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Public awareness and willingness to pay for tackling smog pollution in China: a case study

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ABSTRACT

In recent years, smog has become one of greatest challenges in China and many other countries. However, there are limited attentions of measuring public environment awareness of air pollution and the relations between public environmental awareness and smog prevention in a Chinese context. This study was designed to investigate the facts of public environmental awareness in a typical city of China after the serious smog in the beginning of 2013. The relationship between willingness to pay (WTP) of the residents for tackling smog pollution and their knowledge of the health hazard of smog was also explored. We found that most of respondents heard of smog mainly from news and thought that human activities are the main causes of heavy smog. Around 60% of the respondents wanted to support activities for coping with smog. Using public transportation (77.67%) and using energy saving appliances (72.74%) are environmentally friendly measures that most respondents wanted to practice. The average WTP for self-protection after information disclosure was significantly higher than that before information disclosure. The WTP for supporting smog control and preventive actions before and after information disclosure showed the same trend as WTP for self-protection. However, people wanted to pay more for self-protection than for supporting smog control and preventive actions, which indicated that individuals tend to think that the government should have more roles in smog control and prevention. The factors of age, occupations, education, and income had impacts on the WTP of the residents, but education and income were the most significant. This research suggested that enhancing public environmental education and providing accessible environmental knowledge to residents for tackling smog pollution are of great importance. The knowledge provided by this paper may contribute to smog prevention especially from a public participation perspective.

1. Introduction

Smog is threatening sustainable development in China and globally. In recent years, smog has become one of greatest challenges in China (Zhang and Samet, 2015), as well as in other emerging countries (Sati and Mohan, 2014). Since 2012, the smog issue has become a public event, and it has been daily reported in weather forecasts since then in China (Shi et al., 2014; Tao et al., 2014). Smog is a combined result of human activities and local climate conditions. When air emissions exceed the environmental carrying capacity of the atmosphere, fine particles such as $PM_{2.5}$ (Particulate Matter with a diameter of less than 2.5 μm) as well as other air pollutants continue to accumulate and then after a series of chemical processes they lead to a large scale of smog with a static weather (Ma et al., 2012; Tao et al., 2014; Wang et al., 2014a). Severe smog and haze crises have frequently occurred in central and eastern China especially since 2012. It was reported that the maximum $PM_{2.5}$ concentration of Beijing in January 2013 was about 600 $\mu g/m^3$ and the peak values of PM_{10} in Hebei Province of China were above 1000 $\mu g/m^3$ (Tao et al., 2014; Wang et al., 2014b).

Smog is not new as it has caused problems in developed countries since the 1950s. Several well-known air pollution crises happened in western countries, such as the very famous Great Smog or Killer Smog in London in the 1950s and Los Angeles Photochemical Smog. After the industrial revolution, the extensive using of coal caused severe air pollution in the UK, especially in London and its surroundings. The smog crisis in 1952 caused more

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than 10,000 deaths within two months, and many more people suffered chronic disease from it. The UK worked for over 20 years from the 1950s to turn the air pollution situation around and still continue to reduce air pollution. A series of new policies including a Clean Air Act were introduced after the smog crisis in the UK and other technological, social, and economic methods were used for smog reduction (Zhang et al., 2014). Emissions from industry and vehicles also caused severe smog pollution in Los Angeles in the 1950s–1960s (Boffey, 1968). After that, a Clean Air Act was established by the US government, and market based instruments were introduced as more efficient tools in smog control (Foster and Hahn, 1995).

According to the World Health Organization (WHO), outdoor air pollution has severe negative short-term and long-term impacts on human health, which causes acute disease such as asthma and chronic respiratory diseases. WHO also reported that an estimated 3.7 million premature deaths were caused by air pollution worldwide in 2012 (WHO, 2014). Epidemiologic studies also showed that exposures to outdoor air pollution especially PM_{10} and $PM_{2.5}$ caused an increase of mortality in China (Lu et al., 2015). Zhou et al. (2015) investigated the acute health impacts of the smog episodes and $PM_{2.5}$ on mortality in 2013 and found that the mortality of rural people living close to big and polluted cities in northern China were statistically significantly affected by the smog episodes.

In order to tackle the smog crises, much effort from the government, academia, NGOs, and industries have been made on facing the challenge of smog crises in China. The Chinese government has put forward a series of new policies and regulations. For instance, the “Action Plan on Prevention and Control of Air Pollution Introducing Ten Measures to Improve Air Quality” issued by the State Council of China (SCC) has been implemented since 2013 (SCC, 2013). In the academic world, there have been increasing numbers of researches focusing on air pollution issues in China, from the natural science perspective, technological perspective, public health perspective, and governmental policy perspective. However, it is not enough to only tackle smog and haze issues by technological solutions or top-down approaches. According to China's Agenda 21, to support public participation in sustainable development was clearly listed in Chapter 20 which states that public participation determines the achievements of sustainable development (ACCA, 1994). However, due to the governing structure of Chinese society, public participation has not been well developed in environmental protection. Some researchers have pointed out that $PM_{2.5}$ has created a door for public environmental participation in China (Huang, 2015). However the success of public environmental participation is based upon sufficient awareness of the environmental issues. Studies from western countries have documented that increasing public environmental awareness and knowledge is crucial to the success of pollution prevention (Arcury, 1990). There have also been studies concerning the other dimensions of environmental issues in China, for example, Huang et al. (2006) conducted a survey on public environmental awareness and performance on household e-waste in China and found that the residents have a high willingness to share environmental responsibility. Liu et al. (2009) studied public awareness and its relationship for promoting a circular economy in China and found that the awareness and understanding of the residents about circular economy is positively correlated to their educational level. However, there are limited means of measuring public environment awareness to air pollution and the relations between public environmental awareness and smog prevention in a Chinese context. Thus, this study was designed to investigate the facts of public environmental awareness in a typical city of China. The Contingent Valuation Method (CVM) was used to explore the relationship between WTP and knowledge of the health hazard of smog. The knowledge provided by this paper may contribute to smog prevention especially from a public participation perspective.

2. Methodology

Zibo city is located in the center of Shandong Province, N35°55′20″–37°17′14″, E117°32′15″–118°31′00″, neighboring Mountain Tai in the south and the Yellow River in the north. The neighboring cities of Zibo include Jinan, Weifang, Dongying Binzhou, Linyi, Taian, and Laiwu. The geographic location made Zibo a transportation hub of Shandong Province. As one of the earliest industrial development areas, Zibo city has over a century of industrial development and is regarded as a major industrial city and petrochemical base of the country. The abundance of natural resources, such as minerals, petroleum, natural gas, and predominant geographic location made Zibo city a dominant heavy-industry city, especially in mining and petrochemical industries. At the same time, environmental pollution, especially air pollution, is a very serious problem in Zibo city. Zibo is a typical heavy smog polluted city in the northern part of China. The research of the residents' attitude towards smog in Zibo city is of great importance since the results could provide a valuable reference for smog control and prevention in other cities in China. Also, because Zibo is an important industrial and petrochemical city and one of the key air quality monitoring cities, the air pollution issue in this city is very representative of China.

In order to investigate the residents' WTPs for self-protection and support of smog control and prevention before and after information disclosure of the health hazard of smog and haze, a questionnaire survey was conducted in Zibo city. The questionnaire consisted of part A and part B. Part A included the demographic information of the respondents, information access channel of smog, awareness of seriousness and causes of smog, perceived ways to cope with smog, WTPs for self-protection, and support of smog prevention. In part B, the respondents were first provided with concise information about the facts, causes, and health impacts of smog. Then they were asked the same questions as in part A about their WTPs for self-protection and support of smog control and prevention. Respondents were randomly selected from both urban and rural areas in Zibo. 1200 questionnaires were distributed in July 2013, and 972 questionnaires were returned with a response rate 81%.

The data from the questionnaire survey were analyzed with SPSS. The significance of differences of WTP among different groups was analyzed with one way ANOVA analysis.

3. Results and discussions

3.1. Demographic information of the respondents

The demographic composition of the sample is presented in Table 1. The respondents are predominantly male (65.9%) and from urban areas (67.7%). This might be because there were more males and people from urban areas in our sample areas.

3.2. Information access channel to smog

Less than 3 percent of the respondents had never heard about smog. Most of the respondents heard of smog from different channels. The most common channel to know about heavy smog was from the news, followed by weather forecast, online query, and neighbor dissemination (Fig. 1). The wide spread use of electronic devices, such as cell-phones and tablets, give people easier access to the news. The prevailing use of electronic device programs, such