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An Integrated Sustainable Waste Management System for Urban Communities

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ABSTRACT Urbanization is accompanied by a massive increase in the amount of waste generated from each household and its disposal and management is crucial. The waste pile-up at the household and community level is a source of health and environmental hazards if not handled properly. Keeping the premise in mind that "humans are greedy and would work towards something that yields rewards in some tangible form", this paper aims to come up with an integrated waste management system for the urban communities. A waste management strategy that rewards households in proportion to their contribution towards proper waste segregation and disposal would be proposed. The strategy incorporates several technologies and ideas like garbage chutes, organic local farms, waste segregation, etc. The main focus of this paper is on the inherent selfish and reward-seeking attitude of humans and how it can be used for sustainable waste management at the community level.

I. INTRODUCTION

Sustainability is being considerate in our work and in our daily lives about all the resources this planet offers us (humans, animals, plants, water, air, etc.) and managing them so that the resources that exist today can not only meet the demand today but are also made available to the future generations. It is clear that managing waste is an essential part of sustainable living and managing waste is not only how we dispose garbage in landfill, or how much we recycle or what we recycle, but it is also how we do not create waste to start with. Essentially we need to reduce the amount of waste production by efficient resource utilization and also target the areas where waste is generated. Moreover waste management needs to be an economically, socially and environmentally beneficial. With increasing use of technology both generation and improper disposal of waste has increased over the last few years. An average human in India owns about 10-15 electronic devices and they are replaced every few years generating tremendous amount of waste that needs to be taken care of effectively. Other major contributors in the recent years are pharmaceutical companies, they generate waste that is huge not only in amounts but also in terms of the impact this toxic waste has on the environment. A major barrier to the implementation of the waste management techniques is the fact that waste managers have little control over the generation of waste and therefore reduction in amount becomes difficult. Designers, engineers and managers in industry make decisions about what is manufactured, processed or constructed, and how it is done, and hence the amount and type of waste generated. In order to be effective, huge strides need to be taken not just by the waste control systems, but also by the production systems.

II. IDEA BEHIND THE MODEL

The premise behind the entire formulation of the proposed model is that humans are inherently indifferent and negligent towards the issues of waste management and segregation as they do not get any tangible reward for doing so. Man's attitude towards any environmental issue is of sympathy but he is reluctant to take any action himself unless he sees a positive return in some tangible form quickly. Another emotion that every human rates very highly is his ego and pride. Every person wants to be respected and looked up to by his fellow people. So, he would do every possible thing to maintain his image in the community where he lives in. This model addresses these issues of feedback via rewards which is in proportion to the waste and its quantity that is properly disposed off by an individual.

III. MAJOR COMPONENTS OF THE MODEL

The model requires a number of technologies and institutional set ups which are explained below: -

A. Segregation Bins and Bags

Currently there exist color coded bins which are of Green (Organic), Yellow (Glass), White (Paper), Grey (Metal), Blue (Plastic) and Red (Hazard) colors each denoting the type of waste that needs to be disposed into it. However, in most localities in India color coded bins are rarely seen and if existent, people are not aware of the color coding.

For this model, newly designed bins need to be manufactured that along with the color coding carry an engraved list of items that must be disposed in it, in distinct color that is clearly distinguishable and readable. The listing of item should be done in English as well as a popular local language so that everyone can easily understand and comprehend what should be disposed off in the respective bin.

To ease the segregation process, every household would be provided with segregation bags which would also be color coded. Once the household starts to accumulate reward points for the waste that he segregates and provides to the facility, he can get the color coded bags as well in exchange for the points.

B. Garbage Sensing Chutes

Specially designed chutes that have specialized channels for each types of waste need to be designed. Each channel has a sensor at its head which would check whether the waste disposed in it is commensurate with the type of waste that the channel is supposed to carry. Behind the sensor would be a churner which would break down the waste to facilitate easy carry through the pipe to the processing facility in the community. Each building in the society or community would have these garbage chutes, all of which lead to the centralized waste processing facility.

C. Centralized Waste Processing Facility

Each community or society needs to set up a centralized waste processing facility where the waste from the households lands up. This facility would be well-equipped to handle all kinds of waste. The facility need not be a huge plant but just enough to handle the waste from all the households. It would have a composting unit for bio-degradable waste and an accompanying organic farm wherein vegetables would be grown using the compost from the plant. The other types of waste i.e. plastic, metal, glass, etc. would be sent to the concerned the concerned disposal units across the towns.

D. Computerized Unit for Reward Points Credit

Each garbage chute where the households dispose off their wastes would have a computerized unit along with an assigned personnel who will weigh the garbage that a person disposes off in segregated manner and would credit the individual with rewards points in proportion to the segregated waste he disposes off. Each type of waste will have different weights with the highest weight given to bio-degradable waste and others having lower weightage. In accordance to these weights and the quantity of each type of waste disposed, the rewards points would be credited. These reward points can be redeemed to buy the organic vegetables that would be grown in the community facility and to compensate for other community provisions like maintenance charges, security charges, etc.

IV. WORKING OF THE SYSTEM EXPLAINED

Suppose a community has 20 households and the community adopts the proposed model. The entire flow of the waste from the households to the processing facility or the government institutional set ups meant for waste management would happen in the following manner.

A household segregates the waste into the color coded bags provided to them as a starter kit. It is up to the household when to take the segregated waste to the centralized facility and get reward points in proportion to the quantity of the waste. The centralized facility has personnel appointed to weigh the waste and put them in the correct channel of the garbage disposal chutes which has sensors which checks whether the waste that is passing through it is actually the correct type of waste or not. Once all the types of wastes are put into the chutes, the personnel credits the points using the computerized set up to the individual and the work of the individual is over. He now can exchange the points to obtain compost, organic vegetables, more garbage bags, etc. that are supplied by the facility.

The organic waste channel of the chute takes the waste to the composting unit installed in the facility which processes the waste to generate manure for the small organic farm in the facility that grows vegetables. Other kinds of wastes cannot be efficiently handled in small waste management units so they are sent to the government installed set ups who further process and recycle. Once the organic farms and composting is fully functional people can exchange their reward points to buy these fresh and organic products at subsidized rates and reap benefits.

The facility will maintain a notice board with the names of each household and details about how much segregation the house is doing and will rank each of them. Naturally every household would want to be at the top and be looked up to by the others and hence they will practice segregation more often and the model would get positive feedback.

To encourage households to control the amount of waste that they generate, the households which reduce their total waste generated every month will be credited with bonus points.

Obstacles. The model is susceptible to multiple obstacles and challenges which are enumerated below:

Investment. The institutional set ups like centralized waste processing facility, segregation bins, garbage chutes, etc. entail a significant upfront cost which the community needs to collectively bare.

Co-operation. Since the model is entirely based on the people's willingness to segregate and dispose the waste, the community members must co-operate and practice sustainable waste management.

Maintenance. The institutional set ups need to be maintained continuously to keep them in the pristine and working conditions. Community must be willing to set aside funds for maintenance purposes.

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