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ECONOMICS OF SMALL-SCALE SEED YAM PRODUCTION IN GHANA: IMPLICATIONS FOR COMMERCIALIZATION

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ABSTRACT

This study evaluated the economics of seed yam production in four major yam producing Districts in Ghana. The analysis was based on primary data collected from seventy (70) seed yam producers selected through snowball sampling technique. The data covered seed yam production activities during the 2009 cropping season. Descriptive statistics were used to summarize the data and gross margin analysis was used to assess the profitability of seed yam production. On average, a typical seed yam producer cultivated 4.5 acres (1.8 ha) of seed yam and the yield was estimated at 8,319setts/acre. Average variable cost incurred on an acre of seed yam farm was estimated at GH¢685.68 and planting material costs constituted about 44% of this cost. The gross revenue obtained from seed yam sales was estimated at GH¢1,518.22 per acre and the corresponding gross margin was found to be GH¢832.54 per acre. Evidence from the study suggests that seed yam production is a profitable venture. However, the gross margin of seed yam production varied markedly across yam producing Districts, primarily due to differences in yield and price of seed yams. The two most important production constraints were identified to be inadequate capital and high labour cost. The paper has demonstrated that seed yam production has bright prospects in Ghana and presents an opportunity for private investors to diversify their investment portfolios.

Keywords: Descriptive statistics, Ghana, Gross Margin, Seed Yam, Profitability, Snowball Sampling, Viability.

INTRODUCTION

Yam is an extremely important crop for at least 60 million rural poor producers, processors and consumers in West Africa. It provides multiple opportunities for poverty reduction and nourishment of poor people in the sub-region. However, its production is stagnating, and thus threatening rural livelihoods and urban food security. The crop (yam) remains the preferred starchy staple for many people in the yam belt of West Africa. However, it is the most expensive of the root crops to produce because of the high labour demands for land preparation, planting, staking, weeding, harvesting and transport to market. Also, planting material (seed yam) is expensive and in short supply because of the low multiplication rate of yams. In the face of rapid population growth, there is the urgent need for increased production and supply of yam to satisfy domestic and export demand (Asumugha *et al*., 2009). Increased production of yam is believed to be constrained mostly by high cost of seed yam

(NRCRI, 2004). A large quantity of edible yam, up to 30% (3 - 5 tonnes per hectare) of the previous year's harvest may be used to plant a new crop in Nigeria (Okoli and Akoroda, 1995). Seed yams account for over 40% of yam production cost (Ugwu 1990; Nweke, Ugwu, and Asadu, 1991). The three major inputs in yam production are seed yams, labour, and staking materials and Ezeh (1991) also noted that seed yams account for about 45% of yam production costs. Increasing demand for tubers for food combined with increased loading of the tubers with pathogens and pests means that good quality (low disease) tubers for use as planting material are becoming increasingly scarce and expensive.

Yams are planted using either tuber pieces or small tubers that are stored from one season to the next. Asumugha *et al*. (2009) noted that the biggest problem is that many farmers cannot afford to buy good-quality planting materials. This means that they have to save as much as 10 to 30 percent of the tubers they harvest to plant the next season. This, in turn, reduces the amount of tubers available to eat, sell or process and this drives prices even higher. Today there are many people who can no longer afford to eat yams for several months of the year when they are scarce and expensive.

Current and previous research works have indicated that one of the main limitations to increased productivity from yam cropping systems in West Africa on a sustainable basis is the scarcity of healthy and reliable planting material. Nevertheless, many farmers are reluctant to get involved in the production of good-quality yam planting material, which they consider to be a risky business with no immediate returns (Asumugha *et al*., 2009). In Ghana, there is a paucity of information available on the costs structure and returns associated with seed yam production. The purpose of this study was to examine the economics of seed yam production in Ghana to serve as the basis for investment decision by private entrepreneurs.

The study sought to:

- Estimate the quantity of seed yams produced per year/season in selected yam producing districts in Ghana; and
- Determine the costs and returns associated with seed yam production in the selected districts

THE STATE OF THE ART

Importance of yam

Yams (*Dioscorea* species of family *Dioscoreaceae*) constitute a multi-species crop that is important for food, income and socio-cultural practices. The most dominant production and consumption zone for yams in the world is in West and Central Africa. Yam plays important roles in the nutritional, social, cultural, and economic life of the people in the yam belt of Africa. Nutritionally, yam is a major staple providing food for millions of people in the world. It is eaten in different forms as fufu, boiled, fried, and roasted (Aidoo, 2009). In Ghana, yam constitutes about 13% of household food budget in urban centers (Aidoo, Ohene-Yankyera, Marfo and Blaise, 2009). Economically, yam is important in the local commerce in West Africa and accounts for about 32% of farm income (Chukwu and Ikwelle, 2000). The crop serves as a major source of foreign exchange earnings and is used as raw materials for starch industries and pharmaceutical companies (Amanze, Agbo, Eke-Okoro and Njoku, 2011). As the leading exporter of yam in the world, yam exports contribute significant foreign exchange earnings to the Ghanaian economy (Ohene-Yankyera, Aidoo and Ohenewa-Tawiah, 2011).

The entire production, processing and marketing chain of yam offers vast employment opportunities for millions of people. The supply of yam offers prospects for income generation due to the number of people involved and the value attached to it. The marketing system, which affects the prices received by farmers and those paid by buyers, has a profound impact on sustainable food security (FAO, 2003).

Role of seed yam in sustainable yam production

Constraints in yam production have been identified to include: pests and diseases, the low multiplication rate (and hence low availability of planting material), declining soil fertility as well as high and expensive labour inputs required (Tetteh and Saakwa, 1991; Degras, 1993).Yams are almost entirely vegetatively propagated by planting pieces of tuber or setts. Yam planting materials are derived from the edible portion, which is expensive (50% of production cost), bulky to transport, and has a low multiplication ratio (less than 1:10) in the field (Aighewi, 1998; Ezeh, 1994; Ezeh 1998). A clean and healthy yam tuber (500 – 1000g) is used as the mother seed yam from which yam setts are obtained. These tubers are selected usually after dormancy is broken (i.e. 2-3 months after harvest). The tuber is then cut into pieces (setts), ensuring that each sett has at least two 'eyes' (buds) to ensure good sprouting.

Surveys in West Africa have confirmed that scarcity of seed yams often results in unplanted mounds in farmers' fields (Aighewi, 1998; Ezeh 1998). Some farmers forestall this by always keeping a reserve batch of seed yams (up to a third of the quantity planted) for replacement of seeds that do not germinate. Through previous studies it has been established that there could be significant carry-over of pests and diseases between seasons in the planting material (setts/seed yams), and that good quality, "healthy" planting material is generally scarce and expensive (Kenyon, 2005).Numerous pests and diseases affect yam tubers. These bio-constraints affect seed productivity and viability, reducing germination, plant vigor and yield. The use of good quality and healthy seed material is therefore a crucial foundation for high and sustainable yam production (Coyne, Claudius-Cole, and Kikuno, 2010). The use of diseased seed tubers results in the production of small, poor quality ware yam and a persistent cyclical decline in yield. To prevent the introduction of pests and diseases into the production cycle, it is essential that healthy planting materials (seed yams) are supplied to producers. However, obtaining healthy seed yam is one of the biggest problems for growers. Some farmers use their own seed stock, harvested from the previous season, while others obtain the seed material from specialized seed yam producers (Coyne *et al*, 2010).

In Ghana, farmers have traditionally relied on obtaining their planting material either from their own farms, or by buying the surplus from neighbouring farmers. This means that the planting material is often of low quality, being infected with fungal pathogens, virus and/or nematodes, and may be relatively expensive (Peters, 2000).The habit of retaining small and misshapen ware yams for seed for the following season probably exacerbates the problem of diseases and pests since these are the ones most likely to be infected. In traditional cropping systems in Ghana, in order to ensure the survival and growth of the planting material, relatively large pieces of yam (220+ gm) are used (at least for white yam), which adds to the cost and results in a very low multiplication rate (Peters, 2000).

In a study on the supply seed yams in Nigeria, Asumugha*et.al.* (2009) noted that there were no commercial structures for the supply of seed yams in Nigeria and farmers would only sell seed yams after they have met their own requirements.

There are significant socio-economic benefits to be gained by seriously promoting the production of healthy seed yams. The role of yam in employment generation and food security in rural and urban Ghana makes it imperative to increase the production and supply of the crop to satisfy the ever increasing domestic and export demand. Production of yams has been important to the survival and welfare of many generations of poor people in Ghana and continues to be very important for ensuring sustainable food security and income generation in rural and urban areas of the country. The crop brings flexibility to the annual cycle of food availability through the multiplicity of species and cultivars, broad agroecological adaptation, diverse maturity periods, as well as options for storage and utilization (Kenyon, 2005). The yam tuber remains dormant during most of the unfavourable agroclimatic period between one harvest and the next planting season. This relatively long tuber dormancy ensures longer shelf life of the fresh tuber than in other root and tuber crops. Thus yams contribute to food supply during the period preceding the wet season when food is usually scarce.

Sustainable yam production is contingent upon adequate supply of healthy seed yams (Beckford, 2009). In Ghana, sustainable yam production will ensure that farmers, processors, traders and consumers who depend on the crop for their livelihoods have improved living standards on sustainable basis. If yam production is not sustained, due to unavailability (and high cost) of seed yams it will being in its wake unemployment, lower farm incomes, household food insecurity and reduced foreign exchange earnings as a result of reduced yam exports. The consequence of these is slow socio-economic development for the Ghanaian economy. Sustainable production of seed yam is therefore critical to the sustainable growth of the agricultural sector and the entire Ghanaian economy.

Economics of seed yam production

Seed yams are the most expensive inputs in the yam production business (Asumugah *et al*, 2009; Crentsil and Panni, 2005). A large quantity of edible yam (3 - 5 tonnes per hectare) of the previous year's harvest may be used to plant a new crop (Okoli and Akoroda, 1995). This makes seed yams account for over 40% of yam production cost (Ugwu 1990; Nweke *et al*., 1991).In Nigeria, the cost of yam planting material was found to account for almost 20% of the production inputs (79% for labour) in a yam/cassava/legume/maize cropping system (Okorji, 1992). The high cost of planting material is exacerbated by post-harvest losses estimated at 13% in the dry northern region of Ghana (GTZ, 1994).

A study by Oguntade, Thompson, and Ige (2010) evaluated the economics of seed yam production using the minisett technique in Oyo State, South West Nigeria. The revenue per hectare of seed yam production was estimated at N337, 500 and total cost of production was N150,500, while the cost per seed yam was N16.72. The study estimated that for every naira invested in seed yam production using the minisett technique, farmers were expected to have N1.24 as net returns. The study concluded that seed yam production using the minisett technique was a profitable venture in Oyo State. They pointed out the need to deploy appropriate technologies to reduce costs as a means of further increasing the profitability of seed yam production. Ezeh (1991) also evaluated the economics of seed yam production from minisetts based on input and output data

collected from yam minisett multiplication plots at Umudike, Southeastern Nigeria during the 1990/91 cropping season. He estimated gross margin per hectare and net income per hectare as -4,472.16 Naira and -5,120.16 Naira, respectively, and concluded that seed yam production was unprofitable.

Emokaro and Law-Ogbomo (2008) assessed the influence of different minisett sizes (ranging from 25g to 50g) on the profit realizable from yam production in the Forest and Forest-Savanna transition zones of Edo State, with the main objective of determining the optimum level of returns with respect to the minisett sizes. They determined that the total production cost per hectare increased with increasing sett size, ranging from $1,822.43 for the 25 g sett to $2,942.43 for the 50 g sett for the two zones respectively. The economic returns also increased with increasing minisett size for the two zones, with the highest gross margin and net returns of $12,909.57 and $12,622.78, respectively, from the 50 g sett size recorded in the Forest-Savanna zone.

The economic profitability of seed yam production by the yam minisett technique was investigated in humid south west Nigeria by Adekayode (2004) for three years. The net farm income was estimated at 132,282.00 Naira for the first year, 113,320.00 Naira for the second year and 125,722.00 Naira for the third year. The benefit-cost ratio for production was found to be 1.97, indicating the profitability and viability of the project.

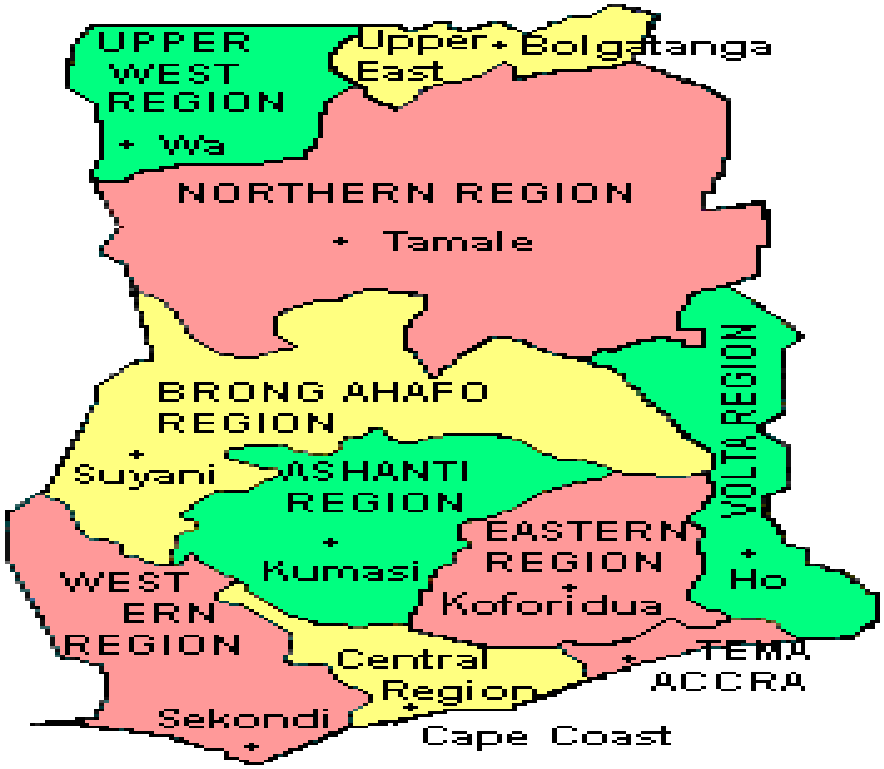
According to Ibana *et al (*2011), some published studies that have suggested that seed-yam (Dioscorea rotundata) production in Nigeria using minisett (~0.025 kg) technology or an adapted form of the technology using larger setts (0.08 to 0.1 kg) was not profitable)often conducted the studies under artificial conditions where labor inputs may have been inflated. Ibana *et al* (2011) describes the results of a questionnaire-based survey designed to explore the economic performance of seed-yam producers in the Ilushi hinterland area of Nigeria, along the western bank of the River Niger. Results suggest that seed-yam production is profitable in the area, with gross margins of between Naira 23,395 and 61,375/ha (or US$175 to $458/ha).

METHODOLOGY

Study areas/Sampling/Data Collection

This study was carried out in four major yam growing Districts in Ghana. The districts included Techiman and Atebubu in the Brong-Ahafo Region, Ejura-Sekyedumasi District in the Ashanti Region, and Nkwanta District in the Volta Region of Ghana (Figure 1).

Figure 1: Map of Ghana showing study Regions (Ashanti, Brong-Ahafo and Volta Regions)



Source: www.ghanaweb.com (Accessed on 9th May, 2012).

These districts were selected purposively due to their strategic importance in the business of yam production and marketing in Ghana. Primary data were collected from seed yam producers through personal interviews with the use of a standardized structured questionnaire. A sample of 20 seed yam producers was selected in each of the four districts, giving a total sample size of 80 respondents for the study. A simple random sampling technique was used to select three yam producing villages in each district. Seed yam producers were selected through snowball sampling technique. Snowball sampling is a special non-probability method used when the desired sample characteristic is rare. It may be extremely difficult or cost prohibitive to locate respondents in these situations. Snowball sampling relies on referrals from initial subjects to generate additional subjects. While this technique can dramatically lower search costs, it comes at the expense of introducing bias because the technique itself reduces the likelihood that the sample will represent a good cross section from the population. Data collected included the socio-economic backgrounds and household characteristics of respondents, volume of seed yams produced per season and the associated costs structure and revenues, among other things.

Method of Data Analysis

The data collected was analyzed using descriptive and inferential statistics. The descriptive statistics comprised the use of frequency distribution tables, percentages, arithmetic mean, median and standard deviation. Gross margin analysis was conducted to establish the profitability of seed yam production. Gross margin was estimated using the relationship:

Gross Margin = Total Revenue – Total Variable Cost

RESULTS AND DISCUSSION

Characteristics of Respondents

Table 1 provides the actual number of seed yam producers whose data were used for the analysis. A total of seventy (70) seed yam farmers provided adequate information for analysis. In Atebubu district only 8 out of the expected 20 suppliers were identified during the survey.

Table 1: Distribution of seed yam producers by location

District	Frequency	Percent
Atebubu	8	11.43
Ejura	20	28.57
Nkwanta	20	28.57
Techiman	22	31.43
Total	**70**	**100.0**

Source: Field Survey, 2009.

Table 2 provides the descriptive statistics for seed yam producers and their households. The age of a typical respondent was found to be about 41 years. The mean age of seed yam producers ranged between 34 years in Techiman and 48 years in Atebubu, and the variation in ages was greatest in the Nkwanta District where the deviation of ages around the mean was about 11 years. Average household size for the sample was estimated at seven (7) members and the mean household income of seed yam producers in the study districts was estimated at GH¢[1] 1421.00 per annum. Average annual income for households varied markedly from a minimum of GH¢611.00 in Techiman to a maximum of GH¢2,050.00 in Atebubu.

[1]*The Ghana Cedis (GH¢) is the Ghanaian Currency and current exchange rate is about GH¢ 1.4=US$1.0.*

Table 2: Descriptive Statistics on Seed Yam Producers

District	Statistic	Age (Years)	Years in School	Household Size	Household members <18yrs	Annual Household Income (GH¢)
Ejura	Mean	45.05	12.50	6.00	2.00	1,575.00
	Std. Deviation	8.68	3.54	3.00	0.89	3669.23
	Minimum	26.0	10.00	2.00	1.00	100.00
	Maximum	60.0	15.00	12.0	4.00	15000.00
Techiman	Mean	34.23	10.73	6.00	4.00	611.36
	Std. Deviation	8.34	2.94	3.00	2.17	331.28
	Minimum	19.0	6.00	4.00	1.00	200.0
	Maximum	52.0	15.00	12.0	10.00	1500.00
Nkwanta	Mean	42.75	10.50	8.00	4.00	1,697.89
	Std. Deviation	11.90	3.21	3.00	1.85	2283.77
	Minimum	28.0	6.00	3.00	1.00	30.00
	Maximum	80.0	18.00	13.0	8.00	10000.00
Atebubu	Mean	47.63	5.20	9.63	5.00	2,050.00
	Std. Deviation	7.03	5.02	4.90	2.39	2023.61
	Minimum	35.0	0.00	6.00	3.00	200.00
	Maximum	58.0	10.00	20.0	10.00	5000.00
Pooled	**Mean**	**41.29**	**9.79**	**6.84**	**3.00**	**1,420.79**
Sample	Std. Deviation	10.54	3.98	3.31	1.93	1919.67
	Minimum	19.0	.00	2.00	1.00	30.00
	Maximum	80.0	18.00	20.0	10.00	15000.00

Source: Field Survey, 2009.

Table 3 shows that 77% of seed yam producers produced ware yam and sold split portions of healthy ware yams to fellow farmers during the planting season. For 17% of respondents, milking of ware yams served as the main source of seed yams. About 6% of seed yam producers indicated that they used the yam minisett technology to produce seed yams, implying the technique has not been adopted widely in the districts under study.

Table 3: Production Systems Used in Seed Yam Production

Production system	DISTRICT				Total	Percent
	Ejura	*Techiman*	*Nkwanta*	*Atebubu*		
Minisett technology	2	-	1	1	**4**	**5.7**
Split portions of selected ware yam	18	12	18	6	**54**	**77.1**
Others (Milking)	-	10	1	1	**12**	**17.2**
Total	**20**	**22**	**20**	**8**	**70**	**100.0**

Source: Field Survey, 2009.

It may be seen from Table 4 that typically, a seed yam farm was weeded three times in a season across all study districts**.** The minimum number of times a seed yam farm was weeded was found to be two times and the maximum number was four times.

Table 4: Number of Times Seed Yam Farms were Weeded

DISTRICT	Mean	Std. Deviation	Minimum	Maximum
Ejura	2.8000	0.41039	2.00	3.00
Techiman	3.3810	1.39557	3.00	4.00
Nkwanta	3.2500	0.63867	2.00	4.00
Atebubu	3.8750	1.12599	3.00	4.00
Pooled sample	**3.5362**	**1.13215**	**2.00**	**4.00**

Source: Field Survey, 2009.

Acreage cultivated, output and yield of seed yams

Table 5 shows that a typical seed yam producer cultivated 4.5 acres (1.8ha) of seed yam. Seed yam production was on subsistence scale and intercropped with other food crops like maize, cowpea, cassava and some vegetable. Therefore, it is not clear whether the acreage is dictated by the potential commercial interest of producers or by the need to ensure household food security. Area cultivated ranged from a minimum of 2.3 acres in Techiman to 5.7 acres in Nkwanta. Total seed yam tubers produced during the 2009 cropping season ranged from 3,200 tubers in Techiman to 9,250 tubers in Ejura with an average total production of 6,722 tubers for the pooled sample. From the Table, average minisett yield per acre was estimated at 8,319 setts. The highest yield of 8,971setts/acre was recorded in Ejura and the lowest yield of 7,150setts/acre was obtained in Nkwanta.

Table 5: Seed Yam Production Statistics for the 2009 cropping season

DISTRICT	Acreage Cultivated	Total quantity Produced (Tubers)	Yield/Acre (Tubers)	Yield/acre (yam setts)*
Ejura	5.25	9,250.00	1761.9	8,971.43
Techiman	2.30	3,200.00	1391.3	8,347.83
Nkwanta	5.67	6,757.14	1191.7	7,150.41
Atebubu	4.96	7,280.00	1467.7	8,806.45
Pooled Sample	**4.545**	**6,721.785**	**1478.9**	**8,319.03**

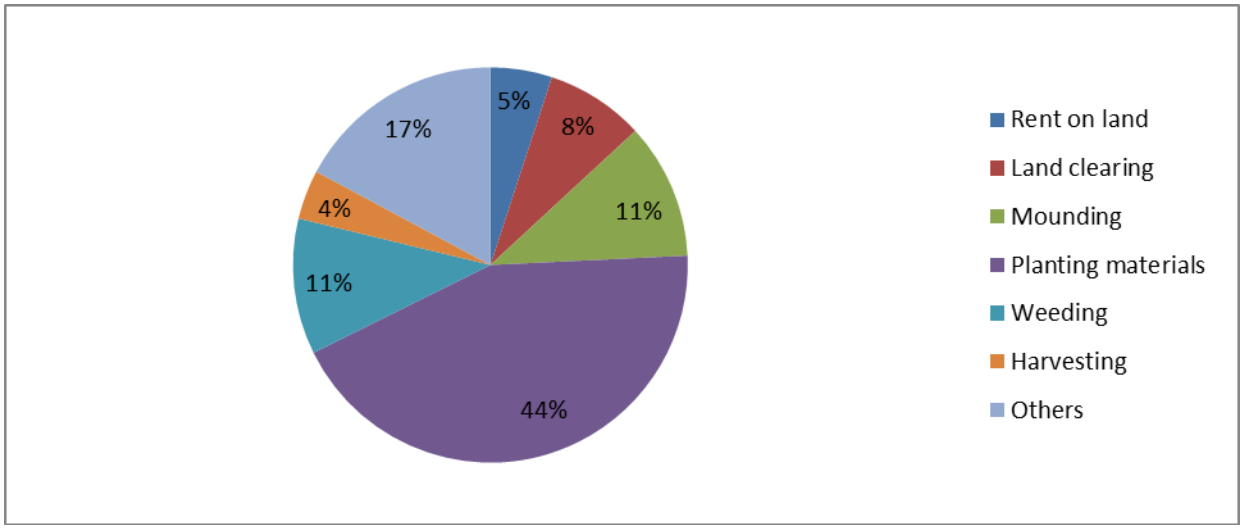
**Typically, about 6 setts were obtained from a tuber of seed yam (source: Informal discussions).*

Source: Field Survey, 2009.

Costs and Returns Analysis of Seed Yam Production

Figure 1 below shows the main costs involved in seed yam production per acre. It may be evident from the figure that planting material costs constituted about 44% of total variable cost of producing seed yams per acre. The other important variable cost components included weeding, mounding and land clearing.

Figure 1: Variable cost components for producing seed yams per acre



Source: Generated from field data, 2009.

The gross margin analysis per acre of seed yam across the four study districts has been provided in Table 6.The gross revenue obtained for the whole sample was GH¢1,518.22 per acre after incurring total variable costs of GH¢685.68, which translates into a gross margin of GH¢832.54 per acre. However, the gross margin per acre of seed yam varied markedly across yam producing districts. The gross margin per acre of seed yam was highest in Ejura and lowest in Atebubu. Farmers in Ejura obtained an average gross margin of GH¢1,400.00 compared to GH¢477.00 obtained per acre by farmers in Atebubu. The

difference in gross margins across districts was primarily due to differences in yield and price of seed yams. The results of our study compare favourably with results of other studies in Nigeria that found seed yam production to be profitable (e.g. Adekayode, 2004; Oguntade *et al*, 2010; and Ibana *et al*, 2011).

Table 6: Gross Margin analysis for an acre of seed yam

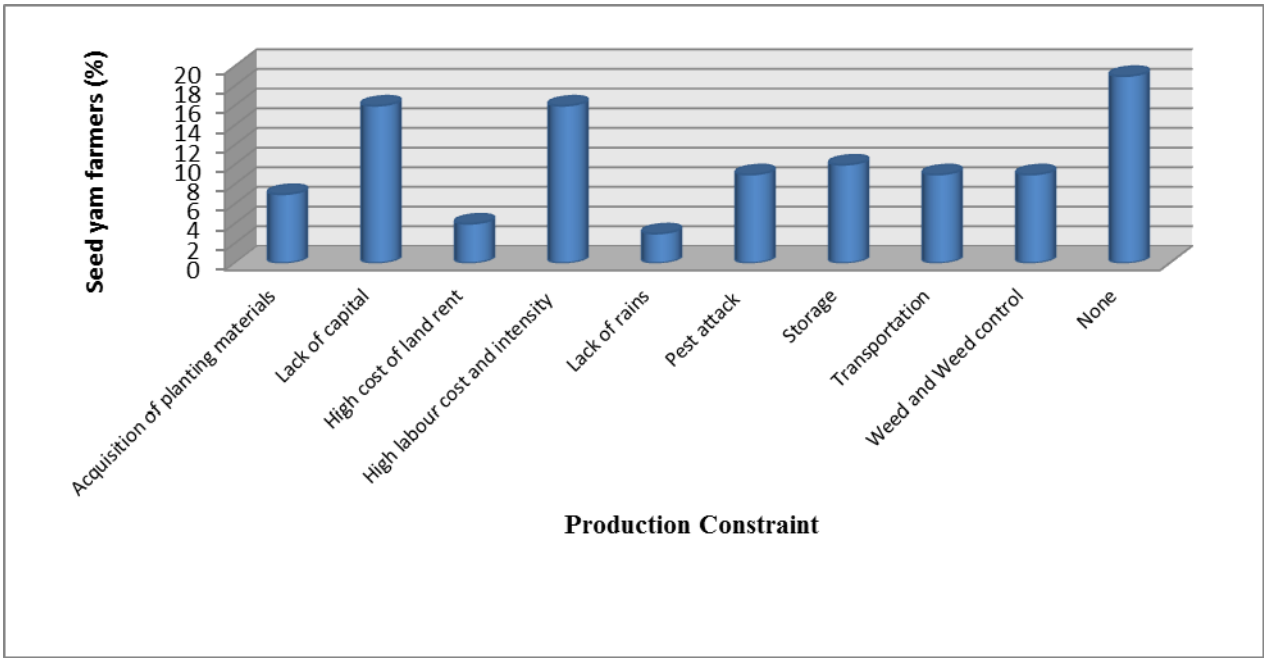
Item	Ejura	Techiman	Nkwanta	Atebubu	Pooled Sample
Output (setts)	8,971.43	8,347.83	7,150.41	8,806.45	8,319.03
Unit Price (GH¢)	0.22	0.17	0.21	0.13	0.18
A. Estimated Revenue (GH¢)	***1973.71***	***1419.13***	***1501.59***	***1144.84***	***1518.22***
Variable costs (GH¢)					
Rent on land	0.0	36.50	17.50	100.00	36.74
Land clearing	45.00	62.68	55.35	46.13	53.99
Mounding	70.50	78.18	86.50	75.71	76.59
Planting materials	265.25	321.90	357.63	230.80	295.89
Planting	11.75	12.18	14.58	13.67	14.67
Weeding	88.16	72.52	34.04	89.00	73.33
Fertilizer	0.0	20.66	23.56	0.0	22.16
Fertilizer application	0.0	5.40	5.00	0.0	5.21
Stakes	19.50	18.72	15.90	17.50	17.81
Staking	5.0	5.13	5.83	6.0	5.56
Disease control	0.0	0.0	8.00	5.0	7.25
Harvesting	35.00	27.70	21.09	38.0	30.78
Carting (farm to home)	17.50	25.73	22.54	25.0	22.92
Storage	0.50	0.0	4.00	0.0	2.25
Others	11.13	14.77	20.73	21.0	20.55
B. Total Variable costs	***569.2879***	***702.0742***	***692.2502***	***667.806***	***685.682***
Gross Margin (A-B) (GH¢)	**1,404.43**	**717.06**	**809.34**	**477.03**	**832.54**

Source: Estimated from field data, 2009.

Seed yam production Constraints

The distribution of respondents according to most critical production constraints in the seed yam business has been provided in Figure 2. The two most important and highly ranked production constraints were *lack of capital* and *high labour cost* or labour intensity. These constraints were cited by about 16% of the seed yam producers sampled. About 19% of seed yam producers did not indicate any production constraints.

Figure 2: Seed yam production Constraints



Source: Generated from field data, 2009.

SUMMARY AND CONCLUSION

The study examined the economics of seed yam production across four yam producing districts in Ghana. The study found that a typical seed yam producer was economically active at the age of 41 years, had attained secondary level of formal education and had been in the business of seed yam production for the past 15 years. Majority of seed yam producers mainly produced large yam tubers and divided selected tubers into various pieces or split portions to sell as seed yams. Typically a seed yam farm was weeded three times across all study districts.

On average, a seed yam producer cultivated 4.5 acres of seed yam and the yield was estimated at 8,319setts/acre with about 70% of this yield being sold to other farmers. Average variable cost incurred on an acre of seed yam farm was estimated at GH¢685.68 and planting material costs constituted about 44% of this cost. The other important variable cost components included weeding, mounding and land clearing. The gross revenue obtained from seed yam sales was estimated at GH¢1,518.22 per acre. Seed yam production was found to be highly profitable. The average gross margin per acre of seed yam was found to be GH¢832.54. However, the gross margin of seed yam production varied markedly across yam producing districts primarily due to differences in yield and price of seed yams. The two most important and highly ranked production constraints were lack of capital and high labour cost or labour intensity.

Since seed yam production has been found to be highly profitable, private investors should take advantage of the potential of seed yam production to diversify their investment portfolios and provide seed yams for sale on the main district markets to ensure sustainable yam production in Ghana.

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