

## WASTE MANAGEMENT: A NEW PARADIGM

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### Abstract

Waste management—collection and disposal of waste—is a complex and burgeoning issue facing the world today. It is nearly spiralling out of control in big cities with direct impact on the general health and well being of the population. Waste generated can be classed into three broad categories: domestic waste—generated by humans, as part of their daily living, industrial waste—generated by the industry as a direct offshoot of the production of goods and services, and agricultural waste—generated by the agricultural sector and the associated processing enterprises. The waste management strategies must address all these three categories in a holistic manner, because there is hardly a margin separating one from another. At the outset, before laying down the strategies for waste management, we must be very clear as to what we mean by the word ‘waste’. Most see ‘waste’ as something they have no need for, have no use of, or have no value. It is hardly a clear definition. In fact, it is more a matter of attitude, than any concrete criteria, and therefore differs from person to person. An empty milk sachet that we throw away as ‘waste’ is an item of livelihood for a rag picker or waste dealer.

The carbon dioxide emission from stoves and cars may be the ‘waste’ that causes global warming through the greenhouse effect, but in fact, it is actually the food for plants and trees—the carbon sinks. But the problem is—there aren’t enough rag pickers, waste dealers or even plants and trees to absorb all the waste we generate today. Waste is simply accumulating, and the attempt is being made only to keep it out of sight. The problem continues to remain, and is turning more acute as the days go by. Most tend to see the entire issue of waste management as the function of the governments, corporations or municipalities. But that is not working out, any more, anywhere. Even if it somehow manages to hold out, it is by far very inefficient, and would soon become unsustainable. It is therefore time to wake up and take responsibility for the waste that each of us generate, as individuals or institutions. Taking such a responsibility would simply mean—firstly, being accountable for the waste each generates; secondly, ensuring safe

disposal of such waste to its logical end use, directly or through appropriate agencies, duly paying for that service; and thirdly, taking necessary measures to mitigate the environmental impact due to waste, particularly that which cannot be contained.

This paper addresses primarily the issue of taking responsibility for the waste we generate, and also to lay down a viable system of accounting and dealing with waste, so that the burgeoning waste dumps, and polluted soils, waters and air are no longer a legacy left for the coming generations. It is pertinent to note that it is certainly not an easy solution, but then there are no easy solutions for the problems we humans create.

## **Introduction**

We have become used to seeing what we no longer need, or have any use of, or find any value as waste. And we deal with that waste by simply disposing away into the waste dump. That is a simplistic way of dealing with the complex subject of waste. In nature, there is nothing called waste. Everything is reused, or recycled and then used. We, humans, are also a part of this nature. Accordingly, we too lived according to its tenets, that is, until quite recently. However, with the dawn of consumerist civilization driven by rapid industrialisation, and more recently, globalisation, we began to see ourselves as separated from the nature. Vicious cycle ensued—rampant production of goods and services—generation of wealth, albeit for few nations and individuals—conspicuous consumption. More than anything else, this turned the world into a waste dump—not just in detriment to those alive, but also the generations yet unborn.

We now behave more like obsessively greedy kids. We just want more and more ‘toys’ to play with—to live happily. When we get bored with a ‘toy’, or when we don’t like a ‘toy’, or we want a latest ‘toy’, we wreck the old ones, and throw them away into the waste dump. And it is someone else’s job to keep that waste dump out of our sight. A saving grace, at least in India, is the emaciated ‘kabadiwala’ who pedals to our doorsteps on his rickety bicycle to collect whatever waste we hadn’t thrown away. He pays for that too! Yet we bargain to squeeze a rupee or two out of him. This kabadiwala is the first cog in the waste recycling business. The desperate rag-pickers join hands with the kabadiwalas to bring some of the waste from the dumps to some use. Yet their laudable effort does little to clean up the waste we generate today. The waste dumps are here to stay, and grow.

The only way to put an end to the waste dump is to put brakes on our runaway consumerism—the unbridled culture of ‘use and throw’. We must grow out this immaturity. The only way to do that would be to make each one of us to be responsible for managing the waste we generate. If each of us—individuals, institutions, enterprises, and corporations—takes responsibility for the waste one generates, then without doubt, we will be very careful about the quantum of waste

we generate, and also do a reality check on our consumption patterns. We will be forced to scale our consumption down to pragmatic levels, so as to reduce waste. That is the need of the hour. In fact, that is the only way forward. Any other attempt to manage waste would be a mere gimmick, and will soon prove ineffective.

## Recasting the Definition of Waste

The first step to waste management is to recast our definition of ‘waste’. Waste must no more be seen as something that we no longer need, or have any use of, or have no value for. Instead, before we deal with any item in the usual ‘use and throw’ manner we must ask ourselves—*if presently we have no need of it, or we have no use of it, or it has no value for us, how then can we treat or deal with this item that it can be made useful or usable to us or others—humans, animals or plants?*

*This question is at the heart of the new paradigm for waste management. As it stands, there is nothing called material waste. However, there may be some items that are presently non-reusable and non-recyclable, for example some toxic and nuclear wastes. Yet, it may only be a matter of some dedicated research even to recycle such waste. Many items that were considered un-reusable or un-recyclable until quite recently have since been transformed into reusable or recyclable substances. For example, the PET bottles—they can now be recycled in India. This was not possible until quite recently due to lack of technology. But for a small list of items, every other that we treat as waste can be put to viable uses.*

Therefore, for every item of waste we generate, our aim must be to find that end use, and ensure it gets there as safely and efficiently as possible. This, by no means, is a complex operation. There is only a need for some attitudinal change to achieve that. Of course, it may be quite effortful, and even expensive, but it can be achieved. That is the only way we would fully bear the cost of our consumption.

The cost of consumption must necessarily include not just the cost of items, and some operating or processing cost thereafter, but also managing the waste of the consumption. Allegorically, it may be like doing the dishes after a good meal—either you do it yourself, or invest in a dishwasher, or employ a maid. The effort and expense after consumption is to ensure the waste is put to its logical end use. We must bear that cost and effort. No longer can we live ‘cheaply’. That will only make the world unliveable for the future generations. In this context a stark truth is—90% of the worlds waste is generated by less than 10% of its population. Obviously, the wealthy are living off the planet, rather cheaply—without taking full responsibility for the mess they are creating. That is both wrong and unethical.

## Classifying Waste

Before we begin to unravel the new paradigm for waste management, we also need more classifications for waste. The fundamental classification of waste is :

- Domestic—this includes all types of waste generated by normal human existence. Of course in today's context many more items, both toxic and non-toxic, have found their way into this category. For example, humans today simply cannot seem to exist without emitting toxic fumes from their automobiles, or by discharging huge quantities of dry cells in gadgets of everyday use.
- Industrial—this includes all types of waste, both toxic and non-toxic, that issue from the industrial processes, which include material handling, production processes and related transportation. Here, the size of the industry does not matter. Often the tendency is to keep a watch on big industries, and turn a Nelson's Eye towards the tiny ones. Very often it is a conglomeration of tiny industries that cause the greatest damage due to lack of control on their waste management—examples abound—tanneries, dyeing units, electroplating, printed circuit board manufacturers and so on. The list is practically endless. When it comes to waste management, there must be no small or big—everyone ought to be treated at par.
- Agricultural—this includes all forms of agricultural waste that issue from agricultural production and related agro-industries. In the good old days, the agricultural waste was a non-issue, because almost every waste generated in a farm was simply ploughed back in. With the advent of the large-scale use of rapid action chemical fertilisers, the slow acting bio-waste has few takers.

In addition to the above classification, we need other classifications as well—

- Based on containability—whether the waste is physically containable or not. Containability is a significant parameter in the waste management process. Energy waste is hardly containable and contributes to the ever-spiralling rise of entropy. Most forms of gaseous wastes, mostly from mobile platforms, are practically impossible to contain. While solid and liquid wastes can be quite easily contained.
- Based on natural degradability—whether the waste is naturally degradable or not. When we talk about a waste substance being non-degradable, it simply refers to something that would take inordinately long periods of time to degrade into another reusable form. There is nothing that does not degrade naturally in time. This natural degradability includes bio-degradability, degradability due to radioactivity, and degradability due exposure to natural UV from the Sun, and also other naturally occurring physical and chemical processes. In the purview of waste management, it may be necessary to find ways and means to hasten the degradability through the natural processes. For example, biodegradability of waste can be accelerated by the addition of certain microorganisms. The time period for natural degradability also dictates the time available to deal with the waste. For example, a rapidly degrading biological waste must be handled rather swiftly,

while those that do not degrade quickly can be stowed away till adequate quantities have been collected and sent for further processing, recycling.

- Based on the process cost and complexity for recycling—this is applicable only to those types of waste that are not naturally degradable, and so require artificial processes to convert them into usable form. The methodologies for recycling waste are based on this classification. The cost and complexity of recycling is a key factor in the waste management scenario.
- Based on toxicity to humans, animals or even plants species—the waste products will also have to be classed according to their toxicity to humans, animals and plants. This classification is vitally essential to decide the methodologies of handling, transporting and containing such waste, and the costs thereon.

Based on these classifications we can evolve multidimensional models to manage waste, and also to cost such operations. This no doubt calls for more research into this field.

## **The New Paradigm**

With such multidimensional form of classification of waste, we can now address waste management process itself. At the outset, the new paradigm of waste management is intended to make everyone—individuals, institutions, enterprises and corporations—responsible for managing the waste each generates. That does appear to be a tall order, but certainly achievable in a three step process :

- Account for the waste
- Deal with the waste
- Mitigate the environmental impact of waste

## **Account for the Waste**

The first step to manage waste is to account for the waste one generates. Accountability is the key to waste management. In very many cases, both individuals and others, including those agencies responsible for waste management simply relocate the waste they generate, mostly on the sly, into someone else's backyard. Then they claim that they have no waste to dispose off, even if it is quite plain that they must produce waste as a part of their operating processes. When challenged, they would invariably retort—*come, visit our premises and prove it.*

*A classic example of such an attitude of wilful lack of accountability pertains to a caustic soda manufacturing unit situated just south of Karwar. For every ton of caustic soda they produce even larger measure of 'semi-solid mercury-rich sludge'*

*is produced as 'waste'. In addition, they generate substantial quantities of various other liquid wastes. In accordance with the provisions, better still, loopholes, in the existing laws, they stow this sludge within their premises, in an open field. As regards the liquid wastes, they fill up tanker-lorries. These tanker-lorries are then driven off, usually at night, to desolate sections of the wooded highways, and simply let off down the hill-slopes, where there aren't any prying eyes. What happens to the sludge is even more interesting. The region incidentally receives annually about 3,000 millimetres of rainfall during the season of Southwest Monsoon. The runoff from such huge downpour simply fluidises the sludge and carries everything to sea via the natural drainage. No one notices this sinister waste management process. This in the bargain contaminates even the ground water, let alone the soil and surface water sources, and the coast. With the plants, livestock and fish easily ingesting mercury from this sludge anyone can gauge the impact on both the environment and the humans who depend on it. The consequence is not simply a case of 'Mina Mata' disease or mercury poisoning, but an epidemic of the sort. Because, over the last 30 years, with unit's mean annual production of caustic soda standing at 59,000 tonnes, and taking into account very modest estimates of mercury loss through the sludge the environment ought to have already absorbed more than 300 tonnes of mercury. The notorious scandal in Japan of 'Mina Mata Bay' in early 1970's involved only 27 tonnes of mercury discharged into the bay over a similar period. Making the industry accountable for the waste they generate is the only way to beat this problem. In fact, every industry can be held accountable for the waste they generate.*

Every industrial or agricultural enterprise, small or big, has a well-defined process, even if it is quite complex and multi-layered, with inputs that go into the process—raw materials and energy. This results in specific waste product(s) that is quantifiable quite precisely. The quantum of waste generated will be directly proportional to the production. Since production is publicly declared, for announcing profitability, and for taxation purposes thereon, it is therefore possible to account for the waste such a production would result in. Therefore, in the case of both industrial and agricultural enterprises accounting for waste is quite an easy matter. Therefore every enterprise, industrial or agricultural must scrupulously account for the waste they generate and prove to the environmental protection agencies how they have dealt with it. Just as in case of dealing with Income Tax, these enterprises must also declare their waste account after necessary audit. Penalty should be imposed on those who are negligent about the way they treat their waste

It may not be so precise when it comes to domestic waste. However, with some door-to-door survey, it may be possible to arrive at a working figure of the average waste generated per human, both in urban and rural contexts.

## **Deal with the Waste**

The second step in waste management is dealing with the waste each one generates. Dealing with waste is simply not disposing the waste into waste dumps. There are many dimensions to it based on above classifications. While some types of waste can be put to reuse almost straight away, other may require some processing, and still others may require major alteration of form or substance. As such, a waste from one source can be the input or raw material for yet another use or production process. Now the question—who is to be made responsible for ensuring that the waste from the point of origin reaches the end-use point? The obvious choice, from the point of view of the responsibility factor, must rest on the one who initially produced the waste. Such an individual or enterprise must either undertake the task of reaching the waste to the end-use point or arrange to ensure it is done through another agency bearing the associated costs. At least, in the case of industrial and agricultural enterprises there is absolutely no need for any further direction on the matter, because they have the necessary expertise and wherewithal to deal with the problem. Dealing with domestic waste is an altogether different scenario, because the individuals, particularly in cities may not have the necessary wherewithal to deal with the issue. Here the civic administration may have to step in to provide necessary infrastructure.

We can look at how the domestic waste from a small household in a city can be ideally dealt with. We shall assume that this small household is in a single dwelling unit built as per byelaws (that is with stipulated setbacks) on a standard residential plot. That leaves plenty of space around the house even to deal with waste. Such a household generates substantial waste, almost every day, ranging from biodegradable to toxic non-degradable, yet suitable for recycling.

In the biodegradable section, human faeces need to be piped away through the city's sewerage system. That part calls for necessary infrastructure. As it stands even the domestic wastewater is also shipped out from the household through these sewerage lines. That's hardly a sensible way to do it. If there is a separate line for the domestic wastewater, then that water can be very easily recycled, at the same time, the sewerage system is not overloaded. In addition, the faeces in fairly concentrated form can easily be routed into gasification plants for generation of biogas, which can be, at least, used for meeting the power requirement of such treatment plants. The other biodegradable waste, such as kitchen waste, can be locally composted, subject to availability of space. In case of large apartment blocks, even this kitchen waste can be introduced into the gasification plants to generate biogas, and the ensuing sludge can find use as high-grade fertiliser for the public parks, etc.

The non-biodegradable waste can easily be stored on board duly segregated into papers, plastic, glasses, metals and so on. When it comes to plastics right down to the small toffee wrappings ought to be stored. And when such waste products have accumulated into sufficient quantities, it would be quite economical to send them to appropriate recycling agencies, either directly or through scrap/waste dealers.

All this requires is an attitudinal change and some patience. The effort is quite minimal. And there are no doubt some returns while keeping waste at bay. An average household (two adults and two studying children) generates nearly Rs. 50/- worth waste that can be readily recycled—polythene bags, wrappers, scrap paper other than newspapers and magazines (which are sold separately anyway), used toothbrushes, bottles, plastic containers, metal caps, tins, pen refills, and so on. It is a fact that a ton of plastic recycled is a ton of petroleum saved.

## **Mitigate the environmental impact of waste**

The third step to manage waste is to take measures to mitigate the environmental impact of waste one generates. This step is necessary to tackle those categories of waste that simply cannot be contained—mainly the energy and gaseous wastes.

The most serious case of energy waste takes place from the thermal power plants, whatever is the source of the thermal energy—coal, petroleum, gaseous hydrocarbons or nuclear energy. The waste energy in the form of heat—spent steam or coolant water—is released into aquatic environments. This results in grievous impact on the aquatic flora and fauna. Here the mitigation measures would mean taking practical steps to absorb such energy from the waters before releasing them into the natural aquatic systems.

Mitigation of the impact of gaseous waste is more of a problem for two basic reasons—firstly, it may hardly be possible to put mitigation measures around the source of the waste due to host of environmental problems, and secondly, even if that was possible the real impact of such waste may be so far away due to meteorological factors, and also where, once again mitigation measures may not be possible or even ineffective. These issues can be made clear with an example.

One of the classic cases of the environmental impact of the uncontainable gaseous waste was the depletion of ozone layer due to the release of chlorofluorocarbons or CFC. There was hardly a mitigation measure that could be put in place to handle this problem but to stop using CFC. However, with nearly a decade of cessation in the use of CFC, both in refrigerating and aerosol industries, the current evidence suggests there is a resurgence of the depleted ozone layer.

There is still no easy solution for the impact of accidental release of highly toxic gases that need not be a waste in the real sense of the word. But after release into the environment that simply becomes a waste, with no mitigation possible for the catastrophic impact that could follow. Bhopal gas tragedy is a classic case. The only possible mitigation is to put in place such fail-safe measures to prevent any sort of leaks and would require in addition to technology an eternal state of vigilance.

The biggest problem related to mitigation comes from the burning fossil fuels and other hydrocarbons, both for power generations and in automobiles. Carbon dioxide is the principal ingredient of such an uncontrollable gaseous waste. As a result of the rapid increase of carbon dioxide in the atmosphere the world has begun to experience the much maligned *green house effect* and the host of environmental problems that comes with it. The only way to contain the carbon dioxide is by creating carbon sinks—simply planting trees that will trap carbon from carbon dioxide and release oxygen back into the atmosphere. Therefore, for every unit, power plant or automobile, depending on the carbon dioxide it generates, the owner(s) must balance out the environmental impact by creating carbon sinks, that is, by planting trees—yet not just planting trees but ensuring their growth to self-sustainability. The annual environmental tax of each unit must be able to defray the cost of creating/maintaining the compensating *carbon sink*.

There is little doubt that such a tax will be a very stiff one, particularly for the individual automobile owners. The best way forward then would be to get rid of private cars and go for mass transportation systems. As it stands the average car occupancy on road in India is only 1.2. That's a colossal waste. With the environmental tax towards mitigation of effects of gaseous waste even the energy cost would go up considerably. So, we have to learn to be extremely careful about the use or rather waste of energy, particularly electricity. There is just no other way to beat the problem of uncontrollable waste. However, one thing is for sure, that would slow down the nearly cancerous growth of economies solely piggybacking on unbridled consumption. The consumption patterns are what the modern economists are looking. They even call it consumer confidence. When the consumers visit supermarkets less frequently, the economists go into a tizzy—stock prices fall, until they are once again lured back with seductive advertisements and titillating incentives. So long as the consumers behave like dumb, programmable Pavlov's dogs, the causality will be the environment.

## Conclusion

The whole idea of eco-friendly technologies means little in the march towards environmental protection—waste will continue to be generated anyway, unless we can seriously regulate our consumption as individuals and societies. We must get clear about the whole idea about sustainable growth. The markets still behave as if afflicted by multi-organ carcinoma, which is steadily spreading into the entire environment. To put it quite idiomatically they continue to make hay when the sun shines—but how long can that go on? Such an attitude is hardly 'sustainable growth'.

The current generation may escape the adverse consequences, but what about the next? Instead of pristine forests and wildlife, they will only get to see huge garbage dumps. Instead of fragrance of flowers, they will get to smell only the stench of decaying garbage and acrid fumes from automobile exhausts and

industrial chimneys. Instead of watching birds flying about in magnificent hues and shapes, they will get to watch only torn polythene bags flying about in harsh unruly winds, charged by the heat of 'global warming'. And instead of listening pleasant sounds of nature, such as cooing of birds, sounds of twittering insects, gentle whooshing of morning breeze, they will hear only cacophonous noises of machinery and blaring horns of irate drivers. Is that our attitude towards the nature's stewardship that we are entrusted with for the sake of the future generations?

The solution lies only in making everyone responsible for the waste one generates—everything will then change. Each individual or institution must adopt the new paradigm for waste management—account, dispose and mitigate—or simply pay for this process fully, with no subsidy support allowed. That would be the greatest service we can do for the future generations. That is the only way we can say 'we love you' to our grand children or even great grand children whom we will never get to meet. It is not a doomsday scenario as yet. There is still hope, but for that we must begin now. There isn't much time left to continue with the current ambivalence, dilly-dallying with cosmetic and half measures towards environmental protection.

#### **Bio Data:**

Commander John Jacob Puthur is a retired naval officer—alumnus of National Defence Academy. He is a hydrographic surveyor, with surveying experience along the entire Indian coasts, and also at Antarctica. He is a graded 'Charge Hydrographer', authorised to certify all types of hydrographic surveys. Presently, he consults in hydrography, coastal erosion, dredging, and on port design matters. He is also active in outbound adventure training. He is a Fellow of Indian Geological Society, Indian Institution of Surveyors and Indian Cartographic Association, in addition to being active member of several prestigious societies/associations. He is a resident of Bangalore.