Feasibility of Haze Governance Based on Carbon Sink Mode

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Abstract In recent years, there are research findings of haze formation in various fields of academic circle. It has proved that causes of haze take on diverse characteristics. Thus, from both the natural and human perspective, haze governance should be diverse. Research conclusions on causes of haze formation mainly focus on special geographical structure, and meteorological factors such as relatively stable atmosphere, high rate of calm wind, high relative humidity and temperature of air, and human factors such as industrial pollution, automotive exhaust emissions, aerosol pollution, eutrophication of soil water, and change of city underlying surface. Carbon sink mode is a new channel for haze governance. In carbon sink mode, it is feasible to regulate relative humidity and temperature in air, enhance global wind, and reduce fine particles and microorganisms of air pollution, so as to reduce haze pollution. Besides, China’s special potential of carbon sink market makes it possible to govern haze on the base of carbon sink.

Key words Carbon sink, Haze, Carbon sink economy

Global ecological environment is constantly deteriorating. After acid rain and greenhouse effects are well known, the haze pollution comes back. As early as the 19th century, industrially developed countries like the United Kingdom had been suffered from haze pollution. They focused haze governance mainly on moving factories and transforming traditional furnaces. However, these failed to solve the haze problem fundamentally. Haze pollution has high degree of harm. Also, it is close to daily life. Thus, its potential safety hazard allows of no negligence. How to effectively and intensively govern haze has become a hot spot of every country in the world.

1 Diverse characteristics of causes of haze

In recent years, rapid social and economic development and accelerating urbanization of China bring considerable benefits, but also bring serious and urgent environmental problems. Due to increasingly deteriorating air quality, haze occurs frequently and it attracts high attention of government and even the whole society. The Ambient Air Quality Standard (GB 3095 – 2012) revised in 2012 changed air quality evaluation standard to AQI from API and added three indicators, particulate matter (PM2.5), ozone (O3) and carbon monoxide (CO). Since the implementation of new air quality evaluation standard, Report on the State of the Environment in China issued by China National Environmental Monitoring Center indicates that major pollutant in days over state is PM2.5[4]. Haze formed by PM2.5 reduces visibility, which not only influences traffic, but also brings great safety hazard. Haze pollution also threatens people’s health[2], especially, the incidence of respiratory and cardiovascular and cerebrovascular diseases is rising. In addition, haze will reduce crop yield and degrade product quality[3]. At present, studies on haze causes are extensive. Researches have shown that haze formation in China takes on complex and diverse characteristics and it is formed in the action of many factors. Haze causes mainly include two types; one is geographical and climatic factor, and the other human factor; the geographical and climatic factor is often influenced by human factor.

From the perspective of geographical and meteorological factor, when atmosphere is in relatively stable state, air current will not have great change, and surface wind speed will be low. In high air relative humidity and temperature, haze will frequently occur [4]. Besides, in areas where the haze is serious, there is special geographical structure. For example, in Shijiazhuang of Hebei Province, western area is surrounded by mountains and cold air is difficult to flow into the downtown. Relative temperature and humidity in downtown are high, and the rate of calm wind is high, so the atmospheric dispersion is slow, leading to serious haze pollution. As to human factors, firstly, fossil fuels combustion and metallurgy, and industrial processing will generate high volume of pollutants and suspension fine particulates. Secondly, increasingly serious aerosol pollution is an essential reason for frequent occurrence of haze. Solar radiation can be scattered and absorbed by aerosol, and can change micro physical structure of cloud, and accordingly change precipitation efficiency through forming cloud condensation nuclei or ice nuclei [5]. In moist environment, dry aerosol absorbs the moisture, forming condensation nuclei making up of droplets. After absorbing moisture, scattering ability of aerosol particle to sunlight is obviously higher than dry particles, so the visibility is lower [6]. Aerosol particles mainly come from industrial emissions and automobile exhaust emissions. Automobile exhaust emission accounts for a little portion. However, automobile exhaust can increase oxidation of atmosphere. It will generate more secondary aerosol particles, leading to occurrence of haze. In addition, according to the latest researches, the haze in China not only originates from secondary aerosol particles in generated in the industrialization process, but also originates from numerous breeding of microorganisms resulted from eutrophication of rural soil and water. Due to evaporation of soil water, microorganisms

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combine with aerosol condensation nuclei bringing ammonia and nitrogen nutrients. They will rapidly in suitable water, nutrient and oxygen condition, volume of aerosol rapidly increases, and finally forming serious haze. Furthermore, increase of haze days is closely related to reduce of average wind speed resulted from human activities. Constant increase of population and rapid development of urban construction lead to change of city underlying surface. Average height of urban buildings is high, average density is high, and it lacks urban ecological planning. Regional wind force is obstructed from city underlying surface, so the surface wind is weak, calm wind increases, and it is difficult for pollutants to diffuse in horizontal and longitudinal direction, leading to lingering of haze particles.

2 Strengths of carbon sink mode in governing haze

From the perspective of causes of haze, governance of haze should firstly control human factor, and secondly take measures to regulate climate and improve environment. Carbon sink mode is an effective approach for regulating climate and improving environment. A carbon sink is a natural or artificial reservoir that accumulates and stores some carbon-containing chemical compound for an indefinite period. The process by which carbon sinks remove carbon dioxide (CO$_2$) from the atmosphere is known as carbon sequestration. Public awareness of the significance of CO$_2$ sinks has grown since passage of the Kyoto Protocol, which promotes their use as a form of carbon offset. There are also different strategies used to enhance this process. Carbon sink mode is the process, activity or mechanism of removing CO$_2$ and other greenhouse gases containing carbon element, aerosol or their precursors. The basic mechanism of carbon sink mode is consistent with haze governance. Although the construction period for carbon sink is relatively long, we should not neglect its science and effectiveness.

2.1 Carbon sink can regulate global climate Relative high surface temperature is an essential condition for frequent occurrence of haze. In the condition of global warming, due to water evaporation and relatively high surface temperature, there is significant influence on environmental condition of haze formation. In view of this, a fundamental approach for governance of haze is to regulate global climate. Extreme weather is mainly due to global greenhouse effect. Carbon sink can reduce greenhouse effect, permanently regulate climate disorder resulted from greenhouse effect, and regulate temperature and humidity balance through increasing precipitation. The carbon sink mode uses branches and leaves of vegetation to shelter sunlight and absorb solar radiation energy, so it reduces temperature of small environment. Vegetation absorbs soil water and transpires to moisture, then the atmosphere has enough moisture, which will increase mobility of global water cycle, regulate relative temperature and humidity of air, and reduce haze pollution.

2.2 Carbon sink can reduce fine particulate and microorganisms of haze pollution Pollutants and suspension fine particles of industrial production and exhaust and dust of traffic are sources of particulate matters (PM2.5). Vegetation can improve quality of living environment. Sterilization elements secreted by some plants can kill various pathogenic bacteria including pathogens and microorganisms brought by dust. Grease secreted by some vegetable skin can adhere to toxic particles and dust, so vegetable can absorb toxic gases exhausted in industrial production, and reduce smoke and dust polluting air. In addition, apart from fixing CO$_2$, vegetable also can absorb ammonia and nitrogen gases, and reduce breeding of microorganisms forming serious haze.

2.3 Re-understanding the importance of haze governance on the basis of carbon sink Forests and grassland have function of checking winds and fixing drifting sand. Through weakening wind speed, forests and grassland can slow down the desertification. As mentioned above, there is a close relationship between increase of haze days and reduction of average wind speed. From this perspective, it seems that carbon sink is not favorable for haze governance. As a matter of fact, it is not like this. Any thing has two sides. Just like there is no thing suitable for any living environment, there will be no measure that only has strength in solving the problem of haze. Forest is not a major reason for deteriorating haze. On the one hand, the distribution of green area is uneven. In urban area, green area is relatively small, so its efficiency of obstructing wind speed is limited. On the other hand, height and density of trees and grasses are far less than the height and density of buildings, thus the function of obstructing wind is relatively small. Therefore, major factor influencing wind force lies in change of city underlying surface. The effect of carbon sink is relatively small. What is more, reasonable planning of vegetable is favorable for precipitation, and promote global water cycle, so as to change global wind force.

3 Huge potential of China’s carbon sink economy Carbon sink market has huge development potential in China. Establishing the carbon sink market has great advantage in China. Rich potential resource makes it possible to govern haze on the basis of carbon sink mode. Once the carbon sink market is established, the benefit performance mechanism can promote cities to make self ecological planning, transform old economic growth mode into new green economic growth mode, balance the relationship between urban industrialization and environment, increase employment, promote dispersion of megalopolises and big cities, and reduce urban environment pressure.

Firstly, no matter through reducing industrial production or making technological innovation, it needs huge costs. In comparison, afforestation and grassland conservation need much lower costs. In China, there are abundant resources. Especially, the grassland area is about 400 million hectare, accounting for 2/5 of the whole national area, 3.2 times the farmland area, and 2.3 times the forest area. Grassland resource area is 10% of the total grassland area of the world, ranking the second place in the world. Besides, according to the Eighth National Inventory of Forest Resources (2009 – 2013) issued by State Bureau of Forest-
ry, the national forest area was 208 million hectare, the forest coverage was 21.63%, the forest area and forest stock separately ranking the fifth and sixth place in the world[1]. Also, per capita labor cost of China is relatively low, so China’s carbon sink projects have considerable advantages in costs.

Secondly, with support of Bio-Carbon Fund of the World Bank, the global first carbon sink project was launched in Guangxi on January 17, 2007. In this project, more than 4000 hectare shelter forests were taken as pilot forests of carbon sink research and transaction. It accumulated certain experience for carbon sink market of China. The Bio-Carbon Fund is proposed according to the provision in Kyoto Protocol that CO₂ emission goal must come from transaction of emission reduction right. At this background, many developed countries have set up various carbon funds, to increase carbon stock, reduce risk of carbon sink market, and support development of carbon sink market, which plays an important role in implementing carbon sink projects in developing countries.

Thirdly, the establishment of carbon sink market will inevitably change existing economic structure. Using market economic rules to make adjustment of urban ecological pattern is favorable for forming green economic system with coexistence of ecology and economy. In carbon sink mode, the establishment of benign system will bring about a series of advantageous effects, limiting carbon emission and rebuilding ecological urban pattern will form chain and comprehensively improve global ecological environment.

In sum, carbon sink mode can promote water cycle, change wind force and regulate global climate, clean the air, so as to reduce haze concentration through reducing relative temperature and humidity, and reduce particulate matters and microorganisms in air. Its operation mechanism is scientific and feasible. Besides, China has huge potential and advantages in implementing carbon sink projects in China. The Doppler effect of carbon sink project will bring considerable positive effect on operating systems of the entire system, forming benign cycle of operation mechanism of the entire society.

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