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# Addendum

Small research and development activity

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# Contents

# COMPOSTING IN BANGLADESH

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**October 2015**

# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| BARI | : | Bangladesh Agricultural Research Institute |
| BBS | | Bangladesh Bureau of Statistics |
| BAU | : | Bangladesh Agricultural University |
| BSMRAU | : | Bangabandhu Sheikh Mujibur Rahman Agricultural University |
| BSS | | Bangladeh Sangbad Sangstha |
| CCAC | : | Community Care Access Centre |
| CCDB | : | Christian Commission for Development in Bangladesh |
| CMES | : | Centre for Mass Education in Science |
| FAO | : | Food and Agriculture Organization |
| GKSS | : | Grameen Krishok Shohayak Sangstha |
| GS | : | Grameen Shakti |
| IAPP | : | Integrated Agricultural Productivity Project |
| IGES | : | Institute for Global Environmental Strategies |
| NATP | : | National Agricultural Technology Project |
| RDA | : | Rural Development Academy |
| RDRS | : | Rangpur Dinajpur Rural Service |
| RUSTIC | : | Rural Unfortunates Safety Talisman Illumination Cottage |
| SSB | | Solid State Bioconversion |
| UNCRD | : | United Nations Centre for Regional Development |

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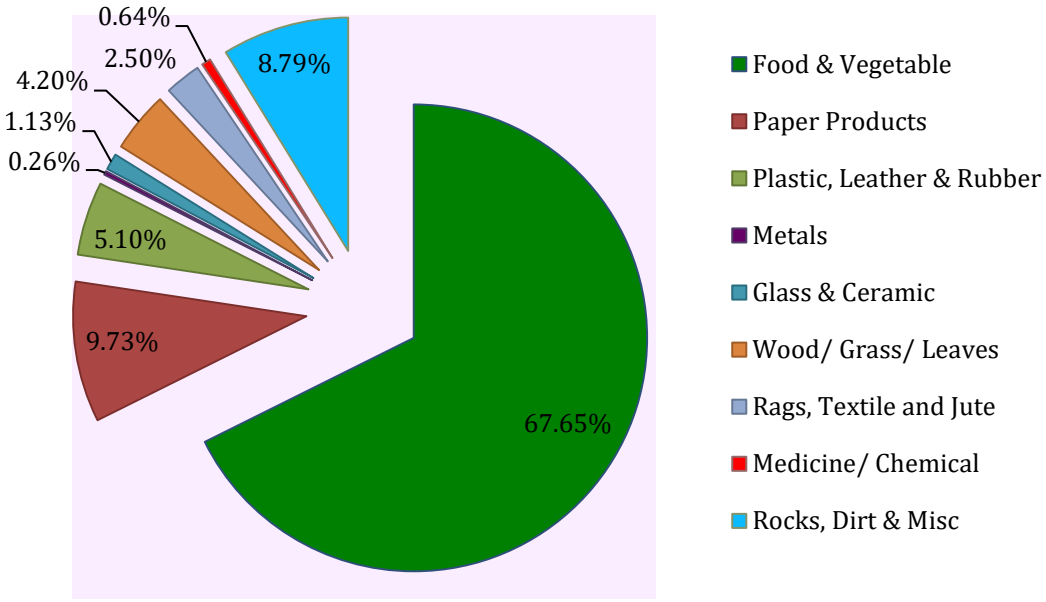
## INTRODUCTION

The term ‘Composting’ was appeared first in the English language in 1587 and the verb ‘to compost’ in 1757 (Mish, 1988) was cited by Fitzpatrick et al. (1998). Composting refers to the biodegradation/bioconversion process, which is controlled by bio-oxidative activities. It is also refers to as an exothermal biological oxidation of organic matter by a group of different microorganisms. It involves a heterogeneous organic substrate, carried out through thermophilic phase and releases phyto-toxin, with leading to the production of carbon dioxide, water, minerals and stabilized organic matter (Haug, 1993 and Campbell et al., 1995). Composting is an aerobic biological process, naturally in which different microbes plays an active role to biodegrade the organic matter into humus, a relatively more stable product (Lau et al. 1992; Liao et al., 1993 and Georgacakis et al., 1996). Composting is generally considered advantageous over landfilling and incineration because of lower investment and operational cost, minimal environmental pollution, and beneficial use of the end product (Wei et al., 2000; Charest and Beauchamp, 2002). Composting process means of producing a valuable end product, by treating of organic wastes without causing a major disruption to the surrounding ecosystem. The product must have some economic values for agriculture use.

Composting is not an innovative process, it is quite old, but recently people interest has turned towards it. However, composting is not anything except bioconversion process (Boopathy, 2000). Recently, bioconversion or bioremediation is already recognized a safe, natural non-hazardous potential avenue of waste elimination (Colwell, 1994; Desai and Banat, 1997). Therefore, composting might be rejuvenated as tool of waste elimination by exploiting the principle of solid-state bioconversion (SSB) process. Baseline information on selected sector of waste (Waste Concern, 2009) is presented in Fig.1. It is also reported average per capita urban waste generation is estimated as 0.41 kg/capita/day and average per capita agricultural waste generation is estimated as 1.68 kg/capita/day (based on rural population in 2008). Agricultural waste is measured as 65 million metric ton annually.

Fig.1. Average Physical Composition of Urban Solid Waste




| | |
|---|---|
| High organic matter | >>(more than 70%) |
| High moisture content | >>(more than 50%) |
| Low calorific value | >>(less than 1000 Kcal/Kg) |
| Lack of space for disposal of solid waste | |

Bangladesh is predominantly an agro-based country. Agriculture is the mainstay of the Bangladesh economy and the means of support for the livelihood of the majority of the people. It accounts for 48.1% of national employment (Bangladesh Bureau of Statistics [BBS], 2011). In Bangladesh, the crops are cultivated in three different growing seasons as cited by Chowdhury & Hassan (2013) namely Kharif-I (mid March to mid July), Kharif-II (mid July to mid October) and Rabi (mid October to mid March). Intensive cropping practice is common in Bangladesh, which requires higher level of land fertility. In order to regenerate the fertility, farmers mostly rely on chemical fertilizers without or less application of compost. Out of the required chemical fertilizer, local manufacturers provide 77% and the rest 23% is imported from abroad (Mamun-ur-Rashid, 2013). Such a fertilizer management practice leaves a massive deterioration of soil fertility status resulting less than 2% organic matter content. In order to overcome this situation, composting/ vermicompsot has been loosely use as one of the feasible alternatives.

The following section outlines the present status of compost and composting technologies, organics recycling and organic waste to agriculture, and innovative programs and practices in composting for the agricultural sector in Bangladesh.

**Composts and composting technologies currently being utilized by farmers, especially poor farmers in Bangladesh**

Composting and uses of compost are being practiced in Bangladesh. No doubt it is the quite old practice for soil improvement and crop production. The use of compost fertilizers however are gaining popularity day by day amongst farmers in Bangladesh (BSS, 2015a). Once its uses were cramped with in the rural areas by poor farmers but recently its demand is gradually increasing and its circle is extended to peri urban and urban areas. Wherever it happens women are directly involved in the whole process. In rural areas, the reasons for practicing compost by the poor farmers are usually to protect their soil from ill effects of chemical fertilizer, avoid high priced inorganic chemicals and to ensure the use of a variety of available organic wastes. The organic wastes, which are usually generated, collected and compiled in household premise for composting, are:

- Crop residues
- Kitchen scraps
- Fruit and vegetable peels
- Grass clippings
- Dry leaves
- Twigs
- Hay
- Ashes
- Cow dung
- Farmyard manure
- Wastes from poultry and animal shade

These putrescible materials are being used traditionally for composting as they do not need (and are not willing) to spend extra money.

**What composting technologies are being used by farmers, particularly the large number of poor farmers, in Bangladesh**

Traditionally composting is practiced as 'trench and pit' systems and sometimes as 'static pile', and it takes six months to one year to be ready for application. Almost every farmer processes compost to his/her household premises in a small scale in order to use in the upcoming cropping season. Farmers are largely motivated to do composting especially for cultivating winter vegetables such as tomato, brinjal, cabbage, cauliflower, radish etc. Still farmers are not aware of and/or lacking in modern techniques of composting. They could not therefore exploit the full potentials of their resources and ultimately fail to get the maximum benefit. Large-scale production of compost/composting process is still missing in rural Bangladesh.

The picture of vermicompost is quite different, not common to every farmer. Although vermicompost has been widely used all over the world including neighbouring country India, it usage is limited to Bangladesh. Yet in Bangladesh, no remarkable research initiative has been made on vermicompost (Mamun-ur-Rashid, 2013). It is, however, becoming popular in farming community in some parts of Bangladesh (BSS, $2015_b$). As cited by Mamun-ur-Rashid (2013), one of the farmers in Manikganj district secures bumper production of eggplants by using only vermicompost presented in Fig. 2. Yadav, Makin, & Khan, (2014) conducted a study on vermiculture technology and proved that nonpoisonous and environmental friendly vermicompost production has a great potential in Bangladesh by earthworm culture. The practice of vermicompost is progressing well in some specific areas of Bangladesh under the tutelage of the Department of Agricultural Extension. Alongside the men, women are also are involved in processing and practising vermicompost technology in rural Bangladesh as shown in Fig. 3.

Fig. 2 Eggplants are cultivated by using vermicompost only

Fig. 3. A woman is separating worms through sieving in Mymensingh District (left) while others are dealing with raw vermicompost in Nilpharmari district (right).

Existing example of good practices is prevalent in the areas of Meherpur district (West part), Mymensigh disctric (Middle) and Rangpur district (North) of Bangladesh.

**What methodologies, what scale, who is doing it, what are they composting/vermicasting?**

Farmers being trained by the Department of Agricultural Extension and some other NGOs practise vermicompost techniques as proposed by Uddin (2015).

## Elements used for preparing vermicompost

- Two species of worms: Red Wigglers (Eisenia f*etida*) and Red Earthworms (Lumbricus *rubellus*)
- Cow dung (60 days of age)/ Household waste/ Straw/ Leaves and twigs
- Ring/ House (One feet high)
- Sprayer for sprinkling water
- Polyethene Sheet
- Sieve
- Bucket
- Shovel

**Production technology**

- Farmers first collect the desired amount of raw cow dung considering the capacity of their house. Then they placed the raw cow dung in the polyethene sheet or floor surface for sixty days in a pile covered with polyethene or sack. As a result partial decompose of the cow dung takes place and it becomes odorless.
- The house is then filled with processed cow dung leaving 2 inches blank on the top.
- Selective worms are released in the house. But the number of worms varies. In a favorable condition, 5000 worms can release 100 kg compost from 200 kg cow dung within 25-30 days. After releasing the worms, farmers lightly sprinkles water in the house. The use of water is critical; either too little or too much water may kill the worms.
- The house is built in a sunny place and fenced it with net to protect from natural enemies such as ants, termites, frogs, chicken and ducks, and other birds.
- The house is covered with sack in order to maintain the natural activities of the worms.
- During sieving if growers identify any other undesirable worms (other than the selective type), they drop it out for composting in the next.

Vermicomposting is currently being practiced by the farmers in 27 districts of Bangladesh under the National Agricultural Technology Project and Integrated Agricultural Productivity

Project of the Department of Agricultural Extension (DAE). In order to promote the technology, DAE provides composting materials such as ring, cements, tin and worms to the poor farmers for preparing vermicompost. In addition to DAE, some other NGOs are also working with poor farmers including women to practice the vermicompost technology. For instance, Rural Development academy intensively works in Bogra and Serpur districts, Unnyaon Dhara covers Dhaka region, CCDB works in Manikgonj, Centre for Mass Education in Science (CMES) and Annapurna Agro Service work in Nilphamari district and Hungers Banglasdesh covers all over the Bangladesh (Pers. Comm, Controll Room, DAE, 2015).

**Is anyone using urban or peri urban organic waste?**

There is no empirical evidence that farmers have started using urban and peri urban organic waste for their composting/vermicompost practices in Bangladesh yet. Around 40=60% of total generated urban wastes are collected for landfilling and dumping; the remaining are kept as open dumped were mentioned by Dhaka North City Corporation (DNCC) in 2007, which was reported by Climate and Clean Air Coalition (www.unep.org/ccac). The urban wastes composted organic substances however are mostly used by urban people in pot cultivation. Recently some NGOs come forward to handle. As reported by UNCRD (2010), the World's First Compost project has been established in Bulta, in the Narayanganj district with the objective of reducing the emission of 89,000 tonnes of green house gas (GHG) in the coming years. Vegetable wastes have been collected using the project's own transport networks and taken to the compost plants. Normally this organic waste is left behind in the city and on the landfill and causes flooding during the rainy season, health hazards and environmental pollution. The project will reduce methane gas (which is 21 times more harmful than $CO_2$) through managing daily waste of 700 tonnes and producing 50,000 tonnes of compost yearly. Besides, the project is said to create employment for 800 urban poor, including women.

**Information about organics recycling and organic waste to agriculture in rural and peri-urban areas**

Cropping intensity is too high in Bangladesh (174%) i, e. a single land is being utilized several times for crop production by the farmers. For these practices increased amount of chemical fertilizers, pesticides and herbicides are being applied for increased crop production. However, the rate of decreasing soil health is higher than the ongoing practices for its improvement. Therefore, it needs to take proper attention to sustain/or improve proper soil health for enhancement of crop growth and yield. The agricultural extension workers are alarming them about the terrible consequences of it and motivating them for using compost and green manuring for soil health improvement. Moreover, farmers are also well experienced about the negative impact of excessive uses of chemical fertilizers. But in

reality, the agricultural extension workers do not have sufficient sustainable technologies to back up farmers. Use of organic waste may be used as a supporting tool for land management and protecting and increasing the fertility of soil as well as agricultural production to the multiple extents (Uddin, 2015).

### Identify and summarize Agricultural Extension work / programs focusing on composting and vermiculture, with a particular focus on poor farmers and/or women

There are several types of compost producers as reported by Rashid (2011) in Bangladesh. Mostly, compost has been produced by private companies like Annapurna Agro service, Waste Concern; autonomous organizations like Rural Development Academy (RDA); NGOs like Grameen Shakti (GS), Grameen Krishok Shohayak Sangstha (GKSS); research/academic institutes like Bangladesh Agricultural University (BAU), Bangladesh Agricultural Research Institute (BARI); and by farmers through traditional methods (mainly using cowdung and ashes). Therefore, by category, several actors are playing role in our compost market sector: entrepreneurs (eg. Achme Laboratories, Rash Agro Enterprise, Farmers), service providers (eg. RDA, GS, Paragon Agro, Rangpur-Dinajpur Rural Service), development facilitators (eg. donor agencies, Katalyst, Innovision Consulting Pvt. Ltd.) and research and extension institutes (eg. BAU, BARI, BSMRAU, RDA).

Recent activities/programs on composting and vermiculture by agricultural extension workers in Bangladesh however are not sufficient and well organized. As usual the agricultural extension workers are merely advocating to the farmers for improvement their soil health by application of compost and green manuring. Also farmers are following their advice to prepare compost but the practicing technique of composting is quite traditional and insufficient. In majority cases agricultural extension workers couldn't provide them any innovative techniques, necessary inputs, practical demonstration for composting process for enhancement of quality or value added compost. Extension workers however, do not have necessary skill and expertise on improved techniques of composting. There is therefore ample scope to help farmers including poor farmers and women by introducing proper project/program by the concerned authorities.

Comparatively the waste (including organic wastes) generation scale is higher in urban and peri-urban areas than the rural areas. Therefore, the scope of recycling wastes as compost in these areas is also higher than the rural areas. Extension workers activities in urban and peri-urban areas are not intensive as in rural areas. But in some peri-urban areas composting of urban organic wastes are being practiced by some NGOs and commercial people. Most of them are practiced it as traditional methods of composting. Semi-improved technique is being practiced by few NGOs. Produced compost is utilized in homestead kitchen garden in peri-urban areas and pot cultivation and roof garden in urban areas.

Sustainable composting project needs continuous supply of sufficient amount of decomposable organic wastes as inputs. By the establishment of well equipped composting and vermicomposting plant in peri-urban areas may ensure quality compost supply to all communities such rural farmers, farmers from peri-urban areas and the people who are uses for roof gardening and pot cultivation.

**Identify programs/projects that include urban or peri-urban organic waste as an input.** Uses of composted urban organic wastes for crop production by farmers are rare. In rural areas, farmers use their own homestead organic wastes (mostly crop residues, cow dung and kitchen waste) for compost production and use it for the sake of their self-cultivation. Generally they do not purchase compost and it is not available in the market as well. But in some specific areas in Bangladesh the uses of vermicompost become popular but not among the poor farmers. Because special type of earthworm and cow dung are required for its production. Both of them are difficult to manage for poor farmers. Urban wastes are not using for production of vermicompost as well. Some NGOs including Waste Concern has undertaken some projects in order to promote composting in some areas of Bangladesh. Some of them are presented below verbatim.

1. Name of the Project: Feasibility Study on Scaling-up of Compost Production and Distribution in Rangpur and Dinajpur District of Bangladesh

   Location: Rangpur and Dinajpur, Bangladesh

   Name of Client: Swisscontact-Katalyst

   Duration of the Project: November 2006 to March 2007

   Objectives of the Project: The broad goal of this study is to come with two major outputs, one is to get an actual overall picture of raw material supply for composting and demand for compost in the Rangpur and Dinajpur and the other one is to prepare an effective business plan to promote sustainable agriculture in Bangladesh. This study will enable to assess the feasibility of compost production, marketing and its use in agriculture in urban and peri-urban areas of greater Rangpur region.

2. Name of the Project: Technical Advisory Services for the Implementation of the Community based Composting Project in Bangladesh

   Location: Kushtia Municipality, Bangladesh

   Project Partners: Department of Environment (DOE), Government of Bangladesh, UNCRD, LGED, and Department of Agriculture Extension

Name of Client: Institute for Global Environmental Strategies (IGES)

Duration of the Project: October 2007 to March 2008

Project Background: The United Nations Centre for Regional Development (UNCRD), under its 3R Initiative, is providing assistance to Bangladesh in implementing demonstration projects to promote 3R in Bangladesh, with financial support from Ministry of the Environment of Japan, through IGES. Waste Concern has been engaged to replicate its model of community based composting system from municipal organic waste in Kushtia municipality.

Objective of the Project: Promotion of 3R (reduce, reuse and recycling) in Bangladesh

Tasks Under the Project: Construction of one community-based composting plant (1.5 ton capacity) in Kushtia Municipality in Bangladesh integrated with house-to-house waste collection. Green house gas emission reduction from the project will also evaluated along promotion of source separation of waste in the municipality. Waste Concern shall carry out a baseline study, prepare IEE report as well as technical design and drawings along with cost estimate and tender documents.

3. Name of the Project: Capacity Building for Composting Activities under Special Programme for Food Security Project in Chak Singa, Bagha, Rajshahi
Location: Rajshahi, Bangladesh

Name of the Client: Food and Agriculture Organization (FAO) of the United Nations

Duration of the Project: October 2005 and July 2006

Objectives of the Project: The main objectives of the project are to provide following services:

- Conducting training sessions (compost unit construction, compost process control);
- Conducting field survey on availability of biomass for composting as well as soil quality;
- Providing periodical supervisions to ensure quality output;
- Preparation of following materials:
    a) Script for capacity building of trainers and farmers, based on which PMU will prepare a Video-CD;
    b) Written manual for farmers;
    c) Written manual for trainers, describing how to facilitate farmers to process

composting and utilize the produced compost; and

d) Posters, particularly on raw material selection and process control.

4. Project Name: Intervention to Improve Existing Composting Technology of Local Compost Producer "Annapurna Agro Service" Based at Domar, Nilphamari, Bangladesh

   Location within country: Dinajpur, Bangladesh

   Name of client: Winrock International, Business Development Service (BDS).

   Duration of the Project : September 2004 to December, 2004

   Narrative description of project and services provided

   - Assess the facilities, raw material and process analysis of a compost fertilizer producer in the greater Rangpur area.
   - Analysis of raw materials and present compost produced by them.
   - Facilitate to improve/develop the composting technology for good quality compost production.
   - Prepare an economic analysis on the cost and benefit of using identified appropriate and affordable composting technology.
   - Analysis of finished compost produced by the semi aerobic composting technology.
   - Recommendation of compost use in agriculture.
   - Build up capacity of the local service provider to produce quality compost followed by appropriate composting technology to cater the need of the farmers.
   - Prepare on economic analysis on the cost and benefit of using the identified appropriate and affordable technology of composting.
   - Recommend application dose of compost along with other chemical fertilizers for maize production in greater Rangpur.

5. Promotion of Composting and Resource Recovery in Dhaka
   Project Period: 2000-2001

   Waste Concern, with support from Oxfam-UK has introduced a pilot barrel type-composting project in two slums of Dhaka city. Under this project Waste Concern will supply specially designed barrel to slum dwellers for composting, which not only solves the waste disposal problem at source but at the same time has created income generating activities for the slum dwellers.

6. Barrel Type Composting for Slums in Dhaka

   Project Period: 1998-2000

   Waste Concern, with support from UNDP's LIFE program has introduced a pilot barrel type-composting project in two slums of Dhaka city. Under this project Waste Concern has supplied specially designed barrel (as shown in Fig. 4 and Fig. 5) to slum dwellers for composting, which not only solves the waste disposal problem at source but also has created income generating activities for the slum dwellers.

Fig. 4. Organic Waste being disposed in the green Barrel

Fig. 5. Composting harvested from the Green Barrel (after four months)

**Are there any examples of composted (or vermicast) urban organic waste being used by farmers?**

Going through the empirical literature it is found that farmers are getting composted urban organic waste being processed by two organizations, which are presented below.

Only a small portion of Dhaka's organic waste is diverted before being transported to the city's landfills or deposited in open spaces. However, on small scale, private composting company is currently collecting (for a fee) and processing approximately 100 metric tons of organic waste per day, and selling the compost to local farmers (CCAC, 2007)**.**

Roy, Rahman, & Dev (2013) conducted a study on compost fertilizer and found that 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 Rural Unfortunates Safety Talisman Illumination Cottage (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.

**Information on innovative programs and practices in composting for the agricultural sector in Bangladesh**

Commercially some NGOs are conducting the project on composting by using urban organic wastes and kitchen wastes in urban and peri-urban area. Generally it is a small scale project and the composting is practicing mostly as windrow and static pile system. In majority cases, neither they use any mechanical device nor they apply any potential microbes for composting. Most of the activities are doing manually. The existing scenario/practicing is not recognized as innovative approach of composting.

**Identify the innovative programs and practices, especially those that involve poor farmers and/or women.**

Based on the informed literature two NGOs are identified, namely GETCO Agro vision and Rural Development Academy are using *Trichoderma* spp for composting process. It is reported by Rashid (2011), Innovision has been facilitating for the development and promotion of *Trichoderma*- enhanced composting (TEC) technology and its sustainable link-up at the farmers' end. Through the collaboration with GETCO Agro Vision, 60 contract seed growers have received extensive trainings on this TEC technology. The TEC refers to the use of *Trichoderma*, the soil borne, natural fungus, as an activator in the decomposition process which efficiently reduces the de-composting-duration and ensures some value addition (eg. bio-pesticide) in the final product (Tricho-compost). By this time, demonstrations and field days on the benefits of using Tricho-compost have created huge response among so many farmers in the community, showing a high potential of its increase usage. Until now, nearly 160 farmers in Rangpur, Dinajpur and Meherpur districts became directly knowledgeable about the TEC technology.

It is also reported by Husain (2011) that Rural Development Academy (RDA) is going to produce *Trichoderma* (a soil borne fungus which speeds decomposition of organic material) activator in its newly established culture laboratory at Sherpur, Bogra. Katalyst partnered with RDA to develop the technology and also to popularize it among the farmers. This intervention has engaged the Integrated Pest Management (IPM) unit of Bangladesh Agriculture University (BAU). The objective of this partnership was to develop technology,

provide technical support and train the staff. Two scientific officers were recruited and trained on *Trichoderma* compost production by BAU under this intervention.

RDA will incorporate the information on benefits of using Tricho-compost in their current and future training modules. The Scientific Officers will conduct six training programs for 180 Local Service Providers (LSPs) and Plant Doctors of RDA on *Trichoderma* based compost production technology and marketing. These LSPs and the Plant Doctors will work as sales agents of RDA to market the *Trichoderma* activators in their respective localities. RDA will also initiate promotional activities to increase awareness on using compost among the farmers. The promotional activities include plot demonstration and field days, distribution of pictorial leaflets on the importance and benefits of Tricho-compost. A video documentary on the use of compost fertilizer will also be developed to help farmers understand better.

Obviously undertaking these innovative approach is quite encouraging and will play a tremendous role for further flourishment of composting process. The performance of *Trichoderma*-enriched composted through SSB technique of organic wastes is quite satisfactory in field crop production. It is not only influence yield of crop and improve of soil health but also enhance nutritional quality (Molla, Haque, Haque, & Ilias, 2012). Moreover, the application of *Trichoderma*-enriched bio-organic fertilizer minimizes NPK uses and most of the cases it reduced the 50-70% cost of N-fertilizer uses as optimal dose for corn, tomato and bottle gourd cultivation (Haque, Haque, Ilias, & Molla, 2011; Molla, Fakhru'l-Razi, Hanafi, & Alam, 2005; Molla et al., 2012)). Presently our poor farmers and /or women are not practicing it. But there is potential scope to involve poor farmers and women at composting process of organic wastes by ensuring availability of potential non-phytopathogenic, beneficial and capable of fast decomposing microbes.

## Where are the opportunities?

There are ample opportunities on production of value added compost in Bangladesh by exploiting huge generated urban organic wastes i.e. municipal solid wastes (MSW) in major cities, and ensuring participation of available poor farmers and/or women along with application of innovative techniques. There are more than 522 towns and cities (UNCRD, 2010) where thousand of tons of waste are generated from domestic, industrial, commercial, health care facilities and agricultural sources. In Dhaka city solid waste generation rate is approximately 4520 metric tons per day, more than 80% of it is organic matter (APO, 2007; Dhaka North City Corporation). Alamgir & Ahsan (2007) conducted a study on solid waste management and reported that potential for waste recovery and reduction based on the waste characteristics are evaluated and it is predicted that 21.64

million US$/yr can be earned from recycling and composting of municipal solid waste. A number of studies have been conducted to determine the composition of wastes including moisture content and calorific value. The data show that the moisture content in city waste is significantly higher and the calorific value is much lower, which determines the viability of composting or anaerobic digestions rather than waste combustion (Yousuf & Rahman, 2007).

In near future Rural Development Academy will ensure proper distribution of produced *Trichoderma* activator through developing a marketing channel. If successful, RDA will expand their commercial production of *Trichoderma* and gradually RDA will be a potential service provider in the commercial compost manufacturing sector in future. Besides, RDA will continue the promotional activities on using *Trichoderma* to cater to the future expanding market. It is expected that as a result of these activities, the growth in supply and usage of low cost demand of compost at farmers' level will increase (Husain, 2011).

With the advent of renewable energy technologies, there has been a strong growth in the number of biogas plants across the country. Both large-scale commercial biogas plants and home-based small-scale biogas plants are increasingly being installed in Bangladesh. Every household, which has a small poultry farm, and/or, a few cattle are the potential customer for a biogas plant. The bio-slurry (by-product generated from bio-gas plant) is an excellent compost source. This bio-slurry can be collected from large bio-gas plants owned by large scale poultry or dairy farms and marketed commercially or it can be used by the small scale plant owners for their own agricultural crops (Rashid, 2011).

**What needs to happen next?**

Using an efficient composting technology and its promotion is a prime need at this moment. All the following activities would hopefully contribute to the development and delivery of quality compost available at the doorstep of farmers and practically its usage in cropland.

- A continuous promotional campaign is essential to develop awareness on commercial value of waste management through information, education and demonstration projects.
- Initiative should be taken to motivate farmers across the country about the benefits of using compost and its actual usage in crop field in a sustainable manner.
- Continuous promotional activities such as demonstrations and field days on the benefits of using compost technologies should be organized to raise awareness

about the benefits of using compost and popularize the increased rate of compost application practice.

- Training on sustainable innovative technologies of composting should be given to potential growers with a particular focus on poor farmers and/or women.

- Development and promotion of value added composting (TEC) technologies and its sustainable link-up at the farmers' end should be facilitated and strengthened.

- Availability of compost should be linked with increased number of producers both at commercial and individual farmers' end.

- Finally, a suitable policy and regulatory environment within the country are imperative to encourage investment by all types of stakeholders for maintaining soil health.

- Concerted efforts should be made to encourage all households to purchase and use compost bins available in the market. As part of the strategy, the City Corporations/ Pouroshavas should provide market information; negotiate with the suppliers and arrange for higher purchase systems; and also develop appropriate subsidies for the poorer sections to obtain the bins.

- Concerned authorities should provide subsidies to potential producers for establishing physical facilities for producing value added compost such as composting shed, composting pad, separator, cutter and sieve for composting substrate, mixer or equipment for tern over periodically, inoculum of non-phytopathogenic beneficial microbes and water spraying operating system, vessel for composting etc.

## REFERENCES

Alamgir, M., & Ahsan, A. (2007). Municipal Solid Waste and Recovery Potential : Bangladesh Perspective. Iran. J. Environ. Health. Sci. Eng, 4(2), 67–76.

APO, 2007. (http://www.apo-tokyo.org/publications/files/ind-22-swm.pdf).

Boopathy, R. 2000. Factors limiting bioremediation technologies. Bioresource Technology, 74, 63-67.

BSS. (2015a). Compost fertilizers gaining popularity in Manikganj. 5th February, The Bangladesh Today.

BSS. (2015b). Vermi Compost Protects soil Nutrients and Raise Crops Production. 20th June, The Bangladesh Today.

Campbell, A. G., Zhang, X. and Tripepi, R. R. 1995. Composting and evaluating pulp and paper sludge for use as a soil amendment/mulch. Compost Science and Utilization 3(1), 84-95.

CCAC. (2007). Solid Waste Management in Dhaka. CCAC. Retrieved from www.unep.org/ccac

Charest, M. -H. and Beauchamp, C. J. 2002. Composting of de-inking paper sludge with poultry manure at three nitrogen levels using mechanical turning: behavior of physico-chemical parameters. Bioresource Technology, 81, 7-17.

Chowdhury, M. A. H., & Hassan, M. S. (2013). Hand Book of Agricultural Technology. (M. A. H. Chowdhury & M. S. Hassan, Eds.). Farmgate, Dhaka-1215: Bangladesh Agricultural Research Council.

Colwell, R. R. 1994. Scientific foundation of bioremediation and gaps remaining to be filled. Research Microbiology, 145, 40-41.

Desai, J. D. and Banat, I. M. 1997. Microbial production of surfactants and their commercial potential. Microbiology and Molecular Biology Reviews 61, 47-64.

Fitzpatrick, G. E., Duke, E. R. and Klock-Moore, K. A. 1998. Use of Compost Products for Ornamental Crop Production: Research and Grower Experiences. HortScience, 33(6), 941-944.

Georgacakis, D., Tsavdaris, A., Bakouli, J. and Symeonidis, S. 1996. Composting solid swine manure and lignite mixtures with selected plant residues. Bioresource Technology, 56, 195-200.

Haque, M. M., Haque, M. A., Ilias, G., & Molla, A. H. (2011). Trichoderma-Enriched Biofertilizer: A Prospective Substitute of Inorganic Fertilizer for Mustard (Brassica campestris) Production. The Agriculturists, 8(2), 66–73. doi:10.3329/agric.v8i2.7579

Haug, T. R. 1993. Biological fundamentals. In The Practical Handbook of Composting Engineering, pp121-159. Lewis Publishers.

Heerden, I. V., Cronjé, C., Swart, S. H. and Kotzé, J. M. 2002. Microbial, chemical and physical aspects of citrus waste composting. Bioresource Technology, 81, 71-76.

Husain, F. (2011). Low cost quality compost to help farmers. Katalyst, (32), 2011–2012.

Lau, A. K., Lo, K. V., Liao, P. H. and Yu, J. C. 1992. Aeration experiments for swine waste composting. Bioresource Technology, 41, 145-152.

Liao, P. H., Vizcarra, A. T., Chen, A. and Lo, K. V. 1993. Composting separated solid swine manure. Journal of Environmental Science and Health, 28(9), 1889-1901.

Mamun-ur-Rashid, M. (2013). Vermicompost or Kecho Fertilizer. September, Krishi Bartha, Krishi Foundation, Krishibid Group, Kazipara, Mirpur, Dhaka.

Mish, F. C. 1988. Webster's ninth new collegiate dictionary. Merriam-Webster, Springfield. Mass.

Molla, A. H., Fakhru'l-Razi, A., Hanafi, M. M., & Alam, M. Z. (2005). Compost produced by solid state bioconversion of biosolids: A potential resource for plant growth and

environmental friendly disposal. Communications in Soil Science and Plant Analysis, 36(11-12), 191–199. doi:10.1081/CSS-200058487

Molla, A. H., Haque, M. M., Haque, M. A., & Ilias, G. N. M. (2012). Trichoderma-Enriched Biofertilizer Enhances Production and Nutritional Quality of Tomato (Lycopersicon esculentum Mill.) and Minimizes NPK Fertilizer Use. Agricultural Research, 1(3), 265–272. doi:10.1007/s40003-012-0025-7

Rashid, S. Z. (2011). Composting and Use of Compost for Organic Agriculture in Bangladesh. In International Conference for the Development of Integrated Pest Management in Asia and Africa (20-22 (pp. 1–9).

Roy, T. K., Rahman, S., & Dev, P. K. (2013). C ompost Fertilizer from Muni cipal Solid Wastes and its Application in Urban Agro-forestry Nurseries: A Case Study on Khulna City. Journal of Bangladesh Institute of Planners, 6 (December), 191–199.

Uddin, S. M. K. (2015). Vermicompost Bangladesh. Retrieved from http://vermicompostbd.com/

UNCRD. (2010). Country Presentation Bangladesh. 2nd Meeting of the Regional 3R Forum in Asia. Kuala Lumpur, Malaysia.

Waste Concern. (2009). Waste Data Base of Bangladesh. Waste concern.

Yadav, S. K., Makin, A. A., & Khan, Z. K. (2014). Small-Scale Compost Production through Vermiculture Biotechnology. International Journal of Research in Agriculture and Forestry, 1(2), 7–12.

Yousuf, T. Bin, & Rahman, M. (2007). Monitoring quantity and characteristics of municipal solid waste in Dhaka City. Environmental Monitoring and Assessment, 135(1-3), 3–11. doi:10.1007/s10661-007-9710-6

Wei, Y. -S., Fan, Y. -B., Wang, M. -J. and Wang, J. -S. 2000. Composting and compost application in China. Resource, Conservation and Recycling, 30, 277-300.

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## Organic Waste Recycling and On-Farm Composting in Bangladesh

**By Dr Tariq Bin Yousuf***

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### Organic waste recycling and its utilization

Agriculture, horticulture, home gardening, nurseries, and municipal gardens and parks are the major markets for compost. In the developed countries compost is also used in landscaping, land reclamation, landfill cover, top soil blender and golf courses. Two types of market exist for compost – one is the high value-low volume and the other is the low value-high volume market. In the high value-low volume market, the customers are willing to pay a high price and want good quality compost. In the low value-high volume market, the customers want bulk volume at a lower price (Dulac 2001). In Bangladesh, Compost production from urban waste is very insignificant. There is a problem from both demand and supply side. In the urban areas, compost is mostly used in nurseries. However, the nursery owners used to make compost of their own by using leaves and cow dung. Some nurseries sell compost of others. But the demand is very slow. In the peri-urban areas, both cow dung and poultry litter are used as soil conditioner for agricultural land. In the rural areas, the farmers use to keep cow dung in a trench, put their daily waste in it, and keep them for 2/3 months. After that they use it in vegetable cultivation.

The most important areas of compost application are:

- Agriculture could be the largest potential market for compost in Bangladesh. However, this sector is mostly controlled by the Chemical Fertilizer dealers. The Agriculture Extension Department of Government of Bangladesh is a big avenue for compost promotion through block supervisors. This channel is used only for demonstration purpose not for marketing gateway of compost. The potential use of compost in (peri-) urban areas for crop cultivation is highly demanded. (Peri-) Urban agriculture can ensure food security, improve the environment and contribute to urban economies. International funding and research agencies are increasingly recognising the great potential of organic waste in urban agriculture and are

advocating for bringing agriculture back into the towns and cities. In Bangladesh, this market is not explored or utilized as yet.

- Horticulture, the growing of fields of fruits and vegetables in the (peri-) urban areas, is a promising market for compost. Organic farming is becoming a growing industry that utilises food wastes to produce fresh foods for the city dwellers. Asia has the growing and exporting potential for organically grown products. The growing interest in organic methods of farming and exporting by Asian countries such as Japan, China, Sri- Lanka, Philippines, Indonesia, Malaysia and India is increasingly recognising the great potential of organic solid waste reuse and recycling in urban lands (Silva 1995). Bangladesh, with the help of the Hortex organic programme, is producing and exporting baby pineapples and organic vegetables (Caldas 2001). Organic farming is more expensive than the traditional farming. Organic foods and vegetables are more highly priced than the conventionally grown foods. The market for organic foods is limited but people from the United States, European Union and Japan who usually buy organic products are motivated by an increased awareness of health and safety (Hart and Pluimers 1996). In Bangladesh, due to uncontrolled use of pesticides and chemical fertilizers, one type of customers buys organic vegetables from malls. But the supply side is poor and the cost is abnormally high.
- Home gardening in yards, containers, roof-tops and balconies is very popular. The urban residents grow ornamental plants and flowers to beautify their houses and sometimes vegetables to supplement their household diets. They use compost buying from the markets. They buy it from nurseries.
- Nurseries in the urban areas grow ornamental plants and flowers. The nurseries are the main suppliers of saplings for city plantation and greening programmes and are potential users of compost.
- Landscaping, public parks and green belts maintained by municipal agencies have a large usage of compost. But due to lack of initiative, the composts from organic wastes are not used much.

## Composting initiative in Bangladesh

### Composting in Mymensingh Municipality (Yousuf 2015)

In 2004, DPHE and UNICEF implemented the 'Environmental Sanitation, Hygiene and Water Supply in Urban Slums and Fringes Project' in four City corporation and ten Municipalities namely Mymensingh, Noakhali, Comilla, Bogra, Jessore, Barisal, Patuakhali, Rangamati, Bandarban, and Khagrachari. The pilot scheme on solid waste management and composting had been implemented under the project. The purpose of the pilot project was to promote the concept of community based solid waste management with 3R (reduce, reuse, recycle of waste) principles by introducing decentralized small scale composting and recycling with a target of reducing the burden of waste of Municipality and generate income and employment opportunities for the urban poor. As part of the pilot project, composting facility in the name of Eco-park was developed. Mymensingh Municipality provided land for the composting facility. Box-type composting with four chambers were constructed and for compost demonstration, flower garden was established. The project invested BDT 1 to 1.5 million for each plant with the assumptions that the plant will generate 100 percent operational costs within six months. However, it was found that not a single compost plant was achieved its objective through regular production and marketing of compost and thus able to demonstrate successful and self-sustainable composting plant. The operation of the composting plant was stopped after the project period.

In 2007 UNICEF engaged CARE Bangladesh to review the operational challenges of the composting plant. The review findings revealed that municipal management and relevant staff members did not receive required support to make them functional as a financially viable unit. The reasons identified were: i) problems with regular and quality waste collections ii) lack of community mobilization and support and iii) no marketing strategies. The plant became liability to the Municipality. Community participation is very important to ensure the supply of the right quantity and quality of waste to the compost plant. Quantity of waste was not sufficient to utilize the full production capacity of the composting plant. Municipality had shortage of waste collection vans. There was no source segregation system in the household level to get the right kind of input in the plant. There was no marketing strategy in place, any packaging, pricing and promotion initiatives as well.

Having come to know the challenges, the composting plant was tried to revive and brought into operation in 2009 by Practical Action by GIZ support. Practical Action engaged Grameen Monobik Unnoyan Shanstha (GRAMUS) to operate the composting plant. For the

efficient collection of waste from Ward- 4, 6 & 8; three CBOs (MATI, TUS and SBSKS) were engaged, 16 rickshaw vans were provided. Power tillar trolleys were provided by the Municipality for collection of waste from the said wards and transported to composting facility. Six more chambers of Box composting were constructed. 4 tons of compost was produced with a brand name GMTS Eco Compost. The compost was tested and demonstrated in Bangladesh Agriculture University. GRAMUS applied certification for marketing of their compost and they have got the approval recently. They sold the compost to the buyers who are their microcredit buyers. For the sales promotion, they organized farmers meeting in nearby areas. After the project period when the waste collection of the pilot wards was taken by the ward councilors from the CBOs, it was hard for GRAMUS to get waste in the composting facility. It was also difficult for them to sale the compost without certification. From February 2015, they stopped the operation of the plant and hoping to start again after getting the certification of selling compost. During the field visit, it was found that another 10 chambers of box composting was constructed from UNICEF-UPPR Community based Integrated Solid Waste Management project spending 20.26 lac BDT but the plant was not started its operation. A new construction of composting project (with 10 chambers box-type) from Department of Environment under Programmatic CDM has been started. The operation of the composting plants in Mymensingh Municipality is challenging; however GRAMUS has a plan to start operation in a larger scale after getting the certification from Ministry of Agriculture which they have got recently.

Under the Practical Action-GIZ program, 4 units of vermin-composting, 9 units of barrel composting and 1 unit waste to bio-gas plant were constructed but none of the initiatives was found operational. Only the bio-gas digester was found operational but the feedstock was cow-dung not kitchen waste.

The success of any composting plant comes from selling of compost. However, in Mymensingh, the private entrepreneurs were struggling for the marketing permission of compost which they have received recently. Service chain for waste collection is established but the compost value chain has still scope to improve.

**Quality of Compost**

Quality is important in creating a demand and achieving a market for compost. Compost should be fully decomposed, should be clean, pathogen free and absence of obnoxious odor. In addition compost should be free from both physical and chemical contaminants and acceptable to the end-users. In Bangladesh, source-segregated wastes are not collected for the composting plant and compost may be contaminated by glass pieces, plastics, heavy

metal etc. Heavy metal contamination may be caused by discarded household items such as batteries (Hg, Cd, Zn), bulbs (Hg), paints (Cr, Pb, Cd) and used medicines. There is a general concern of pollutants in urban solid waste derived compost and there is a fear of contamination of vegetables produced from waste derived compost.

GRAMAUS carried out test of their compost quality in Agricultural University Lab, the SDRI lab. In addition, they have purchased some equipment to run their own lab.

Nutrient Analysis of GRAMAUS Compost

| S.No. | Institute | Date | N (%) | P (%) | K (%) | S (%) | PH | MC (%) | OC (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | BAU | 28.06.2011 | 1.008 | 0.704 | 1.705 | 0.34 | 8.57 | 9.92 | 9.979 |
| 2 | BAU | 09.03.2011 | 1.68 | 0.708 | 1.273 | 0.117 | 7.24 | 12.43 | 15.676 |
| 3 | BAU | 03.02.2011 | 0.784 | 0.37 | 1.364 | 0.05 | 7.25 | 14.89 | 16.24 |
| 4 | BAU | 08.06.2010 | 0.336 | 0.559 | 0.426 | 0.36 | 7.35 | 12.25 | 14.63 |
| 5 | BAU | 24.06.2010 | 1.4 | 0.364 | 1.3 | 12.86 | 7.29 | 37.05 | 10.764 |
| 6 | BAU | 11.11.2010 | 1.176 | 0.0136 | 1.109 | 0.122 | 7.15 | 18.3 | 7.187 |
| 7 | BAU | 11.11.2010 | 1.028 | 0.067 | 1.109 | 0.147 | 7.4 | 27.9 | 12.579 |
| 8 | SRDI | 25.11.2010 | 1.09 | 2.5 | 0.94 | 0.15 | 7.7 | 27.13 | 16.14 |
| 9 | SRDI | 06.09.2010 | 0.84 | 0.44 | 0.83 | 0.07 | 8.2 | 42 | 11.23 |

**Composting in Peri-Urban and Rural Areas**

**Xplore business limited** has developed a model to ensure easy access to quality compost fertiliser to the farmers. This model has created opportunities for Small Compost Producers to expand their businesses throughout the country and also help them to increase their capability of producing and marketing their product. It has ensured an effective and sustainable channel for quality compost production and distribution such that farmers are benefitted.

**Annapurna Agro Service** is a private compost producing company located in the Nilphamari district of Bangladesh. Their main work is to establish a production and distribution network for compost fertilizer in the northern parts of the country. Their

developed model works for ensuring smooth transfer of vermi composting technology to the farmers.

**Innovision Consulting Pvt. Ltd.** facilitates several input companies in the fertilizer sector as implementing partners directly with some promotional activities at their market distribution level like dealers' trainings and farmers' meetings. These activities support to build-capacity of fertilizer input companies also. The activities like dealers' trainings and farmers' meetings are undertaken to disseminate the information on importance of balance fertilization and benefits of applying sufficient amount of compost in the crop land. Currently, micronutrient fertilizer companies like National AgriCare and Paragon Agro, mixed fertilizer company like NAAFCO Pvt. Ltd., have directly trained nearly 400 top distributors/dealers throughout the country. Also, Innovision has facilitated these companies to conduct meetings directly engaging 40,000 farmers' to promote the increased practice of balance fertilizer application and sufficient compost usage to obtain better yield performance and to regenerate the soil fertility of Bangladesh.

**RUSTIC** receives about 65 tons solid wastes per month from Khulna City Corporation (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 BDT 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 BDT15 to BDT 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.

**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 BDT 50 per pack, i.e. BDT 25 per kg. The

wholesale price is BDT 8 per kg., i.e. 50 kg. sack is sold at BDT 400. About 150 packs of fertilizer have been sold in the Tree Fair.

**Both-Aids** Earth worm (Vermi), water and cow dung is 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. Wholesale price of Vermi-Compost is BDT 12 to BDT 14 per kg. and its retail price is BDT 20 per kg.

**Christian Commission for Development in Bangladesh (CCDB)** under its project Comprehensive Poverty Reduction Programme (CPRP) is running the vermi compost programme at Koyer Chala, Bakta, Enayetpur, Rangamatia, Kanchichura and Nischintapur villages in Phulbaria, Mymensingh to make the rural poor women self-reliant through producing vermi compost. The vermi compost can be produced easily at home stead using a cement slab ring or a big earthen bowl (chari) to keep the earth worms. Once bin is ready, bedding materials like sand, small pieces of brick is put in it. The worms put in the bin are covered with a layer of bedding, gunny bags or other structure to protect the worms against sun, downpours and birds. Twenty kgs of cow dung along with 20 kgs of bio-waste like straw, hyacinth and vegetable waste are kept in the bin as feedstock for half kg worms. The amount of bio-compost what the earthworms eat up, they release its half amount as \'tea dust like\' stool which is called vermi compost. Later the vermi compost is separated through chaloni (sieving/straitening). At initial stage a grower will get 20 to 25 kg vermi compost after 45 to 60 days. But the harvest period is reduced when the worms' number increases at the bins. The surplus worms can be sold at BDT 1500 per kg. One kg vermi compost is sold at BDT 8. Now some 200 women are involved in vermi compost production in Phulbaria. The vermi compost improves soil organic matter, maximizes retention of nutrients in the soil and maintains balanced soil level etc.

| Company name | Faruk Fertiliser Limited |
|---|---|
| Product | Nutrient enriched organic fertiliser from poultry litter<br>Brand name: Chook Chook<br>Product variety : 7 product designed according to Fertiliser Recommendation Guideline for betel leaf, root and tuber crops, rice, sugar cane, pot and garden plants , banana and vegetables |
| Location of the facility | Kaliakoir ( 40 km away from Dhaka city) |
| Price | BDT 40/kg |
| Production capacity and sale | Production capacity 1200 ton/year, sale : 600 ton/year |
| Nutrient content | N-7.8%, P-8.45 %, K- 3.75 %, OM 25.36 % |
| Package | 2 and 12 kg bag, information inscription of ingredients, nutrient value, benefits, application dose and procedures |
| Distribution | 250 chemical fertiliser dealers in 46 districts, nursery retailers |
| Promotion | Free samples, advertisement in newspaper, poster, leaflets |

| Company name | Aftab Fertilisers and Chemical Limited |
|---|---|
| Product | Nutrient enriched organic fertiliser from poultry litter<br>Brand name: Power super organic fertiliser<br>Product variety : For rice and potato |
| Location of the facility | Bazitpur (180 km away from Dhaka city) |
| Price | BDT 15/kg |
| Production capacity and sale | Production capacity 200 ton/year, sale : 200 ton/year |
| Nutrient content | N-8%, P-20 %, K-14 %, S- 5% OM 40 % |
| Package | 1/2 and 1 kg bag, information inscription of ingredients, nutrient value, benefits, application dose and procedures |
| Distribution | Own pesticide distribution channel |
| Promotion | Dealer incentives, advertisement in local newspaper and magazines, leaflets |

| Company name | Bangladesh Environmental Products and Management Limited |
|---|---|
| Product | Nutrient enriched organic fertiliser from a mixture of cow-dung, bone meal, dry blood<br>Brand name: Susoma organic fertiliser<br>Product variety : For rice, fruits and orchard |
| Location of the facility | Savar ( 20 km away from Dhaka city) |
| Price | BDT 25/kg |
| Production capacity and sale | Production capacity 100 ton/year, sale : 100 ton/year |
| Nutrient content | N-8%, P-6 %, K-4 %, OM 30% |
| Package | 15 kg bag, information inscription of ingredients, nutrient value, benefits, application dose and procedures |
| Distribution | Fertiliser dealers |
| Promotion | Demonstration plots at Bangladesh Agriculture Research Institute ( BARI) and Bangladesh Rice Research Institute ( BRRI), leaflets |

Alternative agriculture/ecological agriculture introduced by **UBINIG, CDA and PROSHIKA** seems to be a significant step towards bringing back the original biodiversity and ecosystem, conserve the native gene pool and enrich the self-fertility of the soil. UBINIG is trying to conserve or revive the natural ecosystem or resources through its "Nayakrishi". The organization is practicing ecological agriculture at its training center and also motivating the farmers to practice it. CDA is doing farmer-centered research as Regenerative Agriculture, which is mostly concerned about soil conservation. Their activities are confined at Dinajpur district where the soil is hard and dry. The compost preparation of CDA is easier. PROSHIKA is trying to restore the original ecosystem through its ecological agriculture programme. Different kinds of bio-degradable organic matter (leaf, rice straw, household garbage) mixed with cowdung are used for compost preparation, it can make soil soft, moist, and fertile. PROSHIKA uses shal leaves, rice straw, and other crop remnants as mulching for Ginger. Some of the villagers grow pulses, dhaincha in their field and mix with the soil by tillage before crop cultivation as green manuring.

Making quick compost is an option followed by the farmers to make soil fertile. Materials they use for quick compost are cowdung, rice bran (kura), ash, oil cake, chicken and duck manure. First they smash the oil cake which is then mixed with ash, rice bran, chicken and duck manure. After 2-3 days this mixture is mixed with cow dung and kept for 15 days to make it suitable for use. It can be preserved for a long time after drying.

**Rural Development Academy (RDA), Bogra** as a service provider for commercial Trichoderma, the active de-composting agent for compost, and promoting Trichoderma-enhanced composting technology both at the commercial and individual farm level. Trichoderma is a soil borne beneficial fungus, which enhances the de-composition of organic materials within 4-5 weeks.

In Bangladesh decline of soil fertility is due to intensive use of lands without proper replenishment of plant nutrients. Crop residues and cowdung are used as fuel hence farm yard manures or compost are seldom applied in the soil. Organic matter is considered as the life of soil because it increases soil porosity (helps aeration) water and temperature holding capacity, add micronutrients and acts as substrate for the soil microbes. A good soil should have an organic matter content of 3.5%. The organic matter content of our top soil (medium and highlands) has gone down from 2% to 1% over the past 20 years. Similar is the picture of organic carbon and micronutrients. Realizing the problem emphasis has been given for the improvement of soil health in the Agriculture Policy of the Government. As a result the Department of Agricultural Extension (DAE) has been trying to making awareness and encouraging the farmers to make compost using crop and household residues, water hyacinth etc- throughout the country. A large number of farmers have already adopted the technology as evident from the large number of compost heaps by the road side. The information on the exact number of farmers involved and the quantity of compost produced is not available at one point at this moment. This indicates that awareness has been created among the farmers to improve their soil with compost.

Biogas is a potential renewable energy alternative to the energy produced from firewood or kerosene etc. This technology uses cowdung, poultry litter, water hyacinth and other biomass wastes to produce biogas thereby ensuring a smoke free, ordor-free and healthy cooking environment for rural women. Bioslurry is obtained as a by product from the biogas plants. Bioslurry is a 100% organic fertilizer which can play vital role in restoring fertility as well as organic matter status of the soil. It is environment friendly, has no toxic or harmful effects and reduce the use of chemical fertilizers to a great extent. Analysis showed that it contains

both macro and micro nutrients besides organic matter. The infrastructure Development Company Ltd (IDCOL) with financial support of Netherland Development Organization is providing technical and financial support in promoting biogas plant in the country with 28 partner organization. Among these organizations Grameen Shakti is the lead agency which shares more than 50% of biogas plants being constructed in the country. A small biogas plant costs BDT. 24000 of which BDT 9000 is given as subsidy by IDCOL and the rest is either the farmer's own or can take loan from Grameen Shakti or other organization. These organizations have installed 6000 biogas plant during the last 2 years. Currently more than 30000 biogas plants of varying gas producing capacities (2-6 $m^3$) run with cowdung and poultry litter for domestic purposes and some large sized ones in poultry and dairy farms are in operation in the country. These biogas plants produce 200000 tons of bioslurry on dry weight basis worth of BDT 1120 million (@ BDT. 5/kg wet basis) (16.23 million $), which is equivalent to 9000 t of urea + 25000 t of TSP + 3200 t of MoP plus other secondary micronutrients. Grameen shakti is going to market their bio-slurry in the brand name of "Grameen Shakti Joibosar" soon.

**On farm composting in Bangladesh**

Composting from solid waste is very new in Bangladesh. Waste Concern, a local NGO first started community-based composting project in Dhaka in the year 2001. It then replicated through PRISM Bangladesh in Khulna City. Through UNICEF, composting plants were constructed in 14 municipalities. The composting plants were located either in the community or in the dump site of the municipalities. The sizes of the composting plants were 1 to 5 ton capacity. It was found from the mass flow analysis of the composting plant that most of the composting plants were operating below the design capacity. The only large size composting plant (130 tons/day capacity) has been operated by World Wide Recycling (WWR) and Waste Concern (WC) in Dhaka taking the wastes from kitchen markets. However, at present most of the plants become redundant or scaled down in operation because of lack of compost marketing initiative. The total compost production from the composting plants is very insignificant, only 2 percent of the total generated wastes. On the demand side, there is no established market for compost. Most compost plants found difficulty in marketing their compost. However, WWR & WC have been successful in marketing compost through the distribution network of Advanced Chemical Industries (ACI).

There are few but some good initiatives on on farm composting in Bangladesh:

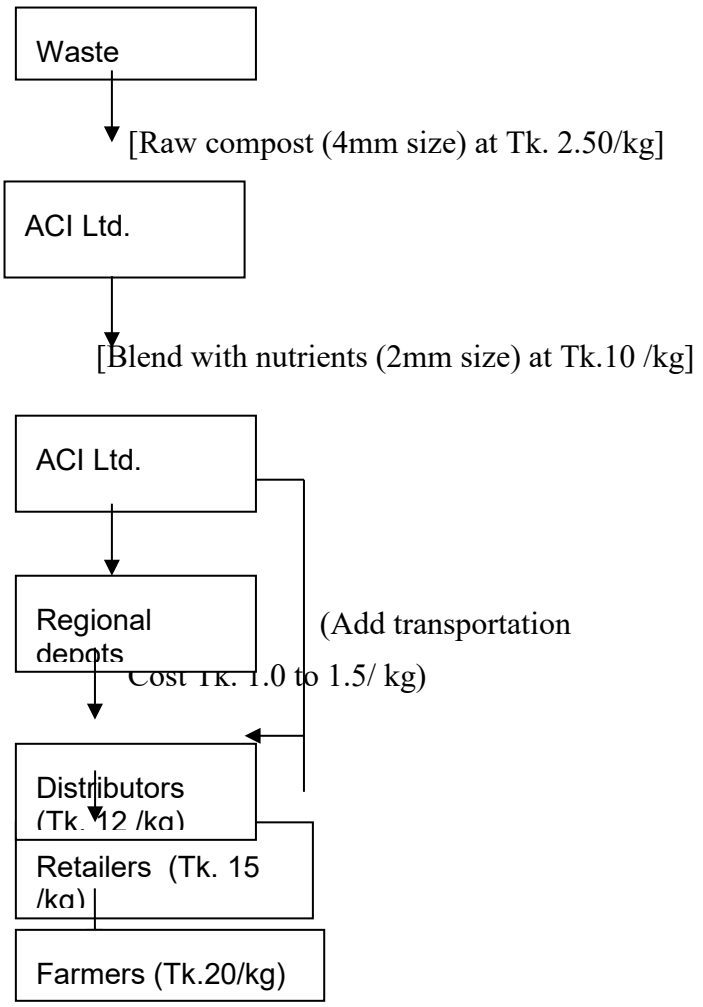
**Kazi and Kazi Tea Estate Ltd.** is practicing organic farming; located at Tetulia Upazila of the Northwestern district of Panchagarh. The farm size is 2500 acre (1012 ha) out which at present the tea garden is 800 acre, medicinal plants 500 acre (254 plant saplings) and the rest is cultivated with rice, wheat, vegetables, pasture etc. organically. They have also a diary farm of 2000 cattle heads maintained on organic feeds only. At the beginning they started intensive green manuring with leguminous crops like dhaincha, cowpea, mungbean, blackgram etc. in addition to heavy use of organic manures like cowdung, compost etc. Later on they have established 40 biogas plants where their own cowdung is used. The bioslurry is now being used as manure. Not only that, after plantation of tea saplings, they are continuously growing green manuring crops intermittently to enrich the soil. They have specially selected medicinal shade trees which protect tea plants from pests. In order to ensure that all resources used in the garden are fully organic, they do not use chemical fertilizer or pesticide. The garden is certified organic by the SGS Organic Production standard in accordance to the EU Regulation 2092/91. They produce about 250 tonnes of tea every year and sell at BDT 350/kg in the local market where as the normal tea price is BDT 200/kg. Thus the total value of their tea is Tk. 87.50 million (1.27 million US$). They also export some tea to USA, Japan and UK.

PROSHIKA has been trying to promote organic vegetable cultivation through their group farmers. They are providing eco-friendly agro-technology and necessary training to the growers as well as marketing facilities for their products. PROSHIKA selected 775 farmers of 25 villages from 10 Upazilas around Dhaka city and provided training on organic vegetable cultivation. They used mainly compost and quick compost for cultivation and IMP technique (including sex pheromone, detergent etc.) for insect control. Last year they produced 3000 tonnes of organic vegetables in 600 acres of land. In addition PROSHIKA produced 38 t on 11.52 acres in their own farm in Manikganj.

PROSHIKA arranged to sell these vegetables in the super market, like Agora, Nandan etc. BDT 1-2 Tk./kg higher prices than normal vegetables. Thus the total value of the produce is around BDT 45.57 million (0.66 million $) @ BDT 15/kg. Initially they faced some problems in marketing and storage and competition with normal vegetable price. However, PROSHIKA has a plan to expand this programme in future where they will develop their own market chain and will create awareness among consumers through vivid publicity. If these can be done organic vegetables will occupy a significant place in the market.

Practical Action, Bangladesh has introduced pit culture of sweet gourd in the barren unfertile sandy river basin and char in the Gaibandha district in 2005 where other field crops are almost impossible to cultivate. It is a very simple and unique technology for the displaced communities (by rivers erosion) living on the edge of mighty rivers and fragile environment in Bangladesh. The technique is very simple i.e. after flood water recedes the river basin dries up in the mid October – November – farmers make pits of 1 m3 size. Then 10-15 kg compost/cowdung is mixed with the pit soil and left for 15 days. Next 4/5 seeds are planted in each pit and the pit is soaked with water. After germination 2/3 healthy seedlings are kept in each pit and the rests are uprooted. They cover the pits with straw mulch to conserve moisture. Farmers soak the pits 2/3 times a week with water carried in pitchers or buckets. When the seedlings are 25-30 days old then quick compost is applied @ 1 kg/pit and at 60-65 days apply 2nd time at the same rate. The compost is mixed well with soils and irrigation is applied immediately.

In Dhaka, Waste Concern has utilised the marketing network of a Advanced Chemical Industries (ACI) Ltd. Waste Concern made an agreement with ACI Ltd. to buy raw compost from the plant. ACI Ltd. improves the quality of the raw compost by removing the physical contaminants and grinding it into smaller sizes. They then blend the compost with chemical fertiliser to increase its nutrient balance and made it attractive to the end-users. ACI ltd. sells the blended compost through its distribution network. Profit margins were shared among the network members from distributor to retailers.




Distribution and marketing network of compost

ACI ltd. is a large chemical and pharmaceutical company having sale centres in 64 districts. They only utilise five marketing depots at Bogra (229 km),Barisal (277 km), Mymensingh (100 km),Chittagong (300 km) and Sylhet (250 km) districts for experimenting and popularising the compost among the farmers. ACI adds transportation cost on an average Tk 1.2/kg which allowed them to sell compost at the same price throughout the country.

For promoting compost ACI ltd. involves marketing officers who usually communicate the product benefits and utility to the farmers through leaflets and verbal discussion. The product is branded as WWR organic fertiliser and sell in 40 kg bags. The distributors or retailers usually sell the product to the farmers on a 'push sale' basis. Waste Concern also sells raw compost to fertiliser dealers at Mirershari (190 km) and Fatikchari (280km). At Mirershari, the dealer uses to sell the compost at a price of Tk. 7/kg and in Fatikchari at Tk. 8/kg. The fertiliser dealers identify transportation costs as one of the problems which fixed the selling price comparatively higher than the chemical fertilisers.

## Future of composting in Bangladesh

Organic agriculture is gradually growing and gaining acceptance of the farmers. High and medium high land particularly adjacent to the homestead areas, fruits and vegetables are suitable to grow in the organic system. With rising awareness and consciousness on environmental, ethical and welfare issues, consumers now expect their food to be produced and processed with greater respect for the environmental safety and organic practices are the right option to fulfill the demand of the consumers.

The community engagement in ensuring the right quality and quantity of wastes is important. However, due to lack of community participation in source-segregation of waste, the quality of compost is a major issue to reach through and getting market of the product. In most cases, the plant management is not aware of the standard of compost and demand of the customer. They do not have any separate business plan or marketing strategy for the plant. Standardization and certification process is complex and lengthy which discourages the commercial possibility of the compost product.

Demand and marketing part of compost has not yet created widely in Bangladesh. The main challenge of the composting plants is to identify potential markets for the compost. There is a need of co-ordination body among the Local Government, Ministry of Agriculture, Ministry of Finance including the Private sectors such as Bangladesh Fertilizer Association, Bangladesh Organic Products Manufacturing Association etc. for effective marketing and sale of the compost product. The Ministry of Agriculture must take a leading role in demand creation and market development for the compost. The Ministry of Agriculture through its research and development wing such as Bangladesh Agriculture Research Council (BARC) do mapping on the agro-ecological locations for finding out opportunity of compost demand and sale. The Department of Agricultural Extension (DAE) in collaboration with the Private Fertilizer and Pesticides companies can build up marketing infrastructure and distribution network for compost along with promotional activities so far. The present status of composting is summarized below:

- **Present capacity of production and consumption of compost is very insignificant and it does not bring any impact on compost demand and sale.** At this present state of production and consumption of compost, it is difficult for the composting projects to sustain their activities by creating demand or developing markets for the product.

- **Farmers in the peri-urban areas have basic knowledge about the benefits of organic fertiliser use. But due to lack of knowledge and experience and concern about harmful materials contained in waste derived compost, farmers are uncertain or sceptical about waste derived compost.**
- **Nurseries are be the largest potential outlets for compost in urban areas. But the nurseries are not aware or lack information about waste derived compost.**
- **City procurement policies have no provision for compost use**. Waste derived compost has not yet received attention of the city authority as an effective organic fertiliser.
- **Agriculture policy of government is supportive to chemical agriculture to bring self-sufficiency in food production.** Government provided tax incentives, credit support and loan facilities to promote chemical agriculture which might affect the natural demand of compost and be detrimental to the development of a market for waste derived compost. Small-scale compost manufacturers could hardly survive or sustain their activities if they would sell their compost on credit.
- **Agriculture extension department is a good avenue to create compost demand but compost from city waste is poorly linked with the agricultural community.**
- **Landownership is an important issue for influencing the farmers' decision to use organic fertiliser in their lands.** Farmers who cultivates their own lands are more interested to use organic fertiliser but they are reluctant to use waste derived compost. Shared or rented croppers are neither interested to use organic fertiliser nor waste derived compost. Small land hold farmers do not find any incentive to use organic fertiliser for the long-term sustainability of land productivity. They are more inclined to chemical fertilisers for a quick return on their investment.
- **Compost demand depends on perceptions of its value, on its quality, comparative price and accessibility to potential users.** Compost from city waste is contaminated with sharp objects and chemicals or even heavy metals. The potential users are discouraged from using compost for quality and safety reasons. Compost is selling at a higher price than both the locally available organic fertilisers and the chemical fertilisers in some places. Due to higher price and small quantity production, compost would not compete or maintain demand against the locally available organic inputs.
- **Compost sale through established marketing networks is effective but is discouraging due to the margin of profits shared among the network members**

**that cause a many fold increase in the compost price.** The compost market is mainly confined to rural farmers. Long distance delivery increased the price which may be beyond the purchasing capacity of the potential customers.

- **Credit support to poor farmers and sales incentive to dealers is good for the aggressive sale of compost but would be risky for small-scale compost manufacturers as it might affect cash flow and compost production.**

Compost is the end product of decomposition of organic waste. Generally, compost is not rich in essential nutrient constituents but it is importantly considered as a soil conditioner and used for balanced fertilization in agricultural crop production. Farmers in Bangladesh mostly rely on chemical fertilizers for higher production without or less application of compost. Despite huge potential, compost sector in Bangladesh is facing three major constraints: complicated and time-consuming licensing procedure, weak market demand for compost; and lack of awareness among farmers on benefits of using compost. However, compost has a high market potential considering the challenge of motivating farmers' attitude towards its increased usage through a strengthened demand-driven supply channel. Government policy is supportive to composting, however the intervention in terms of promotion and incentives is still insignificant. Government has to give more administrative and fiscal incentives to composting to make it popularize among the farmers. More promotional and awareness activities through the government agriculture wing should be taken to bring compost in field along with the chemical fertilizer. At present, Waste Concern is only organization tried to popularize the waste derived composting. But it is not wide spread. More organizations should come forward with building capacity and fiscal incentives from Local Government. In the different donor assisted project, composting from municipal waste is getting priority as part of the integrated waste management system. The utilization of the composting materials, the demand creation and marketing mechanism should be developed. Local government Ministry along with the Ministry of Agriculture should work together for the promotion of compost in Agriculture as well as its utilization in city park and landscape management. The quality control of compost, scaling up of the composting facility, bank loan facilities, credit system and licensing system should be made easier and friendly to the compost manufacturer. Under the programmatic CDM, three composting projects have been constructed under the purview of Ministry of Environment. The Municipalities under the Local Government Ministry should be involved and capacity should be enhanced by incorporating the composting plants under the programmatic CDM system which will ensure the compost demand and marketability.

The following recommendations are outlined for further improvement of Solid waste management including composting:

i) It is essential to identify goals of the composting projects, whether they are planned for demonstration of waste minimization program or to some extent production compost for commercial marketing.

ii) Political support is needed for composting projects to succeed. Enactment and implementation of policies and legislation, incentives and disincentives for organic waste recycling could have a positive impact on overall solid waste management including composting.

iii) Community should organize primary waste collection and the private business sector should operate the composting facility. Setting up a dialogue with the community people and engaging them in the planning and decision making process is likely to increase public confidence. This will ensure sustainability of the project since it empowers the local community, encourages them to contribute and gives them a sense of responsibility and commitment.

iv) Composting can significantly reduce waste stream volume and offers economic advantages to the local authorities. Inadequate understanding of the economics of composting is a challenge for the composting projects. A realistic accounting system with full economic assessment of composting likely to generate business environment and encourage private sector investment.

v) Chemical fertilizers enjoy large subsidies, which affects the natural demand for compost and distorts the market. Therefore organic composts must be provided the similar subsidies or incentives to create a more level playing field for compost and allow its widespread use.

vi) The price of compost depends on transport distance and the price of the alternative products. Compost should receive transport subsidies or price incentives to compete the alternative organic materials in the market.

vii) A Co-marketing policy for compost with chemical fertilizer would be encouraged that make compost more competitive in the agricultural market.

viii) Mixed waste has led to production of inferior quality compost which in turn creates marketing problems. Public awareness and incentives should be introduced to encourage source-segregation of waste.

ix) Quality of compost increases confidence and create demand among farmers. Registration and certification of compost should be made mandatory and

enforced. In that case, the certification process could be made easier and less bureaucratic.

**References:**

Caldas, T. (2001). Seminar paper on 'Production Potential of Organically grown fresh produce in Bangladesh', held on 17th January,2001, Dhaka, Bangladesh.

Dulac, N. (2001). “The Organic Waste Flow in Integrated Sustainable Waste Management Waste.” Tools for Decision-makers Experiences from the Urban Waste Expertise Programme,Waste Consultants,The Netherlands.

Hart, D. t. and Pluimers, J. (1996). “Wasted Agriculture-the use of compost in urban agriculture.” UWEP Working Document 1, WASTE.

Silva, R. d. (1995). “An expanding minority-organic farming in SriLanka & other Asian countries.” Focus, gate 3/1995.

Yousuf, T.B. (2015) “ Feasibility study on Exploring Options for Sustainable Solid Waste Management System in Mymensingh

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