Municipal solid waste management in China: using commercial management to solve a growing problem

Dong Suocheng a,*, Kurt W. Tong b, Wu Yuping a

a Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, P.O. 9717, Beijing, 100101, People’s Republic of China
b Environment, Science and Technology Section, United States Embassy, No. 3 Xiu Shui Jie, Beijing, 100600, People’s Republic of China

Received 13 January 2002; received in revised form 21 June 2002; accepted 25 June 2002

Abstract

The municipal solid waste (MSW) problem in China is expanding rapidly, with annual waste production growing at close to 10% per year, but sanitary landfills are still rare. This paper discusses China’s MSW management problems, analyzes MSW production trends, and proposes countermeasures using commercial management to address China’s MSW problems. Various organizational and technical hurdles, including centralized planning and economic disincentives, stand in the way of the establishment of a vibrant commercial MSW management system. But commercialization of the MSW industry is the optimal and perhaps only route for effectively purging China of its MSW problem. The development of an ‘industry chain’ with upstream and downstream linkages is required. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Municipal solid waste; Solid waste management; Commercial management of municipal solid waste

1. Introduction

A global solid waste crisis is emerging, and the world’s municipalities are affected the most severely. The volume of municipal solid waste (MSW) produced annually is increasing rapidly as a result of global urbanization, rapid industrialization and economic development. Global MSW production in 1997 was 0.49 billion tons, with production of MSW growing at 3.2–4.5% each year in developed countries, and at 2–3% per annum in developing countries. Based on these data, the problem of MSW management has earned increasing attention as a major hindrance to urbanization and economic development all over the world.

2. MSW production trends in China

By the end of 1998, China’s accumulated volume of MSW totaled about 6 billion tons, occupying 750,000 mu (50,000 hectares) of land. Annual per capita production of MSW is about 440 kg (about 1.16 times China’s annual per capita grain production by weight), and the recorded annual production of MSW has expanded at a 9.3% compound annual growth rate over the past decade.

In 1998 alone, China produced some 0.14 billion tons of MSW, of which 0.11 billion tons was collected for disposal, implying a pickup and disposal rate of 79%. The simple landfill rate was 59%, while the sanitary landfill rate was extremely low; sanitary landfill plants exist only in Beijing, Shenzhen, Chongqing and Guangzhou cities.

China already produces 29% of the world’s MSW each year, and with the economy continuing to grow rapidly, it is clear that China bears what may be the heaviest MSW management burden in the world. Table 1 illustrates the relationship between the growth in MSW production in China, and China’s rapid urbanization and economic development.
Table 1
Change of MSW Production in China

<table>
<thead>
<tr>
<th>Year</th>
<th>MSW Production (Billions tons)</th>
<th>Urban Population (Billions)</th>
<th>Urbanization Rate (%)</th>
<th>GDP/capita (RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>0.0313</td>
<td>0.19140</td>
<td>19.39</td>
<td>460</td>
</tr>
<tr>
<td>1985</td>
<td>0.0448</td>
<td>0.25094</td>
<td>23.71</td>
<td>853</td>
</tr>
<tr>
<td>1986</td>
<td>0.0501</td>
<td>0.26366</td>
<td>24.54</td>
<td>956</td>
</tr>
<tr>
<td>1987</td>
<td>0.0540</td>
<td>0.27674</td>
<td>25.32</td>
<td>1104</td>
</tr>
<tr>
<td>1988</td>
<td>0.0575</td>
<td>0.28661</td>
<td>25.81</td>
<td>1355</td>
</tr>
<tr>
<td>1989</td>
<td>0.0629</td>
<td>0.29540</td>
<td>26.21</td>
<td>1512</td>
</tr>
<tr>
<td>1990</td>
<td>0.0677</td>
<td>0.30191</td>
<td>26.41</td>
<td>1638</td>
</tr>
<tr>
<td>1991</td>
<td>0.0750</td>
<td>0.30543</td>
<td>26.37</td>
<td>1879</td>
</tr>
<tr>
<td>1992</td>
<td>0.0800</td>
<td>0.32372</td>
<td>27.63</td>
<td>2287</td>
</tr>
<tr>
<td>1993</td>
<td>0.0860</td>
<td>0.33351</td>
<td>28.14</td>
<td>2939</td>
</tr>
<tr>
<td>1994</td>
<td>0.0998</td>
<td>0.34301</td>
<td>28.62</td>
<td>3923</td>
</tr>
<tr>
<td>1995</td>
<td>0.1075</td>
<td>0.35174</td>
<td>29.04</td>
<td>4854</td>
</tr>
<tr>
<td>1996</td>
<td>0.1083</td>
<td>0.35950</td>
<td>29.37</td>
<td>5576</td>
</tr>
<tr>
<td>1997</td>
<td>0.1300</td>
<td>0.36989</td>
<td>29.92</td>
<td>6053</td>
</tr>
<tr>
<td>1998</td>
<td>0.1400</td>
<td>0.37942</td>
<td>30.04</td>
<td>6392</td>
</tr>
</tbody>
</table>


China is presently experiencing both rapid urbanization and fast population growth—and these trends will strongly continue in the first 50 years of the 21st century. As shown in Fig. 1, the resulting increase in the production of municipal solid waste poses a formidable challenge to the sustainable development of China’s cities (China Urbanization Forecasting and Planning Research group, 1997).

As a result, the Chinese government and other social organizations are devoting more attention to MSW management issues. In late 1999, the first seminar on Chinese MSW management practices and policies was set up, organized by the China Commission for Eco-economics. Various proposals and suggestions were heard at the seminar, and concerned Chinese government departments quickly set about formulating new regulations adopting these proposals and suggestions, in order to better manage MSW operations. But in approaching this problem, the first key is to recognize what exactly are the main problems and issues associated with MSW management in China (Dong, 2001).

3. Problems of MSW management in China

Following are some of the most serious problems with current MSW management operations in China.

3.1. Economic planning system hinders commercialization of MSW management

Under a planned-economy system, all MSW management activities are directly controlled by government entities, as a public service. The disadvantage of this arrangement is that, due to the absence of market mechanisms, economic incentives cannot be used to help improve the government’s MSW management activities. This naturally results in two outcomes: Government entities end up using an excessive amount of public funds to pay for MSW management; and enterprises and residents have no incentive to help rationalize MSW management.

Market mechanisms are playing an increasingly prominent role in the Chinese economic system, and are also starting to be utilized to address certain environ-

![Fig. 1. Forecast population and solid waste growth in China.](image-url)
mental protection problems. In the area of MSW management, a handful of enterprises have entered the field; in late 1999, for example two private MSW enterprises were founded in Beijing. But generally speaking, outside of a few cities, the harnessing of market mechanisms is still not a significant part of MSW management in China, leaving local governments nationwide with the responsibility for and burden of MSW management. Typically, collection and transportation capability, as well as treatment plants, are paid for through direct government investment, and MSW management operations consistently draw on government subsidies. This leaves public sector MSW management entities without any profit incentive to rationalize operations and management.

Fig. 2 presents two alternative models for MSW management. It is our view that the model of MSW management based on market mechanisms is superior to the traditional model that relies only on planning mechanisms. In other words, we believe it is optimal for MSW management to be regarded as a commercial line of business, because this sort of arrangement is more suitable for ensuring sustainable development. Under a commercialized MSW management model, governments, enterprises and the public share responsibility for management of the problem: Governments are mainly responsible for monitoring and the implementation and enforcement of environmental laws; commercial enterprises take part in MSW operations as economic actors, guided by economic incentives, (aiming to do the best job of MSW management at the lowest possible cost); and the public is made more environmentally aware (for example participating in source separation), as a result of user charges and other economic instruments that charge the true cost of waste disposal to the individual producers of the waste material. Sustainable models of commercialized MSW management have been realized in a number of countries overseas, particularly in Europe.

3.2. Imperfect policies strangle MSW enterprises in the marketplace

The MSW industry, like any other environmental remediation or environmental protection industry, produces a public good that has economic, environmental and social efficiency aspects. But in any market, investors must also take economic efficiency into account. Therefore, the MSW industry cannot operate without the support of government policies that allow MSW enterprises to realize a profit from their production of a public good.

The case of a MSW incineration plant in Shenzhen is illustrative. The plant has a capacity of 400 tons per day, but faces an impossible operational situation due to two difficulties: it is not allowed to charge for its waste collection and disposal services; but it also cannot earn sufficient revenue from its main output—electricity—due to high taxes. There are many MSW treatment plants, such as that in Shenzhen, where sufficient funds have been raised to build the plant, but operations cannot be profitably sustained due to government policy.

Within the government, cross-departmental coordination is critical in constructing a policy environment that can support the growth of a commercial MSW management industry. The central government is pursuing sustainable development through a broad range of policies, and involving a number of government departments. Each department aims to integrate environmental considerations into its policies and actions, and formulates its own measures to meet the goal of sustainable development. But these policies require coordination with one another, so that a policy environment is created which supports the development of commercial MSW management.

![Fig. 2. Two Models for MSW Management in China.](image-url)
3.3. Less advanced technologies impede the development of the MSW industry

Modern MSW management requires complex engineering. There are five basic stages: Generation, collection, transportation, treatment and final disposal. Advanced technology can play an important role in every stage. But China, which is a developing country, is using technology that was used in MSW operations in developed countries in the 1970s. Moreover, China’s research and development system lags behind the times, and both enterprises and research institutes are not willing to take the risks needed to bring about technological innovation.

MSW operations in China tend to be very small in scale—a result of the principle that the polluter is responsible for treatment and disposal. But as a result of this set-up, MSW management has not become sufficiently socialized or specialized, with small-scale and inefficient treatment plants (or no treatment at all) being the rule. The prevalence of low-technology industrial practices, and scattered market opportunities, tends to stifle the development of a modern MSW management industry.

4. Measures to promote commercial MSW management in China

The future condition of China’s population, resources and environment may affect the survival and development of all of humankind. But China’s economy is still underdeveloped, and in this context China must search for a least-cost path to achieve optimized MSW management through the promotion of a more sustainable municipal ecological model, and the use of economic incentives to improve MSW management. The primary method for resolving the growing MSW problem is to use the tools of environmental economics to design a rationalized system of MSW generation, collection, transportation, treatment and final disposal.

In Fig. 3, the MSW industry is positioned in its traditional place as a recycler: The environment and resources are utilized by producers and consumers, with the waste treated and returned to the environment. But the figure also shows that MSW, properly treated, constitutes a resource of considerable value that can be used directly by both producers and consumers in a number of ways. In a sense, MSW consists of mis-allocated resources.

Based on China’s endogenous conditions, we believe the following measures should be considered priorities for Chinese government action (Dong, 2001):

4.1. Formulate plans and policies to develop a commercial MSW industry

We recommend that development of a commercial MSW industry should be given a high priority in the long-term plans of the government, including the next five-year plan. The MSW ‘industry chain’ of sorting, recycling, collection, transportation, and treatment should be emphasized as an engine for economic growth in China.

The MSW industry is different from the primary, secondary, and tertiary industrial sectors. Its final goal is not only the maximization of economic efficiency, but also the achievement of ‘comprehensive efficiency’ for society, the economy and the environment. Thus the development of a commercial MSW industry requires a favorable government policy framework, the cultivation of an active market for MSW management, and the improvement of public awareness, in addition to proper economic incentives. Planning and policy related to the MSW industry should be formulated on the basic principle that producers and operators bear the burden, generators pay, recycling and reusing enterprises obtain benefit, and governments support by preferential policy. To date, a policy of charging for MSW management services has been instituted in a few Chinese cities.

4.2. Cultivate the MSW ‘industry chain’ as a whole

The development of the MSW industry will be determined by conditions such as: The amount and composition of waste; the market for recycled materials; the cost and availability of technology and land for disposal; the capacity to pay revenues and possible mechanisms for revenue collection. The MSW ‘industry chain’, which includes picking up, purchasing, sorting, transporting, transferring, sale, processing, finished product marketing, inspection and monitoring, should be designed based on all these factors. The MSW industry chain is closely interlinked. This makes it important to analyze how changes in one link of the chain will affect the others.
4.3. Use economic instruments to achieve ‘whole process’ MSW management

Market forces, which can be harnessed as a driving force in environmental protection, play a major role in the development of environmentally-sound products and services. ‘Whole process’ MSW management should apply in every field, and can start with product design and materials selection, even before later-to-be-disposed-of products are manufactured. For example, international environmental management standards, the ISO14000 series of standards, and life cycle assessments, can and should be used as methods for analyzing and evaluating the environmental impact of individual enterprise’s products and services. ‘Whole process’ MSW management is currently a leading principle for MSW minimization, and for bringing about a move towards cyclic material flows. Through this method, it is possible to internalize the cost of recycling and management of end-of-life products. In certain other countries, economic instruments have gained growing importance in every field, influencing production, sale and packaging, and consumption, as a complement to regulatory measures.

4.4. Participate in international environmental cooperation activities, introduce advanced technology from developed countries, and promote the progress of environmental technology

China is actively involved in many efforts around the world aimed at sustainable development. But because of its less developed MSW treatment technology, China must pay more attention to advanced technology introduction in its international environmental cooperation. Also, China should promote the advancement of its environmental technology capabilities, via the introduction and absorption of advanced technology from developed countries. Through international cooperation, China’s MSW industry could be stimulated to grow more rapidly.

5. Conclusion

The promotion of a high quality MSW industry not only enhances social, economic and environmental efficiency, and promotes sustainable development, but can also help resolve the double crisis of resource shortages and environmental deterioration. Commercialization of the MSW industry is the optimal and perhaps only route for effectively purging China of its MSW problem. China has already recognized environmental protection-related industries as a key economic growth point in every field. The development of an efficient commercial MSW industry will help explore new possibilities for environmental industries in China.

References