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General Research Paper

Strategic Environmental Assessment of the Coal Industry

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ABSTRACT

The application of strategic environmental assessment of coal industry to improve industrial environment and adjust industrial structure is urgently needed. First, a combination of practical situations of coal industry and theory-based dynamic method of strategic environmental assessment, would enable a further development of related strategic environmental assessment that could be applied more effectively when deals with coal industry in practice. Second, based on modern ecological theory, strategic environmental assessment could help reveal the influence of coal industry on ecological and environmental aspects and associated mechanisms. Third, strategic environmental assessment, as well as traditional prevention and control research, could be used as indicators of the development trend of coal industry. Our results showed that when strategic environmental assessment was applied to coal industry, it could provide a strong methodology guidance and help reveal potential mechanisms. On the other hand, from the perspective of model ecological theory, strategic environmental assessment could reflect the applicability and feasibility of related theories in practice.

INTRODUCTION

In recent years, the development of coal industry has become an important energy development trend under the guidance of the national policy in China. The coal industry focuses on the development of modern coal industry so that various energy and chemical products could be produced, for which coal gasification is the key technology and the basis of modern coal industry. Because the development of China's coal industry is at an industrial scale, factors as wide distributions of coal, extensive mode of production and low industrial concentration could all cause an increase of pressure on coal resources and surrounding environment. For example, the coal industry could cause lots of environmental issues, such as air pollution and mitigation difficulties. Therefore, it is urgent to strengthen pollution controls by promoting cleaner production technology, and the premise of which is to develop effective strategic environmental assessment (SEA).

The international Symposium, "Strategy (Planning) of the EIA in China" was held in Beijing on November 3, 2007. The ministry carried out pilot studies of strategic environmental assessment in some regions and industries (Bao 2006). Particularly, the application of strategic environmental assessment to coal industry should be incorporated into decision-making agenda of relevant departments. Although we have accumulated solid scientific experience and related techniques in the coal industry, the strategic environmental assessment at an industrial scale has not been formed or developed yet, which leaves a big knowledge gap, but also provides a promising field for the further development of strategic environmental assessment, both theoretically and practically. In addition, from environmental protection perspective, current environmental pollution management has stepped into a new stage of industrial ecology (i.e., ecological studies of coal industry) with the development of strategic environmental assessment. However, the question of how strategic environmental assessment could be effectively applied to industrial ecology research remains unsolved.

POSSIBILITY OF APPLYING STRATEGIC ENVIRONMENTAL ASSESSMENT IN COAL INDUSTRY

The domestic environmental assessment of coal industry began in the 1980s. Because, the problem of environmental pollution control has become a bottleneck to impede the development of coal industry, interdisciplinary studies that involve coal environmental engineering, environmental assessment and green coal process engineering become more and more important (Fang 2006).

Status and dynamics of strategic environmental assessment: With the increasing complexity of environmental issues, environmental impact assessment (EIA) has been constantly developed to serve as a balance between technical and political relations. British environmental experts, including N. Lee, C. Wood and E. Walsh first proposed the concept of strategic environmental assessment (SEA) (Qian 2007). After that, many countries in Europe and North America launched the SEA to deal with their own situations

(Wang 2009). The civil study from both theoretical and practical aspects began in 1980s. Although the concept of SEA was not clearly stated by then, regional EIA had become a component of SEA (Qian 2007). Since then, the national environmental authorities and relevant research institutions paid more attention to SEA, with some related works published in "Introduction to Strategic Environmental Assessment", "Policy Strategic Environmental Assessment Method Level and Practical Experience" and "Policy Evaluation of Sustainable Development" and so on.

Based on these research efforts, the application of SEA to industry (sector) planning level has been extensively carried out in China, and SEA-related industry policies have been gradually developed (Cheng 2004). However, generally speaking, due to the lack of strong support form policies and regulations and the immature technology involved, domestic SEA is still in its exploratory stage, and cases of its successful application are quite limited.

Situations and background of carrying out coal industry strategic environmental assessment: As coal production has caused serious environmental and ecological problems, some industrial countries start to search for green chemistry, green technology and clean production (Wu 2008). In order to effectively alleviate environmental pollution caused by coal industry, China began to introduce the cleaner production into coal industry decades ago. Regarding environmental issues related to coal industry, Qian Hongwei proposed that strategic environmental assessment at industry scale should be developed on the basis of industrial ecology (Yin 2004). The Songhua River was polluted due to the lack of effective environmental control system, we also proposed that emergency management should be included into strategic environmental assessment to improve the validity of coal environmental protection. However, current domestic coal environmental studies are very limited in terms of clean coal production, coal and industrial ecology. Therefore, the application of strategic environmental assessment to coal industry could help assess major policy decisions, design effective environmental mitigation policies, reduce environmental pollution and solve problems that occur during the process of decision-making, organization and implementation.

ECOLOGICAL TREND OF COMPOSITE SYSTEM OF COAL INDUSTRY AND THE IMPACT ON ENVIRONMENT

Ecological characteristics of the composite system of coal industry: The composite system of coal industry involves multiple links. Traditional micro-management mainly cares about the process of material conversion, equipment optimization, and scale-up production, all of which are considered as the common problems occurring in traditional industry development. Here, we propose an ecological point of view of this composite system. Through recognizing the ecological characteristics and analysing the mechanism of strategic environmental assessment of composite system, we hope to test whether SEA has the feasibility and adaptability when applied to coal industry analysis.

The mechanism that how ecological system of coal industry and environment interact is the main force of composite systems. There are some links between them. On one hand, fast development will inevitably lead to the changes of surrounding environment, accompanied with environmental degradation. What is worse, people seldom realize this until it is too late. On the other hand, changes in the environment inevitably lead to the ecological development of coal industry with complex structure to accelerate. The ecological process is limited when the environment is degraded . We can see that there is a complex relationship between the ecological system of coal industry and related environment. Based on the theory of dissipative structures, this relationship can be described as open, non-balanced and nonlinear self-organization, with evolution-oriented, dynamic gradient-oriented, random fluctuations-oriented, and collaborative-oriented features (Zhu 2005).

***Substance flowing is the factor that affects the ecological process of coal industry composite system*:** The coal industry can cause air pollution, water pollution and soil pollution in certain regions. Because these substances can flow, environmental pollutants can be carried out to other places. Therefore, the pollution effect can be extend to a larger scale and be proliferated temporally and spatially (Xinhua 2007). Given this, the assessment of environmental impact imposed by coal industry development must consider cross-border effects. In addition, any interventions to substance flowing (including the reform of coal industry in the whole process) will affect the ecological processes of complex system of coal industry. Therefore, the ecological studies must be based on the dissipative structure theory and the theory of industrial ecology. Based on these theories, we could better understand the dynamic characteristics of substance flowing, and thus ensure the ecological system of the coal industry to develop smoothly. As a result, the impact of substance flowing of coal industry should be considered as one main research area of strategic environmental assessment.

The stability is the embody that the ecological complex system can be controlled. As the scale of coal industry is relatively large, ecological complexity can show extreme high stability when it meets the pressure of the environment. In fact, the ecological sign of a complete industrial system is

the coordination between it and the external environment. The main performance of the coordination is the stability of the system itself (Li 1996). In this sense, on one hand it is conducive to have coal industry further developed, and on the other hand, it enables environmental pressures to have certain flexibility. Therefore, according to the theory of dissipative structures, as long as the pressure to the environment can be controlled within a certain threshold, that is to say, from the "equilibrium" to "non-equilibrium", the ecosystem of coal industry would have a good stability.

To some extent, as the number of complex factors and human development activities could all lead to the stability of the ecological composite system of the coal industry within the threshold, However, the stability will decrease dramatically once the environmental pressure is beyond the threshold. Therefore, the ecological system of coal industry is dynamic with high complexity.

Environmental and inherent logic effect of coal industry compound system: Better understanding of the complex system of coal industry trend characterized by multifunctional ecological and environment aspects could enable a deep understanding of the inherent logic effect. In this respect, this paper discusses intrinsic mechanisms of coal industry, with a focus mainly on coal technology (Peng 1999), and the environmental impact of Shang Jin Cheng mechanism will also be discussed (Sun 2006). For coal industry, related strategic behaviour varies, but involved mechanisms and conventional environmental impact mechanism remain constant. Therefore, based on characteristics of coal environment impact appraisal, we could tell related practical technology and colour tendency without understanding the specific mechanism. Specifically, based on life cycle assessment mechanism, nonequilibrium thermodynamics and industrial ecology theory analysis are applied to coal industry system to understand environment influence, involving mechanisms, and possible problem-solving approaches.

Based on mechanism analysis, theory and method of strategic environmental assessment for the coal industry should be further explored. In this respect, strategic environmental assessment should include different techniques. However, currently few countries have carried out SEA formally, mainly due to the lack of related methodology (Cui 2008). Given this, strategic environmental assessment based on coal industry environment requires a comprehensive integration method of both coal environment and evaluation system. Current research on coal environment evaluation is confined to a single natural environmental level, mainly due to the lack of coal environment evaluation at multiple levels, conflicts of interest and the lack of a feasible analysis framework.

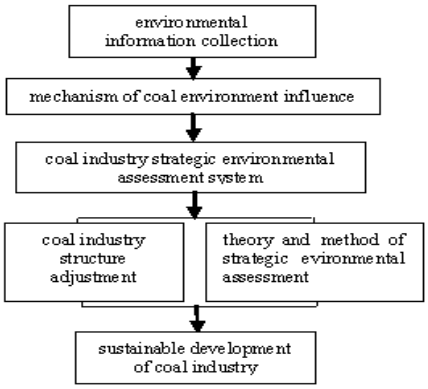

Fig. 1: Relevance of coal industry compound system's environmental impact.

In this sense, coal production process, coal environment engineering project, strategic environmental assessment, emergency management and the theory of system simulation method combined could yield a starting point. Strategic environmental assessment of environmental pollution in coal industry is both necessary and urgent for the development of coal industry and the application of ecological research to industrial scale. Effective coal environment evaluation and emergency management would promote environmental pollution management. Specifically, the application in coal industry would significantly reduce environmental pollution and promote a sustainable development of coal industry as shown in Fig. 1.

TREND'S COAL INDUSTRY COMPOUND SYSTEM TO STRATEGIC ENVIRONMENTAL ASSESSMENT

Currently, strategic environmental assessment of coal industry is extremely insufficient. The first step, namely exploration system simulation, could be applied in ecological and environmental fields to better understand system dynamics (Zhang 2001, Xiao 2003). However, the question of how system dynamics and coal process engineering nested at large scale needs further research efforts. It is also required to build a simulation model based on the ecological system of coal industry so that the causal relationship between the operating system and the process could be further explored. Moreover, the establishment of the state equations, or differential equations, could help establish numerical simulation models that test the validity of strategic environmental assessment on testing the performance of coal industry. In China, the application of strategic environmental assessment to coal industry compound system could serve as a preliminary exploration of industrial system and a test of related ecological theory. Given this, the application of strategic environmental assessment to industrial and cross-industrial fields deserves more attention in the future (also see Fig. 1).

CONCLUSIONS

1 China is facing coal industry development and environmental pollution dilemma. To solve this, we propose the method of strategic environmental assessment to better understand system dynamics from system engineering perspective, and test the possibility and feasibility of the application of SEA to coal industry compound system. In particularly, we emphasize the possibility of using SEA to deal with emergency management and environmental pollution control.

2. Proposed functional characteristics of coal compound industrial and ecological system include the development of coal industry on ecological and environmental aspects, the coupling interactions and associated mechanisms, material flows as ecological indicators of the main carriers of ecological processes and the stability of coal industry compound system. Further research needs to study deeply the environmental impact of coal industry compound system, the inner logic relationship, the updating of strategic environmental assessment, and effective plans and development trend in the near future.

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