmental function zoning, evaluation take the following standards (attached lists):

1.8.1 Environmental quality standards

1)Water environmental qualitystandard

The surface water quality fit "the surface water environment quality standard"(GB3838-2002) class Ⅲ water quality standard, local river section fit the class Ⅱ standard.

2)Ambient air quality standard

Evaluation of air quality in the region of the implementation fit "the environmental air quality standard"(GB3095-1996) class Ⅱ standard and combined with "the ambient air quality standard (GB3095-1996) modified single notice ".

3)Environmental quality standard for noise

According to "the standards for acoustic environmental quality "(GB3096-2008), the project area executive class Ⅱ standard.

1.8.2 Discharge of pollutants standard

During project operation period, there will be no pollutant discharge, all kinds of pollutants is proposed the following standard:

1 Wastewater discharge during the implementation will fit "the integrated wastewater discharge standard of Liaoning Province"(DB21/1627-2008), and it is forbidden to discharge waste water into class Ⅱ water.

2 The discharge of atmospheric pollutants during the implementation will fit class Ⅱ emission standard of "the comprehensive atmospheric pollutants emission standard" (GB16297-1996).

3 Noise control in the process of Construction will fit "Construction site environmental noise emission standards"(GB12523-2011).

c) Safety application of pesticides standard

In the process of cultivation, application of pesticides should fit “the standard for safety application of pesticides” (GB4285-89).

2 Project Description

2.1 Project Properties

Northwest in Liaoning province is the most vulnerable ecological region, soil and water loss and soil erosion is above the severe standards, thousands ha of farmland is stripped by the wind and sand every year, drought and wind damage is also frequent, and these are very harmful to agricultural production. Some endangered and precious plants are endangered, living space of the protection of wild animals is narrow, quantity is reducing, some ecological system has been in different degree of damage, the wetland area is shrinking. Only increasing ecological construction investment could consolidate the achievements in construction, improve the ecological environment, and maintain the safety of ecology.

The governments at all levels pay more attention on ecological environment construction, especially in the northwest of Liaoning. Due to the shortage of domestic forestry construction investment, it is necessary to use the European Investment Bank Loan to build ecological shelter forest.

European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province is an ecological project with social and public welfare undertakings. Project construction could reduce water loss and soil erosion, windbreak and sand-fixation, the land desertification, and improve the level of sustainable forest management, increase the income of forest management, promote regional economic development, provid demonstration and model on ecological forestry construction for northwest of Liaoning and even the whole province. In short, the project construction has important practical significance and far-reaching historical significance, its huge ecological benefit and social benefit, economic benefit is remarkable, project construction is necessary and is feasible.

Project belongs to the new social public welfare ecological class project.

2.2 Project Location

The project is located in the northwest of Liaoning, between the east longitude 118 ° 50 '- 122 ° 55', north latitude and 40° 40 '- 42 ° 55', which is ecological fragile region of Liaoning, and south rim of Horqin sandy land. The average soil erosion modulus is 2834t/km^2.a, and percentage of forest cover is 34.53%.

The principle of site selection: require plenty suitable land for forest, try to choose in poor ecological conditions region; The units or individuals should be voluntary to participate in the project, and has certain technical strength and management experience, prepare and implement the project in accordance with the European Investment Bank Loan conditions.

Table 2-1 distribution of project construction

City(county, district)	Township(forest farm)	Amount
total		124
Chaoyang city		110
Chaoyang	Boluochi, Dongdadao, Mutouchengzi, Nanshuangmiao, Xiyingzi, Qidaoling, Beisijiazi, Ershijiazi, Dongdatun, Changzai, Yangshan, Gende, Wafangzi, Heiniu, Shangzhi, Liujiazi, Xiwujiazi, Beigoumen, Yangshuwan, Wangyingzi, Taizixiang, Jiajiadian	21
Beipiao	Batuying, Baoguolao, Beisijia, Beitazi, Changheying, Daban, Dasanjia, Dongguan, Haernao, Liangshuihe, Loujiadian, Mayouying, Mengguying, Nanbajia, Sanbaoying, Shangyuan, Taijiying, Taijizhen, Wujianfang, Xiguan, Xiafu, Xiaotazi, Xingshunde, Zhangjiying Changgao, Daqingshan forest farm, Heichengzi forest farm, Tashan forest farm	28
Jianchang	Haladaokou, Qingsongling, Luofugou, Machang, Machang forest farm, Shahai, Baishan forest farm, Zhuluke, Laoguandi, Heishui forest farm, Shaoguoyingzi, Qingsongling, Yangshuling, Baishan	14
Lingyuan	Wulanbai, Siguanyingzi, Sihedang, Sanjiazi, Goumenzi, Songlingzi, Niuyingzi, Beilu, Wafangdian, Sanshijiazi, Songzhangzi, Dawangzhangzi	12
Kazuo	Baitazi, Dachengzi, Dayingzi, Dongshao, Ganzhao, Gongyingzi, Kunduyingzi, Laoyemiao, Liuguanyingzi, Nanshao, Pingfangzi, Shanzhuizi, Shuiquan, Wohugou, Xinglongzhuang, Yangjiaogou, Longzhangzi, Zhongsanjia forest farm, Shierdebao forest farm, Taohuachi forest farm, Wohugou forest farm, Xiaochengzi forest farm, Nangongyingzi, Zhongsanjia, Shierdebao, Chaochang	26
Longcheng	Zhaoduba, Bianzhangzi, Dapingfang, Lianhe, Qidaoquanzi, Xidayingzi	6
Shuangta	Taohuatu, Sunjiawan, Changbao	3
Fuxin city		14
Fumeng	Daba forest farm, Daban forest farm, Jianshe forest farm, Jiumiao forest farm, Mangniuhe forest farm, Taben forest farm, Wangfu forest farm, Zhoujiadian forest farm	8
Zhangwu	Shengli forest farm, Sihecheng forest farm, Fengjia, Dasijiazi, Haertao, Weizigou	6

Project locate in 124 villages and towns (forest farms) of 9 counties (county-level city and district) of Fuxin city and Chaoyang city, which are Fuxin county and Zhangwu county of Fuxin city, and Beipiao county-level city, Kazhuo county, Jianping county, Chaoyang county, Lingyuan county-level city, Longcheng district, Shuangta district of Chaoyang city(table 2-1)

The geographical position of project is in figure 1; Planting area in villages and towns see table 2-1.

2.3 Project Construction Content

Afforestation area is 23726 hm^2, in which difficult site planting area is 13450 hm^2; local poplar big-diameter timber repertory forest area is 1556 hm^2; national poplar big-diameter timber repertory forest area is 4518 hm^2; economic forest is 4202 hm^2(including 600 hm^2 of Chinese date, pear and apple; 3080 hm^2 of Prunus armeniaca and wild apricot; 522 hm^2 of Xanthoceras sorbifolia).

Details see attached table 2-2 and figure 2。

Table 2-2 Model of afforestation project plan

Unit (County)	Afforestation							Amount of township
	Total	Soil and water conservation forest on difficult site	Local poplar big-diameter timber repertory forest	National poplar big-diameter timber repertory forest	Pear and Chinese date economic forest	Armeniac a economic forest	Xanthoceras sorbifolia economic forest	
Total	23726	13450.0	1556.0	4518.0	600.0	3080.0	522.0	124
Chaoyang	2401.0	1115.0	400.0	700.0		56.0	130.0	8
Beipiao	2664.0			2400.0		264.0		6
Jianping	2995.0	2426.0	335.0		136	98		28
Lingyuan	3753.0	667.0	334.0	1418.0		1000.0	334.0	14
Kazuo	2597.0	2159.0	158.0			280.0		26
Longcheng	2962.0	2255.0	109.0		40.0	500.0	58.0	12
Shuangta	3079.0	2709.0	160.0			210.0		21
Fumeng	1814.0	800.0	40.0		424.0	550.0		6
Zhangwu	1461.0	1319.0	20.0			122.0		3

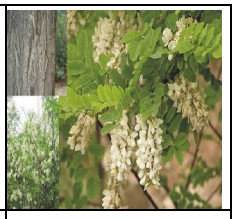
2.4 Technical Design

2.4.1 Tree species selection

For newprotection forests construction in project region, tree species should have

good functions of soil and water retention, wind break and sand-fixing, and farmland protection; Meanwhile, the species will produce the most economic benefit. The species are mainly indigenous species, with strong adaptability, barren resistant, drought resistant, stable growth, deep and developed roots, strong ability of fixing soil, strong ability of self-renewal, rich in litters and easy to be decomposed.

Major species of forestation are: *Pinus tabulaeformis*, *Platycladus orientalis*, *Pinus sylvestris*, *Populus cathayana*, *Ziziphus jujuba*, *Pyrus spp.*, *Malus pumila*, *Prunus armeniaca* L. var., *Xanthoceras sorbifolia*, etc. Species for soil and water conservation forest on difficult site are *Robinia pseudoacacia*, *Acer truncatum*, *Amorpha fruticosa*, *Ansu apricot*, *Caragana microphylla*, etc.

				
P. tabulaeformis	*P. orientalis*	*P. sylvestris*	*P. cathayana*	*R. pseudoacacia*
				
A. truncatum	*A. fruticosa*	*A. apricot*	*C. microphylla*	*H. rhamnoides*

				
P. armeniaca	*Z. jujuba*	*X. sorbifolia*	*P. spp.*	*J. regia*

2.4.2 Afforestation model

Afforestation model is in reference to "National Forestation Project ", "Forest Resources Development And Protection Project", "Afforestation projects in liaoning

province", "difficult site afforestation project", and combined with the actual situation, the project set up 1 afforestation model of soil and water conservation forest in difficult site, 1 afforestation model of Local poplar big-diameter timber repertory forest, 1 afforestation model of National poplar big-diameter timber repertory forest, and 3 afforestation model of economic forest. Afforestation model is shown in the table 2-3。

2.4.3 Afforestation technology

1. Site slashing

Strictly forbid to mountain burnin. Bushes or grasses that hinder the afforestation activities should be removed in patch or strip forms. If Planting area slope is more than 5 °, site slashingin should be accordance with the contour line and keep native vegetation in the reserved zone; Removed bushes or grasses should be piled between such strips or planting holes for natural decomposition. Site slashing is forbidden to take out in steep slope, slope crest, cheuch and shoreside.

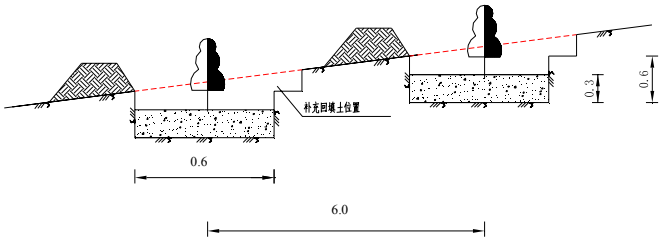
2. Site preparation

Soil preparation should backfill surface soil, and make earth embankment where water loss and soil loss happen. If slope is more than 5 °, soil preparation should use contour line and back-slope terrace methods according to the the different slope; If slope is more than 25 ° and complex terrain slope, soil preparation should use fish-scale pits and keep original vegetation as much as possible, keep vegetation isolation strip on the top, hillside and bottom of the hills during the process of land preparation. Cavernous preparation is prior in land preparation, and the standard of hole is 60cm×60cm×60cm, and standard of the hole for *X. sorbifolia* and *A. apricot* is 40cm×40cm×40cm. Site preparation is mainly carried out in autumn.

Table 2-3 Afforestation models

Project Type	Plating site	Main species and seedling type		Planting density(seedling/ hm^2)	Mixed species	Mixed ratio and mode	Land prepration and standard	Planting mode and season	Chemical fertilizer (kg/hm^2)		Tending			
											Weeding	Watering and replanting	Pruning	
		Main species	Seedling type						Urea	Compound fertilizer			Year limit	Time
Soil and water conservation forest on difficult site	L001-L012, L017	P. tabulaeformis, P. orientalis, P. sylvestris	4 years P. tabulaeformis, 4 years P. orientalis, ≥3 years P. sylvestris	833	R. pseudoacacia, A. truncatum, A. fruticosa, P. armeniaca L. var., C. microphylla	Mixed ratio≥ 20%, block, belt or random mixed forest	Cavernous preparation(60*60*60); along the contour line; retain native vegetation	Plant in the center of hollow place in rainy season			1-1-1	Watering when planting, drought, or the survival ratio ≤85%, Take out prevention and cure measure according to the actual situation		
Local poplar big-diameter timber repertory forest	L014-L018	P. cathayana	1 year or 2 year bare root seedling in grade Ⅰ	667			Avernous preparation(60*60*60)or overall soil preparation	Plant in the center of hollow place in spring or autumn	286(143 for the first 2 years respectively)		1-1-1		3^{rd} - 5^{th} year	1-1-1
National poplar big-diameter timber repertory forest	L014-L018	P. cathayana	1 year or 2 year bare root seedling in grade Ⅰ	667			Avernous preparation(60*60*60)or overall soil preparatio	Plant in the center of hollow place in spring or autumn	286(143 for the first 2 years respectively)		1-1-1		3^{rd} - 5^{th} year	1-1-1
Economic forest	L001, L002, L004, L005, L007, L008, L011, L012	Z. jujuba, M. pumila, P. spp.	≥ 2 years grafted seedling	500			Cavernous preparation(60*60*60); along the contour line; retain native vegetation	Plant in the center of hollow place in spring	300(150 for the first 2 years respectively)	150 (3^{rd} year)	1-1-1			
		A. apricot, P. armeniaca	≥ 2 years bare root or grafted seedling	833			Cavernous preparation(40*40*40); along the contour line; retain native vegetation	Plant in the center of hollow place in spring or autumn	300(150 for the first 2 years respectively)	150 (3^{rd} year)	1-1-1			
		X. sorbifolia	≥ 1 years bare root seedling	833			Cavernous preparation(40*40*40); along the contour line; retain native vegetation	Plant in the center of hollow place in spring	300(150 for the first 2 years respectively)	150 (3^{rd} year)	1-1-1			

PS: 1-1-1means tending once in the first year, once in the second year, and one in the third year. spacing in the rows and between rows should be determined by afforestation entity.



3. Planting

Seedling should be planted in the center of hole. Poplar should be planted in spring or autumn season; *P. sylvestris* and *P. tabulaeformis* should be planted in rainny season; *Z. jujuba* should be planted in spring season; *A. apricot* should be planted in spring or autumn season; *X. sorbifolia* should be planted in spring or autumn season; When planting, the root should be stretch and seedling should be straight; strive to accomplish the seedlings lifted the same day, timely heeled in if could not accomplish. Planting need to apply right amount fertilizers and copious irrigation according to the model and afforestation site conditions.

Initial stand density of planting *P. tabulaeformis*, *P. orientalis*, *P. sylvestris* and *R. pseudoacacia* is 833 per hm^2; Initial stand density of planting Poplar is 667 per hm^2; Initial stand density of planting *P. armeniaca* L. var., *A. apricot*, *P. spp.* and *X. sorbifolia* is 667 per hm^2.

4. Tree species (varieties) selection and distribution

In the project layout of Soil and water conservation forest on difficult site, make full use of wildlife corridor, river conservation, retaining native tree species and natural vegetation to promote the natural plant community protection and recovery, and retention. In the collocationg of tree species, advocates the adoption of multiple species to build

block, belt mixed forest, the mixed ratio should be more than 20%; Mono-species forest areas should not be larger than 5 ha in patch; build block mixed forest with plantation and natural vegetation, and avoid large area of a single species of artificial forest.

In an environment of soil and water conservation forest at the same time, build the model of pure forest for local and national big diameter big-diameter timber repertory forest, and tree species for this kind of afforestation are mainly excellent local tree species as Zhangwu Populus simonii, Xiaomeihan Populus, Beijing Populus, etc.

In the project area, adhere to combine the tree planting with project measures and shelter forest with economic forest construction, build shelter forest in the farm land reclamation area. Meanwhile, construct *Z. jujuba*, *A. apricot* and *X. sorbifolia* to improve management efficiency of forest farmers, increase farmers income and living standard, and promote regional economic development.

5. Tending

Young forest tending mainly refers to hoeing, cutting shrubs, scarification and tiller cutting, pruning, irrigation, fertilization to promote the growth of trees, and should be timely.

Hoeing will be carried out when necessary, and advocate by the Partial weeding, especially in the sand fixed forest to eradicate weeds only around trunk and retain the vegetation outside of crown vertical projection to increase vegetation coverage and make full use of logging slash in the earth as a mulch. For the slope is greater than 5 ° of afforestation plot, keep 0.5 m to 1.0 m wide natural vegetation zone along the contour when weeding.

Scarification is to increase the permeability of soil, and to promote the growth of trees. According to the drought degree and irrigation of forest land, take measures to ensure the water for tree survival and growth if necessary. Poplar generally intercrop in the first 3 years in stead of tending, intercropping plants could increase fertility to crop and not affect the tree growth; In degraded soils, afforestation tending should be 5 times in the first 3 years, twice in the first year, twice in the second year, and once in the third year;

economic forest should betake tending and mangegement every year to keep the quantity and quality of fruit.

Advocate the use of organic manure and green manure, and reduce the use of inorganic fertilizers as far as possible. The use of chemical fertilizer strictly comply with afforestation model, fertilization should be based on soil and plant nutrition analyzation result. Only use hole or belt fertilization, hole fertilization is applied on the top of the hole and cover the soil immediately to prevent loss of nutrients, and surface fertilization is prohibited.

Use basal fertilizer in the holes, usually farmyard manure should be 10-20 kg for each hole, cottonseed and rapeseed cake should be 2.5 kg for each hole, cover with blending of fertilizer and topsoil after fill back 40 cm soil.

Use chemical fertilizers, pesticides timely with appropriate amount in the forest land, and it is forbidden to broadcast excessive fertilizer and spray pesticides on the surface. Avoid to cause soil compaction, soil deterioration, decline of soil fertility, water source polluted, environmental pollution, kill beneficial organisms and unsafe community.

No fertilizer in the afforestation on degraded soils, once base fertilizer in poplar plantation, and fertilization in the protection type economic forest every year to promote the growth of seedling, maintain the ecological environment and the quality of fruit, then start organic fertilizer after fruiting.

6. Regeneration

Regeneration should be executed to the letter of “Forest harvesting management measures”. Slope more than 15 °should take block cutting, cutting area shall not be more than 5 hm^2, and distance between cutting areas in the same year should be more than 50 m. Slope less than 15° slope of cutting area should be no more than 20 hm^2, and distance between cutting areas in the same year should be more than 100 m. The surface vegetation should be protected as far as possible when cutting, and reforest the next year after cutting. In the process of cutting, avoid long-term soil degradation or serious impact of watershed hydrological conditions for cutting technology and allowable cut.

7.Construction

The total afforestation area is 23726 hm^2, and need 19.483 million seedlings, in which 11.764 million seedlings are of *Pinus tabulaeformis*, *Platycladus orientalis* and *Pinus sylvestris* are; *R. pseudoacacia*, *A. truncatum* and *C. microphylla*; 4.255 million seedlings are of Poplar; 244,000 seedlings are of *Z. jujuba*, *M. pumila*, *P. spp.* and *P. persica*; 2.79 million seedlings are of *A. apricot* and *P. armeniaca*; 456,000 seedlings are of *X. sorbifoliaPinus tabulaeformis* and *Pinus sylvestris* use container seedling, *Z. jujuba*, *M. pumila*, *P. spp.* and *P. persica* use grafted seedling, and Poplar and *X. sorbifoliaPinus* use bare- root seedling.

Labor force is mainly composed of local farmers, they make their own arrangement on nursery stock transport and planting, and vehicle for nursery stock transport use small or agricultural motor transportation, slope less than 5° afforestation block take the tractor for land preparation, and slope greater than 5° afforestation block use artificial land preparation. Take manual operation for planting, irrigation equipment for watering, and artificial irrigation for the area without irrigation facility transported by agricultural vehicles.

2.5 Forest Conservation and Management

2.5.1 Forest conservation

1)The forest disease and pest control

The project forest disease and pest control should seriously implemente the relevant provisions of national forest diseases and insect pests control and project plan of plant diseases and insect pests management, and use forest culture, biological gene, physical and chemical prevention and control measures, prior use biological control methods such as bacteria and natural enemy to control plant diseases and insect pests. Once plant diseases and insect pests happen, the purchase of pesticides must comply with the provisions of registration by pesticide quarantine service under national ministry of agriculture, and be in accordance with the relevant provisions of the European investment bank.

2)Forest fire prevention

The project of forest fire prevention should be brong into provincial, city and county level of fire command system. Provincial forest fire system has set up more than 130 monitoring lens, and some watchtower, and will notify the provincial forest fire prevention office timely once on fire by the satellite monitoring point, report to national forest fire prevention center in 2 hours, and do the fire suppression in time.

The mainly job is prevention, and to do the propaganda to prevent fire. The project counties hould strengthen fire monitoring, afforestation entity should set up fire prevention organization, provide fire protection equipment, formulate rules and regulations, and implement system of job responsibility. Building buffer zone for fire prevention and planting fire-resistance species along forest spot line to stop the fire spreading in the project area.

Establish firebreak with fire-resistance species and divide the block into smaller patches. Buffer zone for fire prevention should be 15 m - 25 m generally, and mainly use watercourse and indigenous tree species.

2.5.2 Management engineering

Forest management should be included in the existing forest management system; construct buffer zones for fire prevention and watchtowers, employ full-time forest ranger according to the the project afforestation layout, and sign contract with the village to clear the responsibility. Strengthen the forecast of forest fire and forest diseases and insect peststo improve the comprehensive prevention ability.

Do the hoeing, scarification and fertilization timely according to design requirements to promote crown closure early in young growth stage. Sign the management contract with grassroots units on full-time forest ranger, management task of the forest to prevent forest destroyed by human and animals and cut down disorderly.

2.5.3 Infrastructure and ancillary works

Infrastructure includes forest roads, protection house, irrigation facilities, vihicle, office equipment and ancillary works in the project area.

1)Protection house

Build or espand protection house to manage the forest, store chemical fertilizers, pesticides and peasant tools according to the distribution of afforestation plot and the existing management conditions. Each work area construct one with the area of 50m^2 - 60 m^2.

2)Hill road

Build 1.0 m to 1.5 m width trails in the forest land according to afforestation block traffic situation for the afforestation and tending. Meanwhile, repair the existing road and build hill road along buffer zone for fire prevention and forest spot line as far as possible to minimize broken ground surface and reduce water and soil loss.

2.6 Investment Budget

According to the construction scale and investment unit price, the total estimated investment is RMB 480 million, including RMB 240 million from Europe continent investment bank loans, amount to $30 million euros (in 1 euro = RMB 8.0), or 50% of the total investment, and domestic counterpart funds is RMB 240 million, or 50% of the total investment. In the domestic counterpart funds, 15% is from the province, 10% is from the county, and 25% is form afforestation entities (or labor allowance).

2.7 Project Implementation Plan

Afforestation construction period is 5 years, from 2013 to 2017. The total amount of afforestation is 25,378 hm^2, of which afforestation in 2013-2014 is 4741 hm^2; afforestation in 2014-2015 is 7114 hm^2; afforestation in 2015 - 2016 is 7111 hm^2; afforestation in 2016 - 2017 is 4735hm^2. Afforestation of project schedule is in table 2-5.

Table 2-5 Afforestation of project schedule

unit：hm^2

Year / Afforestation type	Total	2013 -2014	2014-2015	2015-2016	2016-2017
Total	**23726**	**4741**	**7114**	**7111**	**4735**
Soil and water conservation forest on difficult site	13450	2692	4036	4034	2688
Poplar big-diameter timber repertory forest	6074	1215	1822	1822	1215
Economic forest	4202	840	1261	1261	840

3 Project Analysis

3.1 Coordination between Construction and Planning

In December 2007, the European investment bank announced provided with 500 million euro loans to support China's climate change. According to the Chinese and the European investment bank, in the implementation of the relevant agreement during the above framework, loan preferential financing is on significantly reducing greenhouse gas emissions, producing clean development mechanism of the carbon credit, and with other international/bilateral financial institutions to establish financing cooperation projects. On this basis, the relevant domestic departments cooperated with the National Development and Reform Commission has carried out positive selection, determines the framework of forestry special loan from the European investment bank plan and alternative for 6 items. This project conforms to the European investment bank and China forestry framework mentioned in the loan agreement used in protective forest to control the content of the soil and water loss.

The goal of the project is to improve the degradation of forest ecological system, raise the level of management and production capacity, , establish or restoring degraded forest ecosystem by creating a variety of local tree species or other tree species to break wind and fix sand, curb desertification and contain the move to south of Horqin sandy land, the tasks and goals of project construction is consistent with 12^{th} Five-Year Plan goal, the project construction is necessary. The large-scale construction of ecological forest could increase the total amount of forest resources and the forest coverage, have the soil and water conservation, increase water retention forest, increase the amount of fixed carbon dioxide, improve the ecological environment, promote agricultural production, and improve the living standard of peasants' living in the project.

Therefore, the construction of this project is consistent with related planning.

3.2 Comparison with non- project area

The construction of European Investment Bank Loan in Ecological Afforestation

Demonstration Project in the Northwest of Liaoning Province can increase 23726 hm^2 forest land area, and the forest coverage, greening rate will increase more than 0.9%. According to the quality of forest ecosystem services calculation method in Liaoning province, forest ecosystem service function evaluation standard issued by state forestry administration and forest ecosystem services material quantity calculation method in liaoning province to estimate, after the completion the project will regulate 74.7553 million t water, and the value is RMB 612.9935 million in water conservation; promote 1.1448 million t solid soil quantity, and the value is RMB 6.9833 million; preserve fertility 75800 t, and the value is RMB 176.6898 million; pool vegetation and soil solid carbon 64000 t, and the value is RMB 76.8 million; release oxygen 14460 t, and the value is RMB 144.6 million.

Comparison Environmental Impact between the project with non- project area(table 3-1).

The project construction is based on the summaries success experience of European Investment Bank Loan afforestation project and ecological constructions from 1990 to 2011 in liaoning province, and design the advanced, scientific methods of technical scheme, so the impact on the environment can be reduced to a minimum in the project construction and operation process, and strengthen environmental supervision to avoid negative impact on environment.

3.3 Rationality of afforestation site selection

The project locate at the regions in “The sand prevention and control planning”, “Sand prevention and control planning in Liaoning province”, and “Soil and water conservation planning in liaoning province”. The locations contain a certain scale suitable land for forest, and relative concentration, block ownership, clear boundaries, non repeat afforestation project, and not in preservation areas.

Table 3-1 Comparative analysis the environmental influenceon with or without the project

ENVIRONMENTAL INFLUENCE	WITH THE PROJECT	WITHOUT THE PROJECT
Direct environmental influence	Ecological afforestation will increase forest resource, promote forest cover, contain land desertification and the move of Horqin sandy land, conserve soil and water, wind sheltering and sand fixation. At the same time, project will improve the farmer's income. However, improper afforestation and weeding will induce soil and water loss, pest and disease damage; fertilizing will also result in water pollution, and other disadvantageous environmental influence and risk.	Land desertification controlling is slow, Horqin sandy land moves southwardly; water and soil loss, and hazards of sand stoms will be still serious, speed of improving ecological environment is getting slow; the ways for overcoming poverty and achieving prosperity will reduce.
Indirect environmental influence	During the construction period, the ecological impact is not obvious, but when moving to the operation period, the ecological impact is getting significant, namely, farmers can breed or plant some vegetation medicinal materials and other non-wood products. Habitat for wildlife increase, it will be benefitial to wildlife protection.	Water and soil loss, land desertification will not get control effectively, the human environment will get worse, even induce new eco-catastrophe.
Integrated environmental influence comparation	Using scientific and reasonable afforestation techniques and management program, the project will increase forest cover and improve the forest quality, inhance and optimize the ecological environment. But if the afforestation design and construction method is not propor, it will bring about risk for ecological environment degeneration.	Land desertification will not get control effectively, soil and water loss will increase, ecological environment will get worse, and cause poverty of the farmers in the project area.
Reconmmended proposal	Recommend	Not recommend

The project avoid of natural preservation areas, experimental base, and basic farmland.

Project locate in 9 counties (county-level city and district) of Fuxin city and Chaoyang city, in these fields the forest coverage of is lower, soil is barren, and soil erosion resistanceis weak. The construction of project could improve the ecological environment, be helpful in water conservation, promote agricultural production, and improve peasants' living standard.

In conclusion, the project selecte in strong wind erosion, soil and water loss serious plots, and the transportation is very convenient; Power supply, communication, irrigation, drainage facilities are complete, and labor resources is adequate; The project does not take up the basic farmland and destroy the original facilities, and have no resettlement and reconstruction, and other environmental and social problems, therefore, the selection of project area is reasonable.

3.4 Rationality of Project construction scheme

Design 6 afforestation models in 3 afforestation types to build ecological forest, major species of forestation are *P. tabulaeformis*, *P. orientalis*, *P. sylvestris*, *P. cathayana*, *A. truncatum*, *Z. jujuba*, *C. heterophylla*, *A. apricot*, *X. sorbifolia*, in which *P. tabulaeformis*, *P. orientalis*, and *P. sylvestris* could be mixd with *R. pseudoacacia*, *A. truncatum* and *A. fruticosa*.

Cavernous preparation is prior in land preparation, according to the contour line, horizontal terrace,and fish-scale pits. Try not to destroy native vegetation, and keep vegetation isolation strip on the top, hillside and bottom of the hills during the process of land preparation.

During the afforestation, tend and manage on fertilization, intercropping, and thinning, use biological method to prevent and control plant diseases and insect pests, and build needle mixed with broad forest to reduce the threat by forest diseases and insect pests. Build fire barrier and plant fire resistant tree species along the forest spot line to prevent the forest fire spreading.

In conclusion, the construction project consider the impact on the environment during the construction period and operation period, take effective measures to reduce the environmental impact, construction scheme is reasonable.

3.5 Comparation on project implementation scheme design

The design has a certain influence on the environment, and afforestation site selection, tree species selection and afforestation model selection are the main parts.

3.5.1Afforestation site selection

Afforestation site selection： The project follows the ecological niche importance, the status of the ecological environment and forest classification management principle.

Process of afforestation site selection： Tomnship apply for project; send the maps of project field; selecte in the office; field investigation to verify; spot criticize, afforestation design. After the background investigation, all the afforestation sites are barren mountain including half fixed sand, fixed sand, desertification land, barren hills,

flood land, etc.

Block area and distribution: Project locate in 119 villages and towns (forest farms) of 9 counties (county-level city and district) of Fuxin city and Chaoyang city.

3.5.2 Species selection

In project implementation scheme, principle of species selection is matching species with the site, sustainable development and species diversity. And the social principle is to respect the local farmers. Use different operating cycle species, strong stress resistance, and easy to survive indigenous tree species. Species selection in this project are *P. tabulaeformis*, *P. orientalis*, *P. sylvestris*, *P. cathayana*, *Z. jujuba*, *A. apricot*, *C. heterophylla*, *X. sorbifolia* etc.

3.5.3 Afforestation model selection

Afforestation model selection is the design of afforestation technology measures, including afforestation site selection, species selection, site slashing, land preparation, density, planting, tending and fertilization. Afforestation site selection and species selection has discussed above, this part is mainly compare the other measures with traditional afforestation model, and the results is following(table 3-2):

3.5.4 Afforestation and water

Three kinds of water balancing used for afforestation, which are river water, storage water, and underground water.

During the afforestation, water is delivered by labor; During the operation, the river, storage water is directly extracted by pump, groundwater is got from their own wells for watering. According to the current situation, the water consumption of planting *A. apricot*, *Z. jujuba*,and *P. cathayana* is 10 kg/hole (8.5 t/hm^2) in the low soil moisture field, and 3-4 times a year.

Table 3-2 Comparative analysis of the environmental influenceon between project and traditional afforestation model

ENVIRONMENTAL INFLUENCEON	OPERATIONAL MEASURES	PROJECT AFFORESTATION MODEL	TRODITIOANL AFFORESTATION MODEL
Eco- environmental influence	Site slashing	Massive and belt cleaning will save grass belt, reduce water, soil, fertilizer loss, be benefitical to biodiversity protection.	Complete cleaning will destroy original vegetation, result in water, soil, fertilizer loss, adverse to biodiversity protection.
	Site preperation	Cavernous soil preparation will save grass belt. Be notice of the area destroyed, <20%, and use effective water conservation measures.	Complet or belt soil preparation will destroy the area 30-100%, the vegetation will be destroyed completely or partly, soil and water loss is more serious.
	Density of plantation	500-833/ha, the density of plantation reduces by 60% comparing with conventional density, canopy light is larger, shrub-grass growes better, will be benefical to forest health, improve resilience of forests.	1667-3000/ha, the density of plantation is canopy light is larger, will affect individual growth, there is almost not any shrub-grass, resilience of forest is poor, and is apt to pest and disease damage.
	Planting	The ratio of Class Ⅰ seedling is higher, nutrition bag will be teared up strictly and nutrition soil will be kept to ensure a higher survival rate when planting.	The ratio of Class Ⅰ seedling is lower, nutrition bag will not be teared up strictly and nutrition soil will not be kept to ensure a higher survival rate when planting. Seedlings grow slowly, canopy closure delays, adverse to soil and water conservation.
	Tending	Massive or belt grass cleaning, will be benefical soil and water conservation, and biodiversity protection.	Complet grass cleaning, will adverse to soil and water conservation, and biodiversity protection.
	Fertilizing	Fertilizing will be carried out on account of soil nutrition content and forest growth requirement to advance canopy closure, be benefical to soil and water conservation.	Barely fertilizing, forest grow in undesirable way.
Comprehensive assessment		Choose planting specises according to site condition, and afforest based on the specified indexes of forest models to do site cleaning, site preparation, planting, tending (grass cutting, subsoiling, fertilizing), time of thinning and cutting, and environmental protection measures. Planting density is reasonable, forest grow fast, retaining growth space for undergrowth vegetation and forming block mixed forest, meanwhile, keep the vegetation on peak, hillside, foothill and grass belt, reduce the influence on biodiversity. Reduce soil and water loss, and nagetive effect on eco-environment.	Unreasonable plangting design, complete land preparation, compact density, unreasonable fertilization, and extensive planting will result in undesirable growth. Due to the compact density, hinder undergrowth vegetation, bioadversity is lower, biomass reduce significantly, resulting in “no grass growth under pine forest canopy”. Adverse to soil and water conservation, biodiversity protection, have serious nagetive influence on eco-environment.
Reconmmended proposal		Recommended	Not recommended

3.6 Environmental Impact Factors Identification and Evaluation Factor Screening

According to the construction and operation features, identify the environmental impact factors combined with the importance and influence on the project area.

3.6.1 Environmental impact factors identification

1. Environmental impact factor during construction

Environmental impact factors during construction: Water pollution, air pollution, noise pollution during construction; Damage to vegetation and soil and water loss in the process of site slashing and land preparation.

2. Environmental impact factor during operation

Environmental impact factors during operation: Effects on biodiversity; Water pollution and plant diseases and insect pests caused by using pesticide and fertilizer; Effects on atmospheric environment by pollen and willow catkins flying in the air in breeding season.

The environmental impact identification methods use matrix method(table 3-3).

Table 3-3 Recognition Matrix Table of Environmental Impact Factors for Demonstration Project of Ecological Afforestation in Northwest of Liaoning

Project activities	Environmental Parameters															
	Physical environment						**Eco-environment**					**Social environment**				
	Hydrology	Water quality	Soil and water loss	Underground water	Solid waste	Terrain and Topography	Wildlife mmunities	Biodiversity	Soil fertility	Protected species	Diseases and inset pests	Land use	Village-level traffic	Social economy	Public health	Employment
Ⅰ Construction period																
Land preparation		-1	-2		-1	-1	-1	-1				1		1		1
Nursery expansion	-1			-1	-1		-1					1		1		1
Species selection				-1			1	1			1			1		
Site selection	1	1	2	-1			1	1	1		1	1	-1			
Ⅱ Operation period																
Increase fertilizer application		-2							2						-1	1
Increase pesticide application		-2					-1			-1	-2				-1	1
Tending/thinning/weeding			-1	-1	-1		-2	-1	-1				-1	1		1

PS:1= marginal effect; 2= Moderate impact; "—"=negative effects; "+" = positive influence.

3.6.2 Evaluation factor screening

A according to the properties, influence and environmental elements of environmental impact factors, after screening the main evaluation fators are water and soil loss, and water environment during construction; the main evaluation fators are ecological

environment, water environment, and social environment during operation.

3.7 Main Environmental Impact

Main contents of afforestation implementation: Building forest road, site slashing, land preparation, planting, watering, fertilizing, and tending.

19.509 million seedlings will be supplied to the project by the local nurseries in 4 years, the transport of seedlings could make dust raising, tail gas, noise, and increasing traffic. While, due to the wide project scope and dispersion afforestation blocks, the effects to the environment is relatively small.

Building forest road, forest land cleaning, land preparation and tending are the major environmental impact factors during construction. Mainly displays in destroyed the original surface soil stability, temporary dumps during the excavation, backfill surface loose, soil and water loss after the rain, wind. Forest road building, destroy the original vegetation, and make surface and slope bare, which will not only cause soil erosion, and increase the water turbidity.

3.7.1 Afforestation site selection impact on environment

Suitable afforestation site selection is conducive to maintaining regional biodiversity and natural and integrity ecological system; If forest land layout is unreasonable, project activities may affect wildlife habitat environment or destroy wildlife activity and migration channels.

3.7.2 Species selection impact on environment

Afforestation project with good indigenous tree species, including some introduced successful foreign species poplar. Although poplar afforestation area is larger, but in the afforestation model the design is mixed species, so the genetic gene narrow will not have impact on the forest landscape and biodiversity, but will be possible to increase plant diseases and insect pests.

3.7.3 Pesticide and fertilizer application impact on environmental

In the nursery and forest pest control, will increase the pesticide use. The application

of pesticides will kill pests, but they will also kill a lot of beneficial insects, and cause natural forest biodiversity decrease and the imbalance of species. In addition, pesticide may directly harm to wildlife. If the pesticide use undeserved, it could take influence to the nearby water quality and pollution to the soil.

3.7.4 Thinning and logging impact on environment

Cutting logging will harm or break down other residual standing or undergrowth; disturb wild animal breeding and nesting; Over cutting will also impact landscape. Yarding will destroy vegetation, and cause the loss of soil nutrients. Noise of cutting machinery and transport may affect out wild animals.

3.8 Project Operation Impact on Environment

3.8.1 Thinning and logging impact on the environment

Cutting logging will damage or break down the other remaining buck or undergrowth and interfere wildlife breeding and nesting; too much operating strength will affect the surface landscape. Logging will destroy vegetation, easily resulting in the loss of soil nutrients. Cutting machinery and transport noise will affect on wildlife.

3.8.2 Poplar big-diameter timber repertory forest impact on the environment

Crown of Poplar is tall and big which could intercept rainfall, in the drought area it would reduce the rainfall to crops, also keep out the sunlight, influence photosynthesis, so that reduce crop yields.

Poplar root system could rob moisture and nutrient from crop in low rainfall, this may affect the normal growth and yield of crops. But in the network of forest soil evaporation and crop transpiration in the farmland is less than outside of farmland, and this could improve farmland water condition.

3.8.3 Comprehensive analysis

Building soil and water conservation forest, timber stands, economic forests and other technical means on important and fragile ecological environment area in northwest of Liaoning is to increase the total forest area, increase the forest coverage rate, improve areas of poplar timber reserves, at the same time protect soil, conserve water, increase the

quantity of carbon release oxygen, improve the regional ecological environment and increase the level of sustainable forest management and income from forest management.

Soil and water conservation forest and wind break and sand fixation forest will change the local microclimate, reduce the wind speed significantly, inhibit the sandstorm, and retard desertification process; Meanwhile the forests could adjust the temperature and humidity; purify water quality; Effects on water and soil conservation is prominent, litter decomposition to humus increase soil organic matter, make the forest soil has good aggregate structure, high permeability and larger non-capillary porosity. Can make the moderate rainfall completely absorbed, won't form over seepage surface runoff. Above all, the forests play a positive role to the crops'growth and yields.

4 Natural Environment and Assess of Project Areas

4.1Natural Conditions

4.1.1 Geographical location

Project locate in 9 counties (county-level city and district) of Fuxin city and Chaoyang city, which are Fuxin county and Zhangwu county of Fuxin city, and Beipiao county-level city, Kazhuo county, Jianping county, Chaoyang county, Lingyuan county-level city, Longcheng district, Shuangta district of Chaoyang city. And distribute in the west and north of Liaoning province, between 118°50′ and 122°55′ east longitude, 40°40′ and 42°55′ northern latitude. The project area next to Chifeng and Tongliao of Inner Mongolia autonomous region on the north, south is adjacent to Huludao of Liaoning and Qinhuangdao of Hebei province, east is adjacent to Shenyang and Jinzhou, and west is adjacent to Chengde and Qinhuangdao of Hebei province. Total land area is 2.958 million hm^2.

4.1.2 Topography

Surface in chaoyang is mountainous, ravines crossbar, and only a small piece of flat land and flood plains along the river, with the structure of "70% hills, 10% river and 20% farmland". Various types of natural land as mountains, hills, vally and flat land crisscross distribution, the land use type is also diversified. The main mountain range in Chaoyang are Nuluerhushan Mountain, Fenghuangshan mountain, Songling mountain, Daqingshan mountain and Dahei mountain. Nuluerhushan mountain constitute watershed of Dalinghe river and Laohahe river, average elevation is 500 -1000 m, Songlingshan mountains range lies in the centre of the city, which is watershed of Dalinghe river and and Xiaolinghe river. The mountain area of Chaoyang is 6697.30 km^2, accounting for 34.0% of the total area; Hilly area is 10439.90 km^2, accounting for 53.0% of the total area; River valley plain area is 2560.80 km^2, accounting for 13.0% of the total area.

Fuxin region is mostly low hilly land, with high terrain in the northwest and low in the southeast, shallow hill in the centre, windy and dusty in the north. Highest altitude in Fuxin is 831.4 m on Wulanmutushan mountain in the northwest; Lowest altitude is 48.5 m at Nandianzi village of Shijiazi township in the southeast. Low mountain hills area is 543.15 km^2, accounting for 52.61% of the total area, and mainly distributed in northwest;

Plain area is 4891.99 km^2, accounting for 47.39% of the total area, and mainly distributed in the southeast; The north part, which is the south rim of horqin sand land, is 1261.2 km^2, accounting for 12.18% of the total area, and most of it locates in Zhangwu county.

4.1.3 Climate

Project area is located in the middle latitude region, north is adjacent to Inner Mongolia plateau, south is adjacent sea, and belongs to the warm temperate continental monsoon climate zone. The main climate characteristic is hot rainy season, rich sunshine, the long cold period, short spring and autumn, wet in east and dry in west and windy plain. Annual average temperature is 8.0℃ - 9.2 ℃; Annual average sunshine duration hours is 2634 h - 2983 h; Annual rainfall is 442 mm - 615 mm; Frost-free period is 120 - 155 d. The spring and autumn is windy and drought, wind force is uaually grade 2 -3, winter is prevailing northwest wind and stronger.

Project area meteorological elements are shown in table 4-1.

4-1 Meteorological elements of project counties

County(county level city, district)	sunshine duration hours (h)	Temperature(℃)			Precipitation (mm)	Frost free day(d)
		Annual value	Max	Min		
Fumeng	2634.3	9.1	37.8	-23.8	442.6	175
Zhangwu	2866.6	7.1	37.4	-30.4	510.0	150
Beipiao	2983.0	8.6	40.7	-26.6	509.0	153
Jianping	2900.0	7.6	37.0	-36.9	614.7	137
Kazuo	2807.8	8.7	40.8	-29.9	491.5	144
Lingyuan	2850.0	8.0	35.0	-37.6	550.0	150
Chaoyang	2861.7	9.2	43.3	-34.4	481.0	149
Longcheng Shuangta	2900.0	8.4	40.6	-31.1	481.0	158

4.1.4 River system

The project mainly involves Liaohe river, Dalinghe river, details are in table 4-2 and figure 3.

Dalinghe river:

Dalinghe river is the main river through the western province, upstream bifurcates into two tributaries at southeast of Dachengzi township of Kazuo county which one points south, and the other points west, the south branch originates from Shuixigou of Jianchang

county, and the west branch originates from Quanzigou of Pingquan county in Hebei province. Goes through Chaoyang, Beipiao, Yixian, and Linghai (county, county-level city), flows into Bohai sea at the point between Nanquanhe river and Nanjingzi in Linghai, drainage area is 23263 km2, river length is 397 km, in which 19998 km2 drainage area and 373 km river is in Liaoning province. Main tributaries of Dalinghe river are west branch of Dalinghe river, Mangniuhe river, the second Mangniuhe river, and Xihe river.

Table 4-2 River systemof project counties

County(county level city, district)	River basin	River name
Fumeng	Dalinghe river	Xihe,Yimatuhe
	Liaohe river	Erdaohe, Ranyanghe
Zhangwu	Liaohe river	Liuhe, Dihe, Sandaohe, Erdaohe
Chaoyang, Longcheng, Shuangta	Dalinghe river	Dalinghe, Laohushanhe, Gudonghe
	Xiaolinghe river	Xiaolinghe
Beipiao	Dalinghe river	Mangniuhe, Mengguyingzihe
Jianping	Dalinghe river	Diermangniuhe
	Liaohe river	Laohahe, Haitanghe, Benghe
Lingyuan	Luanhe river	Qinglinghe
	Dalinghehe river	Nanhe, Huangjindaihe
Kazuo	Dalinghehe river	Dalinghe, Dalinhe wetern tributary

Liuhe river:

Liuhe is with more sand on the right of the middle and lower reaches of Liaohe river. South tributary Kouhezi river is 122 km long, drainage area is 2413 km^2, which is boundary river between Fumeng, Zhangwu county and Hure Banner, and flood sediment main source in LiuHe. Northern tributary Yangxumuhe river is 105 km long, drainage area of 853 km^2, water potential increased after confluence, which is called Liuhe river. Middle tributary Tieniuhe river is 56.6 km, the basin area is 365.7 km^2.

Raoyanghe river:

Raoyanghe river is one of the important rivers of Liaohe river system, the source locates in Chahaershan mountain in Zhalanyingzi township of Fumeng county (altitude 592.1 m). flow through Xinmin, Heihan, Taian county in the southeast, and falls into Bohai sea at Shuangtaizihe in the west of Panshan county, the river basin area is 10438

km^2, and river trunk stream is 289.7 km long. The parts above Dongbaichengzi is low hilly land, with 95.9 km long and 2081 km^2 drainage area; River trunk stream below Dongbaichengzi is alluvial plain, with 193.8 km long and 8357 km^2 interval river basin area. Raoyanghe river flows through the middle part of Fuxin city, cross 340 villages of 24 townships from north to shouth, drainage area is 3534 , which has the largest drainage area in Fuxin.

Xiaolinghe river:

Xiaolinghe river is one of large rivers in the west of liaoning province, river basin is located in east longitude 120°06′- 121°21′, north latitude 40°55′- 41°21′, Xiaolinghe river is adjacent to Liuguhe river, Xingchenghe river in the south, and Dalinghe river in the north and east. River is originated in Baishan mountains of the county border between Jianchang and Chaoyang, flows through Jianchang, Chaoyang, Nanpaio, Linghai, Jinzhou city, county (district) from northwest to southeast, join into Liaodong Gulf at south of Niangnianggong township of Linghai, main river is 206 km long, and drainage area is 5153 km^2.

4.1.5 Hydrological conditions

The catchment area in Chaoyang is 19,777 km^2, annual average surface runoff is 1.322 billion m^3. Water resources of Fuxin county is 480 million m^3, including: 290 million m^3 surface water and 190 million m^3 groundwater. LiuHe annual average runoff in Zhangwu county is 54.7 million m^3; Raoyanghe river annual average runoff is 48.7 million m^3; Yangximuhe river annual runoff is 95.5 million m^3.

Ground water in project area is mainly quaternary unconsolidated accumulation pore water, occurrence in the round gravel layer, groundwater buried depth is 1.40 m - 22.30 m, watery of ground water is general, but radial flow condition is good, recharge source is mainly from atmospheric precipitation and runoff recharge; Ground water level changed with the seasons is more obvious, water level amplitude is 1.00 - 2.00 m.

Water resources quantity in the project area in various cities and counties are shown in table 4-3.

Table 4-3 Water resourse of project counties

County(county level city, district)	Water resources		
	Surface water		Total amount of groundwater resources (hundred million m^3)
	Drainage area (km^2)	The natural annual runoff (hundred million m^3)	
Fumeng	6284	3.296	1.31
Zhangwu	3753	1.310	3.83
Beipiao	4504	3.192	1.93
Jianping	5003	1882	0.90
Kazuo	2233	1.878	0.86
Lingyuan	3401	3.460	1.58
Chaoyang	4228	3.855	1.32
Longcheng, Shuangta	583	0.443	0.11

PS: natural annual runoff is uniform annual average from 1956 -2000.

4.1.6 Vegetation regionalization types

Vegetation of chaoyang is semi-arid warm temperate deciduous broad-leaved forest belt, and belongs to forest steppe vegetation which is transition zone between vegetation of north China and Inner Mongolia flora. Due to destruction of generations of natural and human factors, the original vegetation has almostly gone, except a few part of the natural secondary forest and jungle of thorns at present, most of the forests were all kinds of plantation built after liberation. Natural secondary forest are needle broad-leaved mixed forests, tree species are mainly *Quercus mongolica*, *Tilia mandshurica*, *Betula platyphylla*, *Ulmus pumila*, *Platycladus orientalis*, while most of the plantations are pinus tabulaeformis, poplar, willow and acacia; After years of management, the forest coverage rate reached 33.5%, pasture vegetation include *Lespedeza virgate*, *Cleistogenes hackeli*, *Furctus Trapae Quadricaudatae*, *Leymus chinensis*, *Eriophorum russeolum* Fries and *Astragalus adsurgen*, *Medicago sativa*. etc. Meadow coverage is 30% and forest coverage is 38.54%.

Fuxin area belongs to vegetation of north China flora, vegetation zone crisscross area between Inner Mongolia and north China changbai flora with wide variety.In project area, the mainly woody plant species are P. tabulaeformis, Quercus mongolica, P. cathayana, P. sylvestris, Larix gmelini, Ulmus pumila and Salix matsudana. The mainly

bush species are Lespedeza virgate, C. heterophylla, Thymus Vulgaris, Rhamnus parvifolia and Vitex negundo; The mainly herbaceous plant species are Bothriochloa ischaemum, Cleistogenes Keng, Zoysia japonica and Medicago sativa.

Project vegetation types see figure 4.

4.1.7 Forest resources

Project constructing community locate in 9 counties (county level city, district), forestland is 777,797 hm^2, non forest land area is 28,770 hm^2, suitable land for forest area is 180,997 hm^2, forest stock volume is 26,348,218 m^3, and the forest coverage rate is 34.53%. The project counties (county level city, area) forest land and forest resources situation is shown in the table 4-4.

Table 4-4The project counties forest land and forest resources situation

Unit: hm^2, m^3

Project area	Forest land	Non forest land	Suitable land for forest	Forest stock volume	Forest coverage rate
Total	777797	28770	180997	26348218	34.53%
Fumeng	136029	8597	33631	4776367	22.1%
Zhangwu	104044	7373	4966	4896730	28.9%
Beipiao	115405	3231	42658	2798190	41.4%
Jianping	147704	3734	29127	6108395	44.7%
Kazuo	69849	1068	11084	1892285	52.8%
Lingyuan	105025	2710	17895	3311167	57.5%
Chaoyang	81402	1505	32384	2148311	47.9%
Longcheng,	10665	352	5571	212581	29.9%
Shuagnta	7673	201	3682	204192	30.9%

4.1.8 Fauna and flora resources

Priority protected wild animals 100 species, including Grade I nationally protected wild animals 17 species and Grade II 83 species；Provincial protected wild animals 91 species；Beneficiary or main economic/research valued wild animals 292 species；Sino-Japan Migratory Bird Protection Agreement includes 227 species of which 202 species are found in Liaoning, Sino-Australia Migratory Bird Protection Agreement includes 81 species of which 54 species are found in Liaoning.

Project area is distributed in the western Liaoning mountain hilly area, northern Nyluerhushan mountain hilly tableland and western Liaohe sand area, has mainly 16

species of terrestrial mammals according to historical records, 12 species of amphibians and reptiles, 139 species of birds, but the species of wild animals have greatly reduced. Most animal formation in the project area are to village and farmland fauna, wild animal species are human companion species, such as frogs, snakes, mice, brown rat, sparrows, and magpies. Plot has no rare, endangered and national, provincial key protected wild animals.

Liaoning province has planty of plants, including nationally protected wild plants 12 species (4 species for Grade I protection,8 species for Grade II protection. Project afforestation site distribution is dispersed, and have no rare and endangered, and national, provincial key protection wild animals and plants in the project area.

4.2 Present Environment Quantity Condition

4.2.1 Surface water

Evaluation on routinewater quality monitoring data for main river water quality present situation carries out the analysis and evaluation in 2011. Monitoring the results are shown in table 4-5, monitoring cross section is shown in table 4-6.

Table 4-5 Water quality evaluation

Unit: mg/L(except pH)

Monitoring items		Water temperature (℃)	pH	Dissolved Oxygen	Chemical oxygen demand(COD)	Permanganate index	Biochemical oxygen demand(BOD)	NH_3-N
Dalinghe	Dry season	6.3	8.46	9.8	14.6	4.90	6.4	1.27
	Normal season	12.7	8.03	10.8	-	4.04	0.5	0.34
	Wet season	26.0	7.51	6.4	11.9	4.40	3.5	0.43
Xiaolinghe	Dry season	10.0	8.27	11.5	16.3	2.51	9.8	0.38
	Normal season	5.0	7.82	11.7	16.8	2.04	5.9	0.17
	Wet season	23.0	7.31	6.8	14.6	2.10	5.5	0.03
Raoyanghe	Dry season	4.7	8.14	8.9	10.9	2.02	5.5	0.09
	Normal season	17.1	7.93	7.3	17.6	5.14	7.9	0.17
	Wet season	25.5	8.23	5.3	15.2	4.76	8.8	0.22
Liuhe	Dry season	8.0	8.02	9.8	23.5	2.31	9.8	1.13
	Normal season	24.0	8.32	7.3	23.6	7.04	12.6	0.11
	Wet season	26.5	7.67	4.8	22.5	6.94	10.6	0.57
Mangniuhe	Dry season	8.0	8.45	8.2	25.3	2.67	10.8	0.29
	Normal season	10.0	7.67	11.9	20.8	2.16	10.6	-
	Wet season	23.0	7.87	8.0	13.0	2.50	4.7	0.24
Xihe	Dry season	5.9	7.95	9.1	33.8	7.45	13.9	5.94
	Normal season	16.2	7.90	5.9	34.5	8.07	16.1	5.26
	Wet season	24.5	8.05	2.0	36.0	5.23	13.4	2.86

PS: "-"means not detected.

Table 4-6 Water quality monitoring section

River	Section name
Dalinghe	Nandaqiao, Dukou, Zhangjiying
Xiaolinghe	Songlingmen
Raoyanghe	Xinglongshan
Liuhe	Changtuozi
Mangniuhe	Mangniuhe bridge
Xihe	Gaotaizi

According to "surface water environment quality standard" (GB3838-2002), using the single factor coefficient method to evaluate the monitoring results, the evaluation results are shown in table 4-7.

Table 4-7 Water quality evaluation result

Monitoring items		pH	Dissolved Oxygen	Chemical oxygen demand(COD)	Permanganate index	Biochemical oxygen demand(BOD)	NH_3-N
Dalinghe	Dry season	0.64	0.35	0.73	0.82	1.60	1.27
	Normal season	0.35	0.04	-	0.67	0.13	0.34
	Wet season	0.01	0.56	0.60	0.73	0.88	0.43
Xiaolinghe	Dry season	0.51	0.05	1.09	0.63	3.27	0.76
	Normal season	0.21	0.16	1.12	0.51	1.97	0.34
	Wet season	0.13	0.69	0.97	0.53	1.83	0.06
Raoyanghe	Dry season	0.42	0.50	0.54	0.34	1.36	0.09
	Normal season	0.29	0.49	0.88	0.86	1.98	0.17
	Wet season	0.48	0.92	0.76	0.79	2.19	0.22
Liuhe	Dry season	0.35	0.34	1.57	0.58	3.27	2.26
	Normal season	0.55	0.45	1.57	1.76	4.20	0.21
	Wet season	0.11	1.59	1.50	1.73	3.53	1.14
Mangniuhe	Dry season	0.63	0.53	1.27	0.45	2.70	0.29
	Normal season	0.11	0.10	1.04	0.36	2.65	-
	Wet season	0.25	0.16	0.65	0.42	1.18	0.24
Xihe	Dry season	0.30	0.45	1.69	1.24	3.48	5.94
	Normal season	0.27	0.81	1.72	1.35	4.02	5.26
	Wet season	0.37	1.90	1.80	0.87	3.34	2.86

Evaluation results show that the main river water quality present situation in the project did not meet the water quality requirements of water function zone, status of water quality is poorer. Project area rivers status is shown in table 4-8.

Table 4-8 Main river and surface water quality president situation

River	Season	Water quality	Major pollution factors
Dalinghe	Dry season	Class Ⅴ	Biochemical oxygen demand, NH_3-N
	Normal season	Class Ⅲ	-
	Wet season	Class Ⅲ	-
Xiaolinghe	Dry season	Class Ⅴ	COD, BOD
	Normal season	Class Ⅳ	COD, BOD
	Wet season	Class Ⅳ	BOD
Raoyanghe	Dry season	Class Ⅳ	BOD
	Normal season	Class Ⅴ	BOD
	Wet season	Class Ⅴ	BOD
Liuhe	Dry season	Class Ⅴ	COD, BOD, NH_3-N
	Normal season	Class Ⅴ-	COD, BOD, Permanganate index
	Wet season		COD, BOD, Permanganate index, NH_3-N
Mangniuhe	Dry season	Class Ⅴ-	COD, BOD
	Normal season	Class Ⅴ-	COD, BOD
	Wet season	Class Ⅲ	BOD
Xihe	Dry season	Class Ⅴ-	BOD, NH_3-N
	Normal season		BOD, NH_3-N
	Wet season		BOD, NH_3-N

4.2.2 Ground water

The groundwater influenced by chemical condition, water quality is relatively poor. Surface water as important water supplies source of groundwater and especially mining underground water, the quality will directly affect the quality of groundwater. According to the underground water quality survey in 22 counties (county-level cities) of Liaoning province, 14 counties (county-level cities) got different levels of pollution, 8 of them were severe pollution. The province had nearly 24% counties (county-level cities) got underground water polluted. The main reason is due to lots of industry and agriculture, sewage discharged into surface water from city life, especially rivers through the urban get very heavy pollution, and make the groundwater water quality on both sides of the river get worse. In over-development groundwater area, the underground water level is lower, which accelerate the surface water leakaging into underground.

Project area is located in 9 counties (county lecvel city, district), the calculation of groundwater area is 29,991 km^2 in total, including: 13586 km^2groundwater class Ⅲ

water area, accounting for 45.3%; 10,329 km^2 class Ⅳ water area, accounting for 34.4%, 6,074 km^2 class Ⅴ water area, accounting for 20.3%. The project area in various counties in groundwater status are shown in table 4-9.

Table 4-9 Groundwater situation in the project counties

Unit: km^2

County(county level city, district)	Total area	All kinds of water quality in the area		
		Ⅲ	Ⅳ	Ⅴ
Fumeng	6284	-	3837	2447
Zhangwu	3753	-	2998	755
Beipiao	4504	1632	-	2872
Jianping	5004	1509	3494	-
Kazuo	2233	2233	-	-
Lingyuan	3401	3401	-	-
Chaoyang	4229	4228	-	-
Longcheng, Shuangta	583	583	-	-

4.2.3 Soil and soil quality

Chaoyang city land area is vast, complicated soil structure and various classification, mainly include 4 soil type, which are cinnamon soil, brunisolic soil, meadow soil and aeolian sandy soil, 12 subcategories, and 60 soil genera. Cinnamon soil is the zonal soil, accounting for 73.16% of the total area of the soil; brunisolic soil, accounting for 19.73%; Meadow soil is mainly distributed in the river and flood land level terrace, accounting for 6.35%; aeolian sandy soil is mainly distributed in northwest of Jianping and Beipiao, only 1 subcategory named fixed sand soil, accounting for 0.26%.

Fuxin distribute 8 major soil types, which are cinnamon soil, brunisolic soil, meadow soil, solonchak, alkali soil, paddy soil, boggy soil and aeolian sandy soil, of which cinnamon soil, brunisolic soil, meadow soil and aeolian sandy soil are the main types. Fuxin area the general situation of soil are low organic matter content, nitrogen, phosphorus and potassium content of 50 PPM, 4ppm, and80ppm respectively. Average soil pH value is 7.5- 7.7, the sandy soil is accounted for more than 70%, soil physical and chemical properties and soil fertility is poor.

The project counties in the soil data is shown in table 4-10.

Table 4-10 Soil data in project counties

City, county	Soil profile	
	Tyoe	Profile
Fumeng county	Cinnamon soil, brunisolic soil, meadow soil and aeolian sandy soil	Suitable land for forest is distributed mainly by cinnamon soil and aeolian sandy soil.
Zhangwu county	Cinnamon soil, brunisolic soil, and aeolian sandy soil	Low mountains and hills is distributed by cinnamon soil and brunisolic soil, plain area is distributed by aeolian sandy soil.
Chaoyang city	Cinnamon soil, brunisolic soil, meadow soil and aeolian sandy soil	Meadow soil is mainly distributed in the river and flood land level terrace, aeolian sandy soil is mainly distributed in northwest of Jianping and Beipiao

4.2.4 Land utilization

Chaoyang city land total area is 1.97 million hm^2, including: agricultural land 1.34 million hm^2 (68.0%), in which forestry land area of 656,100 hm^2, cultivated land area is 456,100 hm^2, grazing land area is 116,700 hm^2; Construction and unused land is 630,200 hm^2, accounting for 32.0%; Fuxin city land area is 1.032 million hm^2, of which the agricultural land (including cultivated land, garden land, forest land, grassland, other agricultural land) is 792,000 hm^2, accounting for 76.7%. Construction land (including residential areas and mining land and transportation land, land for water facilities) is 80,000 hm^2, accounting for 7.8%. Unused land is 161,000 hm^2, accounting for 15.6%.

Project construction is in 9 counties (county level city, district) , the total land area is 2.958 million hm^2, forestland is 777,797 hm^2, non forest land area is 28,770 hm^2, suitable land for forest area is 180,997 hm^2, forest stock volume is 26,348,218 m^3, and the forest coverage rate is 34.53%.

Land use situation in the project area as shown in attached figure 6.

4.2.5 Water and soil loss

Now the soil erosion area is 9,100.4 km^2, or 46.2% of total area in Chaoyang city.In which the mild erosion is 3,048.21 km^2, or 33.5% of the area of loss; Moderate erosion is 4,031.86 km^2, or 44.3% of the area of loss; Strength erosion is 1,736.63 km^2, or 19.1% of the area of loss; pole-strength erosion is 283.73 km^2, or 3.1% of the area of loss. Displacement of the soil erosion in Chaoyang is 86.7 million t, soil erosion modulus is

3788.0 t/a·km^2, and gully density is 2.31 km/km^2.

Fuxin belongs to low soil rocky mountain hilly gully region, soil erosion is serious. Now the soil erosion area is 3,838.99 km^2, or 36.75% of total area in Fuxin city.In which the mild erosion is 2,674.09 km^2, or 69.71% of the area of loss; Moderate erosion is 903.79 km^2, or 23.56% of the area of loss; Strength erosion is 69.36 km^2, or 1.81% of the area of loss; pole-strength erosion is 13 km^2, or 0.34% of the area of loss. Soil erosion modulus is 1,846.65 t/a·km^2, and gully density is 1.7 km/km^2.

Project area of soil erosion intensity distribution is shown in figure 7.

4.3 Social Environment

4.3.1 Population

Chaoyang city census register population is 3.4096 million people. Among them, the agricultural population is 2.3842 million people, accounting for 69.9% of the total population in the city; Non-agricultural population is 1.0254 million people, accounting for 30.1%. Chaoyang city census register population is 1.9307 million people. Among them, the agricultural population is 1.0668 million people, accounting for 55.3%; Non-agricultural population is 863,900 people, accounting for 44.7%. Population data of various cities and counties in the project area are shown in table 4-11.

Table 4-11 Population data of project counties

County(county level city, district)	Total population (10 thousand)	Agricultural population (10 thousand)	Urban population (10 thousand)
Fumeng	73.20	68.40	4.80
Zhangwu	41.40	33.10	8.30
Beipiao	58.47	38.19	20.28
Jianping	58.53	45.77	12.76
Kazuo	42.50	36.00	6.50
Lingyuan	64.98	51.45	13.53
Chaoyang	58.50	54.20	4.30
Longcheng	21.10	12.29	8.81
Shuangta	39.80	9.01	30.79

4.3.2 Minority

Liaoning province is a multi-ethnic province, with a total of 44 mimorities, besides the Han, Manchu, Mongolian, Hui, Korean and Xibe; ethnic minority population is 6.55 million, or 16% of the whole province, population of Manchu, Mongolian, Hui, Korean and Xibe are over 10,000 people, population of Zhuang, Miao, Tujia, Dawuer and Li are also very big. Because the situation of each minority in the region is different, form region of large number of han and small the various minorities living in compact communities, the characteristics of minority mode of production, livelihood source and residence are similar to Han. Liaoning province has 8 minority autonomous counties, in which Fuxin Mongolian autonomous county is involved in the project. Project minority situation, sees table 4-12.

Table 4-12 Minority people of project counties

County(county level city, district)	Minority	Population	Proportion of total(%)
Fumeng	Mongolian, Manchu, Hui, Korean, Xibe, etc.	156000	21.40
Zhangwu	Mongolian, Manchu, Hui, Xibe, Zhuang, Miao, etc.	9108	2.50
Beipiao	Mongolian, Manchu, Hui, Korean, Xibe, Dawuer, etc.	36075	6.17
Jianping	Mongolian, Manchu, Hui, Korean, Xibe, Li etc.	22065	3.77
Kazuo	Mongolian, Manchu, Hui, Xibe, Zhuang, Elunchun, etc.	89335	21.02
Lingyuan	Mongolian, Manchu, Hui, Korean, Xibe, Zhang, etc.	50489	7.77
Chaoyang	Mongolian, Manchu, Hui, Korean, Miao, Weiwuer, etc.	33403	5.71
Longcheng	Mongolian, Manchu, Hui, Korean, Xibe, Li etc.	12195	5.78
Shuangta	Mongolian, Manchu, Hui, Xibe, Zhuang, Zhuang, etc	13293	3.34

4.3.3 Community health

Now Chaoyang city has 4,466 all kinds of health organizations. Including 40 hospitals, 124 institutes of health, 8 centers for disease control and prevention, 8 maternity and child care, 66 community health service institutions. All kinds of health agency has 11,609 sickbeds and 13,655 health technical personnel.

4.3.4 Traffic

The transportation in Liaoning province is convenient; Length of railways in

operation is 9,309 km; traffic mileage is 97,191 km, of which 1,849 km is highway, Length of ports is 49,037 m, quay berth is 310, cargoes loaded and unloaded is 356.66 million t, inland waterway mileage is 813 km; Civil aviation is 376,435 km. The traffic project see table 4-13。

4.3.5 Socio-economic condition

This project construction distribute in 9 counties (county level city, district), the total land area is 2.958 million hm^2, total population is 4.51 million, gross domestic product (GDP) is RMB 82.93285 billion, rural residents' per capita income is RMB 5038. Social and economic situation in the project counties as shown in the table 4-14.

Table 4-13 Social and economic situation in the project counties

City, county	Traffic situation
Fumeng county	The county highway trafic mileage is 2,916.2 km, including 110.1 km national highway, 165.5 km provincial highway, 272.8 km county road; 135 km expressway, of which Fuxin to Jinzhou section is 31 km, Tieling to Fuxin section is 104 km; Railway mileage is 122 km.
Zhangwu county	The county highway trafic mileage is 2,078.486 km, including 149.986 km national highway, 88.882 km provincial highway, 214.158 km county road, 845.419 km township road, and 780.041 km village road. County has been opened Shen-Zhang expressway, total length of 86.5 km. Da - Zheng railway in county is about 76 km long, otherwise, Zhang-Tong and Tie-Fu are under construction.
Chaoyang city	The city highway is 386 km, ordinary highway 13,660 km, there are such as Jin-Cheng line railway.

Table 4-14 Economic and social development in the project counties

County(county level city, district)	Township attend in the project	Population (10 thousand)	Land area (10 thousand hm^2)	Rural residents' per capita income(RMB)	GDP(10 thousand RMB)
Total	124	451.0	295.8	5038	8293285
Fuxin	8	72.5	62.2	5165	1330026
Zhangwu	6	41.4	36.2	4793	239035
Beipiao	28	58.5	44.7	5180	1182412
Jianping	14	54.8	48.7	4878	896332
Kazuo	26	42.4	22.4	4870	1080000
Lingyuan	12	65.0	32.8	4980	1339014
Chaoyang	28	57 .3	37.6	4925	1020000
Longcheng	6	21.0	6.2	5228	736466
Shuangta	4	38.0	5.0	5326	470000

5 Environmental Impact Prediction and Assessment

5.1 Environmental Impact Prediction

5.1.1 Water environmental impact prediction

During construction, enlarge road operation cause soil loose, as the rain goes into the river, which not only increase the water turbidity, but also take the soil organic matter and pollutants into the river.

n the nursery and forest pest control, will strengthen the pesticide use. Pesticide use don't at that time, residue will affect to the nearby water quality; Pesticide container cleaning and handled properly, it will affect the water quality. The application of chemical fertilizers, the residue of groundwater infiltration will produce certain effect.

For construction personnel are local labor, won't increase sewage emissions.

Afforestation is mainly in spring and autumn. In spring, the implementation of the project will increase water consumption, and may cause slight influence to surrounding agricultural production. In autumn, agricultural water consumption is much smaller, and may cause less influence to agricultural production.

In the growth period, the trees absorpt the soil moisture, and may reduce the underground water level. Because most of planting sites are in semi-humid region, the influence of reducing groundwater table is slight; In the semi-arid areas, the planting sites are chosen in the barren hills, wasteland, flood land etc., and far away from villages and farm land, so there are barely influence to drinking water and agricultural production.

According to quantity analysis on the main forest ecological system type precipitation and throttle regular by professor Wenyuanguang from forestry science institute, rainfall interception rate of poplar canopy was 17.85%, rainfall interception rate of larch canopy was 18.86%. In the drought area, due to the increase of forest land, the transpiration, and increase of water output is likely to cause runoff reduced. The increase of forest land could regulate runoff, which could cut the peak flow, put off peak arrival

time, increase the flow of water in dry season, delay arrival time of dry season, and reduce runoff ratio.

The research(China's forestry and ecological environment, edited by Zhou Xiaofeng) shows that, in a dry climate condition, the forest land would absorb 5 m- 6 m deep groundwater evaporation, 13-15 years forest belt could lower average 160 cm of underground water level, and affects 150 m horizontal extent. Forest belt could reduce ground water level, but also can relieve soil salinization degree on both sides of the forest. The project is in the area where the rainfall is 442 mm - 690 mm, usually rainfall between 200 mm and 450 mm or 250 mm and 500 mm is semi-arid area, only in Fuxin county is semi-arid regions and the rainfall is 442.6 mm, all the other counties are in semi-humid region and the rainfall is over 510 mm. In semi-humid region, the influence of forest to water level is weak, in semi-arid area the influence of forest to water level is calculated by rainfall than calculate, and 15 years later the underground water level may reduce 40 cm, and affects 40 m horizontal extent.

According to the quality of forest ecosystem services calculation method in Liaoning province, forest ecosystem service function evaluation standard issued by state forestry administration and forest ecosystem services material quantity calculation method in liaoning province to estimate, after the completion the project will regulate 74.7553 million t water.

5.1.2 Atmospheric environment impact prediction

According to the quality of forest ecosystem services calculation method in Liaoning province, forest ecosystem service function evaluation standard issued by state forestry administration and forest ecosystem services material quantity calculation method in liaoning province to estimate, after the completion the project will absorb CO_2 222,500 t cumulatively, and release oxygen 14460 t. Could reduce the dust weather, purify the air, play an important role on stable CO_2 density of atmospheric.

5.1.3 Soil environmental impact prediction

Building forest road, site slashing, land preparation and tending are the major

environmental impact factors during construction. Mainly displays in destroyed the original surface soil stability, temporary dumps during the excavation, backfill surface loose, soil and water loss after the rain, wind. Forest road building, destroy the original vegetation, and make surface and slope bare, which will not only cause soil erosion, and increase the water turbidity.

In the nursery and forest pest control, if the pesticide use undeserved, it could take influence to the soil. If direct broadcast the pesticide or fertilization on the surface, it will lead to a loss of fertilizer, water and soil pollution. Long-term utilization of chemical fertilizer will cause soil physical and chemical properties change, and make the soil harden and soil deterioration.

Tree growth will absorb moisture from soil. In the drought year, soil moisture can not supplement in time, and it would cause soil drying, fertility decline.

According to the quality of forest ecosystem services calculation method in Liaoning province, forest ecosystem service function evaluation standard issued by state forestry administration and forest ecosystem services material quantity calculation method in liaoning province to estimate, after the completion the project will promote 1.1448 million t solid soil quantity, preserve fertility 75800 t, pool vegetation and soil solid carbon 64000 t, andimprove the soil environment significantly.

5.1.4 Ecological environmental impact prediction

Suitable afforestation site selection is conducive to maintaining regional biodiversity and natural and integrity ecological system; If forest land layout is unreasonable, project activities may affect wildlife habitat environment or destroy wildlife activity and migration channels.

The afforestation site with vegetation coverage under 40% and the forest cover under 30%, no repeat afforestation project, and away from preservation areas.

Afforestation block concentrated in large bare hills and wasteland, along the beach of Liao river, Liu river, DaLing river and its tributaries. During construction, more frequent human activities may influence wildlife habitat, but because the artificial afforestation, no

large mechanical disturbance, this kind of influence is relatively minor.

Afforestation project with good indigenous tree species, including some introduced successful foreign species poplar. Although poplar afforestation area is larger, but in the afforestation model the design is mixed species, so the genetic gene narrow will not have impact on the forest landscape and biodiversity, but will be possible to increase plant diseases and insect pests.

In the afforestation design, build mixed forest with lots of species except poplar big-diameter timber repertory forest, and each block with no more than 35 hm^2, and one species no more than 5 hm^2 in one block to avoid the large area of a single species artificial forest.

Cutting logging will harm or break down other residual standing or undergrowth; and disturb wild animal breeding and nesting; Over cutting will also impact landscape. Yarding will destroy vegetation, and cause the loss of soil nutrients. Noise of cutting machinery and transport may affect out wild animals.

In the process of the implementation, the project will have certain negative effect on the ecological environment, but the operation will play a positive role in improvement of the local ecological environment, by calculation, after completion the project will increase 0.9% forest coverage rate, reduce 189,600 t water and soil loss, manage 23726 hm^2 of soil and water loss area, increase 74.75 million m^3 annual storage, release oxygen 14460 t, play an important role on stable CO_2 density of atmospheric and purify the air.

5.1.5 Social environment impact prediction

Building up ecological forest could increase the total amount of forest resources, and the forest coverage, contain land desertification and the move of Horqin sandy land. Meanwhile, have the soil and water conservation, improve the ecological environment, the economic benefits and living standard of farmers, and promote the regional economic development.

During the and bring certain effect, but the, at the same time to increase farmers' income. The negative impact of construction of ecological forest to surrounding

agricultural production is temporary. With completation of the project, water and soil conservation and economic benefit will be in play, and the income of famers will increase.

5.2 Comprehensive Evaluation

Ecological environment of counties involved in the project is poor; the social economy is relatively backward, and the ecological environment is difficult to self-Repair. Building soil and water conservation forest, timber stands, economic forests and other technical means on important and fragile ecological environment area in northwest of Liaoning is to increase the total forest area, increase the forest coverage rate, improve areas of poplar timber reserves, at the same time protect soil, conserve water, increase the quantity of carbon release oxygen, improve the regional ecological environment and increase the level of sustainable forest management and income from forest management.

The project construction and operation process will 马克 some adverse effect, mainly including soil and water loss during the construction, fertilization effect on water quality, soil harden and land fertility loss caused by use of pesticides, and damage to local biodiversity, etc.

But in general European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province is a public welfare project which is going to improve the ecological environment, and more good than harm, also a series of measures should be taken in the project to reduce the adverse effect.

6 Environmental Impact Mitigation Measures

6.1 Afforestation Project on Environmental Impact Mitigation Measures

6.1.1Afforestation site selection on environmental impact mitigation measures

Build wind break and sand fixation forest prior in half fixed sand, fixed sand, and then in severe, moderate, mild desertification land; Build water and soil conservation forest prior in big slope barren hills, and then flood land.

Afforestation is as far as possible from the wildlife habitat, or leave a certain width wildlife activity and migration channels when construct.

Each block is no more than 35 hm^2 in the project.

Through the above principles, determine the project blocks and area to reduce adverse effect of afforestation on maintaining regional biodiversity and natural ecological system. Reduce the effect of project activities on wildlife habitat environment or destroy wildlife activity and migration channels.

6.1.2 Site slashing on environmental impact mitigation measures

Clear the weeds and stack in the belt or planting hole to make its natural decomposition. Do not clear the vegetation on the top of the mountain, hillside, cheuch, and river shore. Avoid permanent or temporary interference to vegetation and plant resources.

6.1.3 Site preparation, planting and tending on environmental impact mitigation measures

Site preparation method is determined by the slope of planting area accoeding to the project design. Full cultivation is only used in forest site slope less than 5 °; Cavernous soil preparation or belt preparation along the contour is used in 5-25 ° forest site slope; Only cavernous soil preparation can be used in the forest site slope more than 25 °.

Interbands between belt preparation along the contour keep no less than 1 m wide grass. In the local soil and water loss serious slope, soil and water conservation measures

to take, then implement soil preparation afforestation.

l0 m width vegetation protection zone should be retained between afforestation block and farmland; Full cultivation on the long slope should keep 3 m wide sward protection zone every 100 m.

After the preparation, cover surface soil with deadwood and grass to avoid overburden bare. Keep the vegetation on the top of the mountain, hillside, cheuch, and river shore. Proper control of planting scale, keep 50-100 m isolation belt between blocks for wildlife.

Young forest tending is digging and weeding, try to keep the surface vegetation and leave remainder in situ. Forest litter collection is forbidden in order to improve the water retention and soil fertility.

Interplanting should according to the horizontal slope, and more than 25 ° slope is not allowed to interplant. Slope between 16° to 25° should plant nitrogen fixation legumes.

The above measures could reduce water and siol loss caused by site preparation, planting, tending and other activities.

6.1.4 Species selection on environmental impact mitigation measures

Planting with good indigenous tree species, and control the proportion and scale of poplar strictly. In the afforestation design, build mixed forest with lots of species, and each block with no more than 35 hm^2 , and one species no more than 5 hm^2 in one block to avoid the large area of a single species artificial forest. Using multiple clones configurationif plant poplar.

In the implementation, site selection and tree species composition is to combine species, provenance, genetic types and tree age together. Choose fine provenance of good indigenous tree species or excellent clones and high quality seedling to reduce forest diseases and insect pests by threat.

In the design and layout, making full use of wildlife corridor, retaining indigenous tree species, utilizing river to protect corridor, using different tree age and the combination of local tree species and afforestation as the natural forest landscape to promote the natural

plant community conservation, recovery, and retention. Afforestationt with good indigenous tree species, including some introduced successful foreign species. Poplar afforestation area is usually large, if plant it as a single tree species plantation, the forest structure will be simple, the genetic gene would be narrow, the forest will have impact on the forest landscape and biodiversity and be easy to increase plant diseases and insect pests.

6.1.5 Building forest road on environmental impact mitigation measures

Use of the current way to improve, combine with rural road construction, build along the fire line or forest spot line to minimize break ground and reduce water loss and soil erosion. Choose reasonable road materials and pay attention to the temporary pile soil to reduce the damage to vegetation. In construction, dig deep to reduce excavation area, and make balance by excavation for backfill; Excavation and backfill are carrying out synchronously and avoid too long or big excavation line.

Build appropriate slope, drain, retaining wall, and plant trees and shrubs, climbing plants and turfing on the slope and road boundary to increase the vegetation and prevent soil erosion. Recover vegetation after the completion of the project.

These measures could reduce water and soil loss during construction and protect the natural landscape.

6.1.6 Pesticides and fertilizers on environmental impact mitigation measures

Insist to use no quarantine and good quality seedling, breed disease-resistant tree species and excellent clones for afforestation to improve forest, and rely mainly on prevention and biological control methods instead of chemical pesticides.

Chemical pesticides should fit provisions of the class Ⅱ and Ⅲ pesticides published by world health organization, and only to a specific insect pests, harmfulless to the others. Shall not be used according to the world health organization of the first and second the of pesticides. Banned use of first one in class Ⅰ and first one in class Ⅱ.

Workers and farmers who is going to use pesticides must accept training of safety management, storage and use of chemical pesticide before carrying out to avoid directly

pollution to water and food. Package and container of pesticide and fertilizer should be collected and handled together.

Use the scientific and reasonable formula fertilization. Advocate to take organic manure, green manure and forest interplant nitrogen plant; Application of inorganic fertilizer should be in strict accordance with the requirements of afforestation design, using hole fertilization or belt fertilization, and backfilled immediately. Surface broadcasting is strictly prohibited.

In the 6 afforestation models of project design, no fertilizer in Soil and water conservation forest in difficult site, the other 5 models applied inorganic fertilizer, n the first 3 years of afforestation apply inorganic fertilizer to promote seedling growth, maintain the ecological environment and the quality of fruit, and apply organic fertilizer after fructification.

Protect forest litter and groundcover plants, prohibit to collect litter and sod ash, and return logging slash back to forestland to keep the soil fertility.

Pesticide containers are prohibited to clean in the water, but could be cleaned in agricultural irrigation water without cultivation.

These measures could prevent water and soil pollution from using pesticide undeserved. Control fertilizer loss to avoid soil harden and soil deterioration, soil fertility decline from long-term utilization of chemical fertilizer in.

6.1.7 Materials and wood transportation on environmental impact mitigation measures

Sprinkle water to reduce the dust when transport materials at dust produced easily locations; No transport when rest time at dust produced easily locations; Never overload, and protect seedling and materials from scattering; Completes the roadbed retaining wall when widen the road.

These measures could prevent dust and noise from transport when vehicles pass through residential area.

6.1.8 Afforestation water on environmental impact mitigation measures

Underground water is usually between 4 m and 10 m, some areas is even more shallow. When some blocks needed water planting by groundwater, impounding reservoir, pool should be built in suitable region to save precipitation to supplement irrigation; surface water could be transported irrigate if necessary.

These measures could reduce the influence to underground water level during growth period.

6.2 Environment Impact Measures During Operation

Cutting should take thinning way to keep the ecological function of forest land and maintain ecological succession process. As far as possible to preserve vegetation when logging, and reduce the density of the rack and quantity. After cutting, retain the cutting residues (branches, leaves, bark, etc.) in forest land to reduce nutrient loss and increase the surface coverage.

These measures could reduce damage to the standing and undergrowth when cutting; Reduce interference from the cutting to wild animal breeding and nesting; Keep the soil nutrient.

In larger block of poplar afforestation, construct and improve irrigation system to ensure agricultural water, in case of the spring drought season.

7 Venture Analysis

7.1 Environmental Risk Identification

The natural hazards include fire, freeze injury, wind disaster, and plant diseases and insect pests, etc.Fators and levels of risk is in table 7-1.

Table 7-1 Fators and levels of venture

Clssification	Factor	Analysis	Risk degree	Environmental risk
Nature	Fire hazard	Recently years, Liaoning worked on forest fir prevention unremittingly, invest a lot of money on the biological fire prevention forest belt and professional fire-fighting team infrastructure, improve the national and provincial forest fire satellite monitoring system networking, so the victims of forest fire is always lower than the national standard, greatly enhance our capacity for forest fire prevention and fighting, therefore, it is a little chance to happen a large scale forest fire in project area.	Fair	Minor
	Cold damage	Cold damage has a great influence on forest growth, especially the 3-5 years living young poplar forest, or 1-2 years after fertilization are vulnerable to cold damage, tree root fractures, then there will be a lousy skin ulcer and other diseases, which would affect the quality of standing. The influence on general trees is not devastating. Afforestation should choose indigenous tree species, daub plaster in early winter in trunk 1 meters when fertilizing, which will greatly improve the ability of resist cold injury. Above 5 years trees is strong enough to resist cold damage generally.	Fair	Minor
	Windburn	Wind is bigger in northwest of Liaoning, which has potential threat to forest growth, and fruitage of jujube and A. aprico. But the effect of wind break forest has been gradually increased, so windburn has a little effect on the project.	Fair	Fair
	Drought	The weather is very drought in northwest of Liaoning, sometimes, drought successive years, trees may have died because of severe drought, so it may influence the survival rate of afforestation and resistant ability of young trees. When tree species selection must be drought tolerant tree species, a series of drought resistance and water retention measures to ensure the survival.	Medium	Fair
	Plant diseases and insect pests	Forestry harmful biological hazard rate is controlled under 7 ‰ every year in Liaoning, the rate of prevention and cure is more than 75%, in which he rate of biological prevention and cure is more than 30%, monitoring coverage is more than 85%. Establish 55 monitoring points and 43 provincial quarantine nursery, origin quarantine inspection rate is above 90%, so forestry diseases and insect pests is under control continuously. Project afforestation has little chance to get large scale plant diseases and insect pests.	Fair	Fair

7.2 Environmental Risk Analysis

The natural risk of this project mainly includes fire, cold, wind and plant diseases and insect pests, etc.; Ecological risk is developing single species of poplar, and make negative influence to the landscape and genetic diversity. Poplar clones is used in large area, this could break stand stability and reduce resistance.

The project fields is lack of rainfall, once meat the high temperature and dry weather day, the sun radiation would be very strong, and make spontaneous combustion in the forest humus layer or peat layer. But few like this kind of fire happen in forest. The most common forest fire is caused by human. Such as incineration manure, and burn grass on the lynch, burn the frass on the wasteland.

For a long time of severe cold and snow weather will cause serious disaster loss to forest resources, trees would be bent or broken; Insects liveing through the winter bareness such as defoliator would low down the survival rate during this kind of weather, and reduce the population quantity and insect pest possible. The wound is bacteria infection point, and may causie lots of diseasea. Invasion of Stem borer pest is mainly on weak trees and forest, generally in the post-disaster 2-3 years population will rise dramatically, and the forest become to base of plant diseases and insect pests, and finally result in much greater subsequent disasters and vicious cycle.

Main harmful pests to *P. tabulaeformis*: pine moth, dioryctria splendidella, pine needle leaf rollers. Main diseases to *P. tabulaeformis*: Pine needle rust.

Main harmful pests to *P. orientalis*: orientalis caterpillar, orientalis big aphid, Semanotus bifasciatus. Main diseases to *P. orientalis*: leaf withering disease, leaf blight.

Main harmful pests to *P. sylvestris*: Dioryctria mendacella, dioryctria splendidella, Tomicus piniperda, dendrolimus sibiricus. Main diseases to *P. sylvestris*: Seedling damping-off disease.

Main harmful pests to poplar: hyphantria cunea, Leuoma candida Staudinger, Gryllotalpa africana Palisot et Beauvois, Gryllotalpa unispina, Holotrichia diomphalia

Bates, Anomala corpulenta Motschulsky, Xylinophorus mongolicus Faust. Main disease to poplar: Leaf spot disease, Leaf scab, Poplar canker disease, root cancer and Purple root rot.

Main harmful pests to *A. apricot*: Apple tumor aphid, Hyalopterus arundinis, Pseudaulacaspis pentagona, Aromia bungii, EurVoma samaonovi, Boll weevil, Carposina niponensis Walsingham, Grapholitha molesta Busck. Main diseases to *A. apricot*: Apricot furuncle disease, Red wart dea-arm disease, Bacterial perforated disease, bleeding disease.

Main harmful pests to *Z. jujuba*: Carposina niponensis Walsingham, Ancylis Sativa Liu, Sucya jujuba Chu, Cindocampa flavescens, Tetranychus cinnbarinus. Main diseases to *Z. jujuba*: Jujube ache disease, Shrinkage fruit disease, rust disease.

Main harmful pests to *X. sorbifolia*: Mite psyllid, Rust mite, eucleid, *Serica Orieritalis* Matschulsky. Main diseases to *X. sorbifolia*: Yellows, sooty mould.

7.3 Risk Reduction Measures

1) Establishment and improvement of forest protection and forest fire fighting management organizations, by strengthening the capacity building. In line with the relevant laws and regulations, individual staff based work responsibility work plan will be developed to protect forest against. Infrastructure construction such as forest fire team could promote forest fire prevention and fighting capacity significantly. In the next five years, Liaoning province will continue to construct forest fire command center and professional forest fire team, communication, fire extinguishing tool and other infrastructure configuration, observatory, aviation forest guard base and biological fire break forest belt to further improve forest fire prevention system.

2) Strictly use plant diseases and insect pests forecasting system, seriously carry out the policy of “prevention first, integrated control”. Forest pest monitoring and early warning system, forest plant quarantine and pest and disease control system will be improved .

3) Cold, freezing and typhoon risks will be addressed through forestation by

cold/wind-resistant tree species. Poplar after fertilization and the trees between 3 and 5 years, lime whitening should be adopted to prevent or alleviate the harms from low temperature in late autumn. Strengthen breeding technology research to breeding cold/wind-resistant tree species for afforestation.

4) Avoid using a single provenance, the family or the clone afforestation, advocate introduced species mixed with indigenous tree species; in the promotion of clone afforestation, use clone of the genetic diversity, and introduce new germplasm resources continuously to prevent gene narrowing and simplification.

5) Strengthen the breeding and cultivation work, vigorously promote the good quality seedling. Seeds for the afforestation project should be transfered and purchased by the district bureau of forestry, seedling should be used prior from center nursery and specific nursery togurantee the resource of seedlings supplied.

6) To strengthen the ecological environment monitoring, set up fixed sample set for regular positioning observation in the project forest; project implementation unit should cooperate with the relevant scientific research institutions to carry out ecological monitoring, and regularly report to the environment department in charge.

8 Public Consultation

8.1 Public Survey Method and Topics

8.1.1 Public survey objective

The purpose of public consultation is to strengthen two-way communication between the parties and the public in the proposed project, make the public more comprehensive understanding of the European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province, allay public fears of the impact of project, obtain public understanding and support for proposed project, understand the public opinion and the suggestion on the project construction and surrounding environment especially people around this project, absorb public participation in environmental decision-making, which could be in favour of improving the quality of environmental impact assessment, and ensure transparency and credibility of evaluation and decision making, make the project design and operation management more perfect and reasonable, and balance social, economic and environmental benefits.

8.1.2 Public consultation scope

The survey objects are mainly township residents involved in the project which are mainly farmers, also include people's government, social organization, enterprises, cadres, workers, farmers, students, and others along the project region.

8.1.3 Public consultation methods

According to related policies of European Investment Bank and the requirements of "Environmental Impact Assessment Law of the PRC", and to reflect the comments of the public in the project areas, the public consultation adopts the methods of posters, radio and television to open the project imformations, collect the public opinions by convening villager meetings, collective interview, informal discussions.

8.1.3.1 Information disclosure

August 15, 2012, the provincial foreign capital project office held the project preparation work conference to ask each counties to step up publicity of the project by varied form, such as take television transmission, publish in the newspaper, post project

information on the proposed project objective, construction target, the construction content, construction scale, possible negative environmental impact by the project construction and suggestion, each county (county-level city) should take out the publicity according to their respective construction contents.

Each project county (city) should post project information on the stage (figure 8-1) and send out project brief for the project publicity, to make the villagers have a certain understanding of this project construction.

Figure 8-1 Post up the official notice

Figure 8-2 Public discussion

8.1.3.2 Public discussion

This survey includs the 9 counties (county-level city) involved in project. Have an informal discussion with the farmers and construction units about the following topics: if necessary to carry out the construction; if necessary to loan; if volunteer to participate in the project construction; if the construction is reasonable; if project sites is reasonable; The possible environmental problems; what measures will be carried out to protect the environment; Any other suggestions

8.1.3.2 Public participation in the questionnaire

On October 16, 2012, all the construction units related working personnel from cities, counties and districts forestry department, villagers' representatives, forest farm, environmental impact assessment unit and social impact assessment unit came to chaoyang county forestry bureau to attend the training of public consultation and social impact assessment. Foreign capital project office under Liaoning provincial forestry department entrust Academy of Social Sciences of Liaoning province to do the “European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province Social Assessment Survey”. The investigation of public consultation was carried out with social surveys to the social impact of the project simultaneously, and also sand out the Project public consultation survey tables.

Public participated in the questionnaire will be given project profile attached above the table, it is a preliminary introduction of project construction content, composition, environmental impact to the public; At the same time, adopt the method of questionnaire investigation to solicit opinions from the public. Public participation in the questionnaire are shown in table 8-1.

8.2 Analysis and Recommendations of Public Survey Results

8.2.1 Analysis of survey results

8.2.1.1 Public discussion

The environmental assessment of project evaluation group visited some of the farmers and their families, and consulting and record the comments and suggestions from them:

Table 8-1 Public consultation of European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province

Name		Gender	□Male □Female	Age	
Nationality	□Han □Man □Others	Culture	□Junior college or above □Technical secondary school □Junior high school or high school □Primary school or others	Occupation	□Cadre □Worker □Farmer □Student □Others
Home Address					
Work unit					
Project profile and main environment impect	Project profile: The project is planning to plant 23,701 hm^2 in 9 counties (county-level city and district) of Fuxin city and Chaoyang city, which are Fuxin county and Zhangwu county of Fuxin city, and Beipiao county-level city, Kazhuo county, Jianping county, Chaoyang county, Lingyuan county-level city, Longcheng district, Shuangta district of Chaoyang city, including 13,450 hm^2 difficult site planting area and shelter forest 4,176 hm^2. Total investment is RMB 480 million. Benefit: Build ecological forest could increase the total forest area, increase the forest coverage rate, improve areas of poplar timber reserves, at the same time protect soil, conserve water, increase the quantity of carbon release oxygen, improve the regional ecological environment and increase the level of sustainable forest management and income from forest management. Adverse effect: Construction could make noise, dust and water and soil loss, fertilizer and pesticide use can affect water quality, tree species selection improper may damage local biodiversity in the region. Spring planting will increase water consumption, and will have slight effects on the surrounding agricultural production in the project.				
1. The following questionnaire survey in the project, please give your opinion with"√"					
(1)Do you know about European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province?			□Very □General □No		
(2)How did you know about the project?			□Broadcast □TV □The press □Meeting □Otherd		
(3)How do you think about the ecological environment of the project sites?			□Very □General □Bad		
(4)Do you think the construction have any effect on the regional environment?			□Benifit □No influence □Harmful		
(5)Do you think the construction have any effect on environmental impact of the construction area and the surrounding areas?			□Very big □General □Non		
(6)What attitude do you hold to this project?			□Agree □Disagree □No matter		
2. Do you think the project after construction will bring any environmental problems? what environmental problem do you care about?					
3. Do you have any expect on the project?					
4. Do you have any suggections to the project? Do you have any concerns or worry about the project?					
Signature:					

1) Willing to take part in the project, hope to get funds, technology and policy support, participate in seedling cultivation to increase income.

2)Concern about forest product market, some varieties may be good now, but it is unknown in the future.

3)Hope project implementation could hire local labor force, and provide a certain jobs.

8.2.1.2 Public consultation questionnaire

Sent out 151 copies of public participation questionnaire, and took back 151, public inquiry name list see table enclosed, adopt the way of combining distribution and field visits.

Public composition collected by investigators see table 8-2. In the surveyed crowd, respondent is mainly between 25 and 45 years old, accounting for 51.7%; Cultural degree is mainly Junior high school or high school, accounting for 61.6%; farmers account for 67.5%; male account for 94.7%, Han nationality account for 93.4%. Respondent structure is reasonable and representative.

Table 8-2 Public composition collected by investigators

Investigation item	Statistics			
	Sample size	151 person	Effective questionnaires	151 copies
Age	＜25	25-45	46-60	＞60
	2	78	65	6
	1.3%	51.7%	43.0%	4.0%
Culture	Junior college or above	Technical secondary school	Junior high school or high school	Primary school or others
	45	10	93	3
	29.8%	6.6%	61.6%	2.0%
Occupation	Cadre	Worker	Farmer	Student or others
	24	22	102	3
	15.9%	14.6%	67.5%	2.0%
Gender	Male		Female	
	143		8	
	94.7%		5.3%	
Nationality	Han		Others	
	141		10	
	93.4%		6.6%	

Public opinion survey results is as shown in table 8-3. The results of the survey statistics showed that 68.9% of the public think that ecological environment of the proposed project area was bad or general condition; 95.4% of the public think that project construction could be beneficial to the regional environment; 79.5% of the public think that project construction had no impact on the surrounding environment; 99.3% of the public agreed in project construction, 0.7% of the public said doesn't matter, no one objected.

Table 8-3 Public opinion survey results

Question	Opinion	No. of answer	Proportion (%)
1. Do you know about the project?	Very	23	15.2%
	General	128	84.8%
	No		
2. How did you know about the project?	Meidia	20	13.2%
	Meeting	84	55.6%
	Others	47	31.1%
3. How do you think about the ecological environment of the project sites?	Very	47	31.1%
	General	53	35.1%
	No	51	33.8%
4. Do you think the construction have any effect on the regional environment?	Benifit	144	95.4%
	Little impact	7	4.6%
	Harmful		
5. Do you think the construction have any effect on environmental impact of the construction area and the surrounding areas?	Very	31	20.5%
	General	26	17.2%
	No	94	62.3%
6. What attitude do you hold to this project?	Agree	150	99.3%
	Disagree		
	No matter	1	0.7%
7. Do you think the project after construction will bring any environmental problems? what environmental problem do you care about?	Wind break and sand fixed, improve the envirenment	37	24.5%
	Control siol and water loss	6	4.0%
	Construction noise pollution	1	0.7%
8. Do you have any expect on the project?	Implement as soon as possible	18	11.9%
	Increase the investment	13	8.6%
	Improve the environment and promote ecological benefits	11	7.3%
9. Do you have any suggections to the project? Do you have any concerns or worry about the project?	Insist for a long time, develop scale	7	4.6%
	Reasonable planning, increase the ecological forest construction	5	3.3%
	Increase the investment, use of funds as ear-marked	21	13.9%

8.2.2 Comments and recommendations from the public

Through the public investigation, main ideas and suggestions of public on the environmental impact are:

1)Public pay more attention on the function of project implementation to control windbreak and sand-fixation, water and soil loss, and hope that the project could improve the local ecological environment.

2)Public approved the project and actively participated in, and hope that the project could increase investment based on the reasonable planning and improve the ecological benefits of the project.

3)The public is urgent to carry out the project construction, and hope project could implement as soon as possible, and insist for a long term and the large scale of development.

8.3 Public consultation conclution

The public consultation of European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province should be strictly in accordance with the relevant regulations of the state environmental protection department, adopted methods of distributed questionnaires and public discussion, and respondents are typical representative, so the public consultation is quite reasonable.

Questionnaire statistics results show that 95.4% of the public think that project construction can be beneficial to the regional environment; 79.5% of the public think that project construction has no impact on the surrounding environment or influence; 99.3% of the public agreed in project construction, 0.7% of the public said doesn't matter, no one objected.

Poll results indicate that people involed in the European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province are fully aware of the importance and public welfare of the project, construction has widespread support.

9 Environmental Management and Monitoring Plan

9.1 Environmental Management

Project construction put forward in various environmental protection measures that need to be carried out under strict environmental management, environmental management is an important part of the project management and ensure environmental protection work promoted smoothly.

9.1.1 Environmental management principles

a)"Mainly prevention, combined with treatment" principle

In the process of construction and operation, adopt precautionary measure in advance to prevent the environment pollution and ecological destruction, meanwhile, take appropriate control measures to minimize the environmental impact.

b)Hierarchical management principle

Project construction and operation shall be subject to supervision of the competent administrative department for environmental protection in all levels, at the same time, the internal practice classification management to clear responsibility by layer upon layer.

c)Relatively independent principle

Environmental management as part of project management should satisfy the requirement of project management and also has the certain independence; Environmental management based on national environmental protection laws and regulations system, supervise the project from the point of environmental protection, and coordinate the relationship between project construction and environmental protection.

d)Specific principles

Establish reasonable environmental management system, and give targeted solutions on environmental problems to project construction in different periods and regions.

9.1.2 Environmental management system

During construction, municipal, county (district) project management offices are

responsible for environmental management, and participate in the training on farmers involed to achieve the corresponding environmental protection requirements.

During construction, municipal, county (district) project management offices are responsible for implementation of the environmental protection measures, and under the guidance of environmental protection and water administrative department on the business.

9.1.3 Organization of environmental management

According to the provisions of the state environmental protection administration, the project management office should set up the environment management institutions to ensure the smooth progress in project environment management and effective implementation. Environmental management staff should have certain qualifications and experience under guidance of the local environmental protection department on the business.

According to the deffirent nature and scope of management during the project construction and operation period, set up project environmental management institutions respectively.

9.1.3.1 Environmental management institutions during the construction

Project management office should set up project environmental management office in the project construction, including 2 full-time personnel, to lead and organize the environmental protection work.

9.1.3.2 Environmental management institutions during the operation

After the implementatioin, municipal, county (district) the project management office shall establish environmental management office and set 2 full-time personnel to be responsible for environmental protection management during operation.

9.1.4 Environmental management responsibility

9.1.4.1 Environmental management responsibility during the construction

During construction, the construction unit will be responsible for environmental protection management from starting to completion of construction, its main

responsibilities include:

1)By investigation, determine suitable environmental protection policy and economic and technical policies for the project, and establish environmental protection goals;

2)Implement of the relevant laws and regulations, rules and regulations of environmental protection, formulate regulations, measures and details of project environmental protection, and deal with relevant issues in the process of execution;

3)Organize the formulation of project overall planning and annual plan for environmental protection, ensure the full implementation of programs and plans, make annual budget of environmental protection, and cooperate with the financial department to plan and manage the environment protection capital;

4)Entrust the relevant units for environmental protection to do special design and check design progress, organize acceptance check and examination of design results, and guarantee the effective implementation of all environmental protection measures;

5)Supervise and manage the implementation of various environmental protection measures according to the laws, and take the implementation of environmental protection measures as an important content of inspection and acceptance check of project quality.

6)Organize and coordinate the relationship between the departments concerned, listen and deal with relevant issues and reports submitted by environmental management institutions, and report to the superior administrative department for environmental protection timely;

7)Complete the internal rules and regulations, do the daily and propaganda work of environmental management, supervise the work of contractor's environmental management organization;

8)Supervise the normal implementation of entrusted environment monitoring department, strengthen the environment information statistics, and establish environmental information database;

9)Organize project monthly, quarterly and annual reports of environmental protection and implementation progress assessment reports, and report to the competent department

concerned, write brief of environmental protection regularly, and announce environmental protection dynamics and environmental monitoring results timely;

10)Organize to carry out the investigation of project completion acceptance on environmental protection, submit an application for the environmental protection acceptance. Main responsibility forest farms, farmers involved in the project construction is to perform environmental protection measures.

9.1.4.2 Environmental management responsibility during the operation

During operation environment management is one of important contents of project operation and management, and the guarantee for environmental protection carried out properly, the main responsibilities include:

1)To carry out national and local environmental protection laws, regulations and policies, as well as all levels of environmental protection requirements of the administrative department;

2)To implement and monitor environment protection measures, formulate environmental management measures, and processing all kinds of environmental protection problems in the operation period;

3)To carry out environment monitoring content in the operation period, be responsible for reorganizing and submitting the monitoring data, and guarantee the quality of monitoring results.

9.1.4 Environmental Management Plan

Make the environmental management plan to ensure mitigation measures carried out effectively. See table 9-1.

9.2 Environmental Supervision

The environmental supervision refers to the environmental supervision institutions entrusted by the construction unit, based on environmental impact assessment documents, the approval by environmental protection competent administrative department to carry out environmental protection and technical supervision, and cooperate with the competent

administrative department for environmental protection supervision on inspection of project construction.

Implementing environmental supervision system during the project of construction management and environmental management, is good to implement the laws and regulations relevant to state environmental protection, is also benificial to implementi environmental protection measures, and make adverse effect caused by the project on environment reducd to the minimum degree.

This project will be implemented by the farmers, afforestation plots and time is scattered, therefore, each project county should set 1 supervision personnel, a total of 9, the supervision period is 5 years.

9.3 Environmental Monitoring Plan

In order to ensure all relief measures specified in the environmental impact assessment implemente fully, to ensure make use of natural resources sustainably, the project have to implement three aspects of environmental monitoring as following.

1. Implementation Monitoring

To determine whether the progress of the project is in accordance with and the design (project activities; the number of participates, etc.). Through this type of monitoring, can evaluate policies, procedures, programs, or complete degree of other management commitments.

2. Consistency Monitoring

Compare the project implementation situation with decided environmental standards, regulations, permissive conditions and affirmatory items in the plan. Through the results of this monitoring, determine the way of fine or punishment, or the way ofor rewarding good performance.

3. Effectiveness Monitoring

Determine the relationship between environmental impact and the project long-term goals. If the monitoring measured in accordance with the time sequence, the results could

also be used to determine the trend of environment changes. Choose "index" of this type of monitoring, establish a baseline, observe environmental condition regularly, and compare with established environmental condition to determine the effectiveness of environmental management measures.

9.3.1 Topics and Site selection of monitoring

Monitoring plan include effects of project to soil and water resources, the potential influence of afforestation to the biological diversity, and implementation of plant diseases and insect pests management plan.

Environmental protection supervision personnel will monitor the effect on main environmental parameters (including biodiversity, soil erosion, soil fertility and water quality) by field investigation and laboratory analysis. Sign the Sub-Protocol with qualified individuals/organizations, and the monitoring will be carried out by the guidance of the provincal project management office and environmental supervision personnel in strict accordance with the suggested method (biodiversity survey measurement and laboratory analysis). In the operating period, these monitoring activities will be carried out in four project county, namely: Zhangwu, Chaoyang, Beipiao, and Lingyuan. monitoring content see table 9-2.

9.3.2 Monitoring performer

Provincial project management office is responsible for the implementation of monitoring plan. County project management office under the command of the provincial project management office is responsible for environmental monitoring activities within the scope of their respective jurisdictions. According to the project area division, city or county environmental monitoring station is responsible for surface and underground water quality monitoring, and the forest diseases and insect pests control station is responsible for implementation of monitoring pesticide use and plant diseases and insect pests management in the project area. Provincial project management office and the corresponding monitoring stations in the project should sign the agreement before implementation. County environmental supervision personnel will be responsible for

checking the monitoring task execution by corresponding monitoring station according to environmental management and monitoring plan.

9.3.3 Monitoring report system

Environmental monitoring station must report the results after monitoring task completed every time, the report includes monitoring data, the evaluation on data reflected by environmental protection measures, and come to the environmental protection measures improvements, and then report to the provincial project management office and the superior administrative department for environmental protection monitoring. Provincial project management office and the superior administrative department for environmental protection monitoring will make measures of improvement according to the report. In the construction period the first five-years of operation, the provincial project management office should submit annual environmental quality report to the European investment bank, provincial environmental protection department.

9.3.4 Monitoring before construction

Monitoring before construction is to serve two purposes. The first purpose is to check whether the mitigation measures in Environmental Impact Assessment Report are combined with the final project design and included in the construction contract. The second objective is to evaluate the current environmental conditions.

According to the project, fertilizers and pesticides will be used in the project, which may cause potential negative influence on water quality. The surface water monitoring plan before construction establish a baseline. According to the plantation geographical position and the characteristics of the river basin, plan to choose three representative river tomonitor water quality. monitoring plan see table 9-2。

9.3.5 Monitoring during Construction

1. Publilc health

Project is implemented by farmers, and environmental supervision personnel is responsible for on-site investigation on any popular disease, immediately report to relevant departments if have.

2. Soil erosion and surface water sediment

Afforestation could cause land reclamation in large areas and accelerate soil erosion, especially in the afforestation period and in the first few years of the tending. Soil erosion may occur during construction, forest road building, raising seedling and weeding. The erosion would increase cause deposition of water (streams, rivers, wetlands, etc.), and cause negative effects to aquatic animals and plants. County project management office or environmental supervision personnel are to confirm the possible negative effects, and notify the contractor to make slope surface soil and water conservation measures, such as ricks, built mud column and/or spread fiber mat to prevent rivers and lakes sediment to further increase.

Monitor soil erosion in the 12 monitoring sample plot (or runoff plot), the main monitoring content including: rainfall data (from provincial/municipal meteorological station), soil loss, topography, geomorphology, surface composition of the substance, water loss and soil erosion intensity change, wind break and sand fixation effect, and the monitoring is carried out in spring and rainy season respectively.

Investigate soil erosion after rainfall, collect and weighing the soil if there is sediment; calculate the amount by wind erosion after the wind according to buried marking pin. Soil erosion monitoring should be carried out twice in the first year, twice in the third year, and twice in the fifth year, combined with soil erosion in liaoning province survey.

3. Wind break and sand fixation

Wind break and sand fixation monitoring point will be used to monitor the dynamic change of afforestation effect, set a control point (no wind break and sand fixation forest) and 2 repeat points (with wind break and sand fixation forest). Set up 3 soil fertility monitoring points will be set up in 4 counties to reflect influence of afforestation on soil fertility status.

Design and build monitoring sampling plot, set up 3 afforestation point in 4 counties, each afforestation point set 3 treatments, a total of 12 monitoring sampling plots, and sampling and analyse on first, third, fifth year.

The main index of soil fertility monitoring include wind speed, wind force, sandstorm days, surface sediment rate, soil fertility in the dynamic change. Collect soil sample between April and may every two years.

4. Surface water quality and groundwater level

Surface water quality monitoring is mainly judgment whether the implementation of the project basic fertilizer application impact on water quality. The major pollutants concentration would be monitored in the 3 river of 3 selected project county respectively, including pH, COD, BOD_5, total nitrogen, total phosphorus and suspended solids. Establish 2 sampling point (leveling base) on each river , which a point is on the upstream of afforestation as the baseline data and the other point is on the downstream of afforestation, to identify the influence of project activities to bring the real implications of the river water quality. In order to reduce the cost and avoid negative effect to the monitoring plan quality, it is recommended that sampling once a year (May- June).

Monitor underground water level to identify whether afforestation influence underground water level and underground water level affect could meet water demand of various afforestation model. Each model choose one spot in the 6 afforestation models.

The main suggested parameters include surface water quality in afforestation area, soil erosion and soil fertility status. The implementation unit, responsible departments and project monitoring activities are shown in table 9-2.

9.3.6 Monitoring in operating period

The project construction activities may cause some negative impact on the environment parameters, such as natural vegetation, soil erosion, biodiversity and the occurrence of plant diseases and insect pests. In the project operating period (2^{th} - 6^{th} year), potential environmental impact will be mainly soil erosion, surface water and groundwater pollution, related problems cause by the use of pesticides and pest control activities, the influence of soil fertility and biodiversity. Purpose of the project operating period environmental monitoring plan is to know the influence on the environment. The information will be used to further improve the environmental management and

monitoring plan, the corresponding project activities to prevent or reduce negative impact on the environment in the next stage.

Monitoring content mainly includes: soil erosion, wind break and sand fixation, surface water quality and groundwater level. Monitoring methods and construction period is basic the same with the consruction period monitoring plan, operating period monitoring points is five years (2^{th} -6^{th} year), the sampling points, sampling method and sampling time are also the same. See table 9-2.

Table 9-1-1 Environmental management plan

Environmental problem	Mitigation measures	Executor	Responsible Organization
A. Design/ Before the implementation phase			
1. Project alternatives	1. Optimize the project design and plan to minimize potential negative impact to the environment. 2. Project design and planning should avoid to affect environmental sensitive areas, such as the research area, core and buffer natural conservation area, wildlife habitat, as well as the natural and cultural heritage, and arrange of construction progress reasonably to reduce occupied land. 3. Minimize the influence on waterhead, the minimum discharge requirements and water requirements of downstream users in the area. 4. Provincial project management office should strengthen monitoring and protection on biodiversity in the area. 5. Ensure that wild animals' migration routes and their foraging for food/water route will not be cut off. 6. Provincial project management office and relevant departments should provide management plan for the subpopulation close to natural conservation area and wildlife habitat. 7. Ensure that natural forest and high biodiversity bushes would not becut down and develop into commodity timber forest. 8. Carefully select species to protect the local tree species and avoid the interference of exotic trees. 9. Ensure the energy source of local farmers. 10. Do not allow planting a single clone plantation in a large area, and each county has 10 clones at least.	Provincial project management office; Design organization	Provincial project management office
2. Land utilization	1. The design of forest road must be minimized to occupation of land when construction to prevent acceleration of soil erosion and to avoid/minimize damage to vegetation. 2. A place of historical sites and cultural relics can not build with plantation. 3. Greater than 35 ° slopes are not allowed to build productive plantation.	Design organization	Provincial project management office
3. Pesticides use	1. Audit pesticide use in project area, avoid the use of any type I pesticides classified by the world health organization. Selecte efficiency pesticides instead of common pesticides. Advocate to use low pesticide residue ones. Strengthen implementation of the established pest management plan. See appendix "pest control plan"	Proincial forest diseases and insect pests control station	Provincial project management office

Table 9-1-2 Environmental management plan

Environmental problem	Mitigation measures	Executor	Responsible Organization
B. Implementation phase			
1. Natural conservation area and wildlife habitat	1. Construction machines should be away from the natural conservation area and wildlife habitat. If construction site near the buffer, try to adopt the corresponding protective measures (such as the silencer) to reduce the noise influence. 2. It is not allowed to change natural forest as its use, including for timber. Plantation development should be mainly in barren hills suitable for afforestation or low biodiversity region. 3. Deal with construction waste appropriately. Garbage disposal should be away from natural conservation area and wildlife habitat. 4. Construction personnel can not enter the research area or the core and buffer area of natural conservation. It is forbidden to hunting and the destruction of wild plant.	Construction team	Provincial and county project management office
2. Soil erosion	1. When slope is greater than 5 ^{o}, it is forbidden to use the Full cultivation for land preperation. Adopt belt preparation or fish-scale pits, etc. 2. Complete afforestation on the slopes in a month before the rainy season. 3. Avoid reclamation and dug ditches in the rainy season or on the slope greater than 25^{o}. With sandbags, dry straw bag cover on the downhill side of excavation area to reduce water and soil loss. 4. Replanting on the construction site as soon as possible to prevent water and soil loss. 5. Use logging residue to protect the surface vegetation. 6. Thinning should strictly according to the design, and avoid distroy the remained trees and soil. 7. Take measures to maintain and improve soil structure, soil fertility and organism. 8. Advocates the use of organic fertilizer, green manure and interplanting fixed plants in the forest. 9. Use of organic fertilizer according to the afforestation design by acupuncture point or banding, and strictly prohibit fertilizer spraying..	Construction team	Provincial and county project management office
3. Natural and cultural heritage	1. Contractors and construction workers should be aware of the importance of protecting cultural relics. 2. If find cultural sites during construction, stop the construction, protect the scene, and notify the relevant departments to investigate and research. Immediately.	County project management office	Provincial project management office

Table 9-1-3 Environmental management plan

Environmental problem	Mitigation measures	Executor	Responsible Organization
4. Minority	1. Respect the traditional way of life and habits of minorities. 2. Send leaflets and organize training to enhance the consciousness of contractor and construction workers to respect habits and beliefs of minority.	Construction team; Environmental supervision personnel	Provincial project management office
5. Plant diseases and insect pests	1.Build variety ofspecies, provenance and multiple genes mixed afforestation. 2. Conduct quarantine of exotic trees. 3. Keep native vegetation in the valleys. 4. Avoid excessive use of chemical pesticides.	Design organization	Provincial project management office
6. Community	1. Afforestation cannot occupy farmland. 2. Solve the problem of energy source for local farmers. 3. Relevant government departments should help and guide farmers to develop intensive animal husbandry. 4. Set up temporary health and epidemic prevention institutions in construction area to strengthen the epidemic monitoring and health management and health propaganda.	County project management office; Epidemic prevention department	Provincial project management office
C. Operation phase			
1. Animal and plant communities and natural conservation area	1. According to relevant national and local laws, regulations and the report requirements, implement measures of biodiversity reserve and nature conservation strictly.	County project management office	PPMO, and EPBs
2. Plant diseases and insect pests and the use of agricultural chemicals	1. Strictly carry out the proposed pest management plan, improve the efficiency of pesticides use to minimize long-term negative effects on the natural environment. 2. Choose good forest culture methods to enhance the resistance of forest diseases and pests. 3. Choose low residue, low toxicity pesticide 4. Monitor serious insect pest populations regularly. 5. Promote integrated pest management, and reduce the chemicals use.	County project management office forest diseases and insect pests control station	Provincial project management office

Table 9-1-4 Environmental management plan

Environmental problem	Mitigation measures	Executor	Responsible Organization
3. Soil erosion and fertility	1. Protecte vegetation on the ground, cover the soil by plants; Use artificial weeding and guarantee the quality of forest tending and environmental effect of the regulation. 2.Implement the testing technology to balance fertilization soil; Use organic fertilizer as far as possible, and promote bacterial manure. 3. Restore and protect ground cover plant; retain logging slash in the field; new forest road should use soil and water conservation measures.	County project management office Construction team	Provincial project management office
4. Biodiversity	1. Conserve understory vegetation and litter, and protect the original vegetation between the lines and forest edge vegetation. 2. Promote comprehensive prevention and control of plant diseases and insect pests, and enhance the forest health management, reduce the use of chemicals. 3. Control landslide from the hillside.	County project management office Construction team	Provincial project management office
5. Community	1. Help farmers to build biogas digester to reduce the use of fuel wood and solve the energy problem. 2. Help farmers to develop aquaculture and labor export. 3. Support minority and women's employment. 4. Respect the habits and customs of minorities.	County project management office	Provincial project management office
6. Environmental pollution	1. Reduce the use of chemical fertilizers, pesticides, and use it timely and appropriately. 2. Choose organic fertilizer and green manure. 3. Use groove, hole fertilization and covered with soil and deadwood. 4. Choose low toxicity pesticide. 5. Bottle recycling and handling the packaging of pesticides and fertilizers.	County project management office	Provincial project management office

Table 9-2-1 The environmental monitoring plan

Baseline data collection			
1. Surface water	1. Monitoring items: pH, total phosphorus, total nitrogen, COD, BOD_5 and suspended solids. 2. Monitoring frequency: once, in two weeks after beginning od rainy season. 3. Monitoring duration: 9days 4. Monitoring location: Dalinghe river and Xiaolinhe river in Chaoyang, Raoyanghe river and Liuhe river in Fuxin.	Area under administration/ provincial environmental monitor station	Provincial project management office
Implementation stage			
1. Surface water	1. Observe whether it is turbid. If the implementation of the project accelerate soil erosion, the test of suspended solids should be taken and inform the relevant departments and project members to stop construction and strengthen the erosion control measures	County environmental monitor station	Provincial project management office
2. Underground water	1. Monitoring items: monitor underground water level to observe the changes of ground water level and analyse the effect of afforestation on underground water level. 2. Monitoring frequency: once in dry season of the first year 3. Monitoring location: select a monitoring point in each afforestation model, and total is 6 points.	Environmental supervision personnel provincial and county environmental monitor station	Provincial project management office
3. Wind break and sand fixation	1. Monitoring items: monitor wind speed, sandstorm days, surface sediment rate and the change of soil organic content to analyse the effect of afforestation on wind break and sand fixation. 2. Monitoring frequency: once, at the end of first year. 3. Monitoring duration: 6days. 4. Monitoring location: Collect topsoil composite samples in the monitoring point (choose 3 plantation in the 4 typical counties, set 2 repeat and 1 control in each plantation block, total is 12 blocks)	Environmental supervision personnel provincial and county environmental monitor station	Provincial project management office
4. Soil erosion	1. Monitoring items: precipitation data(come from provincial or Municipal weather station), terrain, landform, surface material, soil and water loss intensity, soil loss amount(wind erosion, water erosion, etc.) 2. Monitoring frequency: twice, spring and rany season in the first year 3. Monitoring duration: 5 days 4. Monitoring location: set typical quadrats or runoff plots in soil erosion monitoring points(choose 3 plantation in the 4 typical counties, set 2 repeat and 1 control in each plantation block, total is 12 blocks)	Area under administration/ provincial environmental monitor station or Soil and water conservation monitoring station	

Table 9-2-2 The environmental monitoring plan

Operating period			
1. Wind break and sand fixation	1. Monitoring items: monitor wind speed, sandstorm days, surface sediment rate and the change of soil organic content to analyse the effect of afforestation on wind break and sand fixation. 2. Monitoring frequency: once in every two years(means the third year and fifh year) 3. Monitoring duration: 6 days every time 4. Monitoring location: Collect topsoil composite samples in the monitoring point (choose 3 plantation in the 4 typical counties, set 2 repeat and 1 control in each plantation block, total is 12 blocks)	Environmental supervision personnel; provincial and county environmental monitor station	Provincial and county project management office
2. Soil erosion	1 Monitoring items: precipitation data(come from provincial or Municipal weather station), terrain, landform, surface material, soil and water loss intensity) 2. Monitoring frequency: collect the sediment and weight after rain. Collect erosion soil in the erosion grooves, and analyse twice in the first year and fifth year, could be combined with soil erosion survey in liaoning province. 3. Monitoring location: set typical quadrats or runoff plots in soil erosion monitoring points(choose 3 plantation in the 4 typical counties, set 2 repeat and 1 control in each plantation block, total is 12 blocks)	Area under administration/ provincial environmental monitor station or Soil and water conservation monitoring station	Provincial and county project management office
3. Surface water	1. Monitoring items: pH, total phosphorus, total nitrogen, COD, BOD_5 and suspended solids. 2. Monitoring frequency: once every 2 years in the first 5 years of operation period 3. Monitoring duration: 9 days 4. Monitoring time: 2 weeks after first main rain 5. Monitoring location: Dalinghe river and Xiaolinhe river in Chaoyang, Raoyanghe river and Liuhe river in Fuxin.	Area under administration/ provincial environmental monitor station	Provincial and county project management office
4. Underground water	1. Monitoring items: monitor underground water level to observe the changes of ground water level and analyse the effect of afforestation on underground water level. 2. Monitoring frequency: once in dry season in the first 5 years of operation period 3. Monitoring location: select a monitoring point in each afforestation model, and total is 6 points	Environmental supervision personnel provincial and county environmental monitor station	Provincial project management office
5. Forest diseases and insect pests	Plant diseases and insect pests monitoring according to annex of Forest diseases and insect pests plan	Provincial, municipal and county forest diseases and insect pests control station	Provincial project management office

10 Environmental Economic Cost-benefit Analysis

10.1 Environmental Protection Investment Estimation

10.1.1 Environmental protection investment struction

Environmental protection investment of the project consist of environmental monitoring cost, environmental protection cost during construction, environmental supervision fee and basic reserve funds. Environmental protection cost during constructionis maily used for building stone or earth embankment, taking compaction on forest road, sowing seed, etc. environmental monitoring costis used for monitoring the background, Surface water environment and water and soil loss during construction and operation; Independent cost refers to the construction unit management, environmental protection completion acceptence fee.

10.1.2 Environmental protection investment

By estimation, total investment of environmental protection is RMB 3.9747 million, including environmental monitoring cost RMB 1.188 million; Environmental protection measures fee RMB 429,400; Independent charge RMB 2.1323 million; Basic reserve funds RMB 225,000. Independent environmental supervision cost is RMB 1.8 million. Environmental protection investment see table 10-1.

10.2 Environmental Economic Cost-Benefit Analysis

This is an ecological construction project for soil and water conservation, wind-breaking and sand-fixing, water retention, improving ecological environment, raising farmers' income, etc. These environmental and ecological benefits is invaluable. So using the method of qualitative analysis to analysis environmental economic cost-benefit.

The effects on the environment should be solved from the design firstly, comparison reasoning on afforestation site, species, afforestation model and pest control, finally establish a plan to control biodiversity, soil pollution, water pollution to minimize their

environmental impact.

Table 10-1 Environmental protection investment

No.	Name of the program or budget	Unit	Amount	Unit price(RMB)	Total (10 thousand RMB)	Remarks
Section 1 Environmental monitoring investment					***118.80***	
I	Monitoring in implementation (1 year)				19.80	
1	Surface water quality, underground water level	Individual	12	5000.00	6.00	1 Year
2	Biodiversity	Individual	12	3000.00	3.60	1 Year
3	Wind break and sand fixation	Individual	12	4500.00	5.40	1 Year
4	Soil erosion	个	12	4000.00	4.80	1 Year
II	Monitoring in operation(5 year)				99.00	
1	Surface water quality, underground water level	Individual	12	5000.00	30.00	5 Year
2	Biodiversity	Individual	12	3000.00	18.00	5 Year
3	Wind break and sand fixation	Individual	12	4500.00	27.00	5 Year
4	Soil erosion	Individual	12	4000.00	24.00	5 Year
Section 2 Environmental protection investment					**42.94**	
I	Programs				31.13	
1	Build earth embankment	m^3	113765	1.27	14.45	(80 m Length*0.2 m Height *0.3Width)/hm^2
2	Compaction forest road	m^3	189608	0.88	16.69	(80 mLength *0.2 m Thick *0.5 m Width)/hm^2
II	Vegetation measure				11.80	
1	Broadcast sowinggrass seed on the slope	hm^2	94.80	1245	11.80	(80 m Length*0.5 m Width)/hm^2
Section 3 Independent cost					**213.23**	
I	Overhead of construction units	%	2	1617400	3.23	
II	Environmental supervision charges	person · year	9*5	40000	180.00	
III	Environmental protection completion inspection charges	Term			30.00	
Section 4 Budget reserve					**22.50**	
I	Budget reserve				22.50	
1	Basic budget reserve	%	6	3749700	22.50	
Total investment					**397.47**	

The broken surface, soil and water loss, bare area after construction will be got relief

by specific environmental protection measures, and soil and water loss and solid waste will be got effective governance which could effectively avoid potential economic loss caused by the environmental damage.

11 Conclusion and Suggestion

11.1 Conclusion

The construction of European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province is in compliance with national forestry ecological construction policy, is one efficient method to ensure the fulfillment of eco-province strategy, and the project is in accordance with local national economic and social development, land use, forestry and other relevant planning; According to environmental and social analysis, the project has no significant negative effects to the natural environment, but mainly has positive influence on the society and the environment. The implementation could be successful to increase the forest coverage rate, effectively restrain horqin sandy land moving, land desertification, and water and soil loss, meanwhile, the implementation of the project will be beneficial to increase farmers' income, and promote forestry sustainable development; This project has obvious ecological, social and economic benefits.

In the project construction and operation process, carry out the ecological environment protection measures strictly, and reinforce environmental management, so considering from environment protection, the project is feasible.

11.1.1 Afforestation site selection

Afforestation site selection locates in 9 counties (county-level city and district) of 2 city in northwest of Liaoning, fits project design principle, follows the theme of ecological construction, take full account of democratic unity of environmental protection and social development, so the afforestation site selection is reasonable and feasible.

11.1.2 Environmental Impact Assessment and Mitigation Measures

In the project implementation, if a series of inevitable problem could not be solved properly, it may cause negative influence on natural environment and social environment. The the size or degree of the influence will depend on the implementation of mitigation measures.

The probable environmental impact during construction are:

1. Influence of using chemical fertilizers and pesticides to the the surface water;

2. Soil erosion cause by construction;

3. Vulnerable get plant diseases and insect pests during operation;

4. Influence of artificial planting to biodiversity;

5. Influence of wastewater and solid waste to the environment in short-term at construction site.

Mitigation Measures to solve negative influence on natural environment and social environment:

1、Using organic fertilizer, control inorganic fertilizer use, ban to clean pesticides container in water;

2、During construction, the earthwork shoud be cleared in time, bunds should be built on steep hill, and forest road slope should take grass planting to reduce the bare slope;

3、Prevent plant diseases and insect pests, use much more biological pesticide as far as possible than chemical pesticides;

4、Control scope and form of land preparation, use artificial land preparation as far as possible, and keep the plant out of the hole;

Generally speaking, most of the mitigation measures have practical experience in Liaoning province or adjacent areas, and play a positive role to prevent and slow down the destruction of the ecological environment and influence.

11.2 Suggestion

Suggest to use dynamic scheme of environmental monitoring and management to solve the environmental impact unexpected, take treatment measures promptly, and also Suggest to to strengthen the ecological environment monitoring, select afforestation block strictly to guarantee keeping a certain distance between ecological sensitive area.

11.2.1 Subsequent guarantee scheme

Personnel from foreign capital project office who is responsible for environmental

protection should prepare a series of stage reports to ensure the project environmental management plan (EMP) results could be incorporated into subproject further design, and make the environmental management plan has dynamic implementation method. Contents of stage reports are as following：

Stage report on beforehand construction to provide a reference for the implementation;

Stage report on project annual construction and operation;

Stage report on project annual monitoring during operation;

The final report to generally comment all the influence and summarize the successful mitigation measures in operation process.

In any stage if unforeseen obvious negative effect happened to environment, reassessment of project could be done timely, and further measures could be taken leisurely. The interim report should be submitted to the provincial foreign capital project office, the European investment bank, and regional agency for reviewing and evaluating if necessary.

11.2.2 Public Consultation

According to the above results, the public are very concerned about construction of "European Investment Bank Loan in Ecological Afforestation Demonstration Project in the Northwest of Liaoning Province", the most of local people support the construction of the project, and think it is necessary to carry out the project, the project can improve people's life and local environmental and economic conditions. And nearly have no adverse effect. the project could be launched to add forest vegetation acreage, and improve local environment. Project area residents hope to receive technical training, and get employment opportunities.