Identification of Fodder Plants for Treatment with Planted Drying Beds

This study identified grass plants with market value in Senegal that had not previously been used for faecal sludge treatment in planted drying beds. It evaluated their potential to grow with faecal sludge effluent and their use as animal fodder. Amadou Gueye[1,2], Mbaye Mbéguéré[3], Cheikh Diop[2], Seydou Niang[4], Linda Strande[1]

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Photo 1: Barrels used for planted drying bed trials (Cambèrène Faecal Sludge and Wastewater Treatment Plant).

Introduction

Planted drying beds (PDBs) are a promising technology for faecal sludge (FS) treatment and resource recovery in low-income countries. This technology generates stabilised sludge that can be used for agriculture, and plant biomass that can be used as animal fodder. However, the most commonly used plants (i.e. *Typha, Cyperus* and *Phragmites*) have limited economic benefit. To maximize the benefits of resource recovery, plants need to be identified that have greater market value and are adaptable to regional conditions [1].

Methods

This study was conducted in Senegal in Dakar, St. Louis, Richard Toll, Dagana, and Tambacounda. Potential plants were identified and collected in natural wetlands and wetlands impacted by anthropogenic contaminants. Interviews were then done with vendors and urban livestock holders to collect data on their market value. The next step was a pot study at the Cambérène Faecal Sludge and Wastewater Treatment Plant in Dakar. The plants were irrigated with FS to evaluate which of the collected species had potential for use in PDBs. Based on the following: ability to grow in FS effluent, market value, and not having previously been used for FS treatment in PDBs, three species of grass plants were selected for further treatment and resource recovery analysis: *Echinochloa crus-galli, Paspalidium geminatum* and *Paspalum vaginatum*.

These three species were grown in 200 L barrels filled with a 10 cm layer of coarse gravel, a 10 cm layer of fine gravel and a 15 cm layer of sand to replicate drying bed conditions, and with perforated PVC pipes at the bottom for drainage (Photo 1). During acclimatisation, the plants were irrigated with tap water and FS effluent. Following acclimatisation, the barrels were irrigated three times weekly at a loading rate of 200 kg TS/(m^2 yr) for three months. For each application, FS was loaded onto the barrels and the leachate was collected and analysed for TS, TSS, COD, TN, NH_4^+, NO_3^-, TP and PO_4^{3-} as outlined in Standard Methods (www.sandec.ch/fsm_tools). After three months, a composite sample was taken to study above ground dried biomass and fodder quality, and total mineral (ash), protein, fibre, TP, and TKN concentrations.

Results

All three species were effective for forage production and FS treatment in barrel trials. The concentrations of monitored pollutants (TS, TSS, COD, TN, NH_4^+, TP and PO_4^{3-}) in the leachate were ≥70 % lower than in the FS loaded. However, the leachate did not meet Senegalese standards for discharge, as seen in Table 1.

Pollutant Discharge Standards	Leachate Concentrations: *E. crus-galli*	Leachate Concentrations: *P. geminatum*	Leachate Concentrations: *P. vaginatum*
100–200 mg/L for COD	264 ± 214 mg/L (COD)	232 ± 149 mg/L (COD)	317 ± 257 mg/L (COD)
30 mg/L for total nitrogen (TN)	159 ± 78 mg/L (TN)	169 ± 85 mg/L (TN)	197 ± 99 mg/L (TN)
10 mg/L for total phosphorus (TP)	38 ± 19 mg/L (TP)	36 ± 20 mg/L (TP)	46 ± 25 mg/L (TP)

Table 1: Senegalese Pollutant Discharge Standards **(NS 05-06)** and Leachate Concentrations.

These results are similar to previous research with *Echinochloa pyramidalis* in PDBs for FS treatment in Senegal [2]. The concentrations of protein, mineral, nitrogen and phosphorus in the plant leaves were similar among all treatments, and were two to three times higher than those reported for grasses grown in natural areas. All plants met the recommended nutritional requirements of livestock and were well below toxicity levels.

Conclusion

The results indicate that the indigenous fodder plants, *E. crus-galli, P. geminatum* and *P. vaginatum*, could be up-scaled for FS treatment in PDBs including forage production. Although the leachate does not meet Senegalese standards and requires further treatment before discharge, this can be achieved with an additional series of PDBs [3]. The fodder produced from PDBs can generate revenue to help offset treatment costs.

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