FINANCIAL FEASIBILITY ANALYSIS OF THE FORTIFER BUSINESS MODEL IN THE CAPE COAST METROPOLIS IN GHANA

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Abstract
This study seeks to analyse the financial feasibility of upscaling the fortifer business model in Ghana. Data originate from the pilot project in Accra, extended with expert elicitation. The NPV and IRR were used as decision criteria for Public Private Partnership (PPP) and Private Scenarios. The Spearman rank correlation coefficient was used to identify input parameters which had most impact on NPV. Economic and simulation results reveal higher probability of financial feasibility in the PPP Scenario. Outcomes are useful for policy makers to jointly steer urban waste management and farmers' needs in the area of sustainable soil management.
Keywords: Faecal sludge, Excreta pellets, Waste, Agriculture

1. Introduction

Human excreta have been used in many countries as a good and cheap source of nutrient to enrich the soil. In Ghana, the use of human excreta as a source of nutrient in farming dates back to the early 80s. Its prominence in recent times is seen in the peri – urban agriculture sector due to its nutritional content, cheap cost and safety of usage (Danso et al., 2005). Contrary to this prominence, majority of human excreta are still treated as waste in Ghana. The management of this waste, although not effective, puts a lot of pressure on government's budget (Cofie et al., 2005). Composting is seen as a key step towards tackling waste management problems in Ghana. Studies have shown that farmers are willing to use compost from different waste as soil nutrient supplement. However, the success stories of planned waste collection, treatment and reuse are few and often of small scale, hardly viable and seldom surviving their pilot stage (Cofie et al., 2005).

Studies conducted in Ghana by Cofie et al. (2005) and Murray et al. (2011) on the reuse of human excreta have been geared towards the technical aspect of improving the nutritional composition. These studies have led to the development of fortified excreta pellets, the so called 'Fortifer' by the International Water Management Institute (IWMI) in Ghana. This is viewed as user-friendly, nutritionally enriched and economically assessable to farmers. The fortifer business model which falls within the broader resource recovery and reuse business model is seen as a sustainable way of tackling the waste problem and at the same time as a cheap source of nutrient supply for farmers.

Before this product is rolled out on a commercial phase, a comprehensive investigation into the financial aspect of running such a business model in Ghana and its social acceptability is imperative. Thus, investigations into the financial feasibility of the production of the fortified excreta pellets is crucial before it is up-scaled on a commercial phase. However, studies targeted at the financial aspect are few. An initial attempt to assess the financial feasibility of solid waste composting in Ghana by Cofie et al. (2005), employed a cost versus willingness to pay analysis to conclude that financial feasibility of this business model was unlikely. Although these results give a fair idea about the prospects of the viability of the business model, it incorporates a wider look at municipal solid waste. This study on the other hand, focuses on the fortified co-compost from municipal solid organic waste and faecal sludge. In addition, widely acceptable financial methods of assessing profitability of a business like the net present value and internal rate of return are used.

Thus, the main aim of the study is to assess the financial feasibility including uncertainty of the net present value of the fortifer business model in the Cape Coast metropolis in Ghana to help provide more information for both public and private investors in resource reuse business models.

The remainder of the study is organized into sections 2, 3 and 4. The methods are discussed in section 2. In section 3, the results are presented. Finally, the results are discussed and conclusions drawn in section 4.

2. Methods

This sections covers the types of data collected, the methods of data collection and the empirical methods used to analyse the data.

2.1 Data collection

A mix of primary and secondary data were used in this study. Data were collected from pilot project in Accra, extended with expert elicitation. Data on revenues from faecal sludge disposal were obtained from the Cape coast metropolitan waste department in Ghana. Data on technical parameters such as the ratio of formulation of raw materials, labour, types of equipment and the inputs used for the production process were obtained from the pilot project. Secondary data on both technical and financial parameters were gathered from published literature about the fortifer pilot project and other similar co-composting schemes in Ghana. Data on the cost estimates for machines and other equipment were quoted based on the commercial selling rate from the website of manufacturing companies. The selling price of the fortifer was based on the market price of a substitute good. The NPK is the most used fertilizer in Ghana. Hence, the market price of the NPK was used as the selling price for the fortifer. For projections on annual costs and output price growth, data were retrieved from the yearly consumer price index published by the country's statistical service and annual gazetted publication of the bank of Ghana.

Data sourced using expert elicitation were the specification and cost of land and the building of the composting facility. Data on the land specification and cost were gathered from Ogloo consult, a local real estate company. Data on the composting facility were sourced from Koracle consults, a local expert in building, construction and quantity surveying. The estimations of the composting facility was adapted from the building specifications for co-composting by Rottenberger et al. (2006).

2.2 Empirical method

The net present value (NPV) and internal rate of return (IRR) were used as the valuation criteria for the financial feasibility. The formula for the NPV and IRR are given in equations 1 and 2 respectively.

$$\mathbf{NPV} = -\mathbf{C_0} + \sum_{\mathbf{t=0}}^{\mathbf{n}} \frac{\mathbf{C_t}}{(\mathbf{1+r})^{\mathbf{t}}} \quad (1)$$

Where $\mathbf{C_t}$ is nominal net cash flows, $\mathbf{C_0}$ is initial investment, **r** is nominal rate of return, **t** is time (in years) and **n** is duration of the project.

$$\mathbf{IRR} = -\mathbf{C_0} + \sum_{\mathbf{t=0}}^{\mathbf{n}} \frac{\mathbf{C_t}}{(\mathbf{1+r})^{\mathbf{t}}} = \mathbf{0} \quad (2)$$

From equation 1, the probability of making a loss can be estimated when NPV < 0. The initial investment (C_0) consists of cost items comprising the cost of building the composting facility, faecal sludge treatment site, land, equipment for composting, furniture and fixtures, computer and data handling devices and initial marketing cost.

The annual net cash flows (C_t) = total annual revenue – total annual cost – corporate tax.

The corporate tax (t) is calculated as

$$\mathbf{t} = \mathbf{t_c} * (\mathbf{R} - \mathbf{C} - \mathbf{Ca}) \quad (3)$$

Where $\boldsymbol{t_c}$ is the corporate tax rate, ***R*** is the total revenue, ***C*** is the total cost and ***Ca*** is the annual capital allowance.

A corporate tax rate of 10% is applicable to agro related processing companies as per the taxation laws of Ghana. For waste processing companies, the government of Ghana gives a tax holiday of 7 years, hence taxation was deductible in year 8 onwards. An aggregated inflation rate was assumed based on the consumer price index (combined average of the food and non-food groups) from year 2005 – 2012 of Ghana's statistical. The base rate of 16% set by the Monetary Policy Committee of the Bank of Ghana was used as discount rate **(r)**. A project life cycle of 15 years was considered. Table 1 presents key assumptions and taxation incorporate in the financial feasibility analysis.

Table 1 Assumptions and taxation used in NPV and IRR analyses

ASSUMPTIONS					**Prob. Distribution**	**References**
Annual cost and output price growth rate	%	12.53	0.99		Inv. Gauss	BoG, (2013)
Annual sales volume in tons	tons	104	0	1040	Triangular	Author
TAXATION						
Capital allowance						
(i)Building structures and works of a permanent nature other than those in minerals and petroleum exploration	Straight line basis		10%			Ghana Revenue Authority, 2013
(ii)Plant and machinery used in manufacturing sector	Reducing balance		30%			‘’
(iii)Equipment, office furniture and fixtures	Reducing balance		20%			‘’
Corporate tax rate for agro- processing companies in other regional capital (excluding Tamale, Wa, Bolgatanga)			10%			
Tax holiday for waste processing companies			7 yrs.			
Project life cycle			15 yrs.			Steiner et al., 2002
Discount rate			16%			BOG, 2013

2.3 Scenario and sensitivity analyses

The financial feasibility analysis was considered under two scenarios, the Public Private Partnership (PPP) and Private Scenarios. In the PPP scenario, there exist a collaboration between the local authority (i.e. metropolitan assembly) and a private firm, hence both parties contribute to the business model. In the private scenario, the private firm is autonomous in running the business model, hence all costs incurred and revenues accrued go to the private firm. The difference in the two scenarios arise from the initial cost outlay and the revenue from the faecal sludge disposal fees. In the PPP scenario, the metropolitan assembly incurs the cost of land and construction of the faecal sludge dewatering site, hence they receive the revenue from the disposal fees. The private firm in this scenario incurs the rest of the initial outlay cost such as building of the composting plant, equipment, furniture and fixtures and the recurring costs.

The sensitivity analyses was carried out to determine the effects that changes in parameters had on the NPV. This identifies the project's most important and sensitive parameters. Prior to performing the sensitivity analyses, a preliminary analysis was performed to identify the input parameters that may be important to explore more fully. This was done by ranking the input parameters based on their impact on the NPV and IRR using the Spearman rank. This ranking was used as the basis of selecting the input parameters incorporated in the sensitivity analyses.

3 Results

The economic results for the two scenarios of the fortifer business model are shown in table 2. All the items presented (i.e. total revenue, total revenue and operating profit) in

exception of total investment are presented as average of 15years. From the table, it is evident that the private scenario of the upscale fortifer business model has a higher initial investment cost compared to the Public-Private Partnership. Both Public-Private Partnership scenario and the Private scenarios had positive mean NPV of GH¢ 118,855 and GH¢ 106,847 respectively and IRR greater than the discount rate of 16%. However, the Public-Private Partnership scenario had a higher IRR of 23%.

The simulation results for the two scenarios as presented in table 3, show that there was approximately 48% chance of financial viability for both scenarios when an annual average sales volume is 10% of the production volume. However, the probability of making losses for the Public-Private Partnership scenario (i.e. 52.9%) was a little lower than Private scenario (53.2%) when the NPV is used as the decision criterion. The results of the minimum and maximum NPV affirms the fact that Public-Private Partnership has a higher financial viability compared to the Private scenario.

Table 2 Economic results of the two scenarios of the fortifer business model*

	Public – Private Partnership	Private
Total investment	335,412	372,558
Annual sales revenue	1,506,155	1,506,155
Annual disposal revenue	-	13,488
Total revenue	1,506,155	1,519,643
Annual Production cost	1,073,666	1,073,666
Annual Marketing cost	52,915	52,915
Annual Distribution cost	43,522	43,522
Total variable cost	1,170,103	1,170,103
Depreciation	18,252	20,107
Total fixed cost [a]	22,360	24,837
Total cost	1,210,715	1,215,047
Operating profit [b]	295,440	291,108
Mean NPV [c]	118,855	106,847
IRR (%)	23	22

a. Fixed cost comprise of cost of land, building composting facility and faecal sludge treatment site, equipment, initial marketing cost, furniture and fixtures
b. Average of 15 years
c. Discount rate of 16% for 15 year duration
* The figures are expressed in Ghana cedis

Table 3 Simulation results for the two scenarios of the fortifer business model

	Public-Private Partnership	Private
NPV(GHS '000)		
Min	-2,689	-2,592
Max	4,641	4,505
Mean	119	108
5th percentile	-1,944	-1,952
95th percentile	3,032	3,041
Probability (NPV < 0) (%)	52.9	53.2

5000 @Risk iterations

Prior to the sensitivity analyses, a preliminary analysis was conducted to identify the input parameters which had more impact on the NPV based on the Spearman correlation coefficient rankings. The annual sales volume was ranked as the input parameter with the highest impact on the NPV for both scenarios. The results show a perfect spearman correlation between annual sales volume and NPV (i.e. correlation coefficient of 1). The annual cost

growth rate had a negative spearman correlation of -0.02 and -0.03 for the public-Private Partnership scenario and the Private scenario respectively. Hence, for the sensitivity analyses, the percentage of the assumed most likely annual sales volume was changed to 15% and 5% to see the impact on the NPV and IRR. The simulation results for the NPV and the economic results for the IRR of the sensitivity analyses are presented in table 4. The simulation results of the sensitivity analyses show that at an average annual sales volume of 5%, the PPP scenario will still earn an IRR equal to the discount rate of 16%. However, with the same annual sales volume, the private scenario will be earning less than the discount rate of return.

Table 4 Results of the sensitivity analyses

	Public-Private Partnership		Private	
% most likely sales volume	15%	5%	15%	5%
NPV(GHS '000)				
Min	-2,572	-2,515	-2,483	-2,514
Max	4,656	4,696	4,654	4,753
Mean	234	2	224	-9
Probability (NPV < 0) (%)	50.3	55.5	50.5	55.6
5000 @Risk iterations				
IRR (%)	30	16	28	15

4. Discussion, conclusion and recommendations

Two different scenarios of the fortifer business model used in this study arise from the level of public authority involvement in the business model. The public authority's involvement considered in this study are the provision of land and the ownership of the faecal sludge dewatering site. The results from this study reveal that at an average annual sales volume of 10%, the business model has under both scenarios has close to 50% chance of been financially feasible. The results also show that an investor has about 50% chance of making loss. However, the Spearman rank and sensitivity analyses show that an investor has a higher chance of gaining from their investments when an increase in sales volume is targeted. The tentative constant annual sales volume of 10% makes the analyses a cautiously optimistic one which implies that the chances of financial feasibility can be higher than was has been estimated. Apart from the sales volume, another factor which influence the financial feasibility of the business model is the selling price of the fortifer product. In this study, the market price of a substitute good (i.e. NPK) was used instead of a higher price which was reported in the willingness-to-pay study conducted on the fortifer product. This gives management more room for exploring the different price options, which will be a competitive tool for a new product such as the fortifer. The result from this study resonates with the conclusion drawn by Harper (2004) that individuals and municipalities seeking to venture into the composting business could cover their operating costs and earn some surplus for a production capacity of 1000 tons a year. The first conclusion drawn from the results of this study is that the overall shift towards a cost recovery orientation in the waste management sector is attainable and upscaling the fortifer business model has high potential of financial viability when sales volume increase. Secondly, the public sector involvement will increase the financial feasibility of the business model.

From the conclusions, it is recommended that the policies on waste management should be geared at reusing waste in a more sustainable way. Additionally, the public sector should not relegate the management of the sanitation sector entirely to the private sector. The public sector should be actively involved in cost recovery schemes in collaboration with private investors.

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