Research paper

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SCOPE FOR ECO-FRIENDLY HOUSEHOLD WASTE MANAGEMENT IN HIGH DENSITY HOUSING: AN EMPIRICAL STUDY OF KOCHI CORPORATION AREA IN ERNAKULAM DISTRICT OF KERALA

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Abstract
Historically, health and safety have been the major concerns in waste management. These still apply-wastes must be managed in a way that minimizes risk to human health. Solid waste management could be ideal when tackled at source. Clearing of waste is not just only a corporation job, but every individual has a role to play. People in every neighborhood, street, house and hut need to be guided and motivated. The highly motivated category will practice source solid waste management. Easily 20-40 percent waste can be dealt with at house (source) itself. Most household garbage is recyclable. Paper, plastic, metal, glass and rags can be reused in various manufacturing process. Wet organic kitchen wastes can be used to generate compost, which is rich in plant nutrients. The point of waste treatment at source - Household Waste Management (HWM) has been advocated as a means to substantially decrease the global burden of waste disposal and to contribute to the zero waste. To determine whether HWM should be scaled up now, this paper gives the evidence on acceptability, scalability, adverse effects and non health benefits as the main criteria to establish how much evidence is needed before scaling up. This paper found that the acceptability and scalability of HWM is still unclear and that there are substantial barriers making it difficult to identify populations that would benefit most from a potential effect. The non health benefits of HWM are negligible. Waste treatment by biogas and vermicompost suggest that HWM may reduce the domestic waste disposal problem by 30-40%. Further acceptability studies and trials with an objective of safe disposal are needed before HWM can be recommended to policy makers and implementers.

Key Words: ***Household Waste Management, High Density Housing, Zero Waste*.**

1. Introduction
More than half of world's population is living in cities and towns. Nearly, twenty eight percentage of India's population (285 million) lives in urban areas as per 2001 census. The percentage decadal growth of population in rural and urban areas during the decade is 17.9 and 31.2 percent respectively. With rapid economic growth and massive urbanization in India, many of the people are living in houses without sewerage or water supply and without facilities for the collection and disposal of refuse. This critical situation is of course, overcrowding. With the housing built in very close proximity and then with each individual dwelling occupied far beyond its real capacity there are the ingredients of a health and housing disaster and it is not long before infectious diseases such as small pox, typhoid and most significantly cholera rapidly become widespread. Now, we recognize that most of the diseases are caused by micro-organisms and transmitted either through faecal/oral route or in water. Also there is a belief amongst a large proportion of authority that disease tended to be more prevalent amongst those in the lower social strata because of the moral shortcomings rather than the conditions under which they were obliged to live. It seems that any hope of progress would require not only a conclusive demonstration of the health/housing link, but also of the personal advantage for those in authority in supporting intervention to improve housing conditions. Let us scale up the household waste management with supportive intervention which would reduce the above said problem in high density housing.

2.Analytical Significance

There is an ongoing debate about the relative benefits of households and waste management interventions in high density settings. Historically much emphasis had been given to zero waste management criteria implemented at substantial costs in most cities. However, during 1980s and 1990s, researchers began to argue that insisting on zero waste criteria at source may be counterproductive in high density housing areas. The impact of waste management at source was regarded as limited, based on the assumption that domestic waste consists mainly of biodegradable materials is just one of the decaying process and is disposed of in one or two days and that the risk attributable to waste related infections is low. The assumption was challenged by several recent trials and systematic reviews suggesting that initiating waste management at source (HWM) may reduce the problem of waste disposal upto 40 percent. These findings have gained considerable attention, calling for a shift in current thinking toward greater emphasis on zero waste in high density housing, especially by the use of HWM. The BIOTEC of Kerala (NGO) reported that there was conclusive evidence that simple, acceptable, low-cost interventions at the household and community level are capable of dramatically using biological treatment of household waste and reducing the waste disposal problem. From the scientific point of view, it is also reducing the attendant risks of communicable diseases such as chikungunya, cholera, typhoid, tetanus and hepatitis. Some researchers have rejected claims about the effectiveness of HWM, suggesting that much of the currently apparent evidence for the effect of HWM may be due to bias and that without other environmental improvements the benefits of HWM may be negligible. It is crucial to understand what exactly the debate is about. Protagonists of the view that the available evidence supports the widespread adoption of HWM techniques do not contest the important role that easy access to waste disposal plays for diseases prevention and socio economic development. They also do not contest the role of safe disposal in improving or maintain cleanliness in household. What is being claimed is that HWM significantly reduces waste disposal problem in high density housing, and may significantly reduce communicable diseases in the absence of other environmental improvements, in particular sanitation. The focus of the debate is whether the claims of socio economic benefits are true and whether HWM is scalable among high density housing with highest environment risk, who would benefit most from waste disposal at source.

This paper reviews the existing evidence for the effectiveness of HWM and for its scalability in order to determine whether or not there is now a solid case for promoting widespread adoption of HWM in high density housing. This paper does not give the evidence for the benefits of improving access to zero waste. As out lined above, there are few people who dispute its importance for environment and economic development. Further, this paper gives brief discussion on the potential for HWM to reduce indoor pollution.

3. Profile of the Study Area

Ernakulam is the commercial capital of Kerala. The Ernakulam district includes Paravur, Aluva, Kochi, Kanayannur, Moovattupuzha, Kunnathunadu and Kothamangalam Taluks. Ernakulam district is divided into 7 taluks, 15 blocks, 7 Municipalities and 88 Grama Panchayaths, in addition to the Cochin Corporation, for administrative purposes. The population in Ernakulam is 3.09 million. The Cochin Corporation has an area of 94.88 sq.km and a population of 5.84,008 (2001 census). Urban activities in the Kochi area are of mixed land uses. Sources such as households, shops and commercial establishments and hospitals generated 250 MT/day. In Kochi, there is still no organized waste segregation at source except in some localities. In some places household waste is left open at the nearest open temporary storage dumps and collection occurs whenever transport carriers are available.

The existing Municipal Solid Waste management system demands large scale improvement and augmentation to ensure environmental safety.

4.Methodology of the Study

For the purpose of the study, household waste management means treatment of waste in the household using the process of compost and biogas. Using interview and questionnaire method, HWM is assessed based on household interventions. This approach comprises of three steps.

(i) Define the strength of evidence that would be needed to justify widespread implementation of HWM based on the potential size and plausibility of health effect and the interventions, scalability, acceptability, risk of adverse outcomes and non-health benefits.

(ii) Summarize the strength of evidence and effectiveness of HWM to reduce the waste disposal problem by critically analyzes the information gathered from households who are using biological treatment for household waste management.

(iii) Compare the strength of evidence available against the threshold of evidence that would be needed to recommend widespread implementation.

5.Analysis, Discussions and Findings

5.1 Biological plausibility and potential size of health effects

HWM (especially vermin-compost and biogas) has been shown to dramatically improve microbiological activity of organic wastes, usually in terms of energy and manure. Biogas is produced by means of a process known as anaerobic digestion from locally available wide range of materials like animal dung, human excreta, household wastes, water hyacinth, and agricultural wastes as feed material. It's a process whereby organic matter is broken down by microbiological activity. Biogas is mainly composed of 50 to 70 percent methane, 30 to 40 percent carbon dioxide and low amount of other gases, making it a very clean household fuel. Slurry is the residue of inputs that comes out from the outlet after the substrate is acted upon by the methonogenic bacteria in an anaerobic condition inside the digester. After extraction of biogas (energy), the slurry (also known as effluent) comes out of digester as byproduct of the anaerobic digestion system. It is an almost pathogen free stabilized manure that can be used to maintain soil fertility and enhance crop production.

Drawing conclusions from literature, it is understood that vermicomposting can be of great importance in treating the decomposable organic/domestic wastes. The putreceable wastes can be converted into very useful vermicompost through the use of earthworms. In addition to major nutrients and trace elements, which help in the growth of plants, the vermicompost is known to be rich source of plant growth promoting substances such as auxins and cytokinins. Although it would be argued that microbiological effectiveness is a poor marker of the actual health benefit, it still appears that from the perspective of biological plausibility a potentially large effect size of HWM cannot be excluded for high density settings.

5.2 Acceptability and Scalability

Acceptability and scalability of HWM has been subject to much debate and are closely linked. Government and Non Government Organizations have taken various initiatives in dealing with household waste through biogas and vermicompost. Programmes like "Clean Kerala" that included widespread mass media promotion and other communication channels reached large parts of the population in various districts, with 15-30 percent of respondents reporting having used vermicompost although persistent use was much less common. Biogas has also been found to achieve some coverage and persistent use.

A common finding of acceptability studies is that uptake and use is much less among rich who are generating more waste and are most at risk of disposal problem. Thus it seems that promotion effort at least have the potential to bring HWM techniques to some scale in the long term. However, if one assumes that it takes longer for richer and educated people to change to HWM methods than poorer people it could be argued that current studies may not fully describe the potential for long term behavior change. On the whole there is evidence that sustained promotion efforts may increase coverage and persistent use to significant level, but it seems likely that increasing coverage among the rich who are generating more quantity of waste will be difficult and will require substantial additional efforts.

5.3 Adverse effects

HWM may have adverse effects in these dimensions: risk to consumer (e.g. toxicity), diversion of household income and time/effort from other activities and the risk that potential attention is diverted from door to door waste collection and centralized processing of waste. There is little evidence that use of HWM is associated with health risks. Segregation of waste will usually prevent foul smell. There is some evidence that inappropriate use of HWM (biogas and vermi-compost) can lead to an increase in microbiological contamination, although the relevance for health is unclear.

Uptake of HWM will cause additional costs to households. The additional costs include the cost for vermicompost pot and the ingredients like earthworms, cow dung, and coir pith. And for the biogas users, the additional costs include the digester. These are assumed as costs for households and therefore the risk of substantial diversion of spending are relatively low, although the true costs may need to be reduced by subsidies.

Finally, there is the risk that HWM may divert the attention of policy makers and donors from the promotion of other environmental interventions, such as drainage and sanitations, which of course would only be a problem if HWM were ineffective. HWM has indeed attracted widespread recognition, especially in the context of eradicating various communicable diseases. HWM appears to be widely accepted one as a means to reduce environmental degradation. Waste may be such a household problem rather than a public good for which governments have a clear responsibility. In conclusion, the potential for adverse effects due to the widespread promotion of HWM is difficult to quantify and largely depends on whether HWM is (cost) effective or not. Overall, the risk of adverse effects due to HWM is unlikely to be substantial.

5.4 Benefits other than waste reduction

The benefits are cost savings, convenience and reduction in indoor air pollution. The realization of benefits of biogas is basically on account of cleanliness in the kitchen and environment, saving on the use of traditional fuels and expensive LPG, saving in cooking time and saving in the cost of fertilizers. And HWM promotes eco-friendly, healthy and easy management of household wastes at source. In conclusion we say that disposal of household waste in public places could be reduced.

Many waste management interventions can strengthen the social status of users. These have clear effects on gender equality. They allow women and other household members to save time which may be devoted to other (e.g. economic or educational) activities. HWM is unlikely to contribute significantly to any other issues since it does not affect surrounding environment. Rather HWM may increase the work load of household members especially women, although probably not to a very substantial extent. On the whole the benefits of HWM unrelated to communicable diseases are negligible.

5.5 Determination of strength of evidence needed

Potential effect size – Expected effect size based on biological plausibility only; large effect size means a substantial effect on (largely) biodegradable waste disposal in excess of 40 per cent, moderate reduction between 20 per cent and 40 per cent. Small effect means a reduction below 20 per cent. These figures are indicative only.

Table-1: Comparison of Four Different Environmental Health Interventions Using Critical Criteria for Public Health Decision.

	Potential effect size	Acceptability	Scalability	Potential for adverse effects	Potential for non-health benefits
HWM	Moderate	Moderate among poor and Small among rich.	Small	Small to Moderate	Small
Centralized waste management	Small	Moderate	Small to Moderate	Small	Large
Waste Reduction promotion	Moderate	Small	Small	Small	Small

Acceptability - The extent to which an intervention is accepted and used by the target population. Scalability - The extent to which an intervention can be delivered on a large scale taking into account promotion activities and materials needed, for example, both HWM and waste reduction can be promoted by mass media. While waste reduction is the solution for waste disposal problems everywhere; HWM requires in addition establishing a promotion activity. Potential for adverse effects means that any effect of an intervention which is harmful for health or economic development including potential waste resources. Potential for non health benefits includes that the beneficial effects of an intervention not directly related to disease (although disease may improve indirectly, e.g. by savings in costs and time which can be allocated to other activities like work and education associated with health improvements).

The findings shown in Table.1, along with other waste management interventions were discussed with the aim of putting HWM into real context. Individual items such as the statement of effect sizes may be subject to debate. However, even if we take this uncertainty into account, the table illustrates an important difference between HWM and other waste management interventions. Improving centralized waste management is associated with non health benefits (especially savings in time and costs) and is highly acceptable. Likewise, especially in dense urban settings, waste management is a basic necessity and always worthwhile to implement even if the true effect on health was small. Little evidence on waste reduction is needed to justify implementing these interventions. This stands in contrast with HWM. From the table we can see that the case for HWM largely depends on the existence of a disposal benefit and reasonably precise on the size of this effect. Without a disposal benefit there would be little reason to promote HWM for public health purposes.

In line with the principles of the approach used here to evaluate the role of HWM, the absence of non health benefits, the rather small potential to reduce indoor air pollution and the questions with regard to acceptability and scalability mean that before scaling up there needs to be high quality evidence on the size of the waste disposal effect in different settings. As on other side, waste reduction promotion may also require quite strong evidence on its disposal effect as there are few non health benefits and

questions regarding in acceptability. Thus, the strength of evidence is that HWM reduces the problem of waste disposal

To study the strength of evidence, the data on different waste management interventions like quality of sanitation, various measures on vector control activities, fogging, cleaning of canal and waste treatment by biological methods was analyzed. In general, HWM has found to be effective with average effect sizes suggesting a 30 to 40 per cent waste reduction. A striking finding was that the large heterogeneity of effect of different HWM interventions (especially door to door collection, community bin) ranging from no effect at all to a 60 per cent reduction.

Heterogeneity of effect sizes may be due to many reasons such as different in the efficacy of different HWM methods. The study design, executions, the importance of zero waste in different settings, the extent of respondents and observer showed bias for outcome assessment. This was mainly due to conflict of interest. The Systematic bias was considered as of highest interest in this study.

The results were found based on non health benefit and questions with regard to acceptability. Hence the HWM requires a high level of evidence for health benefits before being promoted on a large scale. Also, the study showed that high level of evidence is not yet achieved. The approach taken in this analysis proposed that policy makers need to decide between various basic options when deciding whether or not to implement an intervention.

6.Conclusions and Policy Suggestions

From the householder's viewpoint, co-mingled collection of all solid waste together probably represents the most convenient method, in terms of both time and space requirements. This collection method will limit, however, the subsequent options for treatment. Most treatment methods will require some form of separation of the waste into different fractions as source, i.e. in the home, prior to collection. At its simplest this might involve removing recyclable materials, e.g. glass bottles for delivery to a bottle bank; more extensive sorting involves the separation of household waste into several different material streams. The degree of home sorting achieved in any scheme will be a function of both the ability and, especially, the motivation of householders.

The findings of this paper suggest that it is possible for HWM to be effective in reducing waste disposal problem in some high density housing, where the waste disposal problems are dominant. High quality studies are needed to prove this and to estimate the size of effect. Safe waste management practices can be promoted that require little investment from households. In other words, there can be little harm in promoting them. Given the current available evidence, there may be a case for implementing HWM as a preliminary method in some settings. Under these circumstances the issues of sustainability and lack of non health benefits may be of fewer problems, while the potential effect size of HWM may be large. Improving waste disposal facilities and sanitation remain the top priorities in waste management and sanitation sector.

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