The management practice and its experience for the collection and treatment of waste home appliances in Taiwan, China

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Abstract. The collection and treatment of waste home appliances (WHAs) is a challenging issue in both academia and practice today. In the 1980s, a WHAs collection and treatment industry dominated by spontaneous market emerged in Taiwan, China, which was featured by small-scale, scattered and unregulated treatment activities, causing serious environmental pollution and health damage. Taiwan authorities have vigorously strengthened the industrial supervision and guidance, and basically curbed such simple treatment activities by the beginning of the 21st century. Focusing on the “Resource Recycling Fund” system implemented by Taiwan, this paper systematically introduces the management measures and implementation effect in WHAs collection and treatment industry in Taiwan, with a view to providing a reference for improving the WHAs management in Mainland China. It is argued that the success of WHAs management in Taiwan attributes to the following three important factors: (1) with the awakening of public consciousness on environmental protection and the gradual improvement of the rule of law, a solid environmental supervision system has been formed; (2) due to the improvement in the economic development in Taiwan and the rising labour costs, the labour-intensive simple treatment operations become unprofitable; (3) a long-standing pricing mechanism for WHAs collection and treatment has been established through the implementation of “Resource Recycling Fund” system.

1. Introduction

Household appliances and electronic products (hereinafter generally called home appliances) account, approximately, for a quarter or one third of the permanent property (also called durable consumer goods), excluding house property of ordinary Chinese families, according to household surveys and online reports on the fortune structure of ordinary homes in China. Along with the progress in manufacturing technology and the improvement of residents’ purchasing power, home appliances are upgraded sooner and obsolete and waste household appliances and electronic products (hereinafter generally referred to as Waste Home Appliances (WHAs)) have become an important source of solid wastes. As a product of modern manufacturing technology, WHAs are composed of complicated materials, including multiple polluting high-molecular compounds and heavy metals[1-2]. Hence,
improper treatment will lead to severe eco-environmental contamination that is hard to remedy. In China, WHAs treatment is always dominated by the spontaneous petty dealers and thus, has been a “black” industry with severe eco-environmental pollution[3-4]. It’s the highest priority to step up the social management and guidance of the industry. This paper contains an introduction to the social management of WHAs collection and treatment and its practice in Taiwan, with the emphasis on the treatment fund system, for the purpose of inspiring, in a helpful manner, the social management of the industry in China.

2. The historical development of the WHAs collection and treatment industry in Taiwan

Taiwan is a treasure island of China. People on both sides of the Taiwan Straits are of the same clan and the same nationality, with many similarities in national culture and humanistic characteristics but also differences in political systems and economic levels. Apparently, it's of positive and important reference value for Mainland China to investigate and analyze the system of social management and practice for WHAs collection and treatment and its evolution in Taiwan.

Taiwan witnessed high-speed development in economy in the 1980s and was honored among the “Four Asian Tigers” (Hong Kong, Taiwan, Singapore and South Korea). Similar to the present Mainland China, there was a simple treatment industry for the recycling of WHAs, in a huge scale, arising spontaneously in Taiwan[5-6]. But it caused exceptionally severe pollution to the environment because it was based on manual disassembly, open burning, acid pickling and other shabby facilities and simple techniques. At that time, a part of the WHAs and scrap metals were generated by local consumption while a pretty large part were imported from overseas. Erren Xi, in southwest Taiwan, was the most representative gathering place of simple treatment activities, very similar to some coastal areas of China.

In 1984, Taiwan Executive Yuan Environmental Protection Administration (EPA) put local scrap metal dealers under centralized management and built an industrial park in the region of Dafa and another in Wanli of Taichung, with the aim to standardizing treatment processes. However, the simple treatment plants couldn’t afford their high-standard facility construction and management and pollutant discharge from treatment processes remained severe as they were of a small scale, based on manual work and faced with a funding shortage. In 1986, the industrial parks caused harm to nearby lobster farms because they discharged a huge amount of heavy metal-containing sewage to nearby waters. In 1992, Industrial Development Bureau and Bureau of Foreign Trade of Ministry of Economic Affairs and EPA changed their thinking and attempted to outlaw simple treatment behaviors. Though EPA banned the import of scrap metals and WHAs, simple treatment activities existed continuously, lots of tiny workshops were operated on the banks of Erren Xi and incineration proceeded at night, hard to control.

At the end of the 1980s, the environmental awareness awaked in Taiwan, when social activities for environmental protection took place frequently and public administration capabilities for pollution abatement improved continuously. Up to June, 2001, EPA had closed down, compulsorily, more than fifty simple treatment plants in Erren Xi, under the positive supervision of many environmental NGOs and the general public[7]. In addition, simple treatment plants with illegal pollution were reorganized, closed down, moved or technologically updated. By the beginning of the 21st century, simple treatment activities had been contained gradually in Taiwan.

There were three major reasons behind the decline of simple treatment of WHAs in Taiwan: ① The society started to be aware of environmental protection, the legal system got improved and implemented, and the atmosphere of public resistance and supervision was formed; ② Taiwan witnessed a general improvement in its economic level and labor cost so that the labor-intensive simple operation became unprofitable; and ③ The long-standing price mechanism for WHAs collection and treatment was straightened out through the establishment of the recourse recycling fund system.
3. The establishment of the WHAs treatment fund system in Taiwan and its practical effect

In 1997, EPA led the establishment of the “resource recycling fund”. It’s also called “treatment fund” because it’s targeted at the reasonable and innocent treatment of WHAs. Mainly, upstream home appliance manufacturers (or importers) were requested to pay a product collection and treatment fee as a source of necessary subsidies provided to the audited downstream legal WHAs treatment companies, with the aim to alleviating the environmental pollution caused during WHAs treatment and promoting the reasonable recycling of WHAs. In 1998, EPA founded the Resource Recycling Fund Management Committee (RRFMC), incorporating treatment fund into government budget. Among the ten categories of recoverable articles covered by the subsidy, WHAs included TV sets, washing machine, refrigerators, air conditioners, electric fans and IT products.

3.1. Participants involved in the collection and their behaviors

In Taiwan, the WHAs collection market was dominated by second-hand goods dealers before RRFMC was founded in 1998[5]. After that, the market was led by private dealers, supplemented by government cleaning squads. It was divided into two tiers: on the first tier was the capillary collection market, where consumers choose, by themselves, to sell obsolete home appliances to floating vendors, retailers, public cleaning squads or community recycling stations; then, WHAs were sold, transported and gathered to private collection dealers with a large scale, which was the second-tier market. In addition, a part of second-hand home appliances in good conditions were transferred to the second-hand market, as shown in figure 1. After that, collection dealers resold WHAs to treatment companies. Under the function of the price mechanism, most WHAs were sold to legal treatment enterprises covered by the subsidy.

![Figure 1. Collection Channels of WHAs in Taiwan][6]

Legal treatment companies alone were covered by the subsidy. Between collection dealers and upstream capillary collection points was a buyer-seller relationship, as same as the relationship between them and downstream legal treatment companies. The survival and development of collection companies relied completely on the income from the differential between purchase and sale prices. The government controlled them by only three measures: operational permit register; requirements of storage sites and necessary facilities and standard operation; and regular reporting of purchase, sale and operation.

In Taiwan, the flows of WHAs collected are controlled by the market and governed by the law of value. Via the first-tier collectors and the second-tier collection companies, most WHAs are transferred to legal treatment companies covered by the subsidy. It can be seen that the effective cooperation between economic incentive policy and market mechanism can build up collection channels where goods flows are controllable.
3.2. Participants involved in the treatment and their behaviors

In the treatment, any enterprise that is engaged in WHAs treatment and abides by operational regulations and emission standards can apply to RRFMC for subsidies. Their application won’t be approved until they pass the unique auditing system of Taiwan.

The specific process of subsidy: A treatment company that has purchased WHAs cannot start the treatment until the number of WHAs is verified by the auditing agency. The auditing agency will then provide a verification certificate to RRFMC, which will then issue the subsidy to the treatment company if it approves the verification certificate. Treatment companies that are not covered by the fund system are not bound to the auditing, neither will they obtain the subsidy. See figure 2 for the procedure.

![Figure 2. Management Frameworks in WHAs Collection and Treatment in Taiwan][8]

Home appliance manufacturers are responsible only for paying a certain fee in proportion to the product sales volume to the treatment fund, other than for the collection and treatment of WHAs. The annual fee for manufacturers is:

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\text{Collection and treatment fee} = \text{Sales volume} \times \text{Collection and treatment fee rate}
\]

As for the collection and treatment fee rate, the RRFMC formulates a preliminary scheme through investigations and argumentations and then submits it to the EPA for approval, which is updated once a year. The argumentation is based on various factors such as the collection coast, treatment cost and recent prices of renewable resources. Manufacturers are qualified for participating in the argumentation and raising appeals.

Treatment enterprises need to comply with strict facility standards and operational specifications, and laws about the pollutant discharge and pollution control. The supervision of the auditing agency assures the treatment companies covered by the subsidy meet legal requirements for pollution control and resource recycling. RRFMC formulates a certification manual as enforcement basis for the auditing agency. The manual contains a series of indicators and technical standards by which WHAs treatment companies should abide, including the quality, inventory management, recycling rate and treatment process of WHAs and the disposal way of derivative wastes. In addition, the auditing also covers the stocking, inventory and shipping management, report forms, file saving and other processes of treatment companies.

RRFMC is responsible for the certification and supervision of auditing agency, with detailed regulations on its qualification requirements, operating methods and supervisory mechanisms.

3.3. Implementation effect of the social management practice of collection and treatment

The “treatment fund” system is adopted, creatively, in the collection and treatment of WHAs in Taiwan, which has shown obvious effect since its implementation in 1998. The audited numbers of WHAs treatment are on a rise (Figure. 3), indicating the apparent growth in the WHAs treated legally and harmlessly. Taking the ration between the audited numbers of WHAs treatment and the sales volume of home appliances as the quantitative assessment method, Wen Liqi et al. reached the conclusion that the harmless collection and treatment rate of WHAs in Taiwan between 1997 and 2009
was 61% for TV sets, 51.7% for washing machines, 55% for refrigerators, and 18.3% for air conditioners[9].

![Figure 3. Audited Numbers of WHAs Treated in Taiwan during 1998-2012](image)

Nevertheless, the treatment fund system is still bothered with three management problems. First, treatment companies are allowed to choose whether to participate in the fund system, and those outside the fund system can be monitored only by the public and laws. Therefore, the supervision of treatment companies outside the system may be insufficient[10]. Second, the collection and treatment fee paid by manufacturers rests with their sales volume, which cannot encourage the green design and manufacturing of enterprises[10]. Third, the subsidy for WHAs treatment companies must be sufficient, or it will be hard to maintain the market price competitiveness; WHAs that can be refitted, repaired or disassembled easily and have a good economic yield, such as air conditioners, still register a low rate of collection.

4. Managerial experience in and inspiration from WHAs collection and treatment in Taiwan

There is already a spontaneous WHAs collection and treatment market in Taiwan, similar to Mainland China. However, Taiwan is successful in establishing the treatment fund system; through policies focused on market regulation, it has achieved basically the goal of controlling goods flows and boosting centralized harmless treatment. The core of the treatment fund system is to grasp the principle of the collection and treatment fee and straighten out the long-standing mechanism for the market prices of collection and treatment.

In Taiwan, the WHAs collection and treatment industry has declined slowly from prosperity in recent thirty years. Nowadays, the spontaneous market still plays an important role in the collection and treatment of WHAs, remarkably different from such developed countries as Japan and Germany. The author has given a thorough introduction to relevant managerial characteristics and practical experience in Germany[11] and Japan in another two papers. The German system is featured by the “manufacturer responsibility system”, where home appliance manufacturers are requested to be responsible for the full life circle of products; Japan adopts the “multi-party responsibility system”, featured mainly by the payment of collection and treatment fee by consumers. In those developed countries, the policy routes are complementary mutually with their respective political background where their people can abide by laws and regulations, cultural characteristics and economic conditions.

In developing countries and regions, economic levels are low, legal systems are to be improved and law is flexibly optional and hard to implement. So, the labor-intensive collection and treatment market is profitable, where spontaneous second-hand goods dealers develop well and dominate the market. In these countries, effective market means should be chosen, according to their respective national conditions, to guide the collection of WHAs, which may always show good effect. Examples include the “Old for New Service of Home Appliances” in Mainland China[12] and the fund subsidy system in Taiwan.
Another important objective reason behind the decline of the simple treatment of WHAs in Taiwan is its profit is decreased substantially by the rapid rise of its economy, the growth of per capita income, the universal basic social security of residents, the shrinking gap between the rich and the poor and the fast increase of labor cost.

The long-standing operation of market means needs the support of steady and sufficient external funds. In Taiwan, the subsidy obligation for the collection and treatment industry is assigned to manufacturers so as to ensure the continuity of capital source. It’s easy to see that the policy route adopted in Taiwan can be regarded as a flexible form of the “extended producer responsibility principle”. Its fund system has successfully solved the problem about the sharing of burden in WHAs collection and treatment, which is more feasible.

Note that the market-oriented coordination mechanism can never work without the effective and powerful support of the legal system for environmental supervision. Taiwan also witnessed a poor level of governance by law in early period. However, its social legal environment improved significantly along with the advancement of democratization, media freedom, public tolerance, economic development and the improvement of people’s environmental awareness. Since the end of the 1980s, Taiwan has improved over time the legal system for solid wastes management and relevant law enforcement abilities. In particular, lots of simple treatment plants were closed down or technologically upgraded and simple treatment activities decreased remarkably in the 1990s. On this basis, the government established a proper treatment fund system. Via market purchase, it guided the flow of WHAs into legal treatment enterprises. A remarkable result has been obtained finally thanks to efforts for more than ten years.

The Waste Disposal Act stipulates strict legal responsibilities of simple treatment activities that contaminate the environment, and encourages the public and media to oversee simple treatment activities through incentive payment and expansion of public interest litigation. With regard to the social supervision atmosphere, Taiwan has intensifies over time environmental supervision enforcement since the 1990s, thanks to which an external supervisory atmosphere where treatment companies don’t dare to discharge pollutants at will has been built up. From legal and moral perspectives, Taiwan government and its residents have effectively downsized the living space of simple treatment activities, and also powerfully assured the survival and development of legal treatment enterprises. In Taiwan, simple treatment behaviors have decreased dramatically and been basically limited to the maintenance, refit and other disposal activities of second-hand home appliances.

5. Conclusions
As the saying goes, stones from other hills may serve to polish the jade of this one. Taiwan has many similarities with Mainland China, so its social management experience and successful practice in WHAs collection and treatment are of very practical significance for Mainland China. People on both sides of the Taiwan Straits have consistent historical and cultural connotations and same thinking and behavioral momentum's and world outlook on survival and development, in spite of the differences in the political system, economic level, legal environment and democratic and public opinion atmosphere. Mainland China can certainly do what Taiwan does well. At present, China’s economy develops rapidly, but accompanied by eco-environmental pollution, which imposes a severe impact on residents’ life, health and happiness. So, green development has become a consensus. In 2012, Mainland China imitated Taiwan to establish a fund subsidy system for WHAs collection and treatment. It has obtained achievements over years, but still unsatisfying. The author has published two articles in this respect to analyze the problems and put forward suggestions according to the conditions of Mainland China[4,13]. It’s necessary to stick to the problem-oriented management pattern according to local conditions. Ultimately, better social management effects will be achieved.

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