Economic Policy Instruments and Municipal Solid Waste Management for Sustainable Economic Development

Dr. R. Sathiendrakumar

ABSTRACT

In the past the assumption was that environment was free and unlimited and this led to both environmental damage and rapid resource depletion. Now humanity is realising that the natural environment is a scarce resource. Therefore the objective of growth should be to reduce the human induced (anthropogenic) waste to a level that is 'acceptable' to society, because it is scientifically impossible to completely eliminate the generation of anthropogenic waste. Also there is a need to balance growth with resource preservation so that the needs of the future generation will be balance with those of the present generation.

Once scarcity is accepted, appropriate technology will be developed to minimise waste generation. This paper will demonstrate how waste reduction is consistent with the principle of sustainable development. The objective for sustainable development is to maximize service to throughput. Constant stock is required for sustainable development, and with this the first sub objective is to maximize service and the other is to minimize throughput, which is the entropic physical flow of energy for maintenance and renewal of the constant stock Minimization of throughput is achieved by adopting the 3 R principles of reduce, reuse and recycle. Environment is not a free good but a composite asset, and excessive waste generation leads to the undue depreciation of this asset, reducing the services it is capable of providing. The paper

There are two basic problems with the disposal of municipal solid waste. The first is that the opportunity cost of land used as landfills is not very low and is rising. The second problem is the NIMBY syndrome (not in my backyard). Even if the opportunity cost of landfill is small, this NIMBY syndrome will make the use of landfills an unattractive option due to the increased transportation cost. This paper aims in identify various mixes of economic policy instruments that may be available to dispose municipal waste. The paper uses a 'cubic' model to evaluate these various policy instruments. The paper then tries to illustrate how using a mix of policy instruments rather than using a single instrument might bring about efficiency in waste minimisation to a level acceptable to the society.

1. INTRODUCTION

Even though, the Industrial revolution has lead to the highly advanced lifestyle that the society is now able to enjoy, it has also taken a toll on our natural environment. The fault is not with the technology that we had been adopting, but with the assumption that the environmental resources are free and unlimited. As such the technologies that were developed also treated the environment as a free good. A free good by definition is when the quantity supplied at any time exceeds the quantity demanded at zero prices. That is, the good does not command a positive price at any time in the market economy. What is implied here is that the natural resources are not scarce. But now humanity is beginning to realise that natural resource including clean air and clean water are scarce resources. The assumption of scarcity is valid because people are willing to pay a positive price for these natural resources that were earlier thought to be in abundant supply. Even though, we do not observe positive prices for some of the environmental resources because there are no markets for some of the environmental resources, they still have positive economic values, because people are willing to pay positive prices for these resources. Once scarcity is accepted then the technology that will be developed will take this into consideration and we will end up with the appropriate technology.

The reason for the scarcity of the natural environment, as the growth of an economy takes place, is due to the fact that during production and or consumption stages in the economy waste is generated. This waste is human induced and is referred to as anthropogenic pollutants. This is different to natural pollutants, which is brought about through natural processes in nature, such as volcanic eruptions, decay of plants and animals etc. This anthropogenic waste reduces the quality of the natural resource, even though the quantity of the natural resource may remain the same. That is, there is a trade-off between economic growth and environmental quality (Sathiendrakumar, 1996). In other words we cannot expect to have perfectly clean air and or perfectly clean water with continuous growth in an economy. The first two laws of thermodynamics support this claim.

Economic growth leads to increase in real per capita income. This in turn will lead to increase in consumption and goods and services. Increased consumption inevitably results in greater waste disposal which uses environmental asst. But the environment is a resource which people want to use for various purposes, such as natural resource base, an aesthetic unit, a waste assimilation unit and a life-support system. Therefore environment is not only an asset but also a composite asset

The first law of thermodynamics states that matter (or energy) can neither be created nor destroyed. But during the process of production and or consumption, matter is taken from the environment in one form, transformed and returned back to the environment as waste. When matter is returned back to the environment it is not returned in the same form in which it was extracted. The returning back of the material taken from one place and put back in a transformed manner in another place in the form of waste creates a problem with regard to the assimilation of the waste material by the environment.

Furthermore, the second law of thermodynamics states that for all processes entropy is either constant or increases. But for irreversible processes such as waste generation, entropy which is a thermodynamic quantity always increases. Increase in

entropy will therefore preclude 100% recycling of waste from energy considerations alone.

Because environment is an asset, with usage you would expect depreciation of that asset. If that depreciation is irreversible then the environmental asset will result in reduced services that the environment can provide for the future generations. Therefore the objective of development in a dynamic sense should be to minimize the undue depreciation of this asset.

2. ANTHOPOGENIC POLLUTANTS

The reason for the scarcity of the natural environment is because during production and consumption stages in the economy waste is generated. This waste is human induced and is referred to as anthropogenic pollutants. This is different to natural pollutants, which are the end result of natural processes such as volcanic eruptions, decay of plants and animals etc. Anthropogenic waste reduces the quality of the environment, even though the quantity of the environment may remain the same. That is there is a trade-off between economic growth and environmental quality (Sathiendrakumar, 1996).

It may not be possible to do anything about natural pollutants. But to achieve sustainable growth we should try to reduce the anthropogenic wastes to levels that are 'acceptable' to society, because it is scientifically impossible to completely eliminate the generation of anthropogenic waste.

There are clear indications that the environmental degradation caused by anthropogenic pollutants can impede economic development in the long-run. Improved environmental management should form the basis of long term development strategies. Therefore, the aim of sustainable development should be to see that the environmental costs to future generations, from current development activities that result in the dumping of anthropogenic pollutants to the environment, does not outweigh the economic benefits to current generation from economic growth

3. SUSTAINABLE DEVELOPMENT AND WASTE REDUCTION

There are a large number of definitions on sustainable development. For example Pezzey (1980) suggests 60 definitions (see Sathiendrakumar, 1996).The World Commission in Environment and Development (WCED 1987) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own need" (WCED, 1987, p.43). Economics does not deal with needs but with unlimited wants that are constrained by limited means. This is why Pearce and Warford (1993, p.49) redefined the WCED definition of sustainable development as "development that secures increases in the welfare of the current generation provided the welfare in the future does not decrease".

A working definition, by Pearce and Turner (1990, p. 24) states that sustainable development as development that "involves maximizing the net benefits of economic development, subject to maintaining the services and quality of resources over time".

Therefore the aim of Sustainable development is to maximize service to throughput. Service to throughput is given by the following identity (Daly, 1983): Service/Throughput = (Service/Stock) (Stock/Throughput)

Service is determined by the quantity and quality of stock of human bodies and stock of artifacts available to any country, which is assumed as given. Since sustainable development implies the maintenance of a constant stock, the first sub-objective at any given time in order to maximize service to throughput is to maximize service to that constant stock. This objective in economics is referred to as economic efficiency. This paper will not deal with this issue but assume that it is a pursued goal.

The second sub-objective in order to maximize service to throughput on the basis of a given stock is to minimize throughput to a given stock. "Throughput is the entropic flow of matter or energy from nature's source, through the human economy, and back to nature's sink, and it is necessary for maintenance and renewal of the constant stock' (Daly, 1983, p.258).

Minimization of throughput is achieved by trying to reduce the material that is used up in the production process or reusing the final product such as packaging or recycling some of the material used in the production process such as recycling paper. The aim of these three principles is not only reducing the raw material demand but also reducing the waste that is deposited on to the environment, thereby trying to minimize the undue depreciation of the environment.

It is not possible to have an economic activity without having an impact on the environment. The objective of growth in an economy should be to reduce the anthropogenic waste to a level that is 'acceptable' to the society, because it is scientifically impossible to completely eliminate the generation of anthropogenic waste. The field of science is used to understand the material balance, because it is impossible to have a quality or a pristine environment that is not scarce, when we have growth in the economy. But growth in the economy is a necessary condition for sustainable development. Therefore we need to learn to balance growth with environmental preservation (or resource preservation), so that the needs of the future generation will be balanced with those of the present generation.

4. MARKET FAILURE IN THE USE OF THE ENVIRONMENT

In economics, environmental problems are modeled, either using the theory of public goods or the theory of externalities. If the market is defined as 'environmental quality' then the cause of market failure is due to the public good nature of the environment.

Public good is defined as 'any good or service that, if they provide benefits to anyone, can, at little or no additional cost, provide benefits to a large group of people'. That is, it is a commodity that is non-rival in consumption and yield benefits that are non-excludable.

On the other hand, if the market is defined in terms of goods whose production and or consumption lead to some environmental damage, then the market failure is due to the presence of an externality. An externality is defined as 'effects, either good or bad, on parties not directly involved in the production or use of a commodity, known as the third party'.

Therefore we have to look at policies that deal with the public good aspect of the environment and the policies that deal in correcting a cost externality.

4.1 Policies that deal with the public good aspect of the environment

If the problem is due to the public good aspect of the environment, then the policy has to deal with the following factors:

- National economic conditions
- Regional economic impacts
- International trade implications
- Politics and public opinion

Because the paper is dealing with non-hazardous solid waste, namely the municipal solid waste, the paper will not consider this aspect, which is more relevant for other types of waste such as gaseous waste, where the market may be defined as 'environmental quality'. 'Environment quality' is a public good.

4.2 Policies that deal with the common property nature of the environment.

Environmental problems are the end result of treating the environment as common property. Unfortunately some of the inexhaustible common property resources do not have sufficient capacity relative to all the demands on them. With many people using common property resources for many purposes the environmentally damaging use dominates the non-damaging use and not vice versa[1].

The damaging use of the environment by any individual is rational in the absence of the following:

- A social conscience;
- Informal community sanctions;
- Formal legal sanctions.

Rational, because the individual reaps the full benefit of using the environment to dispose of their waste, but bears only a fraction of the welfare cost of their pollution activity. This individual selfishness will result in the society as a whole ending up worse-off, if all follow the same selfish action. All individuals in a collective sense will be better-off if they all refrained from attempting to maximise their own self interest.

.Therefore government intervention is called for due to the market failure. Unfortunately, however governments may be despotic, and interested only in favoring

[1] Non-damaging use such as swimming depends on the damaging use such as the discharge of effluent in an inverse manner and not vice versa.

the powerful lobby groups rather than the community as a whole, especially if such policies may impose costs on members of powerful pressure groups. This is so not only in developing countries, but also in developed countries. Therefore, such despotic governments may not be helpful in achieving sustainable development. To achieve sustainable development, a strong socially benevolent political system is required.

The underlying source of this market failure is due to the absence of property rights when environment is held as a common property or not owned at all. Property rights imply a set of valid claims to the environment that permits the use of the environment by the owner of the person who holds the rights, and to transfer their claims on ownership through a voluntary exchange or sale. These rights should be protected from involuntary takeover or encroachment by others.

Well-defined property rights are exchanged in a market economy, that exchange itself facilitates efficiency. It is very difficult to give property rights to the environment, even though it may be possible to give quasi property rights. The lack of property rights results in zero market price for the environment and in turn leads to the externality problem.

In this paper we consider market failure due to the problem of externality. Market failure occurs because at the private market equilibrium, the marginal net social benefit is negative. Implying that, the marginal social cost is greater than the marginal social benefit, even though at the private market equilibrium the marginal private benefit is equal to the marginal private cost.

Social benefit is defined as ‘the contribution that an activity makes to the society’s welfare’. Thus social benefit includes both the private benefit to the members of the society plus any external benefit that accrues to the other members of the society who are not party to the transaction. Therefore marginal social benefit is the value of the benefit from one additional unit of consumption to the society, including the direct benefit to the buyer known as the marginal private benefit, plus any additional indirect benefit to other members of the society who are not direct participation of that transaction, known as marginal external benefit.

Social cost is defined as ‘the value of the best alternative use of resources available to society as valued by society’. Thus social cost includes the private cost (the value of the best alternative use of resources used in the production as valued by the producer) plus any external cost (cost bourn by third party). Therefore marginal social cost is the cost of producing an additional unit of output to the society, that includes the additional cost to the producer (marginal private cost) and any additional cost bourn by the other members of the society (marginal external cost).

5. Types of economic instruments in solid waste management

In Australia, MSW service is charged a fixed fee or a flat fee and is included in the municipal rates that are paid by each householder. This fee is the same in a given municipality regardless of the quantity of waste generated by the households in that municipality and the price does not reflect the rising marginal cost of waste disposal. Efficiency implies that price should be set equal to the marginal cost. That is the price charged for MSW services should be in relation to the marginal cost of waste disposal to the service provider. Therefore, the price charged for MSW services should rise

with the amount of waste generated. That is, the price charge should be equal to the marginal private cost for the MSW service provider in disposing that waste. Therefore, there is no incentive for waste generators to reduce their waste with the current system of flat fee that is charged by the municipality for the disposal of house holds waste.

Even if we have a market for municipal solid waste services and if the prices for that service is based on the marginal private cost, there will be still be an over supply of waste over and above the socially optimal level. This is because there may be some externalities from waste disposal services. Examples of such externalities are ground water contamination from waste disposal or air pollution from incineration of waste or even destruction of aesthetic beauty of the environment where waste is dumped. Ground water contamination may even create an intergenerational problem.

In theory, this externality created by waste generation can be overcome by a Pigovian tax on waste. In Figure 1, this is equal to $t per unit of waste generated. Such a per unit tax will shift the marginal net private benefit (MNPB) to the left, such that the MNPB will be equal to zero at the socially optimal level of waste production, which is at $W_{s.}$ Therefore, it could be argued that pollution taxes are efficient in that they have the in built optimality property.

INSERT FIGURE 1

However, it could be argued, that in practice the imposition of successful pollution taxes is the exception rather than the rule (Sathiendrakumar 1995). For example, in practice marginal external costs are not only difficult but also costly to estimate. Therefore without knowing this marginal external cost it is not possible to estimate the optimal level of tax that is required to bring about the optimal level of solid waste disposal. Hence, the idea that an optimal Pigovian tax can be calculated is not realistic.

In this paper, the economic instruments that may be used in minimising the solid waste generation is divided into three categories (Fenton and Hanley, 1995) namely:

- Purchase relevant instruments
- Discard relevant instruments and
- Jointly relevant instruments.

5.1 Purchase relevant instruments

These are instruments that will that will affect the pricing of the product that generates the solid waste. Therefore, they will bring about changes in consumer choice between substitutes in a competitive market economy. For example, product levies, such as a packaging tax on material used for packaging, which increases the price of the product, will lead to a reduction in packaging material per unit of volume or per unit of weight packed. Similarly goods containing recycled materials might attract a lower product levy than goods that are similar but do not incorporate these recycled materials. Such levies would alter the behavior of both the producers and the

consumers and in turn will force them, indirectly, to take account of the environmental impact of waste disposal.

5.2 Discard relevant instruments.

These instruments work at the time of discard as the name suggests. An example of this is the quantity related garbage collection and disposal fees (Hong et. al., 1993; Jenkins, 1993). Since garbage collection and disposal fees are based on the quantity of refuse discarded, there will be greater incentive to reuse some of the material that is capable of being reused, which would have been normally discarded in the absence of such an instrument. This instrument will not only encourage the reuse of material but also the recycling of material. This is so when the additional charge levied on the household in removing the unwanted material as garbage by the municipality is greater than the additional cost (including the opportunity cost of time) incurred by the household in taking that material to the recycling centre

5.3 Jointly relevant instruments

Here the consumer pays a levy when he/she purchases the product and receives a refund when the consumer returns the container of the product (Bohm, 1981; Porter, 1978). An example of this is the deposit you pay for a bottle on the purchases of a bottled drink and the refund that you receive when that bottle is returned to the place of purchase. The purpose of this deposit is to encourage people to return the container, which could be reused or recycled by the manufacturer, rather than disposing it as garbage. Such a policy instrument will help in reducing the societies total cost of disposal of material by encouraging the reuse or recycling of material.

6. How a market based approach for municipal solid waste should work

The market for Municipal Solid Waste comprises various services such as:

- Collection of waste
- Transportation of waste and
- Separation and recycling of material
- Disposal of municipal solid waste

The demand curve for this municipal solid waste is the marginal private benefit that all these service providers get when they dispose the municipal solid waste generated by all the households in that area. In other words, this shows how the quantity demanded of these municipal solid waste services by the waste generators respond to the price charged by the service providers. This demand curve will shift to the right if the income of the community rises, holding everything else constant (ceteris paribus assumption). Likewise if the generators of this waste become more environmentally conscious or when there are appropriate policy instruments in place that treats the environment as a composite asset and not as a free good, then the market demand curve will shift to the left, ceteris paribus. Treating the environment as an asset helps the society to minimise the undue depreciation of that asset. Because of the impossibility in giving pure property rights to the environment, we have to consider the question of providing quasi property rights to the environment. Therefore such policy instruments that encourage the three ‘R’ principles, namely reduce, reuse and recycle help in providing some form of quasi property rights to the environment.

The supply side of the MSW services market depends on the cost involved in operating such a service. These costs include the following:

- The cost of collection
- The cost of transportation
- Cost of separation of recyclable material
- The cost of disposal of waste in land-fills or by incinerators and,
- The opportunity cost (a reasonable return for the entrepreneur for the above four services provided).

Any economic instrument used in minimising the disposal of waste should satisfy the following three important criteria, namely;

- The principle of economic efficiency. That is, it should provide a least cost solution that is able to mitigate the range of pollution and resource usage impact associated with packaging, including the administrative and compliance costs. Also the policy instrument should provide a continuous incentive for seeking least-cost solution.
- The principle of equity. That is, the policy should not confer disproportionate burden on the least well off in the society. That is, the impact of the instrument should not be significantly regressive.
- The principle of acceptability. That is, the policy should be easily internalised by the existing market and institutional system and should be transparent. Also the instrument should be compatible with the national, regional recycling objectives and existing legislation. The latter is known as institutional concordance.

We could represent the above three criteria as a 'cubic' model. The framework in Figure 2 is in the form of a cube whose surfaces represent the efficiency, equity and acceptability principles.

INSERT FIGURE 2

The eight corners of the cube are labeled as 'A', 'B', 'C', 'D', 'E', 'F', 'G', and 'H'. The positions 'A', 'B', 'C', and 'D' are the ones that satisfy the efficiency principle (or cost effectiveness principle). Likewise, the corners 'E', 'F', 'A' and 'B' are the ones that satisfy the acceptability principle. The corners 'A', 'D', 'E' and 'H' are the ones that satisfy the equity principle. Therefore the policy instrument that satisfies all three principles is position 'A'. The position that satisfies at least two of these principles is corners 'E', 'D', and 'B'. Therefore, we could use the above framework to select the appropriate policy instrument that could be used to satisfy the principles that we aim to achieve, namely, efficiency, equity and acceptability.

7. Economic policies to achieve sustainable development.

Environment is a finite resource. It has limited capacity to assimilate waste that is deposited on to it. If the damage done by the waste is reversible then we need not have to worry about the inter-generation aspect of waste generation. But some of the

damage that we do to the environment when we dispose of our waste on to it may not be reversible. Therefore it leads to inter-generational problems in that we have exploited the environment at the expense of the future generation. If inter-generational problems are going to be taken care of, then the damage done to the environment from waste disposal by the current generation should either be reversible or minimised

The above could be achieved by strategies that involve the use of three 'R's that were mentioned earlier, namely, reduce, reuse and recycle. The policy instruments that may help in achieving the above mentioned strategies are:

- Material levy
- Product charge
- Waste disposal charge

The above policy instruments seek to modify human behavior through the price mechanism, thereby correcting for market failure aspect of the environment. In addition to modifying the human behavior, these instruments could also be used to raise finances necessary to facilitate the collection, processing and storage of waste.

7.1 Material Levy

This is an input tax on the material used in the manufacture of packaging. This is aimed at source reduction. Also such levies could be used to raise finance necessary for collection, storage and disposal of waste. The material levy will raise the price to the consumer and therefore will be a purchase relevant instrument. Such levies will not only help in reducing the material used in packing but also in relative terms help in using material which is less damaging to the environment. But such an instrument by itself may not encourage the participation of the consumers in recycling of the packaging material, as it is only a purchase relevant and not a discard relevant instrument. Also the poor in our society spend more, as a proportion of their income on consumption of food than the rich do. Therefore such material levy on food packaging may be more regressive.

7.2 Product Charge with Refund

Product charge by itself is an out put tax and will be charged on the packaged end product itself. This is a purchase relevant instrument as it raises the price of the packed material to the consumer. But it could be made into a jointly relevant instrument if the policy is to reimburse part of the charge on the packaging component, if the consumer returns his/her packaging material to a recycling centre. Part of the packaging cost is only refunded in order to take into account the administrative cost involved in collecting and transporting the packaging material. When the policy instrument is jointly relevant as in the above case it will not only satisfy the economic criterion but also the criteria of equity and acceptability principles in waste management.

7.3 Waste Disposal Charge

As the name indicates, by itself it is a discard relevant instrument. If this instrument is deployed only to raise finances for collection and disposal of waste as in many municipalities it will not help in changing the behavior of people that is aimed at cutting down on their waste generation. But if the waste disposal charge on the consumer is based on the weight of refuse rather than a flat charge, then it will help in

changing the behavior of people towards minimisation of waste generation. It helps in waste minimisation by encouraging increased reuse and/or recycling of some of the material that may be discarded if waste disposal charge is a flat rate. Such an instrument will not only be more efficient in terms of waste minimisation but also be more equitable and more acceptable.

8. Conclusion

Economic growth and environmental quality are inextricably linked. But if environmental degradation is pushed too far in order to achieve economic growth at all cost, then such environmental degradation will make that economic growth unsustainable. This is because the society continues to ignore the market failure aspect when dealing with the disposal of waste on to the environment. But the welfare gains from income growth by the present generation may be outweighed by the losses from environmental damage created by waste disposal on the future generation.

With the opportunity cost of land rising and with the NIMBY (not in my back yard) syndrome, finding suitable land to dump municipal waste may become a major problem. Therefore, an instrument such as product charge linked to a refund scheme and/or a quantity-related waste disposal charge linked to a deposit refund scheme may help in changing the behavior of both producers and consumers towards minimising the discharge of waste on to the environment.

Furthermore, when land becomes much scarcer for use as dump for waste disposal, it may be necessary to divide the waste into combustible and non-combustible waste. The energy released from the combustible waste may be used in supplying the electricity grid. Therefore valuing the environment, considering the true costs of resource depletion and ensuring that these costs are incorporated into the decision making process is an important factor in ensuring that economic growth and environmental management remain mutually inclusive goals for any country’s sustainable economic development.

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