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Socioeconomic Analysis of Smallholder Yam Production in North Eastern Corridors of Northern Ghana: Does Type of Planting Material Used Makes Any Difference

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Abstract: **The purpose of this paper is to investigate the significant of Yam Minisetts Technology (YMT) on yield and profitability of ware yam production among farmers in Northern Ghana. Primary data were collected from 242 yam farmers sampled through multi-stage sampling techniques in the Nanumba North and Gushiegu Districts of Northern Region. Data were analysed using descriptive statistics, gross margin and benefit/cost analysis with doubled log multiple regression model used in analysing the influence of socioeconomic variables on yield of yam. The study established that farms panted with yam setts generated through YMT yielded relative more than those planted with the conventional seed yam. Similarly, gross margin and benefit/cost ratio of farms planted with the conventional seed yam and those using YMT were found to differ significantly. Respondents who planted their yam farmers using YMT setts obtained relatively higher gross margin than those farmers who used the conventional seed yam. Results of the regression analysis found variables such as type of planting material, age, household size, farm size, labour, number of weeding done and income to be significant at 1% level in influencing yield of yam. The study recommends measures aim at facilitating the adoption of Yam Minisetts Technology in generating yam setts for planting as a way of promoting the expansion of yam farms and increasing yield. Also the youth and those with formal education should be encouraged to take up yam farming as it is a profitable and viable agribusiness enterprise.**

Keywords: **Minisetts Technology, Yam Setts, Conventional, Gross Margin, Yield and Seed Yam**

1. Introduction

Yams (*Dioscorea* species) are starchy staples in the form of large tubers produced by annual and perennial vines grown in Africa, the Americas, the Caribbean, South Pacific and Asia countries. The most widely cultivated species of yam are the Yellow yam, (D. cayenensis) and Water yam, (D. alata), which are widely distributed species in the world [5]. Being one of the most important roots and tubers crop grown widely in West Africa, yam provides multiple opportunities for poverty reduction and nourishment of poor people in the sub-region [2]. Yam grown as food is a predominant practice in West and Central Africa where it plays important roles in the nutritional, social, cultural, and economic life of the people [3]. Yam is widely prepared into many dishes such as fufu, boiled, fried, and roasted and consumed as major staple among people in major producing areas

The production, transportation, processing and marketing of yam provides employment and income for rural smallholder farmers, especially women, who play critical role as aggregated and marketers of yam, and as such contribute significantly to rural economy in major producing areas in Ghana [5]. In Ghana, the crop (yam) is increasingly becoming a major export commodity serving as a source of foreign exchange earner, providing revenue for government and it is being used as raw material for starch industries and pharmaceutical companies [4]. In 2008, Ghana exported 20,841 metric tons to Europe, the U.S. and neighboring African countries, making her the leading exporter of the commodity [14].However, the country's ability to harness her comparative advantage and take advantage of the global demand for yam and to step up her yam exportation is being challenged by the inaccessibility and high cost of yam planting material (yam seeds or setts). Aidoo et al, [2] observed that, obtaining healthy seed yam is one of the biggest problems for growers, limiting areas under cultivation. Inadequate access and high cost of seed yam has prevented producers from expanding the area under yam cultivation, despite the availability of land and demand for yam domestically and abroad [7]. Availability and cost of planting material (seed yam) have been and continue to be the constraints to large scale yam production require in order to take advantage of increasing domestic and foreign demand of yam. As observed by Ike & Inoni, [9] that labour and material inputs are the major factors that influence changes in yam output.

2. Yam Minisetts Technology

Over several decades, the most popular planting materials used by yam farmers in Ghana are seed yams.

The seed yam is one of a cluster of small tubers which develops after the growing vine has been severed from the main tubers towards the end of the growing season. 'The whole operation is described as milking, topping or, in Ghana, pricking' [16 pp93]. Otto, [16] also observed that, the time for this operation varies in the yam growing areas but the timing should ensure that the tuber at the time of topping, is mature and marketable. This affords farmers two harvests a year, the tuber at topping and the seed yam that develops later. Also smaller tubers or mini setts selected from farmers' previous harvest of ware yam, bought or borrowed from colleague farmers are also usually used as seed yam for planting and producing ware yam for the market and consumption. Seed yams are usually a limiting factor to increased yam production as they are expensive and scarce. Prepared mounds are usually found not planted due to the scarcity of seed yams. This conventional or traditional means of generating seed yam have inherent problem of poor multiplication since a whole tuber is used in planting, making farmers to reserve a greater portion of their yam for next season planting [7].

For four decades now, research efforts aim at solving the problem of unavailability of planting material, have led to the development of 'Yam Minisett Technology' (YMT) in the 1970s and had since been shown to be a cost-effective way for yam farmers to grow their own seed yam and plant more yams than traditional or conventional methods [13].The Yam Minisett Technology involves essentially the cutting of yam tuber and appropriately treated to produce seed yams for the next season production of ware yams, for domestic consumption and for other industrial uses. The technology is the most effective method for rapid multiplication of seed yam needed for increased and sustained production of the crop. In applying the YMT, mother seeds are cut into 100 -150g and treated with water solution containing wood ash and fungicide (4-5 handfuls of wood ash, 24g of fungicide and 4 litres of water). Treated yam minisetts are spread under a shade for 1 to 2 hours to dry. Pre-sprouting usually take a maximum of 4 weeks on well prepared nursery beds, baskets or wooden boxes [6]&[15]the most effective medium for pre-sprouting minisetts is sawdust.

Production of planting material for yam as an economic enterprise, involves costs and returns through which productive resources such as land, labour and capital are utilized to produce seed yam as an output which have economic value. As such how productive resources are efficiently utilized to produce a given quantity of ware yam, either through the conventional method or YMT, is imperative in determining the viability and sustainability of each enterprise. Agro-industrial growth is essential for achieving higher economic growth. The efficiency of such industries is crucial in determining their productivity and profitability [8]. It is usually the economic analyses of a firm by assessing the cost and revenue relationship which is used to judge the sustainability and viability of such enterprises which may encourage a would-be farmer/firm to embark on any of the agro-enterprises of his/her choice. Factors of production or input can be combined in one way or the other to produce a given output of a commodity. Therefore the best way is the one that gives maximum output at least cost which is a key to profit maximization and viability of an enterprise.

Many studies have analysis economics of seed yam production by comparing YMT to the conventional methods of seed yam generation [2]&[15], whiles other have analysed economics of yam production without examining if there exist any differences in terms of yield, cost and revenue relationship between conventional seed used and setts generated by using YMT (see [7] and [10]). As a results, information on the variation of yield, gross margin, benefit/cost ratio between farms planted with setts generated from the application of YMT and the conventional seed yam is not found in expression in available literature thereby constraining promoters of YMT in fully communicating the relative advantage of the technology to farmers for adoption. This current, paper therefore sought to bridge this knowledge gap by presenting results of study investigating the significant of YMT in increasing yield and yam farms' gross margins.

3. Materials and Methods

The field survey for this study was undertaken in the Nanumba North and Gushiegu Districts in Eastern Corridor of Northern Ghana. The Eastern corridor of Northern Ghana is the major yam producing area in the country because the soils in the area are the savannah ochrosols Savannah Glysols and the ground water laterite. Which are heavy and dark colored, medium size textured, moderately drained soils suitable for a wide range of crops particularly roots and tubers cultivation [11]. These two districts were selected because they benefited from the Root and Tuber Improvement and Marketing Programme (RTIMP).` In Addressing challenges facing the yam industry in Ghana, the Root and Tuber Improvement and Marketing Programme (RTIMP) and the International Fund for Agricultural Development (IFAD)/Government of Ghana initiative adopted Farmer Participatory Approach in disseminating Yam Minisett Technology in 28 districts (of Volta, Northern, Brong Ahafo and Ashanti Regions) in Ghana [7]. The overall objective of the yam minisett technology initiative was to enhance food security through production of seed yam. Specifically, the initiative aimed at:

- ❖ Promoting the adoption of the minisett technology by farmers in major yam producing areas in Ghana using the participatory approach
- ❖ Making available healthy seed yam to small-scale yam growers to enable them expand and establish as commercial seed yam growers
- ❖ Improving farmer yield and income

By way of sampling, four (4) MOFA extension operational areas were randomly selected from each of the two Districts making a total of eight (8) extension operational areas. With the help of extension agents manning the operational areas, a list of yam farmers for each sampled operational area were obtained and a simple random techniques applied to select 32 yam farmers from each operational area. As a results, 128 yam farmers were sampled from each district (Nanumba North and Gushiegu district) making a total sample size of 256 farmers for this study. However, during the field interviewed, data was successfully collected from 248 farmers, (representing 97% of the target sample size and during data entering, six questionnaire were found to be incomplete. As such, results of this paper is based on 242 yam farmers; 119 from Gushiegu and 123 from Nanumba North districts.

Data Analysis

Data was analysed using gross margin and Benefit/cost analysis to evaluate the profitability of yam farming. Gross margin analysis was considered because the fixed assets and capital inputs such as farm tools were not depreciated and included in the calculation. Aidoo et al., [2] and Jimoh & Onimisi, [10] used gross margin and benefit/cost ratio in evaluating profitability of seed yam production. Also Toba, [19] used gross margin analysis to evaluate the profitability and economic viability of yam production in Osun State, Nigeria.

Gross margin (GM) = Total Revenue (TR) – Total cost (TC)

Benefit/Cost ration (B/C) = **ΣB/ΣC**

Where B= total benefits of yam production

C= total cost of yam production

Decision was based on:

1. If B/C> 1 means that yam production is profitable and as such viable
2. If B/C<1means that, yam production not profitable and as such not viable

Multiple Regression Analysis

A functional relationship was developed to assess factors determining the productivity or yield of yam among farmers in the two districts. The main variable of interest was type of planting material used (conventional seed yam or yam setts developed through YMT). As a results, a multiple regression model was adopted to include other variables such as socioeconomic characteristics and other inputs in yam production. The theoretical framework which guided the determination of functional specification of the empirical model was a production function or production theory. After observing a scattered plot between yield and the selected variables, a Cobb-Douglas doubled log production function was used.

The production function had the form as given by

$$Y= aX_1^{b1}\, X_2^{b2} \ldots .\, X_n^{bn} \;\ldots\ldots (1)$$

Where, Y is output of yam per acre (yield) and X_1 to X_n are inputs

This function was doubled log by transforming both dependent variable and inputs as explanatory or independent variables into logarithmic function. The production function after logarithmic transformation is represented by Eq. (2):

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + \ldots + b_n \log X_n \;...(2)$$

Where,

Y = Yield

a = Constant or intercept

X_1 = Type of Planting Material (dummy; 1 = conventional; 0 = YMT)

X_2 = Age (years)

X_3 = Household size (number of persons in a household)

X_4 = Number of years of formal Schooling (years)

X_5 = Experience in yam farming (years)

X_6 = Yam Farm size last season (acre)

X_7 = Farm size of other crops (acre)

X_8 = Source of land (dummy: 1 = hired/borrowed; 0 = family/clan land)

X_9 = Labour unit used in yam farm (man day)

X_{10} = Weedicide used on yam farm (dummy: 1 = yes used; 0 = no)

X_{11}= Number of weeding done within the farming season

X_{12} = Income (GHS)

X_{13} = Number of Extension contact

X_{14} = Last year's farm income (GHS)

X_{15} = Access to credit (1= borrowed to invest on farm; 0 = could not borrowed)

X_{16} = District (1 = Gushiegu'; 0 = Nanumba North)

Similar model was used by Jimoh & Onimisi,[10]in assessing factors influencing yam production in the Kabba-bunu local governmental area of Nigeria. Also Srinivas & Ramanathan, [18] adopted similar production function in their study on economic Analysis of elephant foot yam Production in India.

4. Results and Discussion

Analysis of survey data gathered on socioeconomics characteristics of the 242 yam farmers interviewed is presented in the Table 1. The analysis revealed that yam farmers in the two districts are quit old with a mean age of 40.48 years (SD = 8.21) whilst the youngest being 27 years, the oldest is 57 years. Only 8% of the 242 farmers surveyed were female, confirming early findings that the yam farming is male dominated crop enterprise as observed by Adam, Zakaria, & Abujaja, [1] and SRID,[17]. Farmers relied mostly on their family labour with an average score of 0.19 (SD = 0.39) on the question 'what is your main source of farm labour' (1 = hired labour; 0 = family labour), with an average household size about 7 persons per house, with minimum household size of about 3 persons and maximum of 13 persons per household. Respondents' level of education was found to be very poor with only 25% of the 242 farmers having some level of formal education. Even among those with formal education the average years of formal schooling completed was 11.32years (SD= 0.82).

Farmers in the study districts, used mainly three ways in generating their seed yam or planting material. These are Yam minisetts Technology (YMT), split portions of selected ware yam from their previous harvest and milking to generate seed yam [2]. In this method of milking or sometime referred to as topping or pricking, the seed yam is one of a cluster of small tubers which develops after the growing vine has been severed from the main tubers towards the end of the growing season (see [16]). In this paper, the two traditional methods (split portion of selected ware yam and milking or pricking to generate seed yam) is referred to as conventional seed yam and the Yam Minisett Technology (YMT) as YMT yam planting material or simply YMT. As shown in the Table 1, majority (59%) of the 242 farmers planted their yam field with planting material using the conventional method in the last season (2013 cropping season), indicating that, most farmers have not adopted the Yam Minisetts Technology inspite of its proven advantage of generating several healthy planting materials. This confirmed early studies by FAO, (2013), Ike & Inoni,(2006) and Odinwa, Alali, Abali and Ahiakwo,(2006). Also Aidoo et al., [2] on their study on economics of seed yam production in four districts in Ghana found that 77% of seed yam producers produced ware yam and sold split portions of healthy ware yams to fellow farmers during the planting season. They also found that, about 17% of respondents, use milking of ware yams to serve as the main source of seed yams and only 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.

Farmers are quit experience in yam farming with an average years of yam farming of about 18 years (SD = 9.41), whilst the least experienced have been farming yam for the past 2 years and the most experienced have been in yam farming for 30 years. Most of the 242 farmers surveyed, farm on their family lands with only 19% indicating they hired or borrowed the land on which they cultivated their yam in the last season. The analysis found an average farm size of yam farms cultivated in the last season to be 3.05acres (SD = 1.22) with a range of 0.5 – 5acres. However, average farm size of other crops, usually sorghum, maize, millet, soybean, groundnut among others, cropped last season was found to be 5.25aacre (SD =3.81) with a range of 1 – 30acres

Local farmers in this part of country measure the quantity of their yam by 'calabash unit'. One calash unit of yam is equivalence to 100 tubers. This unit of measurement is adopted by the Ministry of Food Agriculture (MOFA). An average 100 tubers (one calabash unit) weighs about 250kg [17]. As shown in the Table 1, the analysis found average yield to be 5.12ton/acre (SD = 0.34) with the minimum of 4.8ton/acre and maximum of 6.1ton/acre.

Farmers surveyed relied on their family or household labour for their yam farming activities such as land clearing, raising yam mounds, planting, weeding, application of fertilizer, stalking and harvesting, making labour a heavily demanded input in yam production. The analysis also found average labour input per acre to be 103.35 Man days (SD = 41.83) and a range of 86 – 180 Man days. The use of herbicide to control weeds in yam farms appeared wide spread in the two Districts, with about 79% of the respondents indicating that they have applied weedicides on their farms. Inspite of the wide used of weedicide in controlling weeds, the average number of times farmers did hand weeding of their yam farms using hoes and cutlasses (the usual farm tools used in hand weeding) was found to be about 4 times with minimum of 2 times and maximum of 6 times. Also majority (78%) of farmers said they ploughed their yam fields before raising the mounds with very few (22%) indicating that they still used slashed and burn method of clearing their lands before raising mounds.

Respondents average extension contact, measured as the number of times within the last season farmer had engagement with extension agents or operatives from which they obtained information on yam production, was found to be about 3 times per season (SD = 2.28) and a range of 0 – 9 extension contact per season. Arguable, the poor access to extension information on yam production could explained the low uptake of YMT in generating planting material for expanding yam production. Equally, their access to formal credit is low, with only 18% indicating that they have borrowed to invest in their yam farm during the last season.

Cost Return Analysis of Yam production

Results of analysis of cost, revenue, gross margin and benefit/cost relationship of yam production among the 242 yam farmers surveyed in the two districts is presented in the Table 2. As shown in the Table, the average cost of seed yam per acre was GHS 269.26 (SD = 59.76) and it range from GHS 207.00 to GHS 405. 00. With regard land, information on monetary value of land was obtained through probing, as land is usually not hired or leased in the study area. Farmers usually make their yam farms on their family/clan lands or on communal lands entrusted on their community's chiefs or clan leaders on which they farm on without paying for it. Traditionally, they just have to present 'cola nut' to the chief when informing them of their decision to farm on the community's land or the clan land. Upon further probing, farmers mentioned that non-indigenes will have to present half calabash of yam (50-60tubers) to the chief, clan leader or the person from whom they borrowed the land from per acre. They valued the half calabash of yam tubers between GHS 74 to GHS 39 with average of GHS 55.33.

After clearing their lands, most farmer ploughed their fields before raising the mounds whilst others just slashed and burn. The average cost of tractor services for ploughing in the 2013 season was GHS 42.55 (12.32) per acre and was found to vary between GHS 32.00 to GHS 79.00. Labour was found to be the most critical and costly input in yam production in the study area, constituting about 42% of the total cost of production. The average cost of labour was GHS 319.91(SD = 10.01) per acre with the least labour cost incurred being GHS 160. 00 per acre and the highest being GHS 480.00 per acre. Yam farming is a labour intensive venture as labour is require in land clearing, mound raising, planting, stalking, weeding, harvesting and transporting of yam to house or farm bans as it often carried by women on their heads. However, the average cost of transportation of farm inputs and produce to and from farm was found to be GHS 52.28 (SD = 3.32) and it range from GHS 34.65 to GHS 72.00. Cost of weedicide was the least as some farmers do not spray weedicide in control weeds in their yam farms but rather weed manually. As shown in the Table, the average cost of weedicide per acre was GHS 25.65 (SD = 32. 89) and range from GHS 10.50 to GHS 180.00

In all, the average cost of production was found to be GHS 762.87 (SD = 133.96) and varied between GHS 506.00 to GHS 987.00 and average total revenue being GHS 935.76 (SD = 157.52) with a range of GHS 660.00 to GHS 1,307. 00. As a results the average gross margin per acre, was calculated to be GHS 172.73 (SD = 195.70) with the biggest loss being GHS 239.00 and higher margin of profit being GHS 706.00. Yam farming in the two districts was found to be viable with a mean benefit/cost ratio of 1.27 (SD= 0.32), implying that everyone Ghana cedis investment made in yam farming will yield additional 27 Ghana pesewas in returns.

Effect of type of seed yam used on yield and profitability of yam production

Inspite of the fact that yam planting material (seed yam) is a critical input in yam production, limiting acreage and productivity, farmers' uptake of Yam Minisett Technology (YMT), developed over four decades now, to facilitate generation of seed yam, is not encouraging. Out of the 242 yam farmers interviewed, only 99 farmers, representing 41%, indicated that they used the technology to generate their seed yam. This paper evaluated and compared cost, revenue and returns of yam production using either the conventional seed yam or seed yam generated through YMT based on primary data collected from two hundred and forty two (242) yam farmers in the Nanumba North and Gushiegu districts in the Eastern Corridors of Northern Ghana. A summary statistics and Analysis of Variance (ANOVA) of differences in cost, revenue and gross margins between farmers who planted their fields with seed generated from conventional method of seed generation and those generated by using YMT is presented in the Table 3.

The ANOVA undertaken found significant difference in yield, total revenue per acre, gross margin and benefit ratio at 1% level of significant between farms planted with seed generated from YMT and conventional seed yam. However, while cost of planting material (seed yam) per acre was found to vary significantly at only 5% between farmers who planted their farms with minisetts generated from YMT and those who used conventional seed yam, the analysis did not find any significant difference in total cost per acre between the two types of planting material used.

As shown in Table 3, while the mean cost per acre of farmers who planted their fields with setts produced through YMT was GHS 259.73/acre (SD = 39.36) that of those who planted their farms with conventional seed yam was found to be GHS 275.85/acre (SD = 69.36) with a F-statistics of 4.32 (p = 0.0388), indicating that respondents who planted their farms with minisetts incurred relatively lower cost per acre for their seed yam than those who used the conventional method of seed yam generation. This is significant, considering the fact that cost of planting material constitute greater components of total cost of yam production as noted by Aidoo et al., [2]. In a study by FAO, [7] cost of planting material was found to be about 50% of the total cost of production, however, in this study, cost of seed yam constitute about 30% of the total cost of production.

The study established that farms panted with planting materials generated through YMT yielded relative more than those planted with the conventional seed yam. As shown in the Table 3, the average yield of farms planted with YMT yielded 5.45ton/acre (SD = 0.23) as against the yield of 4.88ton/acre (SD = 0.13) of those fields planted with conventional seed yam. This difference was found to be statistical significant with F-distribution of 13.79 (p = 0.0003) indicating that the use of YMT in generating yam planting material is more productive than the conventional method. Also, farms planted with YMT yielded more revenue than those planted with conventional seed yam. The average total revenue realized per acre by farmers who cultivated their farms with YMT seed was found to be GHS 985.43 (SD = 160.34) as compare with total average revenue of GHS 901.36 (SD = 146.47) of those who used the conventional seed yam. The Analysis of Variance of total revenue per acre between the two methods of seed yam generation as shown in the Table 3, yielded a F distribution F(1,240) of 17.83 (p = 0000) demonstrating that farm planted with seed generated through YMT have a high chances of yielding more revenue per acre than those planted with the conventional seed yam.

Similarly, the gross margin and benefit/cost ratio of farms planted with the conventional seed yam and those using YMT were found to differ significantly with F(1,240) = 12.65 (p = 0.0005) and F (1,240) = 9.87 (p = .0019) respectively. Respondents who planted their yam farms using planting material generated from the application YMT got relatively higher gross margin than their colleague farmers who used the conventional seed yam. As shown in the Table 3, the average gross margin per acre of respondents who used YMT was GHS 225.27 (SD = 199.33) compare with the gross margin per acre of GHS 136.35 (SD = 185.42) for farmers who used the conventional seed yam in planting. Regarding benefit/cost ratio between the two methods of seed yam generation, farms planted with YMT generated planting material with an average benefit/cost ratio of 1.34 (SD= 0.34) was found to be slightly higher than the benefit/cost of 1.2 (SD =0.30) for farm planted with conventional seed yam. Notwithstanding the significant difference in benefit/cost ratios of the methods of seed yam generation, findings from the benefit/cost analysis found yam production in the two districts to be a viable enterprise regardless of which type of planting material is used.

Determinants of Yam productivity

A doubled log production function in a regression model was adopted in assessing determinants of output of yam per acre (yield) in ton/acre. In the model, yield of yam was regressed against selected factors of production of yam to determine the extent to which the selected variables significantly influence yam production. A Cobb

Douglas production function informed the determination of specified model in the analysis. The variable of interest was 'type of planting material used' (dummied as 1 = conventional seed yam; 0 = yam setts generated by using YMT). This was to test how significant planting material used influence the productivity or yield of yam in a multivariate approach which allows the interplay and influence of other variables. As such doubled log multiple regression model was used in determining the empirical model. Other independent variables used in the model were socio-economic variables such as age, income and factor of production such as land, labour and capital. Results of the regression analysis showing coefficients and standard errors with their respective z-test is presented in the Table 4.

With F (16, 225) = 6.78; Prob > F = 0.0000 indicating the significant and best fitness of the model in determining productivity of yam. Also with R-squared = 0.728 and Adj R-squared = 0.690 implies that about 69% of the variation in yield can be jointly explain by the variation in the explanatory variables, whilst the remaining 31% could be attributed to error and variables not included or omitted in the model . As shown in the Table, variables such as 'type of planting material', age, household size, farm size of yam, labour, number of weeding done and income were significant at 1% level in influencing yield of yam. The coefficient of type of planting material is negative, indicating that farms planted with setts generated through YMT were more likely to produce more yield than the conventional seed yam. Also farms operated or owned by young farmers were more productive than those of the elderly. This is so because most of the young farmers used YMT in producing their planting materials or yam setts. Also farmers with large farm size have higher yield than those with smaller farm sizes. Labour was also found to relate positively with yield, showing that increasing labour use is more likely to increase yield. This is understandable because yam farming is a labour intensive enterprise, labour is heavily used in land clearing, mounds raising, weeding, stalking, harvesting among others.

Also variables such as 'number of years of formal schooling completed, 'farm size of other crops', 'number of extension contact' and 'weedicide usage' were found to be significant at 5% and access to formal credit was significant only at 10% in influencing yield. Whiles years of formal schooling completed, extension contact, access to credit and weedicide usage were positively related to yield, farm size of other crops was negatively related to yield. Implying that respondents with higher years of schooling have higher yield than those without formal education. Also, farmers who have more contact with extension agents within the last farming season were more likely to have more yield than those with poor access to extension service. This once again underscore the important of farmers' access to extension service in improving the productivity of farmers. Also use of weedicides have been demonstrated by the results to have positive impact on yield, this could be attributed to the fact that weedicide help manage weed within yam fields and as such reduce competition for soil nutrients between yam crops and weeds and the improvement of organic matter content of soil as result of the decaying weeds caused by used of weedicides. Farmers' access to credit were also found to have positive influence on yield, demonstrating that farmers who borrowed from formal sources to invest on their farm operations stand high chance of increasing the yield of their farms.

5. Conclusion and Recommendations

Labour was found to be the most critical and costly input in yam production in the study area, constituting about 42% of the cost of production. The study found average cost of production of yam in the study area to be GHS 762.87 (SD = 133.96) with average total revenue being GHS 935.76 (SD = 157.52) yielding average gross margin per acre, of GHS 172.73 (SD = 195.70) with the biggest loss being GHS 239.00 and higher margin of 706.00. Yam farming in the two districts was found to be viable with a mean benefit/cost ratio of 1.27 (SD = 0.32), implying that every 1Ghana Pesewa (1Gp) investment made in yam farming will yield additional 27Gp in returns.

Inspite of the fact that yam planting material (seed yam) is a critical input in yam production, limiting acreage and productivity, farmers' uptake of Yam Minisett Technology (YMT), developed over two decades now, to facilitate generation of seed yam, is not encouraging. Out of the 242 yam farmers interviewed, only 99 farmers, representing 41%, indicated that they used the technology to generate their seed yam.

Notwithstanding the fact that the technology cost relatively cheaper than the conventional method of seed yam production. while the mean cost of seed yam per acre of farmers who used YMT to produce their seed yam was GHS 259.73/acre (SD = 39.36) that of those who planted their farms with conventional seed yam was found to be GHS 275.85/acre (SD = 69.36) with a F-statistics of 4.32 (p = 0.0388), indicating that respondents who planted their farms with minisetts incurred relatively lower cost per acre for their seed yam than those who used the conventional method of seed yam generation. Similarly, the gross margin and benefit/cost ratio of farms planted with the conventional seed yam and those using YMT were found to differ significantly with F(1,240) = 12.65 (p = 0.0005) and F (1,240) = 9.87 (p = .0019) respectively. Respondents who planted their yam farms using planting material generated from the application YMT got relatively higher gross margin than their colleague farmers who used the conventional seed yam. The study established that farms panted with planting materials generated through YMT yielded relative more than those planted with the conventional seed yam.

Results of the regression analysis found variables such as type of planting material, age, household size, farm size of yam, labour, number of weeding done and income to be significant at 1% level in influencing yield of yam. Also variables such as number of years of formal schooling completed, farm size of other crops, number of extension contact and weedicide usage were found to be significant at 5% and access to formal credit was significant only at 10% in influencing yield.

The study recommends measures to promote the adoption of Yam Minisetts Technology in generating yam setts for planting as a way of promoting the expansion of yam farms and increasing yield. This is because the findings show that it is more profitable than the traditional seed yam method. It is also important for MOFA to resource the extension department to carry out education on the advantages of the minisetts over the seed yam in order to encourage farmers to adopt the minisetts, which gives them better yields. Also the youth and those with formal education should be encouraged to take up yam farming as it is a profitable and viable agribusiness enterprise. Also banks and other financial institutions should make credit and other investment facilities to yam farmers to help promote the production of the commodity which have high demand both locally and international market.

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Table 1: Descriptive Statistics of Farmers' Socio-economic Characteristics

VARIABLES	MEAN	STD. DEV.	MIN.	MAX.
AGE	40.48	8.21	27	57
SEX	0.92	0.28	0	1
HOUSEHOLD SIZE	6.64	2.67	2	13
TYPE OF PLANTING MATERIAL	0.59	0.49	0	1
YIELD (TON/ACRE)	5.12	0.34	4.8	6.1
FORMAL EDUCATION (YES =1;NO = 0)	0.25	0.23	0	1
NUMBER OF YEARS OF FORMAL SCHOOLING	11.32	0.82	3	12
EXPERIENCE IN YAM FARMING	17.61	9.41	2	30
SOURCE OF LAND	0.19	0.39	0	1
FARM SIZE OF YAM FARM (ACRE)	3.05	1.22	0.5	5
FARM SIZE OF OTHER CROPS (ACRE)	5.25	3.81	1	30
SOURCE OF LABOUR	0.19	0.39	0	1
LABOUR (MAN DAY) PER ACRE	103.35	41.83	86	180
DID YOU APPLIED WEEDICIDE	0.79	0.41	0	1

NUMBER OF WEEDING	3.64	1.19	2	6
DID YOU PLOUGHED BEFORE RAISING MOUNDS	0.78	0.41	0	1
EXTENSION CONTACT	2.63	2.28	0	9
DID YOU APPLIED FERTILIZER	0.04	0.19	0	1
ACCESS TO CREDIT	0.18	0.38	0	1

Analysis of field data, 2013

Table 2: Statistics of Cost Returns of Yam Production

VARIABLES (GHS)*	MEAN	STD. DEV.	MIN.	MAX.
COST OF SEED YAM ACRE	269.26	59.76	207	405
COST OF LAND PER ACRE	55.33	1.52	74	39
COST OF PLOUGHING PER ACRE	42.55	12.32	32	79
COST OF LABOUR PER ACRE	319.91	10.01	160	480
COST OF WEEDICIDE PER ACRE	25.65	32.89	10.50	180
COST OF TRANSPORTATION PER CRE	52.28	3.32	34.65	72
TOTAL COST PER ACRE (GHS) (A)	**762.97**	**133.96**	**506**	**987**
TOTAL REVENUE PER ACRE (GHS) (B)	**935.76**	**157.52**	**660**	**1397**
GROSS MARGIN PER ACRE (GHS) (B-A)	**172.73**	**195.79**	**-239**	**706**
BENEFIT/RATIO	**1.27**	**0.32**	**0.76**	**2.39**

Analysis of field data, 2013
* 1 US Dollar = GHS 3.22

Table 3: Cost Return Analysis between Farms planted with YMT and conventional seed yam

Type of planting material	**Descriptive Statistics**				
Cost of seed yam (GHS)	**Mean**		**St Dev.**		**Frequency**
YMT	259.73		39.36		99
Conventional	275.85		69.89		143
Total	269.26		59.78		242
Analysis of Variance					
Source of variation	**SS**	**df**	**MS**	**F**	**Prob > F**
Between groups	15212.56	1	15212.56	4.32	0.0388**
Within groups	845359.55	240	3522.33		
Total	860572.11	241	3570.84		
	Yield of Yam (tonne/acre)				
	Mean		**St Dev.**		**Frequency**
YMT	5.45		0.23		99
Conventional	4.88		0.13		143
Total	5.17		0.18		242
Analysis of Variance					
Source	**SS**	**df**	**MS**	**F**	**Prob > F**
Between groups	0.4399	1	0.4399	13.79	0.0003***
Within groups	7.65565881	240	0.0318		
Total	8.09553158	241	0.0336		
	Total Cost per Acre (TC/Acre)				
	Mean		**St Dev.**		**Frequency**
YMT	760.11		139.53		99
Conventional	764.95		130.42		143
Total	762.97		133.96		242
Analysis of Variance					
Source of Variation	**SS**	**df**	**MS**	**F**	**Prob > F**
Between groups	1370.3624	1	1370.3624	0.08	0.7829
Within groups	4323370.44	240	18014.0435		
Total	4324740.8	241	17944.98		
	Total Revenue per Acre (TR/Acre)				
	Mean		**St Dev.**		**Frequency**
YMT	985.43		160.34		99
Conventional	901.36		146.47		143
Total	935.76		157.52		242
Analysis of Variance					

Source of Variation	SS	df	MS	F	Prob > F
Between groups	413471.202	1	413471.202	17.83	0.0000***
Within groups	5565985.41	240	23191.6059		
Total	5979456.62	241	24811.0233		
	Gross Margin (GHS)				
	Mean		**St Dev.**		**Frequency**
YMT	225.27		199.33		99
Conventional	136.35		185.42		143
Total	172.73		195.79		242
Analysis of Variance					
Source of Variation	**SS**	**df**	**MS**	**F**	**Prob > F**
Between groups	462577.846	1	462577.846	12.65	0.0005***
Within groups	8775742.15	240	36565.5923		
Total	9238320	241	38333.278		
	Benefit Cost ratio (B/C)				
	Mean		**St Dev.**		**Frequency**
YMT	1.34		0.34		99
Conventional	1.21		0.30		143
Total	**1.26**		**0.32**		**242**
Analysis of Variance					
Source of Variation	**SS**	**df**	**MS**	**F**	**Prob > F**
Between groups	0.98	1	0.9780	9.87	0.0019***
Within groups	23.79	240	0.0991		
Total	24.77	241	0.1028		

Analysis of field data, 2013

Table 4: Estimates of Coefficients of Factors influencing Yield

Variables	Coef.	Std. Err.	z	P>[z]
Type Of Planting Material	-0.0948316	0.0231153	-4.10	0.000***
Age	-0.0601098	0.0068577	-8.77	0.000***
Household size	0.0277718	0.0033864	8.20	0.000***
Number of years of formal Schooling	0.0047951	0.0021746	2.21	0.028**
Experience in yam farming	-0.0016355	0.0017031	-0.96	0.338
Farm size of yam farm last season	0.2739701	0.052499	5.22	0.000***
Farm size of other crops	-0.006728	0.0026752	-2.51	0.013**
Source of land	0.0183362	0.0226058	0.81	0.418
Labour unit used in yam farm (man day)	0.0076561	0.0015055	5.09	0.000***
Weedicide used on yam farm	0.0796694	0.0277824	2,87	0.032**
Number of weeding	0.001214	0.0004189	2.90	0.004***
Income (GHS)	0.0003227	0.0000664	4.86	0.000***
Number of Extension contact	0.0090353	0.0041606	2.17	0.019**
Last year's farm income (GHS)	-0.000151	0.0000523	-2.89	0.004****
Access to credit	0.0415571	0.0251012	1.66	0.099*
District (1 = Gushiegu'; 0 = Nanumba North)	-0.0000457	0.0004079	-0.11	0.911
_cons	2.649375	0.2570051	10.31	0.000***

Number of obs =242; F (16, 225) = 6.78; Prob > F = 0.0000 R-squared = 0.728; Adj R-squared = 0.690: Note: (***) indicate variable is significant at 1%, (**) indicate variable is significant at 5% and (*) indicate variable is significant at only 10%

Computation of field data, 2013