

## **Compost Fertilizer from Municipal Solid Wastes and its Application in Urban Agro-forestry Nurseries: A Case Study on Khulna City**

**Tusar Kanti Roy<sup>1</sup>**  
**Saima Rahman<sup>2</sup>**  
**Papon Kumar Dev<sup>3</sup>**

### **Abstract**

About 70% of the total produced 520 tons of municipal solid wastes per day in Khulna city is organic and suitable for preparation of compost fertilizer. Among the NGOs involved in solid waste management only RUSTIC at present is producing about 30 tons compost per month on its own plant of 0.47 acre land using only 46 tons (0.53%) from 8730 tons. Additional 5663 tons of compost per month can be produced from the unused 8684 tons (99.47%) of organic wastes. In spite of having huge demand for organic compost, only 33% agro-forestry nurseries in Khulna city and its adjoining areas are using the compost fertilizer claiming its low quality and due to having lack of awareness. The compost can be used to the city nurseries for increasing their productivity, reducing the volume of waste to be disposed of and thereby to create healthier urban environment of Khulna city.

### **Introduction**

The rapid development and high population growth of the major cities in developing countries have resulted into a significant increase in household waste and possess a tremendous challenge for the local authorities i.e. City Corporations and municipalities.

Major cities in Bangladesh are facing urban environmental threat in terms of unorganized loads of solid waste and sanitation. Khulna is one of the fast growing cities in Bangladesh with a population of 1.5 million in its 45.65 sq. km. area. It produces about 520 tons of municipal solid wastes per day. Most of the wastes are collected from door-to-door without any sorting and dumped in improperly managed landfill sites. About 70% of the city generated solid waste is organic in nature and suitable for preparation of organic fertilizer.

Compost is the end product of a number of biological degradation processes (composting, co-composting or anaerobic digestion). It is the stable end product from the biological degradation of organic material, which can vary from dead leaves and rots to kitchen waste and vegetable remains. Composting is an aerobic decomposition process in which some of the organic material is decomposed to carbon dioxide (CO<sub>2</sub>) and water, while stabilized products, principally humic substances are synthesized. The composting process is carried out by microorganisms which spontaneously grow in any mixed natural organic waste if it is kept moist and aerated. The growth of these organisms liberates heat, CO<sub>2</sub> and water (Brunt et al., 1985:73).

Today, two strongly promoted urban management strategies for the developing countries are urban agriculture and reduction/reuse of solid waste. Urban waste reduction and reuse involves composting of urban organic wastes (especially in cities of developing countries where the organic fraction of municipal solid waste (MSW) is high). Urban Agriculture (UA) frequently point out

---

<sup>1</sup> Assistant Professor, Department of Urban and Regional Planning, Khulna University of Engineering & Technology (KUET), Khulna, tusarpln@yahoo.com

<sup>2</sup> Lecturer, Department of Urban and Regional Planning, Khulna University of Engineering & Technology (KUET), Khulna, rahman.saima@yahoo.com

<sup>3</sup> M.Sc. Student, Urban Development Department of Technical University Berlin, Germany

that city farming often absorbs urban solid waste, thus reducing the volume of waste and the need to collect and transport wastes to distant dumps. In practice, urban farmers in many cities acquire municipal wastes as resources (Lewcock, 1994:69).

The Ministry of Agriculture (MOA) is the nodal ministry for developing and enforcing compost standards for soil application and registration and certification of compost. Department of Agricultural Extension (DAE) under the Ministry of Agriculture provides license for operation of compost plant as well as for selling of fertilizers. After taking the clearance, the Solid Waste Management (SWM) project has to renew the license from DAE in every two years (BMDF, 2012:13).

Organic fertilizer brings back the natural qualities of soil, resists pests and insects, and increase disease preventive power of the plants. It reduces dependency on high-cost chemical fertilizer, enhances soil fertility, requires less irrigation water, reduces soil salinity, strengthens plant roots and accelerates rapid growth. Organic fertilizer keeps the plants green, helps to build legumes or noodles in the roots of nut and beans like plants, reduces volume of municipal organic wastes, fosters environment friendly agro-forestry practices and improves the urban environment. At present only RUSTIC, an NGO is producing about 30 tons compost fertilizer per month on its own plant having 0.47 acre land from the wastes of Khulna City. This compost is used in some agro-forestry nurseries and farms of Khulna city and adjoining area which fulfills only a negligible amount of organic compost demand. Recycling of the unused huge amount of organic waste into compost fertilizer can efficiently solve the problem of solid waste management.

### **Objectives and Methodology of the Study**

The objectives of the study are- i) to find out the initiatives of NGOs and their current status in preparing compost fertilizer from organic solid wastes of Khulna City; and ii) to explore the potentialities of organic compost fertilizer in terms of its demand and supply for urban agro-forestry nurseries.

In this study, secondary data is collected from different NGOs, Khulna Development Authority (KDA), Khulna City Corporation (KCC) and related reports and research papers. Key Informants Interview (KII) method is used to collect data from NGOs engaged in organic compost preparation. Questionnaire survey is also conducted to collect data from the nurseries located in Khulna city and adjoining areas. A total of 15 nurseries are selected randomly as a representative (18%) of 85 nurseries of Khulna city and adjoining areas.

### **Analysis and Findings**

#### **Municipal Solid Waste Management in Khulna City**

The responsibility of collection and disposal of solid waste generated in KCC area is lying under the management of KCC. There are about 10 NGOs and CBOs in Khulna City for door to door solid waste collection. The NGOs are Clanship Association, Muktir Alo, RUSTIC, BRIC, Rupayan, Nabarub Sangsad, SEIAM, CHD, SPS and Samadhan. The waste collectors of KCC, NGOs and CBOs who collect wastes by the rickshaw vans mainly pick up the saleable non-degradable wastes and metals during household collection and disposal at transfer stations. NGOs and CBOs do not cover all the households and Wards of KCC due to their financial and technical lacking and limitations. KCC trucks pick up waste from the roadside bins and transfer stations having demountable containers (Roy, 2011:148(2-4)).

#### **Past and Present Initiatives of Composting from Organic Wastes in Khulna City**

Among the NGOs of Khulna, Prodipan, RUSTIC, Samadhan and SPS had organic solid waste recycling and compost fertilizer preparation projects during 1998-2010 in Khulna City.

Table 1: Past and present initiatives of NGOs on composting from organic waste

NGO	Initiatives on composting
RUSTIC	RUSTIC started its composting initiative during 2002-2003 in funding support of BEMP/CIDA. It continues the initiative at small scale. At present only RUSTIC is producing about 30 tons compost fertilizer per month on its own 0.47 acre land.
Samadhan	Samadhan had organic compost fertilizer preparation plant under the funding support of Waste Safe/EU during 2007-2010. It has stopped composting before 2 years for not getting certificate/license from the Ministry/Department of Agriculture.
SPS	SPS had a small organic solid waste recycling and compost fertilizer preparation plant under the funding support of PRISM Bangladesh/SEMP during 2002-2004.
Prodipan	Prodipan first time initiated composting in Khulna City under the funding support of World Bank during 1997-2002. It also supported some small NGOs and CBOs on composting during the period. Prodipan compost fertilizer had great demand in Khulna area. At present it does not have any production and marketing.

Source: Field Survey, 2013

#### **Agro-forestry Nurseries in Khulna and the Use of Fertilizer**

There are about 85 nurseries in Khulna city and its adjoining areas. Total 15 nurseries are surveyed to identify their fertilizer consumption pattern and demand of organic compost. Name, location and area of the surveyed nurseries are- 1) The Khulna New Market Nursery, New Market-(0.17 acre); 2) Dahlia Nursery, KDA Outer Bypass Road, Sonadanga-(0.33 acre); 3) Focus Nursery & Horticulture Farm, Mohammad Nagar, Batiaghata-(1.65 acre); 4) Hanif's Nursery, Khulna DC Office & Court Building Premise-(0.03 acre); 5) Town Nursery, Horticulture Centre, DAE, Khulna DC Office & Court Building Premise-(0.20 acre); 6) The Khulna Nursery, BIDD Road, Joragate-(0.22 acre); 7) City Agriculture Farm, Jessore-Khulna Highway, Noornagar-(0.83 acre); 8) Nayan Tara Nursery, Jessore-Khulna Highway, Noornagar-(0.10 acre); 9) Sonali Nursery, Jessore-Khulna Highway, Noornagar-(0.05 acre); 10) Mahua Nursery, Jessore-Khulna Highway, Noornagar-(0.05 acre); 11) Kasem Bihari Nursery, Jessore-Khulna Highway, Noornagar-(0.05 acre); 12) Hamid Nursery, Muzgunni Highway Road-(0.99 acre); 13) Kushum Kanon Nursery, Boyra-(0.10 acre); 14) Nijam Nursery, Moylapota Mosque-(0.13 acre); and 15) Messer's Mousumi Nursery, Gilatola-(1.65 acre). Mainly ornamental, decorative, medicinal, fruit and timber plants and saplings are sold in the nurseries. Fertilizers used in the nurseries are mainly chemical (potash, phosphate, urea) fertilizer, small amount of self made organic compost (compost prepared from cow dung, rotten leaves and trimmings, mustard oil seed cake, water hyacinth, coconut dust, saw dust, bone dust etc.) and purchased organic compost of different brands namely, Samadhan Compost, Both-aid Vermi-Compost, RUSTIC Compost Jaiba Sar, Prodipan Compost, Focus Super Compost, BRAC Compost etc.

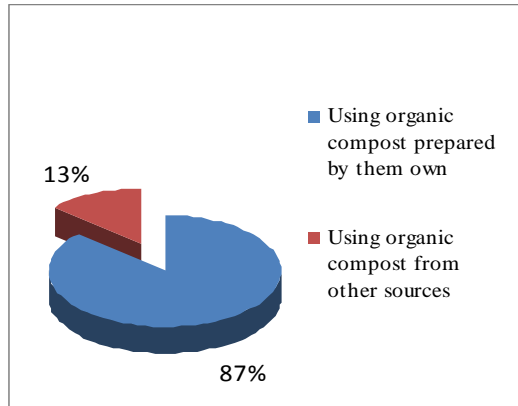


Figure 1 : Pattern of fertilizer use by agro-forestry nurseries in Khulna, Source: Field Survey 2014

Figure 1 shows that maximum, i.e. about 87% of the nurseries are using organic compost prepared by themselves in their own nurseries. Some of the nurseries have compost pits inside the nurseries. The self prepared compost is mainly used after one year. Nurseries using organic compost from other sources also use their own prepared compost.



Figure 2: Pattern of fertilizer use by agro-forestry nurseries in Khulna Figure; Source: Field Survey, 2013



Figure 3: The Khulna New Market Nursery and its own compost pit; Source: Field Survey, 2013

### Organic Fertilizer Sold with Plants and Saplings by the Nurseries

Almost all the nurseries sell different types of organic fertilizers while selling the plants and saplings. The indoor and rooftop gardeners at times buy fertilizers from the nurseries. Prodipan Compost, RUSTIC Compost Jaiba Sar, Both-aid Vermi-Compost, BRAC Compost, Samadhan Compost, Focus Super Compost are the different kinds of compost fertilizers found in the nurseries of Khulna City. At present, Prodipan has no compost fertilizer in the market. But, Reza & Sons at Khan Jahan Ali Road, Khulna is marketing RUSTIC Compost Jaiba Sar in the name of Prodipan compost. In this case, label of Prodipan Compost is being used on small packets.

### RUSTIC Compost Jaiba Sar

RUSTIC receives about 65 tons solid wastes per month from KCC trucks. It produces about 25-30 tons compost fertilizer in the name of "RUSTIC Compost Jaiba Sar". RUSTIC has its own compost plant on 0.47 acre land at Rajbandh adjacent to KCC landfill site. RUSTIC received its

certification from the Ministry of Agriculture in 2012. The existing shed of RUSTIC was constructed in 2002. RUSTIC sells its fertilizer at the cost of Tk. 7/= per kg. at wholesale rate. As dealers ACI Ltd. takes 12 tons, Sikder Seeds takes 2 tons and the Reza & Sons takes the remaining amount. They sell the fertilizer to the farmers of Khulna, Satkhira, Natore, Munshiganj, Mollhat and other areas of the country at the rate of Tk. 15/= - Tk. 25/= per kg. The farmers apply the fertilizer to their paddy fields, betel-nut farms, nurseries and vegetables gardens etc. The fertilizer is packed in 20 kg. and 40 kg. packs/sacks. RUSTIC Compost contains about 10% cow dung.



Figure 4: Composting from Khulna City Municipal solid waste by RUSTIC at Rajbandh; Source: Field Survey, 2013

#### Super Compost of Focus Nursery & Horticulture Farm

The Focus Nursery & Horticulture Farm produces Super Compost using cow dung, water hyacinth, shrubs/trimmings, *Neem leaves*, *Dhan Chitta*, *Khudipana* (small hyacinth) and sawdust etc. It sells about 1.2 tons fertilizer i.e. 600 packs per year (300 packs in seasons-June to August and 300 packs in rest of the 9 months). Retail price is Tk. 50/= per pack, i.e. Tk. 25/= per kg. The wholesale price is Tk. 8/= per kg., i.e. 50 kg. sack is sold at Tk. 400/=. About 150 packs of fertilizer are sold in the Tree Fair 2013.



Figure 5: Focus Nursery & Horticulture Farm and its Super Compost Plant; Source: Field Survey, 2013

#### Both-aid's Vermi-Compost

Earth worm (Vermi), water and cow dung are used to produce Vermi-Compost. Water is used through sprinkling/spraying. Both-aid is a company that helps small farmers in urban and rural areas with technical assistance and guidance to produce Vermi-Compost. It then collects at wholesale rate from the farmers and sell to the agro-forestry nurseries and farms at reasonable discounted rate. A small plant can produce about 200 kg. Vermi-Compost per month. A plant of

Boyra area produced Vermi-Compost during 2011-2012 and supplied to Department of Agriculture and Both-aid's representatives. It supplied about 400 kg. fertilizer to Both-aid representative in 2012 for selling in the Khulna Tree Fair 2012. In 2013 Both-aid had no stall in the Khulna Tree Fair. Wholesale price of Vermi-Compost is Tk. 12/= - Tk. 14/= per kg. and its retail price is Tk. 20/= per kg.



Figure 5: Both-aid's Vermi-Compost at Nayon Tara Nursery for Sale & a Vermi-Compost Plant at Boyra Area; Source: Field Survey, 2013

#### Quality and Composition of Organic Fertilizer in Khulna City with their Certification

Quality and composition of organic fertilizer available in Khulna City with their certification are presented in the below table:

Table 2: Quality and composition of organic fertilizer in Khulna city with their certification

Sl.	Government Standard	Name of Fertilizer	Composition or Nutrients	Certified and Tested by
1.	Moisture=17.0%, p <sup>H</sup> =7.0, Organic Carbon=10.65%, C:N=11.2:1, N=0.95%, P=0.70%, K=1.25%, S=0.29% , Zn=0.04%, Cu=0.016%, Pb=22.5 ppm, Cr=18.28 ppm,	Both-aid Vermi-Compost	PH-7.4%, Organic Carbon-25%, N-2%, C:N-10%, P-1.5-2%, Cu-3%, K-3%, S-5%, Zn-0.5%, Ca-1%, Mg-1%, Fe-0.5%	BSTI
2.	Cd=0.18 ppm, Ni=24.44 ppm, Inert material <1%	RUSTIC Compost Jaiba Sar	Moisture=15-20%, pH=6.0-8.5, Organic Carbon=10-25%, C:N= maximum 20:1, N=0.5-4.0%, P=0.5-3.0%, K=0.5-3.0%, S=0.1-0.5% , Zn= maximum=0.1%, Cu= maximum =0.05%	Ministry of Agriculture, Bangladesh

#### Demand and Supply of Organic Compost Fertilizer for Urban Agro-forestry Nurseries of Khulna City and Adjoining Areas

The Khulna Nursery sells about 50 kg., The Khulna New Market Nursery sells about 60 kg., Dahlia Nursery sells about 40 kg., Focus Nursery & Horticulture Farm sells about 40 kg. and Nijam Nursery sells about 50 kg. compost per months. Other nurseries sell lump sump amount from their nurseries while selling the plants and saplings.

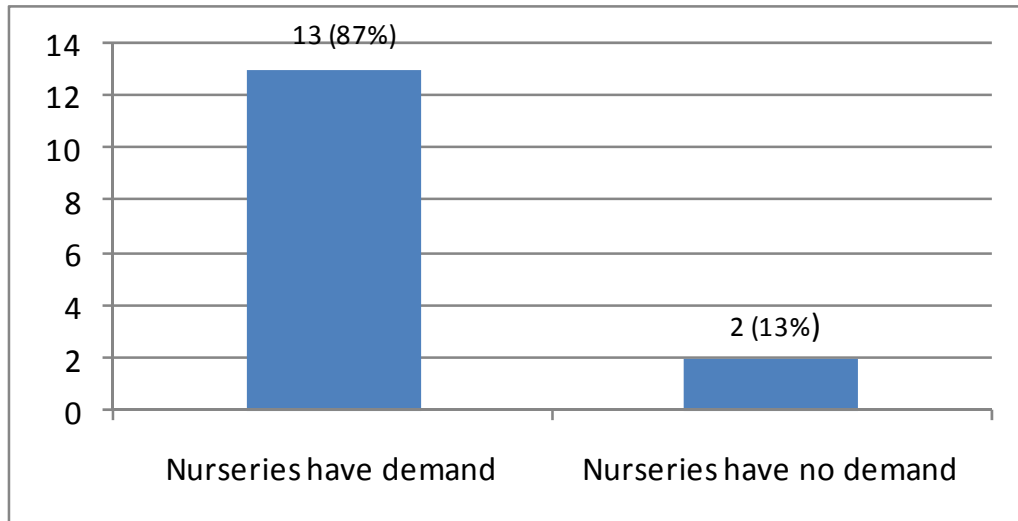


Figure 6: Nurseries having demand of organic compost; Source: Field Survey, 2013

From the study, it is clear that organic compost has great demand in the agro-forestry market. But, as only 5 (33%) nurseries among 15 sell organic compost regularly, supply of organic compost is lower than demand. Project on organic compost preparation has great potentiality here in Khulna City.

Figure 6 shows that almost all (87%) surveyed nurseries have demand for organic compost from other sources in addition to their own source. Because, the amount of organic waste produced from their own source is not sufficient for their use. Almost all the nursery owners prefer to use organic compost than chemical fertilizer as it is more productive and resists insects in a better way.

#### **Potentiality of Compost Preparation in Khulna City from Municipal Organic Solid Waste**

Amount of daily solid waste generated in Khulna City Corporation area is 520 tons and as the collection and disposal efficiency of KCC is 80%, amount of solid waste collected and disposed by KCC is 416 tons per day. About 70% of this waste (416 tons) is organic in nature which is 291 tons per day. Thus, total amount of organic waste, which can be used for composting is 8730 tons per month. At present, RUSTIC is using only 46 tons (0.53%) of this organic waste and producing 30 tons of organic compost per month. So, the unused organic waste is 8684 tons (99.47%) per month. This huge amount of unused organic waste can further produce about 5663 tons of compost per month to fulfill the growing demand of organic compost in urban agro-forestry nurseries and farms.



Figure 7: Unattended organic waste at Rajbandh potential for composting; Source: Field Survey, 2013

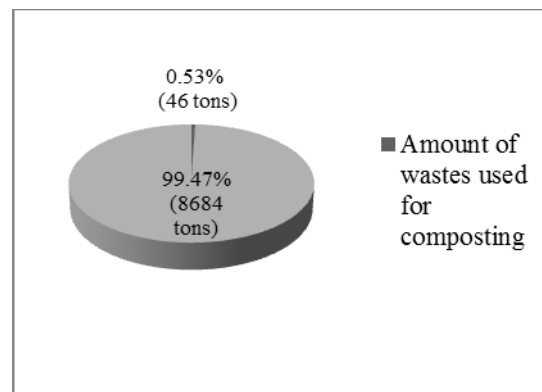


Figure 8: Amount of unused organic waste potential for composting; Source: Field Survey, 2013

### **Problems of NGOs and Agro-forestry Nurseries Facing to Sustain Composting Initiatives**

- NGOs have to face difficulty in getting certificate and license for production and marketing of compost fertilizer from municipal waste. Samadhan NGO has to stop its composting initiative for this reason.
- There exists lack of technical assistance from government concerned departments to time to time test quality of the compost available in market. Once low quality organic compost is prepared, the agro-forestry nursery owners and farmers lose confidence on compost and use chemical fertilizer or self produced compost.
- NGOs, agro-forestry nurseries and farms have to face space problem for establishing plants for preparation of compost fertilizer in urban areas.



- The NGOs, agro-forestry nurseries and farms have lack of fund to run and extend the business or initiatives of composting

### **Recommendations for Overcoming the Problems of NGOs and Agro-forestry Nurseries in Sustaining Compost Fertilizer Preparation Initiative**

- KCC can introduce the system of segregation of wastes at source so that NGOs, agro-forestry nurseries and farms can use the organic portion in producing compost fertilizer
- KCC and different urban organizations that have vacant and unutilized land can provide the NGOs, agro-forestry nurseries and farms for establishing compost plants and nurseries in urban fringe areas
- Concerned organizations i.e. KCC, Universities and R& D organizations can undertake innovative research based activities on organic compost preparation, problems and prospects, quality control, management and sustainability issues
- Concerned authority i.e. Department of Agriculture can have strict control and monitoring on regular basis to assess and evaluate the quality of organic composts available in the market
- Concerned authorities should take strict punitive measures under the national laws, rules and regulations against the compost producers and suppliers for deteriorating quality of the composts
- Government financing sectors, Banks, and National-International NGOs/donors should provide the NGOs, agro-forestry nurseries and farms with adequate funding to run and extend the business or initiatives of composting and agro-forestry nurseries and farms

### **Conclusion**

About 87% agro-forestry nurseries in Khulna City and its adjacent areas are using their self-made compost due to having lack of confidence on quality of organic composts prepared from Municipal Solid Wastes. So, organic compost fertilizer has great demand in the agro-forestry markets. If the huge amount of unused municipal organic waste i.e. is 8684 tons per month can be used in further producing about 5663 tons of compost, it would fulfill the growing demand of organic compost in urban agro-forestry. Likewise linking compost with urban agro-forestry nurseries and homestead gardens will reduce the volume of waste to be disposed of, increase agro-forestry productivity and introduce a healthier urban environment of Khulna City.

### **References**

- B MDF, 'Study on Municipal Solid Waste Management for Chittagong City Corporation, Rajshahi City Corporation, Rangpur Municipality and Patuakhali Municipality', *Bangladesh Municipal Development Fund (BMDf)*, June 21, 2012. p. 13.
- Brunt, L. P., Dean, R.B. and P. K. Patrick. 1985. Composting. In: *Solid Waste Management, selected topics*. M. J. Suess (ed.) *WHO*. pp. 70-75.
- Lewcock, C.P. 1994. 'Case study of the use of urban waste by near-urban farmers of Kano, Nigeria'. *Visit Report. Project no. A0354 for Natural Resources Institute*, Ghatham, U.K. 23 January- March 7, 1994. p. 69.
- Roy, T. K. 2011. 'Implementation of Municipal Solid Waste Management Improvement Proposals for Khulna City in the Master Plan and Structure Plan of Khulna Development Authority (KDA)', in proceedings of the Waste Safe 2011 – 2<sup>nd</sup> International Conference on Solid Waste Management in the Developing Countries, Organized by Khulna University of Engineering and Technology (KUET), 13-15 February 2011, Khulna, Bangladesh. pp. 148 (2-4).