Fertiliser derived from Fecal Sludge in Sri Lanka: Analysis of Plant Nutritional Value and Heavy Metal Contamination

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Introduction

Sri Lanka faces severe issues in handling organic waste streams. The most obvious problem is **urban waste disposal resulting in environmental pollution** instead of resources recovery.

Furthermore, most **current sanitation systems waste agricultural resources from human excreta** like (carbon (C), nitrogen (N), phosphorus (P) and potassium (K) as well as micronutrients, since they are either disposed or enter the aquatic system, where they cause eutrophication and lead to contamination of the groundwater with human pathogen organisms (1).

In general, these **open cycles can be regarded as one cause for soil degradation** and loss of soil fertility since cultivated arable land becomes increasingly deficient in essential plant nutrients and soil organic matter when long term cropping takes place without replacement of nutrients.

In tropical climates soil degradation is even accelerated: Year-round elevated temperature leads to fast microbial decomposition of soil organic matter whereas heavy rains during rainy seasons cause leaching of mineral nutrients (2). Based on the findings of numerous research projects it is widely agreed that preventing soil degradation enhances its productivity and largely contributes to a secure and sustainable food supply.

Main Objective

To address these issues, the IWMI implemented a resource recovery treatment project based on the **co-composting of nutrient rich fecal sludge (FS) and organic municipal solid wastes (MSW).** To support this research the assessment of nutrient contents and relevant properties of compost products to be used as a fertiliser or soil amendment was proposed with following parameters:

- **Macro nutrient content**
- **Micro nutrient content**
- **Organic Matter and organic carbon**
- **Heavy Metal content**

The results will serve as a guide to enhance the production and mixing ratios of the the two main components.

Methods

Four varieties of the co-compost were analysed in the agricultural laboratory at the University of Applied Sciences in Osnabrueck.

Code	*Description*
SL FS	Dewatered fecal sludge compost
SL FS-RH	FS and rice husks, ratio (mass) 4:1, co-compost
SL FS-MSW	Municipal Solid Waste (MSW) + dewatered Fecal sludge, ratio (mass) 10:1, co-compost
SL FS-MSW P	FS-MSW Pellets

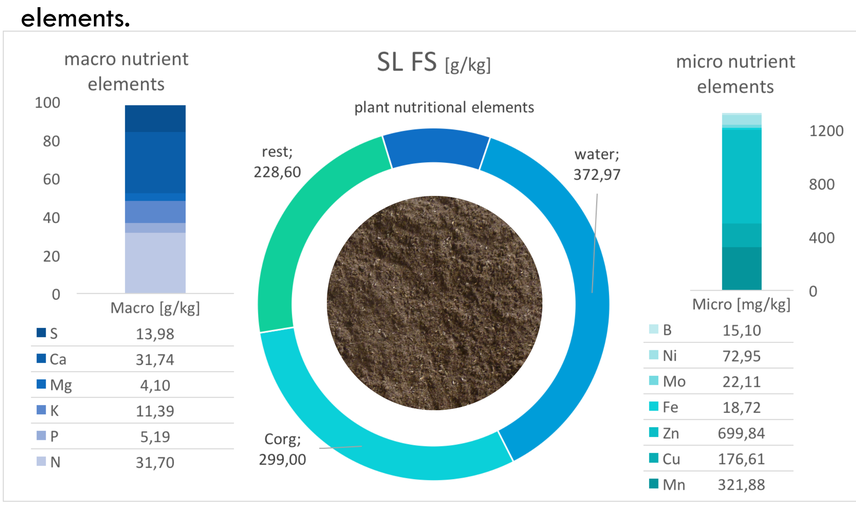
Organic Matter (OM) and organic carbon (C_{org}) were determined by loss ignition and C/S ELTRA elementary analyser CS-500 (3).

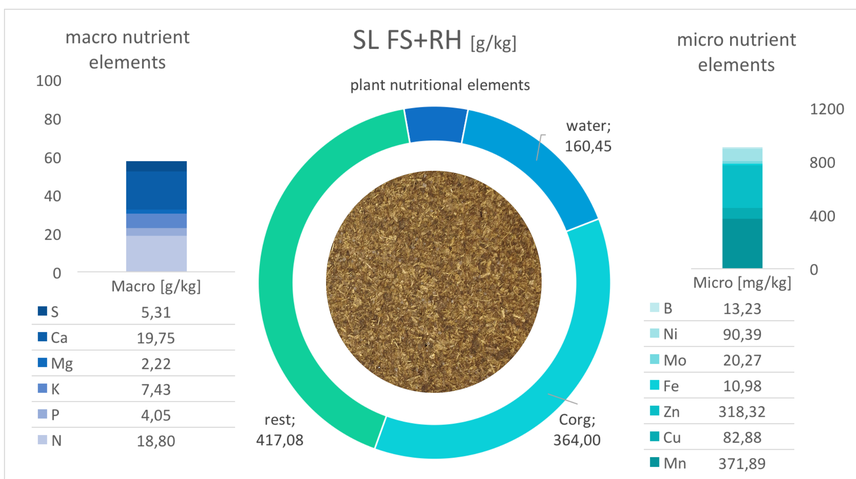
Total Nitrogen was analysed following the Dumas combustion method with a LECO elementary analyser (4), while all other macro- and micro nutrients as well as heavy metals where extracted by using a combination of the microwave digestion in a closed vessel and the aqua regia extraction method (5).

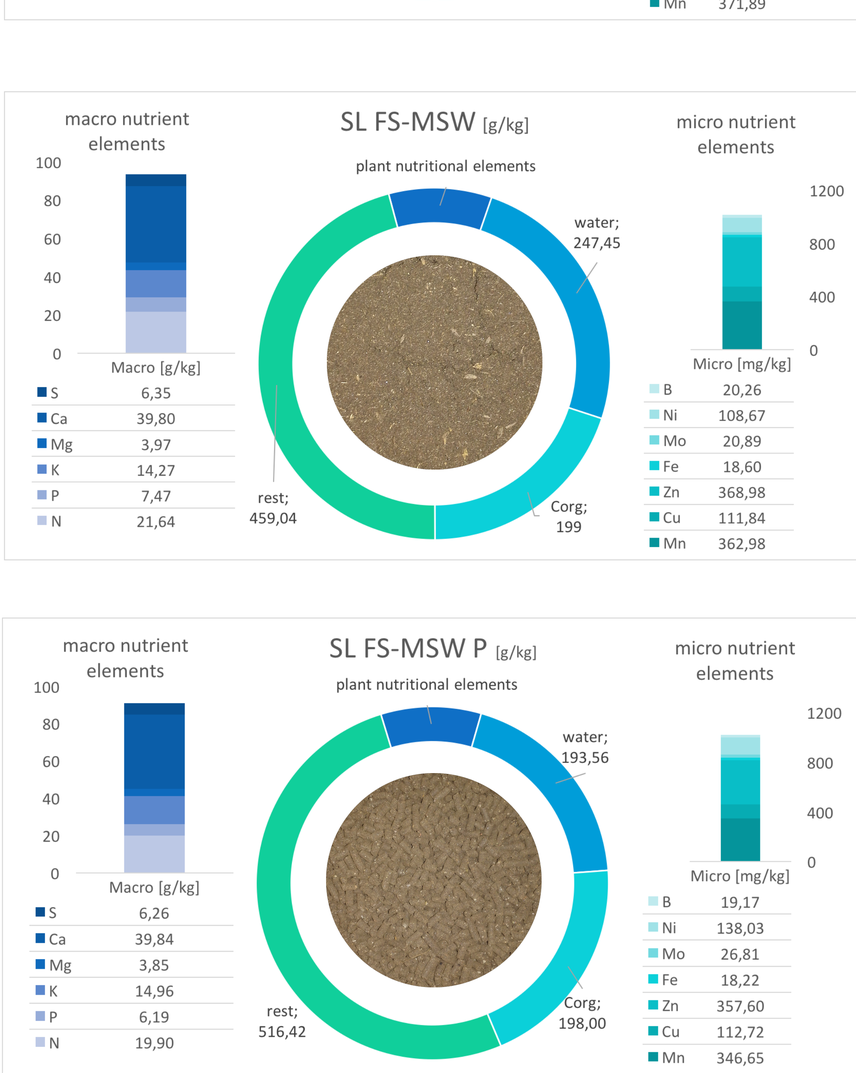
All analyses had been replicated (n=2).

Results

The four evaluated composts and co-composts are displayed as complete content, macro (left) and micro (right) plant nutritional elements.







Heavy metal analysis

Heavy Metals, Lead (Pb) Cadmium (Cd), Arsen (As) and Chromium (not displayed) had been analysed and compared to EU, US and Canadian environmental standards.

Element [mg/kg DM]	*SL FS*	*SL FS+RH*	*SL FS-MSW*	*SL FS-MSW P*
Pb	31.04 (± 0.60)	13.11 (± 0.17)	22.82 (± 1.82)	20.91 (± 0.12)
Cd	1.67 (± 0.00)	LOD	LOD	LOD
As	1.30 (± 0.10)	LOD	LOD	LOD

EU organic thresholds: Pb 100mg/kg DM; Cd 1mg/kg DM in red; Standard Deviation in parentethis

Key findings

- Dewatered fecal sludge (FS) increases Total Nitrogen content by 150 to 300% compared to MSW compost. (6)
- Macro and micro plant nutritional elements of co-composts (FS+RH; FS+MSW) are with minimum thresholds of EU organic label.
- FS enriches co-compost with organic carbon and mineral nutrients. (6)
- FS on its own bares the risk of contamination with heavy metals.
- Pelletisation has no effect on the chemical composition of plant nutritional elements within the co-compost.

Future perspective

- Further analyses of plant available nutrients are needed
- Pot and field experiments are needed to evaluate the performance of co-compost in the soil-plant system
- Sources for MSW and FS have to be monitored to avoid contaminated feedstocks
- Analyses of chemical and biological contaminants have to be done regularly
- Ratios of FS and MSW for co-composting and additional enrichments need to be tested to enhance product quality

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Project Partners

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