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Financial Viability, Value Addition and Constraint Analyses of Certified Organic Pineapple Production and Marketing in Ghana

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Abstract: Pineapple is consumed in Ghana and other parts of the world mainly as dessert in a form of sliced fresh fruit, juice or juice/fruit combination, jam or even oven dried sliced pineapple. In Ghana, the demand for certified organic pineapple is increasing. Certified organic pineapple products, though beneficial as food and revenue sources, could also be costly to the producer in terms of resource consumption and opportunity cost of investment. Using certified organic pineapple producers in the Central and Eastern Regions of Ghana as a case study, the financial viability per acre (0.4 ha) of certified pineapple over a five (5) year period was estimated, using the Net Present Value (NPV) and Internal Rate of Return (IRR) approaches, where cash flows were discounted to their present values. The Net Present Values are positive indicating that the production of certified organic pineapple in both Central and Eastern Regions of Ghana are financially viable. This was further confirmed by the estimated Internal Rate of Returns in both regions which were higher than the cost of capital and hence financially viable. The sensitivity analysis performed on the Net Present Values for both Regions revealed revenue to be the most sensitive and cost of Tools and consumables is least sensitive variable. Total value added and value added per unit cost of certified organic pineapple by pineapple farmers, retailers and processers in both regions were assessed using the absorption costing approach. The study found that the processor (dry processing) is the actor that adds more total value to its primary raw material compared to the other actors. Using Kendall Coefficient of Concordances to test the agreements between ranked constraints, access to cash credit on the whole is ranked the major constraint to certified organic pineapple production in the Central and Eastern Regions of Ghana. These results have policy implications for the production and marketing of certified organic pineapple in Ghana.

Key words: Certified organic pineapple production · Financial viability · Net present value · Internal rate of Return · Value addition · Ghana

INTRODUCTION

In Ghana, the pineapple industry is the most developed horticultural sector and very predominant in the Greater Accra, Eastern, Central, Western and Volta Regions of Ghana [1]. In 2004, pineapple export was estimated to have contributed over 60% of the value of Ghana's non-traditional exports generating approximately 20,000 direct employment and an estimated rural income of GH¢6 million to 2,500 households in the rural communities [2]. In the same year, the total volume of pineapple imported into the European Union (EU) was about 400,000 tonnes, a 54% increase from 1997 with Ghana's export accounting for 70,000 tonnes [3]. From 2005, however the export volumes from Ghana started to decline which is attributed to the preference for the MD2 variety of pineapple in the pineapple export industry at the expense of the local smooth cayenne pineapple variety. Recent data indicates that EU import of pineapple from Ghana dropped from 38,000 tonnes in 2007 to 23,000 tonnes in 2008 [4].

Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inorganic inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and to promote fair relationships and a good quality of life for all involved [5].

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The internet publication dubbed "Renewed demand for organic fruits & vegetables-Tesco" indicates 500%+ increase in the sale of organic pineapple in the UK by Tesco between December 2008 and July 2009 [6]. This could be attributed to an increase in customer consciousness on health and safety issues coupled with the need for environmental safety. Even though the organic market is small, it is growing and expected to grow further as the PAS2050 standard on climate change is taking a global dimension. This development is calling for a reduction in carbon emissions and hence reduction in the use of synthetic fertilizers which is an opportunity for organic producers, processors and exporters. The organic market is a niche one and usually offers competitive premium for exporters which will be an opportunity for certified organic farmers in developing countries including Ghana to improve their livelihood.

The organic pineapple export sub-sector in Ghana can be described as either medium / commercial scale producers (5 ha and above) or processors with export focus usually with or without out-growers or small-scale organic producers (less than 5 ha) producing for both export and local markets [1]. Some of these medium-scale exporters require sophisticated production systems adopted from other countries which is very expensive and unsustainable to the smallholder farmer. The small-holder farmers with organic production potential are normally organized into farmer groups and produce using simple and lower input production systems making their cost of production per hectare lower compared to the medium-scale producers with sophisticated and high input production systems.

However, organic pineapple production especially with the smallholder farmer is engulfed with so many challenges including cost of initial certification, maintenance of the certification, management of Internal Control System(ICS), actual production or processing technology, marketing and high market quality standards. Notwithstanding the challenges, there are a few smallholder and commercial organic certified farmers in Ghana who produce organic pineapple for sale to processors, exporters and the local market.

The Ghanaian pineapple industry especially the export market, which is dominated by fresh pineapple, is challenged with less access to well equipped pack houses, pre-cooling units and other post harvest handling logistics which to some extent makes the Ghanaian pineapple industry less competitive and highly vulnerable in terms of meeting market quality standards. Value addition including processing as a means of adding economic returns and enhancing the shelf life of most perishable agricultural produce including pineapple could be an intervention to overcoming some of the challenges of fresh pineapple. Value addition in pineapple production may take various forms including all the economic enhancements to production such as: certification, input supply, production, processing, marketing, consumption and the contribution of other business operators in the pineapple industry. Promoting value addition, like slicing for fresh export in the Ghanaian pineapple industry, could propel the Ghana's pineapple industry to a more competitive state globally by increasing the level of economic returns as well as reducing post harvest losses [7].

Organic farming is a market standard which is aimed at enhancing quality and satisfying the customer requirement. It is an economic concern as far as organic certification including high cost of certification, documentation, compliance restrictions and traceability management in organic pineapple certification is concerned. It is often questioned by farmers and other pineapple industry players as to whether the benefits of organic certification are commensurate with the associated cost. Agricultural entrepreneurs in developing countries have to be competitive on costs and quality with long established producers and exporters relationships and meet the standards set by major importers, if farmers are to have an assured market for their produce. Increasingly they also need to be able to produce and export on a scale which is more cost-effective and acceptable to the importers [8].

To the best of our knowledge, studies on certified organic pineapple business from production to financial viability and constraint analysis have been scanty or non-existent. For instance, studies have been conducted on pineapple production and processing in Ghana including the estimation of costs, revenue and profit [9, 10]. These studies have focused on one production cycle forgetting that some of the farm inputs like the planting material are more expensive to a beginner who needs to buy it from other sources compared to one already in production who would easily obtain it from his own farm. This study sought to contribute to filling the gap in the exiting literature by analyzing the financial worth, value addition and constraints in the certified organic pineapple industry in the Eastern and Central Regions of Ghana.

The pineapple fruit is a perishable product with a very short shelf life after harvest especially if not processed quickly after harvest. Processing of organic pineapple for export or local consumption is a value addition approach but has its own challenges like sourcing raw materials, reliability of processing plants, financing cost and general overhead costs that needs to

be addressed if a better and sustainable business is the target of the processors. Though there are various actors in the pineapple businesses in Ghana adding value in one form or another, it is not clear which actor along the pineapple value chain (including input provider, producer, processor and trader) adds more value.

The prospects of certified organic pineapple production and marketing like most businesses is constrained by both internal and external factors and sometimes making it difficult in prioritizing the constraints and hence resource allocation. The objective of this study is threefold:

- Assess the financial viability of certified organic pineapple production in the Eastern and Central Regions of Ghana.
- Assess the value added by each actor (producer, retailer and processor) along the organic pineapple value chain.
- Identify and rank the constraints faced by farmers in organic pineapple production in the Eastern and Central Regions of Ghana.

This study provides policy recommendations that will promote the success of pineapple industry in Ghana and also contributes to filling the gap in the existing literature on the production and marketing of organic pineapple in Ghana.

The rest of the study is structured as follows. Section 2 provides the literature review, section 3 outlines the methodology employed; section 4 discusses the empirical application and results; and section 5 provides the conclusions.

Literature Review: The pineapple industry in Ghana is export dominated and experienced some difficulties in recent years (2003- 2008) as a result of the industry's inability to meet the increasing demand for the new variety, MD2 as against the Smooth Cayenne that represented over 95% of Ghanaian pineapple exports. In 2003, Ghana's pineapple export of Smooth Cayenne took a severe hit as a result of the introduction of the MD2 variety. It plunged the industry so badly that exports of fresh pineapples plummeted from a peak of 71,000 metric tonnes in 2004 to about 40,000 metric tonnes in 2005 [11].

Certified organic pineapple is one that has gone through organic certification process. Certification is a process by which a third party gives written assurances that a product, process or service is in conformity with certain standards. A certificate is issued to that effect which demonstrates to the buyer that the supplier complies with certain standards [12]. Organic certification according to Regulation (EC) 834/2007 and (EC) 889/2008 is a prerequisite for any producer wishing to export organic produce to the European market. Organic certification requires producers to adopt certain environmental standards, e.g. to refrain from using synthetic inputs. The rapid growth of the organic food sector with an average growth rate of 13 % between 2002 and 2006 created niche market opportunities and expected to double by 2012 [13]. In the EU, it is now between 2.5 and 4.5 % of total food sales, with Germany being the leader in market size. In general, Europe is the largest market for organic pineapple.

Most organic pineapples for the EU market are produced in Ghana with an increasing amount coming from Costa Rica [14]. The increasing demand for organic pineapples on the international market offers opportunities for small scale farmers in developing countries including Ghana. The organic market usually offers premium price. However, the organic market demands high quality product and farmers and processors need to produce to meet the standards and to also incur certification costs. In addition, the organic market is changing rapidly with high price volatility. Producers or exporters who have to decide whether to invest in certification have to take into consideration the price and demand volatilities in the market.

The key actors identified in the certified organic pineapple value chain in Ghana include; commercial organic certified pineapple farmers, small scale organic certified pineapple producers, processors, private sector support organizations and public sector support organizations.

Value chain is a chain of activities that give more added values to products or services. Generic value-adding activities of an organization are categorized into; "primary activities" include: inbound logistics, operations (production), outbound logistics, marketing and sales (demand) and services (maintenance) and "support activities" include: administrative infrastructure management, human resource management, technology (R&D) and procurement [15]. Global value chains (GVCs) are usually explained by four dimensions: input-output structure, geographical coverage, governance structure and the institutional framework in which the chains operate [16]. In these respects, value chains can be described as the vertically linked interdependent processes that generate value for the consumer. The value-chain concept goes beyond individual organizations and could be functional, institutional or organizational and applies to the whole supply chains and distribution networks.

The value added (per unit of product) is the difference between the price obtained by a value chain actor and the price that this actor paid for the inputs delivered by actor(s) of the preceding stage of the value chain. Thus, it is the worth that is added to a good or service at each stage of its production or distribution.

Analysis of value addition along the value chain requires adequate information about the contribution of the various chain segments to total value. In this case, the profitability as well as value added by each chain actor is important in promoting the sustainability of the chain. Value addition activities include contribution from labor, use of non-current assets, certification and all activities that increase the ecomonic return of the product under consideration.

MATERIALS AND METHODS

In this section, various concepts within the pineapple value chain such as financial viability, value addition and production constraints are discussed. The economic dimension of the food chain highlights financial feasibility, transaction costs, added value, division of chain costs, price-making, the time required to recover the investments, productivity etc. [7]. Financial viability is assessed using the net present value (NPV) and Internal Rate of Return (IRR) approaches together with estimating the sensitivity of the cost and revenue elements. Value addition is assessed using the absorption or total cost technique where the relevant cost comprises direct material, direct labor, direct expenses and overheads. The constraints of organic pineapple production is identified and ranked using the mean ranking approach of Kendall's Coefficient of Concordance. Kendall's coefficient of concordance is a measure of the agreement among several judges who are assessing a given set of objects [17].

NPV as a Measure of Financial Viability: This is estimated by first assessing the various cost items and associated benefits. The costs include; certification, pre-planting, planting and post planting operations including harvesting. The benefits include; revenue from fruits and suckers. These benefits and costs are discounted taking into consideration inflation and time value of money to give the discounted cost and the discounted benefits. This assessment is done for organic pineapple farmers over a five (5) year period starting from 2006 to 2010. The five year period is adopted based on the fact that some cost elements like the planting material (sucker) which forms a bigger part of the initial investment cost would be available for use and multiplication in future. The cost of the sucker in subsequent years especially to the smallholder farmer practicing ratoon cropping would be very minimal whilst at the same time the transportation cost of the sucker for those using a complete start up crop will be reduced to the minimum. The 5 years provide enough room to absorb the initial cost of the sucker and a reliable estimate of costs and benefits. From the survey, it is clear that in the first year of production, the pineapple crop does not fruit except in the second year and for a ratoon crop the yield mostly declines considerably in the fourth and fifth years.

The NPV gives a more accurate definition of the cash flows that accrue to the farmer. The NPV is a useful tool for assessing financial viability which estimates the worthiness of an investment in monetary terms. The NPV is estimated as follows:

$$NPV = (B_t - C_t)/(1+r)^n \quad (1)$$

where; NPV denotes Net Present Value, C_t denotes costs in each year, B_t denotes the benefits in each year, r the discount rate and n the number of years. In estimating the NPV, we assume the following: (a) Initial investment occurs in year zero, once (b) All cash flows occur at either the start or end of a year (c) Other cash flows occur in one year's time after the previous cash flows (c) Inflation is constant throughout the period.

It is worth noting that estimating the cost associated with this kind of projects comprises both investment and operating cost. Investment cost is the initial capital required within year zero and the one to commence the business. It usually involves investing in non-current assets that are expected to last more than one financial year. Operating costs are however the cost (including wages, rent, interest, sales, distribution and administration cost) incurred on daily basis. These are normally incurred throughout the project life and may be partly financed from proceeds realized during production.

Internal Rate of Return: The Internal Rate of Return is a discounted cash flow approach which estimates the opportunity cost of investment capital. It is a rate of return that yields zero Net Present Value (NPV). It involves estimating two NPVs with the same cash flow streams using two separate discount rates (low and high). It is sometimes assumed to be a trial and error method with the expectation that the lower discount rate gives a positive NPV while the higher discount rate gives a negative NPV. The discount rates and the NPV so determined are then modeled to obtain a discount rate which yields zero NPV as in equation (2) below.

$$IRR = L + (H - L)[(NPVL/NPL - NPVH)] \quad (2)$$

where IRR denotes Internal Rate of Return, H and L denote the higher and lower discount rates respectively, while NPVH and NPVL denote the NPV of higher and lower discount rates respectively. The investment is accepted if IRR is greater than the discount rate. The IRR is most effective for assessing the discount rate that will give a break even situation. The implication of the decision is that the farmer should not take loan from the bank whose interest rate is more than the IRR.

Sensitivity Analysis (Switching Values Approach): Sensitivity analysis is done to ascertain the responsiveness of the costs and benefits associated with estimating the NPV. Sensitivity by switching value estimates how much each of the estimated costs and benefits used in the NPV computation can change before the decision alters [18]. This implies if the NPV is positive, the sensitivity shows how much the estimated cost or benefit will change to alter the NPV to be negative. The lower the rate of sensitivity the more sensitive the estimate [19].

The sensitivity margin is specified in equation (3) below:

$$\text{Sensitivity margin} = \frac{NPV}{PV} * 100 \quad (3)$$

where, PV is the present value.

Assessing the Value Added by the Various Actors in the Organic Pineapple Value Chain: Value addition is assessed by estimating the incremental monetary value added to inputs at each actor level to generate output of the next level along the value chain. Net incremental benefit along the chain or value added is determined by the rate at which an actor in the chain contributes money compared to the rate at which he spends money. It is estimated using the absorption or total cost model. Figure 1 shows the organic pineapple value chain of the study.

Absorption Costing: This costing technique assumes that the relevant cost to the business is the total cost which is a sum of total variable and fixed costs [20, 21]. In this research, value (cost) is added by an actor to the end product of the preceding actor to generate the final output. Invariably, the end product of one actor is the primary product of the other.

Value addition estimated by absorption costing approach considers variable cost (direct material, direct labor, direct expense), fixed costs (non-current assets) and overheads as relevant cost.

Value added per actor is specified in equation (4) below:

$$Value\ Added\ (VA) = Total\ cost\ (TC) - Value\ of\ primary\ inputs\ (VP) \quad (4)$$

where; TC is the total cost (value) on relevant activities by an actor to generate the end product (fruit, juice, dried pineapple or sliced pineapple) and VP is the cost (value) of the basic input that a particular actor purchases from the preceding actor.

The value chain for this study starts from the input provider and ends at the consumer level. In this sense and for the industry under consideration, the assessment of value addition is for the farmer, retailer and processor. The standard unit for measuring the value added by each actor is metric tonne of fresh pineapple fruits.

VA1: Value added by primary producer or farmer estimates the value that the farmer adds to a tone of pineapple fruits. It is specified as:

$$VA1 = TC1 - VP1 \quad (5)$$

where; $VA1$ denotes value added by farmer, $TC1$ the total cost (value) for a tonne of fruits from the farmer and $VP1$ the value (cost) of planting material (sucker) to the farmer to produce a metric tonne of fruits.

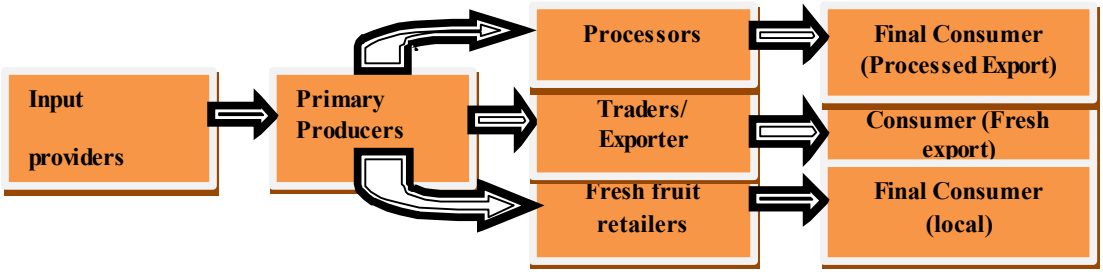

Fig. 1: Organic Pineapple Value chain of the Study

VA2: Value added by Retailer of fresh pineapple estimates the value added by the fresh fruit retailer to a tone of fresh pineapple. This could be local or export fruit. For the reason that the same export market offers fairly the same price for fruits from different countries of equivalent qualities (mostly with different costs of production) and also because different prices are offered in different markets, the study is limited to local fresh fruit retail. It is specified as:

$$VA2 = TC2 - VP2 \quad (6)$$

where; *VA2* denotes total value added by retailer, *TC2* the total cost (value) per tonne of fruits sold by the retailer, while taking into consideration cost of cleaning, grading and carting from the farm gate to the retail outlet and *VP2* the cost of fruit to the retailer.s

VA3: Value added by Processor assesses the value added by a processor to a tone of fresh pineapple fruits obtained from the primary producer. In Ghana, there exist three (3) processed organic pineapple businesses: slicing, drying and juicing. These processing types of pineapple are mainly targeted at the export market, even though they also meant for local consumption. It is specified as:

$$VA3 = TC3 - VP3 \quad (7)$$

where: *VA3* denotes total value added by processor, *TC3* the total cost (value) of the processed product and *VP3* the cost of fruit to processor while taking into consideration costs of carting, cleaning, grading, peeling and cutting, processing and packaging. The three (3) processing types that exist are labeled as follows: *VA31* for juicing; *VA32* for drying; and *VA33* for slicing.

Analyzing the Constraints Faced by Producers: The constraints of certified organic pineapple producers is analyzed by first identifying and tracking the constraints faced by these farmers whilst respondents rank those constraints in order of importance with the most pressing problem. The Kendall's concordance analysis is used to test for the agreement of the rankings by the respondents. Kendall's coefficient of concordance (*W*) is a measure of the agreement among several (*p*) judges who are assessing a given set of *n* objects [17]. W is an index that measures the ratio of the observed variance of the sum of ranks to the maximum possible variance of the ranks. The idea behind this index is to find the sum of the ranks for each constraint being ranked. The Kendall's concordance coefficient (W) is specified in equation (8) below:

$$W = 12S/p^2 (n^3-n) - pT \quad (8)$$

where *W* denotes the Kendall's Concordance Coefficient, P denotes number of constraints, n denotes the number of respondents (sample size), T denotes correlation factor for tied ranks and S denotes sum of square statistic.

Sampling and Data Collection: Purposive sampling was done to solicit information from certified organic pineapple farmers, retailers and processors in the Eastern and Central Regions of Ghana using structured questionnaires. The questionnaires were designed, pretested and then the final questionnaires were prepared for the actual data collection. The questionnaires were administered to 50 farmers and 110 farmers in the Central and Eastern Regions respectively, making a total of 160 farmers. Furthermore, 60 retailers and 5 processors were interviewed to solicit information (i.e., costs and benefits) regarding their operations. The 5 processors interviewed were made up of 1 juicing processor, 2 drying processors and 1 slicing processor.

Empirical Application and Results: This section presents the results of the study including the descriptive statistics of socio-economic characteristics of the respondents, the financial viability of certified organic pineapple production results of the analysis on value addition and discusses the results of the constraints faced by certified organic pineapple farmers in the Eastern and Central Regions of Ghana.

Characteristics of the Farmers: Among the 160 farmers interviewed there were 36 female farmers and 124 Male farmers. The levels of education of the farmers were as follows: primary 130 (81.3%); secondary 8 (5%); non-formal 5(3.1%); none 16 (10%); Islamic education 1 (0.6%). The marital status of the farmers was: single 7 (4.4%); married 149 (93.1%); divorced 1 (0.6%); widowed 3 (1.9%). The age distribution of the farmers: The mean, minimum and maximum ages of the farmers were 45.10, 27 and76 respectively. The minimum, maximum and mean household size of the farmers were 2, 20 and 7 respectivly. The minimum, maximum and mean number of years the farmers' experience in pineaaple production were 3, 50 and10 respectively. Farm size distribution of the farmers ranges from a minimum of 0.5 acres to a maximum of 45 acres.

Results of the Financial Viability Analysis: Tables 1 and 2 below show the average cost and revenue per acre of certified organic pineapple in the Eastern and Central Regions respectively.

Table 1: Average Cost and Revenue per acre of Certified Organic Pineapple in the Eastern Region

	Year 1	Year 2	Year 3	Year 4	Year 5
Cost/Revenue (GH¢)	2006	2007	2008	2009	2010
Certification	50	50	50	50	50
Land Preparation	157	107	126	136	142
Planting materials	1126	528	738	870	1028
Planting	81	82	101	104	115
Maintenance	80	92	93	135	156
Harvesting	42	42	53	54	60
Tools and consumables	21	23	27	30	35
Other costs	30	30	40	50	60
Total cost of production	1587	954	1228	1429	1646
Revenue	0	2392	2998	3194	3082
Net cash flow	-1587	1438	1770	1765	1436

Average fruit weight = 1.5kg, Average number of fruits /acre = 14,000

Table 2: Average cost and Revenue per acre or Certified Organic Pineapple in the Central Region

	Year 1	Year 2	Year 3	Year 4	Year 5
Cost/Revenue (GH¢)	2006	2007	2008	2009	2010
Certification	50	50	50	50	50
Land Preparation	168	189	202	229	237
Planting materials	673	490	503	551	721
Planting	62	74	84	94	102
Maintenance	126	173	193	223	243
Harvesting	31	40	41	50	50
Tools and consumables	24	27	30	33	34
Other costs	33	42	52	62	72
Total cost of production	1167	1085	1155	1292	1509
Revenue	0	2791	3780	3850	3481
Net cash flow	-1167	1706	2625	2558	1972

Average fruit weight = 1.2 kg, Average number of fruits /acre = 14,000

Table 3: NPV Estimation for an Acre of Certified Organic Pineapple in the Eastern Region

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flows(GH¢)	2006	2007	2008	2009	2010
Average cost of production	1587	954	1228	1429	1646
Average revenue	0	2392	2998	3194	3082
Net cash flow	-1587	1438	1770	1765	1436
Discount factor @ 30%	1	0.7692	0.59172	0.4552	0.3501
Discounted cash flow	-1587	1106.11	1047.34	803.38	502.744
NPV (30%) =1873					

The analyses of the viability of the production of certified organic pineapple in the Eastern Region are presented as follows. Discounting the five year cash flows of the farmer in the Eastern Region at 30% (lending rate) recorded an NPV of GH¢ 1,873.00 indicating that certified organic pineapple production in the Eastern Region of Ghana is financially viable using the NPV approach (Table 3). Furthermore, discounting the same cash flow at 90% and 95% gave NPVs of GH¢ 27.59 and GH¢ -46.65 respectively, yielding an IRR of 92% which was higher than the discount rate (30%) and hence the production of pineapple in the Eastern Region is financially viable using IRR estimation approach (Table 4). Sensitivity analysis per switching values examines the extent to which a given parameter changes to reverse the decision from financially viable to financially unviable. The lower the percentage change in the parameter the more sensitive it is. The sensitive analysis indicates that average total revenue is the most sensitive (ranking of 1) and costs of tools of consumables is the least sensitive (ranking 10). Thus, average total revenue is the most sensitive parameter with 33% followed by average total cost with 65%, sucker cost with 131%, cost of land preparation with 426%, maintenance cost with 435%,

Table 4: IRR Estimation for an Acre of Certified Organic Pineapple in the Eastern Region

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flows (GH¢)	2006	2007	2008	2009	2010
Net cash flow	-1587	1438	1770	1765	1436
Discounted factor@90%	1	0.5263	0.277	0.1458	0.077
Discounted cash flows	-1587	756.82	490.29	257.14	110.1
NPV (90%) = 27.59					
Discounted factor@95%	1	0.5128	0.263	0.1349	0.069
Discounted cash flows	-1587	737.41	465.47	238.1	99.37
NPV (95%) = -46.65					
IRR = 92%					

Table 5: Sensitivity Analysis for Certified Organic Pineapple Production in the Eastern Region

Activity/Transaction	Discounted cash flow (GH¢)	Sensitivity/Switching value (%)	Rank
Certification	122.04	1535	7
Land Preparation	289.07	426	4
Planting materials	419.69	131	3
Planting	44.82	983	6
Maintenance	49.64	435	5
Harvesting	23.3	1924	9
Tools and consumables	12.39	2751	10
Other costs	18.57	1626	8
Total cost of production	651.11	65	2
Revenue	948.13	33	1
NPV = 1,873.00			

Table 6: NPV Estimation for an Acre of Certified Organic Pineapple in the Central Region

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flows (GH¢)	2006	2007	2008	2009	2010
Average cost of production	1167	1084	1154	1291	1508
Average revenue	0	2791	3780	3850	3481
Net cash flow	-1167	1706	2625.5	2558	1972.4
Discount factor @ 30%	1	0.76923	0.591716	0.45517	0.3501
Discounted cash flow	-1167	1312.31	1553.55	1164.31	690.59
NPV (30%) =3,553.77					

planting cost with 983%, certification with 1535%, other costs with 1626%, harvesting cost with 1924% and costs of tools and consumables with 2751% being the least sensitive for production in the Eastern Region (Table 5).

This study also revealed that, for certified organic pineapple production in the Central Region of Ghana, discounting the five year cash flows of the farmer in the Central Region at 30% (lending rate) recorded a positive NPV of GH¢ 3,553.77 indicating that certified organic pineapple production in the Central Region of Ghana is financially viable using the NPV approach (Table 6). Further, the same cash flow discounted at 165% and 170% gave NPVs of GH¢ 27.87 and GH¢ -7.93 respectively, yielding an IRR of 169%. This IRR is higher than the discount rate (30%) which concludes that the production of certified organic pineapple in the Central Region is financially viable (Table 7). The sensitivity analysis also revealed that, the rankings from the most sensitive to the least sensitive costs/revenue item for certified organic pineapple production in the Central Region are average total sales revenue (375%), average total cost (546%), planting cost (847%), land preparation cost (1229%), certification cost (2912%), maintenance (7159%), planting materials (7929%), harvesting cost (15252%), other costs (19137%) and cost of tools and consumables (28683%), (Table 8). The sensitivity analysis indicates that the

Table 7: IRR Estimation Table for an Acre of Certified Organic Pineapple in the Central Region

	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flows (GH¢)	2006	2007	2008	2009	2010
Net cash flow	-1167	1706	2625	2558	1972
Discounted factor@90%	1	0.3704	0.1372	0.0508	0.0188
Discounted cash flows	-1167	631.9	360.15	129.95	37.074
NPV (170%) = -7.93					
Discounted factor@95%	1	0.3773	0.1424	0.0537	0.0203
Discounted cash flows	-1167	643.67	373.8	137.36	40.032
NPV (165%) = 27.87					
IRR= 169%					

Table 8: Sensitivity Analysis for Certified Organic Pineapple Production in the Central Region

Activity/Transaction	Discounted cash flow (GH¢)	Sensitivity/Switching value (%)	Rank
Certification	122.04	2912	5
Land Preparation	289.07	1229	4
Planting materials	419.69	7929	7
Planting	44.82	847	3
Maintenance	49.64	7159	6
Harvesting	23.3	15252	8
Tools and consumables	12.39	28683	10
Other costs	18.57	19137	9
Total cost of production	651.11	546	2
Revenue	948.13	375	1
NPV = 3,553.77			

Table 9: Value Added by Actors in GH¢ (per tonne of pineapple fruits)

No	Item	Farmer (Eastern Region)	Farmer (Central Region)	Retailer of fresh pineapple (Eastern Region)	Retailer of fresh pineapple (Eastern Region)	Processor (Drying)	Processor (Juicing)	Processor (fresh Slicing)
1.	Primary raw material	50	30	184	209	5100	300	990
2.	Total cost	82	75	281	288	14051	894	2394
3.	Total value added (2-1)	32	45	97	79	8951	594	1404
4.	Value added per tonne of fruits	32	45	81	66	527	238	425
5.	Total revenue	154	174	350	380	16400	1470	2990
6.	Total value added per day	0.08	0.11	11.57	9.43	75.29	34	60.71

sensitivity levels differ for the different costs/revenue items across the Central and Eastern Regions (Table 5 and 8). However, in general, revenue is the most sensitive parameter while cost of tools and consumables is less sensitive parameter in both the Central and Eastern Regions.

Results of the Value Addition Analysis: Table 9 shows the estimates of the value added by the various actors (farmers, retailers and processors in the Eastern and Central Regions respectively). The standard unit here is a tonne of fresh pineapple for each actor. The results reveal that the processor adds the highest value (GH¢) per metric tonne of pineapple fruits followed by fresh fruit retailer and then farmer. On the average the pineapple drying processor adds the highest total value (GH¢ 527.00) per tonne of fresh pineapple followed by the slicing processor (GH¢ 425.00) and then juicing processor (GH¢ 238.00). On the whole the drying processor incurs the highest cost per tonne (GH¢14051.00) and hence sells at a higher price to obtain a value of GH¢ 16400.00 to recover cost and make some profit to remain in business compared to the slicing and then juicing processor. Among the fresh fruit retailers, the retailers of the Eastern Region add more value (GH¢81.00) per tonne of fresh pineapple fruits than the retailers of the Central Region

(GH¢ 66.00). The farmer of the Central Region adds a higher value (GH¢45.00) per tonne of fresh pineapple fruit than the farmer of the Eastern Region (GH¢32.00).

On a daily basis, the drying processor adds the highest value (GH¢ 75.29) followed by the slicing processor (GH¢ 60.71), the juicing processor (GH¢ 34.00), the retailer of the Eastern Region (GH¢ 11.57), the retailer of the Central Region (GH¢ 9.43), the farmer of the Central Region (GH¢ 0.11) and then the farmer of the Eastern Region (GH¢ 0.08).

The turn over period of the pineapple farmer per tonne of fruits is about 14 months compared to a week or less for the retailer and processor hence the farmer adds more value per unit of total cost. The processor invests more in quality control and assurance and hence adding more value per unit cost. The smooth cayenne and sugar loaf varieties have high water content and hence better return per unit cost for processing as juice than dry and slicing. An interaction with a pineapple dry processing business in South Africa indicated that the return per unit of fruit is 50% compared to that in Ghana of about 17%. The factory in South Africa is using the queen Victoria pineapple variety which has low water content and hence better for dry processing compared to varieties like smooth cayenne, MD2 and sugar loaf with high water content.

Results of the Constraint Analysis: The study also identified and ranked the constraints of organic pineapple production in the Central and Eastern Regions of Ghana (Table 10). The results revealed that in the Central Region, lack of access to cash credit is the main constraint followed by unreliable market, pest and disease control, difficulty in accessing labor, higher weed competition, difficulty in accessing farm land, inadequate tractor services, bad weather conditions, no premiums paid for certified organic pineapple fruits, less access to extension services, higher post harvest losses and then inadequate organic production technology. While in the Eastern Region, high weed competition with plants is the main constraint followed by lack of access to cash credit, no premiums paid for certified organic pineapple fruits, higher post harvest losses, unreliable market, difficulty in accessing labor, inadequate organic production technology, bad weather condition, difficulty in accessing farm lands, less access to extension services, pest and diseases and inadequate access to tractor services.

Table 11 below shows the agreement among the rakings in table 10. The three different rakings (i.e., all farmers, Eastern and Central Region farmers) are all significant as indicated by the asymptotic significance values (i.e., $p < 0.01$).

Table 10: Ranking of Constraints faced by Organic Pineapple Farmers of Central and Eastern Regions

	All farmers (Eastern and Central Regions)		Central Region		Eastern Region	
Constraint	Mean Rank	Rank	Mean Rank	Rank	Mean Rank	Rank
Pest and diseases	6.66	6	5.05	3	10.20	11
No premiums paid for certified fruits	5.81	5	7.12	9	2.94	3
Inadequate organic production technology	8.68	11	9.54	12	6.80	7
Unreliable market	4.88	3	4.74	2	5.18	5
High post harvest losses	7.92	9	9.35	11	4.76	4
Inadequate extension services	8.68	12	8.68	10	8.68	10
Difficulty in accessing labour	5.77	4	5.74	4	5.85	6
Bad weather conditions	7.09	8	6.66	8	8.04	8
Difficulty in accessing farm land	6.78	7	6.00	6	8.50	9
High weed competition	4.74	2	5.79	5	2.43	1
Lack of access to cash credit	2.83	1	2.79	1	2.90	2
Inadequate access to tractor services	8.16	10	6.54	7	11.72	12

Table 11: Diagnostics statistics of the Kendall's Concordance Ranking

Estimate	All farmers (Eastern and Central Regions) N=160	Central Region N=110	Eastern Region N=50
Kendall's W	0.25	0.3	0.7
Chi-square	430.5	362.44	382.94
Degree of freedom	11	11	11
Asymptotic significance	0.000	0.000	0.000

CONCLUSIONS AND RECOMMENDATIONS

The study assessed the financial viability of certified organic pineapple production using Net Present Value (NPV) and Internal Rate of Return (IRR) methodologies taking into consideration cash flows over five years for certified organic pineapple farmers in the Eastern and Central Regions of Ghana.

Discounting the five year cash flows of the farmer in the Eastern Region at 30% (lending rate) of the Agricultural Development Bank, recorded an NPV of GH¢ 1,873.00 indicating that certified organic pineapple production in the Eastern Region of Ghana is financially viable using the NPV approach. Further, discounting the same cash flow at 90% and 95% gave NPVs of GH¢ 27.59 and GH¢ -46.65 respectively, yielding an Internal Rate of Return (IRR) of 92% which was higher than the discount rate (30%), implying that the production of certified organic pineapple in the Eastern Region is financially viable using IRR estimation approach. In addition, the sensitivity analysis for the farmers in the Eastern Region shows that the rankings of cost and revenue reveal that revenue is the most sensitive parameter while cost of tools and consumables is less sensitive parameter in the Eastern Region.

This study also revealed that, for certified organic pineapple production in the Central Region of Ghana, discounting the five year cash flows of the farmer in the Central Region at 30% (lending rate) recorded a positive NPV of GH¢ 3,553.77 indicating that certified organic pineapple production in the Central Region of Ghana is financially viable using the NPV approach. In addition, the same cash flow discounted at 165% and 170% gave NPVs of GH¢ 27.87 and GH¢ -7.93 respectively yielding an Internal Rate of Return (IRR) of 169%. This IRR is higher than the discount rate (30%) which implies that the production of certified organic pineapple in the Central Region is financially viable. Further, the sensitivity analysis also revealed that, revenue is the most sensitive parameter while cost of tools and consumables is less sensitive parameter in the Central Region.

Thus, in estimating the NPV, revenue is the most sensitive parameter while cost of tools and consumables is less sensitive parameter in both the Central and Eastern Regions.

The study also assessed the value added by the farmer, retailer and processor. It established that the processor adds the highest value (GH¢) per metric tonne of pineapple fruits followed by fresh fruit retailer and then the farmer. On the average the pineapple drying processor adds the highest total value (GH¢ 527.00) per tonne of fresh pineapple followed by the slicing processor (GH¢ 425.00) and then juicing processor (GH¢ 238.00). On the whole the drying processor incurs the highest cost per tonne (GH¢14051.00) and hence sells at a higher price to obtain a value of GH¢ 16400.00 to recover cost and make some profit to remain in business compared to the slicing and then juicing processor. Among the fresh fruit retailers, the retailers of the Eastern Region add more value (GH¢81.00) per tonne of fresh pineapple fruits than the retailers of the Central Region (GH¢ 66.00). The farmer of the Central Region adds a higher value (GH¢ 45.00) per tonne of fresh pineapple fruit than the farmer of the Eastern Region (GH¢ 32.00).

On a daily basis, the drying processor adds the highest value (GH¢ 75.29) followed by the slicing processor (GH¢ 60.71), the juicing processor (GH¢ 34.00), the retailer of the Eastern Region (GH¢ 11.57), the retailer of the Central Region (GH¢ 9.43), the farmer of the Central Region (GH¢ 0.11) and then the farmer of the Eastern Region (GH¢ 0.08).

The study also identified and ranked the constraints of organic pineapple production in the Central and Eastern Regions of Ghana. The results revealed that in the Central Region, lack of access to cash credit is the main constraint followed by unreliable market, pest and disease control, difficulty in accessing labor, higher weed competition, difficulty in accessing farm land, inadequate tractor services, bad weather conditions, no premiums paid for certified organic pineapple fruits, less access to extension services, higher post harvest losses and then inadequate organic production technology. However, in the Eastern Region, high weed competition with plants is the main constraint followed by lack of access to cash credit, no premiums paid for certified organic pineapple fruits, higher post harvest losses, unreliable market, difficulty in accessing labor, inadequate organic production technology, bad weather condition, difficulty in accessing farm lands, less access to extension services, pest and diseases and inadequate access to tractor services.

The study provides the following recommendations:

Certified organic pineapple production is profitable and farmers, entrepreneurs and businessmen are encouraged to enter into this industry.

The use of the queen Victoria pineapple variety of pineapple for dry processing as practiced in South Africa generates a higher recovery (50%) compared to its

counterpart MD2 and smooth cayenne varieties (17%). More queen Victoria pineapple plots should be established coupled with improved drying systems to encourage the use of the queen Victoria pineapple for dry processing in Ghana. The smooth cayenne, MD2 and sugar loaf have high juice content and should be encouraged for juicing.

Despite higher input requirement (17 tonnes of fruits per tonne of dry fruits) and lower recovery (17%) for the drying processing, the drying processor adds the highest value per unit of fruits and the highest value per day. Developing the drying processing industry in Ghana with efficient dryers and improved technology could help reduce post harvest losses, create jobs and increase income levels in the pineapple industry.

Even though the government of Ghana has initiated various credit interventions like the Ghana Growth and Poverty Reduction Strategy (GPRS) II, the Agricultural Services Sub-Sector Investment Project (AgSSIP), the Export Development and Investment Fund (EDIF), Millennium Development Authority (MiDA) compact and many others, inadequate cash credit is still a major constraint to pineapple farmers in the Central Region. This may apply to other farmer groups across the country and hence more research should be conducted into the short falls of these credit interventions to suggest possible best alternatives for future crop credit interventions.

The limitations of the study are the following: The study is focused on certified organic pineapple production in the Eastern and Central Regions of Ghana. Time and financial constraints limited the number of farmers, retailers and processors who were contacted. Most of the farmers interviewed do not keep written farm records and therefore many figures are estimates from the farmers. The number and spread of organic certified pineapple farmers in Ghana is limited compared to conventional pineapple producers which might provide a better picture of the pineapple industry. For commercial reasons, the medium or commercial scale farmers failed to provide financial data for analysis which has tailored the study towards the smallholder farmer. The fresh fruit retailers are not organic certified but sell certified produce on the local market with no premium price which may not give a true reflection of the value of the fruits.

The study provides the following suggestions for future research: First, the financial viability of certified organic pineapple production based on returns per variety and probably from within the same community or farm. Second, estimating financial viability by NPV should be based on farm sizes to establish the impact of economies of scale in NPV estimation and hence the viability of the venture. Third, value addition of organic pineapple should be extended to the export market in order to uncover the total value added as a result of organic certification.

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