Don’t Transfer Waste, Transform Waste: A Sustainable Approach Towards Zero Waste Events Initiative During Hockey World Cup in Bhubaneshwar, India

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Abstract: This paper is based on the planning, execution and implementation of solid waste management in the Hockey World Cup hosted by the city of Bhubaneswar and implemented by GIZ (German Development Cooperation). Zero Waste Plan was prepared wherein establishment of a zero-waste facility; collection of waste in colour coded bins of capacity 120l; hands on training provided to the operational staff for ensuring proper segregation. Approximately 1000kgs/day of waste was segregated, out of which 30% organic, 25% Plastic, 30% Paper, 10% Metal and Glass and 5% of rejects. The initiative was successful in diverting more than 90% waste for recycling. Sustainable waste management has been exemplified in the Hockey World Cup 2018, making Bhubaneswar a pioneer city to host large event as a Zero Waste event. Well integrated, efficient and socially inclusive system was ensured in alignment with long term vision of Government of India and Smart City Missions.

1. Introduction

As said by the Father of the Nation, Mahatma Gandhi“ There is enough in the world for everyone’s need but not enough for everyone’s greed. ” With the stress on finite world’s resources and a climate change worldwide, zero waste is the new direction and a revolution towards designing a sound, efficient and sustainable waste management system [1]. The zero-waste concept stimulates sustainable production, consumption, and optimum recycling and resource recovery. Professionals in waste management systems, however, perceive and apply it in different ways. [2] The land constraints in urban or peri-urban areas for establishing processing units or scientific landfilling has been a major challenge for the urban local bodies or municipal authorities to manage municipal solid waste in a scientific manner [3]. The experience of waste management in emerging economies shows that the effective means to solve the problem waste in the city is to control the source of treatment, so as to realize the harmless reduction and resource utilization of waste[4]. Cities in early stage of establishing the sustainable waste management systems and pursuing zero waste goals, focus on establishing universal waste collection, resource recovery, value addition, sanitary disposal system apart from opportunities for organic waste management system. As per report of World Bank,2018 on Global snapshot of waste management [5] it has been critically examined that by 2050, the world is expected to generate 3.40 billion MT of waste annually, increasing drastically from today’s 2.01 billion MT. Worldwide, waste generated/person is 0.7 kg and accounts for around 16-17% of...
world’s population and high-income countries generate approximately 35 percent that is 680 million MT of the world’s waste.

1.1 Current Waste Scenario of India:
India currently generates 62 million MT of municipal solid waste per year. Much of this is left untreated, with 80% being dumped in landfill. This will be more than double to 165 million MT by 2030. As estimated by Central Public Health and Environmental and Engineering Organisation (CPHEEO), the informal sector plays a large role in waste management in India. Approximately, only 25-30% of resource recovery is carried by the formal sector. It is projected that by 2050, half of India’s population will live in cities and solid waste management will be the biggest challenge [6]. According to the “Swachhata Sandesh Newsletter” by the Ministry of Housing and Urban Affairs, India, the solid waste is generated MT/day, from 84,475 wards across all states (Table 1),[7] was as follow,

| State          | Wards | Total (MT/D) |
|----------------|-------|--------------|
| Highest        |       |              |
| Maharashtra    | 7322  | 22082        |
| Tamil Nadu     | 12814 | 15437        |
| Uttar Pradesh  | 12007 | 15400        |
| Lowest         |       |              |
| Daman Diu      | 28    | 32           |
| Others         | 52304 | 1424662      |
| Total          | All states | 1477613 |

1.2 Indian Events and Waste Generation:
India hosts at least 100 mega festivals, those are celebrated across the country, with more than 1000 participants in every festival. These events are the significant contributors of waste in terms of packaging, organic waste fraction and bulk recyclables. In this context, the country’s Solid Waste Management Rules, 2016, clause 4(7) mandate every institution with more than 5000 sq.mt area to ensure segregation of wet and dry waste at source, processing of biodegradable waste through composting or bio-methanation within the premises, facilitate collection of segregated waste in separate streams and handover the recyclables to waste pickers or authorized recyclers. It makes the bulk waste generators responsible for the proper and sustainable waste management and makes event organizers to look at waste management as an integral part of the event management [8].

2. Study Background:
The present study is based on the ground level implementation of the Zero Waste Event during 2018 Men's Hockey World Cup organized by Govt. of Odisha, Bhubaneswar, India, wherein 18 countries of world participated. During this world cup, a zero-waste plan was implemented under the programme ‘Sustainable Urban Development- Smart Cities (SUDSC) under GIZ- India (German Development Corporation). It was implemented successfully with the support and close coordination with the Bhubaneswar Municipal Corporation (BMC) and Sports Authority, Bhubaneswar. The zero-waste event was achieved through baseline assessment, proper planning, execution and implementation of the plan by establishing a material recovery facility and onsite composting unit. The objective to approach the plan execution was,

- Developing a zero-waste plan and its implementation by establishing onsite material recovery facility and composting unit at the premises of the Kalinga Stadium in Bhubaneswar.
- To establish the importance of moving towards zero waste in a large event and to handhold the operational staff to achieve sustainable waste management.
3. Zero Waste Development

3.1 Stage I: Assessment

As a prerequisite for preparing the plan, a baseline information was sought for waste generation like its disposal practices, manpower allocation, overall layout of the stadium for efficient and effective execution of the plan.

**Baseline and estimation** - The existing scenario was assessed in detail to prepare a sound and implementable plan. This baseline was carried out for the stadium layout which included waste generation in the premises, establishment of onsite waste management along with recovery unit.

**Waste generation** - The amount of waste generation was estimated on the basis that one person will generate over 25gms of the organic/wet waste and 75-100 gms of the dry/ recyclable waste over 4 hour duration of the match. Therefore, on site composting facility was designed to handle 350 kg of biodegradable waste per day, whereas MRF (Material Recovery Facility) for component wise segregation of recyclable waste was designed for 1.5 MT for estimated 15000 spectators/ day.

**Kalinga Stadium Layout for alternative plan of waste management** - The overall layout plan of the stadium was studied for better understanding of the entry, exit gates, players movement, vehicle movement, prohibited areas, movement of spectators, seating capacities, positioning of the food & beverage stalls vendor zone, bins storage points etc. The details layout of Kalinga Stadium is enclosed in Appendix A (Figure AI).

After the detailed understanding of the stadium layout and important spots for waste generation like food zones, kitchen or catering areas, the identification of possible routes and timings for movement of waste vehicles was assessed. Further, assessment was carried out for manpower allocation and infrastructure to prepare a final plan of action. One of the critical aspects was identification and allotment of suitable land and adequate space for setting up of integrated zero waste facility comprising of processing of organic/biodegradable (wet) waste as well as setting up of Material Recovery Facility (MRF) for inorganic/ non-biodegradable (dry) waste.

3.2 Stage II Planning and Recommendation:

3.2.1 Plan Preparation:

*Management for Dry and Waste Fractions:* Two plans were proposed for managing waste onsite comprising of establishment of material recovery facility for addressing the dry/ inorganic waste fraction and installation of organic waste composter for obtaining compost from wet/ organic waste.

**Plan A:** The plan A (Figure 1) was based on Installation of a mechanised system where mixed waste was proposed to be placed on a conveyor belt and segregated by workers positioned on either side of the conveyor belt. Each worker had to pick up from the conveyor belt that component of waste that was assigned to him and deposit it in the dedicated bin placed next to him. This plan further envisaged a value addition of the resource recovered by installation of a bailing machine to compact and bale the segregated material to facilitate its easy transport to the recycling facility.

**Plan B:** Alternative plan was proposed as plan B (Figure 2), in case mechanised system could not be put in place within the stipulated timeframe. In this plan manual system of segregation and primary sorting was proposed wherein 3-4 tables on which waste bags would be placed manually for segregation. The segregated material was proposed to be stored in large bags.
Table 2. List of overall bins, manpower allocation and its placement in the stadium.

| Location                  | Bins          | Sacks         | Sanitary workers | Pickup vans | Driver Labor | Junior supervisors | Senior supervisors |
|---------------------------|---------------|---------------|------------------|-------------|--------------|-------------------|-------------------|
|                           | Green - 120 lt| Blue - 240 lt | Green 150 lt     | Blue 300 lt |              |                   |                   |
| Entry gates               | 20            | 20            | 60               | 60          | 24           | 1                 | 3                 |
|                           | 65            | 65            | 114              | 114         | 24           | 1                 | 3                 |
| N, S, E, W stands (FF)    | 82            | 104           | 164              | 208         | 58           | 2                 | 6                 |
| Catering Centers          | 10            | 10            | 10               | 10          | 5            | -                 | -                 |
| VIP area catering area    | 2             | 2             | 2                | 2           | 2            | -                 | -                 |
| MRF                       | -             | 30            | -                | 50          | 28           | -                 | -                 |
| Large storage bins at MRF |               |               |                  |             | 5 cu.m bins  |                   | 1                 |
| Composting facility       |               |               |                  |             |               |                   | 1                 |
| Officer in-charge of SWM at the stadium |               |               |                  |             |               |                   | 1                 |
| Total                     | 179           | 236           | 350              | 444         | 169          | 4                 | 12                |

3.2.2 Manpower Allocation in Stadium

- 12 supervisors: 1 supervisor per entry gate and 2 spares for replacement
- 24 waste collectors/pickers @ 2 per gate and 4 spares for replacement
- 58 sanitary workers for deployment at 52 stalls on North, South, East & West stands
- 5 junior supervisors: 1 per catering facility inside the stadium e) 5 sanitary workers @1 per catering facility inside the stadium.
- 24 sanitary workers for fan villages, 2 senior and 2 junior supervisors for fan villages.
- 5 senior and 5 junior supervisors @ 1 senior and 1 junior supervisor per stand of the stadium to oversee the performance of the sanitary workers and overall management of waste and one spare for replacement
- 1 senior officer to be in charge of waste management and vehicle management at the stadium as a whole
- 4 drivers with 8 Labor for transport of waste from stadium gates, fan villages and from North, South, East and West stands to MRF / composting facility
Figure 1. Plan A: Design of mechanized Resource Recovery Centre at Kalinga stadium (10MX30M)

Here, mixed dry waste brought by waste collector from the catering area was to be handled by two sanitary workers dedicated for the purpose. They would deposit mixed waste directly on the tables placed in MRF facility at a distance of 1 metre from each other. Waste pickers/recyclers were to be placed on both sides of each segregation table of 8/4 size to pick up designated recyclable material and deposit in 0.24 cum wheeled bins placed on both sides of the table behind the waste picker. A set of 6, 240 litre bins to be placed per table for temporary storage of segregated recyclable material such as plastic bottles, mix plastic, fruit juice cans, paper, and other rejects. These bins when full, were wheeled to large bins of 5 cum placed adjacent to segregation area and in the meantime spare bin may be provided to continue the work uninterrupted. The non-recyclable material rejected by the waste pickers was deposited in the 5 cum container placed in the storage area separately. The large bins when full were transported to the recyclers for processing and rejects were to be disposed of at the site designated by BMC. BMC shall arrange to transfer the segregated material and rejects to recyclers and disposal facility.
Here Waste picker/ recycler had to pick up designated recyclable material from the conveyor belt and deposit in the 1.1 cu.m bin placed behind his position on both sides of conveyor belt. There was 1 cu.m bin for temporary storage of segregated recyclable material such as water bottles, fruit juice cans, disposable cups plates, paper plastic etc. Mixed dry waste brought by waste collector from the catering area was deposited in the large bin of 5cu.m. This waste was mechanically put on the conveyor belt which moved at a low speed to enable the waste picker to pick up the designated material only while the waste passes through him/her. The non-recyclable material rejected by the waste pickers was allowed to be deposited in the 5 cu.m container placed at the other end of the conveyor belt for disposal at the place designated by BMC.1.1 cum containers were to be taken to bailing machine installed next to the MRF and segregated material was baled and stored for onward transportation to recycling industry.

3.2.3 Provision of Waste disposal at Stadium:

The colour coded green and blue bins were positioned at all stalls for waste deposition and for services like water, food, beverages and merchandise. The placement and the quantity of twin bins was done after extensive study of layout of the stadium and this was follows,

a) Exclusive 11 stalls were designated for catering need of drinking water, here set of two wheeled bins of blue colour having capacity 240 Litres were placed. Each bin was used one after another for deposition of used water bottles, paper cups and other type of disposable containers.

b) 21 stalls of food and beverage were provided with two green wheeled bins of 120 Litres capacity each and two blue wheeled bins with 240 Litres capacity each. The green bins were used for
deposition of biodegradable (food) material and blue was used for non-biodegradable (dry) waste. The training of house-keeping staff was done to ensure segregation. The bins were clearly marked with instructions for dry and wet waste as an IEC initiative.

c) 15 stalls of merchandise were also provided with two green bins 120 Litres capacity each. Apart, two blue wheeled bins of capacity 240 Litres each were positioned for replacement.
d) 5 stalls for special catering were set up, out of which 2 green bins each on the ground floors of North and South stands. On the second floor 2 green bins of 120 Litres capacity was placed and us of all sets on both floors one bin was to be used at a time and another one was kept for replacement as soon as the first bin was full.

In totality, 10 sets of litter bins were provided for segregated storage and transport of biodegradable and non-biodegradable material, as shown in Table 3.

### Table 3. List of stalls and areas for waste management.

| Description of service | East 1st floor | West 1st floor | East 2nd floor | North ground floor | South 1st floor | Total |
|-------------------------|----------------|----------------|----------------|--------------------|----------------|-------|
| Water                   | 4              | 3              | 2              | 2                  | 2              | 11    |
| F & B                   | 8              | 3              | 5              | 5                  | 5              | 21    |
| Catering                |                | 2              | 1              | 2                  | 2              | 5     |
| Merchandise             | 6              | 3              | 3              | 3                  | 3              | 15    |
| Helpdesk                | 2              | 1              | 1              | 1                  | 1              | 5     |
| **Total**               | 20             | 10             | 2              | 1                  | 11             | 11    | 57    |

The pick-up vans to collect waste were not provided at Catering centers and VIP areas as the waste pickers lack adequate skills to understand the process of segregation at source and during a large-scale event, it is usually challenging to segregate the waste at the source, primarily because of the behavior of the crowd. Moreover, the waste collectors of the city are paid on a weight-based method. Thus, the waste pickers lack incentives to segregate waste at the source, and as a result, they tend to supply the unsegregated waste to the dumping yard.

### 3.2.4 Arrangement for transport of segregated material

To ensure minimum disturbance and restrict the movement of the vehicles, the waste transfer was to be carried out in the evening after 9 pm. Therefore, plan was prepared as such that the waste generated was kept stacked in bins or sacks in an enclosed designated space and after the matches it was transported to the facility. The facility was operational during the daytime between 7am-2 pm that comprises of the segregation and processing of organic waste and resource recovery from dry waste. The routing and loading plan were laid out for effective and efficient transition of waste transportation to the facility was done as per the Appendix -B1.

### 3.3 Stage 111 Execution

In the process of creating a model for managing solid waste in premises, a solution was devised for the site that was executed within 6 weeks comprising of zero waste plan preparation for procurement and its execution. The plan was prepared and executed, as highlighter in Appendix B (Figure B1). During the execution, informal workers were offered training, along with essentials on using personal protection gears, on waste segregation and management. The recyclers available in the city were connected to
provide revenue for the exchange of segregated waste. In the process, informal workers became skilled in waste management and learnt skills to operate organic waste composting machines and techniques to prepare organic compost from food waste. Furthermore 1-1.5 MT/day of waste generation was estimated as per the seating capacity of 15000 spectators every day. Accordingly, to cater this waste in decentralized manner onsite MRF as well compost unit was installed. During the implementation, 95% of waste diversion rate was achieved thereby reducing the burden on the landfills. Also, some of the economic benefits were achieved, for instance in reduction of transportation costs of transferring the waste to the landfill and it. The quantity of waste segregated at MRF is shown below, as per Table 4.

4. Conclusion
This initiative highlights the importance of vision, strategic planning and implementation in managing the municipal solid waste within the premises. However, there were certain limitations to ensure adequate recycling and its value addition through appropriate market mechanism. In future such endeavor should seek to establish the waste management supply chain and the standardization for further utilization.

5. Study Implications
The initiative provides a guidance to the states, cities and peri-urban areas who in future would be organizing such events that will generate waste in large quantities. This study will form as a basis for replicating the model within their jurisdiction that will help meeting the Swachh Bharat Mission overall goal and vision of universal sanitation coverage through improved solid waste management practices.

### Table 4. Quantity of segregated waste fractions at MRF

| Day | No. of bags received | Paper cups, Tetra pack | Pet bottles and plastic | Metal | Glass | Food waste | Total compostable & recyclable salvaged | Qty Rejects (Kgs) | % Rejections | Total weight of material segregated (Kgs) | Diversion rate (%) |
|-----|---------------------|-----------------------|------------------------|-------|-------|-----------|-----------------------------------------|------------------|-------------|----------------------------------------|------------------|
| 1   | 89                  | 162.7                 | 86.2                   | 1.2   | 29.6  | 76.2      | 355.9                                   | 22.5             | 6.93        | 324.5                                  | 94.06            |
| 3   | 114                 | 435.7                 | 164.6                  | 2.2   | 98.9  | 236.1     | 937.5                                   | 53.2             | 5.36        | 990.7                                  | 94.63            |
| 4   | 120                 | 399.7                 | 221.8                  | 31.9  | 81.8  | 108.3     | 843.5                                   | 74.4             | 8.1         | 917.9                                  | 91.8             |
| 5   | 110                 | 408.8                 | 288                    | 6.8   | 43.6  | 106.9     | 854.1                                   | 43               | 4.79        | 897.1                                  | 95.2             |
| 8   | 119                 | 294.2                 | 222.3                  | 4     | 186   | 115.3     | 822                                     | 56.1             | 6.38        | 878.1                                  | 93.61            |
| 9   | 116                 | 559.6                 | 117.9                  | 4.3   | 100.7 | 123.5     | 906                                     | 41.3             | 4.35        | 947.3                                  | 95.64            |
| 10  | 116                 | 239.5                 | 125.6                  | 3.3   | 141.4 | 99.6      | 609.4                                   | 54               | 8.13        | 663.4                                  | 91.86            |
| 11  | 114                 | 211.9                 | 154.4                  | 6.9   | 155.2 | 104.8     | 633.2                                   | 46.3             | 6.81        | 679.5                                  | 93.18            |
| 12  | 108                 | 405.1                 | 144.5                  | 4.3   | 184.3 | 116.9     | 855.14                                  | 81.3             | 8.68        | 936.44                                 | 91.31            |
| 13  | 96                  | 347.7                 | 126                    | 4.8   | 44.1  | 114       | 1316.1                                  | 55.9             | 4.07        | 1372                                   | 95.92            |
| 14  | 147                 | 381.5                 | 202.9                  | 8.3   | 70.5  | 128       | 791.2                                   | 72.7             | 8.41        | 863.9                                  | 91.58            |
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Appendices

Appendix A

Figure A1. Layout of Kalinga stadium
Appendix B

Figure B1. Routing and Bulk-waste collection areas