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E-Waste Recycling and Related Social Issues in China

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Abstract

China has set a goal of establishing a Circular Economy policy for recycling resources in the near future. To further efforts to build a circular society, we analyzed the current status of E-waste recycling and related social issues, including the case of Guiyu town. Some policy suggestions on establishing recycling systems are recommended.

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1. Introduction

Environmental pollution from E-waste and/or waste electrical and electronics equipment (WEEE) is an important issue in this age of electronics. Domestic generation of E-waste, such as televisions, refrigerators, air conditioners, personal computers, mobile telephones, and washing machines, is increasing in most Asian countries [1]. China's Directives on the Restriction of Hazardous Substances and on Waste Electrical and Electronics Equipment were published in 2006, but various issues geared toward developing a sustainable recycling system still need to be addressed [2]. Each country needs a system of recycling that takes into account not only its resources but also economic and social considerations, such as the need to build a materials recovery infrastructure and address the polarization between rich and poor. Intergovernmental cooperation and/or international integrated organization for checking specific waste material balance data may also be needed [3].

In this paper, we report on the status of E-waste recycling systems in China. We first outline the current status of E-waste recycling in China, including a case study of Guiyu town. We then briefly examine other approaches to E-waste recycling. In the last section, we offer our conclusion, namely that

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Guiyu case showed that both negative environmental externalities and the inventory status of E-waste items and material flow analysis are important issues for CE policy makers in China.

2. Current status of E-waste recycling in China

The concept of the Circular Economy (CE), a new economic development paradigm, is an effective approach to solve resource and environmental problems. According to the “Administration Regulations on Recycling Resources” issued jointly by China's Ministry of Commerce, National Development and Reform Commission (NDRC), Ministry of Public Security, Ministry of Construction, State Administration for Industry and Commerce, and State Environmental Protection Administration (SEPA), recycling resources are waste products

- first point, that have lost their original intended use wholly or in part through the processes of production and consumption;
- second point, that could regain their use through recycling and processing.

Recycling resources include scrap metals, waste paper, waste cotton, waste light chemical engineering raw material (such as rubber, plastics, agrochemical packing, and the miscellaneous bone and hair of animals), waste glass, and other products. Of course, E-waste is also a recycling resource. The E-waste inventory is defined as the aggregated information on the material flow of the E-waste from generation to reuse, recycling, and disposal, including transboundary movement (inflow into and outflow from the target country) as well as material balance data from recycling facilities. Therefore, the inventory status of various E-waste items and material flow analysis are important for CE policymakers in China.

From 2000 to 2005, the number of cathode-ray tube (CRT) color TVs, refrigerators, air conditioners, computers, and mobile phones in mainland China increased rapidly. Please note that statistical data on CRT-type black and white TVs are not published in urban area of China. The accumulated number of mobile phones has grown especially rapidly, to about 1 billion units in 2006. From 1978 to 2005, the accumulated number of printed-circuit boards (PCBs) grew to 107.4 billion; if 5% of this accumulated amount becomes waste, the annual amount of waste PCBs can be estimated to be about 5.4 billion. On the other hand, the amount of E-waste was more than 33 million units and 1.1 million tons in China in 2004 previously estimated by Li and Sun & Liu respectively [4-5]. Some research projects concerning with PCBs was carried out, for example, using glass-nonmetals, a byproduct of recycling waste PCBs, are used to replace wood flour in the production of phenolic molding compound [6].

There are two methods of E-waste collection for the average Chinese citizen: in the informal method, E-waste is sold to a traveling individual (often someone who used to work on a farm) or to an electrical appliance repair shop or secondhand shop; in the formal method, E-waste is traded in, generally at a department store, supermarket, or electrical appliance store, to the original manufacturer. According to our investigation of informal trading of E-waste, informal buyers in Jiaying city pay about RMB 10–20 for CRT-type black & white TV sets from final consumers, about RMB 50–100 for CRT-type color TVs, RMB 50–150 for refrigerators, RMB 80–300 for air conditioners, and RMB 70–100 for washing machines. In the secondhand market, however, the price ranges increase to RMB 40–80 (CRT-type black & white TV), RMB 300–400 (CRT-type color TVs), RMB 180–300 (refrigerators), RMB 80–800 (air conditioners), and RMB 200–420 (washing machines) [7].

E-waste recycling in China includes four sectors: individual recyclers, supply and marketing cooperatives, manufacturers, and dismantling companies. As mentioned above, the traveling recyclers purchase used items and often either dismantle or repair them for the secondhand market. This unordered E-waste recycling method is currently flourishing in China. It is an inexpensive system, but it has created serious environmental pollution. In the formal recycling process through a supply and marketing cooperative, E-waste is collected by an individual or at a secondhand market or recovery point. The waste

is then dismantled by a company that can either be part of the cooperative or an outside contractor. Formal recycling through manufacturers involves the collection of E-waste through retailers or a trade-in service. The manufacturer then handles the waste itself or it employs a third party. For example, Motorola, Nokia, and China Mobile jointly initiated a campaign for recycling mobile phones in 2004. For formal recycling by a dismantling company, most of E-waste is collected by an international manufacturer and a little part by individual; recycled materials still flow to the network of the international manufacturer.

Positive aspects of E-waste recycling include saving natural resources, protecting the environment, and solving underemployment problems. The E-waste recycling industry is labor-intensive, and there are currently hundreds of millions of redundant workers in the countryside in China. We estimate that about 20 million off-farm workers are currently engaging in recycling-related activities. However, existing problems with E-waste recycling activities include secondary pollution, occupational health and safety, safety of products made from recycling materials, insufficient technical standards, and security of society (for example, stealing, etc.).

Domestic material flow of E-waste in various regions in China is subject to a westward-moving trend, primarily from cities to the countryside. For example, according to our investigation, waste copper in Chengdu city, Sichuan Province, originated in Baoding city, Hebei Province; Ningbo city, Zhejiang Province; and Urumchi city, Xinjiang Province.

Several national pilot projects for domestic E-waste recycling are listed in Table 1. The NDRC has approved three projects: Haier company for electrical home appliances in Qingdao city, Shandong Province; Dadi company for waste disposal in Hangzhou city, Zhejiang Province; and Datong company for recycling nonferrous metals in Tianjin city. The Ministry of Information Industry and SEPA jointly approved the Guiyu project in Guangdong Province. The Ministry of Science and Technology also approved three projects: Tsinghua University, Changhong company, and Zhizhuo Feigao company.

3. Case study of Guiyu town, Shantou city, Guangdong province

Guiyu is a small town in the Chaoyang district of Shantou city, Guangdong Province, in southeastern China. It occupies an area of 52 km² and has a population of 150,000. It is internationally known for its informal E-waste recycling activities and related environmental and health risks. From a regional perspective, especially due to the proximity to the cities of Puning and Jieyang, it is not clear which city is responsible for administration of Guiyu, thus administration of this city has generally been neglected. Agricultural production in the area is uneven because it is located in a low-lying, flood-prone area. To make a living, farmers in the area initiated E-waste recycling, especially for PCBs, in the mid 1990s. Most of the E-waste arrives at the port of Shenzhen in Guangdong Province from Hong Kong and Shanghai. Many people, including migrants, have become rich only with only "a hammer and a screwdriver". Because workers can make a generous profit, the scale of the informal E-waste recycling has expanded. At present there are 500 recycling workshops registered with the local Industry and Commerce Administration. Among these are about 200 workshops having a recycling capacity of about 1 per day. It is estimated that the annual recycling capacity of the town is 100,000 tonnes, and many of these small recycling facilities cause considerable pollution. There are three types of informal E-waste recycling operations: PCBs are dismantled with a hammer to separate materials such as iron, copper, and other metals; PCBs are melted over honeycombed coal blocks or makeshift grills and the valuable metal original parts are removed with the small tweezers; and PCBs are dipped in a kind of specific acid to recover gold and other valuable metals. The third process has already been banned. None of these activities are efficient, and they depend on cheap labor, open burning of unwanted E-waste, and open dumping, which has caused serious environmental pollution. E-waste recycling activities have also been undertaken by children, with little consideration given to protecting their health. As one of the first in a

series of national demonstration projects of town-level E-waste recycling, Guiyu town would be expected to be a positive case; and in the meantime, as researchers of the masterplan for Guiyu town, we would do the best to promote the transformation.

Activities that encourage further investigation of individual recyclers of E-waste in China should be promoted.

4. International approaches to E-waste recycling

The "polluter pays" principle (PPP) suggests that polluters should bear the cost of preventing and controlling pollution. Its intent is to force polluters to internalize all of their activities' environmental costs so that they are fully reflected in the costs of the goods and services provided. The concept of extended producer responsibility (EPR) holds producers responsible for their products after sale so that they ultimately bear the costs and burdens associated with such things as product disposal. In theory, this will create an incentive for producers to pay closer attention to a product's design and manufacture at the outset to limit costs down the road. The regulatory framework of EPR addresses environmental impacts generated at all points in a product's life cycle. Central to the Japanese approach is the use of EPR in the form of producer "take-back" legislation. The twin objectives of EPR are to provide an incentive for producers to incorporate environmental considerations into product design and to shift the responsibility for end-of-life products (physically or financially, or both) upstream to the producer and away from municipalities. During the past decade, take-back legislation has been widely incorporated into Japanese environmental regulations as well as those in other jurisdictions, most notably the European Union. We think, however, that it may not be possible to apply EPR in China for various reasons. For example, as mentioned above, E-waste is sold to a traveling individual, that means traveling individual would pay a little money for the person who sold the E-waste instead of the final holder of home appliance would pay money for individual recyclers and/or other recyclers.

Therefore, based on the actual situation of China, we think that an effective recycling system for E-waste in China is under the idea of circular society, to establish an advanced system that will be easy for existing individual recyclers to follow.

5. Conclusion

To further efforts to build a circular society, we analyzed social and resource issues related to current E-waste recycling systems in China, including PCBs recycling in Guiyu town. The Guiyu case showed that both negative environmental externalities and the inventory status of E-waste items and material flow analysis are important issues for CE policy makers in China. Obviously, recycling systems for E-waste in China must also consider social issues such as population migration and polarization of the rich and poor, which are as important for a circular society as is a material recovery infrastructure.

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