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Manufacturing Industry Development in Jiaodong Peninsula Area
Based on the Awareness of Conservation Culture

P. L. WU, J. H. Zhou*, X. Han

School of Business Studies, Shandong University at Weihai, 180 Wenhua Xilu, Weihai 264209, China

Abstract

Well-developed manufacturing can symbolize the overall strong competitiveness and high level of modernization of a country or region. So, some local governments in China extraordinarily stress the importance of manufacturing industry development in their urban or regional development planning. In fact, manufacturing industry development must adapt to the local natural resources and environment carrying capacity; otherwise the ecological environment would be disturbed and deteriorated. This paper presents a case study of Jiaodong Peninsula Area, a programmed manufacturing base of Shandong Province in eastern coastal China, demonstrating the manufacturing industry development over the past a few years and such ecological changes and problems as water shortage, air and marine pollution and seawater intrusion. Based on the awareness of conservation culture and sustainability, the authors put forward some suggestions for manufacturing industry development in the following years including adjusting manufacturing structure to give priority to high-tech industries and strengthen modern service sectors, accelerating marine industry and marine economy improvement, promoting circular economy development, and attaching importance to coping with water scarcity and water environmental problems.

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1. Introduction

China has achieved a remarkably fast economic growth in the last decades since the implementation of reform and opening-up policy. However, the growth is realized at an excessively high cost of natural resources and ecological environment, which challenges both social and economic sustainable development of the nation to some extent. For example, about one third of the country's major rivers have been seriously polluted, most of waterways flowing through urban areas are heavily contaminated[1]. More than 400 out of the 650 cities in China are worrying about water shortage, and over 110 are suffering serious water scarcity which badly impacts the urban production and residents living[2]. As energy use has been increasing to support the rapid economic growth and because of the

* Corresponding author. Tel.: 13793399553.
E-mail address: zhoujinghua808@yahoo.com.cn.

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higher share of fossil fuel in energy consumption, China has surpassed U.S. and become the top carbon dioxide emitter in the world[3]. Facing such a reality and in order to achieve a sustainable development, China is striving to transform its economic growth pattern and give prominence to building a resource-conserving and environment-friendly society in its new strategy for industrialization and modernization.

Jiaodong Peninsula Area (JDPA) is located in eastern end of Shandong Province, China (Fig. 1). It covers three cities, Qingdao, Yantai and Weihai, and their jurisdiction areas. The three cities are among the first batch of beneficiaries of the reform and opening-up policy in eastern coastal China, and JDPA is the most competitive and developed area in Shandong. In order to promote Shandong’s industrialization process and accelerate its economic progress, the provincial government decided in July 2003 to construct JDPA Manufacturing Base as the center and leader of Shandong’s manufacturing industry development. The Overall Development Planning for JDPA Manufacturing Industry Base Construction 2003-2010 was completed and promulgated soon after in the same year. The long-term goal of the planning is to develop JDPA to another international advanced and competitive manufacturing base in China[4]. Since then on, JDPA has visibly accelerated the growing speed of manufacturing sector and made significant economic achievements. However, the natural resources and environmental problems have not improved but become more severe somewhere in JDPA in resent years. To harmonize the human activity and ecological environment and maintain a sustainable JDPA, it is highly necessary to introduce the awareness of conservation culture to manufacturing industry development.

Fig.1. The location of Jiaodong Peninsula Area

2. Understanding the Awareness of Conservation Culture

2.1. Concept of conservation culture

The concept of conservation culture was first formally proposed by Hu Jintao, China’s president, in a political report to the national congress of the Communist Party of China in 2007. In the keynote political document, President Hu said that China will promote a conservation culture by basically forming an energy- and resource-efficient and environment-friendly structure of industries, pattern of growth and mode of consumption, that awareness of conservation will be firmly established in the whole society, which is believed to be the first time that China calls for conservation culture.

Conservation culture, or simply read as ecological civilization, in our opinion, refers to an ethical developing model for human society towards sustainable practices using methods of systems ecology and industrial ecology. Actually, the awareness of conservation culture evolves based on the popularization of sustainable development theory and practice. Technological advances give humans increasing control over the natural environments, but the environmental costs associated with the material benefits that humans are enjoying are threatening their own future[5]. As humans are facing a reality of population explosion, depletion of finite resources, excessive
consumption, environment degradation and continue pursuing highly industrialized and urbanized, the awareness of conservation culture calls for a reordering all of human activities around green concerns. For industry development, conservation culture emphasizes the sustainable elements including the right relationship between man and nature rather than economic growth only. Nature is the basis for human survival and development, so human and natural environment should be harmonious and symbiotic[6]. We human beings need to put our relationship with nature in a new perspective: consider nature as part of our life rather than something we can exploit without restraint.

2.2. Indicators of conservation culture

The purpose of conservation culture construction in China is to re-orientate the country's economic development and social progress to a sustainable direction. From the concept, conservation culture contains a much broader meaning than environmental protection or a supporting tool only for balanced economic development. To evaluate the level of ecological civilization development in a region, first of all, we need to frame an evaluation system with a series of indicators including regional economic development, natural resources and environmental conditions, social improvement and other human-environment-economy interactive factors.

At present, though the government is striving to promote the conservation culture construction, official evaluation indicators as influential as those in the field of regional economy or eco-economy have not been formulated. However, with the popularity of sustainable development concept, some scholars and institutions have paid much attention to the research of conservation culture evaluation[7, 8]. Based on the results of previous studies and considering the actual natural, social and economic situation in JDPA, we think that the evaluation system should cover at least five areas, regional economic development, population and social development, natural resources use efficiency, environment protection, and harmonization of regional population, natural resources, ecology and economic improvement, each with a series of relevant indicators to measure the gap between the local value and the optimum value (Table 1). The optimum value can be the best within a province, among regions, in China or world widely in accordance with the evaluation scope and usage of the evaluation results.

| Evaluation area                            | Indicators                                                                 |
|--------------------------------------------|-----------------------------------------------------------------------------|
| Regional economic development              | Total GDP, GDP per capita, Industrial structure, Service industry output and structure, Manufacturing industry structure, Urban and rural household consumption expenditure, etc. |
| Population and social development          | Total population, Population density, Birth rate, death rate and natural growth rate, Urbanization level, Average life expectancy, Education budget and percent of GDP, R&D budget and percent of GDP, Disparity of development between rural and urban, School education and higher education, Percent of population aged 15 to 64, Unemployment number and rate, etc. |
| Natural resources utilization efficiency    | Arable land area per capita, Water resources per capita, Forest coverage rate, Constructed land area per capita, Energy consumption per unit GDP, Water consumption per unit GDP, Industrial water recycling, Public green acreage per capita in urbanized area, Energy and water consumption per unit of added industrial value, etc. |
| Environment protection                     | Surface water quality, Air pollution and air quality, Fertilizer used, Pesticides used, Rate of industrial solid waste treated, Emission of CO2, SO2 and NO2 per unit GDP, Emission of industrial sewage, Environmental invest and percent of GDP, Discharge and treatment of industrial waste water, etc. |
| Harmonization of population, ecology and economy | Environmental legislation and enforcement, Embodying resource-saving and environment-friendly achievement to government appraisal system, Bills, proposals and suggestions of environment protection, Environmental impact assessment and ecological restoration planning, Investment on environment protection and percent of GDP, Frequency of serious environmental pollution and ecological destruction events, Public satisfaction of urban environmental protection, environmental education, etc. |
3. Industry Development in Jiaodong Peninsula Area since 2003

Since the implementation of The Overall Development Planning for JDPA Manufacturing Industry Base Construction 2003-2010 by Shandong provincial government, the industry development has achieved great progress. Contributed by the accelerating manufacturing development, the regional economic strength has notably increased. A few manufacturing industry clusters has formed their primary shape. An export-oriented economy with Japan and South Korea as main trade partners is leading JDPA to become the international trade and foreign investment center of the province.

3.1. Economic growth in JDPA since 2003

The regional economy in JDPA has maintained a sustained and rapid development in the last a few years. By the strategic industrial adjustment, the traditional industries have been upgraded and high and new technology industries and modern services have gained speed. The total gross domestic products increased from 393 billion RMB in 2003 to 965 billion RMB in 2008. Secondary industry is the largest contributor to the gross domestic products growth, from 213 billion RMB to 543 Billion RMB in the five years. It accounted for 56.3% of the total GDP in 2008. And, manufacturing is the main part of secondary industry in JDPA. Its share in the secondary increased from 89.9% in 2003 to 91.9% in 2008, which well demonstrates the influence of the manufacturing base construction strategy implementation (Fig. 2).

In 2008, the primary, secondary and tertiary industry in JDPA produced 21%, 30.7% and 34.6% of Shandong’s total primary, secondary and tertiary industry products respectively. In terms of GDP per capita, Qingdao, Yantai and Weihai achieved 7582 US Dollars, 7054 US Dollars and 9142 US Dollars in 2008 respectively, much higher than the province’s average GDP per capita, 4762 US Dollars. Though the GDP per capita of the three cities were still not so much as that of China’s richest cities such as Beijing, Shanghai, Shenzhen or Guangzhou, it is a fact that JDPA has been the leader of the province economic growth.

3.2. Changes of industry structure in JDPA 2003-2008

Comparing the compositions of primary, secondary and tertiary industry GDP in 2003 and 2008, we found that the percentage of secondary industry GDP increased much obviously and that of tertiary industry increased slightly while the percentage of primary industry GDP declined obviously (Table 2), which can also show the implementation result of government’s manufacturing priority strategy in JDPA. The changing trend in JDPA was much similar as that of the total province, but different changes took place in each city in JDPA. During the five years, the primary industry share of all the three cities decreased continuously. The secondary industry share of Yantai increased by 7.3% while its tertiary share decreased by 4.5%. In Weihai, the share of secondary industry
increased by 2.4% and that of tertiary industry increased, too, by 1.3%. In Qingdao, on the contrary, the share of secondary industry GDP decreased from 52.6% to 50.8%; while the share of tertiary industry increased from 39.1% to 44.1%. Qingdao is a well-know industrial city for a long history. It is comparatively well industrialized and is the leading city of high-tech industries development in Shandong. Optimizing and upgrading the industrial structure is currently the most important changing trend of the industrialization progress in Qingdao. In the long run, earlier or later, similar industry structure changes as happened in Qingdao should appear in all cities and towns in JDPA in accordance with the general industrialization rules.

Table 2. Changes of GDP Composition in JDPA 2003-2008

| Area    | Primary Industry (%) | Secondary Industry (%) | Tertiary Industry (%) |
|---------|----------------------|------------------------|-----------------------|
|         | 2003 | 2008 | 2003 | 2008 | 2003 | 2008 |
| Qingdao | 8.3  | 5.1  | 52.6 | 50.8 | 39.1 | 44.1 |
| Yantai  | 10.8 | 8.0  | 53.6 | 60.9 | 35.6 | 31.1 |
| Weihai  | 11.1 | 7.4  | 58.8 | 61.2 | 30.1 | 31.4 |
| JDPA    | 9.7  | 6.5  | 54.3 | 56.3 | 36.0 | 37.2 |
| Shandong| 11.9 | 9.6  | 53.5 | 57.0 | 34.6 | 33.4 |

Data source: Shandong Statistical Bureau. Shandong Statistical Yearbook 2009.

3.3. The five manufacturing groups and major industry sectors in JDPA

Based on the historical industrialization achievement and recent years’ preferentially development, there has primarily formed five dominant manufacturing industry groups in JDPA, transportation equipment, electronic information and household appliances, textiles and garments, chemicals and pharmaceuticals, and food producing, each with certain competitive sectors and key enterprises. The transportation equipment manufacturing group covers two main industries, automobile manufacturing and shipbuilding industry. The former mainly produces economic-type passenger vehicles, trucks and key vehicle components; and the later focuses on producing large oil tankers, container ships, marine engineering ships, ocean fishing and processing vessels, high-speed luxury yacht and other high valued ships. In 2008, Shandong produced 15.2% of China’s household refrigerators and 9.6% of China’s color television, nearly all of which were made in Qingdao. Exploiting the abundant marine biological resources, JDPA has developed a series of new chemicals and medicines with independent intellectual property rights, especially those of anti-tumor, anti-cardiovascular disease and marine biological vitamins and genetic engineering medicines. Currently, the ten categories of industrial products in JDPA share a large proportion of the country, automobiles, ships, petrochemicals, rubber and related products, new materials, electronic information facilities, textiles and garments, household appliances, food and medicine. Some trademarks are well-known both throughout the country and world widely such as Tsingtao (beer), Changyu (grape wine), Haier and Hisense (refrigerator, television sets, computer, cell phone and other household appliances), Double-Star (Sportswear and shoes), Triangle (tire), etc.

3.4. Foreign direct investment situation and problems

In last a few years, JDPA paid more attention to absorb foreign investment and introduce large-scale foreign enterprises. The foreign direct investment in JDPA during 2003-2008 accumulated to about 33.2 billion US Dollars, which came from Euro Union, the United States, Japan, South Korea, Hong Kong, Southeast Asia and some other countries. The foreign direct investment covers a large scope of manufacturing fields including textile, leather, food, machinery, chemical, electronic accessories and so on, some of which are small and medium-sized, labor-intensive or resource-intensive. Because of the close location and similar cultural practices, JDPA has been Japan and South Korea’s largest investment destination in Shandong Province. Some Japanese and South Korean traditional industries or part of the resource or labor-intensive production process have transferred to JDPA. Those "sunset enterprises", low-tech, labor-intensive, high polluting or energy-intensive small and medium sized enterprises, increased JDPA’s manufacturing output and aggregated the pressure on resources and environment as well.
Recently, a few large capital-intensive and technology-intensive foreign enterprises set up their plants or branch factories in JDPA including Samsung Group and DEAWOOD from South Korea and Mitsubishi Electric Corporation, STX Pan Ocean Co. Ltd and Namura Shipbuilding Co. Ltd from Japan.

4. The Impact of Manufacturing Growth on Ecological Environment

The rapid industrialization in JDPA is accompanied with increasing nature resource exploitation and energy consumption. Water scarcity has been the bottleneck problem for regional development in JDPA. The growth of manufacturing has worsened the water resource situation and brought about some negative impacts on the local ecological environment.

4.1. Water scarcity in JDPA

JDPA, even the whole of Shandong Province, is on the North China Plain where the water shortage situation is most serious of all the provincial administrative regions in China. According to the latest national water resources assessment results, the total water resource including surface water and groundwater in Qingdao, Yantai and Weihai are 1.65 billion m$^3$, 3.19 billion m$^3$ and 1.54 billion m$^3$ respectively. As JDPA is one of the most populous areas in China with a density of about 600 persons per square kilometer, its water resource is clearly insufficient. The water resource per capita in JDPA is only 361.1 m$^3$, which is only 16.94% of the China’s average personal possession, 2139 m$^3$, or only 4.4% of the world average water resource per capita, 8210 m$^3$ (Table 3). In Qingdao, as the population density is as many as 757 persons per square kilometer, the average local water resource is as little as 220 m$^3$ per capita. For decades, water availability has been a major constraint for Qingdao’s urbanization and industrialization. In order to satisfy the urban water consumption and improve economic development in Qingdao, a large cross river long-distance diversion canal from Binzhou near Yellow River estuary to Qingdao was built in early 1990s to transfer the Yellow River water to alleviate Qingdao’s urgent water pressure. As the urban population has more than doubled since mid-1990s, urban water shortage threatens the urban sustainability to some extent. The water resource situation is only a little better in Yantai and Weihai than that in Qingdao as they are not so populous. It is projected that the urban population in 2020 in JDPA will double that in 2006. For example, the urban in Qingdao will increase from 2.5 million in 2006 to 5 or 5.5 million in 2020. In order to avoid a water crisis, an eastern branch water route from The South-North Water Diversion Project is under construction, which will transfer the Yangtze River water to JDPA in 2011. However, the main destination of The South-North Water Diversion Project is Beijing and Tianjin. Who can make sure that there will be enough Yangtze River water assigned to JDPA? So, water scarcity will be a difficult problem in JDPA for a long time.

Table 3. Water resource scarcity situation in JDPA

| Area     | Total water resource (10$^6$ m$^3$) | Population 2008 (10$^6$ persons) | Land area (10$^3$ km$^2$) | Population density (persons/km$^2$) | Water resource per person (m$^3$) |
|----------|-------------------------------------|----------------------------------|---------------------------|-------------------------------------|----------------------------------|
| Qingdao  | 1862                                | 8.46                             | 11.2                      | 757                                 | 220.2                            |
| Yantai   | 3197                                | 7.02                             | 13.7                      | 511                                 | 455.5                            |
| Weihai   | 1542                                | 2.81                             | 5.7                       | 493                                 | 549.6                            |
| JDPA     | 6602                                | 18.28                            | 30.6                      | 597                                 | 361.1                            |
| Shandong | 30307                               | 94.17                            | 157.1                     | 599                                 | 321.8                            |
| China    | 2840500                             | 1328.02                          | 9598.1                    | 142                                 | 2139                             |
| World*   | 54228000                            | 6671.23                          | 134424.8                  | 50                                  | 8210                             |

* From World Resources Report 2008 by UNDP, UNEP, World Bank and WRI.
4.2. Groundwater sinking and sea water intrusion

Along with the rapid industrialization and economic development, great changes have taken place in the local water environment in JDPA. As surface water is always not enough for industrial and urban residential use, groundwater becomes the important part of urban water supply. For decades, the amount of groundwater pumped from the aquifer has exceeded the amount that naturally recharges in both inland and coastal plain area, which has resulted in the large scale of groundwater sinking in JDPA. In coastal area, as fresh water is withdrawn faster than it can be recharged, seawater and salt-water intrusion occur in all the three cities. The sea water intrusion can salt fresh water, destroy farmland and result in fresh water crisis to industry, agriculture and coastal residents. For example, the area of seawater intrusion on border of Laizhou Bay in Yantai has expanded to 1500 km² and the intrusion distance is about 68 km from sea[9]. According to statistics, it has destroyed 8,000 wells, 40,000 ha farmland and resulted in grain loss of about 4 billion kilograms and 400,000 persons are short of drinking water. In Weihai, it is observed that an annual increase of 15 km² area of seawater intrusion has happened since 1992. According to the real-time monitoring by Hydrology Bureau of Weihai, the current maximum concentration of Chloride in groundwater is 599 mg/L and the maximum electrical conductivity of groundwater is 2313 μS/cm[10].

4.3. Ecological deterioration and water pollution by industrial and urban sewage

The water resources, both surface water and groundwater, are over exploited all over the peninsula, which has changed the local water ecosystem and degraded the water sights. Some rivers dried up seasonally or perennial in the lower reach. Due to high exploitation rate of water resources following the rapid industrialization, the local water ecosystem becomes very vulnerable to pollution. Although the local governments tried to control the water pollution, the industrial and urban residential wastewater has not stopped increasing in last decade. In 2008, the JDPA discharged 194.6 million m³ of industrial wastewater and 442.9 million m³ of residential wastewater. The wastewater density was 20835 m³/km², about 3 times that of China’s average wastewater density. Most of the rivers through cities or towns in JDPA are heavily polluted. Bohai Bay, once an ideal spawn field of many varieties of economic fish, has lost its essential function as spawn field because of eutrophication, high salinity and pollution of sewage from inland.

4.4. Emission of atmospheric pollutants by manufacturing

Though all the three cities in JDPA are classified among the cleanest cities in China, Weihai and Yantai once won the Habitat Scroll of Honor Award granted by the UN Habitat Agency in 2003 and 2005 respectively and the local governments have made great efforts to strengthen environmental governance, there is still a great emission of air pollutants every year resulted from the rapid growth of manufacturing in JDPA. In 2008, as counted by the government statistical departments, the total volume of SO2 discharged to atmosphere was 265 thousand tons, 84.6% of which came from manufacturing process; the total emission of soot was 63 thousand tons, 68.2% of which came from industry. Particularly, 91.2% of SO2 discharged in Weihai, 90% of SO2 discharged in Yantai and 86.4% of soot discharged in Yantai was from manufacturing industry. Of the total 36.5 thousand tons of industrial dust discharged in JDPA, 30.1 tons was from Yantai, where the industry share of gross domestic product increased fastest of the three cities. It is obvious that the growing manufacturing industry is the root of atmospheric pollutants and negatively impacts the air quality. To sustain the favorable habitat environment, strict control and management of atmospheric pollutants emission can not be ignored during the following rapid industrialization.

5. Strategies for Manufacturing Improvement from the Perspective of Conservation Culture

5.1. Adjusting industrial structure and strengthening intercity manufacturing cooperation.

We noticed that the manufacturing share in regional industry structure is dominant in JDPA; it is even more than 60% in Yantai and Weihai currently. It is necessary to optimize and upgrade the industrial structure so as to bring about an industrial pattern with high and new technology industries as the leader, basic and manufacturing industries as the kingpin and the service industry developing in all areas. For manufacturing industries, priority should be
given to the development of high and new technology industries to provide breakthroughs in stimulating economic
growth. Those traditional industries, either resource-based or energy-intensive, should be transformed with high and
new technology and advanced adaptive technology in order to decrease the consumption of water and energy or
emission of industrial sewage and air pollutants. The three cities should cooperate closely to improve the
manufacturing according to the local water resources and industrial foundation and advantages. The three coastal
cities, all with beautiful sea views and other interesting places and attractions such as the Habitat Festival in Weihai
and International Yacht Race in Qingdao, should accelerate the development of modern service sector and raise the
proportion of tertiary industry share in addition to encouraging the manufacture growing.

5.2. Optimizing internal structure of manufacturing sector to enhance industrial competitiveness

High-tech industry will be the core manufacturing industry in modern industrialization process. In JDPA, it is
necessary to integrate the high-tech human resources for joint research and organize some major R & D projects to
tackle the key problems in local high-tech manufacturing industry. Try to enhance the core competitiveness of
manufacturing by mastering the intellectual property rights and initiative in high-tech industry development. JDPA
should optimize the allocation of manufacturing productivity and focus on the development of computers,
communications and information appliances, digital equipment, integrated circuits and software, flat panel display,
optoelectronic and photovoltaic solar energy, special fiber and composite materials, polymer materials and products,
special metal materials and products, special vehicles and related products, new energy and biomass energy, new
medicines and high-tech equipment, which are the 10 comparatively well developed high-tech industries currently
and will most likely develop to a group of competitive high-tech industry clusters in both domestic and foreign
markets. JDPA has advantageous condition and foundation to develop advanced equipment manufacturing industry.
In the following decades, JDPA should pay much more attention to develop the five equipment manufacturing
sectors, transportation equipment, digital machine tools, specific industrial equipment, new energy equipment and
aerospace equipment industries, to improve their scale and upgrade the skill level. When introducing the industrial
transfer from Japan, South Korea and other developed countries, the ecological environment influences of those
resource-intensive or energy-intensive industries should be carefully evaluated to avoid short-sighted decision.

5.3. Accelerating the development of marine industry and marine economy

JDPA is surrounded by the Yellow Sea and Bohai Sea with as long as 2700 kilometers coastline. It is rich in a
variety of marine recourses for marine industry development. Currently, Shandong government is planning to build
Shandong Peninsula Blue Economic Zone to promote its future regional development. It is a great chance for JDPA
to accelerate its marine industry and marine economy. According to the local situation, JDPA should strengthen or
promote the following marine industry sectors and make it a modern marine science and technology base and one of
the modern marine industry clusters.

- Manufacturing of marine facilities and equipments such as marine ships, luxury yachts, marine engineering
  machinery, offshore drilling platform and marine instrumentations;
- Exploitation and fine processing of offshore natural oil and gas and seabed minerals;
- Biotechnology-focused modern marine aquaculture and biological extraction technology-focused fine processing
  of marine food products;
- Researching and producing marine biological products, new marine medicine and health food products;
- Development of coastal and island tourism, especially marine culture experiencing tourism;
- Seawater desalination and comprehensive utilization;
- Development of marine renewable energy such as wave, tidal and wind energy.

5.4. Be sure to attach importance to coping with water scarcity

Water scarcity stresses the ecological environment, constrains the local economic growth and affects public
health and welfare in JDPA. It is urgent to improve water resources management by efficient and sustainable
practices and effective water policy reform. As local fresh water is surely inadequate and JDPA has the advantages
of near the sea, seawater desalination should be the first consideration to increase available water resources. The province and local government should increase financial and policy support on seawater desalination from the perspective of sustainability. In view of the great upfront investment and high operating cost, seawater desalination industry should be subsidized and get tax concession for its reasonable profits. Though the water plant’s production cost is much lower when using surface water and groundwater, the excessive exploitation of fresh water is an unsustainable practice. Ecological compensation policy should be implemented as soon as possible to counterbalance the ecological losses of the rural and mountainous inland from where the water resources are diverted to urban. As external water resources especially the Yellow River water and Yangtze River water from a long way is and will be an important part of water supply, and the price of water transferred from Yangtze River is much higher than that of desalinated sea water, conserving water and improving water use efficiency should become the obligation and conscious practice of the whole society. It is necessary to establish a water resource intercity network to regulate the water resource and water consumption within JDPA, by which all kinds of water resources, surface water, groundwater, the Yellow River water and Yangtze River water from transferring projects, desalinated seawater and purified sewage, can be integrated to meet various kinds of need within the region.

5.5. Promoting circular economy development to reduce pollution emissions

Circular economy is a general term for the activities of reducing, reusing and recycling in production, circulation and consumption, which is recognized as an effective production mode for the purpose of raising resource utilization efficiency, protecting and improving the environment and realizing sustainable development. It asks the manufacturing to reduce resource consumption and waste generation in production, use wastes as products or parts of other products directly or after repair, renovation or reproduction, use wastes as raw materials or after regeneration. JDPA should actively explore the practical circular economy development mode for the coastal cities. Based on the natural conditions, current resource and environment situation and industry development, it should take effort to promote the creation of circular economy industrial chain, evolution of circular economy industrial system and formation of circular economy industrial park. The government should coordinate the circular economy development between urban and rural to harmonize urban-rural interaction. All the enterprises, industrial parks and regions should strengthen the development of circular economy by well planning and introducing recycling technology. And, the development of circular economy should be closely combined with industrial structure readjustment and economic growth mode transformation for a resource-saving and environment-friendly society. For the recycling industries in JDPA, the recycling of used household appliances and scrap cars and ships is a promising sector. For equipment manufacturing industries, the manufacturing of energy-saving equipments, environment protection equipments and resources recycling equipments must be highly encouraged to develop. To reduce carbon dioxide emissions, JDPA should accelerate the new energy and renewable energy development and utilization.

6. Conclusion

Though industrialization is an inevitable choice for most regions and cities to safeguard their economic growth, it was not a sustainable practice for most regions or cities in China to excessively emphasize manufacturing industry development as the core of economic or regional development objective as was did in the past. As manufacturing industries consume large amount of natural resources and emit pollutants, they should be scientifically planned according to local ecological conditions and properly developed based on awareness of conservation culture in order to minimize their negative effects on natural resources and ecological environment. The awareness of conservation culture reflects an important change in general understanding of development of the whole society. In accordance with the awareness of conservation culture, all the policy makers, regional development planners and practitioners should clearly realize that development must entail a list of elements including the right relationship between man and nature. China is currently a rapid developing country with huge population, plight of natural resource shortage and threat of environmental degradation. It has to face the increasing ecological pressure during expanding the economic output and improving people's welfare. To promote conservation culture construction supplies developing China a transition opportunity towards sustainability. The manufacturing development and eco-environmental changes in JDPA is a typical representative case in China. Only with systematic strategies, practical
countermeasures and persistent efforts of the whole society can JDPA be expected to achieve an ecological, economic and social harmonious development, which is also true for the whole of China.

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