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Economic Potentials of Plantain and Fluted Pumpkin Intercropping as a Poverty Reduction Strategy in South-Western Nigeria

[1]B. Phillip, [2]A.M. Shittu, [3]I.O.O. Aiyelaagbe and [3]T. Adedokun

[1]Research and Development Centre, University of Agriculture, Abeokuta, Nigeria
[2]Department of Agricultural Economics and Farm Management, University of Agriculture, Abeokuta, Nigeria
[3]Department of Horticulture, University of Agriculture, Abeokuta, Nigeria

Abstract: In this study, economic potential of intercropping of fluted pumpkin (Telfairia occidentalis, Hook. F) -a short gestation crop, with plantain (Musa AAB) a high yielding perennial crop as a poverty reduction strategy is examined. A total of 27, 10m x 12m experimental plots, were cultivated over a two year periods (2006-2007) with nine (9) treatment combinations consisting of Telfairia and/or plantain established either without manure application or with 40ton/ha/year or 80ton/ha/year poultry manure application. The plant population consists of 16 stands of plantain (4m x 2.5m apart) and/or 240 stands of Telfairia (1m x 0.5m apart in the alleys of plantain). Data collected from each plot include weight of fresh vines of Telfairia harvested at 1m height above the ground every 2weeks from the fourth week of planting, number of plantain suckers and weight of fresh fruit harvested and production resource used. The data were analysed by descriptive and budgetary techniques as well as by analysis of variance (ANOVA). The study finds that (a) the gross margin in the first year is significantly higher ($p<0.05$) on an average plantain- Telfairia plot than an average sole plantain plot and not significantly different from what obtains on an average sole Telfairia plot; (b) Telfairia production is significantly ($p<0.01$) more labour intensive and characterized with significantly ($p<0.05$) lower benefit-cost ratio than plantain production; (c) gross margin and benefit cost ratio over the 2-year experimental period are significantly ($p<0.05$) higher on an average plantain- Telfairia plot than what obtain on an average sole Telfairia plot, but are in most cases not significantly different from what obtains on an average sole plantain plot; and (d) application of poultry manure significantly ($p<0.05$) raise returns from both plantain and Telfairia production, with the optimum rate of application being 80 ton/ha for sole plantain as well as plantain- Telfairia intercrop and 40ton/ha for sole Telfairia production.

Key words: Plantain % *Telfairia occidentalis* % Intercropping % Economic potential % Poverty reduction JEL: Q10 % Q12 % Q18

INTRODUCTION

One of the most challenging problems confronting the Nigerian nation today is how to significantly address the problem of a widespread and rising incidence of poverty among the populace. Available statistics shows that as much as 70.8 per cent of the populace lived on less than US$1 a day and are thus classified as extremely poor [1]. This is an increase from 15 per cent in 1970 [2], 46.3 per cent in 1985 and 65.6 per cent in 1996 [3]. Apart from death due to starvation and other health hazards that these poor people are daily faced with [4], poverty induced hunger and malnutrition are known to impair mental (intelligent quotient) development in children and could lead to a large loss in quality of life, productivity and economic growth in developing countries [5]. It is therefore imperative that concerted efforts are made to reduce poverty level among the most vulnerable groups in Nigeria.

Empirical evidence on the level of poverty in Nigeria is that the poor are predominantly the rural households that depend primarily on agricultural income [3, 6-12]. While a plethora of poverty reduction programmes have been put in place by various governments in Nigeria, poverty incidences among these vulnerable groups keep rising unabated, calling to question the effectiveness of these efforts. Babatunde, *et al.* [12] attributed this failure to an inaccurate targeting of the poor.

Corresponding Author: B. Phillip, Research and Development Centre, University of Agriculture, Abeokuta, Nigeria

The challenge was to locate alternative strategies or solutions for helping these group out of poverty? A cursory look at the trend in investment patterns of a typical rural farm household in Nigeria reveals a gradual shift away from medium to long gestation agricultural investments (such as cash crops and livestock production) to the pursuits of short-term gains: Not only are economic trees like cocoa, oil palm, coffee and rubber hardly replaced as they grow old, plantations of many of such cash crops are frequently converted for housing and arable crop production, while the youths move away in droves from farm based activities to non-farm economic pursuits in a drive to subsist [13,14,15]. In the absence of functioning capital market, coupled with the failure of governments to put in place appropriate social safety nets for the most vulnerable groups, it is difficult, if not impossible, for a resource poor farm household to invest in long gestation projects, irrespective of the level of returns they may get from such investments.

It is against this background, that some pro-poor commodity based researches are currently been undertaken at the University of Agriculture, Abeokuta (UNAAB), Nigeria. The research focus is more on empirical investigation into ways of boosting rural household income. The central theme of these researches is to identify a number of short-gestation crops that could be successfully intercropped with commonly grown cash crops in Nigeria. The guiding principle has been that such short-gestation crops can serve as a source of household income and means of family sustenance in the first few years before the cash crop matures. Inter-cropping of the fluted pumpkin (*Telfairia occidentalis* Hook. F) with plantain (*Musa* AAB) is one of such crops and experimental research is currently on at UNAAB teaching and research farm to assess the feasibility of recommending it to the farmers as a poverty reduction strategy. This paper provides a preliminary report on resource (labour) requirements, yield and economic performance of plantain-*Telfairia* intercrop, compared with the evidence when either of the crops was planted sole. Other objectives of the study were to assess *Telfairia* and /or plantain performances under various regimes of poultry manure application.

LITERATURE REVIEW

Fluted pumpkins (*Telfairia*) is a dioecious, perennial tropical vine grown in West Africa as a leaf vegetable and for its edible seeds [16]. The leaf has a high nutritional, medicinal and industrial value. It is rich in protein (29%), fat (18%) and minerals and vitamins (20%) [17]. The seeds, which can be cooked, roasted and eaten, or ground and added in soup, also contain 20.5% protein, 45% fat, 23% carbohydrates, 2.2% fibres and 4.8% total ash [18,19]. The oil in the seeds is non-drying and is useful in soap making and in cooking [20].

Apart from its nutritional value (which is very important for poor farm households), *Telfairia*, like other perennial plants, has deep and extensive root systems that can hold soil to prevent erosion, capture dissolved nitrogen before it can contaminate ground and surface water, out compete weeds (reducing the need for pesticides) and help to mitigate global warming by carbon sequestration [16]. Moreover, the maturity period for vegetative growth is between two to three weeks while for fruits, it fakes 6-8 months. It therefore implies that households that plant *Telfaria* will begin to receive some income at about one month after planting [17]. They would also be able to earn regular income at 2-3 week intervals when fresh vines are pruned. Another important pro-poor property of *Telfairia* is found in its drought tolerance. With very little residual moisture, it is possible for *Telfairia* to keep providing steady income during dry seasons when most other crops have seized to produce. Fresh vine yields could be in the range of 500-1000kg/ha, but could be more if the crop receives adequate manure or when fertilizers are applied after each picking [21,22].

Plantain, (*Musa* AAB) cv 'Agbagba' is a perennial crop that grows well in a wide range of environments [23]. It has been a staple of the human diet since the dawn of recorded history [16]. Plantain and banana have been crops of extraordinary significance to human societies: they are at present the fourth most important food crop in the world (after rice, wheat and maize) and are widely used as food, beverages, fermentable sugars, medicines, flavourings, cooked foods, silage, fragrance, rope, cordage, garlands, shelter, clothing, smoking material and numerous ceremonial and religious uses; while the fruit also enjoy significant worldwide export [23].

Prominent among major pro-poor characteristics of plantain is its ability to survive extended periods of drought unlike most other crops. It can also grow well under a wide range of soil conditions, with its fruits being produced almost all year round. Almost all parts of the plant have one economic use or another and may be harvested for household use or sale to raise income. Plantain also co-exists well with a wide range of plants and trees, except allelopathic plants and is traditionally grown in mixed cropping systems [23].

Uzo [24] examined the effect of mixed cropping of yam, *Telfairia*, maize and okra in a compound farming system of south eastern Nigeria. The objective was to see if there is any benefit from the different crop associations. Who reported that only maize performed better when intercropped with one or two other crops, while mixed cropping did not favour yam, *Telfairia* and okra. Who reported however, that use of *Stylosanthes gracilis* as a cover seems to be beneficial in stabilizing yields of yam, maize, *Telfairia* and okra, particularly by its effect on the improvement of soil fertility.

Emebiri and Nwufo [25] studied the vegetative yield of *Telfairia occidentalis*, grown at various distances (3, 4, 5 and 6 m) from a row of mango trees during 1991-92 growing season. They reported that fresh vegetable yield remained unaffected by proximity to the tree line, until about 170 days after planting. They noted that this coincided with the onset of the dry season when water usually becomes limited; and concluded that the vegetative, harvestable parts of the crops tend to be less affected when the crops are grown in the proximity of trees, provided water is not limited.

Nwachukwu and Onyenwaku [22] examined the production systems and economic efficiency of *Telfairia* production under the Fadama system by farmers in Imo State. The study was based on data obtained from 40 randomly selected farmers that was analyzed by descriptive and econometric methods. They reported that majority (63.33%) of the farmers practised mixed vegetable production and that the profit level was influenced by fertilizer, price, wage rate and farm size, while efficiency was found to be influenced by age, farming experience, membership of cooperative societies, farm and household sizes.

Akanbi, *et al.* [17] examined the growth, herbage and seed yield as well as quality of *Telfairia occidentalis* as influenced by application of Cassava Peel Compost (CPC) with or without mineral fertilizer. They reported that application of 45 kg N from NPK + 15 kg N from CPC brought about significant improvement in growth, shoot and fruit yield as well as shoot and seed quality of *Telfairia occidentalis.* They reported further that this treatment produced herbage yield, shoot protein, N, P and K mineral elements that are similar to what was obtained with application of 60 kg N from NPK alone or joint application of 15 kg N from NPK + 45 kg N from CPC. They concluded that these results support the concept of synergy between composts and mineral fertilizer and provide further stimulus to employ blends instead of sole application of compost or mineral fertilizer for crop production.

Nwufo and Ihejirika [26] examined the influence of inter-cropping and removal of diseased leaves on incidence and severity of leaf spot disease of *Telfairia*. They reported that removal of diseased leaves every two weeks significantly reduced the incidence and severity of leaf spot disease of fluted pumpkin, while inter-cropping of fluted pumpkin with cassava, maize and yam reduced the incidence and severity of the disease. They reported however that the least marketable yield was obtained in the *Telfairia*, cassava, yam and maize inter-crop.

METHODOLOGY

The data was obtained from a field experiment conducted during the 2006 and 2007 growing seasons. The experimental plot is in the research farm of University of Agriculture Abeokuta (7°15'N, 3°25'E). A total of nine treatment combinations of three replicates each were assigned by randomized complete block design on 27 experimental plots, each of 10m x 12m size. The treatment combinations include sole plantain, sole *Telfairia* and plantain- *Telfairia* mix crop, each of which were established either without manure application, with 40ton/ha manure application or with 80ton/ha manure application.

Land clearing and mapping was done in February 2006. Tilling of the soil was done in March 2006 and manure applied pre planting on affected plots in April 2006. The manure was further worked into the soil two weeks after planting. In plots with plantain-*Telfairia* intercrop, the manure was shared equally between plantain and *Telfairia* in the plot. Sword suckers of plantain (*Musa* AAB) cv 'Agbagba' were planted sole and in mixture with fluted pumpkin (*Telfairia occidentalis* Hook.F) in May 2006. The suckers were obtained from an organic plantain farm located some 55 metres away from the present experimental plot. Sixteen plantain sword suckers were transplanted per plot at 3m x 2.5m spacing to give a population of 1,330 plants per hectare, while seeds of *Telfairia* were planted in the alleys of plantain at the rate of 240 seeds per plot giving a total plant population of 20,000 stands per hectare. The same spacing / plant population used on the mixed crop plots were also maintained on sole crop plots. Because most of the *Telfairia* stands did not survive the 2006 dry spell, new set of *Telfairia* seeds were replanted on all the plots designated for *Telfairia* (sole or mixed crop) in April, 2007.

Regular weeding and other maintenance activities on the plots were simultaneously carried out over the two year period and records were taken on the level of resource use (labour, planting materials, etc.), outputs and

other relevant growth parameters. The vines of the fluted pumpkin were trained to platforms to facilitate its creeping habit and vines were pruned one meter above the soil level at two-week intervals. The response of fluted pumpkin to the various treatments in each of the two years was determined by the vine fresh weight at harvest while that of the plantain was determined by number of suckers and fruit weight at harvest at mature green stage. All the outputs were valued at the prevailing farm gate market prices for the products.

The study data was analyzed by descriptive and budgetary techniques as well as by analysis of variance (ANOVA) method. The ANOVA was carried out using appropriate procedure in GenStat Discovery Edition, Version 3.1 (VSN International Limited, 2008). Post-hoc analysis was based on comparison of the difference between each pair of means with the least significant difference (LSD) reported in GenStat outputs.

RESULTS AND DISCUSSION

This section presents results of various analyses carried out in pursuit of the study objectives. The basic results relates to the resource use with specific emphasis on labour requirements, growth performance (yield) and economic returns-cash flow and gross margin (N/ha) of the two crops when planted sole or mixed. Other results relates to the influence of organic manure application on the growth / yield and economic performances.

Cropping System and Performance: Table 1 presents a profile of the level of resource use, cost of production, outputs and farm income per hectare of plantain and/or *Telfairia* either as sole or mixed cropping with zero application of organic manure. As shown in the Table, labour use (based on requirements) in the period under consideration varied substantially across the three categories of plots. The highest average labour use was found in the intercrop plots (1, 716.38 man-hours per hectare) while plots on which sole plantain was planted recorded the lowest average labour use (828.01 man-hours per hectare).

Evidence from one-way ANOVA (in randomised block design) carried out separately using only data from the control reveals that at least some of the observed differences in labour use across the three cropping systems are significant at $p<0.01$ (calculated $F= 38.69$; $df1=2$, $df2=4$, $LSD = 293.5$). Post-hoc analysis reveals that while no significant difference exist between labour use on *Telfairia* -plantain intercrop and the sole *Telfairia* plots, labour use on both type of plots are significantly ($p<0.05$) higher than what obtains in sole plantain plots. The result shows that production of *Telfairia*, either in sole or mixed cropping, is much more labour intensive than plantain production.

Production cost over the two-year period on an average plot of plantain- *Telfairia* (N212, 658.67 per hectare) was almost double what obtains on the sole plots (N126, 528.22 per hectare for sole plantain and

Table 1: Performance of Sole And Mixed Cropped Plantain and/or *Telfairia* Without Manure Application

	Plantain and *Telfairia*			Sole Plantain			Sole *Telfairia*		
Descriptive Statistic	2006	2007	TOTAL	2006	2007	TOTAL	2006	2007	TOTAL
Resource Use per ha									
Quantity of plantain sucker(No/ ha)	1,330.00	-	1,330.00	1,330.00	-	1,330.00	-	-	-
Quantity of *Telfairia* seedlings(No/ ha)	20,000.00	20,000.00	40,000.00	-	-	-	20,000.00	20,000.00	40,000.00
Quantity of manure (tons/ha)	-	-	-	-	-	-	-	-	-
Labour(Man-hours/ ha)	952.80	763.58	1,716.38	547.47	280.54	828.01	816.00	694.42	1,510.42
Outputs per Ha									
Quantity of *Telfaria* (Kg/ ha)	4,238.72	930.52	5,169.24	-	-	-	3,569.30	4,224.83	7,794.13
Weight of plantain (Kg/ ha)	-	3,469.31	3,469.31	-	2,869.33	2,869.33	-	-	-
No of suckers (No/ ha)	266.67	7,444.15	7,710.81	305.54	6,749.73	7,055.27	-	-	-
Farm Income per Ha									
Revenue from *Telfairia* (N/ ha)	148,799.60	30,734.88	179,534.49	-	-	-	122,495.10	132,744.69	255,239.79
Revenue from plantain (N/ ha)	-	156,824.84	156,824.84	-	117,023.10	117,023.10	-	-	-
Revenue from sucker sales (N/ ha)	13,333.33	372,207.33	385,540.67	15,277.17	337,486.50	352,763.67	-	-	-
Total Revenue (N/ ha)	162,132.94	559,767.05	721,899.99	15,277.17	454,509.60	469,786.76	122,495.10	132,744.69	255,239.79
Production Costs per ha									
Cost of plantain sucker planted (N/ ha)	66,500.00	-	66,500.00	66,500.00	-	66,500.00	-	-	-
Telfairia seed cost (N/ ha)	15,333.60	15,333.60	30,667.20	-	-	-	15,333.60	15,333.60	30,667.20
Total cost of planting materials	81,833.60	15,333.60	97,167.20	66,500.00	-	66,500.00	15,333.60	15,333.60	30,667.20
Labour cost (N/ ha)	68,826.67	46,664.80	115,491.47	43,306.67	16,721.55	60,028.22	67,805.56	44,442.67	112,248.22
Cost of manure (N/Ha)	-	-	-	-	-	-	-	-	-
Total Variable Cost (N/ ha)	150,660.27	61,998.40	212,658.67	109,806.67	16,721.55	126,528.22	83,139.16	59,776.27	142,915.42
Gross Margin (N/ ha)	11,472.67	497,768.65	509,241.32	-94,529.50	437,788.04	343,258.54	39,355.94	72,968.42	112,324.37
Gross margin-TVC ratio			3.39			3.71			1.79

N142, 915.42 per hectare for sole *Telfairia*). Results of the ANOVA also reveals that at least some of these differences in production cost are significantly different at $p<0.01$(calculated F= 57.98; df1=2, df2=4, LSD = N23, 583.90). Post-hoc analysis reveals that while no significant difference exists between the production costs of sole *Telfairia* and sole plantain, production cost of plantain - *Telfairia* is significantly higher than the sole crops.

The cost of production in the control plot was generally lower in the second year irrespective of the cropping pattern. In the sole plantain plots, production cost in year2 was 15% of year1. This compares to 41% for the inter crop and 72% for sole *Telfairia*. The highest cost of production for sole plantain compared with sole *Telfairia*, in year1 in this study suggests that one of the main limitations to the commercial production of plantain as a sole crop may be its rather high initial costs (N109, 806.67 per hectare in the first year), which may be out-of-reach of the typically resource poor farm households, considering the low expected returns from the enterprise in the first year.

As shown in Table 1, gross farm income (revenue) over the two year period on an average plantain -*Telfairia* mix (N721, 899.99 ha^{-1}) is about thrice what obtains on an average sole *Telfairia* plot (N255, 239.79 ha^{-1}) and almost double what obtains on an average sole plantain plot (N469, 786.76 ha^{-1}). ANOVA and post-hoc analyses also reveal that the three means are significantly different at $p<0.05$ (calculated F= 21.27; df1=2, df2=4, LSD = N198, 848.40). The mean values for cropping patterns was also significantly different at $p<0.05$ (calculated F= 15.41; df1=2, df2=4, LSD = N199, 403.30).

Considering that resource use and production costs differ significantly across the three cropping systems, gross margin alone may not be a good indicator of economic performance. Thus, benefit-cost ratio was also examined and used as the overall indicator of economic performance of the cropping system (where benefit is the total revenue and cost is the total variable cost of production). Benefit-cost ratio was higher on an average sole plantain plot (3.71: 1), than plantain-*Telfairia* (3.39: 1), while an average sole *Telfairia* plot recorded the lowest benefit - cost ratio (1.79: 1). Evidence from ANOVA (calculated F= 18.25; df1=2, df2=4, LSD = 0.98), however shows that while the mean benefit-cost ratio for sole plantain and plantain-*Telfairia* are significantly higher than sole *Telfairia* at $p<0.05$, there is no significant evidence to show that either sole plantain nor plantain- *Telfairia* is more financially rewarding than the other.

The implication of this result, for policy is that sole plantain enterprise would be the best cropping strategy in situation of full employment for households that can meet the financial requirements in the first year of operation. In situations where the household's labour is not fully employment and / or where the credit market is not functioning properly as to guarantee enough funds for farming operations and family sustenance, it would appear that intercropping plantain with *Telfairia* would be the appropriate cropping strategy.

Organic Manure Application and Performance: The levels of resource use, outputs, production costs and farm income per hectare on an average plot of sole *Telfairia*, sole plantain and plantain-*Telfairia* intercrop with varying levels of organic manure application is presented in Tables 2-4. The results show, (following a-priori expectations) steady increases in labour requirements and production costs in all the three cropping systems as quantity of organic manure applied increased from 0, 40 and 80tha^{-1}. In the same manner, weights of plantain fruits and number of suckers harvested from plantain plots increased as quantity of manure used increases.

Unlike the yield response for plantain however, *Telfairia* yields (and sales revenue) were higher when the manure level was raised from 0 to 40 tha^{-1} in sole crop as well as the intercrop plots, but declined when the manure level was further raised to 80ton/ha. For example, *Telfairia* yield increased from an average of 3.9 ton/ha/year on an average sole *Telfairia* plot on which no manure was applied to an average of 8.3 ton/ha/year on plots in which the manure level was 40ton/ha. The Figure, however, declined to 6.9 ton/ha/year on plots in which the manure level was further increased to 80ton/ha. The implications of this is that while the inclusion of poultry manure significantly raised output levels and farm revenue in both *Telfairia* and plantain enterprises, excessive use of poultry manure is not desirable in *Telfairia* production.

Using gross margin and benefit-cost ratio as indicators of performance shows increasing returns on plots with sole plantain and plantain-*Telfairia* with increases in quantity of manure application (Tables 2-4).

Evidence from two-way ANOVA (in randomised block design) revealed that at least some of the observed differences in gross margin are significant at $p<0.01$ as cropping system vary and at 5% level as rate of manure application varies, while the influence of the interaction

Table 2: Performance of Solely Cropped *Telfairia* at Various Levels of Organic Manure Application

	No Manure			40 tonnes/ ha Manure			80 tonnes/ ha Manure		
Descriptive Statistics	2006	2007	TOTAL	2006	2007	TOTAL	2006	2007	TOTAL
Resource Use per ha									
Quantity of plantain sucker (No/ha)	-	-	-	-	-	-	-	-	-
Quantity of *Telfairia* seed (No/ ha)	20,000.00	20,000.00	40,000.00	20,000.00	20,000.00	40,000.00	20,000.00	20,000.00	40,000.00
Quantity of manure (tons/ha)	-	-	-	40.00	40.00	80.00	80.00	80.00	160.00
Labour (Man-hours/ ha)	816.00	694.42	1,510.42	984.00	898.02	1,882.02	1,632.00	777.75	2,409.75
Outputs per ha									
Quantity of *Telfairia* (Kg/ ha)	3,569.30	4,224.83	7,794.13	9,987.10	6,685.84	16,672.94	7,821.91	5,927.54	13,749.45
Weight of plantain (Kg/ ha)	-	-	-	-	-	-	-	-	-
No of suckers (No/ ha)	-	-	-	-	-	-	-	-	-
Farm Income per ha									
Revenue from *Telfairia* (N/ ha)	122,495.10	132,744.69	255,239.79	326,792.48	182,006.61	508,799.09	240,740.37	212,394.28	453,134.65
Revenue from plantain (N/ ha)	-	-	-	-	-	-	-	-	-
Revenue from sucker sales (N/ ha)	-	-	-	-	-	-	-	-	-
Total Revenue	122,495.10	132,744.69	255,239.79	326,792.48	182,006.61	508,799.09	240,740.37	212,394.28	453,134.65
Production Cost per ha									
Cost of plantain sucker planted(N/ ha)	-	-	-	-	-	-	-	-	-
Telfairia seed cost (N/ ha)	15,333.60	15,333.60	30,667.20	15,333.60	15,333.60	30,667.20	15,333.60	15,333.60	30,667.20
Total cost of planting materials	15,333.60	15,333.60	30,667.20	15,333.60	15,333.60	30,667.20	15,333.60	15,333.60	30,667.20
Labour cost (N/ ha)	67,805.56	44,442.67	112,248.22	77,833.33	56,192.20	134,025.53	88,333.33	46,664.80	134,998.13
Cost of manure (N/Ha)	-	-	-	16,880.00	-	16,880.00	33,760.00	-	33,760.00
Total Variable Cost (N/ ha)	83,139.16	59,776.27	142,915.42	110,046.93	71,525.80	181,572.73	137,426.93	61,998.40	199,425.33
Gross Margin (N/ ha)	39,355.94	72,968.42	112,324.37	216,745.55	10,480.81	327,226.36	103,313.44	150,395.88	253,709.32
Gross margin-TVC ratio			1.79			2.80			2.27

Table 3: Performance of Solely Cropped Plantain at Various Levels of Organic Manure Application

	No Manure			40 tonnes/ ha Manure			80 tonnes/ ha Manure		
Descriptive Statistics(a)	2006	2007	TOTAL	2006	2007	TOTAL	2006	2007	TOTAL
Resource Use per ha									
Quantity of plantain sucker (No/ha)	1,330.00	-	1,330.00	1,330.00	-	1,330.00	1,330.00	-	1,330.00
Quantity of *Telfairia* seed (No/ ha)	-	-	-	-	-	-	-	-	-
Quantity of manure (tons/ha)	-	-	-	40.00	40.00	80.00	80.00	80.00	160.00
Labour (Man-hours/ ha)	547.47	280.54	828.01	742.93	291.66	1,034.59	989.87	291.66	1,281.52
Output per ha									
Quantity of *Telfairia* (Kg/ ha)	-	-	-	-	-	-	-	-	-
Weight of plantain (Kg/ ha)	-	2,869.33	2,869.33	1,133.29	4,063.73	5,197.01	-	5,994.20	5,994.20
No of suckers (No/ ha)	305.54	6,749.73	7,055.27	666.64	10,610.69	11,277.33	916.63	12,082.85	12,999.48
Farm Income per ha									
Revenue from *Telfairia* (N/ ha)	-	-	-	-	-	-	-	-	-
Revenue from plantain (N/ ha)	-	117,023.10	117,023.10	49,998.00	121,384.03	171,382.03	-	281,933.17	281,933.17
Revenue from sucker sales (N/ ha)	15,277.17	337,486.50	352,763.67	33,332.00	530,534.33	563,866.33	45,831.50	604,142.50	649,974.00
Total Revenue	15,277.17	454,509.60	469,786.76	83,330.00	651,918.37	735,248.37	45,831.50	886,075.67	931,907.17
Production Cost per ha									
Cost of plantain sucker planted (N/ ha)	66,500.00	-	66,500.00	66,500.00	-	66,500.00	66,500.00	-	66,500.00
Telfairia seed cost (N/ ha)	-	-	-	-	-	-	-	-	-
Total cost of planting materials	66,500.00	-	66,500.00	66,500.00	-	66,500.00	66,500.00	-	66,500.00
Labour cost (N/ ha)	43,306.67	16,721.55	60,028.22	59,600.00	17,165.98	76,765.98	69,440.00	17,165.98	86,605.98
Cost of manure (N/ ha)	-	-	-	16,880.00	-	16,880.00	33,760.00	-	33,760.00
Total Variable Cost (N/ ha)	109,806.67	16,721.55	126,528.22	142,980.00		17,165.98	160,145.98	169,700.00	17,165.98
	186,865.98								
Gross Margin (N/ ha)	-94,529.50	437,788.04	343,258.54	-59,650.00	634,752.39	575,102.39	-123,868.50	868,909.69	745,041.19
Gross margin-TVC ratio			3.71			4.59			4.98

Table4:Performance opf Plantain-*Telfairia* Intercropat Various Levels of Organic Manure Application

	No Manure			40 tonnes/ Ha Manure			80 tonnes/ Ha Manure		
Descriptive Statistics	2006	2007	TOTAL	2006	2007	TOTAL	2006	2007	TOTAL
Resource Useperha									
Quantity of plantain sucker(No/ha)	1,330.00	-	1,330.00	1,330.00	-	1,330.00	1,330.00	-	1,330.00
Quantity of *Telfairia*seed(No/ha)	20,000.00	20,000.00	40,000.00	20,000.00	20,000.00	40,000.00	20,000.00	20,000.00	40,000.00
Quantity of manure(tons/ha)	-	-	-	40.00	40.00	80.00	80.00	80.00	160.00
Labour (Man-hours/ha)	952.80	763.58	1,716.38	1,120.80	976.63	2,097.43	1,248.00	819.41	2,067.41
Outputs per ha									
Quantity of *Telfairia*(Kg/ha)	4,238.72	930.52	5,169.24	5,771.99	2,452.68	8,224.67	4,747.03	949.96	5,696.99
Weight of plantain(Kg/ha)	-	3,469.31	3,469.31	-	5,030.35	5,030.35	3,510.97	4,549.82	8,060.79
No of suckers(No/ha)	266.67	7,444.15	7,710.81	400.00	9,110.75	9,510.75	316.67	10,027.38	10,344.04
Farm Income per ha									
Revenuefrom *Telfairia*(N/ha)	148,799.60	30,734.88	179,534.49	189,331.32	55,025.58	244,356.89	164,973.96	31,540.41	196,514.36
Revenuefrom plantain(N/ha)	-	156,824.84	156,824.84	-	220,268.97	220,268.97	116,662.00	181,528.85	298,190.85
Revenue from suckersales(N/ha)	13,333.33	372,207.33	385,540.67	20,000.00	455,537.33	475,537.33	15,833.33	501,368.83	517,202.17
Total Revenue(N/ha)	162,132.94	559,767.05	721,899.99	209,331.32	730,831.88	940,163.19	297,469.29	714,438.09	1,011,907.38
Production Costperha									
Cost of plantain sucker planted(N/ha)	66,500.00	-	66,500.00	66,500.00	-	66,500.00	66,500.00	-	66,500.00
Telfairia seed cost(N/ha)	15,333.60	15,333.60	30,667.20	15,333.60	15,333.60	30,667.20	15,333.60	15,333.60	30,667.20
Total cost of planting materials	81,833.60	15,333.60	97,167.20	81,833.60	15,333.60	97,167.20	81,833.60	15,333.60	97,167.20
Labour cost(N/ha)	68,826.67	46,664.80	115,491.47	78,986.67	58,608.77	137,595.43	86,400.00	49,220.25	135,620.25
Cost of manure(N/ha)	-	-	-	16,880.00	-	16,880.00	33,760.00	-	33,760.00
Total Variable Cost(N/ha)	150,660.27	61,998.40	212,658.67	177,700.27	73,942.37	251,642.63	201,993.60	64,553.85	266,547.45
Gross Margin(N/Ha)	11,472.67	497,768.65	509,241.32	31,631.05	656,889.51	688,520.56	95,475.69	649,884.23	745,359.92
Gross Margin/TVCratio			3.39			3.74			3.80

between the two factors are not significant (calculated F = 11.00 for crop mix and F= 4.36 for rate of manure application; df1 = 2, df2 = 16, LSD = N197, 606.30). Similar analysis in respect of the benefit-cost ratio however revealed that it is only the differences in terms of crop type that were significantly different (calculated F = 9.19 for crop mix and F= 1.44 for rate of manure application; df1 = 2, df2 = 16, LSD = N1.09).

Figures 1 and 2 summarises evidences from the post-hoc analyses for gross margin and benefit-cost ratio respectively. They show very clearly, that focusing on sole *Telfairia* production in a drive to subsist would keep gross margin (and therefore, net farm income) at barely about half of what is attainable if the farm household had planted sole plantain on the same plot of land. However, intercropping *Telfairia* and plantain, in addition to providing steady income for household subsistence needs, is revealed to be associated with significant increases in both the gross margin and benefit cost ratio.

The highest average gross margin (N/ha) was recorded on plots on which sole plantain was plated with 80 ton/ha manure applied, followed by plots on which plantain and *Telfairia* were intercropped with 80ton/ha manure application, while the lowest average gross margin was recoded on sole *Telfairia* plot without manure application. Meanwhile, an average plot on which sole plantain was planted maintained a generally higher benefit-cost ratio than what obtains on other crop mix.

Application of organic manure, while not being associated with significant increase in benefit-cost ratio is revealed as being associated with significant increase in farm income (gross margin), with the optimal rate of application being 80ton/ha for sole plantain as well as plantain- *Telfairia* intercropping and 40ton/ha for sole *Telfairia* production.

Plantain-Telfairia Intercropping and Subsistence Income: As stated earlier in our introduction, a major motivation to introduce plantain- *Telfairia* intercropping is to enable the farm household meet their subsistence needs while await the maturity of plantain fruits and suckers. Results on Tables 1-4, have shown (very clearly), that while negative gross margin was recorded on all the sole plantain plots in the first year, positive gross margins were recorded on an average plot in which *Telfairia* was intercropped with plantain or planted sole. Two logical questions are (1) would the gross margin in the first year of intercropping plantain and *Telfairia* be significantly different from sole plantain? (2) Would the additional investment required to intercrop plantain and *Telfairia* not significantly reduce the gross margin in the first year below what is obtainable if the farm household had

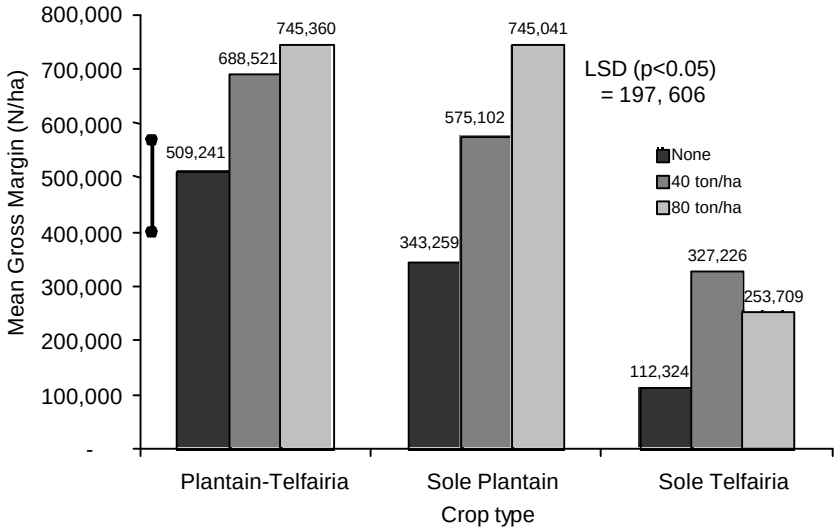

Fig. 1: Gross margin of an average plot on which Plantain and/or Telfairia was planted at different rates of manure application

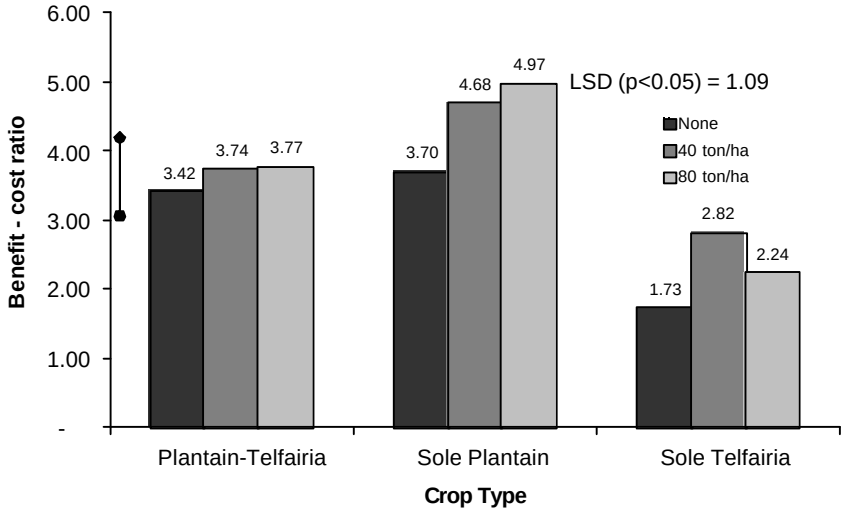

Fig. 2: Benefit - Cost ratio of an average plot on which plantain and/or telfairia was planted at different rates of manure application

Table 5: Results of T-test of Differences in Gm on Plots With/without *Telfairia*

Crop mix/Manure	N	Mean	Std. Error	t-value
Mixed crop Vs Sole Plantain				
ℂPlantain and *Telfairia*	9	46,193.14	55,860.91	2.36*
ℂSole Plantain	9	-92,682.70	18,396.07	
Mixed crop Vs Sole *Telfairia*				
ℂPlantain and *Telfairia*	9	46,193.14	55,860.91	-0.77
ℂSole *Telfairia*	9	119,804.98	78,226.09	

Note: * imply the difference is significant at p<0.05

concentrated on sole *Telfairia* production? Table 5 summarises the results of t-tests of significant differences between two means conducted in an attempt to provide answers to these questions.

As shown in Table 5, the mean Gross Margin (Revenue-Total Variable Cost) in the first year of operation is significantly (p<0.05) higher on an average plot with plantain-*Telfairia* mixed crop

(N46, 193.14 per ha) than on an average plot of sole plantain (a deficit of N92, 682.70/ha). This indicates that the introduction of *Telfairia* would contribute an average of N138, 875.84 towards household sustenance and/or investment. It is important to note however, that the mean GM is not significantly lower on an average plot with plantain and *Telfairia* than on an average plot of sole *Telfairia.* This result confirms the earlier proposition that in the absence of social safety nets coupled with a poorly functioning capital market, intercropping of *Telfairia* with plantain would be an appropriate strategy for escaping the vicious cycle of poverty that may be occasioned by an inability to produce a more financially rewarding crop (such as plantain).

SUMMARY AND CONCLUSION

Against the background that a poorly functioning capital market coupled with the absence of appropriate social safety nets has been a major factor that drive the predominantly resource poor farm households in Nigeria into short-gestation but less rewarding farm and non farm activities, which invariably get them entrenched in a vicious cycle of poverty, this study examined the economic potential of promoting intercropping of fluted pumpkin (*Telfairia ocidentalis*, Hook. F)-a short gestation crop, with plantain (*Musa* AAB) a high yielding perennial crop.

Nine (9) treatment combinations consisting of *Telfairia* and/or plantain planted either without manure application, with 40thaG^{1} poultry manure application or with 80 thaG^{1} poultry manure application were assigned in three replicates by randomised complete block design on 27 - 10m x 12m plots. Sixteen (16) sword suckers of plantain and 240 stands of *Telfairia* were planted per plot to give a per hectare plant population of 1330 plantain stands (4m x 2.5m apart) and 20000 *Telfairia* stands (1m x 0.5m apart in the alleys of plantain). The experimental plots were cultivated over a two-year period (2006-2007). Performance of *Telfairia* was assessed by weight of fresh vines harvested at 1m height above the ground every 2weeks, while that of the plantain was determined by number of suckers and fruit weight at harvest at mature green stage. Data was collected on resource use, growth performance, outputs as well as production costs and returns on each plot. The data were analysed by descriptive and budgetary techniques as well as by analysis of variance (ANOVA).

The main conclusions from the study have been that although plantain production could generate substantial income to the farm households (an average of N437, 788.04 gross margin per hectare starting from the second year of planting), the long gestation (about 1 year) coupled with the high initial capital outlay (an average of N126, 528.22 per hectare in the first two years) could make it an infeasible investment for the resource poor farm households unless they could gain access to a reasonable amount of credit to finance their production and household consumption expenditures in the first two years of operations. Intercropping plantain with *Telfairia* could help ease some of this burden: some income could be raised from planting *Telfairia*; loan procured (if any) could be completely repaid from farm income within a year with an average gross margin of N11, 472.67 per hectare realised in the first year, rising up to an average of N497, 768.65 per hectare from the second year.

Analysis of variance / t-tests revealed that: (a) first year income is significantly higher ($p<0.05$) on an average plantain- *Telfairia* plot than an average sole plantain plot and not significantly different from what obtains on an average sole *Telfairia* plot; (b) telfairia production is significantly ($p<0.01$) more labour intensive and characterised with significantly ($p<0.05$) lower benefit-cost ratio than plantain production; (c) gross margin and benefit cost ratio over the 2-year experimental period are significantly ($p<0.05$) higher on an average plantain- *Telfairia* plot than what obtain on an average sole *Telfairia* plot, but are in most cases not significantly different from what obtains on an average sole plantain plot; and (d) application of poultry manure significantly ($p<0.05$) raised returns from both plantain and *Telfairia* production, with the optimum rate of application being 80 ton/ha for sole plantain as well as plantain- *Telfairia* intercrop and 40ton/ha for sole *Telfairia* production.

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