Segregation of waste at Household level and local composting not only helps protect environment but is also a cost effective proposition for ULBs- A pilot study

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Segregation at Household level and local composting not only helps protect environment but is also a cost effective proposition for ULBs- A pilot study

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Background:

Segregation of waste at household level has always been a problem in India. Despite having several rules and regulations related to Solid Waste Management (SWM) the segregation at source is not on the minds of the public or policy makers. To inculcate the idea of segregation at source a pilot project was initiated under the support of European Union and a small area on pilot basis was undertaken for segregation at source and local composting.

Methods:

A pilot area on a hill slope was selected based on the tough terrain whereas the garbage collector has to climb 446 continuous stairs apart from other interconnecting stairs to bring the mixed household garbage up to the road. A thorough survey was done of the households in the pilot area and trainings were given to garbage collectors and residents for segregation of waste at source and its importance. Two separate bins were provided to each household for segregation of wet and dry waste. A constant household-wise monitoring and education was done to make people understand how to segregate different waste materials. It took about three months to make people fully understand the segregation process. The wet kitchen waste was taken to a pit for composting and recyclables out of the dry waste were recycled and remaining waste was taken to the waste processing facility.

Results:

A week's data on segregation was collected in April 2014 and it was found that the average waste generated per day by a household in the area is 0.568 KG (Wet waste =0.366KG & Dry waste = 0.202KG) per day. Total waste generation per capita per day was found to be 0.205 Kg. The wet fraction of the waste was 64.44 % and the moisture content of waste was about 48% therefore the compost took fairly long time of nine months as the temperatures in the locality was low (Temperature varies from 15-20°C in summers and 0-13°C in winters) and atmosphere is humid and rainy. The total savings per household due to segregation and local composting was Rs. **9.53** per month which turns out to be in Lakhs per year if extrapolated to entire corporation area. This cost saving is in addition to the saving on carbon footprint.

Outcome and recommendations:

The mindset that segregation cannot happen changed at all levels and now we are planning to initiate more areas for segregation at household level and then spread the initiative to whole of the Municipal Corporation, Shimla for saving the environment and the costs of transporting and processing huge quantities of waste at waste processing plant and the landfill.

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Background:

Segregation of waste as per the Municipal solid Waste (Management & Handling) rules 2000 means to separate the municipal solid waste (MSW) into the groups of organic, inorganic, recyclables and hazardous wastes[1]. Further, Schedule II of these rules clearly states that it is the responsibility of Municipality for the implementation of effective collection of waste from the door step of waste generating establishments within municipality and to encourage waste segregation at source. Shimla Municipal Corporation (SMC) started the door to door garbage collection scheme in the year 1999 with the involvement of some Non-Governmental Organization (NGOs) but could not rope in majority households. Attempts to segregate waste at source remained futile due to non co-operation of residents of the city. Thereafter because of the intervention of Hona'ble High Court of Himachal Pradesh that pushed for the framing of Door-to-Door garbage collection bye-laws and execution of Door-to-Door scheme to all wards of the SMC in true spirits, more efforts were done and now we have more than 82% households linked to door to door waste collection scheme.

In view of above court directions the Shimla Environment, Heritage Conservation & Beautification (SEHB) Society was formed under the aegis of SMC in 2009. The society was formed to function as independent body governed by SMC, Commissioner being Chief Executive Officer (CEO) and Corporation Health Officer being Member Secretary. With a major objective of implementation of Door-to-Door garbage collection bye laws-2006[2] effectively, SEHB Society started its operation in the year 2010. Since then SEHB Society has been collecting Municipal Solid Waste from 29,773 establishments out of targeted 36,318 within Municipal limits on daily basis. SMC at the start of this scheme through the society decided to build the capacity at household level to encourage the segregation of waste at source. Under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) 40000 pairs of bins, yellow and green colored were purchased by SMC to build the capacity at household level to encourage segregation at source. SMC provided two bins (yellow & green color) to all the households to practice segregation of waste but despite the fact that SEHB society was successful in carrying out the

Door-to-Door garbage collection effectively, it too failed to impress the segregation of waste at household level. Table 1 below shows the current status of Municipal Solid Waste generation in Shimla city and future projections.

The segregation of waste has also been incorporated in the Service Level Benchmarks (SLB) set by the ministry of Urban Development, Govt. of India. The achievement of Shimla city in segregation of waste is only 10% as per SLB data for the year 2012-13[3] and is not happening in an organized manner.

Despite several efforts, the segregation is still a far sighted thing. Failure to establish the system of segregation of waste may be attributed to the lack of capacity of SEHB Society/Shimla MC. Even if a household segregates waste at his own level, there is no plan as how to collect this segregated waste and how to transport it because there is no collection system in place to collect segregated waste and no separate transportation system. A larger mindset that segregation is not possible prevails all over. Therefore, a Pilot Project for the demonstration of segregation of waste at source and its local treatment was initiated under the project SUNYA-"Towards Zero Waste "supported by European Union (EU) and Municipal Association of Nepal (MuAN). SUNYA project　was aimed at implementation of waste segregation at source level, local composting and integration of rag pickers into the formal sector to reduce the quantum of waste that ultimately needs to be disposed of in the landfill.

Objective & Scope: As stated above, all the efforts were not sufficient to implement segregation of waste at source. Because of this, all of the waste was ending up at the processing and landfill site and therefore burdening the sites.

Keeping in view the facts above, a pilot project on demonstration of segregation of waste at source level was initiated. The segregation can help in changing the way waste can be disposed off. The organics could be composted and recyclables were sold for further processing and rest (reject) was sent to the landfill. Also the terrain being tough at some places in hill stations like Shimla and area being inaccessible, a solution was to be explored to reduce the quantum of waste to be transported for ultimate disposal and rest be taken care of at the area itself. Kachi Ghati area in the Boileuganj Ward (Ward no.-7) was thus selected for the pilot project as this particular region was facing a lot of problem in management of waste due to hilly and difficult terrain.

Some major problems being faced in the Pilot area in SWM:
The pilot area has a cluster of around 281 households and it has no road connectivity. Due to this no vehicle could be deployed to collect waste from this area. Also the area has 446 continuous stairs on one stretch, apart from the other interconnecting stairs which the garbage collector had to climb along with the garbage sack to empty it in the dumper container/ Garbage vehicle on the road upstairs. Lifting the waste up to road head was a time consuming process therefore the garbage collector was not able to cover all the households in the area and the residents were throwing garbage in the open downhill. It was common to have a complaint from the area, almost daily, regarding littering. Only a total of 110 households in the area were having membership under the Door-to-Door Garbage Collection scheme and others were not on the record as member of SEHB society. The area was being covered by

two garbage collectors- husband and wife. It was also ensured that the availability of land for constructing compost pits in the area is there. The compost pit area needed to be sufficiently far away from the habitation so as to prevent the odour nuisance in the area.

Method:
To start the segregation initially, an informal talk/meeting with major stakeholders in the area was done which paved the way forward for taking the idea further. As most of the households in the area were not a member under Door-to-Door garbage collection scheme, a Door-to-Door campaign was started to make all the residents in the area a member under this scheme. People being provided with two bins proved to be a good idea for making people fall to the objective of segregation. Free bins were distributed from the project SUNYA to the deprived sections of the society in the area who could not pay against the membership fee of Rs 200/-. The residents were educated about the segregation at source level at the door step of each household through a mass awareness drive. Few practical demonstrations of waste segregation were also done in the area. People were educated at their door step to keep their kitchen waste or the decomposable waste in Green coloured bin and rest in the Yellow coloured bin. In the meanwhile, garbage collectors were also trained about the segregation and how to collect this segregated waste. The idea was to collect waste from each bin (either yellow or green) on alternative day (Table1.1). The kitchen waste was to be taken to the compost pit and the other recyclable waste was to be collected by the garbage collector for selling to the scrap dealer. The rest was supposed to be taken to the transfer vehicle/dumper.

A compost pit was prepared measuring 8x8x5.5, keeping in view the amount of organic waste collected in a day from the area and availability of space for the pit.

Results:
Exercise to collect data on waste generation:
We formed a special team to collect the waste generation data alongside the routine garbage collection process at the household level. The team followed the garbage collector during his routine work. The number of household from which the garbage collector was collecting the garbage was noted down and when the garbage sack used to fill up it was weighed with a spring balance and the weight was noted down. The practice was repeated for all the households covered by the garbage collector daily for one week. Though there are two garbage collectors in the area but the data for only one garbage collector was collected as the team followed only one of them daily. The data thus collected from the exercise has been presented in tabulated form below at Table 2. From the data, it was found that the average waste generated per day by a household in the area is 0.568 KG (Wet waste =0.366KG & Dry waste = 0.202KG) per day. As the average household size in the area is 2.77 therefore, the Dry & Wet waste generated per capita per day has been calculated based on that. Total per capita waste generation per day was found to be 0.205 Kg which is consistent with other similar settings in India as P.U.Asnani et.al. describe average per capita waste generation in cities like Shimla as to be 210 gms[4]. But since exact data on per capita waste generation is limited, this exercise to calculate the exact household wt. of the waste including recyclables was undertaken to have proper policy and planning in place.

Waste Characterisation:

A waste characterisation exercise was conducted in the adjoining area to the pilot project where mixed waste was taken for analysis and it was found that the area has high moisture content in the MSW.

Total number of household samples analyzed was four with 13 person days having total mixed waste of 1.41Kg. The household mixed waste from residences was 0.108 KG per capita/ day and the moisture content of waste was about 48% with an organic content of 72.34% and recyclable content of about 25%[5].

Costs Saved from local segregation and composting:

We calculated the costs saved from the effort of local segregation and composting (Table 3) and we can see from the table that a huge saving can be made if we shift to the idea of local segregation of household waste and local composting. This would also save costs of processing the waste at 20 Crore waste processing facility apart from transportation costs and help use the compost locally for agriculture or horticulture purposes.

If entire waste of the town is locally processed there would not be any need for any investment in huge SWM processing plants and local landfills would be enough to manage waste of the cities like Shimla. This would also help save environment and earn carbon credits as well.

Outcome of the efforts toward this project:

More and more interaction with the local resident and meetings with them turned fruitful. Nearly 80% resident in the pilot area started segregating the waste at source level which is collected on alternate days by the garbage collectors. Constant efforts are being put in to involve the rest of households to pursue the idea and to keep motivating those who are doing it. In addition to this even the garbage collectors keep a check on the segregation process by day to day interaction with residents so that they don't mix the waste. They have been trained in such a manner that in case they find mixed waste in bins, they immediately take it up with the particular resident and report it to his supervisor as well. Calendars on segregation were also printed for the year 2014 with the two bins showing what is to be kept in which bin and were distributed among the residents. An effective segregation is still not done by some resident therefore the secondary level segregation is done by the garbage collector at compost pit site. Compostable is dumped in the pit and regularly mixed with cow dung collected from local resident's cows. Recyclables are collected by the garbage collectors and sold at the scrap dealer shop and rejects sent to MSW Plant for ultimate disposal.

Sustainability of the initiative:

A workshop was conducted on Lessons sharing from the Pilot Project on 26th Dec, 2014. In this workshop all the supervisors of the SEHB Society, representatives from residents of Pilot Project area and other major stakeholders were invited. The experiences from the Pilot Project were shared in this workshop and possibilities of extending this initiative to the other parts of the city were also discussed.

From this pilot project it was also observed that the average temperature of Shimla city is low and this temperature is not favourable for pit composting. Pit composting takes a longer time to convert wet waste to manure. Therefore, it is now proposed to go in for small bio-convertors to cater to the waste from bulk organic waste generators such as Vegetable market and big hotels or institutes.

Now after several months of running this pilot project successfully, the initiative is planned to be replicated at larger level by starting segregation at source in all the households & other establishments in Ward no. 16 (Engine Ghar) of MC Shimla and thereafter to the whole city. MC Shimla has also been exploring to provide a space enough to be utilized as a dry waste collection centre for further selling of dry waste as recyclable or as RDF (Refuse Derived Fuel).

A major breakthrough came into this initiative when Netherland's Ambassador to India came to Shimla on dated 17th June, 2014. During his visit to Shimla city, he desired to have an interaction with SEHB Society. We showcased the initiative of segregation at source started at Kachi Ghati area under the project SUNYA on pilot basis. Consequent upon that, recently the Directorate of Urban Development, Himachal Pradesh has also signed an MoU with the Dutch company, Nexus Novus for doing the field study to develop a plan for making the state of Himachal Pradesh a "Zero Waste" state in India.

Table: 1: Current status of Solid Waste generation and projected growth

	2011	2021	2031	2041
Resident Population (nos.)	1,69, 758	2,56,883	3,49,361	4,18,296
Floating Population (nos.)	76,000	1,00,000	1,25,000	1,50,000
Solid Waste Generation (MT)	86.01	124.91	166.03	198.90
Source: Municipal Solid Waste Management Plan For Municipal Corporation Shimla.				

Table 1.1 : The dry and wet waste collection frequency in Pilot Project area:

S. No.	Day	Type of waste collected
1.	Monday	Wet
2.	Tuesday	Dry
3.	Wednesday	Wet
4.	Thursday	Dry
5.	Friday	Wet
6.	Saturday	Dry
7	Sunday	Holiday

Table 2: **One week data of dry and wet waste generation from the households in the area**

S.No.	Date	Day	Wet/Dry waste	No. of Sack	No. of households covered for waste measurement	Total weight (Kg)	Average waste generated per household (Kg)	Collection frequency (Days)	Generation per day (Kg)	Average household size	Per capita Daily waste Dry/Wet (Kg)
					(A)	(B)	(C) = A/B	(D)	(E) = C/D	(F)	(G) = E/F
1	05-04-2014	Saturday	Wet	6	110	75.5	0.686	1	0.686	2.77	0.248
2	Holiday										
3	07-04-2014	Monday	Wet	6	132	75	0.568	2	0.284	2.77	0.103
4	08-04-2014	Tuesday	Dry	8	150	95.5	0.637	4	0.159	2.77	0.057
5	09-04-2014	Wednes-day	Wet	3	142	52	0.366	2	0.183	2.77	0.066
6	10-04-2014	Thursday	Dry	9	167	81.5	0.488	2	0.244	2.77	0.088
7	11-04-2014	Friday	Wet	5	163	101.5	0.623	2	0.311	2.77	0.112
	Average Wet Waste generated per day per household (Kg)					0.366					
	Average Dry Waste generated per day per household (Kg)					0.202					
	Average Wet waste generated per capita per day (Kg)					0.132					
	Average Dry waste generated per capita per day (Kg)					0.073					

Table 3: Cost savings per Year by municipality as calculated below:

Cost savings due to Household Segregation and Local Composting	
Total No. of households in the area	281
Wet waste generated per household per day (KG)	0.366
Dry waste generated per household per day (KG)	0.202
Total waste generated per household Per Day in Pilot area (KG)	0.568
% of wet waste to total waste	64.44%
Total Wet waste generation per day in the Pilot area (KG)	103
Total Dry waste generation per day in the Pilot area (KG)	57
Distance of processing plant from Pilot project site (KM) (One way)	7
Total quantum of waste used for composting in 9 months and not transported (KG)	27768.42
Average capacity of a pickup (KG)	500
Total number of trips required to transfer wet waste to the processing facility	55.54
Total distance travelled by a pickup to transfer the waste to the processing facility (55.54x7x2) (KM)	777.56
Mileage of a pickup vehicle (Km/Ltr.)	8
Total fuel required for total number of trips (Ltr.)	97.20
Average rate of Diesel (Rs. Per Ltr.)	50
Estimated fuel cost saved due to non-transportation of wet waste (Rs.)	4860
Total costs (Capital+ maintenance +salary) (per KM running cost) @ Rs. 10/KM	7775.6
Total estimated cost of 27768.42 KG of waste not transported to the processing plant for 9 months	**7775.6**
Compost prepared in 9 months (approx.) (KG)	8000
Processing Cost @300/ton saved in 9 months	8330.40
Savings by selling compost in 9 months (Rs.) (@Rs. 1/- Per KG)	8000
Total 281 household save a cost of Rs. 24,105 in 9 months so cost saved per household per month in Rs.	9.53
Estimated cost in Rs. likely to be saved per month in case we segregate the waste in the entire Shimla MC area from a total of 26362 households currently enrolled from where daily collection of MSW is being done (this comes out to be 45 Tons of waste per month)	2,51,229
Total waste generated in the municipality is 90 Tons and this additional 45 tons is from commercial establishments, if we take 64.44 %(90x64.44/100=58 Tons-45=13 Tones) of this waste as wet waste total additional wet waste becomes about 13 tons. Equivalent costs saved in Rs. From commercial vends per month in Rs. is	72,577
Total costs saved per month by local segregation and composting in Rs.	3,23,806
Total Yearly saving by the municipality in by local segregation and composting in Rs.	38,85,672

Fig 1: Waste being carried uphill in Shimla municipality, HP, India

Fig2: Compost pit before and after manure formation in the pilot project area in Shimla.

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