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ON CONTROLLABILITY OF THE WASTE-PRODUCING LIFE-STYLE FOR WASTE MANAGEMENT POLICY IN JAPAN*

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I Introduction

This paper describes some features of the problems of municipal solid waste in Japan and to clarify the direction towards which the municipal waste management policy of local governments should be encouraged.

Economists are used to thinking of "consumption" as the final act of an economic system. However, we cannot complete production and consumption unless we can dispose of their waste adequately. The first and second law of thermodynamics tell us that waste is inevitably caused by the processes of production and consumption and creation or destruction of any material in the course of economic activity is impossible except for in the production of atomic power. Municipal waste[1] is potentially one of the most serious sources of environmental pollution.

The current problem of municipal waste in Japan has become a very serious issue because it is extremely difficult to construct incineration plants and find land suitable for dumping which can be used later as reclaimed land. In 1977, 64.8% of municipalities in the Metropolitan area and 50.9% in the Kansai district had waste landfill sites in their own destricts. However, here after it will become harder and harder to find sites in the future, as indicated by the forecasted figures of 46.4% in the Metropolitan area and 44.3% in the Kinki district[2]. According to the survey by the Environment Agency in Japan (1978), in February 1977 there were 11 cases pending in court which concerned municipal waste treatment facilities[3]. This is due to the difficulty of getting consensus between the local government and the people residing near the proposed site. This means that local governments are being greatly handicapped in their efforts to promote their municipal waste management policy, that is, expand the capacity of waste disposal. These changes in the

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1) The term "municipal waste" generally includes domestic waste or refuse as well as bulky waste, similar waste from commercial or industrial enterprises and market and garden residuals, which are collected and disposed of by or on behalf of municipalities (OECD, 1985).

2) Investigated by Environmental Health Bureau of the Ministry of Health and Welfare.

3) An issue of the cases is usually the probability of environmental pollution caused by municipal waste treatment facilities. Needless to say, to what extent the environmental pollution is serious partly depends on the quantity and quality of the municipal waste.

circumstances concerning the municipal waste management services of local governments, together with the historically poor condition of their public and financial administration have caused a remarkable increase in the cost of municipal waste management in recent years. For example, the cost of municipal waste management was about 1,270 billion yen in 1982 and was about 380 billion yen in 1972, a substantial increase even when inflation is taken into account[4].

In 1981, central government decided in its 5th Five-year Plan to equip municipal waste management facilities. This plan aimed to raise the rate of incineration treatment of combustible waste by up to about 91 per cent by the end of fiscal 1985. It had stood at about 85 per cent at the end of fiscal 1980. It is, however, questionable whether the plan can resolve the waste problems mentioned above because we have to reevaluate the current waste management policy based on the technology of incineration and landfill; this is because municipal waste, as with mercury and dioxin, is poisonous.

The municipal waste management system consists of three processes: collection, transport and disposal. If local governments define their waste management activity as in this three tier system for the disposal of municipal waste; then soaring land prices and requirements place an unacceptable social and economic cost burden on local government and the community, unless supported by recycling and waste reduction schemes. We need to consider the problems in the system which is currently used, not only from the technological point of view but also from the economic point of view, i.e., the relationship between economic activity and waste problems.

II Household Waste Generation Function

The problem of waste disposal is being aggravated by the inexorable growth in the quantity of waste being generated. Furthermore, the use of non-biodegradable materials is on the increase. Therefore, to predict accurately the quality and quantity of waste collected by local authorities, it is vital that they divise their waste management policy; in particular, the building of new waste disposal plants. We should keep in mind the fact that capital cost will vary enormously according to the scale of waste management facilities, especially given the climate of recent years in which the efficiency of public expenditure has been of great importance.

The household waste generation function may be defined as the estimate of the quantity and composition i.e., quality of waste, in a given region (Turner, 1981, Ueta, 1984a). The waste generation function can be formulated as follows:

$$WG=f(Hs, Ha, Y, Ho, Sl, G, Pg, Wc) \quad \cdots\cdots (1)$$

where, WG=the quantity and composition of waste generated per capita in the

4) This figure includes the treatment cost of raw sewage. However, the increase in the cost is mainly caused by the increase in the municipal waste management cost (Ministry of Health and Welfare, 1985).

region,
Hs=household size and composition,
Ha=household lifestyle and attitude to waste,
Y=disposable income,
Ho=size and character of dwelling units,
Sl=the level of waste management services,
G=geographic and climatic factors,
Pg=a vector of final prices of consumption goods,
Wc=a vector of waste coefficients for all goods and services.

Equation (1) is usually used to estimate a unit such as waste generated per capita per day in the region, and is also recognized as an attempt to isolate the most likely significant variables in the functional relationship which affect the quantity and quality of waste generated. This kind of research has been made from both theoretical and empirical standpoints. Generally speaking, in the United States, it is considered that the income elasticity of the quantity of household waste generated is relatively high (Richardson and Havlicek, 1978, Tolley *et al.*, 1985). By contrast, in recent years, some researchers in Japan emphasize other factors than income level as the primary factors in household waste generation function.

It was considered that the quantity of household waste generated per capita was directly proportional to disposable income. In the proposal of the Economic Welfare Council (November, 1966), estimates of the amount of household waste per capita per day were based on this assumption. For example, 1,310 g per day per capita in cases where the income per capita per month is \$1,500 and 2,190 g per day per capita in cases where the income per capita per month is \$2,500 (Takeuchi, 1967)[5]. The Public Cleansing Council of Tokyo Metropolitan Government also predicted the amount of waste in 1976 following the same assumption (Tokyo Metropolitan Government, 1976). In short, a rise in income level will see an increase in both the living standard and waste generation.

This relationship existed until the 1973 oil crisis for certain categories of waste. For example, while waste plastic reflects this proportional relationship, with food waste it is less clear. Even though this relationship exists from the standpoint of macro-statistics, it is not necessarily true of each individual household. The relationship is more complicated than we had expected. For example, in recycling, an especially labour-intensive industry, any increase in labour cost inevitably makes recycling uneconomical and leads to a decrease in activity. As a result, the quantity of waste collected by municipalities will increase. Following the oil crisis this relationship no longer was valid. Moreover, the increase in the amount of waste generated has occurred together with a change in quality, i.e., the composition of waste. This means that we also have to examine the relationship between the in-

5) The equation is as follows:
$Tr = 1{,}000/365 \times (0.3199Y - 2{,}031)$
where, Tr=the quantity of waste per day per capita (g),
Y=income per capita per month (\$).

crease in the amount of waste and its compositional change. We ought to consider the shape of the waste generation function because it has relevance here.

The variables in Eq. (1) describe the characteristics of household and locational factors and the level of waste management service provided by local authorities. It is not easy, however, to choose moderate indicators whose statistics are available for all the variables. Moreover, because of the diversity of the waste generation functions, weighing methods, and the time when the empirical research was made, the comparative analysis of conclusions based on such data, should only be drawn with caution. However, even if we consider such constraints, it is still meaningful to examine the results of empirical research, since some of them show the functional relationship between variables and waste generation.

For example, Wertz (1976) concludes that both levying a charge on waste collection and the increase in the distance from house to collection station reduce the quantity of waste generated. Conversely, the increase in the collection frequency increases the quantity of waste generated. On the other hand, empirical research suggests that larger dwellings, such as detached houses with extra plottage, are more capable of processing their own waste. It also suggests that both the increase in household size and the purchase of bulk goods tend to reduce the quantity of household waste. Furthermore, empirical research suggests that the quantity of prepackaged commodities purchased by households is nearly independent of household size and composition and depends largely on the place in which they were purchased, that is, consumers buy many more prepackaged commodities at supermarkets than at retail shops (see Kitabatake, 1985).

The quantity of waste generated varies according to what extent recycling activities exist in each area. Resource recovery, through waste reclamation and recycling, becomes one of the principles of a comprehensive waste management policy. However, current waste recycling schemes which have been going on in many countries, are not necessarily assessed by economic criteria; therefore, we have to develop a new framework for judging the economic feasibility of those schemes (OECD, 1983, Ueta, 1984a). This framework starts an examination of the relationship between waste generation and lifestyle.

III Waste-producing Lifestyle in Households

Even though total waste may increase, separate waste categories may follow different patterns. We should therefore focus on the composition of waste, rather than on its total volume; a distinction which is ignored by the current waste generation function.

Hanayama's study (1976, 1978) of plastic packaging suggests that it is advances in the sophistication of the industrial structure of the economy, rather than an increase in income that determines the increase in such waste. Subsequent empirical research has suggested that the income elasticity of the quantity of household waste generated is very small. Increase in total quantity of waste collected is due to the growth of commercial, rather than, household waste (Gomi, 1984). Furthermore, Moriguchi *et al.* (1983) suggested that variables such as (a) the sum of commercial sales in a metropolitan area, (b) the area of the dwelling site and (c) family size have strong positive effects on household waste generation,

according to their multi-regression analysis.

These research results mean that we can analyse the cause of the increase in the quantity of waste generated more accurately, by paying attention to the change in its quality. This change may in part be explained by the change in the taste or habits of the consumer. However, it is not packages or containers, but their contents which the consumer requires. Therefore, in terms of package and container waste, it is unreasonable to insist that the increase in their quantity is caused by the consumer's choice. In addition these results suggest that the change in industrial structure, lifestyle and the level of waste management services also have a strong effect on waste generation. In order to plan waste management policy, we need to isolate those variables within these factors, which may be controlled.

A typical example of mass production of plastic and container waste is that of Japan where it reflects changes in household lifestyle. Kyoto City Government investigated the quantity of household waste generated. They scrupulously classified the waste by material and type of package and weighed it (Kyoto City Government, 1981, 1982, Takatsuki, 1983). The results show that packages and containers account for 56.2% by volume or 21.7% by wet base weight of total household waste (Table 1).

By composition, the quantity of plastic waste shares was 50.0 per cent in volume and 29.1 per cent in weight. The increase in the quantity of container waste is mainly caused by the proliferation of disposable plastic containers and decrease in the reutilisation rate of bottles. In the waste treatment stage, which is outside the sphere of the market system, while plastic containers which may not easily be disposed of cause enormous social cost, returnable bottles save waste treatment cost. Although it is true, that since the economic value of plastic containers within the market system is much higher than that of returnable bottles, plastic containers are preferred in the production, distribution and consumption process. Moreover, the decrease in the reutilisation rate of bottles has rendered returnable bottles into municipal waste. This is mainly because the increase in labour cost decreases the economic viability of a recycling industry which is labour intensive.

Table 1 Compositon of Municipal Waste in Kyoto City

Item	By wet base weight (%)	By volume (%)
Consumer goods	8.9	9.2
Disposable consumer goods	4.6	4.0
Material used in advertising	3.8	3.8
Packages and containers	21.7	56.2
Material used in business	2.1	4.4
Others	4.1	5.2
Food, etc.	48.0	13.7
Weeds, wood, crockery, pottery, etc.	3.2	3.5
Water	3.6	—
Total	100.0	100.0

(Source) Kyoto City Government (1981) p. 21

Kyoto City Government also investigated when packages and containers are attached to products and found that 68.5% of wet base weight of packages and containers are attached to commodities in the production process. These consist mainly of boxes, bottles and cans. A further 27.8 per cent of the total quantity in wet base weight of waste packages and containers are attached to commodities in the distribution process. These consist mainly of trays and bags. By composition, 49.5 per cent of waste paper and cardboard are attached to commodities in the production process. By contrast, plastic materials are mainly attached to commodities in the distribution process.

The results of empirical research on a large quantity of household waste, especially plastic packages and containers, suggest that the increase in the quantity of waste is inseparably related to the change in the quality of waste. To reiterate; any explanation of the mechanism of generating large amounts of household waste should also account for changes in the quality of waste generated.

The increase in the quantity of plastic materials in household waste, in particular as regards synthetic materials, cannot be explained only by the sophisticated development of industrial structure. One should also look at the lifestyle of the household related directly to solid waste. Availability of waste management services coupled with housing factors may influence purchasing behaviour (commodities are obviously potential household waste (Sueishi, 1975)) and attitudes to which types of waste are put out for collection (Kitabatake, *et al.*, 1981). It is important to clarify the structure of the waste-producing lifestyle which is connected with the increase in the quantity of plastic waste and the change of industrial structure. This is closely related to the argument that the reason for the prevalence of scattered empty cans in the streets is due to a decrease in the public behaviour standards.

It is considered that mass-production, mass-distribution and mass-consumption cause mass-generation of waste. Moreover, the waste-producing lifestyle of households is directly related to a mass-consumption lifestyle. Thus , it is relevant here to summarize the relationship between mass-consumption and mass waste generation and to clarify the structure of the mass waste-producing lifestyle of households. This may be performed by using three factors: consumption style, purchase style and evaluation of household labour.

Cans are a typical example of containers used in the production process while plastic-covered trays and packaging materials are used in the distribution process. Canned products can be obtained through vending machines. Protected trays and prepackaged materials are purchased with products through supermarkets. That is to say, they are usually delivered to consumers without the intermediary of sellers. This style of selling is a measure which cuts down on labour costs sharply and makes the mass-distribution system less costly. Thus, mass-distribution has been able to achieve mass-consumption of products, and as a result, is a generator of large amounts of waste.

It is considered that a change in eating habits causes an increase in the quantity of package and container waste. It is true that almost 70 per cent of package and container waste is related to food (Kyoto City Government, 1981). Although it seems reasonable to conclude that an increase in the quantity of package and container waste is caused by an in-

crease in the consumption of processed foodstuffs and beverages, this argument does not apply in the following case. That is, while the consumption of milk per capita decreased by 23.1 per cent in the period from 1958 to 1970, the quantity of milk containers consumed per capita in the same period, surprisingly increased by 26.1 per cent (U. S. EPA, 1974). Similar facts can be found in Goddard (1976)[6]. This shows that although a change in the milk-drinking habits of consumers leads to a quantitative decrease in the consumption of milk, the quantity of containers consumed still increased. This can be explained as follows.

Packages and containers play an important role in marketing to achieve mass-consumption by means of product differentiation and enhancement of products in our modern, industrialized society. Once technological progress achieves enormous production capacity, marketing strategies involving packaging are inevitably adopted. This is because production capacity dictates, that it is of paramount interest that effective demand resulting in sales, must remain at high levels. As regards the petrochemical industry, Watanabe and Saeki (1984) pointed out that the pressure of both cost reduction and all-out use of materials and energy, caused by overesized production technology, calls upon firms to develop unilaterally new demands to maintain effective demand. For example, it is considered that a firm has expanded new demands with throwaway products, non-returnable packages and overpackaging, and then has made a change in the distribution system and furthermore in customers lifestyle.

Thus, the emregence of non-returnable plastic packaging is one of the results of marketing strategies in the over-production system of plastic material to break through the stagnation in demand. Returnable bottles, which are labour-intensive, are to be replaced by non-returnable packaging in the distribution process, under market principles. Mass-generation of package waste is not only a result of mass-consumption but also a tool for achieving mass-consumption.

One of the major features of the change in consumption style is individualization of consumption, such as the change from one television or car per family to one television or car per person. It is a matter of course that the individualization of consumption causes an increase in the quantity of waste generated per capita. It has been apparently recognized that while the total quantity of household waste generated increases as the number of people in the family increases, the quantity of household waste per capita decreases sharply. However, individualization of consumption is a factor which would change this. It can be easily imagined that the problem of bulky waste could become serious in the future because of individualization of consumption.

Furthermore, service economization in the household is growing in modern society. We can recognize it in the percentage increase in the expenditure of eating-out and leisure activities in the total expenditure of the household. The share of expenditure for eating-out in the total expenditure for food of Japanese households has increased to 14.8 per cent

6) This argument can be found in Uusitalo (1983). The interpretation of this fact is different from the author's.

in 1980 form 5.6 per cent in 1959. This means that the quantity of commercial weste generated in eating establishments will increase in place of the decrease in that of household waste generated. It is in considering this change, that we should turn to an examination of the accountability of waste disposal and also examine by whom its expense should be born.

Finally we look at the relationship between the subject of housework and the mode of waste disposal. Most behaviour regarding household waste disposal is related to a housewife's domestic labour. The increase in the value of time for the labour force in the marketplace, promotes labour-saving in housework, as an element in the commmercialization of the female labour force. Commodities and the mode of purchase to save on housework labour cause an increase in the quantity of packaging and container waste and disposable commodities. This means that, although the time during which they are engaged in housework will decrease through a savings in labour, the quantity of household waste generated, associated with housework, will increase. Moreover, even if housewives sought to change the style of waste disposal to generate less waste, such efforts would not be valued in the marketplace. The value of time necessary to make such an effort, cannot compete with the value of time during which they earn money by commercialization of the labour force. It is important to say here that even if the waste-production lifestyle in households contributes to increase in the quantity of waste generated by a small amount per household, such a small decision accumulates in urban space, this produces enormous social costs such as those necessitated by the construction of new waste treatment facilities.

The waste-producing lifestyle in households in a throwaway society is not caused by a decline in standards of public behaviour, but should be understood in the context mentioned above. If this is true, the question then, is what policy local governments should take regarding waste problems caused through such a waste-producing lifestyle?

IV Waste Management Policy in a Throwaway Society

The Waste Management Law (Haikibutsu No Seiso To Shori ni Kansuru Horitsu, 1970) in Japan (referred to as WML) declares that local governments, such as municipalities, are responsible for disposing of household and commercial waste other than industrial waste. On the other hand, Sub-Section 2 of Section 3 of WML declares that producers and sellers who handle commodities which cause waste, are under an obligation to control such commodities and waste, to facilitate waste disposal. Furthermore, Sub-Section 3 of Section 3 of WML states that people who generate such waste are obliged to co-operate with the waste management services provided by the local governments.

In WML, as mentioned above, although the responsibility for waste disposal belongs to local governments, both commercial firms and citizens are obliged to co-operate with local governments waste management services. Three major types of waste management policies are in existence which are divided by the interpretation of these provisions of WML and the application to an actual case (Ueta, 1984b).

One method is a react-and-cure policy; which expands the waste disposal capacity of

local governments regarding the mechanism of mass-generation of waste and the tendency to cause more poisonous waste than before as a given condition. This policy has no more economical value because of the shortage of landfill sites and the difficulty of constructing new waste treatment facilities. The current waste treatment and disposal technology is a series of processes, that is, of collection, incineration and landfill. Since incineration technology turns waste into ash, the volume of waste is greatly reduced so that landfill becomes much easier and more sanitary. Such a sanitary landfill is less costly than any other waste disposal system in metropolitan areas of Japan. Incineration, however, diffuses the waste during the process of disposing of it. The problems of poisonous material, such as heavy metals used batteries and dioxin in waste ash and the gas from incineration factories, obviously show substantial defects in the incineration process. Moreover, it is sometimes the case, that landfill is uneconomical in the long term even though, it is less costly in the short term. For example, we have to control both hazardous materials and the ground at the site for a long period if we reclaim and utilize such a landfill site for schools and housing. On balance, there are more than enough deficiencies and misgivings to warrant a fundamental reappraisal of the current waste disposal methods, even though if they also have many merits.

The second major policy is to clarify the responsibility of firms for waste disposal. The typical example of this policy is shown in the proposal of the Public Cleansing Service Council of the Tokyo Metropolitan Government in 1974. This proposal specified plastic, used pianos, used tyres, etc. as "tekiseishori-konnanbutsu" that is waste which is not easy to dispose of. The principle behind this policy is visible in the subsequent ordinance on public cleansing services by Tokyo Metropolitan Government and, to some degree, the "used can" ordinance by Kyoto City. This has begun an epoch in the history of waste management policy in that local governments utilize Subsection 2 of Section 3 of WML to the full extent and try to control the production, distribution and sales of the firms concerned, to control not only industrial waste but also post-consumer waste. Although the mandatory deposit-refund system on beverage containers is both an economic incentive and disincentive policy, it is also one example of this policy. The deposit-refund system is related to the third policy so far as the necessity for public cooperation is concerned.

The third major policy is separate collection at the source[7] and resource recovery which becomes a more acceptable option as local governments experience increased difficulty with expanding the capacity of waste treatment. This policy's objective is to reduce the quantity of waste and carry out resource recovery. While the aims of this policy may seem generally acceptable, conflict has been created between the local governments and households over the disposal of such waste. This is because it calls on households to change their waste disposal habits and perform source separation. It is fair to say that separate collection at source is considered worthwhile, as it encourages households to address the problems of waste disposal from the standpoint of the local authority. However,

7) There are several types of separate collection at source in Japan. Those can be found in Gotoh *et al.* (1978).

it should be mentioned that local governments or, experiencing difficulties in its implementation in their efforts to obtain the people's acceptance and cooperation (Planning Division of Environmental Health Bureau of Ministry of Health and Welfare, 1982). The conflict with local governments over separate collection at the source concerns every household which discharges waste. With traditional methods of waste treatment, conflict concerns the element of nuisance experienced by householders living near disposal facilities. As is already shown, this new style of conflict has witnessed remarkable increases in the number of householders and the variety of problems concerned (Ueta and Hirano, 1982). Moreover, this policy is a watershed in the history of Japanese waste management because it is the first time that one has attempted to control the waste-producing lifestyle of households, even if only partially.

The economic conditons required in realizing a waste-recycling system are as follows: (1) A high quantity of waste generation; (2) The useful property of waste; (3) Recycling technology; and (4) Demand for the recycled products. Furthermore, it is necessary to meet these four conditions simultaneously. Although separate collection at source contributes to resource recovery, there is a dilemma in that it cannot assure the feasibility, especially financial viability of waste recycling schemes (Ueta, 1984a). There are several types of recycling schemes which have been introduced in municipalities throughout Japan. These resource recovery measures have been initiated in response to crisis situations such as the shortage of landfill sites, rather than cost-saving possibilities for municipal expenditure on waste treatment (Matsushita, 1981). Furthermore, the optimal level of recycling activity cannot be found in general, but only by special case studies of particular activities (Pearcs, 1976, Ueta, 1984a).

V Conclusion

When we consider who should pay for the cost of municipal waste disposal; in the light of the fact that most municipal waste is usually a post-consumer waste, diametrically opposed to industrial waste, it is necessary to create a new cost-bearing principle, which is different from the principle applicable to industrial waste. This, however, does not necessarily mean that the public sector should pay for the cost of any household waste disposal. We are living under an economic system in which each economic activity, such as production, distribution and consumption, is carried out on the basis of each economic principle and followed by each economic subject. Under such an economic sytem, it is unavoidable that the public sector which treats household waste, becomes too unwieldly because of the increase in the quantity of waste generated and changes for the worse in its quality (Tsuru, 1972). Therefore, the public sector, instead of expanding the capacity of waste treatment, should pay attention to establishing consensus systems among firms, households and local government; which is necessary to control excess waste and its ensuing consequences.

To do this, we should consider the willingness of households to show greater consciousness with regard to waste disposal issues by initiating recycling programmes. Typical examples of positive consciousness are, for example, household attitudes toward

waste problems in which reusable, recyclable goods are bought as much as possible with communal use being preferred. It is obvious that such an attitude would contribute to the reduction of waste generated in a community. It implies this: that Ha (Household attitude) is included in the waste generation function (Eq. (1)) as a variable. In this sense, the rise in communal responsibility contributes not only to the reduction of waste generated but also to the creation of the possibility of controlling the quality of waste. However, to establish such a household attitude towards waste problems does not simply depend on the rise in social or communal awareness. Rather, such attitudes can be established through public participation in the process of environmental impact assessment of waste treatment facilities and experiencing of the conflict over waste discharge processes (Yoshimura, 1984).

If citizens carry out their own environmental impact assessment, this may inevitably influence local governments and result in the formulation of more acceptable policies. The role of the public sector is to provide the necessary conditions which would make it possible to proceed from a waste treatment system to a waste control and management system (Ueta, 1983). Such public participation in municipal waste management policy encourages citizens to recognize more comprehensively than before the social cost and social benefit of municipal waste disposal through the acquisition of scientific knowledge and empirical observation of the problems of municipal waste (Kapp, 1963). In this sense, public participation is a process which fills the gap between private evaluation and social evaluation of recycling schemes. In this way, the feasiblity of municipal waste recycling schemes may increase.

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