CAN VERMICULTURE AND VERMICOMPOSTING BY SOLVE THE URBAN WASTE MENACE YET ENHANCE URBAN AGRICULTURAL PRODUCTIVITY?

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Background

The Ugandan population is currently growing at 3.3. percent (Uganda Beaural of Stastics, 2016). There is a need to produce more food for the growing population (World Bank, 2018). This includes both crops and livestock to have healthy lives among the growing population (NPA, 2013). The prices of the major inputs - animal feeds and fertilizers, however, are on the rise and thus unaffordable to smallholder farmers. Animal feeds are important because 70 percent of input costs on the farm goes into feeds and feeding (FAO, 2014). The soil fertility is deteriorating (Semalulu & Kayuki, 2015) but there is a possibility to improve it through application of organic materials (Asare & David, 2011). This is because inorganic fertilizers are either inaccessible to farmers or their prices are exorbitant. Farmers can hardly use the inorganic fertilizers for soil improvement (Woniala & Nyombi, 2014). There is a need to develop affordable and more cost-effective soil enhancers and livestock feeds.

All this happening when municipal waste is becoming a menace to many urban establishments (NEMA, 2016). The processing of urban waste can be an affordable source of soils nutrients and yet relieve urban authorities of this 'burden.' Due to the beneficial contents of Nitrogen (N), Phosphorous (P) and organic matter in urban waste, they may be processed and used on agricultural land where they have a significant fertilizer value (Abulsoud & Hadid, 2015). The municipalities of Uganda generate a lot of waste but garbage collection and transportation to dumping sites is poorly managed and ineffective. Some dumpsites are inappropriately located, poorly managed and merely cause further adverse effects to the surrounding environment and ultimately to human health (NEMA, 2016).

The World Bank commissioned a country report on Uganda in 2014, which included collection of primary data from three representative districts: Mukono for urban areas, Buikwe for semi-

urban and Lira for rural. As a result, the World Bank has provided $350,000 for modern technology to treat urban waste and turn it into compost manure (World Bank Group, 2019). This technology is only in a few towns owing to its complexity. The National Environment Management Authority is also building the capacity of municipal councils to manage solid waste as a way of reducing greenhouse gas emissions into the atmosphere. There are nine municipal councils that have set up solid waste compost plants. They include Jinja, Mukono, Soroti, Mbale, Lira, Fort Portal, Kasese, Kabale and Mbarara (NEMA, 2017). The degradation of waste materials is achieved by beneficial micro-organisms that require huge technological investment. There is need to devise a cheaper technique e.g. use of earthworms for biodegradation.

Culturing of earthworms is one cheaper option to have enough worms for municipal waste biodegradation and this has been studied in some parts of the world (Domínguez, Aira, & Gómez-Brandón, 2010) (Singh, 2014). Singh (2014) studied the effect of substrate depth on growth of earthworms and Dominguez, the interactions between microbes and earthworms during bio decomposition. There is need to investigate more about earthworms and demonstrate the feasibility of this enterprise to decompose urban and farm waste and produce manure for farmers (Abulsoud & Hadid, 2015). The potential of culturing worms for feed needs also to be documented. This is because earthworms are not only a protein source for animals but also are medicinal and can cure human ailments/ disorders. The possibility of using earthworms in latrines to breakdown human waste to produce manure also needs to be investigated. This research study shall therefore establish the appropriate husbandry practices and economic feasibility of rearing earthworms at African Rural University, Kagadi district.

Purpose of the research project

To generate and document information on earthworm rearing for supporting vermicomposting at farms and municipal garbage collection sites.

Objectives

1. To document practical vermiculture and vermicomposting practices for urban waste management in Kagadi town council, Kagadi district.
2. To establish the economics of vermiculture and vermicomposting enterprise.

3. To evaluate the yield enhancing capacity of vermi compost and vermi liquid on 3 selected vegetable crops

Materials and methods

Study area

The project will be conducted at African Rural University (ARU) campus. ARU is located in Kagadi Town council, Kagadi district, Western Uganda.

Setting up the experimental sites

This study will involve setting a vermiculture enterprise. This study will start on 26 November 2019 at ARU. It will be run by research unit and ARU students alongside the Uganda Rural Development and Training Program (URDT). It will start with 20 units of 2m x 2m wooden vermi boxes (grow beds) (Martin, Black, & Hawthome, 1999). Each unit will have 2 sub units. The 10kg parent stock of *epigeic* worms (the red wiggler, *Eisenia fetida*) will be collected from a local vermiculturist in Hoima district. Some other worms will be collected from the demo farm by the URDT and ARU students. The materials to be used include a mix of straw, fresh food remains, cow dung manure and water. They will be fed on of partially decomposed cow manure every week. They will take two months to mature and we shall harvest worms for up to 2 years. Ready earthworms will be sold at 50,000 = per kg to final consumers. The 10 kg of parent stock will produce 640 kgs in one year or 40 tones after two years (Munroe, n.d.). The project will be sustained on generated revenue from sale of products; worms, vermi liquid and vermi compost.

The project will be managed by both URDT, ARU research unit staff and students. It will involve community members at all stages - set up, management, and evaluation of the project. This project will be rolled out to all ARU satellite urban centers (epicenters).

Research designs

a) Experimental design to document practical vermiculture practices at ARU
b) cross - sectional descriptive survey research design to assess the market preference of the vermi products
c) Observations (Field, lab)

d) Participatory Action Research (PAR) – engaging ARU/URDT staff and epicenter managers in vermiculture

Data collection

Data for objective one will be collected on a weekly basis using printed data sheets. Data will be collected on; 1) the size / dimensions of the grow bed, type and amount of; food, water, and vermi liquid produced, temperature, pH, worm population and multiplication rate, amount of vermi compost, common predators, challenges and key lessons learnt.

Data for objective 2 will be collected costs of items and labor, sales revenue from tourists, trainings, worms, vermi liquid, profiles of customers

Data for objective 3 will be collected on growth rate, yield per acre, pest incidence, taste scores, market preferences of the vermi products, nutrient composition of vermi compost and harvested crop

Table 1 ***Techniques and data analysis***

Objective	**Data required**	**Techniques**	**Analysis**	**References**
To document practical vermiculture practices at ARU	the size / dimensions of the grow bed, type and amount of food, water, vermi liquid, temperature, pH, worm population and multiply rate, amount of vermi compost, productivity of cow manure Vs urban waste, challenges and key lessons learnt.	Experimentation Sampling and measuring Field observations PAR	Descriptive statistics t-test ANOVA	(Singh, 2014) (Tumuhe & Khizzah, 2017)
To establish the economics (costs and benefits) involved in vermiculture and vermicomposting enterprise	Costs of items (variable & fixed), interest on capital, depreciation costs Sales revenue from tourists, trainings, worms, vermi liquid, Gross margin, Net profit, gross return, gross cost, Producers share, market preference of the vermi producst	Cost benefit analysis Discounting (BCR, NPV, IRR)	Descriptive stats	(Devkota, Dhakal, Dhakal, Dhakal.PhD, & Ojha, 2014)

To evaluate the yield enhancing capacity of vermi compost and vermi liquid on 3 selected vegetable crops	Growth rate, yield per acre, pest incidence, taste, market preference, nutrient composition of vermi compost and harvested crop	Experimentation, survey Observations (field and lab analysis) PAR	ANOVA, t-test, descriptive stats,	(Tumuhe & Khizzah, 2017) (Bain et al., 2007; Baum, MacDougall, & Smith, 2006; Martínez, n.d.; Pain, Geoff, Trust, & Rivers, 1992; Selener, 1997; Yeates & Amaya, 2014)
To assess the yield (vermi products) from cow manure and municipal waste				

Table 2 ***Budget for conducting a study on vermiculture and urban waste vermi composting***

item / activity	quantity	unit	unit cost	amount
establishment of vermiculture units	20	grow beds	400,000	8000000
establishment of vegetable garden	1	garden	500,000	500000
Attendant	12	months	60,000	720000
stationary	1		200,000	200000
utilities (internet, water, airtime)	12	months	200,000	2400000
Consultation fees	3	persons	300,000	900000
Computer software	4	applications	500,000	2000000
Laptop	1	pc	2,000,000	2000000
survey	1	field activity	4,000,000	4000000
dissemination workshops	2	workshops	500,000	1000000
Publication of journal articles	3	articles	9,000,000	27000000

				48,720,000

Table 3 ***Workplan (Structural Tension Chart Framework)***

Accountable	Outcome; 3 research articles on vermiculture enterprise	**Due date**
Charles	**Action steps**	30 May 2019
Charles	Manuscript preparation and submission	20/5/2023
Charles	Submission or research report to University	1/4/2023
Charles	Report writing	29/8/2022
Dennis – RA	Data collection	27/6/2020
Agaba - attendant	Vermiculture husbandry practices executed	26/11/2019
Dennis	Establishment of research / experimental sites	20/10/2019
Charles	Presentation of proposal to University for approval	1/9/2019
Charles	Knowledge development on vermiculture	26/6/2019
Charles – student	Concept and proposal development	30/8/2019
Current reality: There is a project on micro flush toilets with experts in vermiculture at URDT, ARU has a research unit, available space at ARU, there is demo farm with cow manure, there is plenty of municipal waste at Kagadi town council garbage site.		

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