

RESEARCH ARTICLE

ECONOMETRIC ANALYSIS OF THE IMPACT EVALUATION OF DEVELOPMENT INTERVENTIONS ON GINGER PRODUCTION SYSTEM

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ABSTRACT

Ginger is a therapeutic crop with global acceptability due to its medicinal and economic values. Its value chain has been staggering over time as a result of some underlined factors and their associated effects. In order to stimulate the performance of ginger value most especially, in rural communities where means of livelihood depend mostly on agriculture, development interventions needed to be put in place. In this study, the impact of interventions on ginger outputs were measured from the surveys conducted from some randomly selected Local Government Areas in Kaduna State. Descriptive statistics were used to describe the socio-economic profile of the respondents; cost and return analyses were employed to measure the profitability of the ginger production system and multiple regression techniques were used to estimate the impact of the interventions on ginger outputs. Findings from the study indicated that the ginger production system was dominated by female adults and was also a profitable scheme. This was affirmed by the monetary value obtained from the variable cost of production and increasing rate of returns from the ginger output. It was also asserted that most of the determinant factors that influenced the land productivity of the ginger growers were positively significant with attendant jobs creation.

Keywords: Impact Evaluations, Development Interventions, Ginger output, Baseline, Endline, Multiple Regression Analysis, Socio-economic Characteristics.

INTRODUCTION

Ginger is a crop grown expansively around the globe because of its pungent aromatic rhizome and its medicinal value. Its acceptability and economic^[1] value have grown over the years in Nigeria due to the

health awareness associated with it (World Bank, 2007; Egbuchua and Enujeke, 2013)^[2]. In Nigeria, it is typically cultivated in Kaduna State and listed by Nigerian Export and Promotion Council (NEPC, 2004) as one of the ten commodities that have the potentials for creating increased economic growth, opportunities for employment, increased income and wealth for the Country (Sidi et al, 2014; Ayodele and Sambo, 2014)^[3]. However, the performance of ginger value chain has been staggering over time due to some factors such as inability of farmers to see the crop as a business venture; lack of interest by Nigerian authorities due to the effect of oil receipts on the economy compared to ginger; production inefficiencies, threats posed by value chain participation to small businesses where standards on products and processes^[4] are challenging (Kaplinsky and Morris, 2001; Ponte, 2011; Kilimo Trust, 2012). Recently, the emergence of COVID-19 pandemic and the associated policies put in place by governments to curb the spread of virus also contributed to the ginger value chain shocks^[5].

It has also been established that rural dwellers generally rely on agriculture, and as such productivity and efficiency of agricultural value chain are being enhanced. This automatically stimulates growth in the incomes and economies of rural populace (Laven et al., 2012, KADP, 2007). As a result of this^[6], development interventions in agricultural sector now adopt value chain techniques to reduce poverty. In the light of the foregoing, interventions promoting the value chain integration should find a way of extenuating the factors responsible for the overwhelming performance of ginger value chain. This is achieved through the provision of necessary agricultural facilities and interventions that may be needed by ginger farmers. Thus, the need for this study in some selected Local Government Areas (LGAs) in Kaduna State. Specifically, the objectives of the study are to:

- (i) evaluate the profitability of ginger production system;
- (ii) determine the factors influencing the ginger production system;
- (iii) measure the impact of development interventions on ginger farming operations

Geographical Distribution of Ginger Farmers by LGAs

Table 1 below shows the geographical distribution of ginger farmers randomly from some LGAs in Kaduna State.

Table 1: Distribution of Ginger Farmers by LGAs

<i>LGA</i>	Baseline (N = 341)		Endline (N =212)	
	<i>Frequency</i>	<i>Percentage</i>	<i>Frequency</i>	<i>Percentage</i>
Chikun	22	6.45	12	0.94
Jaba	58	17.01	8	3.77
Jamaa	29	8.50	123	6.13
Kachia	36	10.56	74	34.91
Kaduna South	17	4.99	1	0.47
Kagarko	74	21.70	49	23.11
Kajuru	14	4.11	0	0
Kaura	11	3.23	10	4.72

Kauru	17	4.99	0	0
Lere	19	5.57	0	0
Sanga	18	5.28	0	0
Zangon	26	7.62	55	25.94

The highest number of ginger farmers at the baseline was from Kagarko LGA, representing 21.70% and the lowest from at baseline was from Kaura LGA, representing 3.23%. The highest number of ginger farmers at the endline was from Kachia LGA, representing 34.91% and the lowest number of respondents at the endline was from KadunaSouth LGA, representing 0.47%. Similarly, at the endline survey, there was no response rate from the ginger farmers in four LGAs (Kajuru, Kauru, Lere, and Zanga).

Table 2: Distribution of Ginger Farmers’ Sex-Age by LGAs

LGA	Baseline Surveys				Endline Surveys			
	Male Adult	Male Youth	Female Adult	Female Youth	Male Adult	Male Youth	Female Adult	Female Youth
Chikun	6	2	10	4	1	1	0	0
Jaba	22	6	18	12	2	0	6	0
Jamaa	9	4	9	7	3	1	8	1
Kachia	12	7	10	7	8	9	31	26
Kaduna South	4	1	10	2	1	0	0	0
Kagarko	35	7	26	6	5	10	27	7
Kajuru	5	1	8	0	0	0	0	0
Kaura	3	2	3	3	3	3	4	0
Kauru	2	3	8	4	0	0	0	0
Lere	14	1	4	0	0	0	0	0
Sanga	7	2	7	2	0	0	0	0

Zangon	5	4	14	3	7	16	25	7
Total	124 (36.36%)	40 (11.73%)	127 (37.24%)	50 (23.58%)	30 (14.15%)	40 (18.87%)	101 (47.64%)	41 (19.34%)

At the baseline, largest numbers of female adults were involved in ginger farming, representing 37.24% of the total number of respondents from the twelve LGAs under consideration. This was followed by male adults representing 36.36%; followed by female youths representing 23.58%; then followed by male youths, representing 11.73%. Similarly, at the endline, largest numbers of female adults were involved in ginger farming, representing 47.64% of the total number of respondents from the twelve LGAs under consideration. This was closely followed by female youths, representing 19.34%; followed by male youths, representing 18.87%; then followed by male adults, representing 14.15%. This shows that female adults were more active in ginger farming than any other sex-age group in the study area

Definitions of Terms

Value Chain (VC): This is a sequence of consecutive value added steps and stakeholders that participate in the creation of a process from production level to delivery of the process (product) to the market (World Bank, 2007). In other words, it is a process required to move a product from a supplier to a customer (Kaplinsky and Morris, 2001)

Production System (PS): This is an organizational set up or procedure used to transform input to output.

Development Interventions (DI): These refer to operations of a project used in the real life provided it is effective at the evaluation phase.

Impact Evaluations (IE): Impact evaluations are empirical studies that quantify the causal effects of Interventions on outcomes of interest (Asian Development Bank, 2012; Khandker et al, 2009).

Baseline: This refers to measurements of key indicators prior to project commencement, from which change and progress can be evaluated.

METHODOLOGY

Study Area

The study was conducted in 12 LGAs of Kaduna State for baseline surveys and 8 LGAs for midline and endline surveys. This could be due to the fact that ginger is mostly cultivated in the state when compared with other states in Northern part of the country.

Sampling Method and Data Collection

A set of well structured questionnaires consisting of closed and open ended questions were used to collect primary data from the respondents. The target audience for the study was focused on the women and youth ginger farmers.

The baseline, midline and endline surveys were used as cross sectional representative household surveys for the selected respondents in the study area. The baseline surveys were conducted to measure the estimates on which performance target and implementation scale can be based before intervention.

For the baseline surveys, 341 respondents were randomly selected and for midline and endline surveys, 212 respondents were selected. The data collected included the socio economic characteristics of ginger farmers, agricultural data, and prices of farm inputs, ginger output and challenges faced by the respondents among others

Data Entry and Analysis

Data entry was carried out in Abuja and data cleansing was conducted twice, after data entry and during the analysis of data. Data analysis was conducted using SPSS and STATA statistical softwares.

Analytical Techniques

(a) Descriptive statistics such as frequency distribution and percentage were used to describe the socio economic characteristics of the ginger farmers, identify their challenges and recapitulate the data collected from the field. Gross Margin Analysis (GMA) also was used to measure the profitability of ginger production system as specified:

$$NR = TE - TC \quad (1)$$

where $NR = \text{Net Return (N)}$

$TE = \text{Total Expenditure (N)}$

$TC = \text{Total Cost} = TVC + TFC$

$TVC = \text{Total Variable Cost}; TFC = \text{Total Fixed Cost}$

$GM = GFI - TVC,$

where $GM = \text{Gross Margin (N/Hectare)}$

$GFI = \text{Gross Farm Income (N/Hectare)}$

$TVC = \text{Total Variable Cost (N/hectare)}$

(b) Cost and Return analysis was employed to determine Operating Ratio (OR) and Return on capital Invested (RI) as follows:

$$OR = \frac{TOC}{GI} \quad (2)$$

where $OR = \text{Operating Ratio}$, $TOC = \text{Total Operating Cost}$ and $GI = \text{Gross Income}$

$$RI = \frac{GM}{TVC} \quad (3)$$

where $RI = \text{Return on Capital Invested on Ginger production}$

$$TVC = \text{Total Variable Cost} \quad (4)$$

(c) Multiple Regression (MR) analysis model was used to determine the factors impacting ginger production system. This was achieved by fitting four different functional forms of MR: Linear, Semi-log, Double-log and Exponential as specified:

$$Y = c + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + \epsilon \quad (5)$$

(Linear)

$$Y = c + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + b_{10} \ln X_{10} + \epsilon \quad (6)$$

(Semi-log)

$$\ln Y = c + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + b_{10} \ln X_{10} + \epsilon \quad (7)$$

(Double-log)

$$\ln Y = c + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + \epsilon \quad (8)$$

(Exponential)

where $Y = \text{Ginger output (kg)}$; $c = \text{coefficient of the parameters estimated}$

$X_1 = \text{Quantity of ginger seeds (kg)}$; $X_2 = \text{Quantity of NPK fertilizer (kg)}$

$X_3 = \text{Age (yrs)}$; $X_4 = \text{Household size}$; $X_5 = \text{Farm size (Ha)}$; $X_6 = \text{Labour cost}$;

$X_7 = \text{Educational level}$; $X_8 = \text{Gender}$;

$X_9 = \text{Farming Experience}$; $X_{10} = \text{Membership of co-operative society}$;

€ = the error term

RESULTS AND DISCUSSIONS

Table 3: Socio-economic Characteristics of Ginger Farmers

Characteristics	Category	Frequency	Percentage
Gender	Male Youth	40	11.73
	Male Adult	124	36.36
	Female Youth	50	14.66
	Female Adult	127	37.24
Age Group (years)	15-29	54	15.84
	30-35	94	27.57
	36-39	154	45.16
	60 and above	39	11.44
Marital Status	Single	22	6.45
	Married	289	84.75
	Divorced	2	0.59
	Widowed	27	7.92
	Separated	1	0.29
Educational Status	None	39	11.44
	Primary	44	12.90
	Secondary	137	40.17
	Tertiary	121	35.48
Social Disability	Difficulty in: Remembering	1	0.29
	Seeing	2	0.59
	Walking	2	0.59
	Others	336	98.53
Household Size	Child	9	2.64
	Head	195	57.18
	Spouse	136	39.88
	Others	1	0.29

Farm Size	5-50 (ha)	341	100
Farm Training	LGAs	127	37.24
Membership of Cooperative society	Members	24	7.04
	Non-members	317	92.96

The socio-economic characteristics of the ginger farmers are being discussed as presented in Table 3 above. The gender depiction shown by the result indicated that female adults (37.24%) and male adults (36.36%) dominated the ginger farming system. This implies that the production system of ginger in the study area was dominated by adults.

The majority of the farmers could also be categorized into productive age group (36-39), representing 45.16% of the total selected respondents. The implication of this is that increased

production is guaranteed in the study area since they have more potential for greater productivity than the older group.

Large numbers of the respondents were married ginger growers, representing 84.75% of the farmers with only single category less than 10% of the entire farmers selected. This could be attributed to the burden of family responsibilities on the part of the married folks. Besides, it is generally believed in the rural setting that one of the reasons for marriage is to engage family members in farming operations. This therefore establishes the need for the active involvement of married people.

Most of the farmers had secondary school education which could be taken to be noticeable level of literacy. The level of education of the farmers determines the type of decision taken in terms of production and land managerial capacity in ginger production in the study area.

The level of social disabilities among the ginger farmers was not significantly pronounced (1.47%). Thus, the social disability of status of the farmers could not have impacted negatively on the ginger production system in the study area.

The Head and spouse groups dominated the household characteristics of the farmers representing 57.18% and 39.88% respectively. This could be a good development to improved ginger production since the duet has ‘responsibility status’ that controls the labour used for ginger production and the quantities of farm produce reserved for household consumption.

Farming experience is a function of farm training which serves as an underline factor that determines production level in agriculture. The more exposed a farmer is in terms of training, the better the production capacity.

The majority of the farmers representing 93% of the entire farmers did not belong to any cooperative group. This might be that they were not well informed about huge benefits they could derive for being members of a cooperative society.

The ceiling of the farm size used for growing ginger was 50 hectares of farmland. This implies that the farmlands cultivated by the farmers were relatively very expansive, and could be attributed to gifted or inherited farmlands. Since there is also a relationship between farm size and farmers’ productivity, it means that the larger the farmland the higher the farmers’ level of productivity (all things being equal).

Table 4 shows the gross margin analysis, cost & return analysis of ginger production system in the study area. At the baseline, relatively high gross returns, N247,977,144.32 was estimated from the sales of ginger by the farmers, after investing the sum of N100,830,606.46 into the farming operations as gross income.

The net returns (GRM) N147,146,537.86 realized, indicated that the ginger farmers successfully maximized profits and minimize losses in the monetary value realized from the variable cost of production. The operating ratio for the ginger farming was 0.41 which indicates that 41% of gross income was used for operating expenses. The return on capital invested (1.46) shows that for every N1 invested in ginger production, there is a corresponding percentage return of 146%. This clearly shows that ginger production in the study area was a productive and profitable project.

Similarly, at the endline, relatively high gross returns, N145783084 was estimated from the sales of ginger by the farmers after investing the sum of N84797480 into the farming operations as gross income. The net returns (GRM), N60985604 indicated that the ginger farmers successfully maximized profits and minimized losses in the monetary value realized from the variable cost of production. The operating ratio for the ginger farming was 0.42 indicating that 42% of gross income was used for operating expenses. The return on capital invested (1.34) showed that for every N1 invested in ginger production, there was a corresponding percentage return of 134%. This shows that ginger production in the study area was a productive and profitable project despite the fact that the volume of investment at the endline was strictly less than that of baseline.

Table 4: Regression Outcome on Determinants of Ginger Farm Output

Variables	Linear [^]	Semi-log	Double-log	Exponential
Constant (c)	620.4543 (3.2302)***	540.2301 (3.0532)**	4.7809 (8.9901)***	4.9800 (21.4532)***
Quantity of Ginger Seeds(X ₁)	0.4708 (5.2343)***	106.6723 (5.1208)***	0.3564 (5.0633)***	0.0006 (4.5644)***
Quantity of NPK Fertilizer(X ₂)	1.7756 (0.7801)*	18.4402 (0.7800)	-0.0341 (-0.4523)	0.0031 (0.3521)
Age(X ₃)	5.6812 (3.8043)***	-200.5689 (-4.8012)***	-0.2672 (-2.9543)***	-0.0071 (-2.3111)***
Household Size(X ₄)	16.3523 (1.1012)**	-55.7823 (-1.5245)	-0.1345 (-1.3446)	-0.0030 (-1.2578)
Farm Size(X ₅)	34.6867 (2.5634)**	60.7832 (1.6733)*	0.2345 (2.9523)***	0.0710 (2.1645)**
Labour Cost(X ₆)	74.6767 (0.8821)*	125.8921 (2.8667)	0.1673 (1.8012)*	0.0922 (1.4513)
Educational Level (X ₇)	63.4800 (3.0412)**	158.8923 (3.3409)***	0.3800 (3.2666)***	0.1645 (2.7290)
Gender (X ₈)	-724.4357	-4.7223	-548.6204	-3.0612

	(2.8434)	(-2.6402)**	(0.6400)	(-1.3402)
Farming	3.0534	56.6543	0.1012	-0.0000
Experience (X ₉)	(0.6401)**	(1.7245)	(1.4244)	(-0.0432)
Membership of Co-operative Society (X ₁₀)	-3272.45 (2.4000)	0.7812 (1.0611)	0.8976 (2.6210)	0.5821 (1.8845)*
R ²	0.8965	0.8789	0.7555	0.6567
F-value	(40.23)***	(32.23)***	(30.23)***	0.3334

***, **, * are statistical significance levels at 1%, 5% and 10% respectively.

^ is the lead equation.

The results of multiple regression of the factors that determined ginger farm output were shown in Table 5. The linear functional form is the lead equation as it provides the best fit. It was selected because it has the highest number of significant variables, values of coefficient of determination (R²) and F values. The F value is significant at 10% level of significance, which largely confirms the significance of the multiple regression equations. The coefficient of determination (R²) is 0.8965. This shows that the explanatory variables in the model explained about 89.65% of the total variation in ginger farmer output. The regression results indicated that quantity of ginger seeds, quantity of NPK fertilizer, age, household size, farm size, labour cost, educational level and farming experience were positively significant. However, other variables such as gender and

cooperative membership were negatively significant. The discussions on the results obtained are highlighted below:

Table 5: Discussions of Determinant Factors on Ginger Production System

Determinant Factors	Significance level	Relationship with ginger output	Inference
Quantity of Seeds	1%	Positive and significant	The more ginger seeds planted by the farmers, the more the ginger output. This falls in line with the expectations of the farmers.
Quantity of NPK fertilizer	5%	Positive and significant	This means the more the appropriate quantity of NPK fertilizer used, the better the ginger output.
Age	1%	Positive and significant	Most of the farmers were at their productive ages. Young farmers are known to have more physical strengths and mental capacities to cope with the challenges needed for daily farming operations.
Household size	5%	Positive and significant	The greater the family size, the bigger the farmlands that would be cultivated by the farmers. There is a direct relationship between household size and farmland labour force.

Farm size	5%	Positive and significant	All things being equal, the size of farmland actually determines the ginger yield. The bigger the farmland, the bumper the ginger output.
Labour cost	10%	Positive and significant	This indicates that the amount of labour used by the productive farmers has direct impact on the ginger output. Agricultural production system depends on physical clout.
Educational level	5%	Positive and significant	The education level of a farmer influences his/her output. The more educated farmers are, the more their intellectual capacities improve farm output.
Gender	None	Negative	More of the female farmers were involved in ginger production with increased output than their males counterparts.
Farming Experience	5%	Positive and significant	The coefficient of farming experience was significant. The more farming experiences farmers have in terms of training, the higher the productivity and net returns.
Membership of Co-operative Society	None	Negative	Membership of cooperative society in the study area was not significant, meaning that most of the ginger farmers were not members of a society group. The implication is that farmers who were non-cooperative members would not have been privileged to access credit facilities.

CONCLUSION AND RECOMMENDATIONS

This study has investigated the impact of development interventions on ginger production system in some selected LGAs in Kaduna State, Nigeria. The findings from the study inferred that the socio-economic characteristics of the ginger farmers in the study area variegated with adults (males and Females) dominating the ginger production system. It was also revealed that most of the ginger farmers were in the married status. The gross margin, cost and return analysis conducted on the study showed that the ginger production system was a profitable scheme. This was evidenced from the monetary value generated from the variable cost of production and increasing rate of returns on ginger output. Multiple regression determinants of factors influencing the land productivity of ginger farmers showed that all the variables considered were significantly positive excluding membership of cooperative society and gender with non significant coefficients. Some of the constraints militating against ginger farming expansion and marketing challenges faced by farmers were identified for possible interventions. The study also affirmed that large numbers of jobs were created by the ginger farmers which must have resulted to poverty reduction, healthy economic growth and increased purchasing power in the study area. This has clearly attested to the fact that the main purpose for the study was well achieved.

The study therefore recommends the following:

1. The youths and singles in the study area should be encouraged to delve into ginger production system because of its profitability and economic viability;
2. More development interventions should be given to ginger farmers in the study area to create more jobs;

3. Ginger farmers in the study area should be encouraged to form and join cooperative groups to enhance their financial, economic and productive capacities;
4. Efforts should be made by relevant authorities and agencies to address the constraints militating against the expansion of ginger farming in the study area by providing access to credit facilities, farm inputs and improved planting materials;
5. The major marketing challenges faced by farmers should also be addressed by relevant government agencies by reducing the cost of transportation and high market taxes, removing trade restrictions and providing good transportation network to farm settlements;
6. Further investigations should be made to find out why most of the ginger farmers in the study area are indifferent to expansion of ginger production system at endline.

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