Decentralized
Solid Waste Management
through Community Participation

A Pilot Programme
(In Purdilpur ward of Gorakhpur City)

Asian Cities Climate Change Resilience Network (ACCCRN)

Implemented by :
M.G. Post Graduate College, Gorakhpur &
Gorakhpur Environmental Action Group

Supported by :
Rockefeller Foundation

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INTRODUCTION

Gorakhpur, a low lying and bowl shaped city of Eastern Uttar Pradesh[1], is rich in the cultural heritage and historical importance. Unfortunately, it is expected that by the year 2031, the citizens of Gorakhpur will have tough time in dealing with huge mounds of garbage accumulated in the city, which may cause hindrances in the easy movement of the vehicles on the roads. The amount of solid waste poses a serious threat not only to the human and animals but also to the entire eco-system. According to Gorakhpur Municipal Corporation, approximately 300 tons (table 1) of the solid wastes are generated every day in the city, out of which 240 tons are collected by the Municipal Corporation[2] and the rest one fifth remains strewn all over on the roadside. It is projected that if the present rate of solid waste generation continues then by the year 2031, about 231 quintals of solid waste in the form of paper, rubber, synthetics, glass, metals, polythene bags, vegetable peels, animal remnants, construction materials, medical wastes and drain silt) will be generated every hour in the city. At present, the Gorakhpur Municipal Corporation fails to provide adequate services to the people of the city with regard to solid waste management.

Figure: 1 Purdilpur Ward in Gorakhpur

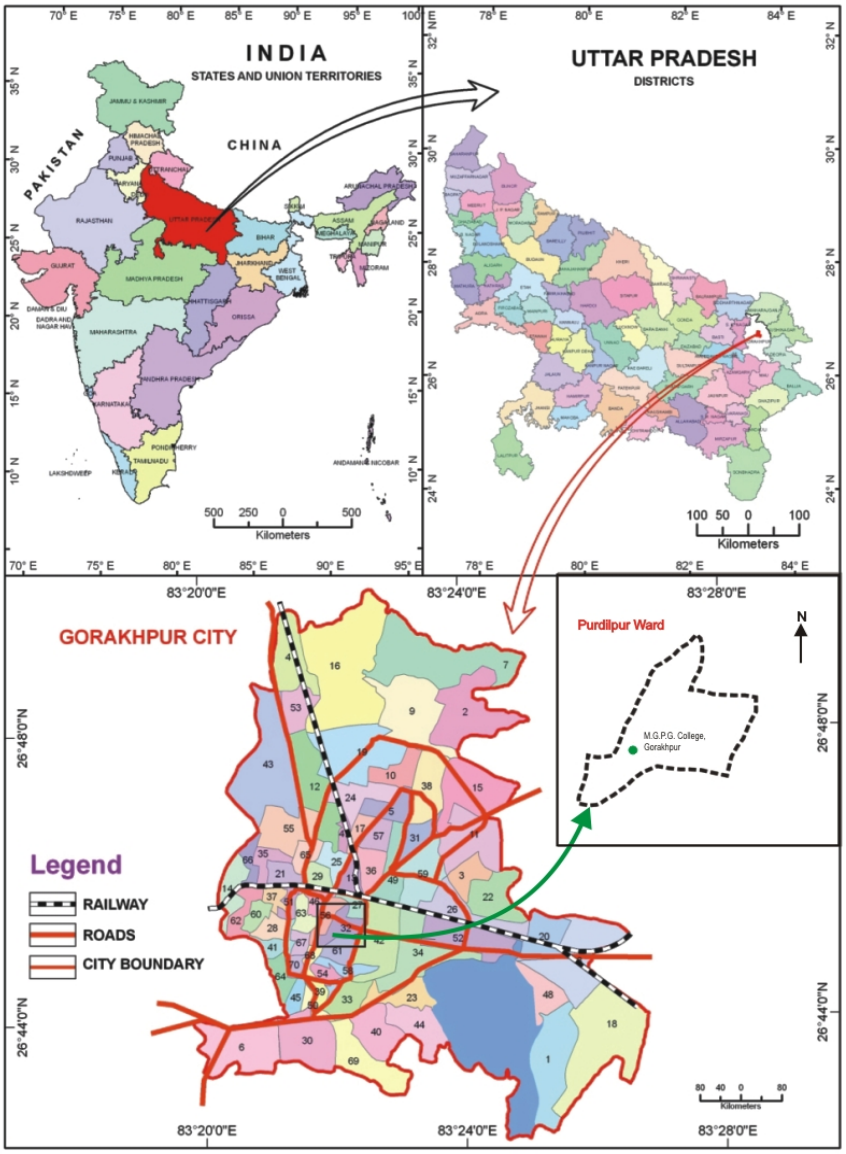


Table 1: **Solid Waste Generation in Gorakhpur City (per day)**

[1] Verma, 2009
[2] Wajih et al, 2009

Category of waste	Generation of waste (in tons)	Waste generated (%)
Residential	168.13	56..20
Construction and demolition	45.4	15.17
Commercial	44.6	14.91
Industrial	40.0	13.38
Hotels	0.53	0.17
Clinical /hospitals	0.50	0.16
Total	**299.16**	**100**

Sources: *Municipal Corporation Gorakhpur, 2009*

This amount of solid waste is certainly a great threat to entire ecosystem and hence, need an immediate remedial strategy. It is, therefore, essential to make efforts to deal with the solid wastes through decentralized system of management.

Gorakhpur Environmental Action Group in collaboration with M.G. Post Graduate College, Gorakhpur, has taken up pilot initiative towards community based solid waste management in Purdilpur ward of Gorakhpur city. This initiative is supported by Rockefeller Foundation under the Asian Cities Climate Change Resilience Network (ACCCRN). The initiative of GEAG and M.G.P.G College was to comply with MSW handling rules 2000[3] in decentralized way through participation of the community to bring sustainability to solid waste management in the city. Initially 120 households of Purdilpur ward responded positively, but latter, the number has gone up to 200 households. This initiative aims at setting up a model of solid waste management before the local government and creates awareness among the community towards community based solid waste management.

RELEVANCE OF STUDY IN CONTEXT OF CLIMATE CHANGE

The Solid waste is an important contributor of green house gases and cause of climate change. The strong link between solid waste and climate change has raised serious concerns all across the world. Increasing problems of solid waste management and its disposal has given rise to environmental and health hazards. Emissions of greenhouse gases in the Earth's atmosphere have caused climate change. Methane is released from the anaerobic decay of wastes in landfills, and nitrous oxide from solid waste combustion.

Both of these greenhouse gases have high global warming potential. Methane (CH_4)has 25 times stronger global warming potential than carbon dioxide (CO_2)and nitrous oxide (N_2O) has 310 times the global warming potential[4]. It is often assumed that reducing the emission of CH_4 from landfill solid waste management would have the greatest potential for reducing global warming impact on the overall climate change. Some carbon compound may be retained in the landfill for a long time and not returned to the atmosphere as carbon dioxide. There is risk of water contamination from leachate (liquor) formed as

[3] MSW, ACT 2000
[4] Takeo Tashiro, 2004

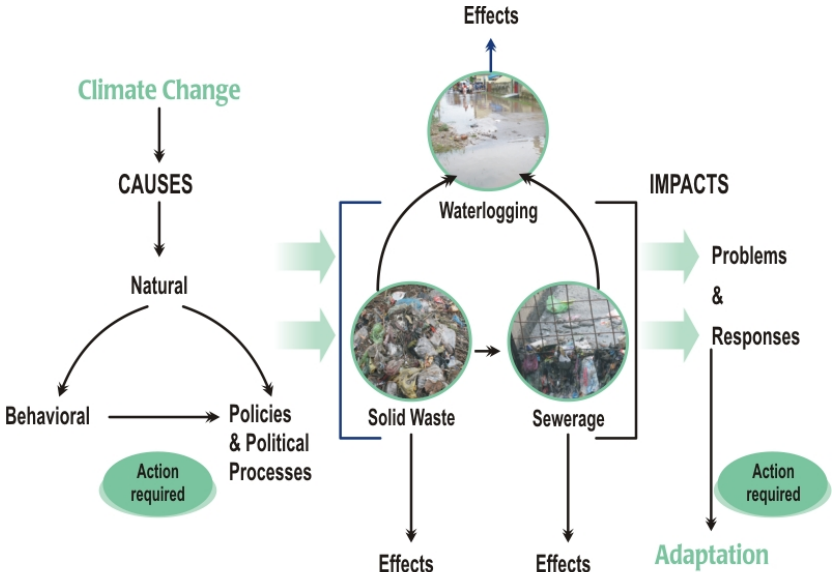
waste decomposes. Solid waste not only contaminates water level but also the soil.

Photo 1 : Unscientific land fill leading harmful effect

The physically fragile Gorakhpur city and indifference attitude of local governance regarding the solid waste has played a catalytic role in aggravating the problem of water logging in the city[5]. Gorakhpur is a low lying city with more than 22 % of the area being the lowest in the city. The low topographic gradient causes slow runoff in majority part of the city and cause widespread water logging for more than 3-4 months[6]. Beside this, the prevailing situation of open drains, inadequate underground drainage (only 20 per cent of the city) irregular collection of solid waste from households and roads to dumping grounds etc aggravated the problem of water logging and many vector and water borne diseases.

In the vulnerability analysis, it has been drawn out that, the populace of the city has described water logging as the most serious risk for the city. This risk is also projected to increase due to climate change in which more rain fall is expected in fewer days. Consequently any obstruction in flow of water will exacerbate the vulnerability of the populace.

Figure: 2 Gorakhpur City : Risk Frame



From the vulnerability assessment and SLDs with stakeholders it was revealed that problem of solid waste and sewerage has its own effect inform the diseases and health risks.

The figure 2 of risk frame of the city explains the inter connectedness of three major identified risks. Water logging being the main risk, which tends to enhance due to the accumulation of solid waste and sewerage[7]. The existing situation of solid waste management in the city is highly unsatisfactory mainly due to non availability of adequate place for dumping of solid waste, inadequate staff, equipments,

[5] Wajih , et al, 2009
[6] Wajih et al, 2010
[7] Wajih et al, 2010

resources with Municipal Corporation, ineffective governance and lack of people participation. In the present situation it is imperative to:

- Evolve model for decentralized and cost effective solid waste management with local people's participation.
- Conversion of waste into compost for useful purposes i.e to help in soil fertility and organic manuring.
- Avoiding accumulation of raw solid waste.

Thus, considering the graveness of the problem, community participation in waste management has now become imperative. In India, the Environment Protection Act 1986 has made mandatory to all the municipal corporations to structure solid waste management plan to manage their solid waste[8]. It is also obligatory that solid waste should be managed in an organized way i.e. starting with collection, segregation, storage, transportation, processing and disposal of solid wastes in compliance with the standards laid under MSW rule 2000.

CENTRALIZED AND DECENTRALIZED SOLID WASTE MANAGEMENT

The Gorakhpur Municipal Corporation practice centralized solid waste management. The disadvantage of centralized control of solid waste management is that the wastes are not collected in an efficient manner.

Photo 2 : Over flowing Garbage bins

As a result, overflowing garbage bins at the public collection sites, scattered garbage all over is common scenario prevailing in most colonies in the city. One of the obvious advantages of a decentralized system is the improved aesthetic and hygiene condition in the locality. Also it will not require a secondary garbage collection service by the municipality. Decentralized schemes provide better income and employment options to the underprivileged sections of the society[9].

The legal framework of the country, headed by the Hon'ble Supreme Court of India has given support to community based waste management schemes through a national legislation – the Environmental Protection Act 1986. The community can thus avail legal support for decentralized initiative of municipal waste management.

NEED FOR DECENTRALIZED SOLID WASTE MANAGEMENT

[8] The Gazette of India, 2000
[9] RWA and toxic link, 2005

For the city like Gorakhpur, decentralized solid waste management system will be more appropriate. Directly proportional to population increase, the solid waste problem has become one of the prime concerns for the city Government. Gorakhpur Municipal Corporation is finding difficult to dispose their wastes. Existing dumpsites are overflowing and finding new dumpsites are difficult due to a shortage of land within the municipal boundaries and surrounding rural communities, inhabitants of cities and towns are denying the dumpsites to be located in their vicinity. The best way to tackle these problems is to adopt community based decentralized solid waste management.

There are many negative impacts that results from improper solid waste management which are listed below and are planned to be minimized through decentralized solid waste management in the city.

- Uncollected waste often end up in drains, causing blockages which result in overflowing and insanitary conditions
- Flies breed in some constituents of solid wastes, and flies are very effective vectors that spread disease.
- Mosquitoes breed in blocked drains and in rainwater that is retained in discarded cans, tyres and other objects. Mosquitoes spread disease, including malaria and dengue.
- Rats find shelter and food in waste dumps, consume and spoil food and spread disease.
- The open burning of waste causes air pollution; the products of combustion are particularly hazardous.
- Aerosols and dusts can spread fungi and pathogens from uncollected and decomposing wastes.
- Uncollected waste degrades the urban environment and aestheticism of the city.
- Dangerous items (such as broken glasses, needles and health care wastes) mixed with Municipal solid waste pose risks of injury or poisoning and consequent health problems.
- Several health care items find their way in municipal dumps, get recycled without sterilization and cause infection and serious health problems.
- Polluted water i.e. leachate growing from the waste- dumps contaminates ground water.
- Liquids and fumes emanating from unauthorized dumping of chemical wastes cause problems of health.
- Landfill gas escapes in the atmosphere and quite often gets trapped resulting in fires at the landfills.
- Methane is a far more potent greenhouse gas that leads to Climate Change.
- Fires often take place at the landfills and cause air pollution in the surrounding areas.

A decentralized initiative has many advantages. The localized collection and processing of wastes, avoids the carting of wastes too far off dumping sites. It reduces the expenditure of imported diesel, consequent traffic congestions, air pollution and road maintenance costs. It also reduces the contamination of ground water through the seepage of leachate. The Government should, thus, see the advantages of local treatment of wastes and provide facilities to

communities in order to make this a widespread practice. Financial support by the Municipalities to the community based decentralized schemes will provide the right impetus to waste treatment method.

BENEFITS OF DECENTRALIZED SOLID WASTE MANAGEMENT

Apart from providing a sustainable solution to waste management, this system has many direct as well as indirect economic, social, health and environmental benefits. Some of the important benefits are:

ECONOMIC BENEFITS

This model is labour intensive rather than capital intensive. Thus, a solid waste management system of this kind provides livelihood option. Proper and skilled segregation of recyclable material fetches higher prices. Consequently, the quality of end products made from these recyclables improves many folds, which in turn, fetches higher prices and helps in preserving and promoting the faith of committed consumers in these recyclable goods plus it can give a new impetus to the recycling industry.

HEALTH BENEFITS

The provision of formalizing the working conditions of waste collectors provides them with the opportunity to work in healthier conditions. The provision of gloves, uniforms and other safety equipment improves their working condition. The neat and clean neighborhood makes the area less prone to diseases. The reduction in number of mechanized vehicles used for primary transportation of waste results in reduced emission of many harmful gases, which indirectly benefit the health of the all the residents of the city.

Photo 3 : Non- biodegradable collection site at MGPG College

SOCIAL BENEFITS

For waste collectors: The waste pickers could be substituted as waste collectors and their livelihood would be formalized. They get better recognition and dignity by working as formal waste collectors than as waste pickers.

Compost: The practice of making compost not only provides an extra source of revenue for the system but also helps to reclaim the lost fertility of the soil. The use and abuse of chemical fertilizers are well known and promotion of compost as a natural manure is a pressing need of the time.

Empowered citizenry: Decentralized solid waste management systems, based on the management and ownership of local people, have a lot to contribute to

the strengthening of civil society and will result in creation of a much more awared and empowered citizens, who will carry forward these new skills in various other walks of life.

PROGRAMME BACKGROUND

INTERVENTION AREA

Gorakhpur Environmental Action Group in association with M.G. Post Graduate College initiated a community based solid waste management as a pilot program in Purdilpur ward of Gorakhpur city from 16th August 2009. This initiative has adopted an integrated approach in implementation of the program.

3HOUSEHOLDS INVOLVED

Initially, in this project, only 120 households were involved, later on, the number rose to 200 households and included one hotel also.

Photo 4: Segregation of Recycled and Inert **Waste**

PROCESS/METHODOLOGY ADOPTED

- Door to door waste collection.
- Segregation of biodegradable and non-biodegradable wastes at sources.
- The biodegradable waste was treated by bacterial culture for composting.
- Segregation of non-bio- degradable waste into recyclable waste and inert waste.
- Recyclable and Inert waste is sold.

PROGRAMME IMPLEMENTING TEAM

Project Coordinator, Research Scientist, Supervisor and two Swachak (waste collectors) were appointed for the pilot project.

PROGRAMME DURATION

10 months

PROGRAMME OBJECTIVES, STEPS AND PROCESS OF INTERVENTIONS

The programme's objective was to develop a model of solid waste management at local level with community participation. Besides it, the sub objective was to evolve a mechanism of solid waste management at an urban locality level for demonstration which includes:

- Conversion of solid waste to useful purpose (through composting)
- Community participation in management
- Integration of civil society, local body (Municipal Corporation) and private sectors (bank and academic institution in management.

COMMUNITY MOBILIZATION

To make the pilot program a successful venture, the community of Purdilpur ward had been mobilized by organizing various meetings, awareness programs. Community accepted the pilot program whole heartily and cooperated for keeping their mohalla/colony clean and healthy.

WASTE COLLECTION

In these process two workers collects waste from the houses of the colony every day. They go from door to door in the morning, collecting the unsorted waste. The waste is transported by a hand cart where the primary sorting of organic and inorganic waste is carried out in two large bags. One supervisor was appointed to cover specific areas to ensure that daily waste collection was done properly. He also attends to the residents complaints about regular collection.

SEGREGATION OF SOLID WASTE

Solid waste of households is segregated into following categories:

1. Different grades of non-biodegradable recyclable plastic materials.
2. Non-biodegradable recyclable thick-paper cartons.
3. Non-recyclable inert plastic materials.
4. Aluminum / metal cans
5. Biodegradable wastes
6. Inert

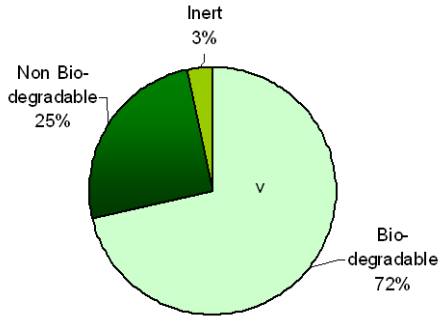
The first four comprise the non-biodegradable type that can be recycled. The fifth type, i.e. the biodegradable waste can be converted into compost in 40 to 50 days by using cultures.

DISPOSAL OF SOLID WASTE

From the served area of Purdilpur about 01 quintal of garbage was collected every day by the workers from the residential location and one hotel. In this waste it is calculated that about 25.23 % of the waste is inorganic material such as cardboard, gutaka wrapper, biscuit wrapper, detergent powder packet, namkeen packet etc while 71.47 % of which is biodegradable waste, and 03.3 % inert.

Recyclable waste is sold to the waste pickers for recycling; inert wastes are dumped at sites for land filling and the biodegradable wastes is used for organic composting for producing good quality of organic manure.

Fig 3: Characteristics of Solid Waste



GENERAL CHARACTER OF SOLID WASTE IN CITY

As per the data provided by the municipal corporation about 300 tons of solid waste is generated every day. It is about 50 tons more than the national average which is estimated to be 350 gms. /p.capita/ p.day. However our study reveals that about 200 tons of waste is generated every day. This household waste, viz. bio-degradable and non-biodegradable waste which includes plastics is collected by municipal workers from dustbins, streets and road sides. The presented quantitative analysis is based on waste generation in Purdilpur mohalla and disposal methods used in the M.G.Post Graduate College. The solid waste produced from city of Gorakhpur comprises of 72%of organic, 25%non organic consisting of paper, metal, glass, textiles, plastic and 3% debris and undefined waste.

Table 2 : **Percentage of Non Bio Degradable Solid Waste**

Plastics	Paper	Glass	Metal
58.98%	33.03%	5.09%	1.93%

Source: *Computed from field study*

AVERAGE GENERATION AND VOLUME OF SOLID WASTE IN INTERVENTION AREA

Table 3 : **Average Weight Analysis of the Solid Waste in Kgs**

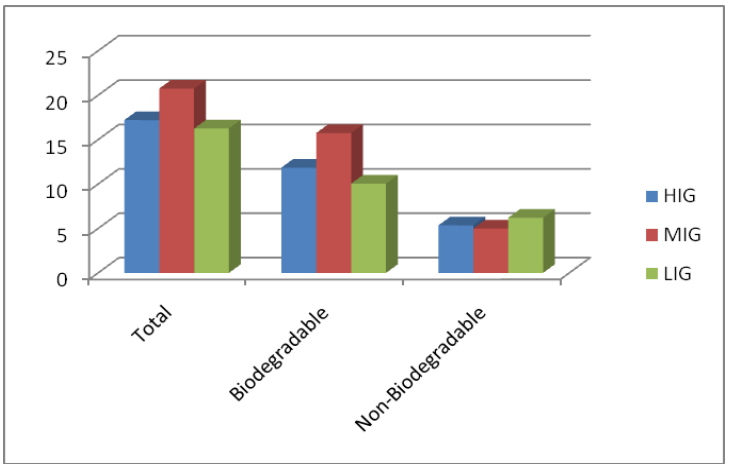
Generation of Waste	Biodegradable	Recyclable	Inert Waste	Total
Average / day	193.400	29.400	11.200	234.000
Per house / day	0.957	0.147	0.056	1.170

Source : *Computed From field study*

WASTE GENERATION BY VARIOUS SOCIO-ECONOMIC GROUPS IN INTERVENTION AREA

Figure : 4 Waste Generation of various socio e roup

Average Solid Waste generation every day by households of Higher Income Group (HIG), Middle Income Group (MIG) and Lower Income Group (LIG) in the intervention area (Purdilpur Ward, Gorakhpur) is shown in the Fig.4.



PROCESS OF COMPOSTING

The process of composting converts the humid organic kitchen waste into compost that can be used as an organic fertilizer. This process involves three steps :

Photo 3 : Spreading of decayed waste

1. **Decomposition** of the biodegradable waste on a decom-position- bed using micro- organisms' culture (s) requires 30 – 35 days to convert the wastes into black decomposed mass.

2. **Composting** of the decomposed matter in concrete composting-pits in which entire mass is rotated using spade at alternate days to provide aeration in composting process. Around 30 – 35 days are required for completing this process.

3. **Quality testing** of prepared compost after drying in the air, sieving and obtaining uniformly granular form for packing.

Photo 4 : View of Composting site

USE OF CULTURE (CHEMICAL AND INDIGENOUS) AND ITS NAMES

The cultures of micro-organisms used, were supplied by the 'Muskan Jyoti' Sansthan of Lucknow[10]. These cultures took 35 days for completing decomposition and these were used for the preparation of first lot of organic compost. The Biotechnology and Molecular Biology Centre of M.G. Post Graduate College, Gorakhpur; started preparing more efficient micro-organism's culture-mixture which replaced the traditional culture, so that the time required on completion of decomposition may significantly be reduced.

METHOD OF CULTURE PREPARATION

In the months of October – November 2009, 152 bacteria and 47 fungal isolates were separated for decaying organic matter near Ramgarh Lake, decaying vegetable wastes in Sahebganj, Sabzi Mandi, Fruit Market and certain stagnant water pools in Gorakhpur City. Each of these isolates, for the purpose of preparation of pure culture in the laboratory, had been tested for its cellulolytic, pectolytic and lignolytic ability and, on the basis of such abilities they had been grouped as relatively higher or lower potential. Those micro-organisms, showing relatively higher lytic potential, had been selected. This way, 19 cultures of bacteria and 7 cultures of fungi were prepared. These cultures were used for the preparation of the culture-mixtures and in turn, for decomposition process.

The bacteria and fungi selected for the preparation of culture-mixtures used in decomposition of humid organic wastes on the basis of their cellulolytic, pectolytic and lignolytic abilities are as follows :

Table : 4 **Bacteria and fungi used in culture preparation**

Bacteria	**Fungi**
Bacillus subtilis	Aspergillus niger
Staphylococcus aureus	Aspergillus flavus
Spirillum sp.	Fusarium oxysporum
Streptococcus sp.	Penicillium notatum
Diplococcus sp.	Rhizopus stolonifer
Escherichia coli	Candida albicans

Source : *Department of Bio technology, MGPG C7ollege, Gorakhpur*

Table shows the variety of microorganisms used for preparation of culture-mixtures which were tested first for decomposition process *in vitro*. After getting better *in vitro* results, these culture-mixtures had been tested directly in the field. The results of such experiment in field had been very encouraging and are described below:

Table : 5 **Types of Culture- mixture and Numbers of Days taken for Decomposition**

[10] Muskan Jyoti Sansthan, is a Non-Governmental Organisation (NGO) which has been successfully providing comprehensive solid waste management services to a part of the city since 1994. Its operations include street cleaning, garbage collection, sorting, transportation, disposal and vermi-composting. It recovers the operation and maintenance cost from the households served.

Type of cultures	No of days taken for decomposition
Traditional Culture-mixture	30 – 35 Days
Culture Mixture – 1	25 – 30 Days
Culture Mixture – 2	15 – 20 Days
Culture Mixture – 3	20 – 25 Days
Culture Mixture – 4	25 – 30 Days

Source : *Department of Bio technology, MGPG College, Gorakhpur*

The Culture-Mixture – 2 has been found to be the most effective because it took 15 – 20 days for decomposing wet kitchen waste which is just half the days taken by Traditional Culture-Mixture (30 – 35 days). This culture-mixture accelerates the process of decomposition of solid waste and saves time, hence, has been used for decomposition purpose.

AMOUNT OF CULTURE USED IN PROPORTION TO THE WEIGHT OF SOLID WASTE

The concentrated culture-mixtures should not be used directly but should be diluted with water in the ratio of 20:1 .The application of culture mixture is based on total weight of the biodegradable solid waste.

TOTAL TIME REQUIRED FOR PREPARATION OF COMPOST

Decomposition of solid wastes requires 30 – 35 days or 15 – 20 days for its completion. Composting requires 30 – 35 days for its completion

INPUT OUTPUT RATIO OF COMPOST MAKING

The Input of biodegradable waste and output of ready-to-use organic manure is obtained in the ratio of 3 : 1.

QUALITY OF COMPOST AND ITS COMPARISON WITH CHEMICAL FERTILIZER

The prepared manure has been tested for its ingredients such as Nitrogen, Phosphorus, Potash and Organic carbon and the Carbon / Nitrogen (C/N) ratio is calculated for its quality assessment. The organic manure prepared from the traditional micro-organism culture-mixture and micro-organism Culture Mixture – 2 contain following quantity of ingredients:

Table: 6 **Difference of Quality of Compost Prepared through Waste**

Compost prepared from traditional micro-organism culture-mixture		**Compost prepared from micro-organism Culture Mixture – 2**	
Components/Ingredients	**Quantity in grams**	**Components/Ingredients**	**Quantity in grams**
Nitrogen (N)	0.85 g / 100 g	Nitrogen (N):	1.00 g / 100 g
Phosphorus (P)	0.47 g / 100 g	Phosphorus (P):	0.60 g / 100 g
Potash (K)	1.05 g / 100 g	Potash (K):	1.50 g / 100 g
Organic Carbon	7.6 g / 100 g	Organic Carbon	11.6 g / 100 g
Carbon and Nitrogen (i.e. C/N) **contained in the compost are in the ratio of 7.6: 1.**		**Carbon and Nitrogen (**i.e. C/N) **contained in the compost are in the ratio of 11.6: 1.**	

Source : *Department of Bio technology, MGPG College, Gorakhpur*

Thus, it is clear that micro-organism Culture Mixture– 2 accelerates the process of decomposition of biodegradable wastes in relatively shorter period containing essential ingredients shown above in better quantity. Thus, this Culture mixture-2 is considered superior to traditional micro-organism culture- mixture .It is important to note that the quality of Organic Manure, being eco friendly, containing perfect ratio of the nutrients should not be compared with the chemical fertilizers. The chemical fertilizer in pure form includes urea, di-phosphate nitrates or in mixtures of N, P, K in a high ratio to enhance the plant growth; whereas in organic fertilizer these components are existing in a biologically active ratio and are eco-friendly.

For sake of understanding the advantages and disadvantages of chemical and organic fertilizers can be explained. The advantage of chemical fertilizer is that chemical fertilizers are rich in three essential nutrients that are needed for crops and are ready for immediate supply of nutrients to plants if situation demands but the disadvantage is that it is costly, artificially produced from synthetic materials and several chemical fertilizers have high acid contents while advantage of organic compost is that it is cheaper and made from natural materials derived from living things. The organic compost adds natural nutrients to soil, increases the soil organic matter, improves soil structure, tilth, improves water holding capacity. It also reduces soil crusting problems, erosion from wind or water and has slow and consistent release of nutrient. The disadvantage is that it has slow release capability and distribution of nutrition in not equal.

CHALLENGES ASSOCIATED WITH COMPOSTING

- The decomposition and the composting sites should be in a covered area with definite boundaries.
- The decomposition process of the biodegradable wastes was disturbed by animals.
- Opening of the culture-treated, air-tight biodegradable-waste-beds cause serious damages to the decomposition process.

- Identifying the active microbial culture-mixture which can decompose the bio degradable waste in shorter period.

IMPACT OF PROGRAMME IN INTERVENTION AREA

ENVIRONMENTAL

The intervention area distinctly exhibits a difference in environment of past and the present. The noted differences are:

- The roads and the lanes are seen clean and there is no dumping of garbage here and there
- No polythene and plastic materials are seen scattered on the road
- There are seen no overflow of drains due to polythene-bags and other plastic materials clogging drains

PEOPLE PERCEPTION

The residents of the intervention area were interviewed to find the difference in the present and past atmosphere and their attitude is noted positive towards the Pilot Project:

- They experience a clean environment in present time with no foul-smelling, rotten organic solid waste scattered here and there on the roads.
- They are now happy to dispose off their solid waste in a better and eco-friendly way.

KEY ISSUES AND LESSONS

These are as follows:

- Implementation of MSW rule 2000 is one of the important aspect of decentralized solid waste management. It includes collection, segregation, storage, transportation and disposal of Solid Wastewith the prescribed standards and parameters.

- For Sanitation and cleanliness issue, public awareness together with prompt action by the Nagar Nigam is prerequisite.

Both the above mentioned issues are to be tackled strongly, distinctly and with full dedication by both public and Municipal Corporation.

After the successful completion of the Pilot Project, all the financial and Personnel responsibilities should be taken over by the Nagar Nigam, Gorakhpur. In case, Nagar Nigam gets certain big Projects on these issues sanctioned by the Central / State Governments, the process of taking over this Project, *in toto,* will be an easier task for the Nagar Nigam.

LONG TERM IMPACT AND VIABILITY OF PROGRAMME

The long term impact and viability of the program depends largely on the people/ citizen of the Gorakhpur city and the Nagar Nigam. The long-term impact of this program can be described as follows :

- Clean roads and lanes.
- Efficient sewerage system
- Portable drinking water
- City free from epidemics such as cholera, hepatitis, diarrhea and dysentery
- There is no problem of traffic jam
- A city free from the menace of water logging
- Pollution free environment
- Earning opportunities and more livelihood options
- Recognition to waste collectors
- Up scaling Solid Waste Management in other communities
- Landfill diversion through composting and increased recycling inorganic waste
- Recovery of natural resources

STRATELGY TO BE ADOPTED FOR ITS SUSTAINABILITY

Strategies adopted for sustainability are as follows:

- Community participation in the program.
- Awareness program for the citizen of Gorakhpur.
- Establishment of Solid waste collection and treatment sites in all the 72 Municipal wards of the city.
- Nagar Nigam should take over the program with complete financial and mechanical support.
- Establishment of sale units for sale of organic Manure.
- Conduct of Advanced research program.

CONSTRAINTS AND CHALLENGES IN UP SCALING

These are as follows:

- Limited resources
- Marketing of compost
- Shortage of land for segregation of wastes and composting
- Monitoring and supervision of the programme
- Availability of the trained personnel for the Program
- Nagar Nigam's unwillingness to implement the MSW rule 2000

OVERVIEW OF COST-BENEFITS OF THE INTERVENTION

An analysis was carried out to understand the overall costs and benefits involved in the Program. Income and expenditure details of the program during

commissioning and operations were collected to see whether the project was capable of making profit and sustaining itself for a long term. The income was calculated based on sale of manure and recyclable materials. Expenditure was figured out through the operational costs in terms of salaries and consumables. Also depreciation costs (at an assumed rate) for hardware installed at the facility were added to this expenditure on an annual basis to arrive at the total expenditure.

- In case the program covers the entire city and the collection and treatment sites in all 70 municipal wards are developed, it may result into production of higher amount of organic manure and the recyclable materials, which, in turn, may result into a higher amount of returns from sale of manure and recyclable material in comparison to the cost involved in their production.

- The high salaried personnel (Research Scientists) are likely to be stationed at the Research Laboratory in the Biotechnology and Molecular Biology Centre of M.G. Post Graduate College; from where they will be monitoring and supervising the functioning of each of the 70 working sites cost effectively.

- Under PPP system of the program, the residents of different wards have to pay nominal charges. This will certainly add up to the benefit side of the program and help in transferring the positive impact of cost benefit analysis to wards.

RECOMMENDATIONS

- As M.G. Post Graduate College, Gorakhpur was taken up as working/operating site for pilot program initiative, similar working/operating sites needs to be established in all the 70 municipal wards of Gorakhpur city.

- Nagar Nigam is required to take up this Project with complete financial and mechanical back-up.

- Biotechnology and Molecular Biology Centre of M.G. Post Graduate College, Gorakhpur is required to be established as the Nodal Unit for developing scientific interventions, formulating strategies for bringing about sustainability of the program and providing recommendations, suggestions ,modifications and alterations whenever and wherever required.

- Marketing units are required to be established for the sale of prepared organic Manure and other products such as efficient Culture-Mixtures and the recyclable materials.

- Since solid waste management is a people's programme, the implementing agencies should adopt the participatory approach during the entire course of implementation, which can create a sense of ownership among the community people and towards the sustainability of the programme.

- Local schools should be involved. The schools can work as a bridge in dissemination of information from the functionaries to the families and the entire community.

- Institutionalization linkage between municipality and the community is critical for sustainability of the programme.

- There should be a provision of the incentives for the communities who are coming forward for the waste management programme in terms of up scaling the SWM.

- For the self-sustainability of the programme, ownership must lie upon waste collectors, community (CBOs, or Committee) that helps in creating sustainable interest among them.

- There is need to incorporate waste management with livelihood, sanitation, health and hygiene issues for a sustainable interest amongst the workers as well the community.

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