STUDY ON QUALITY OF THE COMPOST PRODUCED BY COMPOST BINS AND ECOSAN LATRINES

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Abstract,

Ecosan latrine is one of the environmental friendly systems that recover the nutrients in human fecal matter. Comparing the quality of compost produced by Ecosan latrine and compost bins and results of the KAP survey on both systems aims to compare the nutrient values and knowledge, attitudes and practices of users. Ecosan compost contains 1.35 times of Nitrogen, 0.92 times of Phosphorous and 2.8 times more Potassium than in Bin compost at the 0.05 significant levels. Mean value of the fresh weight (2.72g/plant) of plants grown in Ecosan compost soil mixture (50:50) is not higher than mean value of the fresh weight of plants (4.19g/plant) grown in bin compost soil mixture (50:50) at the 0.05 significant level. Knowledge of the users on Ecosan latrine is lower (19.55%) and attitudes (41%) and practices (82.89%) are adequate enough to maintain the system properly. Attitudes (76.66 %) and of practices (82 %) of the compost bin users are at a satisfactory level even 22.21% don't have the adequate knowledge of the system. Appropriate knowledge, has not been transferred to the Ecosan latrines users for the sustainable use. Nutrient value and N:P:K ration of Ecosan compost depend on the additives used after defecation and it is higher in nutrients, compared to the bin compost. As Ecosan compost is more useful as a soil conditioner rather than an organic fertilizer, due to its unbalanced N:P:K ration.

Key words,
Compost, Compost Bin, Ecosan latrine , Fertilizer, Nutrients

Introduction.

Hygienic sanitation is necessary to sustain human life and to ensure good health and human dignity. Sanitation is key determinant of both equity in society and society's ability to sustain itself. Sanitation has become one of the prioritized focus areas locally, regionally and globally in recent decades due the vulnerability of environment and human health. Because many people use unhygienic places for defecation and normal flush latrine system leads to several environmental and sanitary problems. National sanitation coverage in Sri Lanka is about 76% (Census and statistical survey, 2004) and successive governments, after independence in 1948 laid heavy emphasis on the sanitation aspects both in urban and rural areas in Sri Lanka, to enhance the

sanitation coverage.

Environmental pollution due to unsanitary and improper latrine usage is increasingly becoming irresolvable and severe in Sri Lanka. Appropriate and sustainable technological solutions to overcome the situation at grass root level have to be promoted and justified. Ecosan composting latrine usage is one such solution that needs attention, for promotion and scaling up in environmental sanitation and personnel hygiene. Ecological Sanitation could be explained as one of the methods that are used for managing human waste. The use of human excreta for crop fertilization has been widely practiced in many regions of the world. Dry composting system saves water, protects ground water from pathogens nutrients, organic matters and pathogens that originates from a toilet, improves the soil and enhances food security and water security

Ecological sanitation and use of human excreta as a fertilizer are concepts that have been reintroduced with huge interest and attention (Schonning, 2004). All over the world, several experimental works are being carried out. But at present, there are very few reported studies pertaining to the Ecosan latrines in Sri Lanka, even though there is large potential to take advantage of Ecosan Latrine System in the country. Findings of this research will be useful for promoting Ecosan latrine usage in areas where normal pit latrine system is not a long-term solution as a way of improving environmental sanitation and using compost produced by Ecosan latrines for agricultural purposes.

Key objectives of the study is to compare the quality of compost products of latrine composting with the bin composting in terms of N:P:K value aligned with the survey on knowledge, attitudes and practices of the usage of both systems. The results are expected to provide reliable facts for upgrading the ecological sanitation and usage of compost produced by Ecosan latrines. This study contributes to this aspect, by emphasizing the social concerns with respect to the knowledge, attitudes and practices of the users.

Figure -1 Photographs of Ecosan Latrine

Figure - 2 Photograph of Interior View of Ecosan Latrine

Methods

- **2.1 Literature review**
- **2.2 Primary and secondary data collection**
- **2.3 Field Visits**
- **2.4 Participants observation**

- **2.5 Sample collection**

Samples (10) for N:P:K analysis of the bin compost were taken from compost bin users in Kalutara District in Sri Lanka randomly. Samples (10) of Ecosam compost were taken from the project sites located in Kalutara, Galle, Matara, Hambantota, and Ampara Districts in Sri Lanka randomly.

- **2.6 Field and laboratory tests**

Quality of the two types of compost produced by compost bins and Ecosan latrines were measured with respect to the N: P: K value and, effects of using those two types of compost were measured by the plant growth test. Total Nitrogen and Phosphorous amount were measured using the Spectrophotometer-CECIL-CE-1021-1000 Series and total Potassium was measured by atomic absorption. Fresh weight and dry weight of chili plants *(Capsicum annum)* grown in Ecosan compost and bin compost mixtures (50:50) were measured as indicators of the plant growth rate in order to measure the fertilizing effects of those compost types.

- **2.7 Knowledge, attitudes and practices (KAP) Survey**

KAP (Knowledge, Attitude, and Practice) Surveys on Compost Bin and Ecosan Latrine usage were carried out in 30 households from each to get the understanding of knowledge, attitudes and practice of people in usage of those two systems.

- **2.8 Statistical analysis**

Data sets were analyzed by the single factor ANNOVA, using the SSPS statistical package. The alpha level is a significance level of 0.05 related to the probability of having a type I error (rejecting a true hypothesis). Quantitative results were analyzed by the percentage of the average values and qualitative results were prioritized by the score and ranking method relevant to the KAP survey.

Results and Discussion

Comparison of N:P:K value of Ecosan Compost and Bin Compost

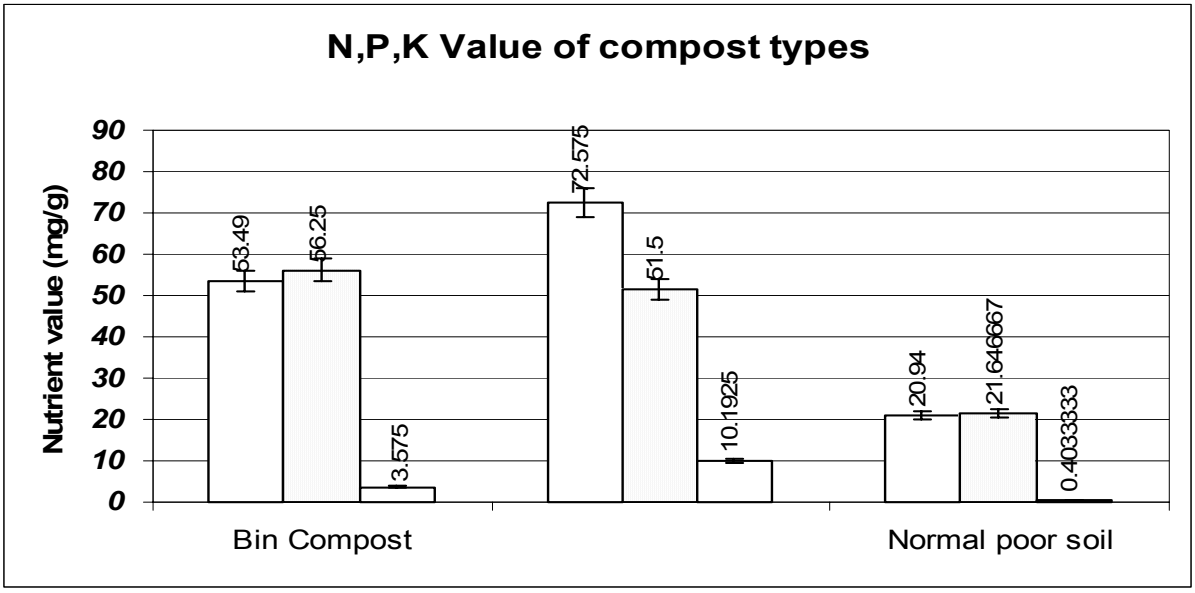

Figure - 3 Graph of the N:P:K values in compost types

The quality of compost depends on the feedstock and efficiency of the micro-organisms in breaking down the feedstock (Berger, 2004). N:P:K analysis indicates the quality of compost and provides basis for the comparison of compost types.

P values for the Nitrogen and Potassium tests are higher than the 0.05 and as null hypothesis are rejected. As mean values of the Nitrogen and Potassium of Ecosan compost are higher than the mean values of the Nitrogen and Potassium of bin compost at the 0.05 significant levels as in the alternative hypothesis. P value (0.018) for the Phosphorus test is lower than 0.05 and as null hypothesis is not rejected. Mean value of the Phosphorus of Ecosan latrine is not higher than the mean value of the Phosphorus of the bin compost at the 0.05 significant levels.

Compost derived from Ecosan Latrine contains 1.35 times more Nitrogen, 0.92 times more Phosphorous and 2.8 times more Potassium than in Bin compost at the 0.05 significant levels.

It was estimated that a city of 100,000 people would produce about 500,000 Kg of elemental Nitrogen, Phosphorous and Potassium per year in human excreta (Uno, *et al,* 2004). Use of human excreta for composting is a sustainable solution for the rising price of commercial fertilizers. Addition of leaf mixtures and soil enhances the quality of Ecosan compost enabling it as a vegetable fertilizer (Morgan, 2004). Humus samples taken from Ecosan latrines, which use wood ash, consisted of comparatively high amount of Nitrogen and potassium. Volume of faeces is very much less compared to the volume of input material.

That is, the quality of the compost derived from Ecosan latrine varies depending on what extra ingredients are added to the pit, in addition to excreta (Morgan, 2004). Sri Lanka is an ideal location for composting due to warm weather and moist tropical air (Berger, 2004). Commercial fertilizers can be replaced by sanitized humus from Ecosan Latrines with little or no extra cost.

Figure -4 Photographs of the chili plants

Dry and fresh weights are reliable indicators of the plant growth rate that can be used for the comparison of the plant growth, grown in different kinds of soil mixtures. Chili is an annual flowering plant which can be easily grown and maintained in a greenhouse.

P value of the fresh weight test is lower than the 0.05 and therefore, the null hypothesis is not rejected. The mean value of fresh weight of plants grown in Ecosan compost soil mixture (50:50) is not higher than that of the fresh weight of plants grown in bin compost soil mixture (50:50). Since the P value of the dry weight test is lower than the 0.05 the null hypothesis is not rejected. This suggests that the mean value of the dry weight of plants grown in Ecosan compost soil mixture (50:50) is not higher than that of the dry weight of plants grown in bin compost soil mixture (50:50). Growth rate of chili plants grown in bin compost and soil mixture (50:50) was higher than that of the chili plants grown in Ecosan compost mixed with soil or sand (control). Plants fertilized with bin compost produced by the compost bins grew rapidly, larger and were healthier than those grown in compost produced by the Ecosan latrines. Leaves of plant grown in compost produced by the compost bin were large and dark green in colour.

Experiments done in Zimbabwe have shown that vegetables such as spinach, covo, lettuce, green pepper, tomato and onion can produce higher amount of yield using the Ecosan compost compared to the normal topsoil. The harvest in spinach, covo, lettuce, and onion increased by 7, 4, 7 and 3 times respectively compared to the poor local soil (Morgan, 2004). Growth of chili plants (*Capsicum annum*) is enhanced by the application (50:50) of compost produced by the compost bins rather than Ecosan latrines due to its N:P:K ratio (15:15:1) which is closed with the N:P:K requirements (15:15:15) of the chili plants. Fertilizing effect of humus taken from the Ecosan latrines can be enhanced by adding garden compost.

Social and economical aspects play important role in introducing the technological options. As Knowledge, attitudes, and relevant practices of the Ecosan latrine users and perceivers of compost bins are very important in decision making.

Knowledge of the users of both Ecosan latrine (19.55%) and compost bin (22.21%) usage is lower. Levels of attitudes (41%) and practices (82.89%) of Ecosan latrine usage among the users are at a satisfactory level. Attitudes and of practices of the compost bin users are accordingly 76.66 % and 82%. Attitudes of the users are negative due to lack of information.

Even though user's knowledge on the Ecosan System and functionality is poor, their practices are adequate enough to maintain the system properly and upheld the sanitation. Handling human excreta is not acceptable among the users as in many cultures for variety of reasons which could be linked to cultural believes and practices. Perceivers of the Ecosan latrines are reluctant to use the system because of the fact that they consider present Ecosan model as not a modern system. Having a commode system in house is considered as modern and a symbol of person's social status and wealth.

Conclusions

The quality and amount of input materials determine the quality of compost. Even faecal matter consisted of high amount of phosphorus, potassium and organic matter; after decomposition the amount of phosphorus, potassium and nitrogen in Ecosan compost varies depending on the type and amount of input material used. Compost produced in ecosan latrine is comparatively rich in nitrogen (7.57 mg/g) and potassium (10.19 mg/g). The amounts of phosphorus in bin and Ecosan composts (56.25 mg/g, 51.5 mg/g) are comparatively same. But the compost produced by the bins behaves as a good fertilizer and improves the plant growth. The significant growth in chili plants *(Capsicum annum)* can be due to the high amount of nitrogen and phosphorous and balanced N:P (13:14) available in the bin compost. Composted faeces can be used as soil conditioner and nitrogen phosphorus and potassium rich fertilizer with the addition of other material which enable to obtain a balanced N: P: K ratio.

Attitudes and practices of home based bin composting and Ecosan latrine usage are positive among the users even though their knowledge is not at a satisfactory level. Ecosan latrines have to be more attractive, comfortable and nuisance-free enough to make it more popular. Behavior and attitudinal changes and individual motivation of users are the most leading factors, which

can make the Ecosan Latrine System sustainable and socially acceptable. Concerns on environmental, social and economical aspects are needed for the household level sanitary-generation options to ensure success and future existence in terms of sustainability.

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