

Environmental Sustainability through Solid Waste Management in Rural India -An Inclusive Model

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Abstract

Needless to say that sanitation promotion is a priority in the rural development agenda of governments in India, both at the Center and State level for the past decades. The Government of India launched Swachh Bharat Abhiyan (SBA) on 2nd October 2014 with an objective to a 'Clean India' by the year 2019. Rural India faces sanitation problems beyond imagination. With its rural population which was estimated to be 915.1 million, according to the World Bank (2023), it disheartening to note that nearly 800 million people in the country live without basic sanitation. Ensuring a clean environment and breaking the cycle of disease depends on various factors that can be ensured through an inclusive and integrated model in place.

Ideally, Solid Waste Management system be it rural or urban should be planned and executed following a step by step inclusive approach. This paper explains how a systematic model can be designed and implemented involving multiple stakeholders. The proposed model suggests a five step approach to the problem of Solid Waste Management in rural segment. There are some activities that need to be undertaken grouped as "Prior Preparation for SWM". The second step is that of a "Roadmap & Planning SWM", followed by "How to Organize a Fool Proof SWP". Execution or Implementation which involve segregating, collection and arranging logistics is the next step. Effectiveness of any plan, programme or projects depends considerably on Monitoring, Feedback & taking Correctives where necessary.

Each of the steps listed above in the suggested solid waste management model requires an integrated inclusive approach with multiple stakeholder's involvements. The paper discusses all these with related illustrations.

Keywords- Sustainability, Solid wastes, Wet wastes, Dry wastes, Biodegradable wastes, Non-biodegradable wastes, Hazardous wastes, Resource Management.

1. Introduction

Rural India faces sanitation problems beyond Western imagination. Nearly 800 million people in the country live without basic sanitation. Ensuring a clean environment and breaking the cycle of disease depends on various factors that include hygiene status of the people, types of resources available, innovative and appropriate technologies according to the requirement of the community, socioeconomic development of the country, cultural factors related to environmental sanitation, political commitment, capacity building of the concerned sectors, social factors

including behavioural pattern of the community, legislative measures adopted, and others.

According to Registrar General Census of India (2011), 69% households in rural & 19% in urban sector have no access to toilets which leads to open defecation. This then made India the number one country in the world where open defecation was practiced. Indonesia was a far second. GoI record shows, less than 10% Gram Panchayats in India are Open Defecation Free (ODF). This has led to problems such as, organic pollution, aesthetic nuisance, water borne diseases like, viral gastroenteritis, typhoid, cholera, diarrhea (annually kills 500,000 children), Viral hepatitis

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(100 cases per 100,000 people).

Need for speeding sanitation programs in India assumes importance since it is estimated that Open defecation is too wide spread due to absence of toilets in 60% rural households. Plus, unsafe disposal of excreta is the main cause for water borne diseases like malaria, cholera, typhoid, polio, and diarrhea. Researchers have estimated that everyday about 1500 children die of water borne diseases. Ministry of Drinking Water and sanitation records reveals that one gram of faeces contain, 10 million viruses, 1 million bacteria and 1000 cyst parasites and about 100 worm eggs.

2. Literature Review

Onwughara (2010), in his research article, list out different waste management hierarchy and waste management options and environmental impact of options. The research article also explains the environmental impact of waste management with special reference to health and social effects. The researcher has suggested legislation of 'Extended Producer (source) Responsibility' where re-manufacturing and reuse is available to insure sound management practice in developing country Nigeria. [3]

Waste is rather considered as a resource in the present time. The revival of this source is the main purpose of the system to function. There can be various ways and methods that seem to be gaining popularity as the developed countries are researching more and more on the same. Further their process is tried and tested in the developing countries. There is the need for new and innovation is important (**Dijkgraaf & Gradus, 2004; Ferrara & Missios, 2005. (Troschinetz&Mihelcic, 2009) (Idris, Inane, & Hassan, 2004).**

There are several solid waste management options: 1. reduce waste generated, 2. reuse materials, 3. recycle waste products, 4. compost organic material, 5. combustion, and 6. landfill. Because solid waste management is important to business, economic developers should have answers ready for any questions a business may

ask and should work to improve the local climate for solid waste management options (**Beranek, W., Jr., 1992; Craggs, R, 1995).**

In a study, the inefficiency of state to address solid waste problems was highlighted. The emphasis was laid on creation of local resources, execution of local codes, and commitment from central government to allow free exercise of existing policies (**Dangi, M. B., Schoenberger, E., & Boland, J. J., 2017).**

From a study of China, it is revealed that the source separation MSW collection, high energy recovery from incineration plants, appropriate leachate treatment, effective landfill location and management, increase waste recycling and proper taxation system for MSW disposal are essential to improve MSWM in China(, **M. M., Zeng, X., Nasry, A. A., Naim, Bin, & Alhamadani, S., 2017).**

Mihai. [84] highlighted the need for circular economy solutions to reduce plastic pollution in rural areas. The authors mentioned a series of possible interventions, such as replacing conventional plastics with more environmentally friendly materials; redesigning products with optimal recyclability; promoting reuse and return schemes by providing local infrastructure and incentives; and promoting creative recycling practices at household and community levels.

Richard Mahapatra, (2023) writes in the article "Is open defecation back in India?" and to quote him, "The behavioral change to use toilets instead of open defecation has not been quantified — rather just qualified as a proxy — to ascertain ODF status with certainty. In July 2021 when the WHO-UNICEF released the Joint Monitoring Programme (JMP) report it said 22 per cent of India's rural population practiced open defecation. Further he writes ".....in July, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) released their Joint Monitoring Programme (JMP) report for water supply, sanitation and hygiene for households for the year 2022. The JMP report gives status on

access to water, sanitation and hygiene to monitor the progress on SDG 6. According to this report, 17 per cent of the rural population in India still defecated in the open in 2022. One quarter of the rural population didn't have even at least basic sanitation facilities. (<https://www.downtoearth.org.in/water/is-open-defecation-back-in-india--90483>).

Objectives of the Study

A 2022 study by the Pratham Education Foundation revealed that only 36% of villages had public waste bins, and just 29% had community waste collection vehicles. Moreover, less than half had access to sanitation workers. Consequently, 90% of villages rely on informal waste collectors, known as kabadiwalas, who often reject low-value plastics like wrappers and sachets. This leads to improper disposal methods. There are other studies that clearly points out that the issue of solid waste management that needs a workable model developed associating every stakeholder, and not leaving it as exclusive responsibility of government. Hence objective of the paper are-

- To develop an inclusive self-sustaining model of solid waste management in the rural areas.
- To design a step by step process driven approach to SWM to make the rural community sensitized on the importance of waste management.
- To develop a model that the Gram Panchayat and its functionaries play a facilitating role on SWM.
- To identify and list out the missing links in SWM process and make the programme more self-sustaining and ensuring inclusivity.

3. Method of Study

The scholar did literature study from the official documents in the Panchayati Raj Department, Health & FW Department of Govt. of Odisha and Centre for Rural Infrastructure, National Institute of Rural Development & Panchayati Raj,

Hyderabad. Focussed Group Discussion (FGD) was also conducted with PR representatives and rural households to gain an insight into the state of awareness and preparedness for waste management. Assessing the gaps, a model is developed for an effective SWM programme in rural areas.

The Study – SWM in Rural Sector

In India, particularly in rural areas, domestic waste generated is becoming increasingly matter of serious concern, though solid wastes generated is mainly organic and biodegradable unlike urban cities. But in rural areas, waste generated is not segregated, and is estimated of the order of 0.3 to 0.4 million metric tons per day as reported by Ministry of Drinking Water and Sanitation, GoI, thereby leading to the problem of their processing and utilization.

Solid wastes generated both in urban and rural areas are in required to be categorised in three categories, namely- Dry wastes, Wet wastes and Hazardous wastes. They can also be classified according their source of generation. The latter classification also can be useful in their management. **Wet wastes** may include- vegetable peels, rotten fruits and vegetables, leftover food, used tea/tea bags, egg shells, tender coconut shells, spoiled spices, used flowers, mean and non-veg remains, garden shrubs, floor sweep, road sweeps, etc. Similarly, **dry waste** are like soap covers/packages/sachets, empty cosmetic bottles, milk covers, used door mats, used tooth brush, chocolate wrappers, used mop cloth, grocery wrappers/covers, package polythene covers, paper napkin, thermo coal, plastic water bottles, broken household plastic items, old brooms leather, Rexene, rubber etc. Category of **hazardous waste** mainly include items such as, mosquito repellent refill bottles, expired medicines, sanitary napkins, medical discard, children diapers, used razors, old used batteries, broken glasses, injection needles, expired cosmetics, rusted iron pieces, old printer cartridge & CDs, old electric items, old chargers, medical wastes etc.

To effectively manage these solid wastes generated in rural areas, the community, household, GP level functionaries and individuals have to be prepared through Information, Education and Communication (IEC) drive so that everyone practice them in their daily life as a matter of habit. Series of IEC campaigns on specific aspects of Solid Waste Management (SWM) such as – why scientific management of SW is necessary, how to segregate wastes at the source level, how and who is responsible for transporting the waste for disposal etc.

Solid Wastes Segregation

Ideally, solid wastes segregation at the source can be done into - biodegradable wastes, non-biodegradable wastes and hazardous wastes which facilitate their later management. For example, biodegradable wastes such as vegetable peels, fruits, flowers, used tea leaves, leftover food; garden wastes can be converted into compost/vermin-compost, which commercially viable business option. Non-biodegradable such as, plastics, papers, cardboards, milk covers, oil covers, and glass bottles, metals etc. can be sold to merchants who deal in recyclables. This again is a good business proposition at individual levels and community levels. Hazardous wastes such as, household chemicals, fused bulbs, grease, old medicines, syringes, blades etc many of them being non-recyclable should ideally be sent to sanitary landfills, so that they do not contaminate the water and environment.

Role of Gram Panchayat (GP)

In the context of rural solid waste management, the Gram Panchayat (GP) plays a critical role in planning and implementing the entire activities as the central nodal point. It is supposed to prepare a Bylaw for Solid Waste Management specifying the jurisdiction, constituting a Village Water and Sanitation Committee (VWSC) which is supposed to appoint and supervise a team of sanitation workers approved by the GP. The VWSC is required to fix a user charge for different categories of wastes generated in the specified

area. Major categories of users in rural area include - households, tea stalls, village eateries, marriage mandaps/halls, vegetable markets, mutton/chicken/fish stalls, grocery shops, schools and offices, places of worship such as temples/churches/mosques etc.

Inspection and supervision of SWM in a GP is required to be undertaken by the members of the Panchayat along with the members of the duly constituted VWSC. The Bye-Law has to stipulate how many and how often, such inspection visits are to be made, Similarly, those households and residents found not abiding by the norms, littering wastes in public places and even around their houses, can be imposed fines/penalty and in extreme cases of deviant behaviour, can even be denied essential services like water supply. Money so collected as user fee or penalty, serve as income and used for meeting expenditure on

Solid Waste Management by-law

Solid Waste Management buy-law need to clearly lay down the responsibilities of the households, that of sanitation workers, Village Waste & Sanitation Committee (VWSC), and Gram Panchayat. Clear roles and responsibilities should be laid down for all stakeholders. For instance-

- i. **The sanitation workers** shall collect wastes primarily segregated at the household level, and after reaching the segregation shed, shall undertake secondary segregation.
- ii. **Sanitation worker has to collect service/user charges** and deposit the same with the Panchayat Secretary, as frequently as prescribed in the bye-law.
- iii. **Each household shall segregate wastes** into –‘Wet wastes’ and ‘Dry wastes’ and put them in the respective bin given for each purpose.
- iv. **Sanitary workers, in uniform and cap, should** visit every household with a cart/tri-cycle and blow a whistle to inform the household/shops/eateries of their arrival.

- v. **Every waste collection worker** should carry a complain book, with mobile number printed.
- vi. **GP and the VWSC shall arrange** for composting, undertake secondary segregation of wastes, promptly attend to grievances, setup sanitary Landfill which should not be used as a place for dumping, etc.

The Suggested Inclusive Model

Ideally, Solid Waste Management system should be planned and executed following a step by step approach, as shown in the **Table-1. This model is to some extent similar to Life Style Approach (LCA) to waste management. LCA to waste management also suggest** options such as reduction/minimization, collection, recovery, treatment, or safe disposal of solid waste.

Table-1 Model Design of Solid Waste Management (SWM) System

Step	Activities
Preparation for SWM	GP functionaries meeting
	Gram Sabha meeting
	Community education
	Identifying infamous spots
	Community preparation and IEC activities.
Planning SWM	Area survey
	Material planning
	Manpower planning
	Technical planning
	Financial planning
Organizing the SWM Programme	Recruiting required manpower
	Arranging materials and facilities
	Arranging transportation
	Technology and operational planning for wastes.
	Funds arrangement
	Coordination and convergence
Execution/Implementation of SWM Prog.	Segregation of wastes at source
	Collection & logistics operation
	Secondary segregation into recyclables & non-recyclables.
	Treating the solid wastes
	Service charge collection from households & others
Monitoring, Feedback & Remedial Action	Household and other source be part of monitoring team.
	Feedback from the households and others
	Feedback from waste collectors
	Physical verification by GP functionaries
	Corrective measures

(Source: Own Compilation)

Each of the five steps needs some illustration as to what they entail.

Preparation for SWM

Before implementing a Waste Management system in a GP, the following “Prior Preparations” are suggested. In a special meeting convened for the purpose, the Panchayat President, Vice-President, Secretary, Ward members should

resolve to support the Waste Management drive and make the GP clean within a time period.

Community preparation, needs **integrating IEC**, first to impart knowledge, awareness. It is suggested a standalone IEC may not be effective; therefore ideally a series of IEC campaigns is

necessary to educate targeted population. IEC activities could start from **distribution of waste bins** and explaining the reasons and importance of the three colour bins. School children are great ambassadors of IEC messages and hence it is better to organize orientation separately on waste management. School children can be involved in preparation of IEC materials in competition held for them and subsequently used in publicity. Handbooks and Field Manuals have been prepared for GPs to guide waste management scientifically and effectively, which advises **GPs to organize cultural evening** where in which messages to sensitize the residents on waste segregation and waste reduction by GP functionaries, should be a part of. The GoI manual also suggests organizing ‘**Rangoli Competition**’ giving prizes to winners in Waste Management & Cleanliness in three categories- Household level, Street levels, and Habitation levels. Now that cell phones and smart phones have penetrated to remote villages, SMS Alert service can be used as an effective tool in morning hours. ‘Clean the Campus’ is another innovative IEC tool used in model GPs. Schools, ICDS Centres, identified ‘Infamous Spots’. Identified infamous spots can then fenced and converted to children playing parks.

Gram Sabha meeting discuss and give final shape, if required after repeated sitting, to a ‘**Resolution**’ that include a pledge to stop using polythene carry bags, instead use cloth bags, tea stall not to use ‘single use plastic or paper cups etc. Equally important is **Community Education**. This includes target groups like, households, SHGs, Eateries and shops, school children marriage/community halls etc. In villages, we often notice ‘**undeclared dump yards**’ where households which are vulnerable to both solid and liquid wastes. These spots need to be identified, cleaned, converted to children play area, planted with saplings but first, garbage dumped there have to be shifted to landfills. Enabling the community can begin by the concerned GP providing **three buckets with handbills- Green** (for wet wastes), **Yellow** bucket (for dry wastes) and **Red bucket** (for hazardous wastes). The green and yellow

bucket wastes better be collected preferably twice a day but the Red bucket hazardous waste may be collected once in a fortnight.

Planning SWM

In the second step, SWM planning has to be undertaken considering both physical and financial requirements. The first task for SWM planners would be, undertaking **area survey** in order to estimate the nature, type and extent of the problem of wastes in general and solid wastes in particular in the GP or villages. Planning collection, transportation, manpower requirement for each sources of wastes such as households, eateries, marriage halls, vegetable and other markets, bus stop, places of worships and educational institutions has to be carefully done. Assessment of wastes generated may require visits to the source/site and recoding data as they emerge. The existing waste disposal arrangements need to be assessed. **Physical inputs or materials** that are necessary includes, vehicles for waste collection such as Tri-cycles, uniform-jackets, globes, cap, first-aid kit for workers, segregation yard/shed, tools & equipment. Work-norm based **manpower planning** is essential to take stock of manpower currently available in the GP, additional requirements considering areas and tasks to be performed, is needed. **Technical planning** to take care of the ‘treatment method’ for the wastes collected and after segregation. Certain parts has to go for vermin-composting that which can be recycled may be sold to scrap merchants, balance have to despatch to ‘landfill’. **Budgeting and financial planning** has to be done for each waste management project separately. The total cost can include **Capital/fixed cost** of creating permanent facilities for collection, transportation, landfill etc. **Recurring expenses** have to incur on a daily, weekly, monthly basis for which budget provision have to made. **Possible revenue sources** have to be identified and likely income to be estimated. This can be from sale of vermin-compost, service charges collection, and sale of recyclables, fines and penalties. Revenue so generated at the initiation stage may not be

adequate, hence support from the government or other sources of revenue for the GP may have to be tapped, but eventually the project has to self-financing.

Organizing and Road Mapping the SWM

Manpower has to be **recruited/ reallocated if they exist as redundants, trained/orientated** and motivated to undertake tasks of waste management. Minimum wages requirements as per law and need, have to be adopted. Next task is to organize **facilities, materials and equipment** which are necessary to commence work. Specific convenient land to construct landfill, segregation sheds, composting yards have to be located. Containers, baskets, tricycles, uniforms, broom sticks, bins, tins are required to be purchased in adequate quantity and of required specification. Decision regarding the **technology to be adopted** in waste collection and transportation, treating the wastes, landfill construction are to be taken. This has a link to the budgeting and financial planning to procure the materials in right numbers and quality. **Funding the SWM** is crucial element on which the entire project success depends. Though income sources from the SWM project can be used, but it may not be adequate. The GoI provides funds for Swachh Bharat Mission (SBM) Gramin, in the shape of grants for SWM. Corporate houses operating in the periphery can support SWM from their CSR budget also. Different stakeholders in the SWM programme such as households, community organizations, NGOs, workers, have to be coordinated by the GP functionaries.

Execution/Implementation

Success of a SWM programme in any Panchayat will ultimately depend on how well every task in different phases is implemented. Starting from primary segregation of wastes generated, their collection, transportation, secondary segregation, treatment of wastes, service charge collection, all, have to be done with seriousness. **Household** should be able to **segregate the wastes** in the three different baskets already provided by the GP, which will make secondary segregation easier and quicker. **Emptying the baskets** at the schedule hour by the sanitation worker is the next task before their secondary segregation. **Composting yards**, with right specification, two in number has to be constructed. One composting yard can be

used for a certain period and once filled up, the second can be used, and the first yard garbage in the mean time gets ready to be used as compost in field. A part of the operating expenses of the waste management can be covered up by **service charge collection** from users and for this option are- the sanitary workers collect and deposit them with cashier of the GP, alternatively the designated cash counter of the GP is open at specific working hours for users to deposit charges along with other dues such as house tax, drinking water/electricity charges

Monitoring, Feedback & Remedial Action

Just as any other programme/project, in respect of SWM, it is required to **regularly monitor** and ensure that households and other sources of waste generation, sanitation workers, and Panchayat functionaries are adhering to the provisions of the bye-law and also behaving in a way that helps to manage the waste, without adversely affecting the environment. The programme so designed and implemented should have a **channel to obtain feedbacks from multiple sources**- households, waste collectors. **Complaints and suggestions** should be received by the GP President, Secretary through their cell phones. GP functionaries can make **random physical verification** when sanitation workers are duty.

4. Conclusion

Here, an attempt is made to develop an inclusive solid waste management model for rural community. Integrating the broad principles of management, it is felt a step wise process from end to end can be a workable model. This is shown in the table-1 and briefly explained thereafter.

1. Gram Panchayats (GPs) have to be the nodal agency to oversee the entire gamut of activities. GP and Grama Sabhas will be involved in community awareness and education, identify infamous spots and prepare the community in through IEC activities.
2. Planning for waste management should include procuring materials, arranging manpower at different functional levels, budgeting and sourcing funds from multiple

sources. Exclusive state funding has its own inbuilt drawbacks.

3. Organizing the SWM Programme, is the most important segment, which involves arranging trained committed manpower, arranging transportation, operational planning for waste handling from sources, coordinating all segments.
4. Closely linked to organizing, is the next step of execution/implementation of SWM Prog. Waste segregation at primary levels have to be ensured by waste collection personnel, followed by secondary segregation into recyclables and non-recyclables. Treatment of solid wastes, regular collection of service charges from waste generating sources are all part of implementation step.
5. Monitoring, Feedback & Remedial Action, though is indicated as the final step in the suggested model, is actually a step that starts the activities suggested yet again. It is essential to regularly monitor and ensure that households and other sources of waste generation, sanitation workers, and Panchayat functionaries are adhering to the provisions of the bye-law and also behaving in a way that helps to manage the waste, without adversely affecting the environment. A dedicated desk should function in Panchayat office to receive complains and suggestions, and prompt action taken.
6. Gap in the management of solid waste in the country which equates to 22% of the total generated waste. This means the amount of wastes generated far exceeds that is treated. This may be more serious when only rural area is considered.

The model suggested explains how the objectives set for this paper can be achieved to take SWM forward for the rural community. An inclusive self-sustaining model of Solid Waste Management in the rural areas need pre-preparation for the

Gram-Panchayat and their functionaries, clearly mapping manpower and other resources. Community participation through IEC can be a great support. Comprehensive planning for manpower, technology, financing through self-generating funds, can ensure the management of solid wastes, self-sustaining.

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