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Viability of Vermicomposting for Solid Waste Management in Ganderbal Town

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ABSTRACT

The newly created Ganderbal district came into existence in 2007 by the deletion of areas of Ganderbal and Kangan from the erstwhile Srinagar district. The main sanitation work in the district is carried by MCG (municipal committee ganderbal) which comprise of 17 municipal wards for the collection and disposal of solid wastes. About 80% of the working population is engaged in farming. Besides the agricultural wastes large quantities of domestic wastes are generated which is presently dumped by MCG around Beehama, resulting shabby surrounding besides having major impacts on health of inhabitants. The Ganderbal town has witnessed threefold increase in the water borne disease such can be only attributed to poor management of solid wastes. In the present paper comprehensive physical and chemical examination has been made to utilize decomposable organic waste generated in the district to produce valuable organic manure using Vermicomposting technique. This technique accelerates organic stabilization and giving chelating and phytohormonal elements which have high content of microbial matter and stabilized humic substances. From the study it has been observed that almost all biodegradable waste is decomposed in a very short period of time compared to simple composting with very high values of nitrogen, potassium, and phosphorus within a period of 5-6 weeks. The method at household level can reduce the workload of MCG by 30-35%. A small scale industrial setup can be both economically beneficial as well as employment generating option.

Keywords: Chemical analysis, Ganderbal, Vermicomposting, biodegradable.

I. INTRODUCTION

Solid waste is defined as discarded organic or in organic waste material, arising from domestic, trade commercial, industrial, agricultural, institutional and public services and mining activities. The term waste refers to useless, unwanted or discarded material.the discarded material is very heterogeneous nature and its characteristics vary from place to place and season to season. Refuse comprises of the entire solid from the community. Environmental impact due to the gaseous and liquid discharges has received greater attention than he solid waste. Progress in improving solid waste management is not yet satisfactory. The problem has further increased because of shortage of dumping sites. Municipal solid waste is highly organic in nature, so vermicomposting has become an appropriate alternative for the safe, hygienic and cost effective disposal of it. The earth worms feed on the organics and convert the material into the casting (ejected matter) rich in plant nutrients. the chemical analyses of the casts shows two times available magnesium,15 times available nitrogen and seven times available potassium compared to surrounding soil. Vermicomposting improves the soil structure, texture, and aeration as well as increasing the moisture holding capacity. Plants grow stronger and have deeper root system for better drought tolerance and disease resistance. The economic growth of the Jammu and Kashmir has simulated urbanization; lack of commensurate investment in urban infrastructure and services has resulted in an overall deteriotiation of urban quality of life. The present study has been carried out with a primary aim of carrying out comprehensive physical, chemical analysis of the waste sample in the ganderbal town (J&K) and access the viability of the vermicomposting by which we find out solid waste generation can be reduced by about 60-80% besides making it unharmful for any natural resource. The total generation of the whole town is 15.9 tonnes/day as per MCG figures. With the present population expected to be 26434 the waste generation by each individual is 605.28 grams total waste generated by the individual by the end of 2039 in which population is expected to be around 30818 and assuming that the waste generation to be 605.28 grams per captia then the total solid waste generation will be around 19q/d considering the limited available land dumping can't be followed and as such new methods which are both eco friendly and don't pose any burden on state economy have been suggested in the paper.

II. MATERIALS AND METHODS

The experimental programme consists of sampling, physical analysis, chemical analysis and vermicomposting. The samples were collected from 17 municipal wards viz. beehama(nagripora), beehama(Wahid shah sahib), Ganderbal(A), Arampora(A), Daderhama Gousia, Chieki Duderhama, Cheki Fateh pora(A), Gangerhama(A), Wanipora, Bamloora, saloora(A), Saloora(B), saloora(C), Gangerbal(B),Arampora(B), Fathipora(B), Gangerhama(B).

A. Sampling

A Quartering method was used for the sample collection. While collecting the solid waste sample, at a point, from 10 different points within the waste heap, samples were each weighing approximately 10kg. The grabbed sample was mixed together to obtain the sample of 100kg.the material was spread in the rectangular heap and divided into four equal parts. The diagonally opposite portions were mixed together and the remaining part was discarded. The process is repeated till a sample of 10-12 kg remains. This representative sample was used for the chemical analysis.

B. Physical Analysis

The physical analysis of these samples was carried out by weighing the various constituents separately after the manual separation and the results are expressed as percentage of the total weight the mixed sample was taken and subjected to moisture determination. The total weight of the sample was recorded initially. The whole sample was the screened through 20mm sieve to separate the fine fraction of the refuse containing mainly the earth, small stones and some fine organic fraction. The course fraction of the refuse was further separated manually into different ingredients e.g. hay and straw, leaves, paper and cardboard, food & fruit waste (kitchen waste),plastic, metal, glass, ceramics, stores & bricks, inert fine (<20mm), wood , leather, textile & rubber etc. each fraction was weighed separately and represented on the percentage basis as given in Table-1

Table 1-physical characteristics of waste sample.

Sr. No.	Ingredients	Percentage (%)
1	Paper	2.52
2	Leaves and wood	16.59
3	Food waste	46.72
4	Plastic and rubber	10.67
5	Textiles	6.306
6	Others	17.194

C. Chemical Analysis.

Part of the organic sample was oven dried at 100^0C for 24 hours. After this sample is taken out of the oven allowed cooling down and then it is weighed again to find out the moisture content. The carbon content of the sample is calculated by taking a known quantity of sample in a silica crucible. The crucible is then put in a muffle furnace which is set to attain a maximum temperature of 600^0C. The sample is placed in the furnace for an additional 1 hour after the required temperature has been attained. It is assumed that during this period all the carbon in the sample is burned out. Loss in the weight of the sample gives us the carbon content. Direct type of flame photometer was employed for the potassium determination. The organic phosphorous is converted into inorganic form digestion with concentrated nitric acid. The total phosphorous is then converted by the calorimeter method employing ammonium molybdate and stannous chloride.Net absorbance is the difference between the spectrometer reading of sample and spectrometer of blank, obtaining concentration of phosphorous from the standard curve between net absorbance of pure phosphorous and concentration, and nitrogen content of the sample is found by using the kjeldhal flask, mixing wetting the sample with distilled followed by the addition of catalyst and sulphuric acid to carry out the digestion. Mix bromocresol green solution and methyl red solution in the ratio of 2:1 used as mixed indicator.

D. Vermicomposting

Vermicomposting is the process of using earthworms to decompose organic food waste, turning waste into nutrient rich material capable of supplying necessary nutrients. Epigeics have been used in converting organic waste into vermicompost [6], [7].Earthworms feed on the organics and convert material into casting (ejected matter) rich in plant nutrients[3]. The organic refuse changes into a soft, spongy, sweet smelling, dark brown compost [4].Worm bins are generally made of wood or plastic, or from recycled containers like old bathtubs, barrels or trunks etc. As red wigglers tend to be surface feeders, bins should be no more than 8 to 12 inches deep. Bedding materials high high in cellulose are the best because they help to accelerate the bin so that the worms can breathe alongside some girt is also added for the better digestion of worms. Earth worms eat all kinds of food and yard wastes, including coffee grounds, tea bags, vegetable and fruit waste, pulverized egg shells, grass clippings, manure, and sewage sludge. The compost should be kept at pH of 6.5 if possible with upper and lower limits as 7.0 and 6.0 respectively. On an average, however it takes approximately 900 grams (approx. 2000 breeders) to recycle a pound of food waste in 24 hours. The same quantity of worms requires about 4 cubic feet of bin to process the food

waste and bedding. Food scraps can be continually added to bin for 2 to 3 months or until the bedding material disappears. When the bedding disappears, worms are harvested from the finished compost using harvester frames or other means Red worms can survive the wide range of temperature (40^0 F-80^0 F) but they reproduce and process food waste at optimum bedding temperature in the range of 55^0 F-77^0 F

III. RESULTS AND DISCUSSIONS

As the study is intended to find the scope of the vermicomposting to the domestically generated waste so the choice of the final values for the sample will vary with the mode of collection whether collected from the houses or from the Aggregate Dumping Site. Assuming door to door collection mode final values of the comparative chemical analysis of the waste sample as shown in Table-3,there is about 27% decrease in the carbon content with the simultaneous increase of approximately 304, 257, 108 (%)in potassium, phosphorus, and nitrogen, respectively from their initial values in waste sample.

Table 2- Results of the chemical examination of solid waste from each ward of gandebal town.

Ward No.	Name of Ward	Moisture content(%)	Carbon content(%)	Total potassium(%)	Total Phosphorous(%)	Total Nitrogen(%)
1	Beehama Nagripora	27.6	78.9	2.27	1.18	4.20
2	Beehama Walid Shah Sahib	45.3	70.46	2.32	1.20	3.92
3	Ganderbal A	35.35	75.14	2.30	1.23	4.62
4	Arampora A	40.6	70.48	2.33	1.25	4.34
5	Daderhama Gousia	34.1	74.45	2.32	1.16	4.62
6	Cheki Daderhama	43.1	82.71	2.20	1.15	3.92
7	Cheki Fathipora A	34.25	87.96	1.98	1.12	4.90
8	Gangerhama A	43.45	83.90	2.00	1.14	4.90
9	Wanipora	27.4	76.40	2.29	1.21	4.34
10	Bamloora	18.85	72.41	2.16	1.25	4.76
11	Saloora A	34.45	70.40	2.35	1.29	4.90
12	Saloora B	36.5	86.24	2.01	1.19	4.62
13	Saloora C	30.1	82.56	2.25	1.24	4.48
14	Ganderbal B	23.55	78.20	2.31	1.23	5.04
15	Arampora B	34.4	74.60	2.32	1.20	4.48
16	Fathipora B	25.1	68.22	2.40	1.31	4.20
17	Gangerhama B	24.75	66.71	2.38	1.35	4.34
Average of 17 wards		32.87	76.45	2.26	1.21	4.50
Aggregate Dumping Site		38.3	73.45	2.31	1.25	4.76

Table 3- Comparative results of chemical analysis.

Chemical Property	Moisture content (%)	Carbon content (%)	Total potassium (%)	Total Phosphorous (%)	Total Nitrogen (%)
Waste Sample	32.87	76.45	2.26	1.21	4.50
Compost Sample	25.12	55.77	9.14	4.33	9.38

V.CONCLUSION

Physical and chemical analysis indicates high biodegradable waste with high moisture content, low recyclable waste and higher concentration of inert waste. Commercial waste with good source of recycla le waste with low bio-resistant and ash contents. Almost all the biodegradable waste is decomposed by the vermicomposting and this technique helps to decompose the biodegradable waste in a very short period of time when compared to the conventional methods like simple composting.Ganderbal town waste is having high percentage of biodegradable matter and the high moisture content, therefore, suitable for the vermicomposting.End product of the vermicomposting when analyzed chemically gives the very high values of nitrogen, potassium, and phosphorus which are the essential ingredients of the good fertilizer. The market value of this product is quite good varying from 25-30 INR/kg, thus additional benefit of being economically lucrative besides reducing the menace of biodegradable solid waste disposal. The method if employed at household level can reduce the workload of the Ganderbal municipal committee by about 30- 40%. A small scale industrial setup using this method can be both economically beneficial as well as an employment generation option.

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