

Requirements of Solid Waste Management System in Savina Vegetable Market at Smart City Udaipur in Rajasthan



Sangeeta Choudhary, Kunjal Jain, Praveen Choudhary, Kishan Dangi, Kirtesh Kalal

Abstract: Awareness of Solid Waste Management is main requirement in India. Environmental deprivation, hygiene and health problems are raising due to increasing quantity of solid waste and improper execution of this service. It is need of hour to conduct detail surveys of different areas and identify the solutions to manage the solid waste. The main object of this study was to educate people about Solid Waste Management, benefits of separation at source and to estimate the quantity of separated wastes for design of processing centre for Savina Vegetable Market. Processing centers in campus of market can reduce transportation cost and also problems associated with landfills. After conducting 5 days workshop it was estimated that an average per day 3464 kg fruit-vegetable waste, 504 kg paper waste, 111 kg plastic wastes are generated in this market. Vegetable and fruit waste is generated in very high amount which can be converted into compost. It can be converted in to revenue for this market because farmers are the customers for compost and they visiting everyday in this market for selling the vegetables and fruits. As per calculation based on this study Rs 15, 60,000 revenue and 5, 59,200 profits per year can be generated after expenditure for maintenance of processing centre.

Keywords- Fruit and Vegetable Waste, Composting, Solid Waste Management, Separation at Source, Processing center

I. INTRODUCTION

It is responsibility of municipal authorities of Udaipur to provide facility of Solid Waste Management but this service is not properly performed because systems applied are unscientific, obsolete and incompetent. Udaipur city on an average generates about 250 metric tons of solid wastes daily. Udaipur Municipal Corporation claims 120 metric tons waste is collected and disposed off daily [1]. Purpose of this project is to achieve waste handling, separation at source, storage and processing at the source to reduce the load on main processing centre of city. Waste segregation at source improves collection efficiency and leads to better processing of waste [2]. There are different requirements of Solid Waste Management in different types of areas. It is need of hour to conduct detail surveys of different areas and identify the solutions to manage the solid waste.

Manuscript published on 30 December 2019.

* Correspondence Author (s)

Dr. Sangeeta Choudhary, PhD, Environmental Engineering, MBM Engineering College, Jodhpur

Kunjal Jain, Student, B.Tech., Civil Engineering, Techno India NJR Institute of Technology, Udaipur.

Praveen Choudhary, Student B.Tech., Civil Engineering, Techno India NJR Institute of Technology, Udaipur.

Kishan Dangi, Student, B.Tech., Civil Engineering, Techno India NJR Institute of Technology, Udaipur.

Kirtesh Kalal, Student, B.Tech., Civil Engineering, Techno India NJR Institute of Technology, Udaipur.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](https://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

This study focuses on the problems and solutions associated with the management of solid waste in Savina Vegetable Market, which is the largest market in proposed Smart City Udaipur. Effective system to treat solid waste in an environmental friendly approach is required to be designed. In vegetable market organic waste is available in large amount. This waste can be converted into profitable revenue through composting [3]. Composting is a scientific alternative for processing of organic waste. Microorganisms decompose fruit and vegetable waste in warm, humid and aerobic or anaerobic environment to turns the waste material into a valuable natural fertilizer [4]. Chemical fertilizers are used widely in market. Productiveness and carbon content of soil are decreased due to extensive use of chemical fertilizers. Hence, there is a critical need to provide humus to the soil to facilitate it to regain its fertility as well as water retaining capacity [5].

There are following three objects of this project

1. To conduct survey for knowledge of existing problems associated for proper solid waste management system
2. To educate the people about benefits of Solid Waste Management and develop the habits of separation at source through conducting live workshop of separation at source.
3. Quantitative estimation of separated waste for design of processing centre for this market.
4. To estimate the total revenue and profit from the processing centre for waste.

A variety of technology options should be provided because it helps community to select an option that is most satisfactory to them, based on their requirements, local conditions and affordability [6]. If people are educated and skilled on the various technological options, it helps in the selection of technology with the highest degree of usability and sustainability. People find it easier to participate in simple solutions that are easy to understand and operate [7]. The decision to execute any particular technology needs to be based on its techno- economic possibility, sustainability, as well as environmental implications, keeping in view the local conditions and the available physical and financial resources [8, 9]. The current practices for disposal of waste are unscientific.

II. METHODOLOGY

The scope of this study are to aware people about Solid Waste Management and calculate the quantity of vegetable waste, plastic waste and paper waste separately and executes the process of separation of waste at source in Savina Vegetable Market.

Requirements of Solid Waste Management System in Savina Vegetable Market at Smart City Udaipur in Rajasthan

This will provide a better solution for Solid Waste Management problem. Figure 1 is map and Figure 2 shows Google image of Savina Vegetable market.

On-site investigation was made for 7 days at vegetable market. This survey was conducted by 27 students in different teams to understand the existing system, requirements for execution the activity of separation of waste at source and design the processing center for this market.

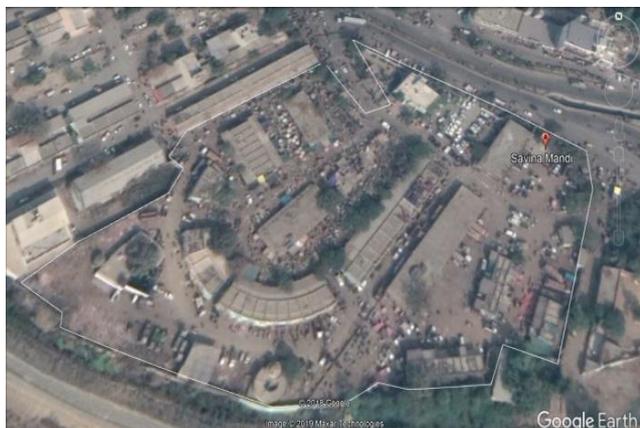


Fig. 1. Map of Savina Vegetable Market

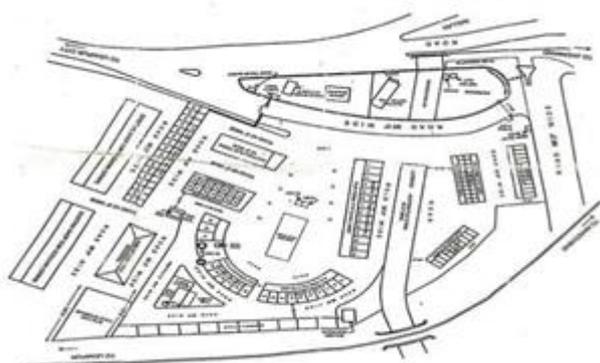


Fig. 2. Google Image of Savina Vegetable Market (Source Google Earth)

Following activities were conducted during this study:

1. Preliminary survey about area of market, numbers of shops, number of shopkeepers and visitors, customers.
2. To spread knowledge of about importance of solid waste management and benefits of separation of waste at the source.
3. Survey of existing situation of Solid Waste Management like collection frequency of waste, frequency of sweeping, problems associated with existing system and knowledge level of SWM among the people through personal interviews.
4. Estimation of separated waste through collection of separated waste.
5. Design a processing centre on the bases of quantities of separated waste.
6. Estimation of revenue and profit from processing center at market.

There were total 9 teams of 27 students for three time slots and three different type's waste separation at source. Teams were divided in Green team, yellow team and blue team which had collected vegetable, paper and plastic waste respectively with help of 12 street cleaners. Three different

colors of bins were used for executing the activity of Separation at Source.

The object of this study was also to enhance the habit of separation at source in society and to estimate the quantity of separated wastes for design of processing centre for study area Savina Vegetable Market. Information, Education and Communication (IEC) program for awareness about Solid Waste Management at study area was conducted by students and separated waste was collected in different dustbins and biodegradable polythene.

III. RESULT AND DISCUSSION

In this study there was two days for identify existing situation through interviews of shopkeepers, visitors at this market and also educate people about importance of separation of waste at source. Another 5 days were used to estimate separated waste for this market.

Total area of this market is 16187 m² and around 310 shopkeepers are working in this area. Around 5000 customers are visiting every day. There are 195 shops in Savina Vegetable Market. During the survey work it was found that existing situation was very pathetic. Although collection frequency of waste are three times in a day, but still this activity unable to reflect the cleanliness of this market. Street sweeping in this market is carried out only one time in 24 hours. At least two times street sweeping is required for proper cleaning of market area. The road of this market is damaged badly and sufficient drain system is not available so condition in rainy season has been worst. In existing system collection frequency are 3 times in a day and shopkeepers drops mixed waste in tractor. People generate solid waste and throw it on the roads. It becomes very difficult to handle this waste. There is need of awareness in people about the effect of solid waste on environment and health. It was found through personal interviews of 1000 people that knowledge level about Solid Waste Management and its new technologies is very less but knowledge level about benefits of organic compost to soil is high. More of people know about composting through cow dung and leaves but awareness about composting through vegetable and fruit waste is very less.

After educating the vegetable sellers during this study work, they have kept the three separated dustbins for three types of waste. During the interview surveys it was concluded that there is very less collaboration among the agencies of Solid Waste Management. Waste collection facility is not proper at this market for customers. Different colored dustbin sets are required for separating waste at source. Table (I) shows existing Solid Waste Management system in Savina Vegetable Market. Municipal authority can divide teams of sweepers based on types of wastage. It is required to train sweepers about new concept and technologies of Solid Waste Management.

Table I: Existing Situation of Solid Waste Management in Savina Vegetable Market

Generation	Average 4450 kg/day
Segregation	No Provision

Collection	Door to door Collection daily
Transportation	Site – Dumping site at Balicha, Titardi in Udaipur
Disposal	No Sanitary Landfill site, dumped as it is

Table II: Quantity of Separated Waste

S.No	Day	Vegetable waste in kg per day	Paper waste in kg per day	Plastic in kg per day	Total waste in kg
1	Monday	3453.8	435.8	118.9	4008.5
2	Tuesday	3573.2	578.2	95	4246.4
3	Wednesday	3296.5	532.7	123.4	3952.6
4	Thursday	3600.6	472.4	114.6	4187.6
5	Friday	3398.8	502.5	106.3	4007.6
Average Waste		3464.58	504.32	111.64	4080.54

Data of separated waste was estimated for 5 days through different teams to identify the requirements and estimation of processing centre at site. Table (II) and Figure 3 show the quantities of separated waste at Savina Vegetable Market.

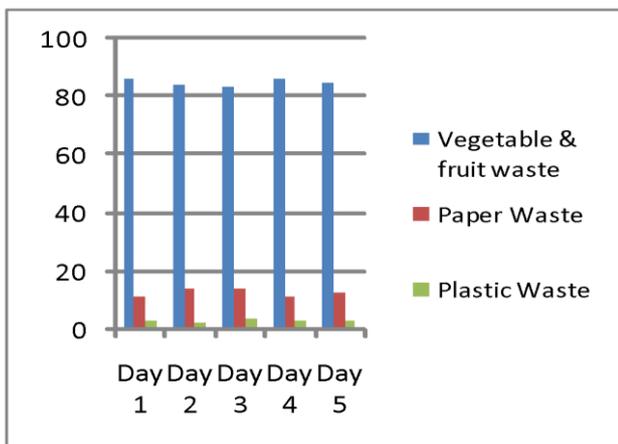


Fig.3. Quantity of Separated waste in Percentage

Fruits and vegetables account for the largest portion of that wastage. There are 195 shops in Savina Vegetable market. On an average 3464 kg/day Organic and 504 kg/day Paper wastes and 111 kg per day Plastic waste are generated in this market.

Separation at source is main requirement because it is very difficult and costly to separate the mix waste at processing centre. Around 85 percent of the accumulated wastage at the fruit and vegetable whole sale market centers being biodegradable is easily recyclable. This is a cheap and easily available resource which can be recycled through composting. There are various methods of composting. Vermi composting is very popular method but it takes time around 30-40 days and large area is required. One more problem is associated with vermi composting which is that the unhygienic conditions are developed. Fastest Aerobic Composting Technology is most useful in this situation. All wet waste converted to usable compost within 6-8 hours. 1000 kg organic waste can be converted in single batch and 2000 kg in two batches. 8x6x5 ft machine required 15-20 units per day and cost of machine is Rs 20, 00, 000.

● **Revenue from composting and collection of waste charges:**

Around 3000 kg vegetable and fruit waste can be converted in 300 kg compost per day. If assumed rate of 1 kg compost is 12 Rs than following is estimation of revenue from compost:

Per day compost production = 300 kg

Rate of compost per kg = 12 Rs

Days in month = 30

Monthly revenue = 300 x 12 x 30 = 108000 Rs

Total working days in a year = 300

Yearly Revenue = 300 x 12 x 300 = 1080000 Rs

Collection charges from each shopkeeper = 200 per month

Total shopkeeper = 200

Total amount of per month collection charges = 200 x 200 = 40000

Yearly Revenue from collection charges = 40000 x 12 = 480000

Total revenue = 1080000 + 480000 = 15, 60, 000 Rs

● **Expenditures for collection of waste and Maintenance Staff**

1. **Collection charges:** If charges will be decided on per kg then it encourages the collection tendency in workers. An average weight of vegetable waste is 3000 kg per day and collection charges per kg is 0.25 Rs.

One day collection charges = 3000 x 0.25 = 750 Rs

Monthly collection charges = 30 x 750 = 22, 00 Rs

Annual waste collection charges = 22,500 x 12 = 270000 Rs

2. **Electricity charges:** Fastest aerobic composting Technology machine which can convert all wet waste to usable compost within 6-8 hours, 1000 kg in single batch and upto 2000 kg in 2 batches. Two units are required for whole processing. 15-20 units per day electricity are required for one unit. So total 40 units electricity is required for composting process. Per unit electricity charge is 7 Rs.

Per day electricity charges = 40 x 7 = 280 Rs

Per month electricity charges = 280 x 30 = 8400 Rs

Annual electricity charges = 8400 x 12 = 100800 Rs

3. **Staff expenditure for operating machines:** Requirement of 2 supervisors with monthly salary 10000 Rs. and 4 skilled labours in different shifts.

Monthly expenditure on 2 supervisor = 2 X 10000 = 20000 Rs.

Monthly expenditure on 4 skilled labour = 4 X 5000 = 20000 Rs

Total Monthly expenditure of staff = 40000 Rs

Annual expenditure on staff = 40000 X 12 = 480 000Rs

4. **Maintenance charges:** Maintenance cost for machine and other devices are assumed Rs. 1, 50, 000.

Total Expenditure = collection charges + Electricity charges + Staff expenditure + Maintenance charges

Requirements of Solid Waste Management System in Savina Vegetable Market at Smart City Udaipur in Rajasthan

= 2, 70, 000 + 100800 + 4, 80, 000 + 1, 50, 000

= 10, 00800 Rs

Annual Profit = 15, 60, 000 – 10, 00800

= 5, 59, 200 Rs.

Separated waste can open the door of many business of recycling of waste. According to City Sanitation Report the waste generated in the city is 231 MT per day; out of this the bio-degradable waste is 74 MT (32%).

Bio-manure can be generated from this biodegradable waste by decaying it. The current market price of Bio manure is Rs. 3000 tone. If Nagar Nigam is selling this waste, a sum of Rs. 33,000 per day can be earned. Annual income generation from waste is 1.21 crore. Whole city can be divided in different areas and detailed different type waste generation survey is required for proper design of processing centers. More number of processing centers is required for reduction of transportation cost and load on main processing center and landfills.

IV. CONCLUSION

This study emphasizes that separation at source is very essential activity for proper implementation of Solid Waste Management. This management is chain of consecutive steps and every step is dependent on each other. Even one failed step can spoil whole system. It was concluded from preliminary survey that there is no practice of storing the waste at source in scientifically segregated way in Savina Vegetable Market in Udaipur, Rajasthan. It was estimated that fruit and vegetable waste is generated in very high amount which can be converted into compost. Profitable revenue can be generated from composting for this market. It is required to aware and built up well trained team for Solid Waste Management to improve existing conditions.

ACKNOWLEDGMENTS

This study was performed by students and faculties of Civil Engineering Department in Techno India NJR Institute of Technology, Nagar Nigam Udaipur for providing sweepers, Management of Savina Vegetable Market, Swiss Development Cooperation funded Capa CITIES Project for training of students for executing this activity and Secure Meter Udaipur for providing bins for collection separated waste.

REFERENCES

1. City Sanitation Plan – Draft Report – Udaipur City
2. Akolkar, A.B. (2005). Status of Solid Waste Management in India, Implementation Status of Municipal Solid Wastes, Management and Handling Rules 2000, Central Pollution Control Board, New Delhi.
3. India wastes fruits and vegetables worth Rs 13300 crore every year: Emerson study [Online] Available: <http://www.2emerson.com/en-in/News/Pages/india-food-waste-and-cold-infrastructure-report.aspx>
4. Word Bank. (1997) The Use of Compost in Indonesia: Proposed Compost Quality Standards.
5. Savala C. E. N., Omare M.N. and Woome P.L. (2003): Organic Resources Management in Kenya, Perspectives and Guidelines
6. Asnani, P.U. (2004). United States Agency for International Development, (2005). Technical Committee Report, West Bengal SWM Mission 2005, Government of West Bengal, Kolkata.
7. SC (1999). Report of the Supreme Court Appointed Committee on Solid Waste Management in class I Cities in India, Supreme Court of India, New Delhi.
8. Krishna, S. 1994. "Solid Waste Management: A Community based Approach", Monograph on Solid Waste Management, Bangalore:CEE.

9. N.B. Mazumdar. 1996. "Municipal Solid Waste Management – Indian Perspective, "Energy Environment Monitor, 12(2).

AUTHORS PROFILE



Dr. Sangeeta Choudhary, B.E in Civil Engineering. MBM Engineering College M.E. and PhD in Environmental Engineering from MBM Engineering College, Jodhpur

Publications and Research Details

1. Available online at <http://ssm.com> SSRN-ELSEVIER (2018-2019) *International conference on "Recent Advances in Interdisciplinary Trends in Engineering & Applications"*
"Development of Rain Water Harvesting System through National Highway Profiles by Using GIS and Field Survey"
 2. Available online at: www.isca.in, www.isca.me ISSN 2319-1414 Vol.6 (10), 23-31, October (2017)
"Qualitative analysis of socio-environmental factors of sand mining of Mithri Tributary of Luni River at Kosana, Pipar Jodhpur Dist. of Rajasthan, India"
 3. National Workshop & Exhibition on "Problems of River Sand Mining and its Alternate"
"Mathematical Modeling of Sand Erosion and Yield of Kosana Sand Mining Site on Mithri River to Determine Safe Allowable Limit of withdrawal of Sand Per Year"
 4. ENGINEERING AND TECHNOLOGY IN INDIA
Volume 8 | Issue 1&2 | April & October, 2017 | 49-57
ISSN-2230-9284
"Environmentally sustainable sand mining based on GIS based sediment yield estimation"
- Best Paper Presentation Award at International Conference in Indore
 - Rain water Harvesting Project has been selected as Finalist by NITI Aayog for Atal Innovation Mission in 2019.



Kunjal Jain, B.Tech. Final Year Student of Civil Engineering from Techno India NJR Institute of Technology, Udaipur.

- 1) Won 1st prize in PowerPoint presentation on the occasion of International Day for the preservation of the ozone layer and Engineer's day.
- 2) Won 2nd prize for presenting WRICKS in Smart India Hackathon, 2018.
- 3) Won 3rd prize in Conquer-It held at AAKAAR 2018, IIT Bombay.



Praveen Choudhary, B.Tech. Final Year Student, Civil Engineering from Techno India NJR Institute of Technology, Udaipur.

- Winner of Top 10 in All India Rank of Bentley Institute Student Design Challenge 2018



Kishan Dangi, B.Tech. Final Year Student, Civil Engineering from Techno India NJR Institute of Technology, Udaipur.



Kirtesh Kalal, B.Tech. Final Year Student, Civil Engineering from Techno India NJR Institute of Technology, Udaipur.