The emergency response and its impacts assessment in Western China

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ABSTRACT

This paper uses an eco-economic classification of western China and a human activity analysis to evaluate policy impacts. Specifically, eco-economic regions were classified and mapped by means of GIS, and a model was developed, concerning environment and socio-economic inter-linkages. The physical environment of Western China determines the basic pattern of regional socio-economic differentiation, with major cities and developed areas distributed along rivers and suitable traffic corridors in a manner consistent with the point-axis regional differential law. Three cases studies in the region were examined to evaluate the benefits and impacts of the response and measures taken by western peoples and local governments, which are including the ecologically fragile and poverty stressing region, Dingxi Prefecture of Gansu Province on Loess Plateau, the integrated model of water and soil preserve in an arid and mountainous watershed named Jiuhua on Loess Plateau, the scenarios analysis of Wuwei city in northwest China's oasis region, facing the crisis of water shortage. Based on these analyses, a number of emergency response policies are suggested to formulate eco-economic development model, make ecosystem restored and environment protected in western China. These responses involve: improved industrial and urban planning; restoration of forest and grasslands in some currently cultivated areas, watershed protection, investment for the establishment of high-tech industry, establishment of a regional tourism policy, mechanisms for compensating upstream landowners for watershed protection, use of green GDP and green economic accounting, and changes to property rights.

KEY WORDS: Response, Impacts assessment, Cases study, Western China

INTRODUCTION

In China, regional disparity is huge, regional economic patterns are various, and there are many regional ecological problems. There are four main water zones and four terrain ladders from the east China to the west, and four thermal zones from south to the north, and there are four main rivers flow from the west to the east. Based on this large-scale natural differential pattern, China can be divided into three economic zones, i.e. east, west and middle, and it can be divided into seven major economic regions. Ecological problems varied from one region to another. Western China's ecosystem is very fragile. The problem of the northwest lies in drought, and the problem of the southwest lies in too much karst and too many mountains.

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Four ecologically fragile zones are mainly existed in the Western China, which are characteristic with cold and high elevation level land, desert, Loess, karst,. At the same time, it is the spatial coupling of ecological system with economy system that results in the systems' complexity. Generally, this fragile ecosystem was influenced by human being's activities. Fortunately, the governments of Western China implemented a series of measures to protect the eco-environment in ecologically fragile regions while developing regional economy, such as managing small scale watershed area to control water and soil erosion, taking different ecological economy ways in different cities, devising intensive ecological city, developing new industries, including ecological agriculture, ecological industry and ecological traveling, etc. These responses not only relieve the pressure on local ecosystem, but also provide the useful lessons and experiences for ecological renovation to the other regions in China.

1 Eco-economic classification of Western China and human activity analysis

Developed areas of Western China such as principal axis areas in overall arrangement and those areas exploited intensively are simultaneously most ecologically fragile areas, where environmental problems are more austere than other areas. So attentions must be paid to both economy and environment while developing economy and carrying out any exploitation.

We can see in national scale that the distribution of population and GDP is similar to the spatial distribution of water and heat in China. Large and middle scale human activities spread along the main traffic lines (axis) or grand rivers, where distribution of population in more intensive than that of GDP. Spatially small-scale human activities centralize predominant cities, and distribution of GDP is more intensive than population. (Fig.1)

Fig1. The spatial distribution of GDP and population in Western China

According to climatic and meteorological factors data from more than 700 stations (most of them own data of more than 40 years) throughout China, social economy data from more than 900 counties of Western China in 2000, land use survey data of Western China from State Statistics Bureau and on-the-spot investigation data, by using the spatial statistics analysis module, we simulate the surface of the whole country, from which we selected the Western China and mainly analyzed ecological environment and the main social economic indexes quantitatively. And referring to the accumulated experiences of the former research, summing up and analyzing them, spatial simulation and on-the-spot validation, we divided Western China into more than 20 ecological economical regions. The results can be concluded as follows:

The first part is ecologically fragile zone with intensive human activities. It stretches along Daxinganling mountain-west Taihang mountain - areas along Yellow River banks in the autonomous regions of Ningxia and Inn Mongolia-valleys of Lanzhou near Yellow River - Guanzhong plain-Chengdu, Chonqing urban areas-Guiyang-Kunming urban regions, and at last connects with Hexi corridor along the west new Longhailan railway-Tulufan-Hami basin-regions along the north Tianshan mountain in Xinjiang autonomous region, whose shape likes a "T" letter. This region is a populated area, also owns many developing cities. It belongs to the pivot area and first level axis zone in the strategy of national economic distribution. However, conflicts between ecology and economy are also the acutest, so social economical development must explore a new way of ecological economy, based on the protection and conservation of ecological environment in the Western China.

The second part is comparative ecologically fragile but with less human activities. It includes Gannan tableland and stretches along west Qinghai and hinterland of Qing-Tibet tableland-Talimu basin and at last connects with Tulufan basin. This zone's ecological environment is fragile and sensitive, thus, natural variation and human activities caused this zone most fragile in the past few years, so the emphasis in this zone in future is to control the intensity of human and reinforce the ecological protection and management

The third part is ecologically comparatively high or high fragile, simultaneously, it is very poor, and disturbed by intensive or comparatively intensive human activities. It starts from Guanzhong basin, stretches along Loess tableland and Eerduos tableland locating in the border of Shanxi, Gansu and Ningxia Provinces. This zone is faced with the biggest crisis of ecological degradation. Measures must be taken to father ecological environment, to control human activities. Only by doing so, they can pull away poverty and harmonize the relation of ecological environment and social economy. In a word, they must lead a road of ecological economy and sustainable development. (Fig.2)

Fig 2. The intensity of human activity in Western China

Generally, in Western China, conflicts between eco-environment and human activities are severe; ecological economical system is unbalanced and developing in a vicious circle. What's more, this situation is apt to deteriorate, so the problem is most austere. Ecological environment restricts social economy development of northwestern China greatly. Therefore, the development of Western China must obey the ecological economical differential law and must make the measures of ecological environment construction into the first account and hold the line at all times in the future 3. (Fig.3.)

Fig 3. The eco-economic regional classification in Western China

2 Development of Western China Strategy

2.1 The main contents of development of Western China strategy

Since the end of 1999, the central government of China implemented the new strategy of development of Western China. The main contents of development of Western China policy are reconstruction of ecological environment, construction of infrastructure, adjustment and optimization of industrial structures, further opening-up to the world, and enhancement of education and technology.

From the infrastructure point of view, Western China is an underdeveloped region in traffic, communication, and water conservancy etc. From that of economic structure, Western China centralizes many heavy enterprises, which need to be adjusted. From the environment point of view, Western China' is affecting all the country. From the quality of people and enterprise point of view, Western China is an underdeveloped region in education, science and technology. We think the strategy of development of Western China is very important to both Western China and all the country.

The former China president Jiang Zemin said: "To ameliorate the environment is the first and chief task in the strategy of developing Western China". And if we don't put efforts to make an obvious amelioration of eco-environment, the sustainable development strategy in Western China would be frustrated, and the Chinese ethnic survival and developing conditions would also be more and more threatened.

The report of sixteenth national delegation of Communist party pointed out that during the first 20 years of 21st century, China will focus its all ability to construct an all around wealth society to benefit billions of Chinese people, and make the economy more developed,

democracy more healthier, education more advanced, culture more boomed, society more harmony and civilians more wealthier, and this is the critical phrase of strategy of three-steps development.

The requirement of national modernization goal to the Western China is: to eliminate the poverty as soon as possible, lessen the distance, strengthen the construction of eco-environment, insure the safeguard of eco-environment, adopt an unconventional eco-economic development way, realize the sustainable development.

2.2 Introduction of developing Western China strategy and countrywide modernization construction, and their impacts to the ecosystem service function in Western China

Increasingly deteriorating environment endangers economic and social development in Western China, and the deteriorating environment is rootstock of multitude poverty. Therefore, during resuming and reconstructing environment, the government must take measures to break the vicious recycle of environment deteriorating and poverty. At present, 90 percent of poor people in village of Western China lived in the region where the eco-environment is very fragile. If the expanding trend of water and soil erosion and desertification were out of control, the sustainable development and stability and solidarity would be badly affected. So the main task of eco-environment construction in Western China should include: to break the bottle-neck problem of water resource, resume vegetation, effect a radical cure of water and soil erosion, keep within limits of the spread of desertification, recognize the resuming and reconstruction of eco-environment in ecological fragile zone, and strengthen the measures which eliminates environment pollution in mining city, medium city, and metropolis.

Basic supporting services of west ecosystem are those that are necessary for the production of all other ecosystem services, such as primary production, production of oxygen and water, and soil formation. Provisioning services are the products people obtain from ecosystems, such as food, fuel, fiber, fresh water, and genetic resources. Regulating services are the benefits people gain from the regulation of ecosystem processes, including air quality maintenance, climate regulation, erosion control, regulation of human diseases, and water purification. Cultural services are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. These services above will be improved with the implement of development of the west eco-environment construction. See those effects in table 1. :(Table 1)

Table 1. The impact assessment to the ecosystem's service function of the strategy of development of Western China and national modernization to Western China

3 Cases studies on impacts of policy evaluation

The policies' impacts, such as environmental reconstruction, e.g. taking grain production as the priority, cultivating grassland and filling up lakes for increase arable land, cutting trees and grass for fuel, family planning population production, poverty –alleviation to the ecosystem, etc., are evaluated through the following case studies in Western China, to make clear of the mechanism and tradeoff between ecosystem goods and services in Western China, to provide scientific bases for the policy-making of sustainable development of Western China.

3.1 Case 1. Implementation of eco-economy to alleviate poverty in the eco-environment vulnerable Loess Plateau region, taking Dingxi Prefecture

Dingxi Prefecture is located in the middle of Gansu Province, the total area is 20,330 km^2, and the population in 2003 is about 2.9 million. It is a famous poverty stricken area in China's history because of the fragile eco-environment and laggard local economic system.

The projects of eco-environment construction and returning the arable land back to vegetation on Loess Plateau are proved to be effective. It is helpful to the establishing a characteristic regional economy by selectively planting economically valuable trees and developing stock breeding industry when planting grass. In this way, the farmers can not only improve their incomes, but also protect the environment in these projects. So the harmony relationship and the benign recycling socio-economy system can be realized, concerning the local conditions and the market requirement by encouraging the development of ecological agriculture, ecological industry and ecological tourism industry, and so on.

Ding Xi Prefecture is the typical representative of Loess Plateau vulnerable and poverty area, in which the ecosystem is unbalanced and has little self-controlling ability. The characteristics of Ding Xi's eco-economical system are basically four more and four less, which means that there are more of population, arable lands, evaporation, and calamity, however, but less of precipitation, vegetable areas, industries and incomes. This phenomenon shows that Ding Xi's natural reproduction and economic reproduction belong to the non-ecologically economic and the ecosystem is in a kind of vicious circle state.

Some experts, because of its vulnerable eco-environment and poverty stress, had regarded ding Xi Prefecture as the non-suitable for human habitation area. From the 1980s, under the supporting of the central government's poverty alleviating polices, this region have fundamentally realized the "double-win" goals, which were the melioration of eco-environment while in the whole region the problem of the food were solved and people's getting rich.

After decades of development, Dingxi Prefecture is now striding on an eco-economical developing road, sticking to the strategy of planting trees and grasses, constructing terrace, renovating small drainage area, combing the ecosystem construction with the poverty alleviation and social-economic development. By the end of 2000, the whole prefecture's 100 percent of countryside, 99.9 percent of village and 87 percent of poverty people in rural area had basically settle their food problem, the number of poverty population decreased from 1987's 1.7 million to the 2000's 80.3 thousand, the poverty area decreased from 78 percent to 8.5 percent, rural area people's income grow from 1982's 105 RMB Yuan to 1268 RMB Yuan, which realized the historic transition from totally poverty to the basic living standard, and realized the aim of dual objectives to realizing the economic growth, poverty alleviation and eco-environment amelioration, and the integration of economic benefit, social benefit, and eco-environmental benefit.

Now Dingxi Prefecture has engaged in fostering the ecological industry chains and industry community to establish a characteristic regional economy, which won many national honors by it's special local products, for example, the "home" of China's potatoes, herbs of Huang Qi, Dangshen and Danggui, flowers plantation, painting and calligraphy. There are also many ecological industry chains now, such industry chain as potato, Chinese herb, stock raising, flower, edible mushroom, health-keeping food, aluminum, small hydro-electricity, tourism and holiday preventing sunstroke industry chain, etc. (Fig 4,5,6)

Fig.4. The ecological agriculture industry chain Dingxi Prefecture

Fig 5. The models of ecological industry chain in Dingxi Prefecture
Fig.6. The model of Dingxi's high efficiency and technology park

This case mainly analyzes the eco-environment vulnerability index, poverty index, the coupling relationship and the driving forces' distribution on the space and time since the

foundation of PRC in 1949. The result shows that the human activity, especially after the opening policy's implementation in 1978, have been the major driving force to the eco-environment's renovating and the poverty alleviation policy have also attributed to the ecological reconstruction. (Fig. 7, 8, 9)

Fig 7. The ecological vulnerability's changing from 1949 to 1978
Fig 8. The ecological vulnerability's changing after 1978
Fig 9. The poverty degree's relation index to the main factors

Especially in the recent 20 years, factors such as industry structure, population stressing, eco-environment background, investment, land cultivation are the major players effecting the vulnerability of eco-environment, on the other point of view, the economic poverty is mainly related to the factors like population structure and its stress, land yield ratio, food production, etc. Polices' function should be the most important factor, like the national poverty alleviating policy, the land family contracting policy in Chinese rural area, the policy of returning the arable land back to vegetables, etc. These sustainable developing polices effectively ameliorated the vulnerability of eco-environment, but we also have to face the challenges brought by the population stressing to the regional sustainable development.

3.2 Case 2.The eco-economic reconstruction model and its effectives in Jiu Hua watershed on Loess Plateau's hills and ravines areas in Dingxi Prefecture of Gansu Province

Jiuhua Watershed is located in the north of Dingxi county of Gansu Province, which is a classic represent of poor, water and soil erosion area and fragile ecosystem on Loess Plateau in Western China's. The total area is 83 km^2, there are 5 villages, which is about 1476 families dwells here. The arable land area is 3231.3 ha and the yield per ha is only 500 kg. And the topographty of this region is seriously cut by rainwater, while the stress of population is heavy, which is 80 persons per km^2, much higher than the criterion of international standard of semi-arid area's population density (20 persons per km^2).

After decades of local people's hard working, the watershed is known as the national model for the sustainable reconstruction of ecosystem and development of local economy. Their major experiences are to manage the region at small watershed and integrate the construction of eco-environment with the local economic development. The goals of high and stable harvest have been reached and the synthesis systems of agricultural industry have kept in a better recycling.

This model have experienced three major phrases, which are respectively constructing terraces, comprehensive renovation, integration of the construction of ecosystem with the exploration of natural resources. The eco-environment construction phrase was firstly started from 1960s to 1970s, which was simply constructing terraces, to the 1980s, the second phrase began with the comprehensive renovation in hills, water, arable land, forest, grass and road, and after 1990s the construction phrase improved to the synthesis construction and exploration, which combined the renovation projects, terrace construction and exploration projects to realize the goals of integrated renovation and higher economic profits. So the water and soil were kept while local people's income had been added. This model also presents a new eco-economic way of poverty alleviation in the semi-arid and arid mountain areas of Western China. (Fig.10)

Fig 10. Integrated eco-construction model in Jiuhua watershed

This model also establishes a kind of tri-dimensional exploration way of integrated renovation and water flow controlling, using the systematical projection principles and eco-economic principles. Now Jiu Hua water shed has been becoming a beautiful landscape and

ecological manual projects, in figuration, the peak capping with trees planting, the slope coating with vegetables recovering, the mountainside banding with terrace constructing, hill-foot under-dressing with canopy, the valley booting with damming sluice. These renovation ways integrates the physical projecting measures, biological measures and agriculture cultivating measures together to optimize and distribute the precipitation resources, constructing with local characteristic and defending according to the local deficit or potential calamity. The local people created a new way to collect the rare precipitation (100 mm - 200mm/year) to batting with drought, which is to build a water cellar with the volume of 50 cubic meters in a field or along the road and collect rainfall from the surrounding areas, based on the gravity of rain water from the slope. In this way, an integrated synthesis defending and renovating system of multi-function and multi-objectives' water and soil saving has been established to control the loss of water or soil.

3.3 Case 3. Wuwei City in Hexi Corridor of Northeast China, a medium size city and typical oasis arid area in Gansu Province

Wuwei city is located in the northwest of Gansu Province, and to the east of ancient silk way. The total area is 33,200 km^2, the population in 2003 was 1.92 million, and there has been developed characteristic industry in this city.

We analyzed Wuwei's indicators of energy, waste discharge, traffic and transportation agriculture, industry, etc, based mainly on the investigation figures, utilizing the systematical dynamics model Stella and Polestar language to simulation the future development of the research area. It showed by the research that the Wuwei city is facing a severe eco-environmental crisis under the conventional development patterns and a better future under a sustainable urbanization scenario in the future twenty years.

We find out that the strategy of **Intensive Urbanization** can improve the structure and efficiency of energy utilization. And a relative integrated technical equipment system taking certain environmental protection measures can cut down the waste discharge largely. In the model of **Intensive Urbanization** the driving forces will continually increase, however, the intensity of resources consumption and the waste discharge will be decreased, at last, the aim of environment protection will be fulfilled. The output of end-using analysis indicates that by the 2015, the difference of total emission volume of CO_2 between two kinds of scenarios will be 300 thousand tons; by the year 2030 the difference will be 500 thousand tons. See table 2 (Table. 2)

Table 2: The Total Waste Discharge in Two Kinds of Scenario

The research shows that the traditional developing model will threaten the sustainability of eco-environment and economic development, to this challenge, the intensive urbanization policy should be conformed to, so by the end of year 2020, the benign circling economy can be established. Under the background of globalization, human activity's intension in the arid northeast China's oasis eco-economic system will be aggregated, and the per capital ecological foot print will surpass the carrying capacity of eco-environment. So the ecological deficit will grow up. If the traditional developing model would be adopted, the oasis ecological footprint would have been three times of the eco-carrying capacity, and the natural oasis would have been disappeared. So it is urgent to salvage the oasis ecosystem, and the regional developing strategy must be adjusted, at the same time, the structure and distribution of industries should also be optimized. The ecological water saving industry and structure system of high appending value should be encouraged. The metropolis' development of oasis area must be constrained, and the intensive urbanization policy should be implemented. In this kind of super-normal way of eco-economic developing model, Wuwei's eco-city

construction will successfully solve the contradiction between human and .the nature**.** (Fig.11 - 13)

Fig 11. The scenarios on urbanization and environment of Wuwei in next 20 years under the BAU model

Fig 12. The scenarios on urbanization and environment of Wuwei in next 20 years under the IU model

Fig 13. The analysis of Wuwei's ecosystem under the Intensive Urbanization model in next 20 years

4 The emergence response options and policy suggestions for ecosystem restoration and environmental protection in Western China

4.1 Eco-economic developing mode should be adopted in the Development of Western China

Western China has very vulnerable eco-environment, and the economic and social development is still very poor. As Chinese government has brought forward two important development goals (one is that the Chinese people on the whole will have enjoyed a well-off standard of living in 2020, and the other is China will realize their aim of modernization in 2050), so Western China should protect eco-environment as well as keep on developing economy. According to the many experiences and lessons of and out of China, eco-economic developing mode has been advanced, which take the recycle economy as core matter.

(1) Follow the evolution principle of systematic structure—function—balance—benefit—recycling model.

(2) Change development goal from pursuing single economic benefit to pay attention to the harmony of economic, ecological and social benefit.

(3) Set up ecological social-economic system.

We should establish ecological and resource-saving systems both in production and in consumption. Try to construct eco-city, eco-county and eco-community. Thus achieve regional sustainable development.

(4) Cultivate eco-industrial system.

In Western China, development emphases should be put on the following industries such as tourism, eco-agriculture, Biological pharmacy, green food and organic food industry, as well as environment industry and Nonferrous Metals processing. Try to set up eco-industrial system and put forward eco-agricultural industrialization. Develop eco-industry, exploit characteristic bio-resources and speed up to cultivate new and high-tech industries, such as biologic industry, bio-chemical pharmaceutical industry and electronic information industry.

(5) Create after-superiority depending on the new and high-tech industry.

Western China should develop some high-tech industries and father eco-environment through fetching in advanced technologies. Actively cultivate new points of economic growth by developing emerging industries. Take those big cities (for example, Xi'an, Chengdu, and Chongqing city) as growth pole and thus bring along the whole western area to develop.

(6) Implement ecological urbanization.

Gradually advance ecological urbanization according to four administrative levels that is regional core city, county, town and emphases bazaar. Establish eco-counties, eco-villages and eco-communities. In the near future, build sewage and rubbish disposal establishments respectively in different cities to which can help to disposal garbage. Actively develop

township enterprises, and transfer surplus labor force from those ecological fragile areas to small towns. Boost up carrying capacity of regional eco-system.

4.2 Perfect financial policies to ensure the successfully implement of Western Development.

Promote effective collocation of natural and environmental resources by exerting the leverage of revenue. Set up eco-compensation fund to advance environment protection. The government should give those developing area some special treatment on credit to help their further development.

4.3 Set up ecological compensation mechanism

Eco-environment protection should be a business of the whole drainage area. On the one hand, the inhabitants and the corporations in Western China should pay some economic compensation for the environmental loss caused by their economic activities. On the other hand, the lower and middle reaches, which benefit from the environmental construction in the upper reach of rivers, should afford some of the environmental construction costs that the people in the upper reaches paid by sacrificing their economic benefits. Only if the economic externality has been internalized, can the middle and upper reaches remain their enthusiasm in eco-environmental construction, and ecological construction can last long. So the government should set up ecological compensation fund as soon as possible, thus to ensure sustainable development of the whole drainage area.

4.4 Build the Pith Silk Road of Tourism & Economic Belt.

Based on the precondition of region division of labor, profit share and market-oriented principle, different provinces along the Silk Road should work together to build a huge tourism economics belt. For example, Xinjiang, Gansu, Shannxi, Ningxia, Qinghai, and Inner Mongolia, as well as Tibet, Sichuan, Chongqing, Guizhou, Yunnan and Guangxi all have their own unique tourism resources, such as the Great Wall, figures of warriors and horses found from the Qin tombs, the desert scene, DunHuang Buddhist Cave, and so on. This superiority on tourism resources can help Western China to become an international famous scenic area.

4.5 Implement the marketization of water right to save water resources.

Water price reform is now being put on much primacy in China. Western China should catch hold of this opportunity to implement new market-oriented water price policy, which can promote people to save water and to speed up the innovation of water-saving technology. For instance, water price can be divided into different grades according to different purpose, different season, etc.

4.6 Popularize environment-friendly production and consumption of energy sources.

Actively advance environment-friendly energy sources such as solar energy, firedampand natural gas. Change the traditional fuel structure, which take Crop Straws, woods and grass as main fuel sources. Through these improvements, the project of replacing farmland with forestland or grassland in Western China can be successfully implemented.

4.7 Improve regional system innovation and enhance inhabitants' capability

The emphases of regional system innovation should be put on the country system innovation, enterprises system innovation and financial system innovation. At the same time, development of education and technology should be enhanced. Management of household registration, Reform of Household Registration System and Management of immigrated population in the countryside should be paid more attention.

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Table 1. The impact assessment to the ecosystem ’s service function of the strategy of development of western China and national modernization to west China

Urbanization and industry develepment (strategic infrastructure, mining industry and capital and technology investment	Eco-environment construction and water-land resources collocating and modulation	Social infrastructure and material benefits mechanism (education, labors ’ quality)
better	better	better
better	better	worse
better	worse	better
better	worse	worse
worse	better	better
worse	better	worse
worse	worse	better
worse	worse	worse

Table 2: The Total Waste Discharge in Two Kinds of Scenario s

Total Waste （t)	2015(BAU)	2030（BAU）	2015（IU）	2030（IU）
CO2	2314580.0	4529159.2	2005969.5	4003327.6
CH4	2408.36	4616.71	2087.24	4053.37
Nox	8299.71	15505.42	7152.35	13204.33
Sox	13317.42	26634.85	11541.77	21307.88
COD	30846.53	63561.61	28600.8	56468.9
BOD（living)	18831.5	20840.2	17930.2	17859.8
SS（industry)	21339.6	61775.4	18936.6	56322.2
Nox Waste (t)	113274.2	138972.3	113274.2	126770.3
P Waste (t)	38970.44	43556.98	369874.4	428975.6

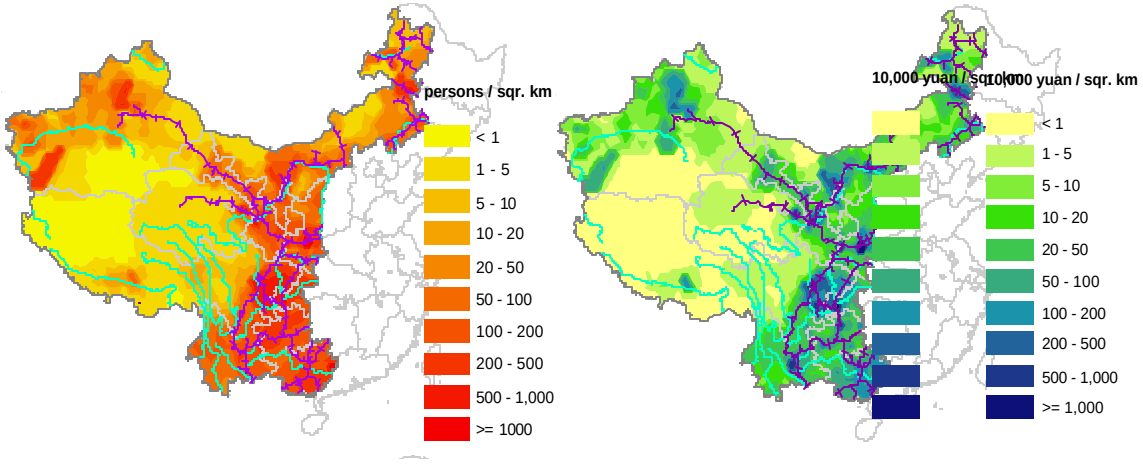

Fig1. The spatial distribution of GDP and population in western China

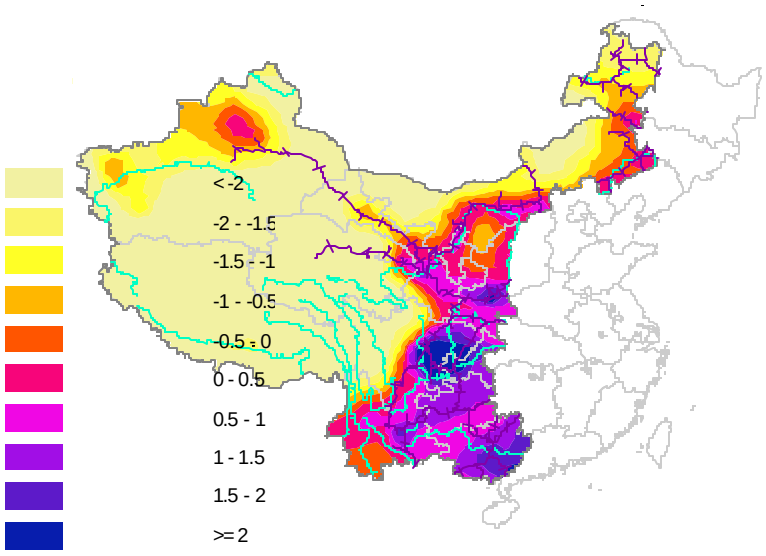

Fig 2. The intensity of human activity in west China

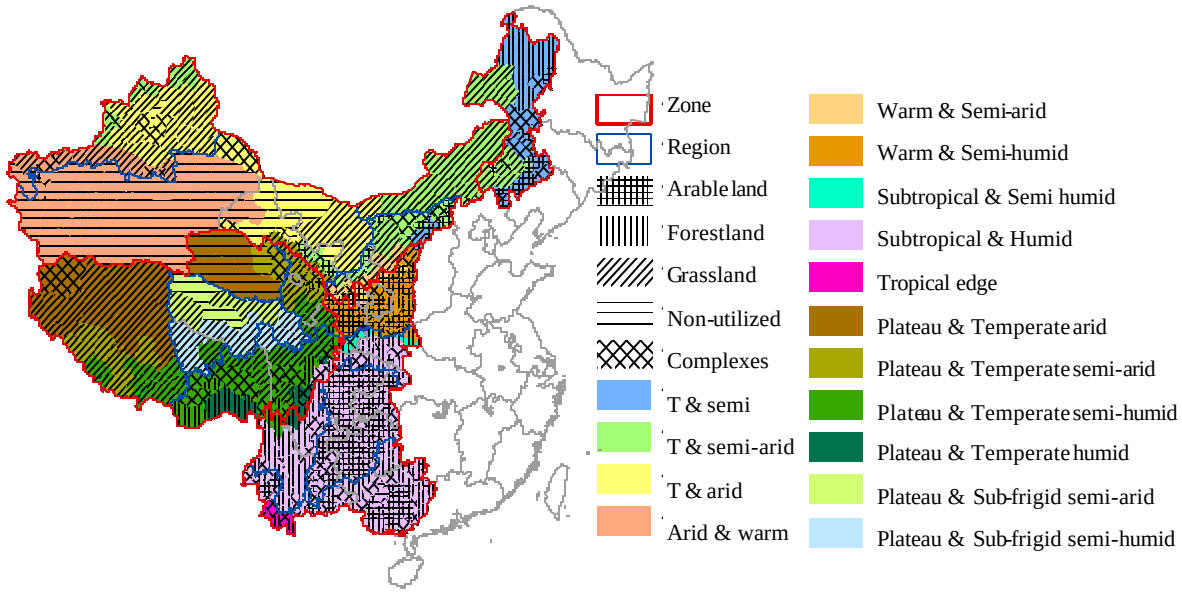

Fig 3. The eco-economic regional classification in west China

T means Temperate

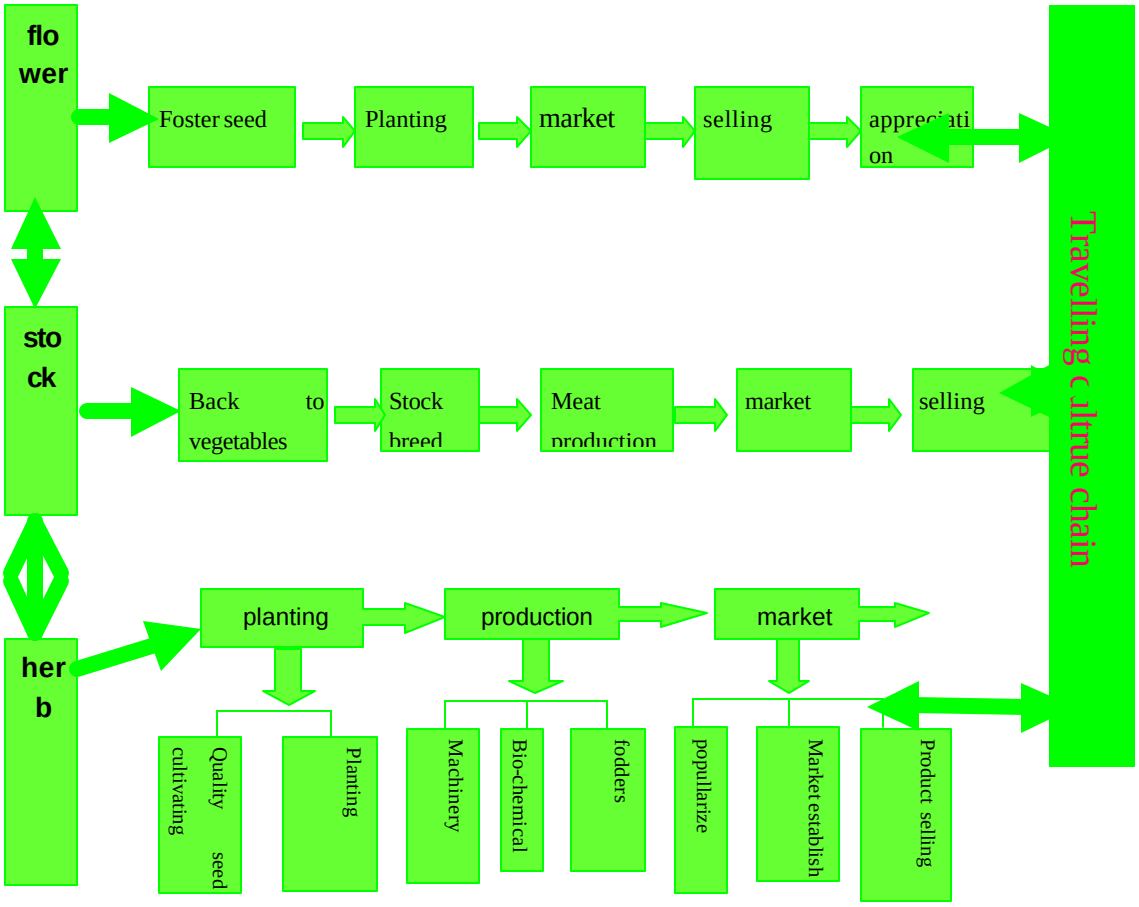

Fig.4. The ecological agriculture industry chain in Dingxi Prefecture

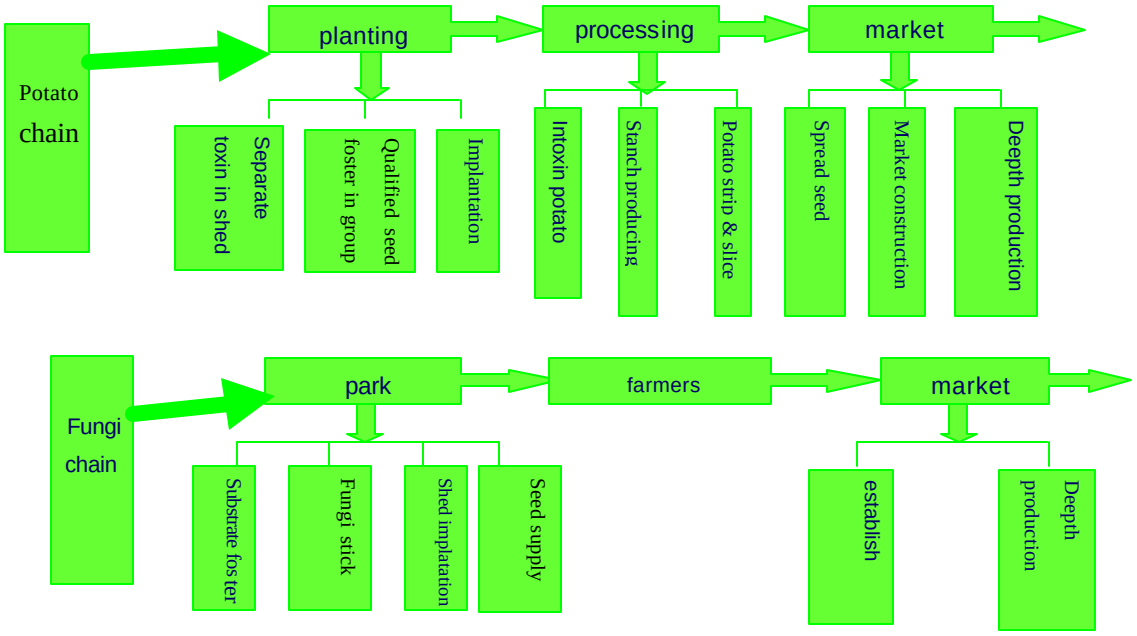

Fig 5. The models of ecological industry chain in Dingxi Prefecture

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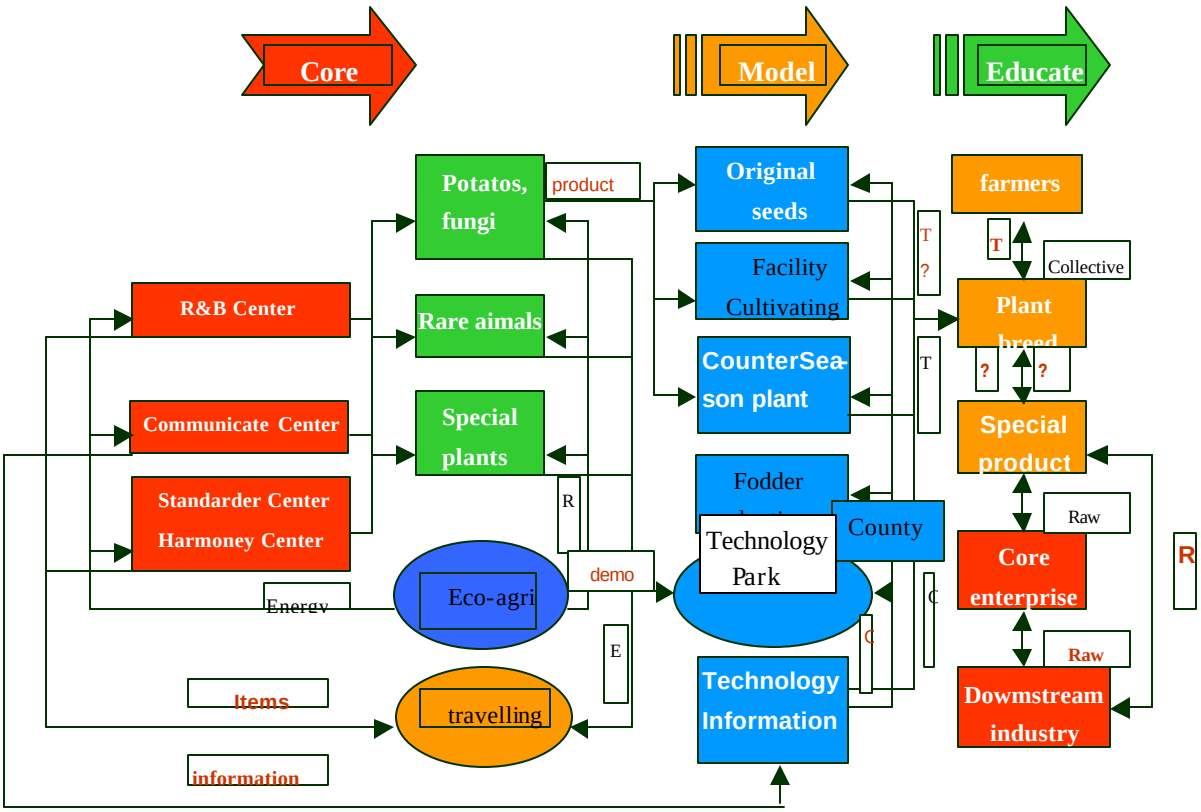

Fig.6. The model of Dingxi's high efficiency and technology park

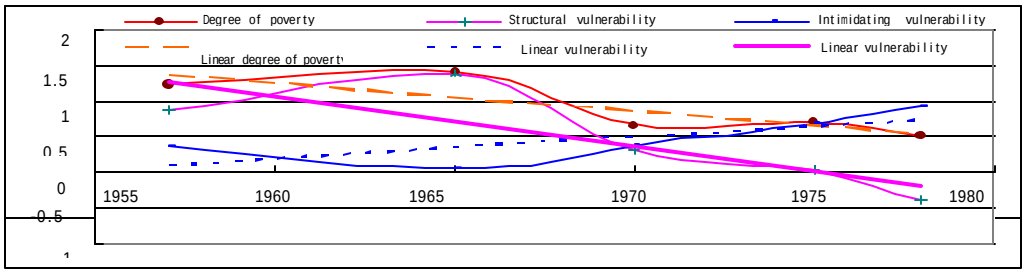

Fig 7. The ecological vulnerability's changing from 1949 to 1978

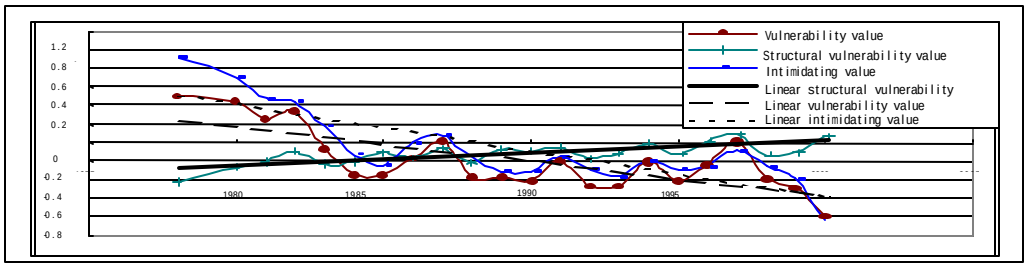

Fig. 8. The ecological vulnerability's changing after 1978

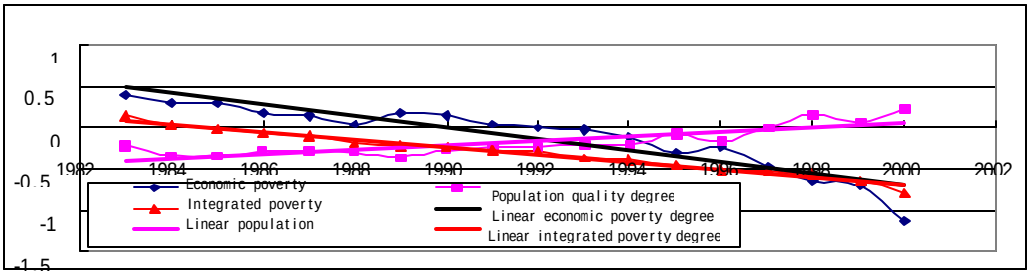

Fig 9. The poverty degree's relation index to the main factors

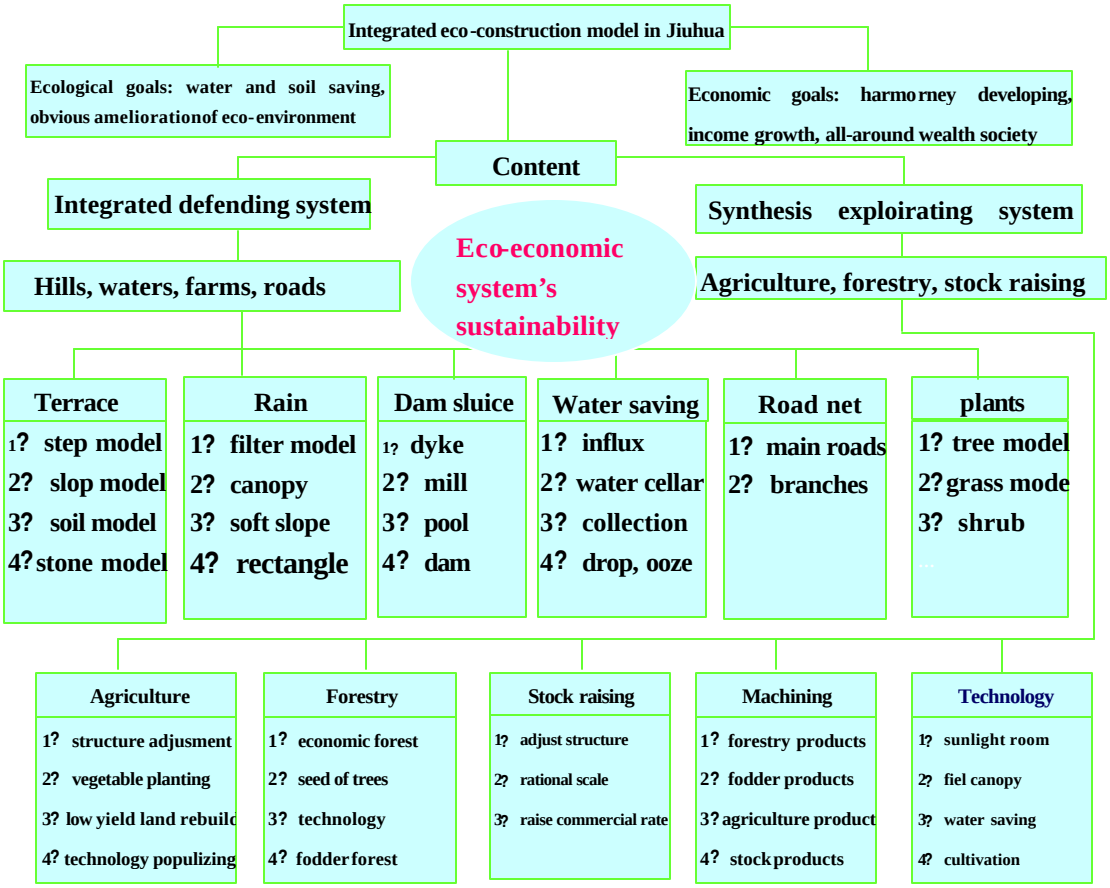

Fig10 Integrated eco-construction model in Jiuhua watershed

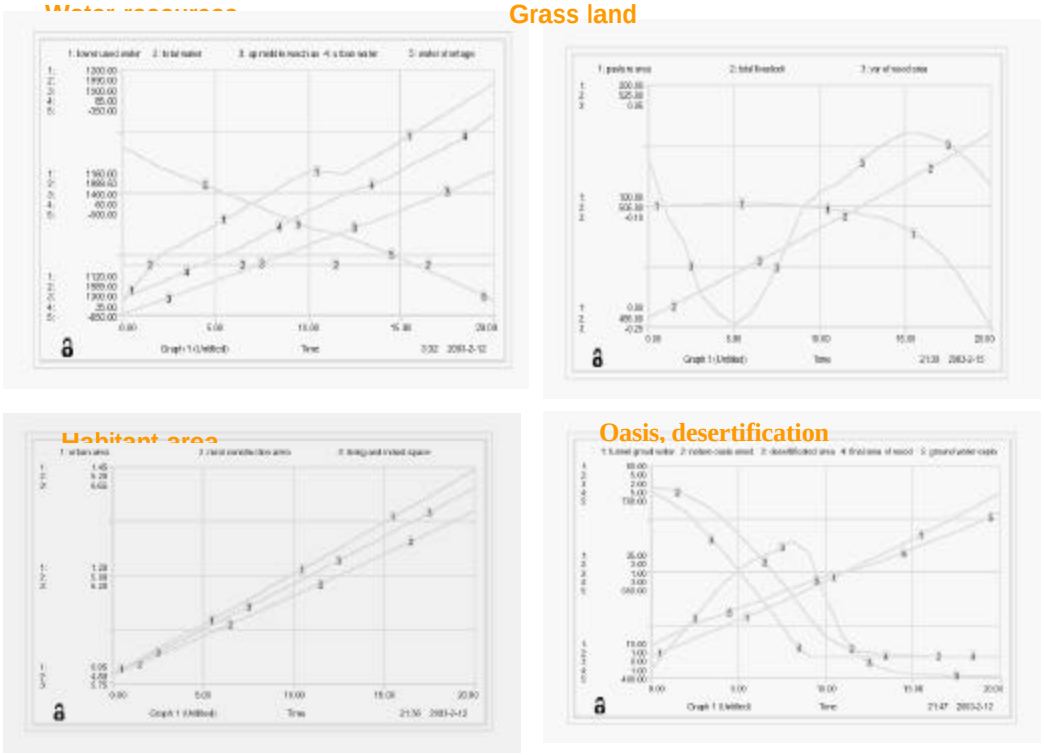

Fig. 11 The scenarios on urbanization and environment of Wuwei in next 20 years under the BAU model

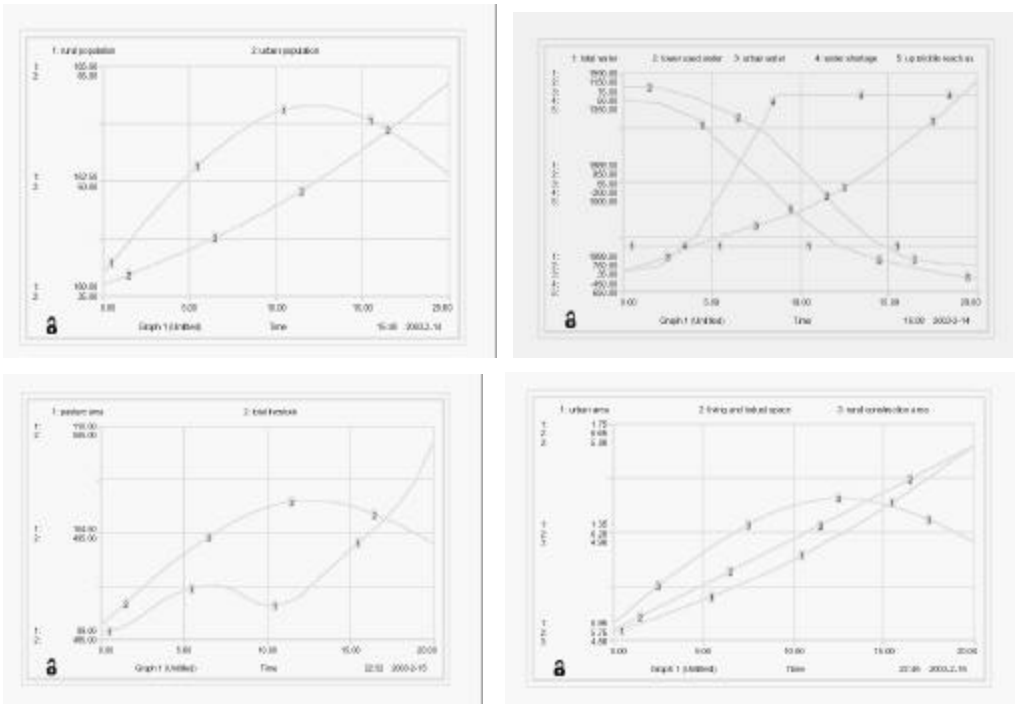

Fig 12 The scenarios on urbanization and environment of Wuwei in next 20 years under the IU model

Urban economy will improve, and the urban populations grow, while the rural area 's population will decrease;

With the immigration of rural area, water using in the agriculture irrigation will be under control, at the end of 2009, the stressing to underground water will be alleviated.

The construction land and the country people will decrease; the land use in this area will be more rational.

After 2013 the number of stock will be decreased, and the bearing stocks per hectare will be less, and after the year 2015, there will be a stable growth of grass land

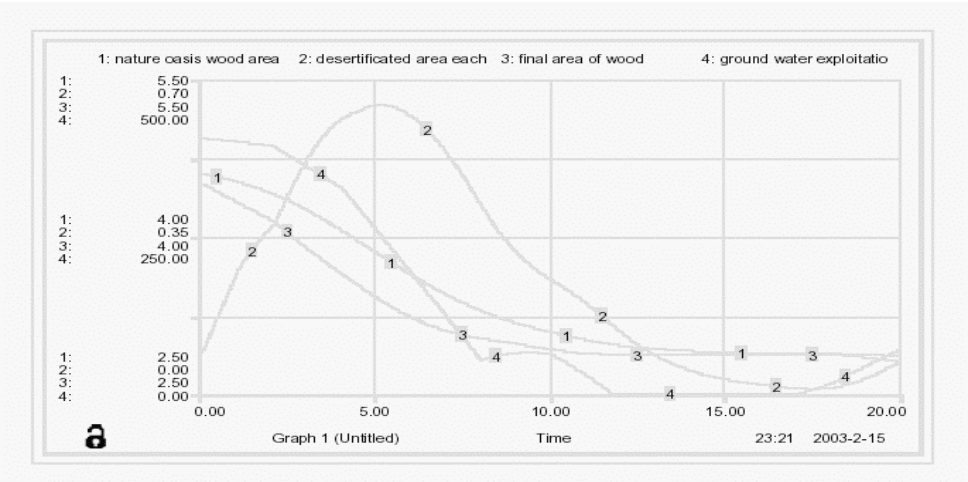

Fig 13 The analysis of Wuwei's ecosystem under the Intensive Urbanization model in next 20 years

The underground water level will granularly elevate, and the down stream's desertification ratio will slow down, and the manual ecological buildings' benefit will be improved, hence, the deteriorating trend of ecosystem will be slowed down and the benign recycling come into forth.