



ASSESSING THE POTENTIAL OF USING COAL ASH AND BAGASSE ASH AS INORGANIC AMENDMENT IN THE COMPOSTING PROCESS OF MUNICIPAL SOLID WASTES: IMPROVEMENTS IN COMPOST QUALITY FOR AGRONOMIC APPLICATION

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INTRODUCTION



- The Maurice Ile Durable concept aims to make use of renewable energy sources for sustainable growth of Mauritius
- About 20 % of electricity generated was derived from bagasse and hydro; with an expected 40% for the coming decade
- However, heavy oil and coal will remain the main energy sources, with coal offering significant pricing advantages over oil

INTRODUCTION



- Use of bagasse for electricity generation avoids importation of 200,000 t of coal and an atmospheric emission of some **650,000 tCO_{2e}**
- **105,000 t of coal ash (high in carbon content) together with 30,000 t of bagasse ash (high conc. of K & P) are generated each year**
- **Thereby, the need to assess potential avenues to add value to coal and bagasse ash**

Aims & Objectives of study



- 1) Characterize coal ash and bagasse ash for their potential as soil amendments
- 2) Assess environmental consequences of use of ash in agriculture
- 3) Set up and monitor composting experiments with coal and bagasse ash amended MSW composting substrates
- 4) Estimate quantities of (avoided) GHG emissions through use of ash-amended compost
- 5) Develop protocols for use of ash in soil management
- 6) Quantify beneficial effects of ash on growth, yield and yield quality for crops

Objectives of Project



1

- Investigate feasibility of co-composting coal and bagasse ash with sorted /unsorted MSW to produce enhanced quality compost

2

- To optimize the proportion of coal and bagasse ash to be mixed with waste streams to get best quality compost for agricultural use


3

- Assessing envtl. impacts of ash-amended compost with attention on global warming due to effects of the composting process



LITERATURE REVIEW

Composting is the solution: Reducing climate change, not just landfill space



1) Removal of atmospheric carbon through soil carbon sequestration, achieved:

- directly through storage of compost carbon
- indirectly through enhanced plant growth, which in turn contributes also to increased soil carbon levels;

2) Reduction of greenhouse gas (GHG) emissions:

- through reduced production and use of chemical fertiliser and pesticides,
- through reduced irrigation.

Past Studies for use of ash as amendment in agriculture




Study	Observation	Reference
<i>Effects of coal fly-ash amended composts on the yield and elemental uptake by plants</i>	Addition of fly ash (20 - 40%) to compost facilitated efficient plant utilization of nutrients	Menon et al. (1992)
<i>Uptake of multi-elements by corn from fly ash-compost amended soil</i>	Fly ash (20-25%)-amended compost increased plant growth and yield; while being beneficial to corn production without any deleterious effects	Ghuman et al. (1994)
<i>Research on municipal solid waste composting with coal ash</i>	Favorable thermophilic temperatures generated at application rate of 40-60% coal ash; optimum = 45%	Zheng at al. (2003)

Past Studies for use of ash as amendment in agriculture



Study	Observation	Reference
<i>Study of plant growth and yield of underground stem crops in fly ash amended soil</i>	Plant growth and yield were significantly increased in 10 - 20% fly ash amended soils	Khan et al. (2007)
<i>Effect of coal ash residues on the microbiology of sewage sludge composting</i>	With 25% fly ash amendment, reduction in thermophilic bacterial growth and CO ₂ production	Fang et al. (1997)
<i>Impact of organic wastes (bagasse ash) on the yield of wheat (Triticum aestivum L.) in a calcareous soil</i>	Yield and yield components of wheat increased significantly with application of bagasse ash at 2 % to calcareous soil	Jamil et al. (2004)

Study	Observation	Reference
<i>Enhancement of heavy metals stabilization by different amendments during sewage sludge composting process</i>	Addition of coal fly ash up to 20% enhance stabilization of lead and diethylenetriaminepentaacetate (DTPA)-Pb contents decreased from 40 to 21% due to higher alkalinity	 <p>Chiang et al. (2007)</p>
<i>Coal Combustion By-product (CCB) Utilization in Turfgrass Sod Production</i>	Increased yield of biomass with a greater nutrient content in tissue; Volumetric water content of CCB media exceeded that of control	Schlossberg and Miller (2004)
<i>Chemical, microbial and physical properties of manufactured soils produced by co-composting municipal green waste with coal fly ash</i>	Addition of 25% ash to green waste resulted in a 75% increase in available water holding capacity	Belyaeva and Haynes (2009)



METHODOLOGY:

**Major phases and
components of study**



Phase 1

Addition of coal and bagasse ash in **different proportions** in sorted and unsorted MSW

Drum composting of these mixes

Proportion of ash mixed with MSW for composting



- Based on literature review, the following values were chosen:

Substrate	Control	Application rates of Bagasse ash (w/w)		Application rates of Coal ash (w/w)	
Sorted MSW	<i>0% ash</i>	<i>20 %</i>	<i>40 %</i>	<i>20 %</i>	<i>40 %</i>
Unsorted MSW	<i>0% ash</i>	<i>20 %</i>	<i>40 %</i>	<i>20 %</i>	<i>40 %</i>

Phase 2

Detailed physical, chemical and microstructural analyses of coal ash and bagasse ash

Addition of coal ash and bagasse ash to final compost for production of ash- amended compost

For land application

Measurement of water retention, heavy metals, nutrients content and phyto-toxicity bioassay tests



Percentage of ash added to final compost



- The table shows the percentage of ash added to final compost as amendment:

	Proportion of ash added to compost (% w/w)		
Coal fly ash	0 (control)	20	40
Coal bottom ash	0 (control)	20	40
Bagasse fly ash	0 (control)	20	40
Bagasse bottom ash	0 (control)	20	40

Phase 3



Assessing environmental impacts with use of ash-amended composts and composts produced from composting MSW and ash

Use of CDM approved consolidate and baseline methodology, ACM0022 “Alternative waste treatment process” to evaluate effects of ash in composting process on global warming



**Drum
composting of
MSW and
coal ash and
bagasse ash**

***Recommend an
optimum
application rate
of ash for both
sorted and
unsorted MSW***

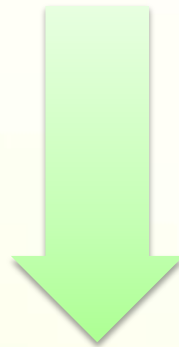
RA1

**Compare effect
of ash in sorted
and unsorted
MSW
composting
process**

**Compare
effect of
different
mixing ratio
of ash in
MSW**



Comparing the use of coal ash and bagasse ash as amendments in compost or as substrate in composting process of MSW



Assessing the effect of varying proportion of coal ash and bagasse ash as amendment in final compost

Estimation of greenhouse gas emissions reductions for the composting process and utilization of ash in agriculture using ACM0022




RA2



EXPECTED OUTCOMES



- 1) Demonstrate feasibility of using coal ash and bagasse ash as additive in composting of MSW with appropriate application rates
- 2) Adding value to these wastes while reduce amount of coal ash, bagasse ash and organic MSW being disposed of at the landfill
- 3) A decrease in GHGs emissions at landfill owing to waste diversion for composting



4) Carbon in agricultural lime is ultimately converted to CO₂ while with the use of ash as its substitution, this GHG is avoided, aiding in climate change abatement

5) Results of the study will provide for the development of appropriate treatment of solid wastes by coal ash and bagasse ash amended composting

6) Finally, to produce final compost of good and safe agronomic quality

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**Thank you for your
attention**

Questions !