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Full Length Research Paper

Attributes of push-pull technology in enhancing food and nutrition security

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Push-pull technology (PPT) is an agricultural novelty that eliminates pest infestation (specifically, Striga and Stemborers) from cereal farm. It was invented by Professor Khan in 1997 to help reduce degradation of crops by pests which were adversely affected by yields. By this, an increased production was evidenced amongst the sub-Saharan farmers. This study aimed at determining the basic attributes of PPT that enhance FNS. It found out that PPT plots had more yields that influenced the entire pathway. Production recorded data for; maize (PPT-1393kgs, NPPT-401kgs), sorghum (PPT-556kgs, NPPT-125kgs), millet (PPT-930kgs, NPPT-107kgs), fodder (PPT-7163kgs, NPPT-891kgs), and beans (PPT-122kgs, NPPT-88kgs). Data for cereals consumed domestically were; maize (PPT-1215kgs, NPPT-349kgs); sorghum (PPT-415kgs, NPPT-105kgs), millet (PPT-596kgs, NPPT-93kgs), fodder (PPT-3844kgs, NPPT-727kgs), and beans (PPT-119kgs, NPPT-81kgs). Amount of the cereals sold recorded; maize (PPT-Kshs. 28,152, NPPT-Kshs. 7,477), sorghum (PPT-Kshs. 10,907, NPPT-Kshs 2,620), millet ((PPT-Kshs. 2,778, NPPT-Kshs. 3,110), fodder (PPT-Kshs. 19,444, NPPT-Kshs. 2,250), and beans (PPT-Kshs. 3,259, NPPT-Kshs. 2,410). And the amount of cereals sold that contributed to food were; maize (PPT-Kshs. 10,556, NPPT-Kshs. 4,667), sorghum (PPT-Kshs. 3,407, NPPT-Kshs. 600), millet (PPT-Kshs. 411, NPPT-Kshs. 1,500), fodder (PPT-Kshs. 13889, NPPT-0), and beans (PPT-0, NPPT-Kshs. 1,225). Furthermore, PPT registered an average monthly food adequacy of 9.62 out of 12 while NPPT had 8.34. The regression model gave a significant r^2 of 0.9162, an indication of 91.62% variation in the PPT's influence on food adequacy (p=0.00187). The study found out that PPT has both direct and indirect impact on FNS of the adopters.

Key words: Push-pull technology (PPT), Non push-pull technology (NPPT), Food and Nutrition Security (FNS), Production, Consumption, Sales and Food Diversity.

INTRODUCTION

A ‘push–pull’ strategy is a cropping system in which specifically chosen companion plants are grown in between and around the main crop. These companion plants release semiochemicals that (i) repel insect pests from the main crop using an intercrop which is the ‘push’ component; and (ii) attract insect pests away from the main crop using a trap crop which is the ‘pull’ component (Cook et al., 2007).

The PPT uses an intercrop of a fodder legume Desmodium spp., including *D. uncinatum* (Jacq.), with maize and a perimeter of Napier grass, *Pennisetum purpureum* K. (Schumach), planted around the plot.

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Stemborer moths are effectively repelled away from the maize crop (push) by Desmodium spp., and are subsequently attracted to and trapped by the Napier grass (pull) (Khan et al., 2000, 2006a, 2007).

By this strategy, it has seen a practice of defence against the herbivory by these pests limiting effective growth of the cereal crops on sub-Saharan farms (Bruce and Pickett, 2007).

Over the past two to three decades, PPT has been tested on several fields in different regions of Eastern Africa infested by these pests (Striga and Stemborers) and the outcome was always positive. Until today, there has been enhanced cereal production and sufficient food for farmers practicing the technology.

Cereals, including maize (*Zea mays* L.) and sorghum (*Sorghum bicolor* (L.) Moench), are the most important food and cash crops for millions of rural farm families in the predominantly mixed crop-livestock farming systems of SSA (Romney et al., 2003). The efficient production of cereals per unit of input is therefore central to the food security challenge (Khan et al., 2014).

In determining the effectiveness of PPT to ensure adequacy in food supply and security, the element definitions of how, what, and why it is likely to achieve that, is highly essential. Food security has been for centuries interpreted as the possibility of providing food produced in a given country in full or in the majority to satisfy the demands of all inhabitants (Mariola, 2012). The definition proposed by the FAO in 2002 includes four more important dimensions: physical availability (food production, stocks and trade), economic and physical access (incomes, expenditure, markets and prices), food utilization (sufficient energy and nutrient intake) and stability (of the other three dimensions over time). The four aspects of food security that are distinguished by FAO are geared towards achieving an ultimate goal of good nutritional status (IOB Study, 2011).

In APA 2007 Policy Guide, it contends that although there is no agreed upon formal definition of food access, researchers have often established that the components of food access are three pronged. Access includes the availability of nutritionally adequate and culturally appropriate food, households possessing adequate income to acquire such food, and the proximity and the ability to travel to sources that offers such food.

Food security has become a serious challenge for various reasons: high food prices, import dependency, the rising food demand linked to population growth and problems of access to water resources (IFPRI, 2012). It remains a prominent concern for economists (Barret, 2002).

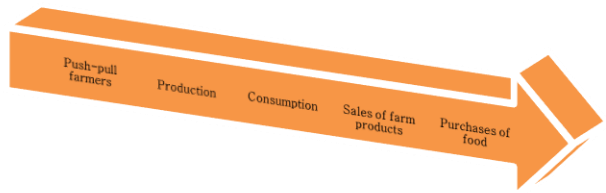
With the rising of the agricultural interventions, a positive path to the assurance of food security is set. Push-pull agriculture has handily impacted on a two-dimensional benefit at the time of need through reducing or eliminating pests to increase cereal production (most importantly). In its general aspects, pest is managed and the quantity of cereals production is equivalently enhanced.

Objective of the Study and Conceptual Framework

The main objective of this study was to find out how Push-pull Technology attributes to FNS. PPT has shown varied characteristics of importance that have attracted its probe on promoting FNS. Many researchers studying this technology have ventured a lot of resources to research on its diversity in management of several factors that include ensuring food security. This study basically studied the PPT's elements of production, consumption, sales of farm products, purchase of other food products (diversity).

and food adequacy across the previous years. The Non Push-pull groups provided a medium through which a control experiment was based for comparison reasons.

Research Chain



METHODOLOGY

This study developed a critical conceptual and theoretical review in order to define the research design and sample size of the population for the study, that is, Push-pull and Non push-pull fields/households. A theoretical review describes in a critical way the evolution of theories and the way they are understood in different contexts. It draws on existing research literature to advance theory in education research (APA, 2003). Cross-sectional survey design (Olsen and Marie, 2004) was employed. It covered five different counties of Western Kenya namely; Busia, Siaya, Kakamega, Vihiga and Kisumu Counties. These regions were endowed with sufficient resources and goodwill that would encourage the study since they were major areas of push-pull strategy initiation (ICIPE Final Technical Report by Prof Zeyaur R. Khan, 2011). In the specific counties, enumerators from the locality were tasked to conduct the study under routine supervision after being trained. The counties and villages that the survey took place in are as in Table 1 below. Figure 2 displays the map of the surveyed regions.

Map of the surveyed regions of Western Kenya

The social and demographic factors play very important roles (Drewnowski and Barry, 1997). In this study they gave a moderation link to define the Push-pull and Non push-pull facets. This provided a framework to examining production, consumption, products' sales and income for food and, contrasting them between the two households (OECD, 2002).

Both quantitative and qualitative analyses were used (World Bank Organization, 2006). Quantitative analysis used quantitative data obtained from the field. The data included the kilograms of production and consumption amongst the households recorded in both the long rain season (LRS) and short rain season (SRS). It also included of the amounts obtained from selling of farm products and amount from the sales used to buy other foods (Hinrichs, 2000). Qualitative analysis defined the

Table 1. Table of the regions of nutritional survey.

No.	County	Villages
1.	Busia	Bulanda, Emasiebi, Igero, Sigomre
2.	Siaya	Gula, Indor, Maroche, Mlago, Munara, Ndagaywa B, Oolre, Opata, Rabolo, Ragwar, Uloma A, Yuaya
3.	Kakamega	Butayi, Ekhaba, Elubonje, Emakhweri, Emungweso, Eshikungulu
4.	Vihiga	Bongu, Ebumbayi, Ebusembe, Elwambilo, Esabalu, Kaila, Mukhuyu, Sunrise
5.	Kisumu	Magwar, Yenga

Note: Data obtained from analysis of information from the field.

lists of foods purchased and their diversity in accomplishing nutritional requirements (Losey, 2010).

The selection of food security indicators depends on the context. Indicators can be used in a wide range of contexts, such as sustainable development, food security, policy and economics. The SMART criteria are frequently adopted by international organizations (UNDP, 2004) with reference to specific subjects such as sustainable development and project evaluation. SMART is an abbreviation standing for specific, measurable, achievable, relevant and time-bound (Laura, 2017).

This study gave weight to studying sustainability of PPT as a development and its implications to food security. The specific (S) involved locating regions of specific interest and that are data-rich. The study was measurable (M) with a manageable sample size that was calculated as 100 households (see below). It was also achievable (A) by delegating the field tasks to the enumerators who worked on simpler numbers of households (20) each per region. It was further relevant (R) by dictating the specific objectives to be achieved and what to be probed from the field for the analysis and required results. Finally, it was time-bound (T). The entire schedule for the whole study was placed. The questionnaire was formed, pretest was done in two days, training of enumerators was done in one day and field survey proceeded for five days.

Push-pull agriculture is hypothetically defined in an empirical specification of food and nutrition security which is modelled econometrically in the following equation of interest (Mbu et al., 2016);

FNS = $\Phi + \lambda$PPTagric + $\Psi\pi + \varepsilon$ (Hypothetical equation)

Where FNS is Food and Nutrition Security (outcome variable of interest); PPTagric is Push-pull agriculture; π is a vector of exogenous demographics of household heads, sex, age, marital status and total number of family members; λ portrays the actual effect of PPT on food and nutrition security; Φ and Ψ are parameters for estimation; and ε is the error term.

The equation is a factor of hypotheses;

H0: $\beta = 0$ (Months of food adequacy is not a useful predictor of the PPT's role in FNS)

H1: $\beta \neq 0$ (Months of food adequacy is a useful predictor of the PPT's role in FNS)

This was computed at significance level, $\alpha = 0.05$. The null hypothesis was to be rejected if p-value ≤ 0.05 (Dalson et al., 2013).

In cross-sectional studies, the aim is to estimate the prevalence of unknown parameters from the target population using a definite sampling method. So an adequate sample size is needed to estimate the population prevalence with a good precision (Mohamad et al., 2013). This study used a cluster sampling technique. This type of probability sampling (cluster sampling) occurs when the researcher wants to generate a more efficient probability sample in terms of monetary and/or time resources. Instead of sampling individual units, which might be geographically spread over great distances, the researcher samples groups (clusters) that occur naturally in the population, such as neighborhoods or schools or hospitals (Charles and Fen, 2007).

Each region where PPT is practiced was marked. A specific sub-region (locality) was picked and on the location, PPT and NPPT households were identified. This formed a cluster sample which the enumerators used to collect the data for this study.

Generally, sample size was calculated on the basis of manageable data and budget. This took into consideration the number of PPT adopters and the non-adopters. It also sustained the acceptable statistical requirement of a normal distribution. It was obtained from the formula below;

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where n is the sample size, Z is the statistics corresponding to level of confidence, p is expected probability to being a Push-pull or Non push-pull farmer and d is precision corresponding to effect size (Mohamad et al., 2013).

In this study, Z = 1.96, p = 50%, and d = 0.098. Sample size calculation is therefore;

$$n = \frac{1.96^2 \ X \ 0.5(1-0.5)}{0.098^2}$$

$$\boldsymbol{n = 100}$$

The sample of 100 was divided into two; Push-pull household – 50 and Non push-pull households – 50.

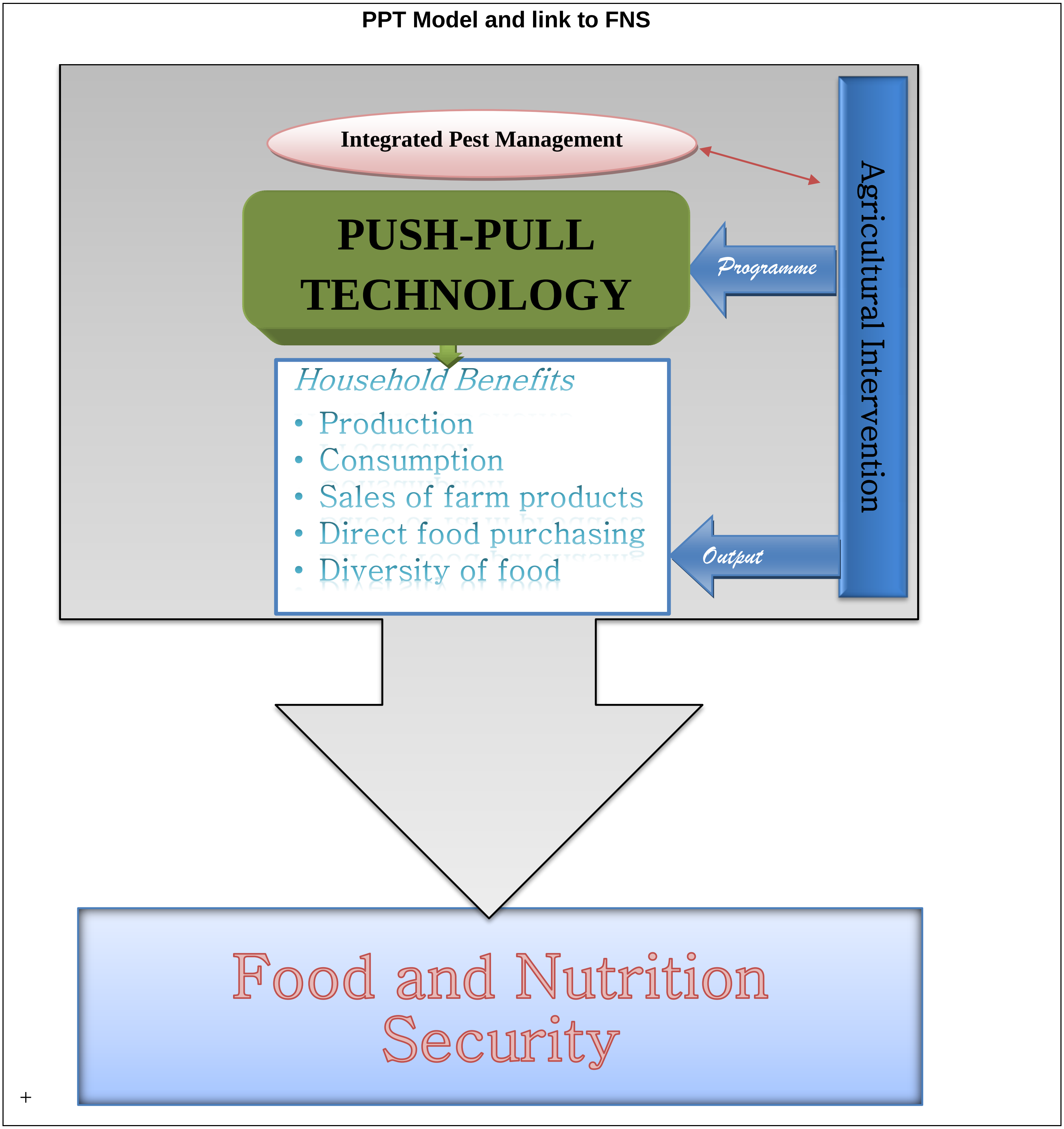


Figure 1. Conceptual framework of the study (personally formed).

Land sizes for both PPT and NPPT households were standardized into a unit acre. The measurements of production, consumption, sales and income were therefore on the basis of a unit acre of land (Lei et al., 2013).

Regression statistics was computed to assess the crude

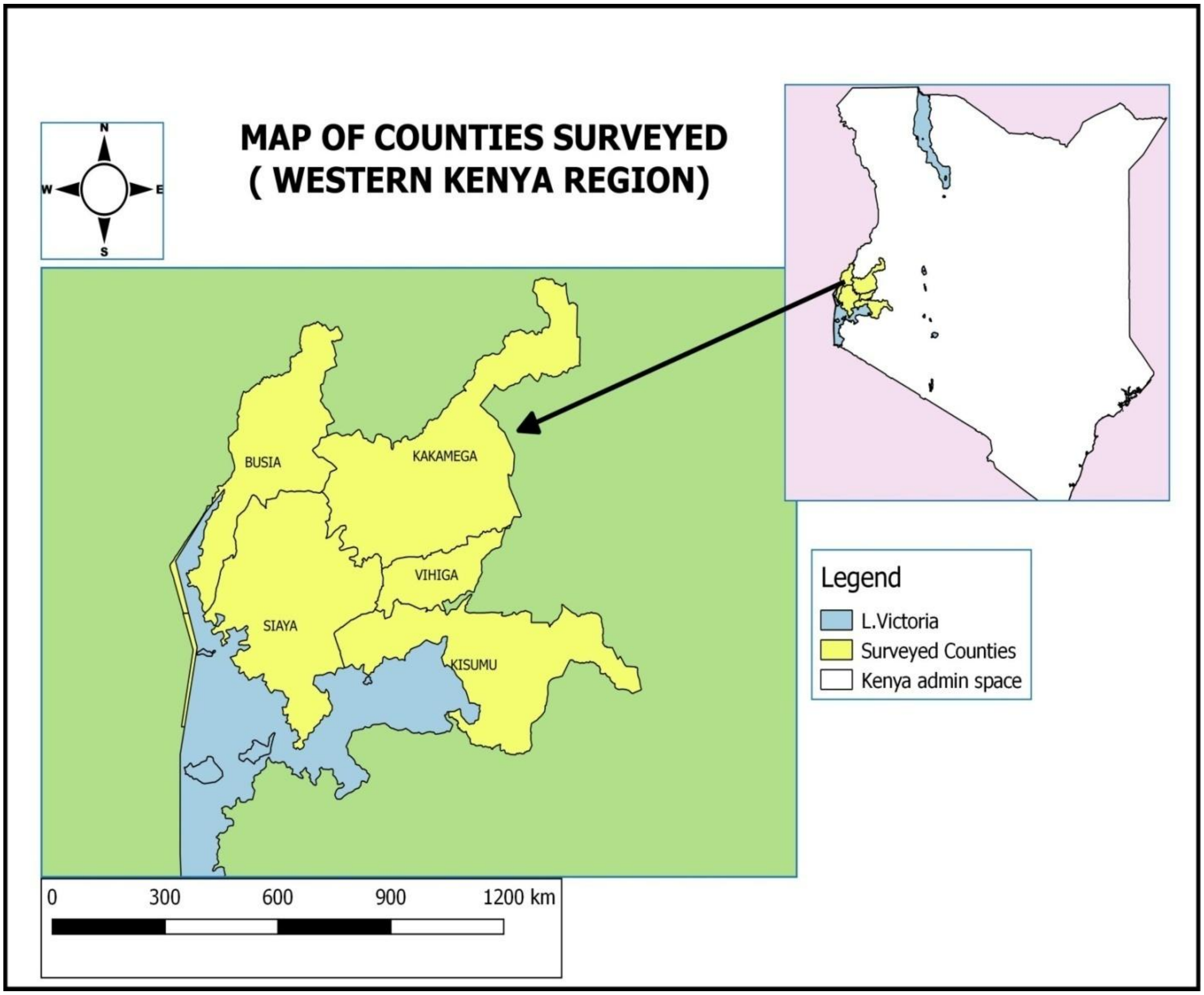


Figure 1. Map of Western Kenya where survey was undertaken.

impact PPT has on FNS factor. This involved analysis of the months of food adequacy for the year 2016 and the production made in same year. Adoption of PPT was a dependent factor in this case. It was also meant to test the hypothetical equation. The study employed a Statistical Packages for Social Sciences software for computation. The output was additionally exported into Microsoft Excel to generate tables and graphs.

RESULTS

Demographic Characteristics

The study registered a higher number of mothers largely involved in farming as the heads. With the 67% of mothers taking the farming initiative (32-PPT, [n=50] and 35-NPPT, [n=50]), attention is drawn on female's role in farming and their empowerment. This is different with the male headship of the farming activities which registered a total of 28% for fathers. Generally, female accrues a percentage of 69% (n=100) that includes mothers and sisters all together. The male lags behind at 31% (n=100). While reviewing the marital status of the farmers, married couples registered a higher percentage at 77% (n=100), single farmers were 5% (n=100), widowed farmers were 18% (n=100) and none was divorced. Finally, the average number of family members per single household of PPT was 7.38 (n=50) while that of NPPT was 7.08 (n=50). The general mean and standard deviation of the demographic analysis was 1.80 and 0.636 respectively. Table 2 below shows the values of the socio-demographic characteristics.

The land sizes were also assessed for a case of variability. PPT had a general mean of 0.2664 acres (n=50), a percentage of 21.7 (n=100) and NPPT had 0.9620 acres (n=50), a percentage of 78.3 (n=100). This reflected a higher variance that required standardization. A fixed model was adopted to fit the variability into a uniformed unit, that is, per unit acre, which would descriptively and equally characterize quantities and amounts of production, consumption, farm

Table 2. Table of the demographic characteristics of the study.

Farming groups	Who heads the farming?						Gender			Marital Status					Averages of family members
	Father	Mother	Brother	Sister	Others	Total	Male	Female	Total	Single	Married	Divorced	Widowed	Total	
PPT	17	32	0	1	0	50	17	33	50	1	40	0	9	50	7.38
NPPT	11	35	3	0	1	50	14	36	50	4	37	0	9	50	7.08
Total	**28**	**67**	**3**	**1**	**1**	**100**	**31**	**69**	**100**	**5**	**77**	**0**	**18**	**100**	**7.23**
N (PPT) = 50, N (NPPT) = 50; Total N = 100; Mean = 1.80; Std Dev = 0.636; Std error of mean = 0.064; % of Total sum = 100%															

Note: Data obtained from analysis of information from the field.

products' sales and amounts used to buy food. Table 3 below shows the plan model.

Households Farm Production

There are higher quantities of production evidenced from the PPT fields. Maize is substantially better in production amongst the PPT plots as it reflects approximately three times of the NPPT plots, that is, 1393Kgs–PPT and 401Kgs–NPPT. The rest of the products portray a same trend with sorghum's production at 556Kgs for PPT and 125Kgs for NPPT, millet at 930Kgs for PPT and 107Kgs for NPPT, fodder at 7163Kgs for PPT and 891Kgs for NPPT, and beans at 122Kgs for PPT and 88Kgs for NPPT for the year of 2016. Graph 1 below shows the production of the farm products for the year of 2016 as described above. (PPT [n] =50 households, NPPT [n] =50 households; X = 1 acre)

Households Consumption

Relatively, the amount of consumption relies on the amount of production from the farm. Maize consumption reflects a higher quantity in PPT than in NPPT (PPT-1215Kgs and NPPT-349Kgs). Sorghum also shows a higher value for PPT (PPT-415Kgs and NPPT-105Kgs). Other farm products also reflect higher quantities of consumption in PPT as is in Graph 2 below. (PPT [n] =50 households, NPPT [n] =50 households)

Production, Consumption and Sales of Households

The summary of production, consumption and sales is in Table 4 below. In the table, the amount of consumption of products produced from the farms is evidently above 50% for both PPT and NPPT. However, beans is majorly consumed due to its less production from the farm compared to the other products, and therefore, it is likely to be consumed more abundantly than to be sold. But the most sold product is fodder at 46.1% for PPT and 18.4% for NPPT. The other products also contribute abundantly to the households in income source with PPT showing higher percentages values.

Households' Sales and Income

Income obtained after the sales of the farm products is quite distinctive among the two groups of households. With the definite contribution of higher production, the sales of these products are made easy and convenient. Maize sales seem to capture more income for the PPT fields compared to any other product (Kshs. 28,152). This might not be necessarily a comparative element to quantity but to the amount of sales per kilogram which differ across the products. In all cases of sales, PPT reflects significant amounts as compared to NPPT as is in Graph 3 below.

Households' Sales and Food Purchases

One of the primary aims of this study was to find out the amount used to buy

Table 1. Table of Means for Land Sizes.

	N	Mean of land size in Acre	Standardized land size in Acre (X)	Aggregate adjustment	Standard Deviation	Standard Error of Mean
PPT	50	0.2664	1	0.7336	0.23299	0.03295
NPPT	50	0.9620	1	0.038	0.78523	0.11105
% of Total Sum	**100%**	**100%**	**100%**			

Note: Data obtained from analysis of information from the field.

Table 2. Table of summary for production, consumption and sales.

	Production		**Consumption**				**Sales**			
	Qty in Kgs		***Qty in Kgs***		***%***		***Qty in Kgs***		***%***	
	PPT n=50	NPPT n=50	PPT n=50	NPPT n=50	PPT n=50	NPPT n=50	PPT n=50	NPPT n=50	PPT n=50	NPPT n=50
Maize	1393	401	1215	349	87.2	87.0	178	52	12.8	13.0
Sorghum	556	125	415	105	74.6	84.0	141	20	25.4	16.0
Millet	930	107	596	93	64.1	86.9	334	14	35.9	13.1
Fodder	7136	891	3844	727	53.9	81.6	3292	164	46.1	18.4
Beans	122	88	119	81	97.5	92.0	3	7	2.5	8.0
Aggregate standard error of mean (PPT = 127.025, NPPT = 52.838)										

Note: Data obtained from analysis of information from the field.

Table 3. Table of varieties of foods bought by the farmers.

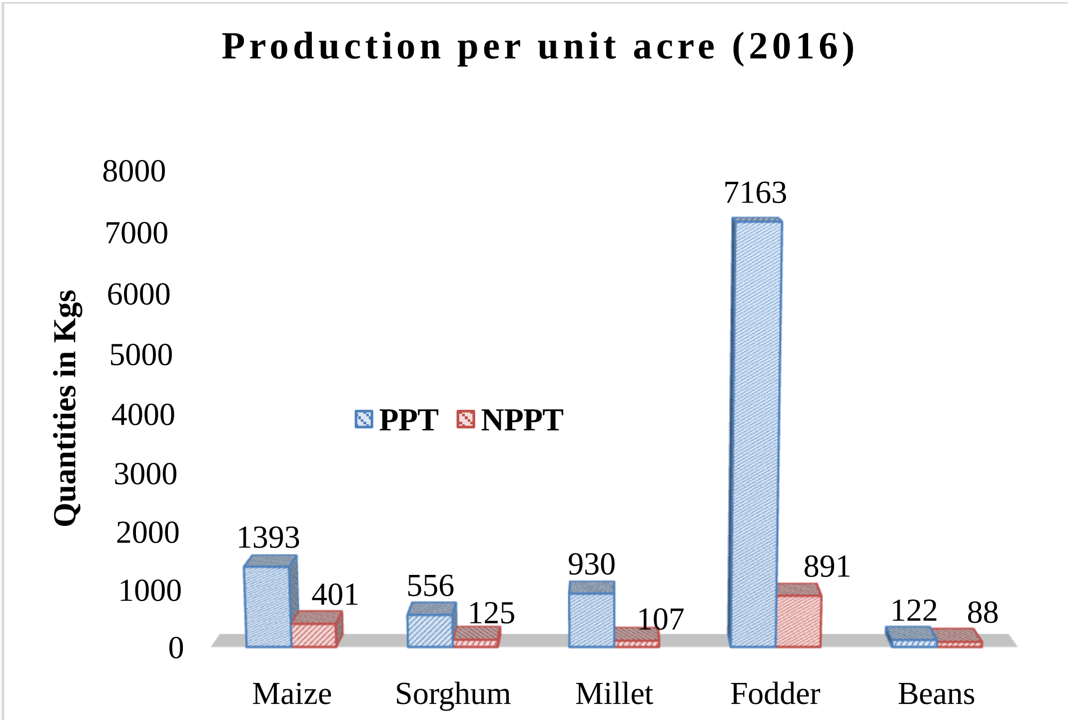
	Carbohydrates	**Proteins**	**Fats/Oil**	**Vitamins & Fibre foods**	**Minerals/Additives**
PPT	Rice, bread, cassava, sweet potatoes, irish potatoes, sugar and milk	Meat, tilapia, nile perch, dagaa, green grams, milk and groundnuts	Cooking oil/fats	Traditional vegetables, kales, cabbage, tomatoes and onions.	Salt, sugar and tea leaves.
NPPT	Wheat, maize, millet, rice, sugar and milk.	Beans, meat, dagaa, nile perch, tilapia and milk.	Cooking oil/fats	Avocado, traditional vegetables, kales, tomatoes and onions	Salt, sugar and tea leaves

Note: Data obtained from analysis of information from the field.

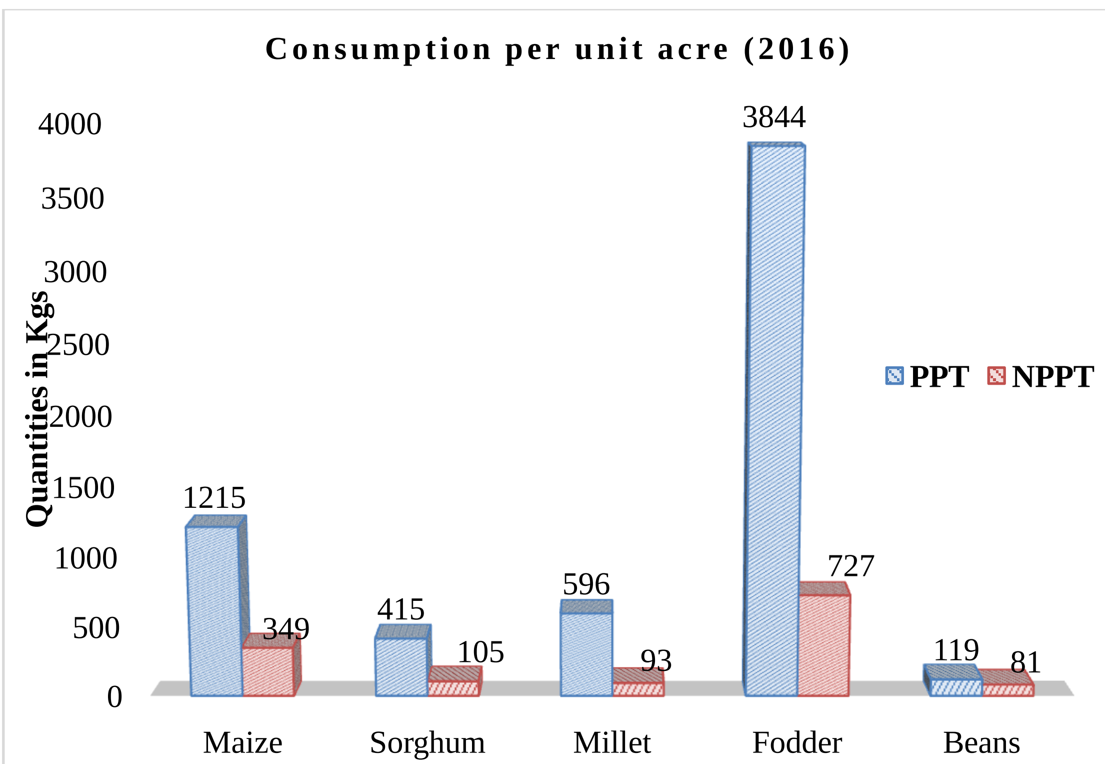
food after selling the products harvested from the farm. As a concern, it was reviewed that the availability of money leads to purchase of food that are not obtained from the farm. The critical contribution to food after the sales of the farm products are portrayed in Graph 4 below. In PPT, fodder seems to contribute a lot from its sales at Kshs. 13,889. Maize follows after fodder at Kshs. 10,556, and sorghum and millet contributes minimally at Kshs. 3,407 and Kshs. 411 respectively. Beans had no contribution made on food purchases. As for the NPPT, amounts used to buy food were significantly low with maize having a greatest contribution at Kshs. 4,667 and millet following at Kshs. 1500. Fodder sales made no contribution to its food purchases.

Food Diversity (Purchases list)

The products obtained from the farms alone may not attain full food diversification. Food diversity can only be attained both directly from the harvests and indirectly through purchase. The indirect connection to diversity of the PPT and NPPT yields is provided through the local foods purchased after the sales of the products. Table 5 below shows the varieties of foods that were bought from the PPT and NPPT yields. It represents an

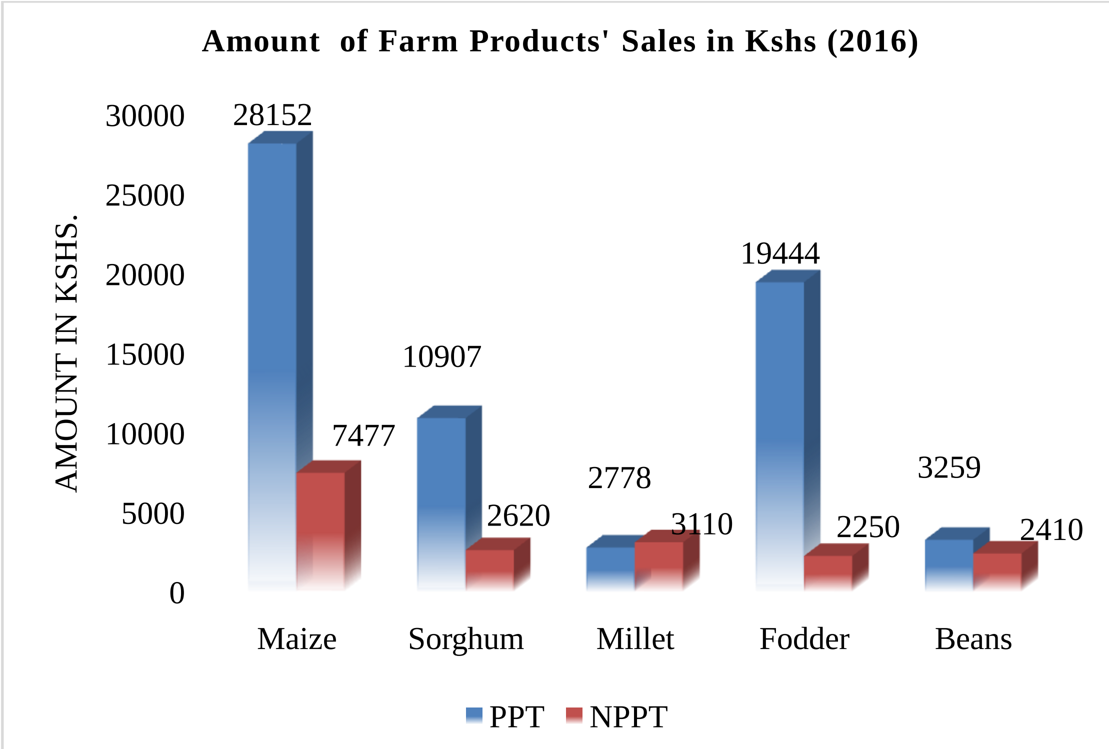


Graph 1. Graph of Production per unit acre for year 2016 (generated from the field data).

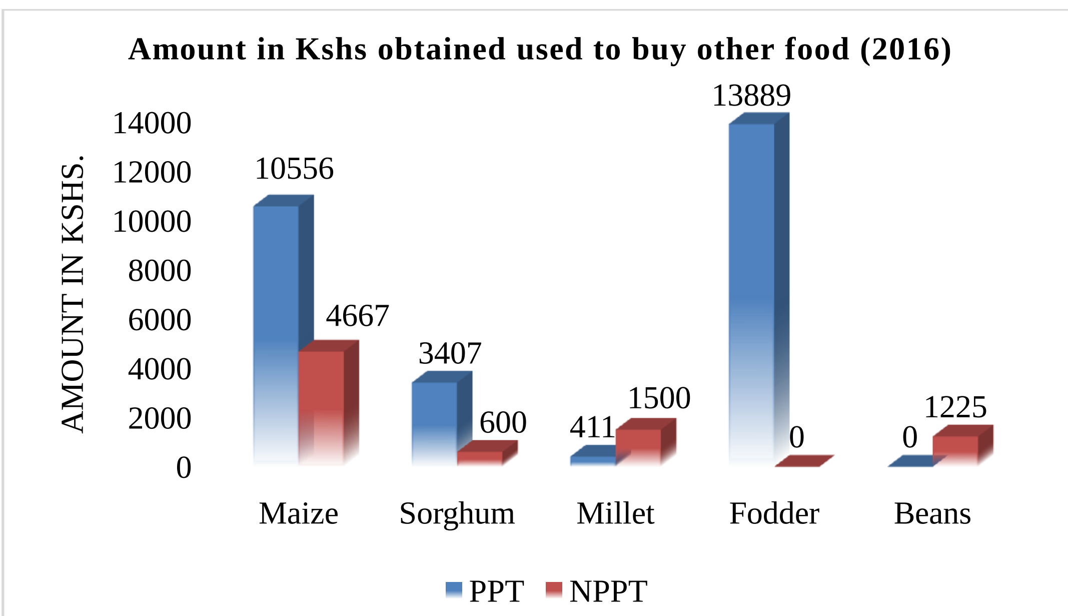


Graph 2. Graph of Consumption per unit acre for year 2016 (generated from the field data).

inclusiveness nature and types of food purchases from both households but with difference in varieties and quantities bought. This study is dependent on household dietary diversity score (next paper) for completeness and tangibility. PPT is however enjoying a variability of food purchases as an advantage above NPPT.



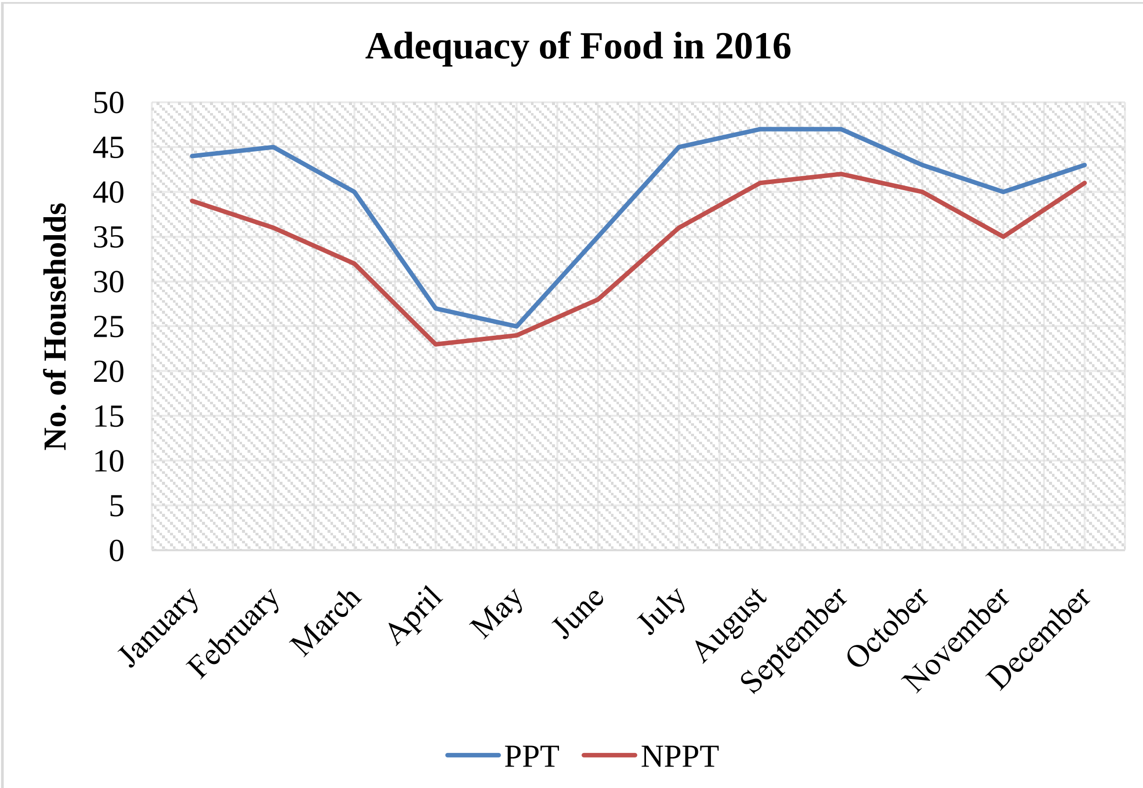
Graph 3. Graph of farm products' sales for year 2016 (generated from the field data).



Graph 4. Graph of money from sales used to buy food (generated from the field data).

Food Adequacy

Food adequacy is the state of sufficiency of food in the households. This does not necessarily mean the abundance or excellence or more than what is absolutely necessary. The two groups of households portray a conspicuous trend of levels of food adequacy. Each group had 50 households, and so, the monthly featured number of households in Graph 5 below indicates a number that was food sufficient out of the



Graph 5. Graph of food adequacy from January to December, 2016 (generated from the field data).

total 50 households per group. PPT households seemed much more stable in food adequacy than NPPT households with its line graph dominantly above the NPPT's. Its peak months of adequacy are evidently August and September which registered 47 households (n=50) for both months while NPPT's had the same peak months at 41 and 42 households (n=50) respectively.

DISCUSSION

Push-pull agriculture is an intervention with several statistical parameters which factors into FNS either directly or indirectly. The principles of the push-pull strategy are to maximize control efficacy, efficiency, sustainability, and output, while minimizing negative environmental effects (Khan and Pickett, 2004). Each individual component of the strategy is usually not as effective as a broad-spectrum insecticide at reducing pest numbers. However, efficacies are increased through tandem deployment of push and pull components (Duraimurugan, 2005; Martel et al., 2005; and Nalyanya et al., 2000).

Firstly, this study appreciates the role of women venturing much into farming. Women give an upper hand to household food and nutrition intervention owing to the fact that women understand food and nutrition issues better than men. FAO (2011) states that agricultural interventions that involve women (who often are more concerned than men with family health and food consumption) are more likely to lead to an improved translation of household income increases into improved household food security. This is evidenced in PPT's adoption where females are seen maximally reaping from their fields. That eventually increases the household consumption and enhances income to achieve FNS directly.

Furthermore, the averages of family members per household show that PPT have more mouths to feed. Food security cycles around everybody in the household and its major determinant is the presence of the members sharing in the family's meals (majorly children). Research by USDA (2016) states that, the food security survey is designed to measure the food security status at the household level. And while it is informative to examine the number of persons residing in food-insecure households, these statistics should be interpreted carefully.

This study has revealed that even with more mouths to feed, PPT can still sustain other chains of household demands to reaching the ultimate goal of nutrition through selling the farm products and buying other foods lacking in the household for diversification. Acceptable level of food security is when food is available and accessible (firstly). PPT farmers are no less into this transaction as they make food highly available through the much enhanced production and accessible through reaching out to markets for other foods with the cash they obtain after selling their percentage of stock produced from the farm. The utmost attainment of this chain is an improved nutritional consumption or diet diversification.

There is distinctive evidence in graphs 1, 2, 3 and 4, that PPT has an enormous contribution in production, consumption, income from sales of the farm products and income used to buy food. Most importantly, production by the PPT fields shows very high contrast with their level of quantities for maize, sorghum, millet, fodder and beans against NPPT. Consumption imitates from the same trend to verify that the higher the production is, the higher the household consumption will be.

The quantity of production is highly proportional to the income level of the household just as it is with consumption. If production is higher as in the case of PPT, consumption and sales is likely to be higher as observed in Table 4. Sale is another form of income just before it is incorporated into the household budgets for other demands. Babatunde (2009) hypothesized that off-farm income contributes to better nutrition in terms of calorie and micronutrient supply and child anthropometry. But in sameness, all incomes; off-farm and on-farm, contribute largely to the better nutrition. For instance, the income obtained after selling maize can be used for paying school fees, purchasing clothes, paying other bills as well as buying other unavailable foods. But dominantly, this study was more concerned on which food and what amount would the income from the sales of farm products be used to buy. The general outcome is, varieties of foods were bought in return for extended household consumption – a food diversity attainment, that is, foods other than what farmers obtained from the farm (Table 5). Another research paper will mention out other elements of nutritional assessment of PPT farmers beyond variety of foods obtained. Their utilization to enhance nutritional status would make a complete study of this FNS study by PPT.

Further, the months of food adequacy avails much to food security assessment (Alisha et al., 2016). PPT is dominantly higher across the months of 2016 with an average food adequacy of 9.62 out of the 12 months. NPPT seems to have lower average due to lesser households attaining the food adequacy level compared to PPT. It registers an average of 8.34 out of the 12 months. The level of food adequacy across 2016 gives substance to drawing unbiased conclusion about PPT and its involvement to achieve food security. PPT is averagely better in sustaining households across the year owing to the fact that over half (better number than those of NPPT) of its population was food secure throughout 2016.

Regression

In the regression model below, the co-efficient of determination is 0.9162; therefore, about 91.62% of the variation in the PPT's data is explained by the months of food adequacy. The regression equation appears to be very useful for making predictions since the value r2 is close to 1. Where p-value = 0.00187; ≤ 0.05, the null hypothesis is rejected. In this case, there exists enough evidence to conclude that the slope of PPT's regression line is not zero, and hence, months of food adequacy as a predictor of food security is ascertained.

CONCLUSION

This study was undertaken to determine the attribution that PPT makes on FNS of the households. Many significant signs in production, consumption and sales of products have outlaid a positivity of PPT in enhancing security of food and nutrition. The set of combination study between PPT and NPPT variables deduced reliability on PPT. PPT is substantial and the likely intervention for food insecurity challenges.

The definite approaches of PPT are a chain. Each level of PPT is impact-oriented. The normal setting of a PPT plot acquires an optimal effort and resources. Afterwards, yields are reaped sufficiently (production is high) and the household consumption of the harvested products increases. Furthermore, the farmers are able and willing to market their products for cash. This transforms the process to an improved income. A high income facilitates the households' activities which include making payments for school fees, health services and other bills. But a purchase of concern for this study is other foods. The variability of foods purchased is an entry to food diversification which attributes to a nutritional fulfillment. And PPT achieves this in a long chain of productivity where indicated tracks reflect positivity.

It is therefore mandatory to conclude that the parametric test for attributes of PPT on FNS is certain, and that this intervention is a problem-solver to numerous households experiencing food insecurity challenges and insufficient knowledge on nutritional values. However, this study is giving way to further nutrition determination aspects of PPT that surges beyond just variety of foods bought but to the basics of household energy consumption and anthropometric measurements and their interpretations.

RECOMMENDATION

This study recommends a way forward to finding out the basic interventions such as home gardening which can be collaborated to this noble technology (PPT) to boost production to an even higher production.

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Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.9679[a]	.9162	.8942	1394.491

a. Predictors: (Constant), Food Adequacy in 2016

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2272.758	1	2272.335	91.387	.00187***
	Residual	201.241	10	201.241		
	Total	2474.000	11			

a. Dependent Variable: PPT or NPPT farmer (FNS)

b. Predictors: (Constant), Food Adequacy in 2016

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.710	.332		2.138	.035
	Food Adequacy in 2016	.181917	.202167	.143583	6.836	0.041033***

a. Dependent Variable: PPT or NPPT farmer (FNS)