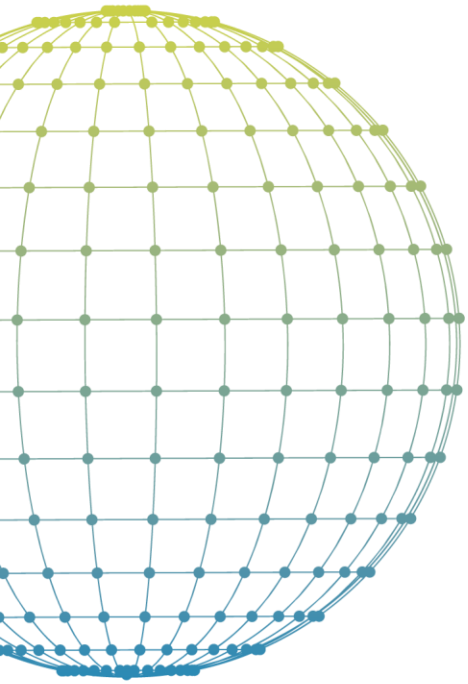
CNNC Beijing Research Institute of Uranium Geology

European Investment Bank Financed Eco-Economic Shelter Forest Construction for Comprehensive Desertification Control of Horqin Sandy Land in Tongliao City

Environmental Impact Assessment

August,2019

Beijing Research Institute of Uranium Geology



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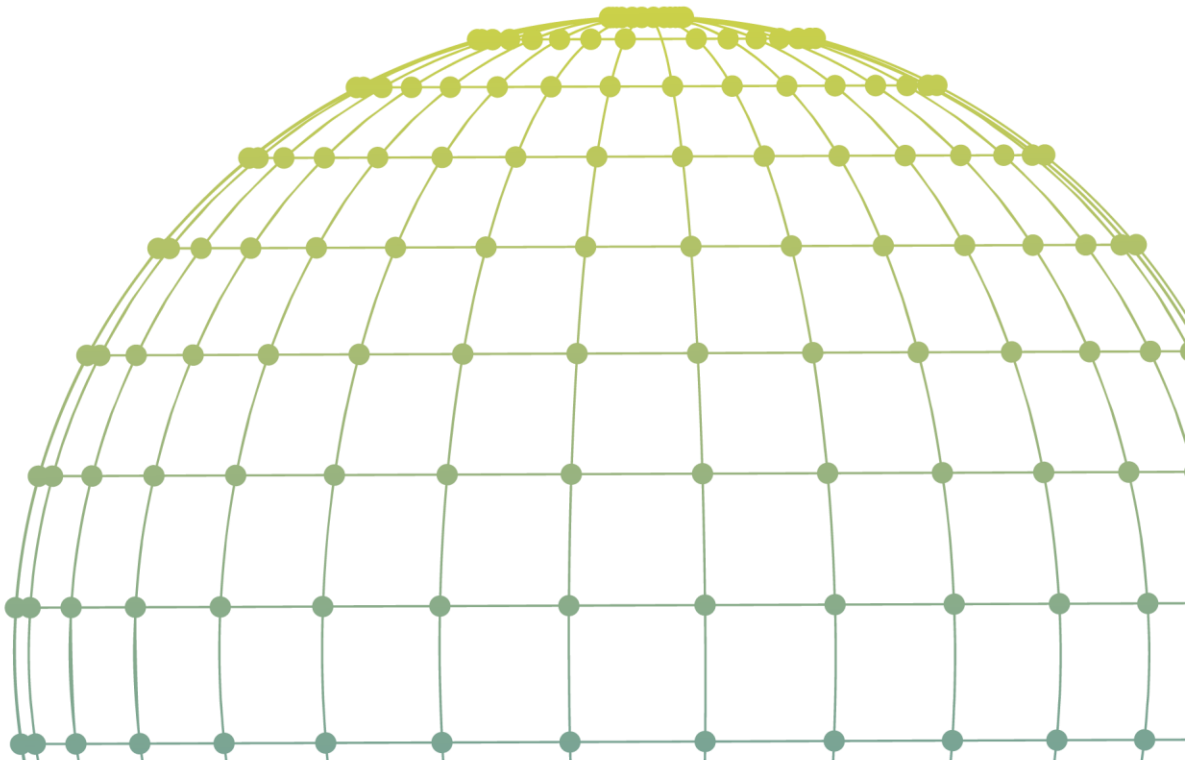

建设项目环境影响评价资质证书

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中华人民共和国环境保护部
2017 年 01 月 10 日

Project Name ： European Investment Bank Financed Eco-Economic Shelter Forest Construction for Comprehensive Desertification Control of Horqin Sandy Land in Tongliao City

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Project Name: European Investment Bank Financed Eco-Economic Shelter Forest Construction for Comprehensive Desertification Control of Horqin Sandy Land in Tongliao City

Competent Unit: Tongliao Municipal People's Government

Construction Unit: Inner Mongolia Tongliao Hengrui Investment (Group) Co., Ltd.

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List of Abbreviations and Acronyms

BRIUG	Beijing Research Institute of Uranium Geology
DBH	Diameter at breast height
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMS	Environmental Monitoring Station
EMP	Environmental Management Plan
EMMP	Environmental Management and Monitoring plan
EPB	Environmental Protection Bureau
EQS	Environmental Quality Standard
ESMP	Environmental and Social Management Plan
ESPH	Environmental and Social Practices Handbook
HSL	Horqin Sandy Lands
IMAR	Inner Mongolia Autonomous Region
PMO	Project Management Office
PRC	People’s Republic of China
TMFGB	Tongliao Municipal Forestry and Grassland Bureau

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This is to certify that the bearer of the Certificate has passed national examination organized by the Chinese government departments and has obtained qualifications for Environmental Impact Assessment Engineer.

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Introduction

Tongliao City, located in the east of IMAR, is a prefectural-level city. It is on the west of Siping City, Jilin Province, on the east of Chifeng City and Xilinguole League, IMAR, on the north of Shenyang City, Fuxin City and Tieling City of Liaoning Province, and on the south of Xingan League of IMAR and Baicheng City and Songyuan City of Jilin Province.

Horqin Sandy Lands, the total area of which reaches 77.63 million Mu*, stretches across IMAR, Jilin Province and Liaoning Province. It is the largest sandy land in China, whereas faces the most severe desertification. Its ecological environment is quite fragile. Its wind-break and sand-fixing function plays an important role in the ecological safety in North China. 52.7% (40.86 million Mu) of the Horqin Sandy Lands is in Tongliao City. With the loan from EIB, Tongliao City aims to strengthen the comprehensive control of Horqin Sandy Lands through the ecological forestation project to improve the ecological environment and promote the ecological industrial development, which is of great significance for the local farmers to overcome poverty and achieve prosperity.

This project locates in 8 banners/counties/districts including Horqin District, Kailu County, Horqin Left Middle Banner, Horqin Left Rear Banner, Naiman Banner, Kulun Banner, Zhalute Banner and Economic Development Zone. All these areas are typical rural environment far from urban. The sites selected in this project are main rural pollution sources whose environmental factors including atmosphere, water and sound are all meet national standards.

During the project construction, packaging wastes may be remained after forestation, and underwood planting and some waste gas may be discharged by the transport vehicles. During the site preparation, forestation may cause soil erosion and the damage of hyper gene vegetation. Other pollution includes packaging waste, insecticide and fertilizer pollution and traffic noise.

While these pollutions can be prevented or reduced by appropriate land area selection, reasonable mode of operation, less chemicals, better original vegetation protection, prompt waste disposal, close environmental factor monitoring and frequent public participation.

This project follows China’s industrial development layout and policies of forestry. It helps to improve the forest quality and structure, makes full use of foreign capital and creates significant economic, ecological and social benefits. The environmental management measures put forward in this project are efficient and economically feasible. There are no obvious environmental factor restrictions.

Based on the Law of PRC on EIA and the Classified Catalogue on EIA of Construction Project (2018), no forestry planting except for raw material forest base planting requires EIA approval, so there is no approval for this project.

According to the EIA requirements by EIB and the principle of safety first, this project will conduct EIA. Authorized by TMFGB, Beijing Research Institute of Uranium Geology will undertake the assessment. As

requested, BRIUG wrote the work plan and completed the environmental impact statement after the spot investigation and public participation survey.

At last, we would like to express our sincere appreciation to the leaders from departments of forestry at all levels and experts from Indufor who offered great guidance and support for this statement.

Content

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1 Pandect

1.1 Project Background

Tongliao City, located in the hinterland of Horqin Sandy Lands, is among the areas that face the most serious desertification in China. Through the persistent protection and governance for about four decades, 2 million Mu sandy lands inside the city have got preliminary treatment. However, over 2 million Mu sandy lands are not efficiently protected and governed. What's worse, these sandy lands are far more difficult to be treated. The trend of desertification has not yet restrained fundamentally and the ecological environment is still fragile, which is the main constraint on the social and economic development in Tongliao rural and pastoral areas. In recent years, due to the successive drought, the regional water table continuously goes down. The ecological water shortage results in the dried-up of the vegetation in some sandy lands, which dramatically accelerates the desertification. Especially in the 2 million Mu untreated sandy lands, the farmlands, villages, paths and grasslands begin to be covered by sands. Most residents in these areas are minority peoples whose production mode and life style is simple and backward. The low per capita income pushes them to reclaim farmlands, expand planting area and overgraze to increase income, which further destroys the sandy vegetation. Thus it forms a vicious circle of social and economic development and ecological construction in the sandy lands. If the problem is not solved in time, the living space, social stability and safe production of the agricultural and animal products will be largely influenced. Furthermore, the sustainable economic and social development and ecological safety of Tongliao City will be under serious threaten.

On the basis of the general requirements of building moderately prosperous society, promoting a conservation culture and building a beautiful IMAR, of the strategic blueprint of the IMAR Major Function-Oriented Zones and the realities of the forestry ecological protection and construction of the autonomous region, and of the main target of forestry development raised in the 13th Five-Year Plan for Forestry Development in IMAR and the national forestry development strategic plan, the Horqin Sandy Lands require integrated control to meet the demands of eastern China wind erosion and desertification control. Guided by the 13th Five-Year Plan for Forestry Development in Tongliao City, the project of an integrated control of Horqin Sandy Lands is initiated via artificial forestation, tree planting, enclosed protection and aerial seeding afforestation etc. By 2020, the sandy lands throughout the city will be preliminarily treated and protected, biodiversity loss will be relieved and wetland degradation will be decelerated. The ecosystem services of forests including climate change adaptation and soil and water conservation will see dramatic enhancement, which will largely improve the ecological environment. Till then, a land ecological safety system of biologically diversity will be preliminarily formed by forest vegetation as main body together with forests, grasslands and wetlands. It can be seen that it is urgent and necessary to conduct this project of An integrated Control of Horqin Sandy Lands by Ecological forestation.

With the loan of EIB, this project will greatly advance the ecological environmental construction and development in Horqin Sandy Lands and makes full use of foreign capital to create significant economic, ecological and social benefits. It follows China's industrial development layout and policies of forestry and is of great significance for the local farmers to overcome poverty and achieve prosperity.

1.2 Previous Environmental Governance Experiences and Lessons of Foreign Invested Forestry Projects

1.2.1 Environmental Governance Experiences

Tongliao City has successfully completed several foreign invested projects including the key engineering project of the ecological governance of Horqin Left Middle Banner, Tongliao City, IMAR co-conducted by China and South Korea; the carbon sequestration afforestation project loaned by EIB; and the pilot sustainable construction project in ManduLahugacha, BaiyinTarasumu, Naiman Banner (GEF Project)，EIB Loan Financed Demonstration Project of Carbon Sink Forest in IMAR. These projects introduced investment as well as advanced technology and management philology into Tongliao forestry industry. The forestry industry is developed and the management level is raised thanks for the following experiences:

(1) Establish project management organizations. During the preparation period, provincial, municipal and county level project leading groups and their management offices consisting of staff from the departments of Finance, Development and Reform Commission, Audit and Forestry are established. Experts in the fields of finance, forestry and environmental protection are allocated to the offices.

(2) Form a supporting system to guarantee the project management. In order to meet the requirements of the foreign loaned forestry project, a supporting system is formed to guarantee the operation and management of the project. The system, covering each link of the project, includes 10 items, namely organization coordination, plan control, quality supervision, finance management, material management, germchit supply, research promotion, environment monitor, information system and technology training.

(3) Formulate normative regulations. More than 20 rules and regulations on scientific norms are formulated, such as Project Management Regulation, Finance Management Regulation, Inspection Management Regulation, Project Environmental Protection Regulation, Project Environmental Monitor Plan, Pest and Disease Control Management Plan etc.

(4) Supervise the project quality strictly. The management follows the mode of training before the project, guidance during the project and inspection after the project. As for the quality supervision, the project will be inspected step by step and level by level.

(5) Pay close attention to the technical team training. Six training approaches are adapted: going out and inviting in, centralized training, training in meeting, site training, bringing technology to the countryside and Technical Understanding Paper Distribution.

(6) Strengthen the construction of “three teams and one site”. Three teams are Pest and Disease Prediction and Forecast Team, Pest and Disease Prevention Team and Environmental Protection Supervision Team. One spot is Pest and Disease Prediction and Forecast Site. The above experiences will definitely promote the successful practice of this Tongliao ecological afforestation project.

1.2.2 Main Lessons

(1) The single variety planting may cause potential threaten of Pests and Diseases to the artificial poplar forests. The ecological instability due to the single variety may breed Pests and Disease. Although timely prevention and treatment avoids serious consequences, the pests may still be harmful to the poplars.

(2) Farmers are used to traditional insecticides. They are unwilling to accept new things. Despite of repeated training on the choice of insecticides and their safe usage, it is difficult to change their existing habits. Typical cases may work.

These experiences and lessons have been drawn into the EMP of this project. This chapter works out an environmental monitor and training plan to reduce the potential negative influences. This chapter will also clarify the executive, monitoring and oversight responsibilities of each unit at the stages of project design, construction and operation.

2 Policies, Regulations and Management Framework

2.1 National and Local Laws, Regulations and Policies

2.1.1 National Laws, Regulations and Policies

(1) Environmental Protection Law of People's Republic of China 2015

(2) Forest Law of People's Republic of China 1998

(3) Law of People's Republic of China on the Protection of Wildlife 2018

(4) Water Law of People's Republic of China 2016

(5) Law of People's Republic of China on Prevention and Control of Water Pollution 2017

(6) Law of People's Republic of China on Prevention and Control of Atmospheric Pollution 2018

(7) Law of People's Republic of China on Prevention and Control of Ambient Noise Pollution 1996

(8) Law of People's Republic of China on Water and Soil Conservation 2010

(9) Law of People's Republic of China on Environmental Impact Assessment 2016

(10) Law of People's Republic of China on Sand Prevention and Control 2018

(11) Classified Catalogue on Environmental Impact Assessment of Construction Project2018

(12) Regulations of People's Republic of China on the Protection of Wild Plants, Decree No. 204 of the State Council,2017

(13) Regulations on the Prevention and Control of Forest Pests and Diseases, National Bureau of Forestry 1989

(14) Interim Measures on Afforestation Quality Management, National Bureau of Forestry 2001

2.1.2 Strategic Plan

(1) The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China

(2) Decision of the Central Committee of the Communist Party of China and the State Council on Accelerating Forestry Development

(3) China's National Program to Address Climate Change

(4) The 13th Five-Year Plan for Forestry Development (National Bureau of Forestry)

(5) National Strategy of Climate Change Adaptation (2013—2020)

(6) National Climate Change Planning (2014—2020)

(7) Action Plan on Climate Change Adaptation in Forestry (2016—2020)

(8) National Medium and Long Term Development Plan on the Prevention of Forest Fires

(9) Key Points of 13th Five-Year Plan for Climate Change in Forestry

(10) Plan on the Comprehensive Control of the "Dual Twenty Million Mu" Horqin Sandy Lands

2.1.3 Rules and Regulations

(1) Interim Measures on the Management of Projects Invested by International Financial Organizations and Foreign Governments

(2) Technical Regulations on Non-Commercial Forests Construction (GB/T 18337.3-2001)

(3) Technical Regulations on Afforestation (GB/T 15776-2016)

(4) Operative Regulations on Deforestation (LY/T1646-2005)

(5) Technical Regulations on Forest Tending (GB15781)

(6) Rules on Afforestation Operation Design(LY/T 1607-2003)

(7) Technical Standards for the Prevention of Forest Fires, Professional Standard of the People's Republic of China (LYJ127-91)

(8) Quality Grading on the Main Tree Seedling Species for Forestation (GB 6000-1999)

(9) Main Tree Seedling Species for Forestation (GB 6000-85)

(10) Construction Standards for the Comprehensive Control Project in Key Forest Fire Risk Zones

(11) Indices for the Estimation on the Shelterbelt Afforestation Investment, National Bureau of Forestry, 2016

(12) Specifications for evaluation of forest ecosystem services（LY/T1721-2008）

2.1.4 Local Laws, Regulations and Policies

(1) The 13th Five-Year Plan for Economic and Social Development of IMAR

(2) The 13th Five-Year Plan for Forestry Development of IMAR

(3) The 13th Five-Year Plan for Economic and Social Development of Tongliao City

(4) The 13th Five-Year Plan for Forestry Development of Tongliao City

(5) General Plan on the Comprehensive Control of the "Dual Twenty Million Mu" Horqin Sandy Lands

2.2 Related Policies of EIB

(1) Environmental and Social Practice Handbook, 2010.02

(2) The environmental impact assessment processes as specified in the European Union Directive 2001/42/EC of European Parliament and of the Council of June 27, 2001

2.3 Technical Regulations Related to EIA

(1) Technical Guideline for Environmental Impact Assessment · General Principles (HJ2.1-2016)

(2) Technical Guideline for Environmental Impact Assessment · Atmospheric Environment (HJ2.2-2018)

(3) Technical Guideline for Environmental Impact Assessment · Surface Water Environment (HJ/T2.3-2018)

(4) Technical Guideline for Environmental Impact Assessment · Underground Water Environment (HJ610-2016)

(5) Technical Guideline for Environmental Impact Assessment · Acoustic Environment (HJ2.4-2009)

(6) Technical Guideline for Environmental Impact Assessment · Ecological Effects (HJ19-2011)

(7) Technical Guideline for Environmental Risk Assessment on Construction Projects (HJ/T169-2004)

(8) Technical Regulations on Water and Soil Conservation Plan of Development and Construction Projects (GB50433-2008)

(9) Measures on Public Participation in Environmental Impact Assessment, Ministry of Ecological Environment, January 1st, 2019

2.4 Documents Related to Construction Projects

(1) Feasibility Study Report on the European Investment Bank Loan Ecological Forestation Project of An Integrated Control of the Horqin Sandy Lands in Tongliao City

(2) 2017 Report on the Work of the Tongliao Government

(3) Essential documents provided by TMFGB

3 General Situation

3.1 Basic Situation

(1) Project Name: European Investment Bank Financed Eco-Economic Shelter Forest Construction for Comprehensive Desertification Control of Horqin Sandy Land in Tongliao City

(2) Construction Sites: Tongliao City, IMAR Autonomous Region (Horqin District, Kailu County, Horqin Left Middle Banner, Horqin Left Rear Banner, Naiman Banner, Kulun Banner, Zhalute Banner and Economic Development Zone)

(3) Project Type: New Project

(4) Construction Unit: Tongliao Municipal Forestry and Grassland Bureau, governments of all banners, counties and districts

(5) Governing Body: Tongliao Government

(6) Project Aim: Through implementation of this programme, it aims to effectively control land desertification in the region, and continuously promote the construction of green ecological barrier for wind-breaking and sand-fixing, water and soil conservation, also protecting agriculture while promoting animal husbandry. By the end of the operation period, it is expected that a total area of 103,000 ha desertified land will be effectively controlled, the forest coverage rate will increase by 1.73%, the forest resources will continuously grow, and the coverage of forest and grass vegetation will steadily increase. During the implementation period, the annual amount of water conserved by forests will increase by 91.57 million m^3, annual conserved soil will reach 2.31 million tons, and annual detained dust will be 2.21 million tons. During the operation period (20 years), forest carbon storage will increase by 2.37 million tons through afforestation, with an annual average fixed carbon dioxide of 430,000 tons. Significant progress on comprehensive desertification control will be achieved in Horqin Sandy Land, both ecological environment and quality will be significantly improved, and the forestry industry will be developed steadily. Therefore, the programme will effectively lift farmers and herders out of poverty and promote the development of rural areas, and make positive contribution of the forestry in Tongliao City to respond to climage change.

(7) Project Period

Construction Period: 5 years (2020－2024)

Operation Period: 22 years (2025－2044)

(8) Investment Scale and Fund Resource

The total investment costs of the program is 4.999 billion RMB, of which, 1.956 billion yuan in 2020, 1.156 billion yuan in 2021, 1.334 billion yuan in 2022, 302 million yuan in 2023, and 251 million yuan in 2024.

3.2 Project Content

The programme will cover an area of 138,000 ha, of which:

(1) The total area of mixed forests of native tree species will reach 125,300 ha, which will accelerate desertification control in Horqin Sandy Land. Meanwhile, native precious forest with the purpose of timber production will also be developed, to improve the enthusiasm of forest farmers in forest tending and management, and achieve sustainable development of ecological shelter belts.

(2) The total area of eco-economic forests will be 10,000 ha, to upgrade and develop large-scale forest and fruit production in Tongliao City, and solve the problem that forest farmers have no enthusiasm in construction of ecological shelter belts due to limited economic benefits while using their land and other inputs.

(3) The total area of newly established nurseries will be 2,700 ha, to establish seedling support system of high-quality and native tree species (such as Phellodendron amurense and Fraxinus rhynchophylla), and economic fruit tree species (such as Malus spectabilis), to provide seedlings required for this programme .

In addition, capacity building will be strengthened from the aspects of fresh products storage, forest certification and project training, by using self-raised funds.

3.3 Project Layout

There are 1 municipal district, 1 development district, 1 county, 5 banners, and 1 county-level city under the administration of Tongliao City. According to the natural geographical location and desertification control status of each banner/county/district, 8 banners/counties/districts are chosen as project implementation areas, namely Horqin District, Kailu County, Horqin Left Middle Banner, Horqin Left Rear Banner, Naiman Banner, Kulun Banner, Zhalute Banner and the Economic and Technological Development District. The terrain is mainly hilly and mountainous and is not included in the scope of project areas.

On the basis of the above layout, the construction of each banner/county is summarized as below:

Table 3- 1 Project Sites and Afforestation Area（ha)

Site	Project type	2019	2020	2021	2022	2023	Total
Project Zone	Subtotal	59204.74	35234.61	43560.65			138000.00
	Mixed Forests of Precious Native Tree Species	54090.27	32576.46	38666.60			125333.33

Site	Project type	2019	2020	2021	2022	2023	Total
	Eco-economic forests	2895.60	2210.35	4894.05			10000.00
	Support Base for Seedling Trees	2218.87	447.80				2666.67
Kailu County	Subtotal	8831.34	8118.53	10267.33			27217.20
	Mixed Forests of Precious Native Tree Species	7994.78	7671.93	8538.11			24204.82
	Eco-economic forests	434.55	364.80	1729.22			2528.57
	Support Base for Seedling Trees	402.01	81.80				483.81
Horqin District	Subtotal	3279.14	1528.91	4547.85			9355.90
	Mixed Forests of Precious Native Tree Species	2877.20	1189.50	3699.56			7766.26
	Eco-economic forests		318.85	848.29			1167.14
	Support Base for Seedling Trees	401.94	20.56				422.50
Horqin Left Rear Banner	Subtotal	15968.06	6896.78	6466.61			29331.45
	Mixed Forests of Precious Native Tree Species	15695.55	6437.80	6303.49			28436.84
	Eco-economic forests	109.59	223.76	163.12			496.47
	Support Base for Seedling Trees	162.92	235.22				398.14
Horqin Left Middle Banner	Subtotal	8228.32	6761.56	8442.00			23431.88
	Mixed Forests of Precious Native Tree Species	7816.94	6383.10	7463.19			21663.23
	Eco-economic forests		357.90	978.81			1336.71
	Support Base for Seedling Trees	411.38	20.56				431.94
	Subtotal	1321.51	2617.27	1271.39			5210.17

Site	Project type	2019	2020	2021	2022	2023	Total
Kulun Banner	Mixed Forests of Precious Native Tree Species	668.06	2465.30	1173.51			4306.87
	Eco-economic forests	397.22	131.41	97.88			626.51
	Support Base for Seedling Trees	256.23	20.56				276.79
Naiman Banner	Subtotal	17178.12	4751.77	9482.95			31412.84
	Mixed Forests of Precious Native Tree Species	15372.20	4027.80	8504.14			27904.14
	Eco-economic forests	1620.99	696.08	978.81			3295.88
	Support Base for Seedling Trees	184.93	27.89				212.82
Zhalute Banner	Subtotal	3925.93	4406.55	2855.64			11188.12
	Mixed Forests of Precious Native Tree Species	3334.09	4332.60	2790.40			10457.09
	Eco-economic forests	290.86	53.39	65.24			409.49
	Support Base for Seedling Trees	300.98	20.56				321.54
Economic and Development Zone	Subtotal	472.32	153.24	226.88			852.44
	Mixed Forests of Precious Native Tree Species	331.45	68.43	194.20			594.08
	Eco-economic forests	42.39	64.16	32.68			139.23
	Support Base for Seedling Trees	98.48	20.65				119.13

Figure 3- 1 The General Layout of the Project

3.4 Technical Plan of the Project

3.4.1 Technical Plan for Forestation

Based on the layout of the five function zones by the 13th Five-Year Plan for Forestry Development, different species of trees and kinds of forests are planted in different sizes according to the particular features of and tasks for these five function zones. Combined with the forestry industrial structural supply-side reform, targeted poverty alleviation and rural vitalization, this project coordinates with other forestry and agriculture projects in plan or in progress to avoid redundant work. Taking advantage of the distribution and characteristics of existing soil resources, the project makes a reasonable adjustment of current single production mode and industrial structure of forestry, creating economic superiority from its natural conditions, to continuously improve the comprehensive function and benefits of the forestry ecological system.

3.4.2 Tree Species Selection for Forestation

1. Selection Rules

When selecting tree species, comprehensive factors shall be considered, including site conditions, irrigating conditions, cultivation objectives, management capacity, and seedling price. In addition, the willingness of implementation entities shall also be heard.

(1) Drought-tolerant, stress-resistant, low-water consumption, suitable for the local situation and deep-rooted native tree species.

(2) Strong ability of ecological protection (such as water and soil, wind and sand fixation) and carbon sequestration.

(3) High quality tree species for economic forest, with high output, and strong market demand.

(4) The local forestry germplasm resources are rich. Seedlings breeding technology is mature, sufficient seedlings supply.

2. Selected Species

According to the above principles, the tree species listed in Table 3-2 are selected for afforestation. Among them, Pinus tabulaeformis, Pinus sylvestris var.mongolica, Ulmus pumila, Populus simonii, and Salix matsudana are designated for the construction of desert border forest and shelter forest for farmland and pasture. Tree species with colorful leaves such as Syringa, Caragana microphylla and Amorpha fruticose are designated for greening and beautifying roads, intersections and streets in the villages. Pinus tabulaeformis (Pinus koraiensis grafted by Pinus sylvestris var. mongolica), Ulmus pumila, Armeniaca vulgaris, and Malus baccata are designated to build sand-fixing sand-blocking forests in areas with severe desertification situation. Morus alba, Hippophae rhamnoides, Armeniaca vulgaris, Xanthoceras sorbifolium, Robinia pseudoacacia, Xanthoceras sorbifolium, and Acer truncatum are designated as feed, energy and medicinal use, but also for the cultivation of sand-fixing and sand-blocking forests. Fraxinus mandshurica, Fraxinus rhynchophylla, Juglans mandshurica, Phellodendron amurense and etc., are designated for cultivate precious large-diameter timber forests.

(1) Construction of mixed forests of native tree species. Selected tree species include Hippophae rhamnoides, Armeniaca vulgaris, Xanthoceras sorbifolium, Acer truncatum, Morus alba, Pinus tabulaeformis, Pinus koraiensis grafted by Pinus sylvestris var. mongolica, Crataegus pinnatifida, Fraxinus mandshurica, Fraxinus rhynchophylla, Phellodendron amurense, Juglans mandshurica, Sorbus pohuashanensis, Euonymus bungeanus, Malus baccata, Ulmus pumila, Betula platyphylla, Malus spectabilis, Populus simonii, Robinia pseudoacacia, Salix matsudana, Caragana microphylla, Amorpha fruticosa, Pinus sylvestris var. mongolica, Syringa, Prunus cerasifera and other arbor and shrub species.

(2) Construction of eco-economic forest. Main species include Chinese pear-leaved crab-apple, Huangtaiping apple (crab apple),and Hawthorn.

(3) Seedling support base construction. It can be used to cultivate the seedlings needed for this project, and at the same time, it has the afforestation capacity to serve other ecological projects.

Table 3- 2 Tree species selected for by this project

Target afforestation type	Common name of tree species	Latin name	Age for forest maturity/ rotation age (year)
Mixed forest of native tree species	Seabuckthorn	*Hippophae rhamnoides*	Shrubs

Target afforestation type	Common name of tree species	Latin name	Age for forest maturity/ rotation age (year)
	Apricot	*Armeniaca vulgaris*	Shrubs
	Yellowhorn	*Xanthoceras sorbifolium*	41
	Shantung Maple	*Acer truncatum*	41
	Mulberry	*Morus alba*	41
	Chinese red pine	*Pinus tabulaeformis*	41
	Mountain hawthorn (Hawthorn)	*Crataegus pinnatifida*	41
	Manchurian ash	*Fraxinus mandshurica*	51
	Chinese ash	*Fraxinus rhynchophylla*	51
	Amur cork tree	*Phellodendron amurense*	51
	Manchurian walnut	*Juglans mandshurica*	51
	Rowan fruit/ Mountain ash	*Sorbus pohuashanensis*	Sub-arbor
	Spindletree	*Euonymus bungeanus*	Sub-arbor
	Siberian crab apple	*Malus baccata*	41
	Siberian elm	*Ulmus pumila*	41
	Japanese white birch	*Betula platyphylla*	21
	Chinese Flowering Apple	*Malus spectabilis*	Sub-arbor
	Littleaf Caragana	*Caragana microphylla*	Shrubs
	Cherrry plum	*Prunus cerasifera*	Sub-arbor
	Desert false indigo	*Amorpha fruticosa*	Shrubs
	Lilac	*Syringa*	Shrubs

Target afforestation type	Common name of tree species	Latin name	Age for forest maturity/ rotation age (year)
	Simon poplar	*Populus simonii*	21
	Weeping willow	*Salix matsudana*	21
	Black locust	*Robinia pseudoacacia*	21
	Scots pine	*Pinus sylvestris* var. *mongolica*	41
Eco-economic forest	Crab apple	*Malus asiatica Nakai*	25-30
	Huangtaiping apple	*Malus pumila*	25-30
	Mountain hawthorn	*Crataegus innatifida*	25-30

3.4.3 Seedlings Selection

Seedlings selected for afforestation should be Grade I and II seedlings specified in the Seedling Quality Classification of Main Afforestation Tree Species (GB6000-1999). Among them, seedlings used for the mixed forest of native tree species should be Grade I and Grade II seedlings. Seedlings used for eco-economic forest should be Grade I seedlings. The quality inspection, harvesting, packaging, transportation, storage and other activities should be consistent with the provisions of the Seedling Quality Classification of Main Afforestation Tree Species (GB6000-1999) and Container Seedling Technology (LY/T1000-2013).

Seedling selection requirements by tree species see table 3-3.

Table 3- 3 Seedling selection requirements by tree species

Construction Content	Tree species	Seedling specification
Mixed forests of native tree species	Model Ⅰ Pinus tabulaeformis (Pinus koraiensis grafted on stock of Pinus sylvestris var. mongolica), Ulmus pumila (Morus alba, Acer truncatum, Euonymus bungeanus, Armeniaca vulgaris, Crataegus pinnatifida, etc.)	Coniferous trees: 4 years old or above, full top bud, seedling height 60cm or above container transplanted seedlings or seedlings wth soil ball; Broad-leaved trees: 2 years old or above. Container based seedlings with height of over 60cm.
	Model Ⅱ Xanthoceras sorbifolium, Acer truncatum, Morus alba, Hippophae rhamnoides and etc.; Fraxinus mandshurica, Fraxinus rhynchophylla, Phellodendron amurense, Juglans mandshurica, Quercus mongolica and etc.; Sorbus pohuashanensis, Malus spectabilis, Prunus cerasifera and etc.	2 years old or above, container based seedlings, height 60cm or above, Grade I seedlings.

Construction Content	Tree species	Seedling specification
	Model Ⅲ Pinus tabulaeformis (Pinus sylvestris var. mongolica, Ulmus pumila, Salix matsudana, Euonymus bungeanus, Acer truncatum, Populus, Prunus cerasifera and etc.), shrubs with flower, such as Syringa (Caragana microphylla and etc.)	Conferous trees: 4 years old or above arbor trees. height of 100cm or above, container transplanted seedlings or seedlings wth soil ball, with full top bud; Broad-leaved trees: transplanted seedlings, DBH of 2.5cm above, branches start 1.8m or above; Shrubs with flower: 2 years old or above, at least three branches at the seedling root-zone.
	Model Ⅳ Crataegus pinnatifida, Morus alba, Hippophae rhamnoides, Armeniaca vulgaris, Xanthoceras sorbifolium, Robinia pseudoacacia and etc.	2 years old or above, container based seedling with the height of 60cm or above.
Eco-economic forests	Model V Malus asiatica Nakai (Malus pumila, Crataegus pinnatifida)	1 year old, grafted seedlings, ground diameter of 0.8cm above, seedling height of above 0.8m.

3.4.4 Forestation Models

According to the site status and hydrothermal conditions of Horqin Sandy Land, namely, site condition (sand, sand marsh, sandy meadow), sand type (moving sand, semi-fixed sand, fixed sand) and climatic conditions (arid area, semi-arid area and semi-humid area), complying with the principal of mixing coniferous and broad-leaved tree species, arbor and sub-arbor, arbor and shrub, the traditional afforestation model of pure forest dominated by Populus will be abandoned. Mixed forests of native tree species and eco-economic shelter belts will be established, to promote native tree species and deep-root tree species with strong-resistance, and mixed forests of which the post-successive tree species are constructive species. Stable forest community with multiple layers, thick canopy, and ecological niche will be formed, to stably play the role of forest vegetation in sand fixing and blocking, soil and water protection, water source conservation, and other ecological benefits. Eco-economic forest will be established with well-known and high-quality new varieties that have been tested and promoted as the dominant species, combined with understory interplanting, to increase the productivity and output of forest land, and increase the income of economic forest products.

The afforestation models, including 4 mixed forest of native tree species and 1 eco-economic shelter forest models, are designed using research achievements and technology of desertification control, and successful models of sandification control and afforestation in recent years, with consideration of the project content. Detailed afforestation models are shown in Table 3-4.

A. Mixed forest of native tree species

(1) Afforestation Model Ⅰ

The model is mainly applied to construct mixed forests with the purpose of sand fixing and blocking, in afforestation sites with relatively big slope (25°-35°) and severe sandification issues. Land preparation will be hole, strip or groove based, with specifications of 40cm×40cm×40cm or round hole of 40cm×40cm, groove opening width of 60cm or above. The initial planting density is 1425 plants/ha, and the afforestation specification is 3×3m for coniferous trees and 3×2m, 2×3m or 1.5×4m for broad-leaved trees. Main tree species include Pinus tabulaeformis (Pinus koraiensis grafted on stock of Pinus sylvestris var. mongolica), Ulmus pumila (Morus alba, Acer truncatum, Euonymus bungeanus, Armeniaca vulgaris,

Crataegus pinnatifida, etc.). For shifting sandy land, a small number of biennial shrubs such as Caragana microphylla and Amorpha fruticose, as well as above two-year-old Populus trees can be used, but the proportion shall not be over 15%. The mixing ratio is 4:6, in Mosaic, strip, block shape, in a group or naturally mixed.

(2) Afforestation Model Ⅱ

This model is mainly applied to construct ecological shelter forests with the purpose of sand fixing and blocking, in afforestation sites with relatively small slope (15°-25°) and relatively dry sandy swamp. Mixed forests are established. Land preparation will be strip, groove or hole based, with specifications of 40cm×40cm×40cm or round hole of 40cm×40cm, groove opening width of 60cm or above. The initial planting density is 1665 plants/ha or above, afforestation specification is 3 × 2m, 2 × 3m, 1 × 6m or 1.5 × 4m. Main arbor tree species include Xanthoceras sorbifolium, Acer truncatum, Morus alba, Hippophae rhamnoides and other tree species for energy forest; Fraxinus mandshurica, Fraxinus rhynchophylla, Phellodendron amurense, Juglans mandshurica, Quercus mongolica, Celtis nervosa and other native species; Sorbus pohuashanensis, Malus spectabilis, Malus royalty, Prunus triloba, Prunus cerasifera, Prunus padus and other tree species with colorful flower, leaf and fruit, to establish precious and colorful forest. The mixing ratio is 6:4, in Mosaic, strip shape, block shaped.

(3) Afforestation Model Ⅲ

This model is mainly applied to construct shelter forests for key greening area as well as farmland and pastures, such as desert border forest, forest for road protection river/reservoir bank protection and forest around the village. Mixed forests are designed, including arbor-shrub, arbor-arbor mixing. Hole or groove shaped land preparation will be applied, with specifications of 80cm×80cm×60cm or 80cm×60cm (diameter×depth), groove opening width of 60cm or above. The initial planting density is 1665 plants/ha or above, with afforestation specification of 3×2m. The width of new forest shall be in accordance with the allowed width of existing forest land, at least two rows, wider if it is applicable. Main tree species are Pinus tabulaeformis, Pinus sylvestris var. mongolica, Ulmus pumila, Salix matsudana, Euonymus bungeanus, Acer truncatum, Populus, Prunus cerasifera and other arbor tree species. Shrubs include Caragana microphylla, Syringa and etc, with a plant and row spacing of 3×2m.

(4) Afforestation Model Ⅳ

This model is mainly applied to the construction of wind breaking and sand fixing forests in relatively flat areas (slop less than 15°) with serious sandification problems. Mixed forest will be established, hole or groove shaped land preparation (40cm × 40cm × 40cm or 40×40cm, 80×80cm hole) will be adopted, with groove opening width of 60cm or above. The initial planting density is 1665 plants/ha, with afforestation specifications of 2×3m, 1.5×4m, 1.2×5m, 3×5m or 3×4m (Armeniaca vulgaris and etc.), 1×6m (forest- herbs mixing). Main tree species include Crataegus pinnatifida, Morus alba, Hippophae rhamnoides, Armeniaca vulgaris, Xanthoceras sorbifolium, Robinia pseudoacacia and other species that have strong stress resistance for food, medicine, and feed use. The mixing ratio is 6:4, in strip, block or inter-row mixing.

B. Eco-economic forest

(1) Afforestation Model Ⅴ

This model is mainly applied to the construction of eco-economic forests on desertified non-stocked forest land, mainly distributed in both sides of the Xinkai River, Xiliao River, Jiaolai River and Qing River. Main tree species include native economic species with strong stress resistance, such as Malus asiatica Nakai, Malus pumila, Crataegus pinnatifida and etc., with a mixing ratio of 6:4. Strip based mixing will be applied. The plant spacing and row spacing of Malus asiatica Nakai (Malus pumila, Crataegus pinnatifida, etc.) should be 3 × 6 m or 3.6 × 5m, and the initial planting density is 555 plants/ha. Hole-like land preparation will be applied, with specification of

80cm×80cm (round hole). Permanent irrigation will not be carried out. In case of extreme dry weather, rain water collecting pool will be built on the side for irrigation use, or to introduce water from the river.

Table 3- 4 A Summary of Forestation Models

Project type	Afforestation model	Landform type	Tree species	Initial planting density(plants/ha)	Plant spacing（m×m）	Tree species composition	Mixing ratio	Mixing method	Afforestation type	Afforestation season	Land preparation
Mixed forest of native tree species	Model Ⅰ	Large scale desertification control area with relatively big slope (25°-35°) and serious sandification problems	Pinus tabulaeformis (Pinus koraiensis grafted on stock of Pinus sylvestris var. mongolica), Ulmus pumila (Acer truncatum, Armeniaca vulgaris, Morus alba, Euonymus bungeanus, Crataegus pinnatifida, etc.)	1425	3×3m for coniferous trees and 3×2m, 2×3m or 1.5×4m for broad-leaved trees	Mixed	4：6	Mosaic, strip shape, block shaped, in a group or naturally mixed	Seedling planting	Spring or fall	Hole, strip or groove based
	Model Ⅱ	Relatively dry sandy swamp with relatively small slope (15°-25°)	**Energy oriented tree species:** Xanthoceras sorbifolium, Acer truncatum, Morus alba, Hippophae rhamnoides and etc.; **Precious native tree species:** Fraxinus mandshurica, Fraxinus rhynchophylla, Phellodendron amurense, Juglans mandshurica, Quercus mongolica and etc.; **Fruit trees with colorful flower/leaf/fruit:** Sorbus	1665	3×2, 2×3, 1×6, 1.5×4	Mixed	6:4	Mosaic, strip or block mixing	Seedling planting	Spring or fall	Hole, strip or groove based

Project type	Afforestation model	Landform type	Tree species	Initial planting density(plants/ha)	Plant spacing（m×m）	Tree species composition	Mixing ratio	Mixing method	Afforestation type	Afforestation season	Land preparation
			pohuashanensis, Malus spectabilis, Prunus cerasifera and etc.								
	Model Ⅲ	Plain meadow, roads in the village,	**Arbor trees:** Pinus tabulaeformis, Pinus sylvestris var. mongolica, Ulmus pumila, Salix matsudana, Euonymus bungeanus, Acer truncatum, Populus, Prunus cerasifera and etc.; **Shrubs with flower:** Caragana microphylla, Syringa and etc.	1665	3×2 2×3	Mixed	-	-	Seedling planting	Spring or fall	Hole or groove based
	Model Ⅳ	Relatively flat area (slope less than 15°) with serious sandification problems	Crataegus, Morus alba, Hippophae rhamnoides, Armeniaca vulgaris, Xanthoceras sorbifolium, Robinia pseudoacacia and etc.	1665	2×3, 1.5×4, 1.2×5; Prunus armeniaca: 3×5 or 3×4; Forest-herbs mixing model: 1×6	Mixed or Forest-herbs model	6:4	Strip based or inter-row mixing	Seedling planting	Spring or fall	Hole or groove land preparation

Project type	Afforestation model	Landform type	Tree species	Initial planting density(plants/ha)	Plant spacing（m×m）	Tree species composition	Mixing ratio	Mixing method	Afforestation type	Afforestation season	Land preparation
Eco-economic forest	Model Ⅴ	Non-stocked forest land in sandy and relatively flat area	Malus asiatica Nakai, Malus pumila, Crataegus pinnatifida, etc.	555 +3330	3×6 or 3.6×5 for Malus asiatica Nakai and etc.		6:4	-	Seedling planting	Spring or fall	Hole shaped land preparation

3.4.5 Site Selection

Suitable sits for afforestation are selected according to the hydrothermal conditions in the project area and conditions suitable for native tree species, as well as considering the willingness of farmers and herders, while taking into account the ecological benefits and income growth for local farmers and herders.

Afforestation should be conducted only on the barren or degraded areas which is suitable for forest, including non-stocked forestland, open forestland and land suitable for forest.

(1) For mixed forest of native tree species, afforestation plot should be land suitable for forest (desertified moving or semi-fixed sandy land) and open forestland with poor site conditions.

(2) Regarding plot for eco-economic forest, afforestation plot should be barren non-stocked forestland.

(3) Plot for newly established nursery should be land that is suitable for breeding seedlings but never used for breeding or seedlings previously breed are not qualified or need to be re-breed.

Geomorphic types are mainly mesa, hills, sandy land, desertification land, etc.The selection of sites should not involve water source reserves, nature reserves, military sensitive zones and other sensitive environmental areas

3.4.6 Seedling Planting

1. Planting Approaches

Planting quality is the main factor of the seedling survival rate, so planting should strictly follow the request. Only grade Ⅰ and Ⅱ seedling should be used and the density should be determined according to the forestation models. Planting in spring is the priority, while in the areas where farmers plant in deep autumn, the fast growing timber species like Acer truncatum Bunge grown in the plain can be promoted. One month before planting, bury the topsoil back to underground and spread enough base fertilizer. Planting should be conducted in cloudy day or after raining. Planting in sunny or windy day, low soil moisture and soil freezing period should be avoided. The depth of planting depends on the nature of different species. The key point is deep planting, wide root space and firm soil. There is a skill for this: cover the root three times, tread on it two times and raise the seedling to check whether it is firm enough. The key is to make sure the soil is firm enough after planting. Eco-economic forests and timber forests in plains should be watered immediately if possible. Different species should be planted together in belt shape: within 1 hectare, deep and shallow rooted trees or conifers and hardwoods should be planted together. In Eco-economic forests, two rows of Cerasus humilis, Lycium ruthenicum Murr., aralia elata seem and tree seedlings shall be planted between each row of Saiwaihong or golden red apple (apple pear). In the support base for seedlings, native precious colored leaf and fruit tree species and seedlings for Eco-economic forest are cultivated. There are two approaches for seedling planting: first, plant the seedlings in light containers with appropriate

soil; second, plant the seedlings in the open field, such as sowing, transplanting, cutting and grafting.

2. Fertilization

Spread base fertilizer while planting. Due to objective conditions and economic limitations, mixed forests of native precious tree species are not fertilized except for some fast growing timber species and economic tree species. Main base fertilizer is barnyard manure, while nitrogenous phosphate fertilizer can also be applied. Topdressing should be used in growing season or hibernation period. The detailed type, amount and ratio of fertilizer depend on the chemical analysis result of the soils. In winter, barnyard manure and cake fertilizer are best for Eco-economic forest.

3. Irrigation

Planting should be closed followed by irrigation to improve survival rate.

3.4.7 Tending Management

Tending and patrol are necessary to avoid damages by human and animals. Tending management is one of the key steps for forestation. The tending of timber tree species should be conducted during the growth period. Tending includes weeding, tiller cutting, earth up, pruning, fertilizing and irritation. Tending usually lasts 3 years, once to three times every year. Eco-economic forests should be tendered (pruning, bending, fertilizing and irrigation etc.) each autumn. Farm manure is the main fertilizer. For some delicate economic tree species, pruning should be guided by experts.

1. Cutting and Weeding

Weeds and shrubs that may inhibit the growth of the seedlings should be eliminated.

2. Watering

Within two weeks since planting, seedlings should be watered once a week. After that, pay attention to the soil moisture and prevent drought. Within three years since planting, water in each October or November to prevent autumn and spring drought. Water-saving irrigation is encouraged. For mixed forests of native precious tree species and fruit economic forests, water three times in the first year, twice to three times in the following two years and then stop watering.

3. Topdressing

Spread topdressing for three years since planting, once a year. For Eco-economic forests, during the growth period topdressing can be integrated with watering by adding some chemical fertilizer like urea and some compound fertilizer, once to twice a year. 20-30cm from the seedlings, dig a channel of 15-20cm and then expand it year by year. Water the channel and over it with soil after topdressing.

4. Replanting

Some seedlings may die due to various reasons. To ensure an even distribution, replant in the first winter or next spring. Use big seedlings and water on them. Make sure the trees grow orderly.

5. Managing and Protecting

Managing and protecting the forests is the key of forestation, and it is even more important than planting. Rangers should be determined before forestation. They should be healthy and responsible, have a passion for forestry and get along well with others. Rangers should go on duty immediately after planting. The size of forests assigned to them depends on the difficulties to manage. Generally one ranger is responsible for 30-50 hm^2 forests. Their rights and responsibilities should be clear. They should be inspected regularly and the results directly decide their income.

3.4.8 Infrastructure and Supporting Facilities

Judging by the productivity, fresh storage containers with the capacity are necessary to preserve fruits for sale and seeds and cuttings collected from the support base for seedlings.

4 The Natural Environment and Social and Economic Status of the Project Area

4.1 Natural Conditions

4.1.1 Geographic Location

Tongliao City is in the east of IMAR and the west of Songliao Plain. It is on the west of Jilin Province, on the east of Chifeng City and Xilinguole League, on the north of Liaoning Province, and on the south of Xingan League. The total area reaches 59.535 thousand km^2. It is about 418 km length from south to north and 370 km width from east to west. It is located at 119°14′～123°43′ E and 42°15′～45°59′ N. This project is conducted in 8 banners/counties/districts including Horqin District, Kailu County, Horqin Left Middle Banner, Horqin Left Rear Banner, Naiman Banner, Kulun Banner, Zhalute Banner and Economic Development Zone.

4.1.2 Geomorphy

Tongliao City is in the hinterland of Liaohe Plain. It presents in a saddle shape of high in north and south and low in the middle. It is about 396 km length from south to north and 270 km width from east to west. The total area reaches nearly 60 thousand km^2.The north of Tongliao City is the Greater Hinggan Mountains, the south is loess hills and in the middle are plains. Plain is the main body of the city. The rocky hills, at an altitude of 400-1300m, of the southern stretching branch of the Greater Hinggan Mountains possess 22.8% of the city; the loess hills and shallow mountains, at an altitude of 550-730m, at the edge of mountains in western Liaoning possess 7%; while the sandy alluvial plains, at an altitude of 120-320m, in the Xiliao River areas possess 70.7% of the city. Between the alluvial plains and the hills are wavy dunes and sands at an altitude of 200-400m. There are several mountains in the city: Hanshan Mountain, Aqima Mountain, Laodao Mountain and Qinglong Mountain.

4.1.3 Soil Resources

The zonal soil in Tongliao City is chestnut soil. There are other 10 types of soils including Aeolian sandy soils and grey meadow soils etc. 43.5% of the total area are Aeolian sandy soils.

The mountains in the northern Tongliao are parts of the northern Greater Hinggan Mountains. Most soils in the mountains are chemozem and chestnut soils. Meadow soils, dark brown soils and bog soils distribute in small areas of the mountains. Soils in the plains are calcareous and salinized grey meadow soils, Aeolian sandy soils and a few salinized soils. The loess hills are mainly distributed by Castano-cinnamon soils together with a few cinnamon soils, fluvo-aquic soils, chestnus soils, albic soils, bog soils and skeletal soils etc.

4.1.4 Climate and Meteorology

(1) Temperature

Tongliao City belongs to temperate continental monsoon climate. The yearly average temperature in Tongliao is 0-60~6℃. The plains along the rivers are a bit warmer than the south and northeast of the city. July is the hottest month of a year and the monthly average temperature reaches 23.4-24.0℃; the coldest month is January when the monthly average temperature ranges from -13.4 to -14.7℃. The highest temperature reaches 41.7℃, and lowest -30.4℃. Frost-free period starts from 8 or 9, May and ends in 27 or 28, September. The period lasts 126 to 171 days, 143 to 144 days in average.

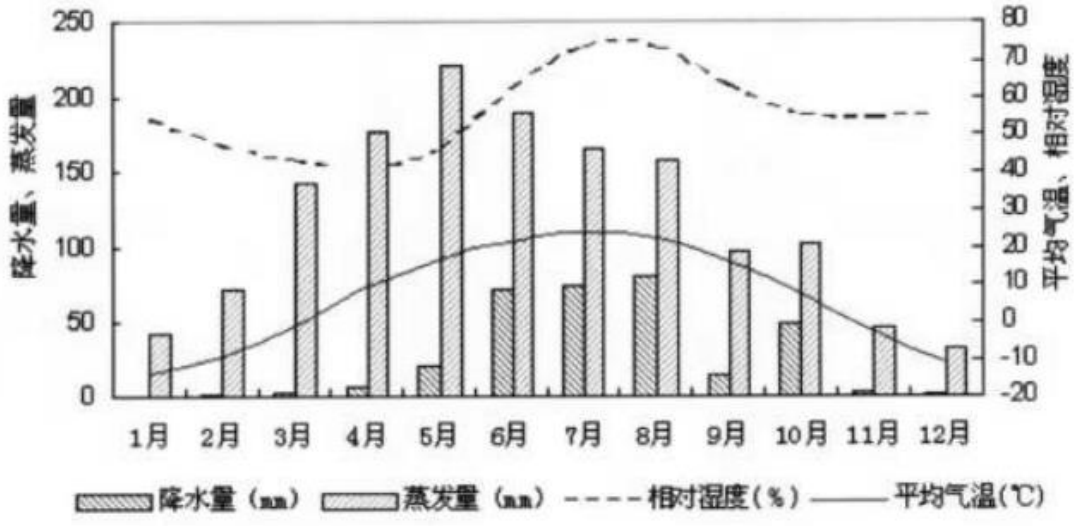

Figure 4- 1 Monthly Average Numbers of Metrological Factors in Tongliao

(2) Precipitation and Evaporation

The average annual precipitation in Tongliao is 341.8mm. In Spring (March to May), the precipitation reaches 41.6mm, 12% of the total annual precipitation; in summer (June to August), the amount is 244.5mm, 72% of the total; in autumn (September to October), the amount is 47.9mm, 14% of the total; in winter (November to February), the number is 7.8mm, 2% of the total. 91% of the precipitation, as high as 310.7mm, falls in April to September. The precipitation varies year from year, and the yearly average rate of change reaches 20%. The average annual precipitations present different periods of the city. From 1953 to 1963, the city was in a high moisture period when the average annual precipitation was 389mm; while from 1964 to 1982, it was a relative low moisture period when the number was only 306mm. Since 1983, the city entered another high moisture period when the number reached as high as 406mm.

(3) Wind Regime

The project zone belongs to mid-latitude westerlies where the cold fronts from west, north west and north pass by. In addition, the zone locates in droughts of the south of the Greater Hinggan Mountains, the northeast of Yanshan Mountains and Nuluerhu Mountain and the west of Changbai Mountain. It is characterized by high weed speed, frequent windy days, blowing sand and dust storm. The yearly average wind speed reaches 2.91m/s. In spring, the wind speed reaches 4.9~5.5m/s and in summer,2.8~3.8m/s. The northwest wind is most frequent in a year and the frequency reaches 12% (the average frequency of westerly northwest wind, northwest wind and northerly northwest wind is 28%). Northwest wind is followed by south wind, the frequency of which is 8% (the average frequency of southerly southeast wind, south wind and southerly southwest wind reaches 20%. From October to next April, northwest wind is most frequent. From June to August, south wind takes the upper hand. In May and September, the frequency of northwest wind equals to that or south wind. Fresh gale and stronger winds blow 8 to 57 days in a year, with an average of 27.8 days. 58% (16.1 days) of the annual average days falls in Spring.

4.1.5 Hydrologic Condition

1. Surface Water

Tongliao boasts over 600 lakes, 121 reservoirs of all sizes and 47 rivers with drainage areas of above 100 km^2. The main water system is the Xiliao River system which includes its branches Xar Moron River, Laoha River, Jiaolai River and Xinkai River. Lower reaches of Dongliao River, some branches of Liao River and a part of Daling River and Huolin River also flow through Tongliao. Due to successive drought years, the water table goes down and Liao River, Xinkai River and Jiaolai River and over 70 medium and small reservoirs often dry up.

In Horqin District, there are two rivers (Xiliao River and Qing River) and three reservoirs, and the gross reservoir capacity reaches 288 million m^3. Underground water (bicarbonate freshwater) is mainly used. The underground water in the quaternary system is of high quality and capacity. The amount of shallow layer water reaches 5.4 billion m^3 and intermediate water 13.2 billion m^3.

Kailu County belongs to Xiliao River Area, Xiliao River System. As long as 320 km of Xiliao River, Xinkai River, Xar Moron River, Jiaolai River and Wulijimuren River flow through the county. The area of reservoirs inside the county reaches 106 thousand Mu. 26 reservoirs occupy more than 100 Mu. Most natural ponds are available. 13 of the ponds have been put into use, and the total area reaches 37.8 thousand Mu.

There are 11 rivers inside Horqin Left Rear Banner. Some main rivers are Dongliao River, Xiliao River, Hong River, Qinggou River, Wujiazi River and the continental river of Chaotulu Town. Ganxie, Xinmin, Ganji, Yiliao and Baliao run through the banner, connecting rivers and 325 lakes of 92523 Mu. 143 lakes of 50295 Mu flow all year round. The total length of the rivers reaches 1188.5 km and the area reaches5443.5 km^2.

There is rich water resource within Horqin Left Middle Banner. Xiliao River, Xinkai River, Wulijimuren River and Qing River flow through the banner. The total runoff is 585 million m^3. It

varies largely in different seasons and years. Most rivers dry up in the dry season. There are 5 medium sized reservoirs and 97 thousand Mu of natural surface water.

There are 3 main rivers and 21 branches inside Kulun Banner, all belong to Liu River Area, Liao River System. The total drainage area reaches 2860km^2. The average runoff depth is 77.7 mm, and the annual runoff amount is 22.2 million m^3.

Naiman Banner is densely distributed with rivers including Laoha River and Xiliao River in the north, Jiaolai River and Mengke River in the middle, and Mangniu River and Dugui River in the south. Jiaolai River System is the main water system. The runoff amount varies largely in different seasons and years. Most rivers dry up in the dry season. The annual runoff amount is 670 million m^3. There are 5 medium and large reservoirs, 21 small reservoirs and 31 small dams. 0.13 Million Mu of surface water achieves the standard to raise fishes.

9 main rivers and 49 branches flow through Zhalute Banner. Huolin River, Wubuerkunduleng River, Arikunduleng River in the north belong to Taoerhe River System. Wuegeqi River, Baiyinjvliu River, Dengling River (Lubei River) in the middle and Wulijimuren River, Dalelin River and Bayantala River in the south belong to Xiliao River Area, Xinkai River System. Wulijimuren River originates from Balinzuo Banner, Chifeng City and all other rivers originate from Zhalute Banner. The total area of as many as 90 small lakes reaches 38373 Mu. 56 lakes of more than 100 Mu occupy 37380 Mu in total。Most lakes locate in Wulijimuren, Daolaodu and Bayanmangha.

Xiliao River flows through the Economic Development Zone. The runoff amount reaches 585 millionm^3. It varies largely in different seasons and years. Most rivers dry up in the dry season.

The distribution of Xiliao River system see Figure 4-2.

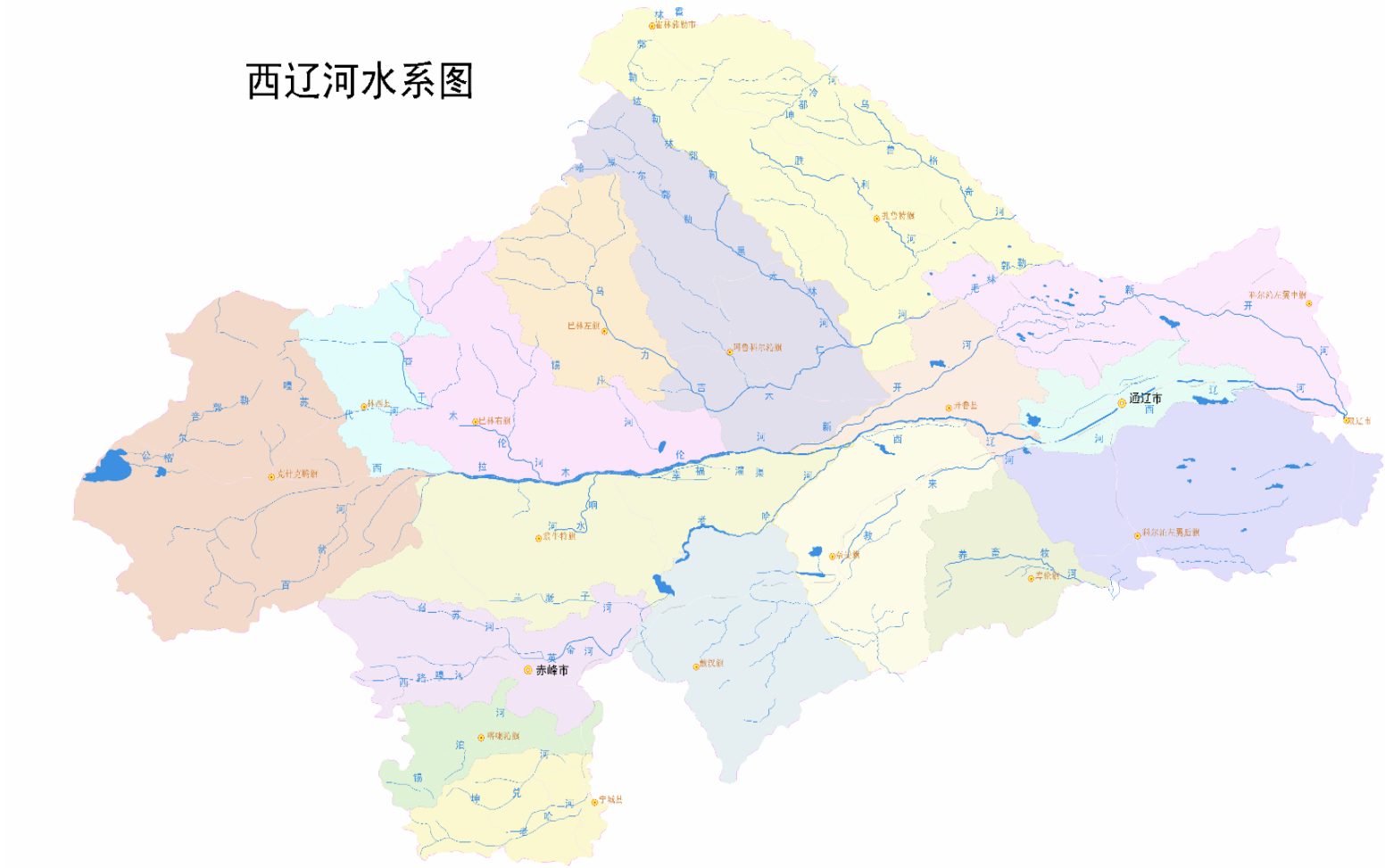

Figure 4-2 Distribution of Xiliao River System

2. Underground Water

In Tongliao City is widely distributed with underground water of four main types: quaternary pore phreatic water in loose rock mass, bedrock fissure water, pore fissure water in loess hills and fissure water in basalt terrace. The quaternary pore phreatic water is the main water supply source of the city. The capacity volume of underground in Tongliao is 3.53 billion m^3, 2.76 billion m^3 of which can be exploited. The comprehensive underground water supply reaches as high as 3.68 billion m^3, 70% of the total water resources. However, the distribution is uneven in different regions. The richest underground water resources remain in the bogs followed by the mid plains and mountains in the south and north. The depth of underground water in the plains is 70-100 meters. The depth of micro confined aquifers is 30-70 meters. The daily water yield reaches 2000-3000 m^3 for a 10 inch single-well of 20 m depth.

4.1.6 Land Use

The total land area of Tongliao is 5.983 million hectare, 71.88% (4.3 million hectare) of which is used as farmland. 23.9% (1.03 million hectare) of the farmland is arable land, 0.41% (17.496 thousand hectare) is garden plot, 31.33% (134.73 thousand hectare) is woodland, 42.73% (1.84 million hectare) is grassland, and 1.63 % (70.27 thousand hectare) is for other use.。

3.61% (261.23 thousand hectare) of the total land area is used as building land, 3.8% (8.21 thousand hectare) of which is urban construction land, 59.06% (12.90 thousand hectare) is organic town land, 7.13% (15.42 thousand hectare) is land for mining and independent construction, 21.65% (46.81 thousand hectare) is land for water and transportation, and 2.4% (5.18 thousand hectare) for other use.

The current land use of Tongliao City see Figure 4-3.

4.2 Ecological Environment

4.2.1 Ecological Function Regionalization

Based on the Ecological Function Regionalization of IMAR, the sites of this project belong to the protective functional region of paleobiodiversity.

The ecological function regionalization of IMAR see Figure4-4.

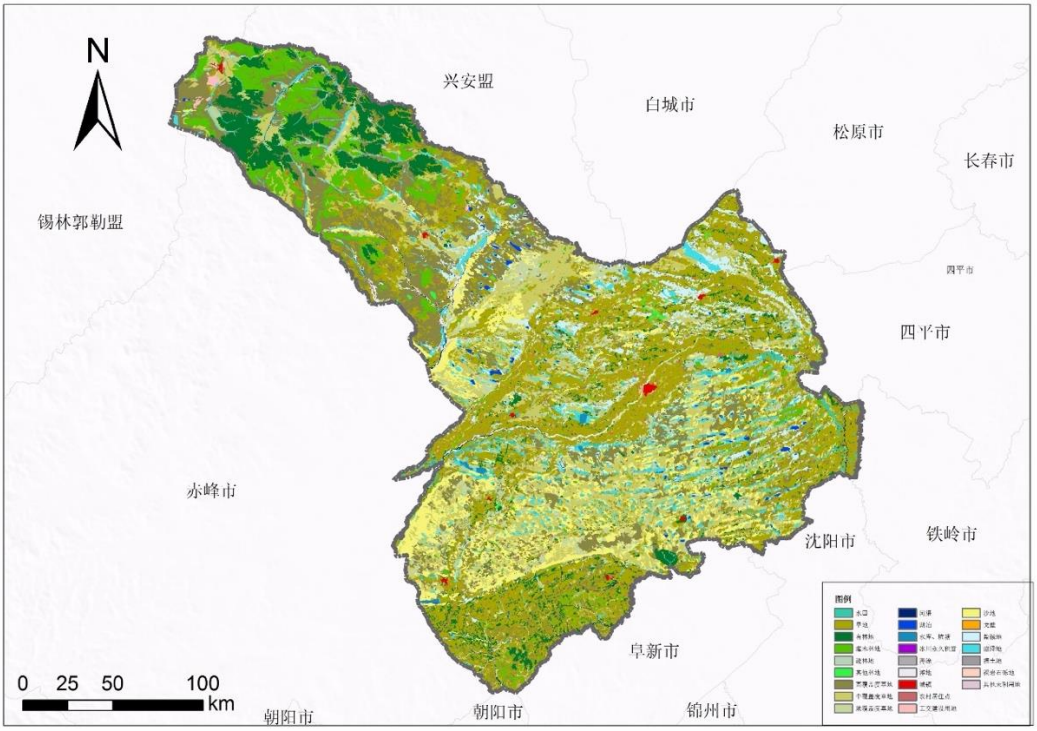

Figure 4-3 Tongliao Current Land Use

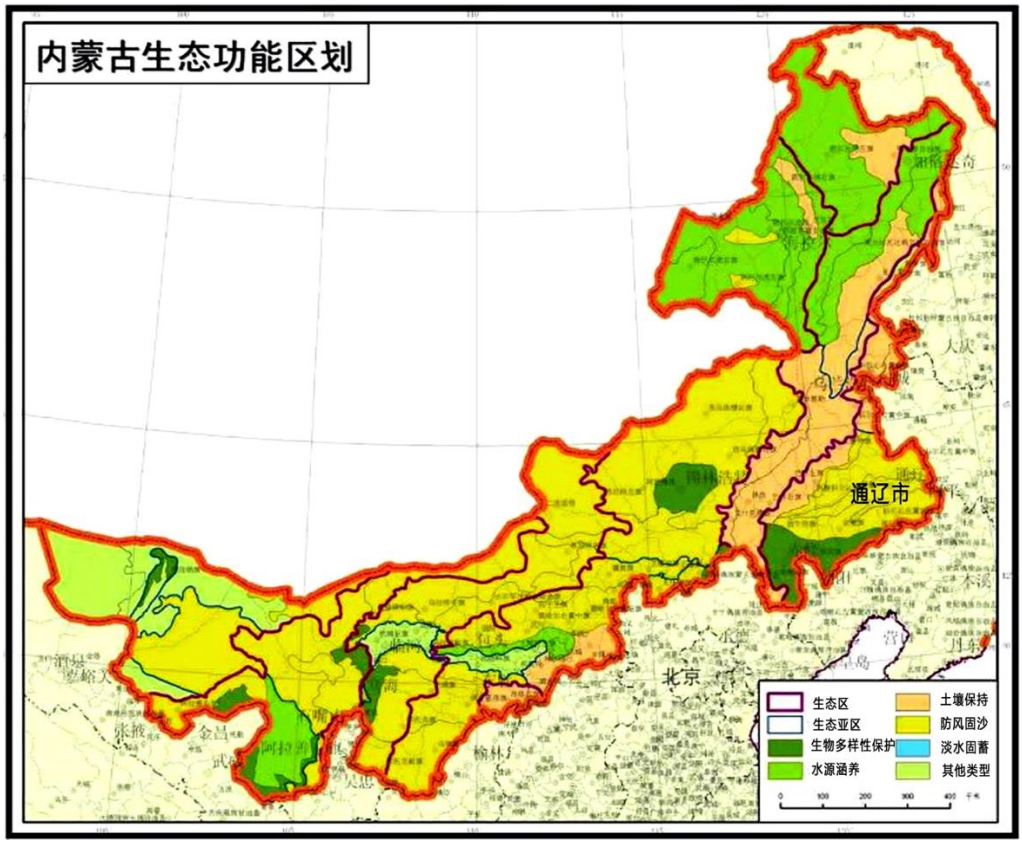

Figure 4- 4 Ecological Function Regionalization of IMAR

4.2.2 Vegetation Type

Tongliao City is in the transitional zone of forests and grasslands. The primitive landscape is elm steppe-woodland. The city is mainly covered by prairie vegetation, and also covered by forest vegetation. The most common vegetation is arid grasslands and xerophyticherbs. The natural tree and shrub species include elm, Quercus mongolica Fisch. ex Ledeb, black birch, Flueggea suffruticosa Baill., Lespedeza bicolor Turcz., Caragana sinica Rehder, Armeniaca sibirica Lam, salix Mongolica etc. There are 112 families, 446 genus and 1169 of natural grassland plants, among which 578 species can be used as forage. The 185 major feeding plants are Leymus chinensis, Stipa capillata Linn., Cleistogenes squarrosa Keng, Arundinella anomala., Aneurolepididum chinens, Medicago ruthenica Trautv. and Artemisia halodendron etc. The mountains and sands are suitable for such trees and shrubs as poplar, willow, elm, Pinus sylvestris var. mongolica Litv., Armeniaca sibirica Lam, Caragana sinica Rehder and Salix gordejevii Y. L. Chang et Skv.

4.2.3 The Status Quo of Forest Resources

According to the latest (2017) forest resources planning and design survey results, Tongliao has a forest area of 1.3728 million hectares, with a forest coverage rate of 23.27% and a forest volume of 39.7 million cubic meters. Arboreal forest area is 90.59 million hectares, among them, plantation forest occupies 76.42%. Shrubbery area of 518,600 hectares, of which, artificial shrubbery accounted for 32.59%. There are 253,200 hectares of standing forest land. 528,800 hectares are suitable for woodland, among which 315,500 hectares are suitable for sand and wasteland, accounting for 59.67%.

The main tree species in natural arbor forest include white birch, black birch, oak, elm, poplar, willow, aspen, sticky plum, maple, linden, basswood, pentagon maple, ash, thorn elm, mountain red, small leaf bodhi. The main tree species of artificial arbor forest include spruce, arboreal, larch, camphor pine, pinus tabulaefolius, elm, poplar, willow, plum, maple, mountain peach, pentagon maple, sand jujube, yellow pineapple, robinia pseudoacacia, ash, elm. Among them: poplar 94.87%, pinus tabulata 2.33%, pinus camphor 1.57%, larch 0.44%, willow 0.42%, elm 0.31%. The main tree species of artificial economic forest include sand fruit, pear, plum, apricot, apple, jujube, peach, begonia, hawthorn, Chinese crown fruit, almond, mulberry and other economic tree species. Among them: sand fruit accounted for 36.45%, apricot accounted for 15.22%, apple accounted for 14.68%, crown fruit accounted for 10.39%, hawthorn accounted for 7.05%, pear accounted for 4.91%, begonia accounted for 4.73%, plum accounted for 3.84%, jujube accounted for 1.52%, apricot accounted for 1.15%, mulberry accounted for 0.04%.

4.2.4 Animal and Plan Resources

Animal Resources: various species of wild animals live in Tongliao City. Red-crowned crane, white stork, bustard, sika deer and sable are first-class national protected animals. There are nearly 30 species of second-class national protected animals: grey grus, anthroodiesvirgo, Aixgalericulata, cygnus, felis lynx, cervuselaphus and procapragutturosa etc. In the National Nature Reserve Daqinggou Ditch live ring-necked pheasant, Perdixdauurica, hare, fox and turtledove. General

economic animals can be found everywhere in Tongliao. There are 18 phylums, 49 families and 212 species.

Plant resources: Tongliao City is in the transitional zone of forests and grasslands. The primitive landscape is elm steppe-woodland. The city is mainly covered by prairie vegetation, and also covered by forest vegetation. The most common vegetation is arid grasslands and xerophytic herbs. The natural tree and shrub species include elm, Quercus mongolica Fisch. ex Ledeb, black birch, Flueggea suffruticosa Baill., Lespedeza bicolor Turcz., Caragana sinica Rehder, Armeniaca sibirica Lam and salix Mongolica etc. There are 112 families, 446 genus and 1169 of natural grassland plants, among which 578 species can be used as forage. The 185 major feeding plants are Leymus chinensis, Stipa capillata Linn., Cleistogenes squarrosa Keng, Arundinella anomala., Aneurolepididum chinens, Medicago ruthenica Trautv. The mountains and sands are suitable for such trees and shrubs as poplar, willow, elm, Pinus sylvestris var. mongolica Litv., Armeniaca sibirica Lam, Caragana sinica Rehder and Salix gordejevii Y. L. Chang et Skv. Ephdra, Radix Rhizoma Glycyrrhizae, Armeniaca sibirica Lam and Hippophae rhamnoides Linn. are unique wild plants in Tongliao.

Table 4- 1 Forest land area of each banner within project site by type

Unit: **hectare**

Unit	Arbor forest land	Open forest land	Shrubs land	Unestablished forest land	Nursery land	Non-stocked forest land	Land suitable for forest	Forest coverage rate
Horqin District	44852.3	37.8	2213.6	2136.3	1076.5	21102.6	1703.5	13.38
Kailu County	59027.2	1434.8	5354.0	3319.4	676.1	41116.7	31802.0	15.59
Horqin Left Rear Banner	191215.2	19432.7	22993.9	15371.6	123.7	64176.3	82906.8	18.57
Horqin Left Middle Banner	130845.2	6431.2	18295.0	8708.9	625.0	44501.8	115113.5	14.35
Kulun Banner	104367.9	2435.3	51713.2	2589.4	287.6	17714.0	24145.2	22.44
Naiman Banner	178803.5	8285.7	67861.6	14367.9	235.6	56643.4	43268.0	30.32
Zhalute Banner	193449.3	2974.6	347201.2	5428.2	781.7	7920.9	215486.9	32.73
Project Ares	902560.6	41032.1	515632.5	51921.7	3806.2	253175.7	514425.9	23.39

Note:The latest(2017)forest resource planning,design and survey results in Tongliao City.

4.3 Natural Reserve Distribution

According to the website of the Department of Environmental Protection of IMAR and Tongliao Natural Reserve Directory, Tongliao City boasts five natural reserves: Tejinhan Mountain Natural Reserve, Lotus Leaf Wet Land and Waterfowl Natural Reserve, Wudantala Natural Reserve, Wusitu Natural Reserve and Daqinggou Natural Reserve

This project will not be implemented in any natural reserves.

4.4 Status Quo of Social and Economic Development

Tongliao City has jurisdiction over Horqin Municipal District, Tongliao Economic Development Zone, Kailu County, and Kulun Banner, Naiman Banner, Zhalute Banner, Horqin Zuoyizhong Banner and Horqin Zuoyihou Banner.Itis authorized to manage one county-level city Huolinguole City. By the end of 2017, the registered population in Tongliao reaches 3.16 million, 25.4 thousand less than last year. Urban population is 956.9 thousand and rural population 2.21 million.546.8 thousand aged0~17, 810.6 thousand aged18~34, 1.31 million aged35~59 and 498.8 thousand aged above60. The male to female ratio is 1.02：1, with 1.60 million males and 1.56 million females. The resident population is 3.13 million, among which 48.56% (1.52 million) is urban population. The annual birth population is 30.9 thousand, with a birth rate of 9.88‰. The annual death population is 19.8 thousand, with a death rate of 6.33‰. The natural growth rate of population is 3.55‰. The main ethnic in Tongliao is Mongols while Han nationality occupies the majority of the population. The city lives more than 40 nationalities including Mongols, Hui, Manchu, Korean, Daur, Evenki and Oroqin etc.

In 2017, GDP of the city was 122.26 billion Yuan, 0.3% higher compared with last year by the comparable price. The value-added of Primary Industry is 26.30 billion Yuan, 3.6% increase, that of Secondary Industry is 44.10 billion Yuan, 6.1% decrease, and Tertiary Industry 51.87 billion Yuan, 4.3% increase. The ratio of the three industries is 21.5:36.1:42.4. The Per Capita GDP by resident population is 39.10 thousand Yuan, which equals to 5.79 thousand Dollars according to 2017 average annual exchange rate, 0.2% increase. The Public Budget Avenue is 12.83 billion Yuan, 6.5% increase compared with last year. Tax revenue is 7.57 billion Yuan, 2.3% increase. Value Added Tax revenue is 1.18 billion Yuan, 78.5% increase. Sales Tax revenue is 818 million Yuan, 40.5% decrease. Business Income Tax revenue is 375 million Yuan, 12.6% increase. Individual Income Tax revenue is 171 million Yuan, 0.5% increase. The Public Budget Expenditure is 35.81 billion Yuan, 2.4% increase. The CPI of downtown resident sees a year-on-year rise of 1.6%. The Retail Price increases 2.0%.

4.5 Status Quo of the Environmental Quality of the Project Sites

The data source of the environmental quality status quo in the project sites is from 2017 Report on the State of the Environment in IMAR and documents provided by Tongliao BEP. The following is the details:

4.5.1 Ambient Air

In 2017, according to the Ambient Air Quality Standard (GB 3095-2012), the monitoring result showed that in Tongliao, 305 days were of good air quality, 83.4% of the whole year. In the rest days, 11.6% was lightly polluted, 4.1% moderately polluted, 0.8% heavily polluted and 0.2% severely polluted.

4.5.2 Water Environment

Tongliao City is located in Xiliao River Area. In 2017, the monitoring result of the mainstream (6 cross sections) and 8 branches (11 cross sections) of Xiliao River showed that the water was generally lightly polluted. Both the mainstream and branches were lightly polluted. The main contamination index was COD. COD_{Mn}. NH_3-N and BOD_5. Among the branches, the water in Wuerjimulun River was good, the water in Xilamulun River and Beng River was lightly polluted, the water inXiluga River, Sibe River and Xinkai River was moderately polluted and the water in Yin River and Yingjin River was heavily polluted.

The qualified rate of water drawqualitywas68.3%.The contamination index included Fe. Mn. NH_3-N. COD_{Mn}. SO_4^{2-} and F^-.

4.5.3 Acoustic Environment

The average equivalent sound level of Tongliao road traffic noise is 65.4dB. The acoustic environmental quality is classified as Grade One. The average equivalent sound level of urban noise is 54.4dB, and the quality is Grade Two.

4.5.4 Ecological Environment

Tongliao City is in the hinterland of Horqin Sandy Lands. The area of sands reaches 40.86 million Mu, 45.4% of the total area of the city and 52.7% of the area of Horqin Sandy Lands. The area of drifting sandy lands reaches 2.95 million Mu, that of the fixed or semi-fixed sandy lands is 32.11 million Mu, and the potential desertification soil 5.8 million Mu. The total area of grasslands is 51.29 million Mu, 46.82 million Mu of which is utilizable grassland. 82% of total grasslands or 90% of the utilizable grasslands (42.17 million Mu) has degraded, desertified or salinized. The total area of forestry reaches 20.51 million Mu, and the living wood growing stock is 26.02 million m^3. The percentage of forest cover reaches 623.7%. In 2017, the Ecological Environment Index of Tongliao was 44.97 and the rate was Moderate.

5 Environmental Impact Assessment and Mitigation Measures

5.1 Assessment Approaches

5.1.1 Assessment Range and Period

The total construction area of this project is 138,000 ha, involvingHorqin District, Kailu County, Horqin Left Rear Banner, Horqin Left Middle Banner, Kulun Banner, Naiman Banner, Zhalute Banner and Economic Development Zone. Considering that it involves a quite wide range, the area, a total of 59,835 km^2, assessed in this project is measured by administrative boundaries of Tongliao.

The assessment period is in consistent with the feasible study report: construct from 2020 to 2022, and operate from 2023 to 2044.

5.1.2 Assessment Standard

Environmental Quality Standards:

(1)The secondary standard specified in the Ambient Air Quality Standards (GB3095-2012) for ambient air

(2)The Grade Ⅲ 、IV、Vstandard specified in the Environmental Quality Standard for Surface Water (GB3838-2002); the secondary standard specified in the Water Quality Standard for Drinking Water Sources (CJ3020-93) for reservoirs

(3)The Grade Ⅲ standard specified in the Quality Standard for Underground Water (GB/T14848-2017) for underground water

(4)The 1、2 standard specified in the Environmental Quality Standard for Noise for acoustic environment

Discharge Standard for Pollutant:

(1)The corresponding standard specified in the Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011) for the construction noise

(2)The related regulations specified in the Standard for Pollution Control of General Industrial Solid Waste Storage and Disposal Sites (GB18599-2001) and its amendment (Announcement No.36 [2013]) for general solid wastes; the related regulations specified in the Standard for Pollution Control on Hazardous Waste Storage (GB18597-2001) and its amendment (2013) for hazardous waste storage

(3)No construction waste water

(4)No polluted gas.

Table 5- 1 Environmental Quality Standard for Air Unit: ug/Nm^3（CO：mg/Nm^3）

No.	Pollutant	Sample time	Concentration limit	Standard source
1	SO_2	Annual average	60	GB3095-2012 Secondary standard
		24-hour average	150	
		1-hour average	500	
2	NO_2	Annual average	40	
		24-hour average	80	
		1-hour average	200	
3	PM_{10}	Annual average	70	
		24 hours	150	
4	CO	24-hour average	4	
		1-hour average	10	
5	$PM_{2.5}$	Year	35	
		24 hours	75	
6	O_3	Daily maximum 8-hour average	160	
		1-hour average	200	

Table 5- 2 Environmental Quality Standard for Surface Water Unit: mg/L

Serial No.	Indicators	III	IV	V	Source of Standard
1	sulfide	≤0.2	≤0.5	≤1.0	*EQS for Surface Water*(GB3838-2002)
2	pH (dimensionless)	6～9			
3	Dissolved Oxygen	≥5	≥3	≥2	
4	Permanganate index	≤6	≤10	≤15	
5	Chemical oxygen demand	≤20	≤30	≤40	
6	Biochemical oxygen demand（BOD_5）	≤4	≤6	≤10	
7	ammonia nitrogen (NH_3-N)	≤1.0	≤1.5	≤2.0	
8	Total phosphorus (in terms of P)	≤0.2	≤0.3	≤0.4	
9	Anionic surfactant	≤0.2	≤0.3	≤0.3	
10	Cu	≤1.0	≤1.0	≤1.0	
11	Zn	≤1.0	≤2.0	≤2.0	
12	Fluoride (in terms of F)	≤1.0	≤1.5	≤1.5	

Serial No.	Indicators	III	IV	V	Source of Standard
13	Se	≤0.01	≤0.02	≤0.02	
14	As	≤0.05	≤0.1	≤0.1	
15	Hg	≤0.0001	≤0.001	≤0.001	
16	Cd	≤0.005	≤0.005	≤0.01	
17	Cr^{6+}	≤0.05	≤0.05	≤0.1	
18	Pd	≤0.05	≤0.05	≤0.1	
19	cyanide	≤0.2	≤0.2	≤0.2	
20	volatile phenol	≤0.005	≤0.01	≤0.1	
21	petroleum	≤0.05	≤0.5	≤1.0	

Table 5- 3 Environmental Quality Standard for Underground Water Unit: mg/L

No.	Indicators	Concentration limit	No.	Indicators	Concentration limit
1	pH	6.5~8.5	14	Total hardness（in terms of $CaCO_3$）	≤450
2	NH_3-N（in terms of N）	≤0.5	15	chloride	≤250
3	NO_{31}^-（in terms of N）	≤20	16	fluoride	≤1.0
4	Nitrite（in terms of N）	≤1.0	17	cyanide	≤0.05
5	Volatile phenols（in terms of phenol）	≤0.002	18	SO_4^{2-}	≤250
6	Oxygen consumption	≤3.0	19	Total dissolved solids	≤1000
7	As	≤0.01	20	$CO3^{2-}$	/
8	Hg	≤0.001	21	HCO^{3-}	/
9	Cr^{6+}	≤0.05	22	K^+	/
10	Pb	≤0.01	23	Na^+	200
11	Cd	≤0.005	24	Ca^{2+}	/

No.	Indicators	Concentration limit	No.	Indicators	Concentration limit
12	Fe	≤0.3	25	Mg^{2+}	/

Table 5- 4 Environmental Quality Standard for Noise

Type	Daytime dB(A)	Nighttime dB(A)
1	55	45
2	60	50

Table 5- 5 Standard Limits of Emission Standard of Environment Noise for Boundary of Constructionsite

Unit: dB(A)

Daytime	Nighttime
70	55

5.1.3 Assessment Content and Key Point

On the basis of related environmental regulations and requirements of EIB on Forestry Special Framework Loan Project, the content of this assessment includes background introduction, description of natural, social and economic environment of the project area, analysis on the project construction and its environmental impact and corresponding feasible mitigation measures, environment management and monitoring plan, environmental risk analysis and public participation survey.

Considering the nature and features of this project, the key of this assessment is the ecological impact during the construction period and the corresponding measures on the pollution prevention and control as well as ecological protection.

5.2 Positive Environmental Impact Analysis on the Project

The forestation project will bring enormous ecological benefits including water conservation, prevention of water and soil loss, wind break and sand fixing, carbon fixing and oxygen release, biodiversity increase, soil improvement and micro climate and environment regulation etc.

5.2.1 Water Conservation

Lots of research at home and abroad, according to the results of forest water conservation functions in many aspects, mainly including water storage function, the runoff regulation function, the function of flood and drought cutting forest and purifying water quality, etc., the main performance of the water conservation forest in interception of precipitation, absorption and infiltration, to spatial and temporal redistribution of precipitation, reduce invalid water, increase water effectively. According to the regulations for evaluation of forest ecosystem service functions (LY/ t1721-2008), by the end

of the implementation period of the project, the forest water storage volume in the project implementation area could be increased by 91.57 million cubic meters.

5.2.2 Soil Retention

The roots of the trees grow into net shape under the soil. Studies show that the space roots stretch under the ground is equal to (or larger than) the crown width. Roots widen the soil pore space. Branches and leaves can detain water and roots can fix soil so that soils can be prevented from rain erosion. Thus soil loss can be prevented, soil fertility maintained, sediment accumulation avoided and soil collapse reduced.

The soil conservation benefits of afforestation are mainly reflected in reducing soil erosion, preserving soil fertility, preventing and controlling sediment retention and deposition. According to the evaluation specification for forest ecosystem service function (LY/ T1721-2008), by the end of the implementation of this project, 2.31 million tons of soil can be fixed.

5.2.3 Wind Break and Sand Fixing

Most of the project areas are located in sandy areas, with increased forest vegetation and protection of the surrounding soil against wind and rain erosion. Project area after closed forest, can reduce the sandstorm damage to crops, increase the output of grain and forage grass, on the basis of the forest ecosystem service function evaluation specification (LY/T1721-2008), after the completion of the project, achieve dust capacity is 2.21 million tons, forest litter and soil animal, microbial synthesis of soil nutrient cycle system, increase forest soil fertility.

5.2.4 Carbon Fixing and Oxygen Release

Through the implementation of the project, it is estimated that during the operation period (20 years), the afforestation project will increase the forest carbon reserves by 2.3727 million tons. The cumulative absorption of atmospheric carbon dioxide is 8.7079 million tons, and the annual fixed carbon dioxide is 435,400 tons. Among the forest carbon reserves increased by the afforestation project, the carbon reserves of mixed forests of native tree species are 2,324,400 tons, and the carbon reserves of ecological economic forests are 48,300 tons.

5.2.5 Biodiversity Increase

Forests are able to restore and increase the gene pool of living beings. Biodiversity usually increases with the restoration of forest vegetation. The gene pool of living beings in the project area will be better restored and protective due to the increase and scientific management of forest vegetation. Meanwhile the wild animals and plants can enjoy a better inhabit environment.

5.2.6 Soil Improvement

Forests improve soil structure and fertility. The test results shows that for the soil bulk density of soil with the depth of 0-40cm in forests is lower than that in bare lands. The soil is more porous and the soil permeability is higher, which is better for microorganism and the activation and accumulation of nutrition. The soil in forests also gets an upper hand than that in bare lands in terms of soil moisture and soil porosity. On the one hand, forests largely promote the breed of soil

microorganism, while on the other hand, the decomposition of branches and leaves provides the soil with substantial organic matter, available nitrogen and Olsen-P.

The CO_2 from soil microorganism and root respiration can dissolve in water and produce carbonic acid which, together with the citric acid and malic acid from the halophyte roots, promotes the dissolution of the insoluble substance of P, K, and Ca. The soil fertility thus gets an overall improvement.

5.2.7 Micro Climate Regulation

Site preparation and soil retention measures will cause the changes of underlying surface. The change of soil roughness and the increase of water storage change the equilibrium relationship of humidity, heat quantity, radiation and some other matter between local atmosphere and underlying surface, which further exerts influence on the regional micro climate.

(1) Control the Temperature to Reduce Hot-Dry Wind

The reflectivity of forests is dramatically lower than bare lands or wastelands, and the low wind velocity in forests reduces the heat exchange in the atmosphere and on the ground, in addition that the crown canopy and humid soil absorb more radiation, part of which is consumed via evaporation and transpiration, as a result, the atmospheric and ground temperature remain relatively stable within one day and night. Frost and hot-dry wind is thus reduced.

(2) Improve Humidity to Create Foggy Days

The rainfall and runoff retained by forests promotes transpiration of trees, which accelerates hydrologic cycle and improves air humidity, creating more foggy days. Furthermore, the continuous convection encourages the diffusion and exchange of water vapor among the air masses, which produces humidity effect around forests.

(3) Increase Precipitation

Along with the latitude, distance from ocean and topography, atmospheric circulation and monsoon determine the precipitation of an area. However, because that the change of underlying surface and the rise of forest coverage increase the rainfall retention, which accelerates regional hydrologic cycle, and that the higher roughness of underlying surface enables the crown canopy to uplift the air flow and strengthen the convection exchange, the precipitation in the project area and its downwind areas nearby is increased even though it is in warm season.

5.3 Negative Impact and Mitigation Measures

Though this project brings positive ecological benefits of water conservation, soil retention, air purification, and carbon fixing and oxygen release, the construction may cause some small-scale negative impact such as the damage of a few original vegetation, water and soil loss and Insecticide and fertilizer loss.

5.3.1 Analysis on the Negative Impact during Construction Period and Mitigation Measures

5.3.1.1 Water and soil erosion

It is inevitable that some acts during the construction period will to some extend cause the damage of original vegetation and the loss of water and soil. However, the damaged area will gradually move towards a good condition after construction, and the construction helps to improve the land use ratio of the area.

Main Impacts:

(1) Inappropriate forestation site selection: the gradient of forests larger than 35° may cause water and soil loss; unreasonable forest layout, for example, locates too close to natural reserves or non-commercial forests, may affect the inhabit environment of wild animals or destroy their migration passage.

(2) Inappropriate tree species selection or unreasonable layout: single tree species may increase Pests and Disease risk.

(3) Wood cleaning: the cleaning of residual woods and miscellaneous shrubs for the follow-up construction. The cleaning may cause temporary or permanent interference with the vegetation and plants. The original vegetation may be damaged, which may cause the loss of surface soil and nutrition.

(4) Site preparation: inappropriate approaches may cause partial loss of water and soil.

(5) Forest tending: tending may damage the original vegetation, cause a disturbance of the surface soil, and further cause water and soil loss.

(6) Reconstruction of fire prevention road: the excavation may cause partial loss of water and soil.

(7) Temporary land occupation for construction: working road for construction and temporary material storage yard etc.

Main Mitigation Measures:

(1) Invite experts to investigate on the plant resources before cleaning, and deforestation should be prohibited.

(2) Find out those areas of bad ecological conditions or severe ecological problems that are badly in need of treatment. Try not to damage the original vegetation, clean the residual woods and miscellaneous shrubs (grass). Preserve the original vegetation to full extent to keep the balance of the ecological system.

(3) Select appropriate forestation site and tend the low yield forest. The gradient must be lower than 25°. Full reclamation is prohibited. Carven site preparation, fish-scale pit site preparation and drilling can be applied depending on the site conditions. Avoid working during pluvial periods and prevent soil erosion.

(4) Good native tree species are main choices. Exotic trees and invasive species are prohibited. Use fine seedlings to increase resistance to Pests and Diseases and reduce these risks.

(5) Strictly follow the forestation models designed for this project. Mixed forests of multi species are preferable. Single species and large-scale planting shall be strictly limited. If remodel the mixed forests, the dominant species should be no more than 70% of the total amount.

(6) While tending the young forests, weed partially. Reserve the surface vegetation and remain the miscellaneous grass. Dried branches and leaves must be remained to improve the capacity of water conservation and maintain soil fertility.

(7) Avoid heavy excavation while reconstructing the fire prevention roads. Minimize the damage to original surface soil and vegetation. The earth work (surface soil included) from site preparation and working roads shall be backfilled in time other than piled up at random.

(8) Intensify the publicity and education of animal protection. The slaughter of wild animals is prohibited. Make full preparation for fire safety to avoid forest fires.

5.3.1.1 Insecticide and Fertilize Loss

Frequent use of fertilize may exert negative effect on soil. Approximately 126,000 ton of Organic fertilizer (farmyard manure, 2.5% N and 0.5% P) will be applied during forestation and young forest tending. Statistics show that the soil loss tolerance of N is 1.6% and that of P is 0.4%, so 50.4 ton of N and 2.52 ton of P will loss during the construction.

Main Impacts:

(1) Fertilizer: Spread fertilizer on the surface soil or other inappropriate behaviors will cause fertilizer loss and water pollution; long-term application of fertilizer will change the physic-chemical characters of the soil, which leads to soil compact, soil degradation and loss of soil fertility.

(2) Insecticide: It may cause biodiversity loss and species imbalance. Inappropriate application of insecticide may cause water pollution, soil contamination and direct harm to wild animals. Clean and store the container in improper manner may affect water and soil.

Main Mitigation Measures:

(1) Mitigation Measures on fertilizer application

① Enhance the training on fertilizer and make a plan for fertilizer application;

② Promote the application of organism fertilizer (farmyard manure) and reduce fertilizer use;

③ Test soils and recommend proper fertilizer. Overuse of fertilizer will cause the loss of fertilizer and environmental pollution. Use proper type and quantity of fertilizer.

④ Spread fertilizer in holes or in rows and cover it with soil immediately. Avoid spreading on the surface.

⑤ Dispose the packages in a proper way. Prevent the residual fertilizer dissolving into the water and causing water pollution.

⑥ The forestation site must be beyond the protection zone for drink water resource and its upper reaches within 1000 m.

(2) Mitigation Measures on Insecticide Application

① Conduct insect quarantine to prevent the invasion of insects in seedlings.

② Reduce the incidences of Pests and Disease by purifying the environment of the project area, making a survey on the forestation sites and their neighborhoods, controlling the sources of Pests and Disease, tending the forests in time, keeping the sites clean and strengthening the resistance to Insects.

③ Pests prevention and control should be given priority to. Avoid frequent use of chemical insecticide.

④ If pharmacotherapy is inevitable, use light poison, low residual and pollution free Insecticides recommended by the EU or WHO. High toxic Insecticide like DDT is prohibited to alleviate environmental pollution. The insecticide application of this project see Table 5-6.

⑤ Intensify technical trainings on insecticide application. The training includes the safe management, storage and application of chemical Insecticides, and the prevention of direct harm to human and pollution of food and water resources. Pay attention to the spraying volume, time and method. Redundant insecticide is a waste and will cause pollution. Avoid spraying in rainy days, especially before rainstorms.

⑥ Formulate pesticides and clean the containers beyond drink water sources of human and wild animals as well as livestock. The containers can be cleaned in the water for irrigation.

Table 5- 6 List of chemicals potentially used in the program

Type	No.	Common Name / Commerce Name	Chemical Component	Application (Targets, Tree species. Plantation	Classification of WHO	Chinese Ratification No. or other certificate	EU Registration ID
Insecticide	1	Abamectin	Abamectin	Rhynchaenus empopulifolis Chen	Light poison	PD20102110	2008/107Reg. (EU) No 2019/168Reg. (EU) No 540/2011 (Reg. (EU) 2017/438)
	2	Azoxystrobin	Azoxystrobin 25%	Alternaria Mali	Light poison	PD20130457	Reg. (EU) No 2019/291Reg. (EU) No 540/2011Reg. (EU) No 703/2011 (1998/47/EC,2007/21/EC,2010/55/EU)
Germicide	1	Trichoderma Harzianum	Trichoderma Harzianum T-22	Sheath Blight	Light poison	PD20140319	2008/113Reg. (EU) No 2019/168Reg. (EU) No 540/2011

5.3.1.2 Solid Waste

Solid Wastes during the construction are waste packages and household waste etc.

Main Impacts:

(1) Plastic film and chemical fiber bag: To avoid root dehydration during transportation, seedlings wrapped with soil are packed in plastic films and chemical fiber bags to the forestation sites.

(2) Waste plastic film and chemical fiber bag for fertilizer packaging.

(3) Waste package and container of insecticide including glass bottle, plastic bottle and aluminum foil bag.

(4) Household wastes.

Main Mitigation Measures:

(1) Reuse the plastic films and chemical fiber bags for seedling packaging.

(2) The broken plastic films and chemical fiber bags shall be sent to the landfills.

(3) The insecticide packaging and container shall be collected by the construct unit who shall entrust the qualified organization with the disposal.

(4) Since the project sites are all located in rural areas, the operators are hired from the villages nearby who live in their own houses. No construction camp is necessary. So there are no household wastes.

5.3.1.3 Waste Water

Considering the wide range and heavy workload of this project, a large number of operators are demanded during forestation and forest tending. There will be some waste water during construction. Since the project sites are all located in rural areas, the operators are hired from the villages nearby who live in their own houses. No construction camp is necessary. So there is no household wastewater.

5.3.1.4 Exhaust Gas

Main Impacts:

(1) There will be exhaust and dust caused by the vehicles for the transportation of seedlings, fertilizers, constructors and construction machinery, but the volume is quite low. Foreign statistics show that when a rock truck passes by at the speed of 4m/s (14.4km/h), the volume of dust raised in the air is about 10~15mg/m^3. During this project, the trucks will drive on simple roads at a speed of lower than 15km/h, so the volume of dust will be less than 15mg/m^3.

(2) The fine granular material stacked at the construction site may raise dust.

Main Mitigation Measures:

(1) The find granular material shall be covered or kept closed to reduce dust volume. The earth and stone shall be covered and centralized.

(2) Strengthen the management of transport vehicles. The vehicles shall not be overloaded in case of falling down. Vehicles that may raise dust shall be covered.

(3) Sprinkle the temporary roads in time to reduce dust volume.

There will be certain dust and exhaust emission from the dump truck used to transport earth and rocks. The volume depends on the road type, whether condition and vehicle speed. The influence stops when the construction completes. A small amount of vehicles will be used during the project

and most are hole borers and transport vehicles for seedlings; in addition that the project is located in remote mountains that are far from villages, the impact on environment is limited.

5.3.1.5 Noise

Main Impacts:

Hole borers, loaders and transport vehicles are used for excavation during the construction. The sound power level of the noise sources ranges from 70~90 dB (A), which will have impacts on the acoustic environment. The analogy value of the noise source strength of the machineries see Table 5-7.

Table 5- 7 A List of Noise Source during Construction

No.	Machinery	Noise Value [dB (A)]
1	Loader	70
2	Hole Borer	90
3	Truck	80-90

Main Mitigation Measures:

Currently technical level of construction and machineries used are similar, so the analogy value of the noise source strength is used here. The machinery noise source can be regarded as the point source. Based on the point source attenuation formula, the noise value in different distances from the noise source can be calculated. Below is the predictive formula:

$Lp=LP_0-20Log(r/r_0)$

In the formula: Lp—— the predictive noise value [dB (A)] of r meter from the noise source;

LP_0—— the reference noise level [dB (A)] of r_0 meter from the noise source

The noise values of different machineries in different distances see Table 5-8.

Table 5- 8 A List of Noise Values of the Machineries in Different Distances

No.	Machinery	Predictive Noise Value (dB)				
		5m	10m	20m	40m	60m
1	Loader	90	84	78	68	58
2	Hole Borer	86	80	74	62	57

The construction sites are in the remote mountains or waste lands which are far from residential areas. In addition to the long distance, buildings and construction barriers, the construction sites

meet the requirement by the Noise Limits for Construction Site (GB12523-90) that in the daytime the value ≤ 75 dB (A) and in the night time the value ≤ 55 dB (A). There is no obvious effect of noise on the nearby environment.

5.3.2 The Negative Impact during Operation Period and Mitigation Measures

This is an ecological control project, so the ecological environment will be improved during the operation period. Nevertheless patrol, fertilizer (topdressing) and Pests and Disease control are still necessary. The negative impacts during the operation period include:

5.3.2.1 Impacts of Insecticide

Main Impacts:

Insecticides are inevitable during the Pests and Disease prevention and treatment, underwood planting in particular. Frequent use of pesticides, especially those of the high toxic and long residue duration, may cause environment pollution. While the insecticides will kill injurious insects, they also kill beneficial insects, which may reduce biodiversity and break species balance. Besides, insecticides are directly harmful to wild animals. The improper disposal of the waste packaging and container will cause environment pollution.

Main Mitigation Measures:

The mitigation measures during the operation period refer to those for the loss of insecticide and fertilizer during the construction period.

5.3.2.2 Impacts of Fertilizer

Main Impacts:

Each fruited tree requires 10-15 kg organism fertilizer in winter and 0.5-1 kg NP compound fertilizer in spring and summer. Dig a pitch to spread base fertilizer and the pitch for topdressing can be a shallow one. If spread in an improper way, the N and P in the compound fertilizer will dissolve with the surface runoff into the water nearby, which may water eutrophication.

Main Mitigation Measures:

The mitigation measures during the operation period refer to those for the loss of insecticide and fertilizer during the construction period.

5.3.2.3 Impacts of Underwood Planting and Product Transport

Main Impacts:

Pollution is inevitable during the underwood planting. The collection and transport of economic or underwood planting products requires a large number of vehicles which may cause dust and exhaust emission.

Main Mitigation Measures:

(1) Underwood planting shall follow corresponding regulations.

(2) The solid wastes during the transport can be collected and disposed by the transportation company.

(3) Apply vehicles that meet emission standards. Vehicles and machineries of loud noise are prohibited in the nighttime.

5.4 Risk Analysis and Preventive Measures

5.4.1 Risk Analysis

Forestation technique is an important factor of the project. Inadequate technique of planting and tending, such as insufficient water and soil, improper operation and inadequate investment on Pests and Disease prevention and treatment, will directly reduce the survival rate and ecological benefits.

The immature management system may lead to mismanagement and failure to meet expectations.

There may be force majeure risks like severe natural and environmental disasters.

5.4.2 Preventive Measures

The main risk factors of this project are technique, management and force majeure.

(1) Technical Risk and Preventive Measures

The project area belongs to semi-arid monsoon climate of warm temperate latitude. Inadequate investment on Pests and Disease prevention and treatment will directly reduce the survival rate, ecological benefits and the ability of wind break and sand fixing.

Preventive measures: enhance technological investment and operate the forests with intensive management; hire skilled technical managers to hold regular training for the technicians, draw lessons from the key ecological projects of forestry, take the strategy of prevention first to control Pests and Disease, and intensify disaster prevention to minimize any potential loss.

(2) Management Risk and Preventive Measures

Risk of forest fires and illegal tree chopping shall be prevented by experienced managers and strong protection team. The immature management system may lead to mismanagement and failure to meet expectations.

Preventive measures: make a full investigation, understanding and management risk analysis on the project area, and then improve the fire protection system by predicting potential disadvantages and corresponding areas, paying particular attention to the key links of the prevention and control of key areas where fires broke before, and intensifying tracking and

monitoring management. Minimize the fire damage to forest resources by preventing fires in the wild, establishing fire alarm and monitoring system and improving the ability of firefighting. Establish an efficient management mechanism via accountability system or target responsibility system: management level and results determine personal income.

(3) Force Majeure and Preventive Measures

There may be force majeure risks like severe natural and environmental disasters. Severe natural disaster may bring disastrous consequences, but the probability of occurrence is very low. Environmental disaster may create high risks, but the probability of occurrence can be lowered by preventive measures.

Preventive measures: take measures on risk avoidance, risk transfer and risk prevention. Make an analysis on potential risk factors and work out preventive and remedial measures. Meanwhile, enhance management and improve forest quality to strengthen the ability of forests to resist natural disasters. Establish forest alarm and monitoring system and continuously improve the scientificity, accuracy and timeliness of the monitoring and forecast. Improve the level of biological disaster prevention and control, especially the Pests prevention and control technology and non-pollution control technology.

6 Environmental Management Plan

Environmental management and monitoring plan facilitates the supervision and guarantees the smooth implementation of the project. The plan specifies the monitoring responsibilities of the units during project design, construction and operation. As long as the key environmental issues are monitored, the impacts on local environment can be effectively managed. This is an ecological project, so emphasis of monitoring will be put on soil erosion, water and soil loss, soil fertility, plant species diversity and Pests and Disease etc.

6.1 Environmental Administrative Organizations and Their Responsibilities

The environmental management of this project is implemented under the supervision of local bureau of environmental protection and the project implementation unit.

TMFGB is responsible for the environmental protection and coordination management of the affected areas. Tongliao BEP (municipal environmental monitor station) provides guidance on the environmental management and monitoring technology. The county-level project office is responsible for daily inspection and monitoring, so appropriate amount of full time environmental staff is allocated to the office. The monitoring of Pests and Disease, soil fertilizer and ecological factor is implemented by county-level environmental monitor stations or relevant qualified organizations.

The environmental administrative organizations and their responsibilities see Table 6-1.

Table 6- 1 Environmental Management Organizational Setting

Period	Organization Name	Organization Type	Responsibilities of Environmental Management and Monitoring	Staff Allocation
Design and Preparation	PMO	Administration	1. Responsible for the document application of EIA, EMP, Pests and Disease prevention and control plan; 2. Design forestation models for the project; 3. Organize training	2
	TMFGB	Administration	1. Undertake the establishment and improvement of Pests and Disease monitoring and prevention and release related information in time.2. Attend training.	2
	EIA Unit	Consulting and Service	Responsible for the EIA.	2

Period	Organization Name	Organization Type	Responsibilities of Environmental Management and Monitoring	Staff Allocation
Afforestation	PMO & TMFGB	Administration	1. Responsible for the control of forestation progress; 2. Responsible for the annual environmental management implementation plan and disbursement schedule; 3. Responsible for the organization and coordination of environmental monitoring during forestation; 4. Responsible for the organization of technical training during forestation; 5. Responsible for the collection, collation, summary, statistics and report of constructive information and material; 6. Provide consultant services of forestation policy and technology.	2
	Banner/County Bureaus of Forestry and Grassland Bureau	Administration	1. Execute the environmental monitoring plan including urging and supervising the monitoring organizations to take samples in accordance with the plan; 2. Make periodical report on the environmental issues during construction and operation periods to related environmental administrative departments and EIB; 3. Deal with complaints about environmental issues and accept supervision by the environmental protection departments; 4. Arrange visits for bank representatives and necessary staff from bureaus of environmental protection and environmental monitoring stations; 5. Monitor environmental matters during construction periods, urging and supervising the construction teams to follow relevant regulations; 6. Responsible for the remaining issues of environmental management and monitoring plan implementation.	8
	Banner/County Bureaus of Forestry and Grassland Bureau	Administration	1. Organize the study and implementation of national and local environmental protection regulations and environmental standards, and attend relevant trainings;2. Ensure all environmental management and monitoring plans at the county and forestry station level are fulfilled, repot the environmental issues to the municipal executive organizations and county bureau of environmental protection, collect data and provide technical support for environmental officials. 3. Responsible for the publicity and education of environmental issues and environmental protection knowledge at county and forestry station level as well as the promotion and application of the new technologies suitable for environmental protection. 4. Create environmental information profile and statistics files of environmental protection.	8
	Forestry farmers and herdsmen,	Implementation	1. Responsible for forestation and forest tending.2. Follow the forestation regulations and realize scientific forestation and optimal management. 3. Improve the percentage of greenery	

Period	Organization Name	Organization Type	Responsibilities of Environmental Management and Monitoring	Staff Allocation
	forestry farms, companies and cooperatives		coverage year by year. 4. Follow the existing national regulations on forest protection and fire prevention and guarantee the public security of the forestry. 5. Master the techniques of Pests and Disease control and insecticide safe application. 6. Make full use of the trainings to improve technical management.	
Management	PMO & TMFGB	Administration	1. Carry out the regulations and standards of environmental protection; 2. Organize the environmental protection planning and annual plans as well as the implementation of the plan; 3. Responsible for the publicity and education of environmental safety management and environmental protection and safety knowledge as well as the promotion of new technologies; 4. Periodically inspect the implementation of mitigation measures, discover and solve the problems; 5. Create environment profile, Pests and Disease prevention and control profile and environmental protection statistics files; 6. Organize and coordinate the environmental impact monitoring during forestation; 7. Responsible for the municipal inspection and acceptance of the forestation; 8. Responsible for the monitoring and summary of the environmental Management of the subordinate project offices.	2
	PMO & TMFGB	Implementation	Authorized by the provincial project office, conduct spot checks of the county monitoring of environment quality on the basis of national environmental standard planning. Submit the dynamic monitoring technical report on environmental protection.	2
	County Monitoring Group of Forestry Environmental Protection or relevant qualified organizations.	Implementation	1. Carry out the regulations and standards of environmental protection; Periodically monitor the soil erosion, soil fertility and salt content, plant species diversity and water conservation, and report and file the monitoring results.2. Complete monitoring tasks, and make reports on the problems and reasons and corresponding measures and suggestions to the provincial monitoring group of forestry environmental protection. 3. Strengthen the safeguard, maintenance and verification of the environmental monitoring instruments to guarantee the normal operation of monitoring; 4. Intensify the technical exchange and training to improve professional qualities, accept superior appraisal, and accountable for their environmental monitoring materials. 5. Monitor the natural environmental changes including water and soil conservation and wind disasters and report to municipal monitoring group of forestry environmental protection.	

6.2 Environmental protection during afforestation and management

According to the forest management plan, the project should consider forest health and protection, and wildlife protection, especially the protection of precious, rare and endangered species.

6.2.1 Cultivation and utilization of forest resources

The impact of forest management activities on forest ecological environment is concerned. Various protective measures will be adopted to maintain the natural characteristics of forest land, protect water resources, and prevent land degradation. Effective measures will be taken to minimize human-induced forest land degradation by activities such as land preparation, afforestation and tending, to maintain the natural characteristics of forest soil and its long-term productivity. The adverse effects of forest management on the quality and quantity of water resources should be reduced, to control water and soil erosion, and avoid major damage to forest watershed. Use of chemical fertilizers will be limited, and organic fertilizers will be used to increase soil fertility. Use of chemicals will be strictly controlled to minimize the environmental impact of chemicals. The pesticides used by the forest management units and fungicides are not those strictly prohibited by the State and the EU, and are high-effective, low-toxic and low-residual products, to minimize adverse effects on the environment.

Table 6- 2 Major environmental impacts of the project and mitigation measures

Activity	Mitigation measures	Actuator	Supervisor
A. Design/Implementation			
1、Tree Selection	(1) Select local species (2) the project site should avoid nature reserves and military bases	TMFGB	PMO
2、Site Selection	Geomorphic types are mainly mesa, hills, sandy land, desertification land, etc.The selection of sites should not involve water source reserves, nature reserves, military sensitive zones and other sensitive environmental areas	TMFGB	PMO
B. Afforestation			

Activity	Mitigation measures	Actuator	Supervisor
1、Land preparation	(3) Afforestation is strictly forbidden on terraced land and cultivated farm land, and it is strictly forbidden to afforest on hills with a slope of over 30 degrees and marshes. (4) Adopting hole-like and other land preparation method, planting immediately after land preparation, prohibiting farming, grazing and logging.	Banner/County Bureaus of Forestry and Grassland Bureau	PMO、TMFGB
2、Seedling Planting	(5) Only grade Ⅰ and Ⅱ seedling should be used and the density should be determined according to the forestation models. (6) Planting in spring is the priority。	Banner/County Bureaus of Forestry and Grassland Bureau	PMO、TMFGB
3、Tending Management	(1) after afforestation, it is necessary to carry out nursing management and protection, strengthen patrol protection, and prevent human and animal damage. (2) Watering For mixed forests of native precious tree species and fruit economic forests, water three times in the first year, twice to three times in the following two years and then stop watering. (3) Topdressing Encourage the application of organic fertilizer and green manure to guarantee the nutrition supply of the seedlings and tree species to accelerate the forestation。	Banner/County Bureaus of Forestry and Grassland Bureau	PMO、TMFGB
4、Insecticide and Fertilize	(1) Mitigation Measures on fertilizer application	Banner/County Bureaus of	PMO、

Activity	Mitigation measures	Actuator	Supervisor
Loss	① Enhance the training on fertilizer and make a plan for fertilizer application; ② Promote the application of organism fertilizer (farmyard manure) and reduce fertilizer use; ③ Test soils and recommend proper fertilizer. Overuse of fertilizer will cause the loss of fertilizer and environmental pollution. Use proper type and quantity of fertilizer. ④ Spread fertilizer in holes or in rows and cover it with soil immediately. Avoid spreading on the surface. ⑤ Dispose the packages in a proper way. Prevent the residual fertilizer dissolving into the water and causing water pollution. ⑥ The forestation site must be beyond the protection zone for drink water resource and its upper reaches within 1000 m. (2) Mitigation Measures on Insecticide Application ① Conduct insect quarantine to prevent the invasion of insects in seedlings. ② Reduce the incidences of Pests and Disease by purifying the environment of the project area, making a survey on the forestation sites and their neighborhoods, controlling the sources of Pests and Disease, tending the forests in time, keeping the sites clean and strengthening the resistance to Insects. ③ Pests prevention and control should be given priority to. Avoid frequent use of chemical insecticide. ④ If pharmacotherapy is inevitable, use light poison, low residual and pollution free Insecticides recommended by the EU or WHO. High toxic Insecticide like DDT is prohibited to alleviate environmental pollution. The insecticide application of this project see Table 5-6. ⑤ Intensify technical trainings on insecticide application. The training includes the safe management, storage and application of chemical Insecticides, and the prevention of direct harm to human and pollution of food and water	Forestry and Grassland Bureau	TMFGB

Activity	Mitigation measures	Actuator	Supervisor
	resources. Pay attention to the spraying volume, time and method. Redundant insecticide is a waste and will cause pollution. Avoid spraying in rainy days, especially before rainstorms. ⑥ Formulate pesticides and clean the containers beyond drink water sources of human and wild animals as well as livestock. The containers can be cleaned in the water for irrigation.		
5、Water	(1) The project will ban on long-term irrigation and installation of new permanent irrigation systems，For mixed forests of native precious tree species and fruit economic forests, water three times in the first year, twice to three times in the following two years and then stop watering. (2) keep the project away from river courses and water bodies to establish a buffer zone wide enough. (3) Use farm manure, not chemical fertilizers.	Banner/County Bureaus of Forestry and Grassland Bureau	PMO、TMFGB

6.2.2 Biodiversity conservation

In the event of precious, rare and endangered animals and plants, a protected area that is compatible with the scope and scale of forest management and the characteristics of the protected resources will be established. Unauthorized hunting, trapping and gathering activities will be strictly prohibited. The typical, rare and fragile forest ecosystem will be protected to maintain its natural state.

The project mainly applies the following biodiversity conservation measures:

(1) Protecting habitats

Be aware of protecting the ecological environment of ancient and previous trees in the region, also the national and local key protected wildlife habitats, and protect the trees around the nests, animal caves (holes) and habitats of wild animals. When creating pure forests, natural vegetation should be preserved as an ecological corridor. In places that are far away from water

surface, a drinking pool for wild animal will be built, and bird drinking facility will be attached to the tree trunk.

(2) Control of alien species

New or improved varieties should be tested first, and they should be used only if they will not cause any negative impact on native species and ecosystems.

(3) Protection of rare and endangered species

Rare and endangered tree species, ancient and well-known trees in the afforestation site should be strictly protected. During land clearing and immature forest land tending, the rare species seedlings and trees should be preserved to provide conditions for the seeding of rare and endangered tree species.

(4) Mixed forest construction and management

The characteristics of different tree species will be considered to adopt the appropriate mixing method. When it is difficult to implement strip-based and inter-row mixing, block (landscape) inlaying should be adopted to avoid large-area plantation of single tree species. It is encouraged to establish coniferous and broad-leaved mixed forest. Compound management of eco-economic forest will be implemented. Arbor trees, shrubs and herbs with economic values will be planted, to form a multi-level composite plantation community. Cerasus humilis, Lycium chinense and Aralia elata will be planted understory of eco-economic forest.

6.2.3 Soil protection measures

The following soil protection measures will be mainly adopted:

(1) Afforestation is strictly forbidden on terraced land and cultivated farm land, and it is strictly forbidden to afforest on hills with a slope of over 30 degrees and marshes.

(2) Adopting hole-like and other land preparation method, planting immediately after land preparation, prohibiting farming, grazing and logging;

(3) It is strictly forbidden to use pesticides that have been banned by the State or the EU;

(4) The pesticide residues shall not exceed the threshold promulgated by the state standards;

(5) Controlling the dosage of pesticides;

(6) Applying more organic fertilizers and compound fertilizers, and apply inorganic fertilizers as little as possible.

6.2.4 Pesticide and chemical use

All pesticides used in this project are in accordance with eu and domestic regulations, and records are kept for safe use of pesticides, chemical safety guidelines are followed, appropriate equipment is used and training is conducted.

The project has formulated a pest control plan, and stipulated the transportation, storage, use and emergency handling procedures of chemicals after accidental spillage.

(1) Procurement of Pesticides

The procurement of pesticides should be based on the recommended list using counterpart funds. The pesticide type and amount to be purchased should be determined according to the pest forecast and reported to the county PMO. The county and province PMOs will prepare the procurement list jointly.

(2) Transportation of Pesticides

For pesticides purchased in bulk, a technician should be commissioned to escort pesticides to ensure timely and safe delivery. Once containers containing pesticides are damaged, effective remedial measures must be taken to prevent environmental pollution. The county PMO will keep the original records of transportation and delivery.

(3) Storage of Pesticides

The local forestry & grass bureau where the project is located shall use special facilities to store the pesticides. Units and retail stores that provide services to afforestation entities shall maintain their storage facilities on a regular basis. The remaining pesticides shall be returned to the designated pesticide storage depot. According to the relevant laws and regulations, empty pesticide containers shall be returned to the designated warehouse for reuse or disposal.

6.2.5 Natural disasters and forest protection

Natural disasters in the project area are mainly forest fire, wind disaster, drought and forest pest disaster. Tongliao city people's government or bureau of trees and formulated the special forest fire emergency plan, major sudden sandstorm disaster contingency plans and emergency forestry harmful biological event emergency plan, emergency plan in all clear about the leadership team members and their responsibilities, and emergency response, emergency measures, monitoring and early warning, etc., can effectively to prevent and deal with natural disasters, maximum limit to reduce disaster losses.

Tongliao municipal government established the headquarters of flood control and drought relief, and mainly adopted preventive measures for the drought, such as regular monitoring of the drought, scientific allocation of water resources, refinement of the management of drought relief water, etc., the action plan to strengthen the weak links in water conservancy after disasters, improve the system and mechanism of disaster prevention and reduction, and reduce disaster losses.

6.2.6 Effects of grazing on forest and mitigation measures

After the afforestation is completed, the project will send people to conduct regular inspection to prevent human and animal damage. In addition, the forestry department will strengthen communication and cooperation with the agricultural department to prevent inter-forest grazing activities. Once found, it shall immediately stop and report to relevant departments for treatment.

6.2.7 Occupational safety and health

Major safety and health risks during the implementation of this project include:

- Mechanical equipment (such as noise, dust) harm to human body during the process of forestry production
- Risk of contagion from temporary or permanent Labour
- Sudden illness caused by invasion of alien species

Measures：

(1) TMFGB and the implementing entities shall strictly abide by the laws and regulations concerning labor protection and safety in China

(2) TMFGB formulated the safety production plan and the safety responsibility system, which regulates the administration of production safety, the main responsibility of the forestry and timber production of grass-roots unit, unit personnel to make production safety requirements and guidelines, this responsibility will also extend to the implementing entities.

(3) TMFGB shall implement the goal management of production safety responsibility for the relevant forestry production personnel, including strengthening the safety of field fire use, strengthening the safety of machinery and equipment production, strengthening the safety of staff production, strengthening the safety of disease protection and corresponding reward and punishment measures, and sign the certificate of production safety responsibility with them.

(4) There is no large-scale construction equipment in this project, and the construction area is outdoor, and the construction activities are temporary. The afforestation company will provide necessary labor protection supplies to the construction personnel, so the influence of mechanical noise and dust on the construction personnel is small.

(5) The implementing entities shall sign a labor protection contract, and train the personnel who plant trees in sanitation and labor protection。

(6) Do a good job in summer construction to prevent heat and cool down, such as distributing wind-oil essence, and work together with many people, rather than acting alone.

(7) TMFGB will regularly conduct a comprehensive investigation of key areas and key work to completely eliminate potential safety hazards, conduct regular random inspection of forestry activities, and ensure the safe production of forestry activities.

(8) Local labor force and local species are mainly used during the afforestation, so the possibility of epidemic diseases is relatively small. At the same time, TMFGB will require the construction party to strengthen the training on disease safety protection for the construction personnel。

(9) Involving hazardous chemicals department - the forest quarantine station of tongliao city, tongliao city make the administration of dangerous chemicals safety management plan, set the storage place of pesticide safety, such as with a heavy iron gate, from the inside locked, only the wrist into the lock hole, there are 24 hours on duty personnel, etc.; The application personnel are required to be equipped with necessary protective equipment, such as gas masks, protective clothing, gloves, etc. The application area shall be delivered to residents by the local government's announcement and leaflets. At the same time, a certain amount of first-aid detoxification drugs should be provided to ensure the safety of people and animals in the application area.

6.3 Environmental Monitoring Plan

6.3.1 Monitoring Content and Index

This project mainly exerts ecological influence on the environment, so the monitoring lies in the ecological environmental effects.

(1) Pests and Diseases

Pests type, pest population density, percentage of pest damaged plants, occurrence area; disease type, disease index, percentage of disease damaged plants, occurrence area; pesticide type, application dose.

(2) Biodiversity

Diversity survey on artificial undergrowth such as shrubs and herb layers including the species, amount, coverage rate, distribution and growth; the judgment on diversity changes.

(3) Soil Fertility

Soil bulk density, total porosity, capillary porosity, non-capillary porosity, maximum capillary water retention capacity, soil water content at saturation, soil organic matter, total nitrogen, total phosphorus, total potassium, available nitrogen, available phosphorus, available potassium, PH Value, soil enzyme activity, moisture and total salt; also monitoring groundwater depth.

(4) Soil Erosion

Rainfall, water content of litter layer, soil layer water content, soil erosion amount.

6.3.2 Monitoring Frequency

Once in the first, third and fifth year of the construction period for plant diversity, soil fertility, soil erosion; twice in the first, third and fifth year of the construction period for Pests and Disease.

6.3.3 Monitoring Point Selection and Layout

One representative monitoring point in each county/banner involved according to the forestation models.

6.3.4 Monitoring Methods

(1) Pests and Diseases

Fixed monitoring points will be set up in the forest land and non-forest land within the project area. 20 to 30 trees will be identified by suitable mechanical sampling methods, and labeled as fixed monitoring standard trees. During the monitoring year, the occurrence of Pests and Diseases in fixed standard trees will be investigated regularly. The investigation contents include the types, occurrence rate and damage degree of Pests and Diseases, and the prevention measures will be recorded as well as application times.

(2) Biodiversity

Select representative areas through on the spot survey. Set up at least 3 fixed quadrats of 10*10 m3 for each forestation model. At the same time, set up contrasts in a similar forest (same species, density and age) beyond project area. Determine the diversity of the trees by their species, amount and growth condition. Divide the fixed quadrats into 4 small quadrats of 5*5 m3 and determine the diversity of the shrubs by the species, amount and growth condition of each quadrat. Set up at least 3 small quadrats of 1*1 m3 in the representative area of the fixed quadrats and determine the diversity of the herbs by their species, amount and growth.

(3) Soil Fertility

Using fixed standard plot survey and analysis, soil samples for fixed-point observation and measurement will be identified, for data collecting. The database of soil physical structure, soil fertility, water and salt monitoring information will be established, as well as soil monitoring module. A representative standard plot (0.1 ha) will be selected in a representative area by afforestation model. Special pipes will be buried inthe standard plot to measure soil water content by a Time Domain Reflectometry (TDR). Soil profile was excavated in the standard plot, soil at different layer will be sampled, to measure soil porosity by the ring knife method, soil mineral nutrition by flame spectrophotometric analysis, soil nitrogen content by nitrogen analyzer, organic matter content by hillock method, salt content by conductance method, and particle size composition of the soil through sieve analysis.

(4) Soil Erosion

Rainfall data are obtained from provincial/county weather stations or by self-metering. The water source conservation and soil erosion intensity are measured by fixed plot survey and analysis.

Selecting representative plots, at least 3 plots are selected for each afforestation model, of which the standard sample plot for water source conservation survey is 20m×20m, and the tree growth will be investigated using 0.5×0.5m sample plot, take un-afforested land with the same or similar site conditions for comparison. To inspect soil erosion, 10×20 m fixed runoff plots will be sampled, to investigate tree growth status, and excavate 100 cm deep trench around the runoff plot, bury high-strength aluminum-plastic composite board, joints are fixed with viscose and rivets, and a sedimentation pool and a water storage pool will be established at the lower water outlet place. During the rainy season, the surface runoff and sedimentation process during the rainfall are recorded. Place 3 to 5 self-recording rain buckets or sump in standard sample plot, measure rainfall (penetrating rain, canopy rain) in the forest during raining season. The un-afforested land with the same or similar site conditions will be used for comparison (the same runoff plot will be set up), so that to observe and compare the benefits of forest to water conservation and soil erosion.

6.3.5 Implementation and reporting system of monitoring

The PMO is responsible for the implementation of monitoring plan. A special monitoring team will be set up consisting relevant technicians, to undertake the monitoring work. With the support of County PMO, the monitoring team will monitor the occurrence and damage degree of the forest Pests and Diseases of the project area within the county.

At the end of each monitoring year, the provincial project office should organize the summary, analysis and reporting of monitoring results and data, summarize and evaluate all monitoring results by content, and report the summary and evaluation results as the project implementation progress report of the monitoring year to the EIB, as well as relevant environmental protection departments.（If necessary）.

Table 6- 3 Environmental Monitoring Plan

Monitoring Content	Monitoring Index、Monitoring Frequency、Monitoring Point Selection and Layout& Monitoring Approaches	Supervisor
Biodiversity	1. Monitoring Index Diversity survey on artificial undergrowth such as shrubs and herb layers including the species, amount, coverage rate, distribution and growth; the judgment on diversity changes. 2. Monitoring Method Select representative areas through on the spot survey. Set up at least 3 fixed quadrats of 10*10 m^3 for each forestation model. At the same time, set up contrasts in a similar forest (same species, density and age) beyond project area. Determine the diversity of the trees by their species, amount and growth condition. Divide the fixed quadrats into 4 small quadrats of 5*5 m^3 and determine the diversity of the shrubs by the species, amount and growth condition of each quadrat. Set up at least 3 small quadrats of 1*1 m^3 in the representative area of the fixed quadrats and determine the diversity of the herbs by their species, amount and growth. 3. Monitoring Frequency Once in the first, third and fifth year of the construction period 4. Monitoring Point Selection One representative monitoring point in each county/banner involved according to the forestation models.	PMO
Soil fertility	1、Monitoring Index Soil bulk density, total porosity, capillary porosity, non-capillary porosity, maximum capillary water retention capacity, soil water	PMO

Monitoring Content	Monitoring Index、Monitoring Frequency、Monitoring Point Selection and Layout& Monitoring Approaches	Supervisor
	content at saturation, soil organic matter, total nitrogen, total phosphorus, total potassium, available nitrogen, available phosphorus, available potassium, PH Value, soil enzyme activity, moisture and total salt; also monitoring groundwater depth. 2. Monitoring Method Using fixed standard plot survey and analysis, soil samples for fixed-point observation and measurement will be identified, for data collecting. The database of soil physical structure, soil fertility, water and salt monitoring information will be established, as well as soil monitoring module. A representative standard plot (0.1 ha) will be selected in a representative area by afforestation model. Special pipes will be buried inthe standard plot to measure soil water content by a Time Domain Reflectometry (TDR). Soil profile was excavated in the standard plot, soil at different layer will be sampled, to measure soil porosity by the ring knife method, soil mineral nutrition by flame spectrophotometric analysis, soil nitrogen content by nitrogen analyzer, organic matter content by hillock method, salt content by conductance method, and particle size composition of the soil through sieve analysis. 3. Monitoring Frequency Once in the first, third and fifth year of the construction period 4. Monitoring Point Selection One representative monitoring point in each county/banner involved according to the forestation models .	
Soil erosion	1. Monitoring Index Rainfall, water content of litter layer, soil layer water content, soil erosion amount, surface. 2. Monitoring Method Rainfall data are obtained from provincial/county weather stations or by self-metering. The water source conservation and soil	PMO

Monitoring Content	Monitoring Index、Monitoring Frequency、Monitoring Point Selection and Layout& Monitoring Approaches	Supervisor
	erosion intensity are measured by fixed plot survey and analysis. Selecting representative plots, at least 3 plots are selected for each afforestation model, of which the standard sample plot for water source conservation survey is 20m×20m, and the tree growth will be investigated using 0.5×0.5m sample plot, take un-afforested land with the same or similar site conditions for comparison. To inspect soil erosion, 10×20 m fixed runoff plots will be sampled, to investigate tree growth status, and excavate 100 cm deep trench around the runoff plot, bury high-strength aluminum-plastic composite board, joints are fixed with viscose and rivets, and a sedimentation pool and a water storage pool will be established at the lower water outlet place. During the rainy season, the surface runoff and sedimentation process during the rainfall are recorded. Place 3 to 5 self-recording rain buckets or sump in standard sample plot, measure rainfall (penetrating rain, canopy rain) in the forest during raining season. The un-afforested land with the same or similar site conditions will be used for comparison (the same runoff plot will be set up), so that to observe and compare the benefits of forest to water conservation and soil erosion. 3. Monitoring Frequency Once in the first, third and fifth year of the construction period 4. Monitoring Point Selection One representative monitoring point in each county/banner involved according to the forestation models .	
Pests and Diseases	1. Monitoring Index Pests type, pest population density, percentage of pest damaged plants, occurrence area; disease type, disease index, percentage of disease damaged plants, occurrence area; pesticide type, application dose. 2. Monitoring Method Fixed monitoring points will be set up in the forest land and non-forest land within the project area. 20 to 30 trees will be identified	PMO

Monitoring Content	Monitoring Index、Monitoring Frequency、Monitoring Point Selection and Layout& Monitoring Approaches	Supervisor
	by suitable mechanical sampling methods, and labeled as fixed monitoring standard trees. During the monitoring year, the occurrence of Pests and Diseases in fixed standard trees will be investigated regularly. The investigation contents include the types, occurrence rate and damage degree of Pests and Diseases, and the prevention measures will be recorded as well as application times. 3. Monitoring Frequency Twice in the first, third and fifth year of the construction period 4. Monitoring Point Selection One representative monitoring point in each county/banner involved according to the forestation models .	

6.4 Training Plan

6.4.1 Training Object and Mode

During the implementation of the project, scientific technologies will also be the priority. It is planned to set up a project expert supporting group composed of experts from Academy of Forestry, Technology Extension Station, Seedling Station, and Forest Pests and Diseases Prevention Station, to actively compile the existing scientific research results and promote the application. At the same time, the necessary scientific research work will be carried out in conjunction with the implementation of the project, so as to study, summarize and promote new technologies, to improve the scientific and technological content and implementation quality of the project.

Strengthen training at all levels, formulate detailed training plans, and carry out various forms of training activities such as training courses, handing out pamphlets, on-site meetings, radio and television based education, etc., Main training targets should be county-level project management personnel, technicians from township forestry workstation and key afforestation households. Giving full play to the project's driving and radiating effects, to improve and enhance the forestry production skills and management level of grassroots forestry management personnel and farmers, and ensure the realization of the overall project objectives.

Training methods include training courses and on-site guidance provision, handing out technical pamphlets and video materials.

6.4.2 Training Content

According to the needs of project implementation, the training course includes the following aspects:

(1) EIB's environmental policies, environmental laws and regulations of China and local governments;

(2) Environmental impacts of the project, environmental protection regulation and its implementation;

(3) Pests and diseases management plan and its implementation;

(4) Identification, prevention and integrated management techniques for major Pests and Diseases associated with the project forests;

(5) Environmental monitoring plan and implementation method;

(6) Pesticide procurement and safe use methods

It is planned to conduct trainings at different level, specifically for managers, technicians and beneficiaries (especially farmers), as follows:

Municipal level training: It is arranged by the PMO, and the targeted groups are mainly project management personnel, technical personnel and financial personnel of Tongliao City. The content

includes environmental protection policies for domestic and foreign forestry projects, foreign financed project management, project digital management, technical and economic policies, participatory planning and evaluation, forest management, implementation design methods, engineering supervision, monitoring and evaluation, promotion and application of new technologies, forest safety and environment protection technology, financial management, etc.

Banner/county level training: The PMO at Banner/county level will arrange training regularly, targeting the technical and management personnel of relevant town (township) and various implementation entities, forestry professional technicians and farmers' representatives. Training content mainly includes forestry policies and regulations, project management, participatory planning, implementation design, seedling cultivation technology, afforestation technology, identification and life history of Pests and Diseases, biological characteristics of Pests and Diseases, prevention and control technology, basic knowledge of Pests and Diseases, pesticide management and safe use, forest pests control technology, forest safety and environmental protection measures. The detailed contents will be adjusted according to the level of participants.

Overseas study tour and training: it will be organized by the PMO mainly targeting main management and technical personnel. It aims to learn advanced forest management technology and experience abroad.

On-site practice: it aims to provide on-site demonstration of the correct and safe use of pesticides for forest farmers.

6.5 Implementation and Supervision

6.5.1 Implementation

During the project implementation period, representatives from both China and EIB as well as expert groups will form an evaluation team to provide guidance, inspection and evaluation during the whole implementation process. After the completion of the feasibility study report, the evaluation team will inspect and provide guidance for afforestation activities, conduct inspection during the project implementation period, and evaluate the implementation process after the project implementation completed. The PMO is responsible for the management of monitoring, coordination and evaluation of the project operation.

In order to monitor the progress to ensure the achievement of expected outcomes and outputs, a project performance management system will be developed to flexibly and timely refine the project design, implementation arrangements, project activities and their impact. The improvement work should follow the following indicators:

(1) Progress in afforestation and replantation (by survival rate);

(2) Use of project funds and documents required to make payment;

(3) The allocation of long-term forest land use rights of beneficiaries;

(4) The provision of technical services in the project area.

PMO will monitor the implementation progress of these plans in accordance with the monitoring and evaluation criteria in the Environmental and Social Security Plan (Ethnic Group Development Plan, Community Consultation and Participation Plan). According to the framework of the project performance management system, within six months after the project kick-off, feasible monitoring objectives will be identified, monitoring and recording procedures will be finalized, and corresponding systems and procedures will be established. In addition, Provincial, county (district, city) project offices will also responsible for collecting baseline data and progressing data and reporting to the National Project Office within the prescribed timeline.

The PMO is responsible for the implementation and management of the project. In the project implementation process, objective-based management will be carried out at each stage, such as work progress and afforestation quality. Furthermore, afforestation quality and survival will be further clarified, and contracts will be signed with afforestation entity.

6.5.2 Inspection and Supervision

TFBG will provide guidance for the project management units at banner/county level, in terms of project monitoring and evaluation. By setting tree species, compartment, and beneficiaries as monitoring targets, the project objectives, implementation process, project benefits, impacts, and sustainability are evaluation indicators, TMFGB will follow the project's standards, indicators, and procedures to keep abreast of changes in project implementation, make necessary adjustments in a timely manner to improve project implementation quality, prevent environmental degradation, and forecast project benefits, so as to serve the expected goals.

7 Alternatives

7.1 General Introduction

This chapter aims to make a comparison and analysis on the impact range and extent on ecological environment of different construction plans and provide scientific decision-making basis by recommending optimal plans from the perspective of environmental protection.

There are no alternatives in the feasibility study report, so this chapter makes a comparison between project and no project (an alternative of doing nothing).

7.2 A Comparison and Analysis on the Environmental Impact of Project and No Project

The impacts on ecological environment in the project area of constructing project (project) or not (no project) see Table 7-1. The analysis will be made on direct impact and indirect impact.

Table 7- 1 A Comparison of Environmental Impact of Project and No Project

Environmental Impact	Project	No Project
Direct	Positive Impacts 1. Afforest: improve the percentage of forest cover, which is benefit for water and soil retention, water conservation, wind disaster prevention and air purification etc. 2. Beautify the environment to improve the landscape effect. 3. The large amount of dried branches and leaves are resolved into soil organic, available N and available P to activate the breed of soil microorganism, which promotes soil organic growth.	
	Negative Impacts 1. Unreasonable forestation may damage the original vegetation, disturb the surface soil and cause soil erosion and water and soil loss, affecting the environment in the project area and nearby. 2. Inappropriate application of insecticide and fertilizer may cause fertilizer loss which will harm beneficial organisms	Without management, the sparse natural vegetation and over-disturbed waste lands and grassy slopes may face fire hazards, severe water and soil loss and soil degradation. The degraded forest lands are vulnerable to Pests and

Environmental Impact	Project	No Project
	and contaminate water resources; 3. Soil turning and transport vehicles may raise dusts and cause ambient pollution.	Disease if no improvement.
Indirect	The waste lands and slopes are reduced, so the ability of water conservation is increased. The saline-alkali soil is reclaimed, and wind bread and sand fixing is realized, so the living environment and life quality is improved; the inter-planting in some areas improve the land use ratio of cultivated land; habitats for wild animals increase, which protects biodiversity.	Without management, the frequent disturb by human leads to the further degradation of forests, which may cause water and soil loss, animal migration or extinction and even new biological disasters.
Comprehensive Comparison	By scientific and reasonable forestation technology and management, the project increases the percentage of forest cover and forest quality, thus improves ecological environment. However, inappropriate design or construction method may cause negative influence and even risks on ecological environment.	Without planting in waste mountains and grass slopes, effective management in degraded forests, the forest regressive succession will ultimately lead to decreasing percentage of vegetation cover, aggravation of water and soil loss and deterioration of ecological environment, which will indirectly bring poverty of the farmers.
Conclusion	Recommended	Not Recommended

8 Public Participation

The core target of public participation is to improve the effectiveness, validity and veracity of EIA. Public participation ensures the public to exercise their participation rights and rights to know the truth, enables them to know related environmental information and gives them usual channels to express themselves. Meanwhile the public participation in the environmental decision-making improves EIA quality and guarantees the transparency and authority of the assessment and decision-making.

8.1 Public Participation Approach and Object

8.1.1 Public Participation Survey Approach

This public participation survey applies a combination of posts in project area, meetings with villagers, group interviews, individual consultation and questionnaires (onsite pictures see Figure 8-1).In addition, visits are paid to some peasant families to have a deep understanding on their existing forest lands, application of insecticide and fertilizer, living standard as well as their attitude toward this project.

The main approaches are random interview and questionnaire. The questions will be raised in standard method and order to the public and the interviewees answer the questions independently. The results of questionnaire and interiew will be summarized and analyzed.

The public participation survey is supported by the social assessment team of who conducted profound investigation on the social assessment of this project.

8.1.2 Public Participation Survey Object

(1) Individuals

Individuals mainly are residents near the project area, including government cadres, technicians and farmers. The selection and random and wide-ranged and factors of area, age structure, cultural fabric, occupational composition and proportion of ethnic minorities are taken into consideration.

(2) Unit Groups

Unit groups mainly include large forestation households, local government units, village committees and enterprises near the project area.

On Site Introduction

EIA Consultation

Group Interview Site

Individual Questionnaire Interview Site

Figure 8- 1 Public Participation Survey Sites

8.2 Information Publicity

Stage One: post notice in the project area on below information: project name and outline, construction unit name and contact, the name and contact of the EIA organization, the process and main content of EIA, main issues to solicit public opinion, the main channel to collect public opinion.

Stage Two: when the environmental impact statement completes, the assessment organization elaborates the project basic situation, potential environmental impact, prevention or mitigation measures and preliminary conclusion of environmental impact analysis, and invites the public to give suggestions in written form or other forms.

Public participation questionnaire see Table 8-1.

Table 8- 1 Public Participation Questionnaire

European Investment Bank Loan Project “An Integrated Control of Horqin Sandy Lands in Tongliao City by Constructing Eco-Economic Shelterbelts”

Public Participation Questionnaire

Hello! I am an interviewer of the European Investment Bank Loan Project “An Integrated Control of Horqin Sandy Lands in Tongliao City by Constructing Eco-Economic Shelterbelts”. This project takes advantage of EIB loan to conduct plot selection, operation design, farmer training, technology popularization, use of funds, forest management, and environmental protection supervision. This survey aims to optimize the project design as well as advertise the project by understanding some basic situations of your family and your own opinions this project which will bring benefits to the peasant household in the project area. All your information will be confidential. We really appreciate your time for this interview!

Questionnaire No.:_. Interviewer:; Checked by (Supervisor)

Name:. Interview Date:.

Interviewee Information: Tongliao City/County/District/Town/Village

Name; sex; age; nationality; head of household: A. Yes B. No

D1.How do you think local ecological environment? ( )

①Good; ②Moderate; ③Bad; ④Very bad

D2.What do you think are main local environmental issues (multiple choice) ? ( )

①Air; ②Surface Water; ③Underground Water; ④Noise; ⑤Ecology; ⑥Others (please specify)

D3. Do you think this project will improve local economic development and living standard of the farmers? ( )

①Yes; ②No; ③I don’t know

D4. Do you think this project will improve local ecological environment? ( )

①Yes; ②No; ③I don’t know

D5. What are your most concerned environmental issues during the project construction and forestation? ( )

①Chemical fertilizer pollution; ②Water and soil loss; ③Insest and disease

D6. What is your attitude toward this project? ( )

①Strongly supportive; ②Supportive;③I don’t care

D7. Do you have any other suggestions on the environmental protection of this project??

8.3 Survey Result Analysis and Suggestion

8.3.1 Analysis on Individual Interviews

Following the principle of right to know, the individual survey is conducted in the form of questionnaire hand out. The factors of area, age, culture, occupation are taken into consideration while selecting public representative. During this survey, 566 questionnaires are issued and 566 questionnaires are recovered. The rate of recovery is 100%.

Results show that most interviewees are strongly supportive for the project. They think that this project is benefit for the economic development and able to improve local ecological environment. No objection against the project.

Below is a summary of suggestions in the interview:

(1) 62.2% of the interviewees think that the local ecological environment is good, 33.3% think it is moderate, while 4.2% think it is bad and 0.3% think it is very bad.

(2) 44.8% of the interviewees regard air issues as main environmental problem, 53% regard ecology, 11.1% noise, 63.2% underground water, 47.3% surface water and 6.5% choose others.

(3) 95.2% of the interviewees believe that the project will improve local ecological environment, while 2.1% hold a contrary opinion. 2.7% have no idea whether it will improve the environment.

(4) 95.2% of the interviewees regard chemical fertilizer pollution as the main environmental issues caused by the project construction and forestation, 59% think it is water and soil loss and 22% think it is Pests and Disease. 6% of the interviewees don't think this project will cause any problem. Two interviewees worry that the project may disturb the residents.

(5) 40.8% of the interviewees accept the adverse effects on the environment of this project, 44.3% keep their options open. 40.9% of the interviewees think that the adverse effect is Pests and Disease.

(6) 75.6% of the public strongly support the project, 2.9%support it and 1.4% held an indifferent attitude.

8.3.2 Analysis on Group Interview

This survey issues 14 questionnaires to unit groups including the government units, forestry station, large forestation household, village committee, enterprise and public institutions.

Below is a summary of suggestions in the interview:

(1) 58% of the interviewed unit groups are clear about the basic situation of the project before the interview, 21% generally know the situation, while 21%have no idea of it.

(2) 43% of the interviewed unit groups consider the local ecological environment is good and 57% consider it is moderate.

(3) 50%of the interviewed unit groups regard air issues as main environmental problems, 50% regard ecology, 14% regard noise, 7% regard underground water and 7% choose surface water.

(4) 93% of the interviewed unit groups believe that the project will improve local economic development and living standard of the farmers. 7% have no idea about that.

(5) All the interviewed unit groups believe that the project will improve local ecological environment.

(6) 21% of the interviewed unit groups regard fertilizer and insecticide pollution as the major environmental problem during construction and forestation periods, 57% regard water and soil loss, and 22% regard Pests and Disease. 3% don't think this project will cause any problem.

(7) All the interviewed unit groups accept the adverse effects on the environment of this project.

(8) All the interviewed unit groups believe that this project is feasible.

Other suggestions made by the interviewed unit groups see Table 8-2.

Table 8- 2 Group Suggestions

On Environmental Protection	On Project Construction
Protect existing ecology and don't damage the original vegetation.	① I am supportive for planting. ② I expect more similar projects. ③ This project can improve economy, environment and the income of farmers.

8.4 Conclusion on Public Participation

The results of this survey show that the public individuals and unit groups strongly support this project. They believe that the project will improve local economic development and living standards of the

farmers as well as local ecological environment. They are acceptable for the adverse effects on the environment during the construction.

9 Conclusion and Suggestion

9.1 The Necessity of the Project

The Integrated Governance on Horqin Sandy Lands by Forestation Project is in accordance with the strategic approach to the economic and social sustainable development of ecological construction. Based on the classified management of forest, this project building ecological forests at a large scale in the key areas of wind-drift sand hazard, targets at the improvement of resource quality and effects. The project gives priority to ecology at the same time gives consideration to the interests of the public. In conclusion, it is urgent and necessary to implement this project in Horqin Sandy Lands.

9.2 Main Project Content

The total construction area of the project is 138,000 hectares, among which:

(1) Build 115,300 hectares of local mixed tree species forest, accelerate the control of sandy land in horqin, give consideration to the development of timber forest at the same time, and improve the management efficiency of shelter forest.

(2) Build an Eco-economic forests base of 20 million hectares to promote the upgrading and large-scale development of forest and fruit products in Tongliao.

(3) Build a seedling support base of 27,700 hectares, and promote the development of the tree seedling support system, which is mainly composed of fine and rare local tree species such as yellow pineapple and Chinese ash, and economic fruits such as red outside the plug.

In addition, capacity building has been strengthened in the areas of preservation, forest certification and project training.

9.3 The Compliance of the Project with Industrial Policies and Related Plans

This is a project of forestation, greening and forest tending project that complies with the national and IMAR policies and related planning.

9.4 Conclusion on the Environmental Quality Status Quo Assessment

The main ambient air contaminants in the project area are SO_2, NO_X and PM_{10}. The annual average of SO_2 and PM_{10} exceeds the Grade 2 standard limits specified in the Ambient Air Quality Standards (GB3095-1996). The overall assessment on the water of Xiliao River System is lightly polluted, both the mainstream and branches of which are lightly polluted. The acoustic environmental quality of Tongliao road traffic noise is Grade 1 and that of urban noise is Grade 2.

9.5 Conclusion on EIA

The implementation of the project helps to bring various forest functions and effects into full play, especially the increase of project area and improvement of regional ecological environment. The positive impacts of the project are water and soil conservation, air purification, carbon fixing and oxygen release.

The project may have certain negative impacts. During the construction period, the main impacts are original soil surface damage, water and soil loss, vegetation removing and cutting and animals being affected. The inappropriate use of fertilizer may cause soil and water contamination, and the waste packaging materials like plastic films and chemical fiber bags and the containers of fertilizer may cause solid waste pollution. Since there is no construction camp, this project will not bring household wastes and waste water. The environmental impact of the exhaust from transport vehicles is limited. During the operation period, the main impacts are soil and water contamination by inappropriate use of fertilizer and potential ecological environmental risks of Pests and Disease and forest fires. There is only a small amount of household wastes and waste water produced by the forestation managers, so the environmental impact is limited.

9.6 Measures of Environmental Pollution Prevention and Control and Ecological Protection and Their Validity Analysis

(1) Water and soil loss prevention and control: Organize trainings on water and soil loss prevention before construction; forbid forest cleaning by burning during forestation; apply partial weed and soil loosening for young and middle aged forests to keep surface vegetation and keep the miscellaneous grass in place to reduce water and soil loss; separate a protection area during the forest clearing depending on the stream size, stream flow, cross section and stability of the river course; apply manual operation as much as possible to avoid severe soil surface damage and great water and soil loss by mechanical operation; avoid construction during rainy days and prevent erosion. The above measures may alleviate the water and soil loss caused by the soil surface damage.

(2) Ecological protection: appropriately select forestation site which shall not be places where vegetation is well distributed and protected ecologically sensitive areas; pay attention to the protection of precious plants during the forest clearing and a detailed investigation on the plant resources of the forestation site by the forestry professionals before clearing is suggested, and then protect the confirmed precious plant species in situ or transplant them for protection; deforestation is prohibited; protect the arable lands and forestation on them is prohibited; intensify education on animal protection and wild animal slaughter is prohibited; take fire prevention measures to avoid forest fires during construction. The above measures can effectively protect the animal and plant resources.

(3) Pests prevention and control: conduct pests quarantine to prevent the invasion of pests with seedlings; purify the forest environment by investigating on the environment of the forest sites and nearby areas before forestation, and control Pests and Disease sources by forest tending and sanitation improvement to enhance the resistance of forests to the pests and decrease the occurrence rate of Pests and Disease. Residual insecticide prevention and control: give priority to biological control and reduce the use of insecticide; select low toxic, low residual or pollution free insecticide if pharmacotherapy is inevitable; pay attention to the amount, time and method and insecticide use to avoid wasting and the residual insecticide dissolving into the environment due to the overuse; avoid using insecticide in rainy days, especially before rainstorm; avoid formulating the fertilizer and cleaning the container near the drink water sources of wild animals and men and livestock; training on the safe management, storage and application of chemical insecticide is a must for workers and farmers before they using the insecticides. The above measures will reduce the negative impacts of insecticide on the environment to largest extent.

(4) Mitigation measures on the negative impacts of fertilizer: intensify the training on fertilizer knowledge for the forestation managers and work out reasonable fertilizer plan; encourage the use of organic fertilizer (farmyard manure): spread organic fertilize during site preparation and replace chemical fertilizer with organic fertilizer by burying the grass and leaves near the tree stump while tending forests; formulate fertilizer according to the actual situation of the soil to ensure the use of proper type and amount of fertilizer and avoid fertilizer loss and environmental contamination due to the overuse; collect and dispose the fertilizer packages in a proper manner in case that the residual fertilizer in the packages dissolve into the water with the rainfall and cause environmental pollution. The above measures can prevent obvious impacts on water environment.

(5) Prevention and control of solid waste pollution: repeatedly use the plastic films and chemical fiber bags during the construction for seedling packaging and send the damaged ones to the

landfill; properly dispose the household waste from the forestation personnel during operation period; the waste packages and containers of fertilizer shall be disposed by the county construction or operating entities. The above measures will prevent solid waste pollutions.

(6) Ecological risk control measures: strengthen the prevention and control of forest fires by fire barrier zones according to related regulations; establish a professional prevention and control team so that the fire can be put down in a short time and the extend and range of fire disaster can be minimized; enhance management and patrol periodically to prevent fire disasters; establish an advanced monitoring and prediction system of Pests and Disease to discover Pests and Disease in time; prevent and control the Pests and Disease by the use of biological prevention and control, manual capture and low toxic and residual insecticide of high effect; the prevention and control by pharmacotherapy shall take the type and age of the Pests and Disease into consideration; use low toxic and residual biological insecticide of high effect to reduce the harm to beneficial organism and the environmental pollution; no use of high toxic fertilizer and those have been prohibited by explicit order.

To sum up, this assessment considers that it is economically and technologically feasible for the prevention and control and mitigation measures on the environmental impacts required by the statement.

9.7 Public Participation

As mentioned above, this survey enables the interviewees express their opinions and suggestions freely. The public awareness of environmental protection has been raised because the interviewees have expressed due concerns on the social and economic influence, environmental pollution and ecological damage. Most of the interviewees are supportive for this project and respond positively to the project construction.

9.8 Overall conclusion on EIA

This project comply with the national industry polices and the 13th Five-Year Plan for Forestry Development of IMAR. It is necessary to complement this project since the positive effects are distinguished. Though there are some negative impacts like vegetation damage, water and soil loss and insecticide and fertilizer contamination, they can be alleviated by some effective prevention and control of pollutions and biological protection measures. The current environmental quality of the proposed project area is good and there are no obvious environmental constraints. This assessment believes that in terms of environmental protection, this project is feasible under

the condition that the pollution prevention and control measures and ecological protection measures are implemented in time.

9.9 Suggestion

(1) Strictly follow the training plan and the ESP to ensure the project works in a scientific, reasonable and ordered manner.

(2) For the prevention and control of Pests and Disease, prevention goes first. Realize the sustainable governance goal of low input, high effect and insect not causing disasters.

(3) Encourage the application of organic fertilizer and green manure to guarantee the nutrition supply of the seedlings and tree species to accelerate the forestation.