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Government initiatives

An innovative system for promoting cleaner production: mandatory cleaner production audits in China

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ABSTRACT

Many studies have shown that positive and negative incentives can greatly promote cooperation in public goods games. The best policy for turning a population of defectors into a population of cooperators is to provide the "carrot" first and the "stick" later. Cleaner production (CP) is a new preventive environmental strategy, and its promotion is also an example of a public goods game. Voluntary participation and other positive incentives have been widely used to encourage industries to implement CP worldwide. However, taking into consideration specific industry characteristics and new environmental management requirements in China, the Chinese Cleaner Production Promotion Law proposes use of mandatory cleaner production audits (as compared to voluntary cleaner production initiatives) as innovative measures for advancing CP. This paper provides a general overview of this innovative system, explaining how the mandatory audit system was established and promoted in various policies, regulations, and national plans, and analyzing the design of the system. The paper also summarizes implementation results of the mandatory cleaner production audit system, based on annual surveys conducted in all provinces of China between 2008 and 2011. The Chinese experience can be used as a reference case by other developing countries similar to China.

1. Introduction

It is well known that environmental issues provide an example of public goods games (Hardin, 1968; Hauert and Szabó, 2003; Ostrom, 1990). Collective efforts to protect a group's interests (e.g., by protecting the environment) present individuals with the temptation to defect, i.e., to take advantage of the public good without contributing to it, known as the free-rider effect (Hauert et al., 2002). In such social dilemmas, the pursuit of individual interests conflicts with the maximization of social welfare (Michael et al., 2009). Game theory has been considered the most appropriate method for studying conflict and cooperation in the provision of public goods (Archetti and Scheuring, 2012; Hardin, 1968; Ostrom, 1990). Cooperation and defection are the two strategies that are usually at the heart of every social dilemma (Dawes, 1980; Perc and Szolnoki, 2010), including public goods games. While cooperative individuals contribute to collective welfare at personal cost, defectors choose not to (Perc and Szolnoki, 2010). Many studies have shown that positive and negative incentives can greatly promote cooperation in public goods games (Hilbe and Sigmund, 2010; Olson, 1965; Ostrom and Walker, 2003). The best policy for turning a population of defectors into a population of cooperators is to use positive incentives, followed at a later point by negative incentives, i.e., providing the "carrot" first and the "stick" later (Hilbe and Sigmund, 2010).

Cleaner production (CP) is a new preventive environmental strategy that is applied to processes, products, and services so as to increase resource efficiency and reduce risk to humans and the environment. The promotion of CP faces the same social dilemma situation, where some industries effectively prevent and control their emissions to protect the environment while others pursue their individual interest in making profit by ignoring emissions. Voluntary participation and other positive incentives have been widely used to encourage industries to implement CP worldwide. Japan, for example, was one of the earliest known countries to adopt voluntary programs for pollution prevention, which can be traced back to 1952 (Welch and Hibriki, 2002). In general, voluntary agreements were developed between local government and industry to suit specific environmental conditions (Chittock and

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Hughey, 2011). One of the most well-known voluntary programs in the US is the 33/50 program, which was launched by the US Environmental Protection Agency (EPA) in late 1990, targeting 17 major chemicals. All participating companies committed to reduce usage, discharge, and disposal rates of these chemicals by 33% by 1992 and by 50% by 1995 from 1988 values (Borkey et al., 1999). Voluntary initiatives in Canada have been in place at federal and provincial levels since 1988 and have focused on setting targets to reduce chemicals or hazardous byproducts from production processes (Chittock and Hughey, 2011). In Europe, CP was promoted on a voluntary basis from 1987 in several countries, such as the Netherlands and Sweden. Common measures include financial subsidies, taxes, and environmental labeling. In Iran, voluntary CP approaches are collaborative arrangements between individual businesses, industry associations, and regulatory agencies at local and/or national levels, reflecting a "multiple criteria decision making method" (Ghazinoory, 2005).

Iraldo et al. (2009) suggest that in order to protect the environment, governments need to adopt a policy mix instrument combining mandatory and voluntary approaches based on market dynamics, in addition to voluntary measures and programs. The promotion of CP also requires such an instrument. The 1990 US Pollution Prevention Act (PPA) is one of the first national acts in the world to clearly establish a national policy for pollution prevention, focusing on source reduction as the top priority. The Act requires the EPA to develop and implement strategies to promote source reduction, to establish a source reduction program that collects and disseminates information, and to provide financial assistance to States. The Act also clarifies the responsibilities of enterprises, with these mainly being to file annual toxic chemical source reduction and recycling reports. The Act was the first instance in which the US legally approved the substitution of end-of-pipe measures by pollution prevention and represents a radical change in industrial pollution control strategies. In general, the PPA of the US promotes implementation of pollution prevention policies and strategies (Schierow, 1999; United States Congress, 1990). The Integrated Pollution Prevention Control regulation introduced by the European Union is a good and successful example of direct regulation that mixes the characteristics of command and control with flexibility and technological incentives (Testa et al., 2014).

In China, the CP Promotion Law was designed largely on a positive and voluntary basis, as reflected in its title. However, on the basis of experiences in the US, EU, and in other countries, and taking into consideration specific industry characteristics and new environmental management requirements in China, a number of mandatory items and requirements have been included in the Law as negative incentives. One of the most important and practical regulations proposed in the law is the concept of a mandatory CP audit, an innovative element that is central to pollution prevention in China. China is in fact the first country in the world to have issued a "Cleaner Production Promotion Law", making the implementation of CP practices mandatory for certain enterprises and organizations (Hicks and Dietmar, 2007). This study provides an overview of this mandatory audit system to show how this can effectively promote wider CP scope and encourage a larger number of industries to cooperate in its implementation; the collective efforts of industries could contribute to sound social welfare in resource conservation and environmental protection, so as to help avoid the tragedy of the commons (Hardin, 1968).

2. Methodology

This study commenced with a brief literature review of public goods games and their basic rules. We then reviewed laws, regulations, policies, and plans aimed at establishing and promoting a mandatory CP audit system in China; these include the following:

- CP Promotion Law of the People's Republic of China, issued in 2002 and revised in 2012;
- The Interim Measures on CP audit, jointly issued by the National Development and Reform Commission (NDRC) and the Ministry of Environmental Protection (MEP) (2004);
- The Administrative Procedures for Conducting CP audit in Key Enterprises, issued by MEP (2005);
- The Administrative Procedures for Evaluation and Acceptance of CP audit in Key Enterprises, issued by MEP (2008a);
- Further Promoting CP audit in Key Enterprises in Depth, issued by MEP (2010a).

Additionally, national plans for environmental protection, heavy metal pollution control, and chemical pollution control were also analyzed for their effectiveness in promoting different aspects of mandatory CP audits.

Table 1 shows all the above-mentioned legislation and policies and explains specific requirements related to mandatory CP audits.

This study also used and analyzed official MEP statistics (2007–2011) regarding the promotion and implementation of mandatory CP audits.

Field visits to various provinces were carried out by the research team in 2008, 2010, 2011, and 2012 to obtain first-hand materials, with these visits focusing on the implementation of mandatory CP audits. During field visits, meetings were organized with local administration, research institutions, and other related stakeholders. Additionally, about 60 enterprises in total were surveyed, including non-ferrous metals, paper, dyeing and textiles, beer, sugar, chemicals, mining, tanning, cement, coke, rare earth minerals, and other key industries.

3. Design of mandatory cleaner production audit system

As noted above, the best policy for turning a population of defectors into a population of cooperators is to use positive incentives before negative ones (Hilbe and Sigmund, 2010). Many different mechanisms have been identified in order to promote or otherwise affect cooperation in public goods games, such as voluntary participation (Perc and Szolnoki, 2010) as a positive incentive. While the government of China positively encourages enterprises to voluntarily participate in CP audits, mandatory CP audit (as a negative incentive) has also been implemented in the country to encourage the cooperation of more and more enterprises in CP activities and to contribute to the environment as public social welfare. The mandatory CP audit system in China aims at urging enterprises generating heavier pollution, with higher energy consumption, or that use and generate hazardous substances to apply CP audits as key tools to identify all potential pollution reduction and energy saving measures, so as to improve resource and energy efficiency, reduce the generation of pollutants, and eliminate or decrease the use and generation of hazardous substances throughout the entire production process.

Governments can develop their own national environmental policies and regulations to create positive incentives for companies to initiate specific environmental improvements (Hillary and Thorsen, 1999). The mandatory CP audit system is such a regulation, requiring national administrative structures and authorities to exercise command and control (including inspection activities by local or state inspection bodies) and enforcement activities (Hillary and Thorsen, 1999). The mandatory CP audit system in China includes government administration as well as enterprises. It

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