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Driving system of ecological construction

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Abstract
Ecological construction had been a hot topic for environmental degradation since the late 20th century. The goal of ecological construction is to assure from planning to implementing minimal environmental impact and to achieve the environmental, economical, and social benefits together. Ecological construction is also a kind of social activity, which means human power on environment. The system is helpful for ecological construction going well and social development sustainable. Based on the study on the concept and course of ecological construction, a driving system with several interacting drivers has been proposed in this article.

Key words: Drivers, Driving system, Ecology, Ecological construction, Ecological degradation, Model, Sustainability.

Abbreviations: BOG - Beijing Olympic Games; **Env.,** environment; **Gov.,** government; **PRRFF -** project to reconvert farmland into forest; **PPNF -** project to protect the natural forests; **Z:** ecological construction; **N:** natural drivers; **C:** cultural drivers; **S:** social drivers; **E:** economic drivers; **O:** Intersection point; **OZ:** temporal scale.

Introduction

With economic and social development, environmental degradation becomes more and more serious. Human actions are having large and accelerating effects on the climate, environment and ecosystems of the Earth (Haberl *et al.,* 2007; Foley *et al.,* 2005), thereby degrading many ecosystem services (Aladin *et al.,* 2005). Many people and governments have recently started to know the importance of ecological construction. But many ecological works do not go along well due to lack of efficiency and associated beneficial effects. The term of ecological construction was brought up by in 1980s (Lu *et al.,* 2006)ÿwhich has the similar meaning as ecological restoration, ecological rehabilitation or ecological reclamation. Ecological construction is a systematic process, which is driven by particular force, and consists of a series of steps and procedures (Wu *et al.,* 2002). The goal of ecological construction is to assure from planning to implementation, minimal impact to the environment and to achieve the environmental, economic, and social benefits together. Ecological construction is also a kind of social activity, which means human power on environment. It is analyzed in this article how the factors called drivers or driving forces are affecting ecological construction. The driving system of ecological construction were proposed and analyzed in this study. The system is helpful for ecological construction going well and sustainable social development.

The relationship between four drivers and ecological construction: The driving force or drivers as considered in this article is any natural, human-induced or other factor that causes development or change in an ecological construction activity. There are positive and negative driving force and different strength level. It was proposed that there are four drivers which effect ecological construction, natural drivers, economic drivers, social drivers and cultural drivers. As shown in figure 1, the relationship between four drivers and ecological construction is like a pyramid of which the peak symbolizes ecological construction. The four bottom points symbolize four drivers—natural, social, economic and cultural drivers. The volume of pyramid symbolizes the driving strength on ecological construction influenced by the whole drivers.

Natural drivers include physical, biological, and chemical drivers, which are induced by nature or human. Ecological construction is affected by global economic growth and its distribution by country, sector, and individual. Social drivers are involved in demographic factors, science and technology factors, policy changes *etc.* Culture is the values, beliefs, and norms that a group of people share. Cultural impact on ecological construction works by people's thoughts and activities.

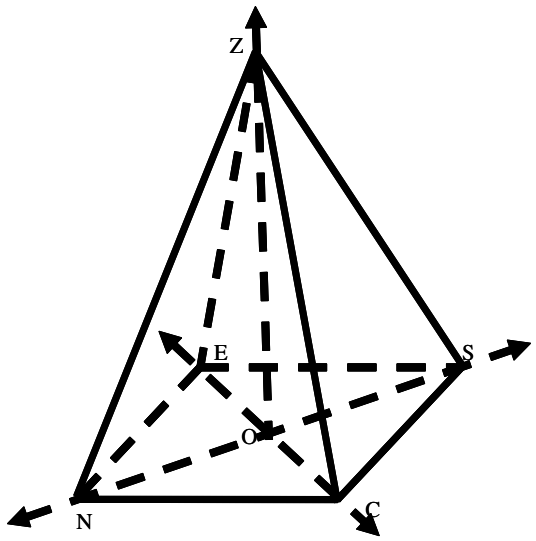

Fig. 1. Relationship between four drivers and ecological construction. The volume of pyramid symbolizes the driving strength of the whole drivers.

There are natural and human-induced physical, chemical, and biological drivers. Natural drivers include solar radiation, climate variability and extreme weather events (such as droughts, floods, hurricanes and cyclones), fires, volcanic eruptions, earthquakes, pest and disease outbreaks, and natural biological evolution (Alcamo, *et al.,* 2003). The primary human-induced drivers include land use changes, climate change, air and water pollution, acid deposition, soil erosion and fertility changes, irrigation, fertilizer use, harvesting, use of persistent organic chemicals, and introduction of non-native species.

Natural factors leading to changes in environment are key points that people take into consideration when ecological environment and civilization are reformed and related policies are formulated. However, the reformed activities may lead to a positive or negative result for ecological construction.

From international sight, Global economic trends that began in the last century will persist and probably strengthen as the twenty-first century unfolds. The economic development causes deep changes in every aspect, including ecological construction. International trade, capital flows, and technology are crucial elements in global growth and its consequences for the world ecosystem and ecological construction. Moreover, the unprecedented rate of global interconnection is leading to dramatic changes in lifestyles and consumption patterns, the consequences of this for global ecological construction need to be researched deeply.

Decision-makers are always influenced by many social and political factors in making a decision. The good trend being observed is the general role of the public in decision-making appears to be expanding, with the development of democratization. The voices that are heard and how they are expressed has changed. Democratic institutions have also encouraged decentralized decision-making, with the intended beneficiaries having a greater say in the decisions made. This trend has helped people make good decision in ecological construction.

Culture can condition individuals' perceptions of the world, and influences what they consider important, and suggests courses of action that are appropriate and inap propriate. Thus cultural drivers affect the course of ecological construction *via* people's thoughts and activities. In most cases, the four drivers do not work independently, but rather affect the ecological construction interactively. One driver can become a factor influencing another driver. It is a very complicated system that influences the course of ecological construction.

Case study on natural drivers

Extra-large floods in China in 1998: China suffered extra-large floods concentrated in 3 areas of Yangtze river in 1998. Although government tried the best to combat the flood, the floods destroyed many counties and villages, and made many people homeless and dead. According to Qianzhengying, there are 2 reasons leading to the cataclysm. Except the meteorological factors, the main reason is vegetation damage in the middle and upper reaches of the Yangtze River (Qian, 1998). After the cataclysm floods, government started two very important ecological projects - project to reconvert farmland into forest and project to protect the natural forests. As the 2 projects going, vegetation and environment improved gradually in the middle and upper reaches of the Yangtze River, which prevented soil and water loss, finally mitigating intensity and frequency of floods (figure 2).

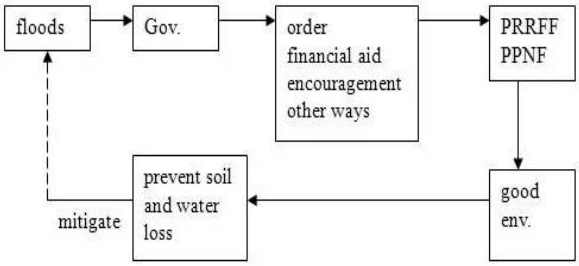

Fig. 2. Driving force of the extra-large floods in China in 1998: Gov., government; env., environment; PRRFF, project to reconvert farmland into forest; PPNF, project to protect the natural forests

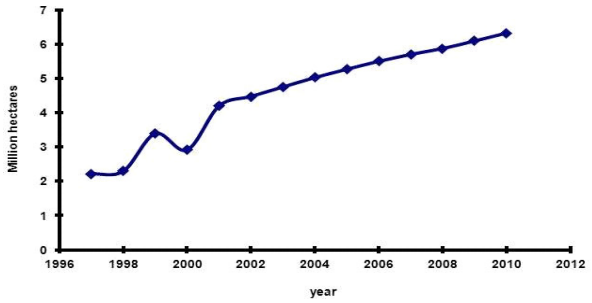

Figure 3: Area of soil erosion under control in Sichuan province

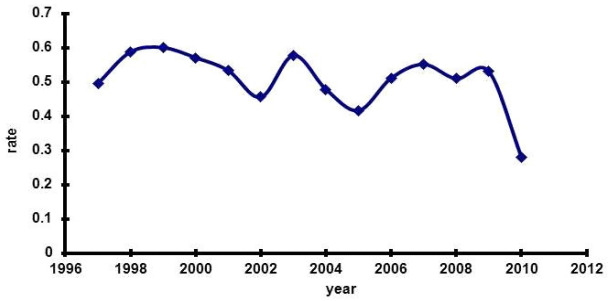

Figure 4: Rate of flood affected area

Sichuan province in China is taken as example in order to show the result of PRRFF and PPNF, which were started in 1999 in Sichuan. By the end of 2008, the total area of afforestation was 2.617 million hectares through PRRFF and the one was about 2 million hectares through PPNF. As a result, the area of soil erosion under control increased in Sichuan province from 1997 to 2010 (figure 3). The trend grows up year by year, which indicates the soil erosion was well controlled. The rate of flood affected area also declined gradually from 1997 to 2010 (figure 4).

Case study on social drivers

Beijing Olympic Games in 2008: As shown in figure 5, The Olympic Games are major social factor, and has great influence on many aspects of society. Green Olympic Games was accepted as one of the three themes to hold 2008 Olympic Games in Beijing. It was also a great plan of construction of Beijing city (Xiong, 2002). The Olympics, generally give a strong impetus to reforms and therefore have the potential to function as a catalyst for environmental, social and political change (Beyer, 2006). Olympic Games rendered government to make decisions which are involved in voluntary planting, building parks and greening city in the way of order, financial aid, communication and encouragement. A beautiful Beijing drives social development smooth and made a positive impact on holding the Olympic Games. From the Olympic Games back to the Olympic Games, the whole driving process constituted a social development cycle.

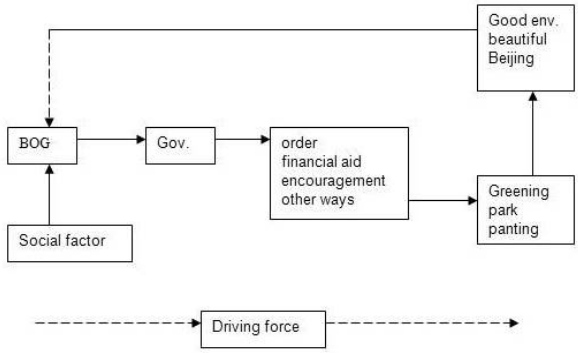

Fig. 5. Driving force of the Beijing Olympic Games
BOG, Beijing Olympic Games; Gov., government; env., environment

Case study on economic drivers

***Ginkgo town in Jiangsu province*:** Taixing is a city in Jiangsu province of China and it is known as "Ginkgo town" because of long history of Ginkgo cultivation, richness of Ginkgo resource, and perfect quality of Ginkgo products. In recent years, Ginkgo industry has been developing rapidly and the levels of industrialization has been rising gradually under the government's strong support. There have been currently 6.3 million Ginkgo trees in the city which were planted artificially. Annual output of Ginkgo in the city is more than 4000t, which is 1/3 of the national Ginkgo output. The Ginkgo timber volume in the city is 252000 m^3. The local government made scientific planning on Ginkgo cultivation and distribution, -resulting in better and better development of Ginkgo industry. In the course of planning, both the economic and ecological benefits were considered. The ecological tourism developed very well and the ecological environment was improved greatly (figure 6).

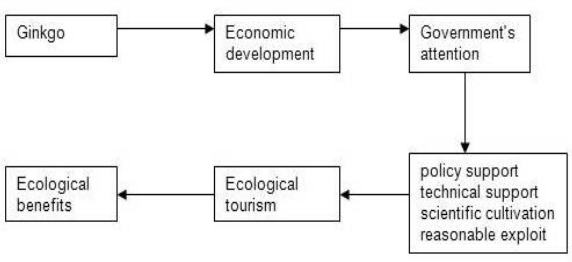

Fig. 6. Driving force of Ginkgo town

Case study on cultural drivers

Sacred mountain culture of the minority in Yunnan province: Yunnan province is one of the areas with the highest biodiversity in the world, and its cultural diversity is also very rich. Most of the races in Yunnan province, such as Dai ethnic minority, Blang ethnic minority, Yi

ethnic minority, Hani ethnic minority, Naxi ethnic minority and Jino ethnic minority, have a traditional taboo. They consider certain areas around village as sacred areas and make specific measures to protect them (Luo *et al.,* 2001).

There is a unique landscape and rich biological diversity in Shangri-La Canyon of Diqin Tibet Nationality Autonomous prefecture, which is located in the northwest of Yunnan Province, China. Tibetan is the most important local Aboriginal people, whose culture has important influence on the local natural environment. According to the research from Zhouli (Zhou *et al.,* 2005), Tibetan sacred mountain widespread in Shangri-La Canyon plays an important role in the local village biodiversity and environmental protection. The protection course is described in figure 7. On the basis of Aboriginal people's identification and protection, different grades of the sacred mountains constitute a bottom to up protection system from the village to local area. The system is an excellent complement to the existing nature reserve system and is also a typical example of cultural practice of traditional culture to promote the environmental management and conservation (Schelhas and Greenberg, 1996).

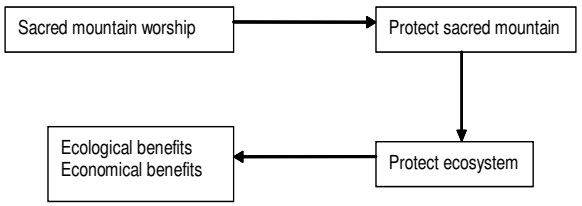

Fig. 7. Driving force of sacred mountain culture

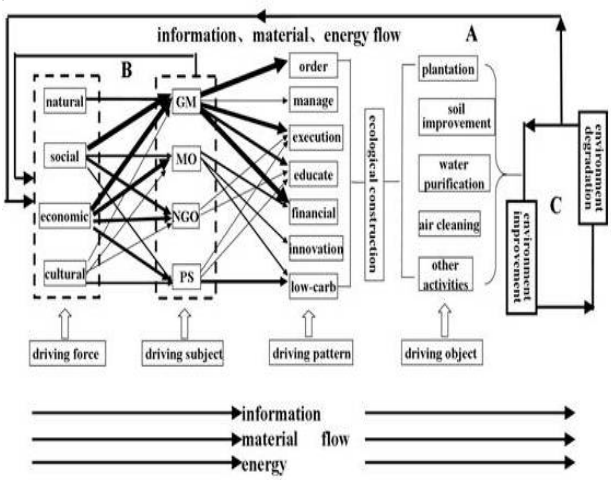

Fig. 8. The driving system of ecological construction
GM- government; MO- market organization; NGO- non-government organization; PS- person; carb-carbon.

***The driving system of ecological construction*:** The driving system is shown in the figure 8. There are four driving characteristics, four driving forces, three cycles, and three transmission media. The direction of driving force is marked with arrows and the strength of driving force is indicated with arrow's width. The transmission process begins with natural, economic, social, and cultural factors, then to driving subject, to driving pattern, and the last station, driving object. The good or bad conditions of environment have impact on the natural, economic, social, and cultural factors, so making up a big driving system cycle.

The 4 driving characteristics are driving force, driving subject, driving pattern, and driving object. The driving force includes natural, economic, social, and cultural factors. The 4 driving forces work through the 4 driving subjects, which contain government (GM) or public organizations and affiliates, market organizations (MOs), non-government organizations (NGOs), and person (PS). The driving subject is decision-makers and responsible for specific implementation. Different driving subject plays different roles in the system.

There are many driving patterns in the system, including government communication, order, management, execution, education, financial aid, technology innovation, low-carbon emission *etc.* The driving object is the specific ecological construction activities, such as plantation, soil improvement, water purification, air cleaning, *etc.* Ecological construction activities have influence on environment, which isalways in the state of improving and declining.

There are 3 cycles in the system, cycle A, cycle B and cycle C. The system itself make up the cycle A, from driving force, to driving subject, to driving pattern, to driving object, to ecological construction activities, to environment, and back to the driving force at last. Cycle A is the biggest one that contains cycle B and cycle C. Information flow plays an important role in cycle A.
The driving force and driving subject form cycle B. The 4 driving forces assemble driving force set while the 4 driving subjects assemble driving subject set. Among the 2 sets is complicated interaction. Information flow and material flow, including cash flow play more important role in cycle B.

Cycle C is made up of environment developing and changing, from improvement to degradation, then back to improvement. Environment improvement and

degradation are absolute concept, at the same time, also relative concept. Absolute concept means ecological restoration and ecological damage while the relative concept means whether the environment is in harmony with social development. If the environment adapts to social development, it is considered improvement. If the environment can not adapt to social development, it is considered degradation. Energy flow and material flow play more important role in cycle C.

The 3 flow media contains Information flow, energy flow and material flow, which run through the whole driving system. Information flow is the flowing process of physical, chemical, or other information, such as transmission of order, dissemination of knowledge, experience, theory *etc.*

Material flow is the process of transformation each other or transmission one to one, such as carbon cycle, nitrogen cycle, cash flow, *etc*. Energy flow is one-way in a closed ecosystem, for example, in food chain. In this article, the 3 cycles are open and complex, and interact with external part constantly. So, the 3 flows are all cycle flow, not in one-way.

Conclusions

The specific issues that drive ecological construction vary tremendously across social activities and daily life. So no single formula or model or institutional arrangement is absolutely correct and or absolutely applicable to every ecological construction activity. Nonetheless, following clear inferences can be drawn regarding driving ecological construction.

- Ecological construction is complicated social activity, complex process and still is important for sustainability. So, it is necessary to study and analyze the driving system of ecological construction.
- The four drivers interact with each other and form an integrative force that influences ecological construction. At particular scales in space and time, there is an optimal force that is most suitable for the ecological construction.
- At different spatial and temporal scales, the drivers' direction and strength level are different.
- The type and quantity of driving pattern and driving object, which need to be studied deeply, are related to spatial and temporal scales and particular activity.

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