Research Article

The Impact of RTEP Technology Adoption on Food Security Status of Cassava-Farming Households in Southwest, Nigeria

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Adoption of yield increasing technologies among farming households is one way of improving food insecurity. This study assessed the impact of Root and Tuber Expansion Programme (RTEP) improved production technology on the food security status of cassava-based farming households in Southwest, Nigeria. The data for the study were collected with the aid of structured questionnaire through a multistage sampling technique. A total of 540 households were sampled comprising RTEP beneficiaries (RTEP), Non-RTEP beneficiaries within RTEP LGAs (NRTEPW) and Non-RTEP beneficiaries living outside RTEP LGAs (NRTEPO). The data were analyzed using Propensity Score Matching, descriptive statistics and Foster-Greer-Thorbecke model. There were 387 households with similar characteristics were used for analysis in the study. The mean per capita household food expenditure (MPCHHE) was ₦172726.53 while the food insecurity line was ₦20132.22 per annum. The food insecurity incidence of RTEP was lower than that of the non-beneficiaries, this reveals that RTEP improved production technology has the potential to improve food security. The FGT food insecurity indices of the beneficiaries declined due to participation in the programme. The food insecurity incidence reduced by 16.27%, 12.02% and 21.54% when compared with ANRTEP, NRTEPW and NRTEPO respectively. This suggests that the cassava production technology promoted under the programme is food insecurity reducing, therefore, there should be further sensitization on this technology to improve food security.
INTRODUCTION

The adoption of improved agricultural technologies is a tool needed to improve agricultural productivity which serves as the key to global food security. In Nigeria, despite projects, programmes and policies targeted at reducing the problem of food insecurity, the country ranked 18th on the Global Hunger Index (GHI) of 81 countries with a GHI of 15.5 indicating a serious hunger situation (IFPRI, 2011; UNDP, 2011). The level of food insecurity in the country continued to rise steadily since the 1980s. It rose from 18% in 1986 to 41% in 2004 and stood at 65% in 2009 (Sanusi et al, 2006; Davies, 2009).

Food insecurity is predominant in the rural areas where the main occupation is farming. 48.3% of the rural households are described food poor compared to 26.7% in the urban areas (NBS, 2010). Nigeria focuses on sustainable agriculture and rural development as a means of reducing rural food insecurity. However, Agricultural growth and development is not possible without yield-enhancing technological options because merely expanding the area under cultivation (except in a few places) to meet the increasing food needs of growing populations is no longer sufficient. Thus, research and adoption of technological improvement are crucial to increasing agricultural productivity and food security (IFAD, 2011). Agricultural productivity particularly in poor countries is the key to global food security and fight against poverty (Braun et al, 2008). Therefore, the resulting gains in greater food security will depend in part on an integrated set of research outputs which include high yielding and pest resistant varieties, improved crop management, processing equipments and procedures as well as improved policies that facilitate the development and adoption of these innovations (Nweke, 1992).

It is interesting to note that many of the developing world’s most food insecure households depend on root and tuber crops as a contributing if not the principal sources of food, nutrition and income (Alexandratos, 1995). The Root and Tuber Expansion Programme (RTEP) whose improved technology adoption was assessed in this study was among several agricultural programmes targeted towards improving food security in Nigeria. The programme was designed to consolidate the gains made under the Cassava Multiplication Programme (CMP). The implementation of the project commenced in July, 2001 with the goal of increasing income, alleviating poverty and improving food security status of the farmers with less than 2.0 hectares of land, growing and processing cassava, yam, cocoyam, Irish and sweet potato in the project area.

This study contributes to the scanty literature that exists on the impact of RTEP in Nigeria. The few studies on RTEP (Ater et al, 2006; Ibrahim and Onuk, 2010; Tijani and Thomas, 2010; Olujide and Leoto, 2010) were on the impact of the programme on productivity and Ater et al (2006) was on poverty. However, none has assessed the impact on food security. Also, these studies have assessed the outcomes of the programme using only data from participants and by employing descriptive and inferential statistics which prevented them from getting the counterfactual outcomes, that is, the outcomes of the participant if he had not participated in the project. This study on the other hand, used propensity score matching (PSM) to address the evaluation problem and employed the counterfactual outcome framework to show the impact of the outcome defined in the modern policy evaluation literature as the average effect of the treatment on the treated (ATT) which helps to reduce biased estimates. It pursues a targeted evaluation of whether adopting RTEP improved technology causes resource-poor farmers to improve their income and decrease the propensity to fall below the food insecurity line. Therefore, this study assessed the impact of RTEP production technology adoption on food security status of cassava-based farming households in Southwest, Nigeria.

OBJECTIVES OF THE STUDY

The main objective of the study is to evaluate the impact of RTEP production technology on food security among cassava-based farming households in southwest, Nigeria. Specific objectives are to: (1) examine the socio-economic characteristics of cassava-based farming households in the study area (2) determine the food insecurity status of cassava-based farming households in the study area (3) examine the impact of RTEP production technology on food security among cassava-based farming households in the study area.

METHODOLOGY

The study Area

The study was carried out in Southwest, Nigeria. South west is one of the six geopolitical zones in Nigeria. It falls on latitude 6° to the North and latitude 4° to the South while it is marked by longitude 4° to the West and 6° to the East. It is bounded in the North by Kogi and Kwara States, in the East by Edo and Delta States, in the South by Atlantic Ocean and in the West by Republic of Benin. The climate is equatorial with distinct wet (rainy) and dry seasons with relatively high humidity. The mean annual rainfall is 1480mm with a mean monthly temperature range of 18°C–24°C during the rainy season and 30°C–35°C in the dry season. Southwest Nigeria covers approximately an area of 114,271 kilometer square that is approximately 12 percent of Nigeria’s total land mass and the vegetation is typically rainforest. The total population is 27,581,992 as at 2006 and the people are predominantly farmers. The climate in the zone favours
the cultivation of crops like maize, yam, cassava, millet, rice, plantain, cocoa, kola nut, coffee, palm produce, cashew etc (NPC, 2006). The zone comprises of six states namely: Ekiti, Lagos, Ogun, Ondo, Osun and Oyo states.

**Sampling and Data Collection Procedure**

Primary data was collected for the purpose of this study using structured questionnaire. Some of the data include: socio-economic and demographic characteristics, participation in RTEP productive activities, cassava production, RTEP cassava production technology, and household food expenditure details. The list of the RTEP participating LGAs and communities were collected from ADP and other relevant information were retrieved from RTEP programme implementation manual (PIM).

Multistage sampling technique was employed in this study. The first stage was the random selection of Ondo and Ogun states from the RTEP participating states in Southwest, Nigeria. The second stage involved the random selection of two RTEP participating and Non-RTEP participating LGAs from each state while in the third stage, three communities were randomly selected from each LGA. This resulted to 24 communities in the two states. The final stage involved a random selection of 30 households from each of the RTEP communities selected (comprising of beneficiaries and non-beneficiaries) and 15 households from each of the selected Non-RTEP communities resulting to a total of 540 respondents. However, a total of 482 were retrieved and completely filled from the field.

The analytical techniques used in this study includes: propensity score matching (PSM) descriptive statistics and Foster- Greer- Thorbecke (FGT) model.

Propensity Score Matching, one of the most commonly used quasi-experimental methods was used to address the evaluation problem (Mendola, 2007; Nkonya et al., 2007; Akinlade et al., 2011). The sample collected was matched using PSM; the aim of PSM is to find the comparison group from a sample of non-participants that is closest to the sample of programme participants so as to get the impact of the project on the beneficiaries. Though, the beneficiary and comparison groups may differ in unobservable characteristics even if they are matched in terms of observable characteristics, however, it has been put forward that selection on unobservable is empirically less important in accounting for evaluation bias (Baker, 2000). Also in a situation where the same questionnaire is administered to both groups (so that outcomes and personal characteristics are measured in the same way for both groups) and the participants and controls are placed in a common economic environment (such as the case in this study), matching substantially reduce bias (Heckman et al., 1996).

Main steps involved in the application of statistical matching to impact evaluation are: estimating the propensity score, matching the unit using the propensity score, assessing the quality of the match and estimating the impact and its standard error.

Out of 482, only 387 beneficiaries and non-beneficiaries that had comparable propensity scores were matched which includes 157 RTEP participants (RTEP), 123 Non-participants within RTEP LGAs (NRTEPW) and 107 Non-participants outside RTEP LGAs (NRTEPO). After matching, the testing of comparability of the selected groups was done and the result shows statistically insignificant difference in the explanatory variables used in the probit models between the matched groups of RTEP participants and non-participants.

Since the match has been deemed of good quality, this study then used the matched sample to compute the Average Treatment Effect for the Treated (ATT) to determine impact of the programme. This is defined by Rosembaum and Rubin (1983) as follows:

$$E\{Y^1 - Y^0 / D = 1\} = E\{Y^1 / D = 1\} - E\{Y^0 / D = 1\}$$  \hspace{1cm} (1)$$

where, \(E\{Y^1 / D = 1\}\) is the observed outcome of the treated, that is, the expected income earned by programme beneficiaries while participating in the programme and \(E\{Y^0 / D = 1\}\) is the counterfactual outcome - the expected income they would have received if they had not participated in the project. The counterfactual outcome represents outcome of the non-beneficiaries since they have similar characteristics with beneficiaries. Standard errors were computed using bootstrapping method suggested by Lechner (2002) to generate robust standard errors in light of the fact that the matching procedure matches control households to treatment households with replacement.

Changes in food insecurity of RTEP and Non-RTEP households were achieved by using Foster, Greer and Thorbecke- FGT (1984) model, households' expenditure on food per capita equivalent was used to determine households' food insecurity status (Omonona and Agoi, 2007).

This is defined as:
\[ P_\alpha = \frac{1}{N} \sum_{i=1}^{q} Gi \]  
\[ (12) \]

Where,
\[ Gi = \left[ \frac{Z - Y_i}{Z} \right] \]  
food expenditure deficiency of household \( i \)

Head count ratio (H) = \( q/N \)

\( Z \) = food security line (2/3 mean per adult equivalent food expenditure)
\( q \) = the number of households below the food security line,
\( N \) = the total number of households in the total population,
\( Y_i \) = the per capita equivalent food expenditure of household \( i \),
\( \alpha \) = the degree of food insecurity aversion; \( \alpha = 0 \) measures the incidence of insecurity. \( \alpha = 1 \) measures the depth of food insecurity. \( \alpha = 2 \) measure the severity of food insecurity.

RESULTS AND DISCUSSION

3.1 Distribution of Respondents by Socio-economic Characteristics

Table 1 shows the distribution of the respondents by socio-economic characteristics across the three types of respondents considered which are: RTEP beneficiaries (RTEP), Non-RTEP beneficiaries within RTEP LGAs (NRTEPW) and Non-RTEP beneficiaries outside the RTEP LGAs (NRTEPO). The average values of their socio-economic characteristics are within the same range due to propensity score matching (PSM) used in selecting the respondents with similar observable characteristics. The male respondents constitute the larger percentage across the three types of respondents with RTEP beneficiaries having 74.63% which shows that more males were involved in the programme. The average household size was 6 for RTEP, all NON RTEP beneficiaries (ANRTEP) and NRTEPO while the household size for NRTEPW was 5. The majority of the respondents have their household sizes falling within the range of 5 to 9 people, with the average age of the respondents being 44 and 45 for RTEP and NRTEP respectively. Implicit in these findings is that a large proportion of the respondents were middle aged and can therefore be regarded as active, agile and with more energy to dissipate and concentrate on productive effort. The average years of experience in cassava farming was 16 years for all respondents. The average area of land cultivated was about 1 hectare for all the respondents. Accessibility to credit facility and participation in off-farm activity was higher among RTEP beneficiaries compared to non-beneficiaries.
Table 1: Distribution of Respondents by Socio-economic characteristics

| Characteristics          | Categories/Statistics | RTEP Percentage | ANRTEP Percentage | NRTEPW Percentage | NRTEPO Percentage |
|--------------------------|-----------------------|-----------------|-------------------|-------------------|-------------------|
| Gender                   | Female                | 24.37           | 22.17             | 17.07             | 28.04             |
|                          | Male                  | 74.63           | 77.83             | 82.93             | 71.96             |
|                          | Total                 | 100             | 100               | 100               | 100               |
| Household size           | 0-4                   | 16.25           | 26.09             | 30.89             | 20.56             |
|                          | 5-9                   | 77              | 68.26             | 63.41             | 73.83             |
|                          | >9                    | 6.75            | 5.65              | 5.70              | 5.61              |
|                          | Total                 | 157             | 230               | 123               | 107               |
|                          | Mean                  | 6               | 6                 | 5                 | 6                 |
|                          | SD                    | 1.9942          | 1.9576            | 1.96              | 1.91              |
| Age                      | ≤30                   | 13.12           | 6.09              | 10.57             | 9.36              |
|                          | 31-40                 | 30.25           | 26.09             | 34.96             | 15.89             |
|                          | 41-50                 | 35.63           | 36.95             | 34.96             | 39.25             |
|                          | >50                   | 21              | 30.87             | 19.51             | 34.50             |
|                          | Total                 | 157             | 230               | 123               | 107               |
|                          | Mean                  | 44.2685         | 45.1913           | 45.07             | 44.97             |
|                          | SD                    | 10.1317         | 10.7219           | 10.99             | 10.84             |
| Level of education       | No formal             | 35.67           | 26.09             | 25.20             | 17.11             |
|                          | Primary               | 51.59           | 36.52             | 40.65             | 31.78             |
|                          | Secondary             | 12.74           | 37.39             | 34.15             | 41.12             |
| Credit access            | Yes                   | 82.50           | 48.26             | 54.47             | 50.47             |
|                          | No                    | 17.50           | 51.74             | 45.53             | 49.53             |
| Area of land cultivated( ha) | ≤0.5                 | 26.75           | 22.17             | 22.76             | 14.95             |
|                          | 0.6-1.0               | 64.33           | 50.00             | 54.47             | 53.93             |
|                          | 1.1-1.5               | 8.92            | 28.63             | 22.76             | 31.12             |
|                          | Total                 | 157             | 230               | 123               | 107               |
|                          | Mean                  | 0.98            | 1.01              | 1.03              | 1.01              |
|                          | SD                    | 0.35            | 0.56              | 0.47              | 0.59              |
| Off-farm activity        | Yes                   | 73.13           | 67.78             | 68.67             | 66.88             |
|                          | No                    | 26.87           | 32.22             | 31.33             | 33.12             |

Source: Field Survey, 2011
RTEP beneficiaries (RTEP), All Non-RTEP beneficiaries (ANRTEP), Non-RTEP beneficiaries within RTEP LGAs (NRTEPW), Non-RTEP beneficiaries outside RTEP LGAs (NRTEPO).

Food Insecurity Status of RTEP and Non-RTEP Households

This section focuses on household expenditure on food items, the estimation of food insecurity line and the impact of RTEP improved production technology on the food security status of cassava farming households.

From Table 2, the estimated annual household expenditure on food consumed was ₦172726.53 while the mean per capita household food expenditure (MPCHHFE) was ₦30198.34. The food insecurity line was computed for respondents using the two-thirds MPCHHFE, the food insecurity line was ₦20132.22 per annum.
Table 2: Annual Household Food Expenditure Profile

| Item                                             | Average annual expenditure |
|--------------------------------------------------|----------------------------|
| Food Mean per capital household food expenditure (MPCHHFE) | 172726.53                  |
| Food insecurity line (2/3 MPCHHFE)               | 30198.34                   |
| Food insecurity line                             | 20132.22                   |

Source: Field Survey, 2011

Food Insecurity Status and Impact on Respondents

Based on the food insecurity line, 51.25% of cassava farming households that are beneficiaries of RTEP live below the food insecurity line (food insecure) (Table 3). The food insecurity incidence of RTEPB was lower than that of the non-beneficiaries, this reveals that RTEP improved production technology has the potential to improve food security. The food insecurity incidence was 0.5125 for RTEP beneficiaries compared to 0.5959, 0.5741 and 0.6229 for ANRTEPB, NRTEPBW and NRTEPBO respectively. The food insecurity gap and severity shows that the non-beneficiaries are farther away from the food insecurity line and that food insecurity is more severe among them compared with the beneficiaries.

Furthermore, the table reveals the impact of the RTEP improved production technology on the food insecurity incidence, depth and severity of beneficiaries. The food insecurity incidence of RTEP reduced by 16.27%, 12.02% and 21.54% when compared with ANRTEPB, NRTEPBW and NRTEPBO respectively. Due to spillover effect of the programme, the impact was deeper on FGT food insecurity indices of RTEP when compared with the NRTEPBO than when compared with NRTEPBW. The result also shows that food insecurity gap and the severity of food insecurity indices dropped when compared with non-beneficiaries. The food insecurity gap of RTEPB dropped by 25.11%, 22.56% and 45.69% while the food insecurity severity reduced by 33.06%, 31.69% and 50.82% when compared with ANRTEPB, NRTEPBW and NRTEPBO respectively.

Table 3: Food Insecurity Status and Impact on Respondents

| Type of Respondents | Statistics | Food insecurity | ATT | Impact (%) |
|---------------------|------------|-----------------|-----|------------|
| RTEPB               | F0         | 0.5125          |     |            |
|                     | F1         | 0.1414          |     |            |
|                     | F2         | 0.0366          |     |            |
| ANRTEPB             | F0         | 0.5959          |     | -16.27     |
|                     | F1         | 0.1653          | -0.0355 | -25.11    |
|                     | F2         | 0.0448          | -0.0121 | -33.06    |
| NRTEPBW             | F0         | 0.5741          |     | -12.02     |
|                     | F1         | 0.1615          | -0.0359 | -22.56    |
|                     | F2         | 0.0444          | -0.0116 | -31.69    |
| NRTEPBO             | F0         | 0.6229          |     | -21.54     |
|                     | F1         | 0.1696          | -0.0546 | -45.69    |
|                     | F2         | 0.0456          | -0.0186 | -50.82    |

Source: Field Survey, 2011

CONCLUSION AND RECOMMENDATION

This study assessed the impact of RTEP improved production technology among cassava-based farming households in Southwest, Nigeria. The food insecurity incidence of RTEPB was lower than that of the non-beneficiaries, this reveals that RTEP improved production technology has the potential to improve food security. The food insecurity indices of the beneficiaries declined due to participation in the programme, this indicates that the technology has impacted food insecurity negatively suggesting that the technology promoted under this programme is good enough for improving food security. Hence, there should be further sensitization on this technology to improve food security in the nation. The programme should also be reorganized in the second phase to maximize its food
insecurity decreasing potentials in order to enhance performance.

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