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Review on Natural Resources Utilization in China*

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Abstract: Natural resources are fundamental requirements for development. Even though with abundant natural resources, China is encountering the most difficult situation to preserve the natural resources while keeping the economic growth and social development. Currently in China, the majority (about 93%) of energy consumption is fossil fuels, for example coal, petroleum and natural gas. Owing to fast industrialization and urbanization, the needs for fossil fuels are getting higher and higher. In order to ensure energy security, it is necessary to reform the energy structure and to find alternative energy sources, due to rapid depletion of natural resources. In addition, the Chinese Government is under tremendous pressure in seeking harmonic balance between economic growth, social development and environmental protection. Through literature review and survey, the purpose of this study is to review the status of natural resources utilizations, to analyze the natural resources management system, to summarize existing problems during natural resources exploitation and utilizations, and then to provide appropriate and feasible recommendations for future improvement.
Key words: Natural Resources; Exploitation; Utilization

INTRODUCTION

Natural resources, the foundation of human survival and development, such as land, forest, grassland, water, ocean, mineral and energy resources, are important bases and crucial constrains of economic and social development. In China, though with abundant variety of natural resources, average available natural resources per capita is quite small, due to enormous population (CAI 2008; HONG & ZHOU 2009). Excessive exploitation and inefficient utilizations of natural resources has not just only caused rapid depletion of natural resources but also resulted in severe conflicts between environmental protection and economic and social development. Therefore, effective and efficient exploitation and utilization of natural resources has become the significant essence of economic and social developing strategy. In order to ensure economic and social development, it is essential to preserve the ecosystem and environment, to conserve the natural resources, through proper and necessary measures and management, for example low carbon economy (LCE) and circular economy (CE). The purpose of this study is to review the natural resources utilization and to analyze natural resources management system in China, and then to provide appropriate and feasible recommendations.

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1. CURRENT STATUS

In China, there are diverse varieties of natural resources, such as land, forestry, grassland, fresh water, primary energy, mineral resources, ocean, and etc, with abundant reserves. However, due to enormous population, the available natural resource per capita is quite low, in comparison with world average, as shown in Table 1 (State Council Information Office of the People's Republic of China 2007; CAI 2008; Hong & ZHOU 2009; LIU & FAN 2009; State Forestry Administration 2009).

Table 1
Total Amount and Availability of Natural Resources in China

Natural Resources		Total	Unit	Per Capita	Unit
Population		13.407	(10^8 capita)		
Land		9.600	(10^8 hm^2)	0.716	(hm^2)
	Cultivated Land	1.217	(10^8 hm^2)	0.091	(hm^2)
Forestry		1.950	(10^8 hm^2)	0.145	(hm^2)
	Standing Trees and Logs	137.210	(10^8 m^3)	10.234	(m^3)
Grassland		4.000	(10^8 hm^2)	0.298	(hm^2)
Fresh Water		28,124.000	(10^8 m^3)	2.098	(10^3 m^3)
Primary Energy (recoverable reserves)	Coal	1,145.000	(10^8 ton)	0.085	(10^3 ton)
	Natural Gas	19,000.000	(10^8 m^3)	1.417	(10^3 m^3)
	Petroleum	21.200	(10^8 ton)	1.581	(10^3 ton)
	Hydropower	17,600.000	(10^8 KWH)	1.313	(10^3 KWH)
Primary Energy (proven reserves)	Solar Energy	17,000.000	(10^8 TCE)	1.268	(10^3 TCE)
	Wind Energy	10.000	(10^8 KW)	0.746	(KW)
	Thermal Energy	31.600	(10^8 TCE)	2.357	(TCE)
	Biomass Energy	2.600	(10^8 TCE)	0.194	(TCE)

* TCE: tons of coal equivalent

1.1 Land

Though the dimension of China is huge (3rd in the world) and the area of cultivated land is vast (2nd in the world), the percentage of cultivated land is quite small in comparison with other countries, as shown in Table 2. In addition, the per capita cultivated land is quite low, and the area of high quality cultivated land is much lesser. According to the Agriculture and Village Committee of the NPC, the area of cultivated land has decreased from 1.299×10^8 hm^2 (1997) to 1.217×10^8 hm^2 (2010). And, the per capita cultivated land has decreased from 0.105 hm^2 (1997) to 0.091 hm^2 (2010), which is about 8% drop. For some provinces, for example Beijing, Guangdong, Fujian and Zhejiang, the per capita cultivated land is less than 400 m^2, lower than the international standard of 534 m^2, and is even lower than 467 m^2 in Japan. Therefore, the protection of cultivated land is of extremely importance for China, right now.

Table 2
Percentage of Cultivated Land Among Countries

Country	India	France	Italy	USA	Israel	China	Japan	Germany
% of Cultivated Land	54%	34%	33%	28%	19%	17%	13%	12%

1.2 Forestry

Forestry is mostly distributed in northeast and southwest China, for instance, Heilongjiang, Jilin, Inner Mongolia, Sichuan, Yunnan, Xizang. By the end of 2008, the area of forestry in China is 1.95×10^8 hm^2 to cover about 20.3% of the entire country, with per capita forestry of 0.145 hm^2. The standing trees and logs are 137.21×10^8 m^3, and the per capita standing trees and logs is 10.234×10^8 m^3 (State Forestry Administration 2009). Both numbers are quite low in comparison with world average. Hence, as instructed by President Jintao HU, the area of forestry shall be increased 0.4×10^8 hm^2, and the standing trees and logs

shall be increased 13.0×10^8 m^3, by 2020, at the level of 2005. Tremendous efforts on afforestation shall be required.

1.3 Grassland

The area of grassland is approximately 4.0×10^8 hm^2 (2^{nd} in the world), which is about 40% of the total area of the homeland. The per capita grassland is nearly 0.3 hm^2, only half of the world average. There are three major types of grassland in China, temperate grassland in the north (from Heilongjiang to Xinjiang), alpine grassland in the southwest (mostly in the Tibetan Plateau), and tropical-subtropical grassland in the south (the area south to the Qinling Mountains and the Huaihe River) (Geography Teacher 2010). However, majority of the grassland are experiencing various degrees of degradation, mostly moderate and severe.

1.4 Fresh Water

The annual average total fresh water is around $28{,}124\times10^8$ m^3 (6^{th} in the world), where 96% ($27{,}115\times10^8$ m^3) is surface water. Per capita fresh water is nearly 2,100 m^3, less than 25% of the world average. Due to uneven distribution, fresh water in northern China (e.g. the Songliao River, the Haihe River, the Yellow River, the Huaihe River and inland rivers) is only 19% with per capita fresh water of 1,127 m^3, and fresh water in southern China (e.g. the Yangtze River, the Zhu River, and rivers in southeast and southwest regions) is 81% with per capita fresh water of 3,380 m^3. Therefore, water scarcity in northern China is more critical than that in southern China, especially for the Yellow River, the Haihe River.

1.5 Primary Energy

There are various kinds of primary energy, such as coal, natural gas, petroleum, hydropower, solar energy, wind energy, thermal energy and bioenergy, with abundant reserves. However, per capita primary energy is way below the world average due to huge population. Coal is mostly distributed in north and northwest China, petroleum and natural gas are mainly located in east, central and west China and sea area. Hydropower is concentrating in southwest China. Solar and wind energy are widely spread out to cover 2/3 of the homeland. Thermal energy is sited in north, southeast and southwest China (State Council Information Office of the People's Republic of China 2007; Hong & ZHOU 2009; LIU & FAN 2009; State Forestry Administration 2009).

2. EXISTING PROBLEMS

Though with abundant natural resources, there are several critical circumstances to restrict the exploitation and utilizations of natural resources, in addition to huge population.

2.1 Irrational Energy Structure

According to the investigation, primary energy consumptions almost rely on fossil fuels only (~93.0%), for example, coal (~70.0%), petroleum (~20.0%), and natural gas (~3.0%) (LIU 2003; ZHANG & CHENG 2009; YANG & QU 2009; LI 2010; LIN et al. 2010). The ration of renewable energy is only ~7%. Thus, the exploitation and utilizations of coal have become the major concern of energy supply. As described in the above, most of the fossil fuels reserves are located in north, northwest, and west China. However, major energy consumptions are concentrating on east and southeast coastal areas. As the consequence, long distance transportation for fossil fuels and electricity is required to elevate the cost and reduce the efficiency. In addition, China has become the 2^{nd} largest petroleum consumption country (3.54×10^8 ton/yr) and the 7^{th} largest petroleum import country, where more than 47% of consumed petroleum is imported. According to the estimation, petroleum consumption will be increased to 4.07×10^8 ton/yr in 2010 and 5.63×10^8 ton/yr in 2020 (LIU 2003; Chinese Academy of Social Sciences 2008; ZHANG & CHENG 2009). Therefore, energy security has become another focus of attention.

2.2 Poor Development Conditions

The developing conditions of a lot of natural resources reserves are poor due to located in remote areas. For instance, underground mining is required for most of the coal reserves, in stead of open-pit mining. Moreover, due to uneven spatial distribution of natural resources reserves, much more investment will be

required for additional infrastructure building, such as storage facilities, transportation network, electricity grids and etc., in order to exploit and utilize natural resources. As the result, the development cost for exploitation and utilizations is increased rapidly to cause a lot of natural resources reserves being unexploited due to low or even negative economic benefits. In addition, some natural resources located in remote areas are extensive exploited and utilized, due to lack of advanced instruments and modern technologies. Thus, the efficiency of natural resources exploitation and utilizations is quite low.

2.3 Imbalance Between Supply and Demand

In China, due to fast development of industrialization and urbanization, economic and social structure has been transformed drastically. It is then critical and essential to locate sufficient energy supply for industrial development, urban development, domestic life improvement, infrastructure building and etc. Energy consumption has been continuously increased since the reform and opening-up commenced in late 70s. Consequently, the speedy growth of energy demands has resulted in the imbalance between supply and demand. In order to meet with the energy demands for development, the Country has to explore and exploit more primary energy resources, domestically, and to import petroleum, internationally. Currently, almost half of the petroleum is imported and the percentage is expected to be higher and higher. Though, some efforts are spent on the exploration and exploitation of renewable energy, the major concern is still around the exploration and exploitation of new fossil fuels sources (coal, natural gas and petroleum), which has generated tremendous pressure on natural resources conservation.

2.4 Economic Benefits Oriented

For market economy development, economic benefit is first priority for any business, including the exploitation and utilizations of natural resources. Presently, the utilizations of natural resources are inefficient, owing to outdated instruments and techniques, poor management, and inappropriate product market. Hence, natural resources are overexploited in an unsustainable pattern, in order to meet with the demands for economic and social development, as well as population growth. Moreover, in most cases, the cost of exploitation and utilizations has been significantly underestimated in cost effectiveness analysis, because that the values of natural resources and environmental cost have been externalized and ignored. Accordingly, economic benefits are overestimated, even though a considerable amount of natural resources are wasted during exploitation, transportation and utilizations.

3. RECOMMENDATIONS

Based upon thorough analysis summarized in the above, several suggestions are provided for future improvement.

3.1 To Promote Sustainable Consumption Pattern

Most of the waste generated is due to carelessness, since resources values have been neglected or underestimated, and environmental cost has been externalized. Therefore, to designate appropriate resources values, and to internalize environmental cost are the key issues of sustainable development. However, resources values (including direct use value, indirect use value, option value, and existence value) should be carefully calculated through market price, replacement price, and willingness to pay. And, environmental cost (ecological compensation, ecological rehabilitation and restoration) should be fairly evaluated and allocated, in addition to the cost for pollution prevention, control and remediation. Furthermore, resources values and environmental cost should all be included in national economic accounting to truly reflect their importance and necessity.

3.2 To Optimize Energy Structure

In order to optimize energy structure, it is essential to reduce the dependency on fossil fuels (coal, petroleum and natural gas), in other words, to decrease the ratios of fossil fuels and increase the portion of renewable energy in energy consumption. As mentioned, there are rich renewable energy resources (hydropower, solar energy, wind energy, thermal energy and bioenergy) but underexploited or uneconomically utilized, in China. Therefore, there are great potentials for further exploitation and fully

utilizations of these renewable energy, for instance, hydropower in Yunnan and Guizhou, solar energy in Tibet and Inner Mongolia, wind energy in Xinjiang, Inner Mongolia, and Gansu, thermal energy in Tibet, Yunnan and Sichuan. In addition, biomass, including wood, wood waste, straw, manure, sugarcane, and many other byproducts from a variety of agricultural processes, is another important source for renewable and clean energy.

3.3 To Improve Techniques, Facilities and Management

As mentioned previously, a quite portion of natural resources were wasted through inefficient exploitation, long distance transportation, irrational utilization and unscientific management. First, it is critical to implement more advanced exploration techniques to have a thorough understanding and evaluation on natural resources reserves. Second, it is necessary to apply more advanced exploitation techniques to increase the efficiency of mining. Third, it is important to reduce unnecessary transportation by employing onsite processing and transforming facilities, if applicable and possible. Fourth, it is essential to attain the values of natural resources by rational utilizations. The last, the most significant step is to adopt scientific management system to monitor the entire life cycle from exploration, exploitation, utilizations, recovery to disposal.

3.4 To Implement Resources Recovery System

Waste is a misplaced resource. Most wasted resources, such as waste heat, waste gas, waste residue, and kitchen waste, can be and should be collected for reuse, recycle, and recovery to minimize the amount for final disposal. For instance, biogas (generated from agricultural and pastoral organic waste) for power generation and cooking fuels; waste heating recovery for heating supply, kitchen waste for organic fertilizer, solid waste for construction material, and etc. Nevertheless, the Governments should take the leading role in instituting the legal framework, facilitating policy incentives, constituting technological guidelines, providing financial support, and establishing market mechanisms to promote the implementation of resources recovery system.

CONCLUSIONS

Natural resources are the foundations of human survival and development. To exploit and utilize natural resources more wisely, rationally and efficiently has become the important consensus worldwide. China, the biggest developing country in the world, should take the leading role to balance the interests between economic, social and environmental benefits to fulfill sustainable development, while exploiting and utilizing natural resources.

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