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DEVELOPMENT OF STRATEGIC PLAN FOR SOLID WASTE MANAGEMENT AND BIO-CONVERSION: A CASE STUDY OF MARIS STELLA COLLEGE

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ABSTRACT :

Educational institutions such as Schools and Higher educational institutions can be considered as mini autonomous cities, they can act as a model for solid waste management and enhance sustainable growth. Furthermore, solid waste management in higher educational institutions can informally train students to practice good solid waste management approaches and take this experience back to their homes. Therefore, successful approaches and practices can be easily adopted by surrounding society. Solid waste management is the estimation of solid waste generation rate, controlled generation, collection, processing, conservation in to organic manure by waste decomposition and vermicomposting during the academic calendar.

The present research work discusses about the development of strategic plan for solid waste management and bio conversion at Maris Stella College campus through the characterization and analysis of waste collected from academic buildings, cooking and pre-cooking hostels, mess, paper waste from class room, food waste from canteen, higher plant debris and waste from gardens and orchards for beneficial utilization by waste decomposition and Vermiculture biotechnology during the academic calendar. The result of this decomposition process is compost, a crumbly, earthy-smelling, soil-like material. Here, a study is undertaken to compost the solid waste collected from Maris Stella College, Vijayawada. In this study three varieties of earthworms used



such as *Eisenia fetida*, *Eudrilus eugeniae* and *Perionyx excavates* in the decomposing and vermicomposting of collected waste from college campus including cow dung are rich in carbon. A mixture of solid waste paper from office, plant debris, hostel waste, canteen waste, and cow dung. In 180 days' time excellent quality and quantity of organic manure was produced by vermicomposting. Increase was found in all the parameters like, nitrogen (0.5-1.80%), phosphorus (0.3-1.0%), potassium (0.5-1.2%), carbon and nitrogen ration (5.5-9.0%) and sodium (0.3-0.80%) and other micronutrients, beneficial soil microbes and also contain 'plant growth hormones & enzymes. The Maris Stella College has the potential to manage its solid waste properly conversion into beneficial organic manure through the vermicomposting technology discussed in this paper. This would reduce the amount of waste diverted to landfills and the problems arising on campus due to solid waste, thus leading to a zero-waste campus.

KEYWORDS: Higher educational institution, solid waste, vermicomposting, earthworms and organic manure

INTRODUCTION

Higher educational institutions such as College and universities can be considered as small communities that have significant impact on surrounding urban areas [1,2]. Furthermore, solid waste management in higher educational institutions can informally train students to practice good solid waste management approaches and take this experience back to their homes. Therefore, successful approaches and practices can be easily adopted by surrounding communities [3]. Accordingly, solid waste management in higher educational institutions is gaining more seriousness in detailing and evaluation of resources recovery from in around the campus and conversion possibilities [4]. Adopting zero-waste policy among educational institutions have been shown to be achievable but requires full scale cooperation. Mason et. al. concluded the zero-waste program and environmental management structures at Massey University campus, New Zealand. The study showed that linkage between all involved sectors is needed to have a successful program and exhibited the necessity of including a formal waste management system [5]. Armijo de Vega et. al. established similar work and presented the development of a recycling program at the Autonomous University of Baja California. The study concluded that such programs require the involvement of different parties at the different levels within the University campus [3].

Sustainable solid waste management plan incorporating fully developed recycling programs at higher educational institution level became an obvious need. Generally, higher educational institutions in developing countries are running their solid waste management programs individually or with huge reliance on their governments. A reference framework for solid waste management in educational institutions is needed [9]. Currently, recycling became one of the profound measures the institution can take to show commitment to environmentally sound practices [3].

Disposal of solid waste is done most commonly through a open dumping yards, sanitary landfill or through incineration. But one of the best methods is composting. The organic portion of the solid waste however could be utilized in a very profitable way by using Vermicomposting. Vermicomposting is done with the aid of earthworms, which adds up more nutrients to the fertilizer obtained from it. Earthworms from time immemorial played a key role in soil biology by serving as versatile natural bio reactors to harness and destroy soil pathogens, thus converting organic wastes into valuable macro and micro nutrients, enzymes, growth hormones and proteinaceous worm bio-mass. Earthworms ingest, digest and excrete vermicompost with excellent nutrient content. Excretion ensures the grading of the vermicompost as opposed to any inorganic matter [6].

In this study, an attempt has been made to convert domestic food wastes into compost by Vermicomposting method. Food waste has collected the waste from administrations paper waste, students class room waste, higher plant debris, garden and orchids waste, canteen and students' hostel, mess, of Maris Stella College, Vijayawada is situated in NTR District, Andhra Pradesh.

MATERIALS AND METHODS:

The cattle dung (20 days old) was procured from nearby penamaluru village dairy farm. The moisture content of the medium was maintained at about 40% to 70%, solid waste collected from academic buildings, cooking and pre-cooking hostels, mess, paper waste from class room, food waste from canteen, higher plant debris and waste from gardens and orchards in Maris Stella College, Vijayawada, NTR District, Andhra Pradesh, India (Table 1.). The procured campus waste was segregated before using by means of a separation of if any plastic and metals. Earthworms (*Eisenia fetida*, *Eudrilus eugeniae* and *Perionyx excavates*) were procured from Atlantis Phyto Tech, Hyderabad, Telangana, India. For the present study, separate solid waste decomposition and vermicomposting concrete pit in the campus. It was made with the different layers using 20 days old cattle dung, black soil, and college campus waste from the different places with addition of decomposed bacterial culture (Fig 2). After decomposition of waste material for mass culture of *Eisenia fetida*, *Eudrilus eugeniae* and *Perionyx excavates*. The culture was constantly monitored throughout the period of study with time by time spraying of water.

The experiment was conducted in to two parts in the present study. The first part of pre-decomposition experiment in a same concrete pit of 9x9x9 feet (Fig. 1) measurement was filled with a mixture 1 tone of 20 days old cattle dung and 77.2 kg. of campus solid waste it was daily sprinkled with water so that it gets decomposed. Also, this waste was turned up and down for proper aeration and decomposition. This experiment was continued for 125 days and second part of composting experiment was study in same concrete pit was filled with mass culture of *Eisenia fetida*, *Eudrilus eugeniae* and *Perionyx excavates*. 5 kg numbers of each variety of adult, mature, clitellate worms were taken from the stock culture and were uniformly released on the top of the containers of all the two experimental containers along with college solid waste. The experiments were conducted inside the vermicompost shed located in Maris Stella college, Vijayawada, NTR district, Andhra Pradesh, India in order to avoid the danger of predators. The concrete pit was covered by iron shed and were observed daily in order to check the various parameters necessary for the survival and reproduction of earthworms. These two experiments were maintained for 180 days till the finely granular vermicompost was prepared. During the experiments of composting process, the material was analysed for different physico-chemical attributes such as total Nitrogen, available Phosphorus, exchangeable Potassium and pH, by using conventional methods as well as for earthworm number, cocoon production and weight loss of organic substrate. During this research experiment, the samples were examined at periodic intervals after 40 and 70 days of vermicomposting.

Table 1. Types of solid waste and sources of generation

S.No.	Type of Solid waste	Sources	Waste generated/per days (Kg.)
01	Paper waste	College Administration Building and Students class rooms	2.5Kg.
02	Food waste	Canteen and Hostel mess	10kg.
03	Pre-cooking vegetable waste	Hostel cooking area	15kg
04	Plant debris and Leaf	Campus Higher plants, garden and orchids	50kg



Fig 1. Solid waste management and vermicomposting concrete shed

RESULT AND DISCUSSION:

The obtained output has high quality of the manure from organic material sources from different areas of Maris Stella College. Composting, normally used for organic farming, occurs by allowing organic materials to sit in one place for months until microbes decompose it. Decomposition and composting are one of the best methods of organic solid waste disposal as it can turn unsafe organic products into safe compost (Fig 2.). On the other hand, it is a very slow process and takes a lot of space. Due to the limitation of land, machines can be used for organic decomposing and shredding of waste. The results of the individual composition of waste samples collected from various sources were shown in Table 1. Food waste was predominantly observed from hostel mess and canteen areas, in form of peels of vegetables and fruits, discarded food. Paper waste was generated mostly from the academic areas followed by administration building and students class rooms. Plant material generated from higher plants in the campus and from garden trimmings. However, nutrient such as total nitrogen, phosphorus and potassium (NPK) were found in organic solid waste and excellent result was obtained for nutrient ratio carbon and nitrogen. The process of vermicomposting activity showed significantly changes in the physical and chemical properties of plant debris, cattle dung, hostel, canteen waste materials and paper waste material that can be an important tool for organic compost farming and zero waste in the higher educational institutions. It is indicated in Table.3.

The result of Table 3 that the ratio of carbon and nitrogen and values phosphorus and potassium increased over 180 days of vermicomposting. Excellent values of total nitrogen (0.5-1.80%), phosphorus (0.3-1.0%), potassium (0.5-1.2%), carbon and nitrogen ration (5.5-9.0%) and sodium (0.3-0.80%) were compared with control that is before addition of earthworms.

Vermicompost is generally a free service provided by earthworms [7,8]. Thus, farmers should be educated about the prospects and the merits associated with the process. Higher education institutions could play a key role in this regard. Vermicompost has been emerging as an important source in supplementing and substituting chemical based fertilizers in agriculture. Vermicompost, also known as 'farmers' friend' is used for general crops and plantation crops. It is a valuable input for sustainable agriculture and wasteland development. It is a growth promoter and helpful in providing hormones required for plant growth. There is a lot of demand for vermicompost among farmers as its use increases quality of agricultural products and its price is also cheaper. It is also used widely in pot culture and in home gardens. In this research paper discusses in detail the effects of vermicompost technology useful model for solid waste management and enhance sustainable solid waste management in higher educational institutions can informally train students to practice good solid waste management approaches and take this experience back to their homes. Therefore, successful approaches and practices can be easily adopted by surrounding society. The Maris Stella College has the potential to manage its solid waste properly conversion into beneficial organic manure through the vermicomposting technology discussed in this paper. This would reduce the amount of waste diverted to landfills and the problems arising on campus due to solid waste, thus leading to a zero-waste campus.

Table 2. Vermicomposting process of turning organic solid waste into worm casting of primary nutrients

S.No.	Parameters	After 180 days nutrient Percentage (%) of organic manure
01	PH	7.2-8.5
02	Nitrogen	0.5-1.80
03	Phosphorous	0.3-1.0
04	Potassium	0.5-1.2
05	Carbon and Nitrogen Ration	5.5-9.0
06	Sodium	0.3-0.80
07	Calcium	1.2-2.2%
08	Magnesium	0.1-0.7%

**Fig 2. Organic solid waste into worm casting of organic manure**

CONCLUSION

The results from the worm casting analysis had revealed that the organic waste of college campus solid waste can be converted into beneficial conversion form with its excellent macro nutrients and micronutrient release. Though there may not be a great increase in nutrient, the small change in nutrient value and the reduction in C:N ratio make the plant to uptake. The worm castings which are rich in microorganism enhance the plant growth hormones. The result showed the increase in three types of Earthworm population in three substrates of organic solid waste. The vermibiotechnology is an eco-friendly and less cost-effective methods. It is an ideal method for the management and development of solid waste. Finally, conclude the characteristics values of composting organic solid waste material and compost are found to be comparable with the standards. With this view, we proposed a proper solution for the disposal of our college solid waste sources from hostel, canteen food, office and students paper waste and higher plant debris waste as well as it was suggested to utilize composted material as an organic manure through the vermibiotechnology processes.

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