11.3 URBAN WASTE AS AN ECONOMIC GOOD

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The theory of inferior goods

There is a small tentacle on the body of micro-economic theory which deals with the behaviour of what economists call 'inferior goods'. While this topic is rarely of any practical interest, I was delighted to discover a possible application in the field of low-cost waste disposal during the recent trip to East Asia. If the hypothesis is correct that urban wastes exhibit 'inferior goods' behaviour, then some interesting theoretical implications can be derived which may aid us in understanding and promoting the diffusion of low-cost technologies of waste disposal.

Three variables which affect the demand for all goods are the price of the goods, the price of other goods which may be substitutes or complements for the goods in question, and the preference of the consumer. A fourth determinant of demand is the income of the consumer. For most goods, as income increases so does the quantity demanded. When one diagrams this relationship between income and the quantity demanded the result is known as an Engel curve. For most goods the Engel curve is upward sloping when income is measured on the vertical axis and the quantity demand on the horizontal axis. For inferior goods, however, the Engel curve is downward sloping. That is, as the consumer's income increases he demands less of the good in question. One example of an inferior good which is often cited is the potato. Historical data in Ireland shows that during good years when consumers' incomes were high, fewer potatoes were demanded, while during bad years the consumption of potatoes increased. Of course, since potato sales formed a large part of many consumers' incomes, this demand behavior itself generated income cycles. Another example is beer. Consumption of beer by poorer families is much larger than the consumption of beer by richer families. Presumably this is due to the substitution of more expensive beverages as income rises.

Waste as an inferior good

In the spring of 1977, I spent three weeks in Japan, Korea and Taiwan in connection with a World Bank sponsored research project on low-cost waste disposal (described in Section 3.3). One of the particular questions with which I was concerned was the demand pattern for night soil. Japan, Korea, and Taiwan offered a unique group for comparison, because of the fairly similar cultural backgrounds of the three and the relatively large differences in income levels and general stage of economic development. Per capita income ranges from around $450 in Korea to $700 in Taiwan and $3600 in Japan[43].

Very little night soil is still used as fertilizer in Japan, the most affluent of the three countries—perhaps less than 2 per cent of all night soil collected. By contrast, in Taiwan, there is still considerable demand from farmers for night soil to put on the land, although this demand is decreasing. In Korea, however, the poorest of the three countries, night soil is still routinely used as fertilizer, often without treatment. These comparisons therefore illustrate the relationship between income levels and the demand for night soil predicted by the theory.

A second crude method of testing the hypothesis is to examine demand behaviour within a single country. In Japan, we talked to officials of the Kyoto night soil treatment plant about changes in the pattern of night soil use. Until about 1945, all the night soil was used by farmers, we were told. During the next 15 years

the use of night soil as fertilizer declined steadily. Thus by 1960, almost no night soil was demanded or used by farmers.

The official with whom we spoke cited four main factors behind this change. These were the increased cost of farm labour, the increased use of mechanical equipment, the cleaner and easier application of chemical fertilizer, and higher farm incomes. In passing, one may note that during these decades, official Japanese policy focused on increasing farm income partly through subsidies on chemical fertilizer. Today, in the Kyoto area, some farmers still use their own night soil as fertilizer, and there have been instances of farmers obtaining city night soil to restore the humus content lost from their land through intensive use of chemical fertilizer.

At the same time that farmers' demand for night soil has decreased, the city dwellers' demand for modern plumbing has risen, so that the availability of night soil has also declined. In Kyoto, only about 40 per cent of city residents have access to underground sewerage, but septic tanks are becoming even more widely used.

Two cities in Taiwan provided relevant data. In Tainan, a city of about half a million people, only about 30 000 are now served by night soil collection. Since there is no underground sewer system, the rest of the city uses septic tanks and surface drainage. In 1961, when the population was around 100 000, nearly all used night soil collection. There has been a fairly rapid shift from night soil collection (which the city provides free) to private septic tanks (which cost about $80 to install plus another $80 for plumbing) as local prosperity has risen. The city's night soil is sold to people involved in fish farming, who use it to grow chlorella (algae) which is fed to the fish along with bean cakes. The farmers pay about $0.50 per tonne for the night soil, plus $0.50 per 2-tonne truck load per kilometre for transport. The entire operation is fairly profitable, even during years of poor weather.

We also visited a smaller city in Taiwan called Pingtung, located about 40 km southeast of Tainan. Out of a total population of 180 000, about 35 000 use septic tanks, 80 000 use the public night soil collection system, and the remaining 65 000 use their night soil as fertilizer or give it to farming neighbours. In addition, there are more than 200 household biogas plants in operation.

Public night soil collection is free, so the 65 000 people who do not use this service are demonstrating an awareness of the value of night soil as a fertilizer. Thirty years ago, night soil removal was organized privately throughout the city. Groups of 10-15 households each hired a man with a bullock cart to collect the night soil and sell it to the farmers. As chemical fertilizer became more widespread, and the demand for night soil decreased to the extent that farmers were no longer willing to pay for it, the city took over night soil collection. However, it was still able to give away all the night soil to farmers, and nowadays this practice continues, but the city treats the night soil before the farmers use it.

In Korea, we visited Chuncheon city and talked with the deputy mayor about his new night soil treatment plant. He stated that this plant was necessary because farmers were no longer willing to use aged night soil as fertilizer. In his opinion, this change was due mostly to rising farm income, and the country's self-sufficiency in chemical fertilizer.

Thus cities visited in all three countries have exhibited the same pattern of change over the last two or three decades: as incomes rise, the use of night soil as fertilizer falls. In addition, a rough cross-country comparison shows that less night soil is used today in the richest country, Japan, than in Taiwan and Korea. These two types of comparison lead me to suggest that considering urban wastes as an example of an inferior economic good may yield some useful policy implications.

Implications for policy

Among the four variables which influence the demand for a particular good, the first is the price of that good. Obviously, if one wishes to encourage the purchase of night soil, one should not set its price too high. We saw a case in Pingtung, Taiwan, where the price of night soil had dropped to zero at the time when the city first took over collection. As the quality of the night soil was improved for use as fertilizer, the price charged to farmers was again raised to a positive amount. Of course, the price of the night soil itself does not constitute the entire cost of using it. Since the application of such organic fertilizer is generally much more labour-intensive than the application of chemical fertilizer, the cost of labour is also an important determinant of the total cost of using night soil. In labour-scarce economies like Japan, the cost of farm labour may make night soil use uneconomical. In countries where minimum wage legislation distorts the price of unskilled labour, organic fertilizer may be rejected by farmers on financial grounds. Thus promoting its use may require politically difficult corrections in macro-economic policy, or some offsetting subsidy.

The second variable affecting demand is the price of other goods. The most important goods to consider are substitutes, for example, chemical fertilizers and bottled gas for cooking. In both Japan and Korea, when the government subsidized chemical fertilizers, the demand for night soil to use as fertilizer decreased. In Pingtung, the difference in price between liquid petroleum gas and methane from the biogas units was striking. One family we visited used the waste from four pigs plus night soil in its biogas unit and was able to produce enough methane to run a one-burner stove all the year round. This family had an additional stove which it used for large dinners on special occasions and which used liquid petroleum gas costing $6.25 per 20 kg cylinder. Before constructing the biogas unit, the family needed about one cylinder per month for cooking (thus costing about $75 per year). But with the biogas stove in use and the cylinder simply held in reserve for special occasions, it had lasted four years (costing $1.50 per year). However, the housewife told us that although she was very happy with the biogas stove, she might have to discontinue using it because the price of pig feed had risen so high that they were thinking of selling their animals.

The third determinant of demand is the preference function of the consumer. While it is difficult to collect actual data on preference in different situations, countries such as those visited in East Asia have a long history of using night soil as a fertilizer, and thus few ingrained prejudices against its employ. This situation might not obtain in other regions of the world. There, considerable education of

farmers might be necessary to induce them to use night soil even under optimal economic conditions. The example quoted in Kyoto of farmers returning to the use of night soil when they noticed a decline in soil productivity after intensive use of chemicals, is an illustration of a change in preferences growing out of education which affected night soil demand.

Income is the final demand determinant. If urban waste is indeed an inferior good, we can expect demand for it to decline as incomes increase. This implies that countries with relatively low per capita incomes are likely to be more susceptible to the spread of low-cost re-use technologies. There is nothing new or startling about this conclusion, of course; it is simply another example of the general principle that for a technology to be 'appropriate' in a given country, it must be relatively intensive in those factors of production which are relatively abundant in that country.

Another conclusion is possible. If the current burst of research activity leads to the development of re-use technologies which appear to have widespread application even in the labour-scarce (and increasingly energy-scarce) developed world, then the biggest obstacle to their diffusion may be the attitudinal block toward waste as an inferior good. In that case, rather than concentrating on making technology as low in cost as possible, an educational campaign stressing the environmental and ecological benefits of waste re-use may be the best marketing strategy. Through such an approach, it is even possible that innovative methods of waste disposal may become so fashionable as to need reclassification from inferior goods to what economists call Veblin goods—those status symbols for which demand actually increases as their price goes up.