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SNV SMART DEVELOPMENT WORKS

Co-composting of Faecal Sludge and Municipal Organic Waste for Sustainable Crop Production in Southern Bangladesh

WASH | Bangladesh

Faecal sludge (FS) has been used for centuries to fertilise fields and fishponds, and to maintain or replenish the soil. These practices have led to a strong economic link between urban dwellers (food consumers as well as waste producers) and urban farmers (waste recyclers and food producers). Due to exponential population growth and declining agricultural land, there is high pressure to increase productivity, as well as demand for innovative ways to increase soil fertility. On the other hand, due to the growth of urban areas, the importance of managing faecal sludge and municipal solid waste (MSW) to avoid environmental degradation and public health risks has increased. Though this resource has potential value for use as good quality fertiliser, its utilisation has been limited by insufficient evidence and social taboos. This action research was formulated to generate sufficient scientific evidence for the use of treated faecal sludge, co-composted with municipal waste, as an agricultural resource.

Agriculture in Bangladesh

Agriculture alone still stands as the main economic sector of Bangladesh. This sector contributes about 20% to total GDP, while the crop sub-sector itself adds more than 60% of total agricultural GDP. However, this sector has been facing challenges through climate change impacts, loss of arable lands, high population growth and imbalanced use of fertilisers. It is extremely important to balance fertiliser use, in order to ensure high productivity and protect soil fertility. Several studies show that most of the soils of Bangladesh contain very low organic matter. Continuous cultivation of the same crops on the same land is also a reason for decreasing organic matter in the soil. Chemical fertilisers are rarely mixed with organic manure, whose application could ensure sustainable agriculture. Composting could potentially be used to achieve high agricultural productivity without losing soil fertility. The Bangladeshi government has also acknowledged the importance of using balanced fertiliser in the National Agricultural Policy (NAP). The co-composting of faecal sludge and municipal organic waste could provide an opportunity to increase soil fertility while ensuring a clean environment.

Co-composting in crop production

Co-composting means the composting of two or more raw materials together, such as FS and MSW. Co-composting can be used successfully for crop production, but its effectiveness depends on cropping systems, the crop varieties in use, soil types and agro-ecological zones (AEZs). Neither co-compost nor inorganic fertiliser alone are enough to meet the demand of soil-crop systems. On-farm research is required, to find the most suitable combinations of co-compost and inorganic fertilisers for major crops and cropping patterns grown in major AEZs.

The nutrient content of composts, which have been produced by co-composting human waste (faecal or sewage treatment plant sludge) and organic solid waste are shown in the table below.

Constituent	% of dry weight	Reference
Nitrogen (as N)	1.3 - 1.6	Shuval et al. (1981)
Phosphorus (as P2O5)	0.6 - 0.7	Shuval et al. (1981)
Potassium (K2O)	1.0	beng and wright (1981)
Organic matter	12 – 30 Kim	Kim, SS, 1981
Carbon (C)	46 – 50	Byrde (2001)

Even though co-composting might increase soil fertility, there are concerns about the associated health and environmental risks due to co-compost's pathogen content. Therefore, it is also important to understand the possible health and environmental impacts of this co-compost before its use in agricultural research.

The Faecal Sludge Management (FSM) programme

The adoption of strategies to treat and manage faecal sludge has long been neglected in developing coun-

tries, resulting in indiscriminate and uncontrolled disposal of faecal sludge into drains, canals and open spaces, thus causing pollution and damaging public health. In recent times, several initiatives have been taken towards improved FS management in many countries including Bangladesh. However, this sector still needs better integration and planning in terms of treatment plant design, sector financing, behavioural change, and so on.

The programme aims to improve the living environment and ensure access to safe faecal sludge management services to residents of three cities in southern Bangladesh. A range of stakeholders, including different organisations and experts, will work together to achieve the basic components of this programme:

- Understanding the differences in needs, preferences and attitudes towards sanitation services;
- Developing and testing business models for improved sanitation and FSM activities;
- identify ways for collaboration and cooperation through strengthening sanitation governance
- Make available improved technologies for sludge treatment and reuse; and
- Influence sector investment choices by proper dissemination of FSM knowledge.

Action research on applying FS in agriculture

The high volume of human faeces generated every day offers great potential as a valuable nutrient source for agriculture. A survey conducted by KUET and AIT in 2014 estimates that about 628,070m3 of FS is produced every year in Khulna City Corporation as well as 99,274 m3 in Kushtia and 57,915 m3 in Jhenaidah. Unfortunately, according to the baseline study conducted by SNV, two-thirds or more of the households in these three cities practice environmentally unsafe FS treatment and disposal. More research and development initiatives are required to properly institutionalise the FSM sector.

The programme has the mandate to explore the possibility of promoting the reuse of FS, while making the products safe (pathogen free) and inexpensive. Therefore, the identification of an appropriate co-composting mechanism is very important to define standards and set treatment parameters, considering its low production costs and benefits for soil nutrients and plant growth. For this reason, SNV has initiated an action research project with Bangladesh Agricultural Research Institute (BARI), the national agricultural research organisation under the Ministry of Agriculture, to generate evidence for reusing treated faecal sludge as an agricultural input and to ensure that health and hygiene standards are complied with. Under this initiative, the FS will be co-composted with municipal organic wastes and tested for its applicability for key vegetable crops in Bangladesh.

Table: Research questions

Research Questions	Indicator
1.How co-composting may maintain/improve soil fertility and increase yield of major vegetables?	Quantify the agronomic, soil, physical, chemical and economic effectiveness of co-composting
2. What should be the best method of co-compost usage?	Generate information on the best method
3. What should the impacts of co-compost usage be?	Determine the impacts on environment and safe vegetable production
4. How vegetable production in Bangladesh may respond differently by using co-compost from faecal sludge and municipal organic waste at varied proportions?	Crop yield and plant nutrient value - Heavy metal concentration both in plant and soils - Pathogen dissemination in soil

BARI will conduct both on-station trials and laboratory tests to generate results that will be properly documented and compared to other countries' experiences through an in-depth literature review. The main components of this action research are:

1. Laboratory tests: Two laboratory tests will be performed to evaluate the nutrient and pathogenic status of co-compost, soil and plant parts.

   a. FS contains varying concentrations of chemical, heavy metals and pathogens that need to be treated before being used in agriculture. It is possible that these pathogens could affect human health. In laboratory tests, the status of these components will be tested in different treatment settings.

   b. The second laboratory test will be performed to understand the nutrient uptake of soil and plant parts. Organic fertilisers stabilise the soil structure, which allows crops to consume organic matter. FS is considered to have long-term beneficial effects on the soil as it contains relatively high nutrient content. So, while applying co-compost in the soil, the changes in soil nutrients need to be tested. Thus, a before and after soil analysis will be performed to understand the impacts of co-compost on soil nutrients and the soil's physical, chemical and biological properties. As fruit also receives nutrient from the soil, these plant parts will also be analysed in the laboratory.

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Demonstration of Pro-poor Market-based Solutions for Faecal Sludge Management in Urban Centres of Southern Bangladesh

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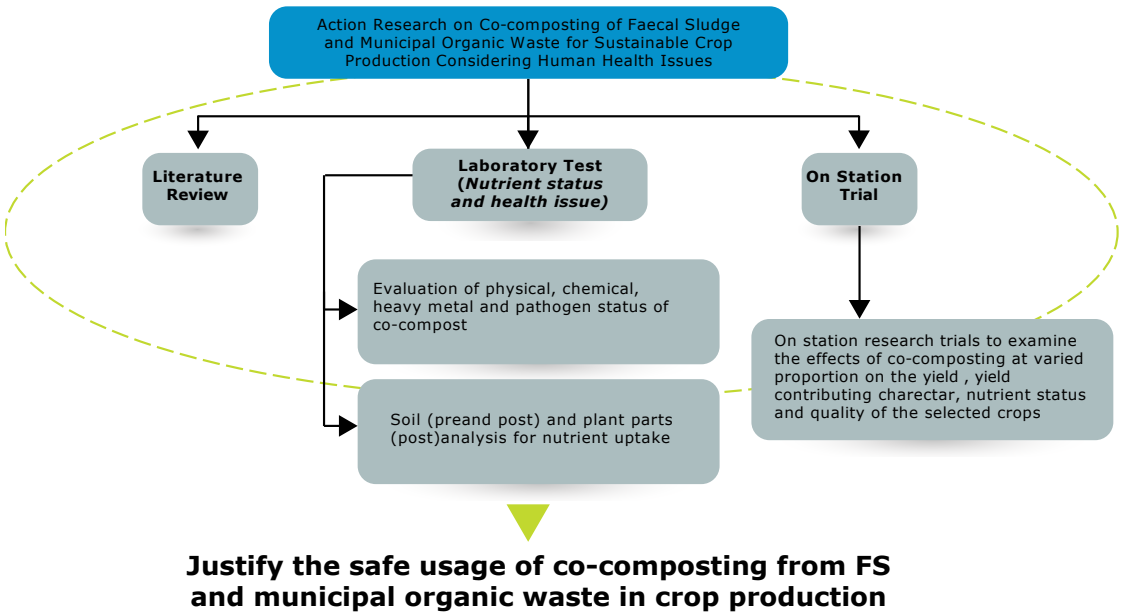
2. On-station trials: The BARI research team will facilitate on-station research trials for four vegetables – cabbage, cauliflower, sweet gourd and okra – to understand the effects of co-composting at varied proportions on the yield, yield-contributing character, nutrient status, quality and human health impact of the selected crops. These crops will be cultivated in two seasons – sweet gourd and okra in summer, and cabbage and cauliflower in winter – to understand the seasonal applicability of co-composting. Five treatments will be set up for each crop, three of which will use different proportions of co-composted FS and municipal organic waste. The other two will use inorganic and native fertility. This trial will be replicated twice within the project period. Five treatments will be set up for each crop, three of which will use different volume of co-composted FS and municipal organic waste per hectare (3t/ha, 4t/ha and 4t/ha). The other two will use only inorganic and farmers practices.

Action Research Outputs

For the two years beginning in July 2015, this action research is expected to demonstrate some specific outputs:

a. Propose suitable treatment methods to ensure that the co-compost from FS and municipal organic waste does not represent a risk to human health and crops.

b. Identify the optimum agronomic and economic doses of co-compost for crop production.



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