Promoting the Adoption of Innovations through Participatory Approaches: Example from Northern Nigeria

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Summary

Participatory research and development approaches involving all stakeholders along the value chain have recently been hypothesized to produce quicker outcomes than the linear technology transfer model. This paper analyzed the crop yield obtained by farmers and their uptake of improved technologies in a 2009 survey, one year after the completion of project field activities. It was a multi-stakeholder project involving research, extension, farmer groups, marketers and policymakers, that operated for 4 years (2005-2008) in Borno state of Nigeria. Survey results indicated that farmers who participated in project activities' have been successful in increasing crop yields. Both yields and per capita production of major crops were statistically significantly higher ($\rho \leq 0.05$) in project communities compared to non-project ones. It is also estimated that there was a decline in percentage of households in food insecurity situation in project communities. Probit regression revealed that participation in project activities had a positive and significant effect on household food security ($\rho \leq 0.05$). It is then concluded that development interventions that involve multiple stakeholder partnership, use of participatory research and extension approach can help increase technology uptake among resource-poor farmers as well as increase food production and food security in a region.

Résumé

Approche participative pour la promotion de l'adoption des innovations: cas du nord du Nigeria

Les approches participatives de recherche et développement impliquant tous les acteurs le long de la chaîne de valeur sont supposées produire des résultats beaucoup plus rapidement que le modèle linéaire de transfert de technologie. Cet article a analysé les rendements des producteurs et leur adoption de technologies améliorées à travers les résultats d'une enquête en 2009 dans la zone d'un projet, un an après l'achèvement des activités de terrain. C'était un projet à multiple acteurs impliquant la recherche, la vulgarisation, les groupes d'agriculteurs, les commerçants et les décideurs, qui ont fonctionné pendant 4 ans (2005-2008) dans l'Etat de Borno au Nigeria. Les résultats ont indiqué que les agriculteurs qui ont participé aux activités du projet ont réussi à augmenter les rendements des cultures. Les rendements et la production par habitant des principales cultures étaient significativement plus élevés ($\rho \leq 0,05$) dans les villages du projet par rapport à ceux qui n'étaient pas liés au projet. Il est également estimé qu'il y avait une baisse du pourcentage de ménages en situation d'insécurité alimentaire dans les communautés ayant travaillé avec le projet. Les résultats du modèle de régression, Probit, ont révélé que la participation aux activités du projet a eu un effet positif et significatif sur la sécurité alimentaire des ménages ($\rho \leq 0,05$). On a alors conclu que les interventions de recherche-développement qui impliquent un partenariat à multiple acteurs et l'utilisation d'une approche participative de recherche-vulgarisation peuvent aider à augmenter l'adoption des technologies chez les producteurs pauvres ainsi que l'augmentation de la production alimentaire et la sécurité alimentaire dans une région.

Introduction

Agricultural development interventions in rural Africa were based for several decades on telling farmers and communities what to do and what technologies to adopt by researchers and institutions that had not bothered to understand their most important needs (8). This top-down and linear transfer of technology model has failed to yield desirable outcomes in technology uptakes and productivity enhancement among smallholder farmers in sub-Saharan Africa (4). However, in recent years, participatory research and

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development approaches involving all stakeholders along the technology development value chain have been hypothesized to lead to quicker outcomes compared to the linear model of technology transfer and other conventional approaches (10).

The participatory research and development approach brings together elements of the transfer of technology model (13) and the farmer first model (3) to provide a more holistic approach that is assumed to enhance speedy achievement of desirable research outcomes in the rate of technology adoption and agricultural productivity enhancement. The use of participatory approaches in agricultural development is assumed to offer far-reaching benefits to all stakeholders in agricultural research and development, and some authors have even argued that the approach fosters greater efficiency and effectiveness of research investment and contributes to a process of empowerment of rural farmers (5).

Drawing example from a multi-stakeholder project that was implemented in Borno State, Nigeria from 2005 to 2008, this paper contributes to the discussions on the relevance of the use of participatory approaches to promote the development and dissemination of pro-poor agricultural technologies among resource poor farmers in sub-Saharan Africa. The remaining part of the paper discusses details on the Borno State's participatory research and extension approach, materials and methods for the collection and analysis of the case study data, and a result and discussion section on outcomes from the multi-stakeholder projects.

Overview of the Borno state's participatory research and extension approach

The specific objectives of the project were to contribute to improved and sustainable agricultural production through the transfer of improved agricultural technologies and management practices to both male and female farmers. The project used an approach which was termed 'innovations systems approach'. The innovation systems approach followed the work of Barnett (2). It aims to better integrate the supply 'push' of research and the demand 'pull' of farmers, improving the flow of information between the two by strengthening the capacity of partners in the public sector, private sector and civil society to work together to achieve project objectives. The innovations systems' approach attempted to enhance the capacity of potential adopters to source, evaluate and apply information in adoption decision-making. The fulcrum of the model includes an attempt to do less of farmers' teaching, discourage single ownership of research products by researchers, and eliminates the inflexibility that characterizes the linear and top-down transfer of technology model.

Central to this approach was the development of strong partnerships to build "innovation platforms" that was comprised of the key partners to address constraints and needs identified by communities in the project area. Partners included the International Institute of Tropical Agriculture (IITA), Ibadan; the International Livestock Research Institute (ILRI), Addis Ababa; the University of Maiduguri (UNIMAID), Nigeria; the Borno State Agricultural Development Programme (BOSADP), Nigeria; and Community Research Empowerment for Development (CRED) which is a non-governmental organization. There was also the recognition of the role of farmers, their needs and abilities as being important to any intervention. This involved a facilitation process linking researchers, extension workers and farmer groups allowing farmers to prioritize their own problems; select alternative strategies to overcome these and importantly learn by doing. There was also the strengthening of both existing and newly formed community based organizations. This was undertaken though training of male and female farmer groups in organizational development to improve group cohesion, leadership, communication and importantly technical training associated with new technologies.

Materials and methods

Project implementation covered 30 communities. Data were collected from 20 randomly selected communities spread across the four LGAs in the project area, 16 of the communities were selected from the 30 communities where the project has been directly promoting improved crop technologies and better crop management practices since 2004. The remaining four communities, although within the four project LGAs, are not among the 30 project communities that were earlier identified and selected for project implementation activities. In each selected community, a random sample of 30 households was selected, which gave a total of 600 sample households (480 households in project communities and 120 households in non-project communities). The main instrument for data collection was a structured questionnaire administered on households by trained enumerators. A combination of analytical tools was employed in analysis of data. These included descriptive statistics, Cost of Calorie (CoC) food security status estimation and Probit regression techniques. The study used cost-of-calories (COC) method proposed by Greer and Thorbecke to determine a food insecurity line (7).

Results and discussion

Adoption of improved varieties

Introduction of improved crop varieties through participatory approaches was a key project output in the project implementation communities. The project focussed on four major crops, these are maize, soybean, cowpea and rice. Independent adoption studies were carried out to examine the rate of adoption of the various crops. Findings from these

studies revealed that the adoption rate for improved maize was 53% (11); soybean, 97% (9) and cowpea, 64% (6). A detailed impact study carried out in 2009 revealed that the adoption of the improved crop varieties by farmers had socioeconomic impacts on other spheres of their livelihoods such as improved crop productivity, food consumption patterns and household food security. Details on these impact areas are discussed below.

Crop productivity and food consumption patterns

Concerning per capita crop production and food consumption, significant differences existed between the project and non-project communities. Averagely, the households in the project communities produced more grains per capita for all crops except millet, which was not promoted by project (Figure 1). The major gain was made in groundnuts (a crop that farmers had almost abandoned) and soybeans that is a relatively new crop to the area. Concerning household food consumption, data analysis revealed that the project communities consumed more maize, rice, soybeans and cowpea per capita than non- project communities (Figure 2). This is a direct consequence of the realized higher production levels of these crops by farmers in project communities. In general, per capita home consumption of soybean is quite low in the area as much of the soybeans produced were sold to market agents and industrial processors through the project market linkage.

Food insecurity lines of N2160.94 and N1748.99 were estimated for the households in project and non-project communities respectively. These food insecurity lines were expected to meet the minimum recommended daily energy level (2250 kilocalories) of an adult per month in the participating and non-

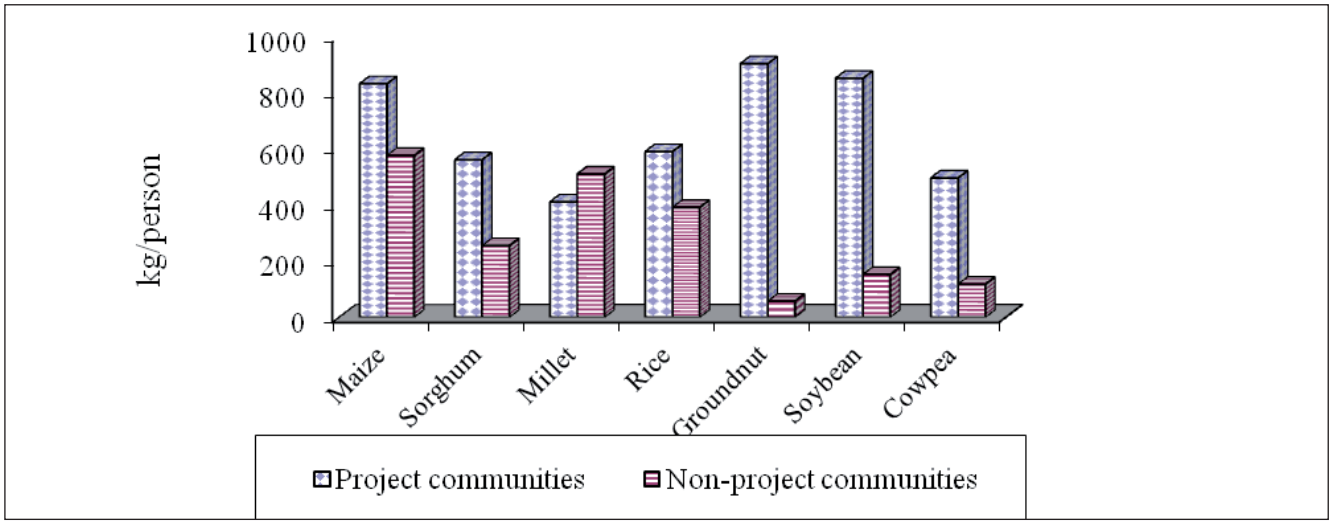

Figure 1: Per capita food production in project and non-project communities.

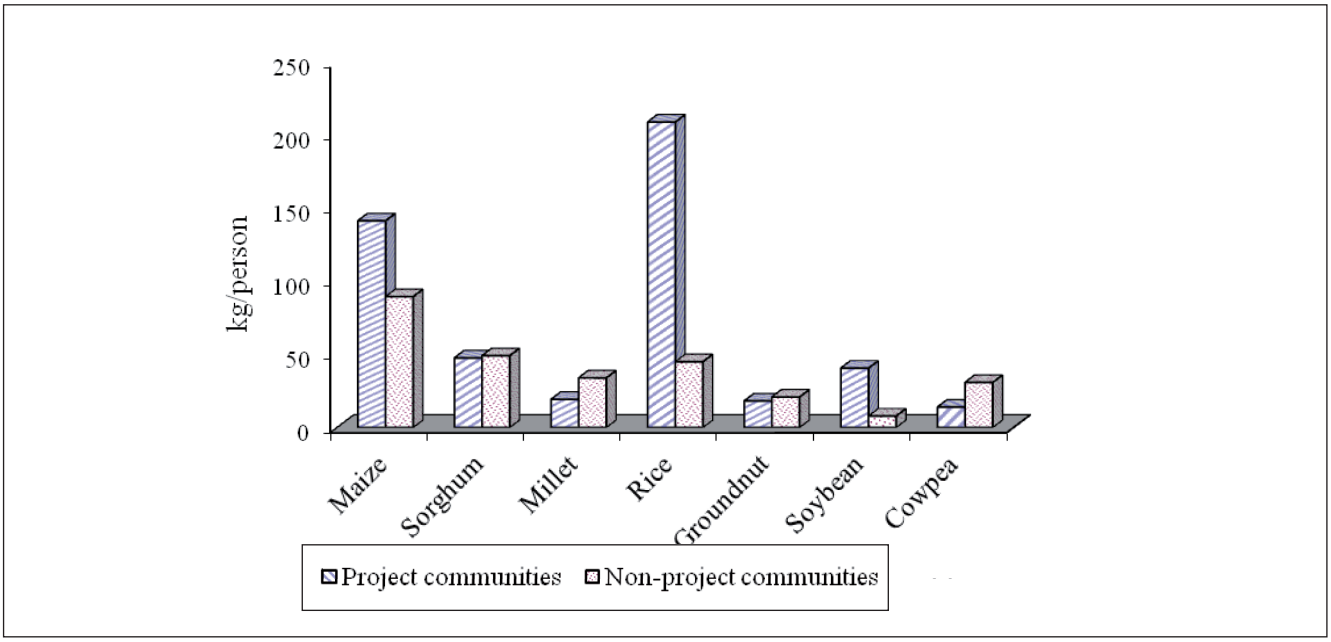

Figure 2: Per capita food consumption in project and non-project communities.

participating communities. The results of the food security measures for the project and non-project communities are compared in Table 1. Based on these food insecurity lines, 49% of households in the project communities and 61% in the non-project communities were classified as food insecure. The aggregate expenditure gap or shortfalls of the food insecure households were 51% in the project communities and 25% in the non-project communities respectively.

A comparison of the food insecurity status in the two types of communities revealed that the food insecurity level is higher in non-project communities by 12%.

Though the percentage of aggregate expenditure shortfalls is higher in project communities, the number and intensity of food insecure households was higher in the non-project communities.

A number of factors determined the food security status of the rural households. These include crop yields/ha, per capita production and consumption of major food crops by households in the project and non-project communities. Yields of major crops such as maize, rice, soybeans, cowpea and groundnuts were higher in the project communities than the non-project communities (Table 2), and the differences were statistically significant ($p \leq 0.01$). The differences were not statistically significant for millet and sorghum, which incidentally were crops on which the project did not promote any improved varieties.

At the farmer household level, per capita production was also significantly higher in the project communities for maize, rice, soybeans and cowpea. The statistically significant yield levels and per capita household production for maize, rice, soybeans and cowpea in project communities is associated with the adoption of improved varieties of these crops. The per capita consumption of maize was lower in the project communities indicating that households are selling more maize and also consuming more of other crops such as soybeans and rice. The per capita consumption of rice, soybean and cowpea was higher in project communities than in the non- project communities.

Table 1
Food insecurity status in project and non- project communities

	Project communities	Non-project communities	Difference (%)
Food security line (Naira)	2160	1749	19
Food insecurity status (%)	49	61	12
Aggregate expenditure gap (%)	51	25	27

Source: Survey data analysis, 2009.

Table 2
Differences in average yields, per capita production and consumption of major crops in the project and non-project communities

	Crop yields (kg/ha)	Per capita production (kg/person)	Per capita consumption (kg/person)
Maize	379 (3.710**)	254 (2.044**)	-52 (-2.593**)
Sorghum	-296 (-1.585)	-306 (-1.884)	-1 (0.086)
Millet	412 (1.257)	-99 (-0.567)	-15 (-0.830)
Rice	651 (2.128**)	198 (2.681**)	164 (5.355**)
Groundnut	664 (2.332**)	845 (0.491)	-3 (-0.199)
Soybean	931 (3.469**)	698 (2.618**)	33 (3.166**)
Cowpea	220 (2.464**)	178 (2.321**)	17 (1.951**)

Source: Survey data analysis, 2009.
**Significant at 0.01; * significant at 0.05.
Note: Figures in parenthesis are t-ratio values (assuming equal variances).

Determinants of food security in project communities

Determinants of food security in sub-Saharan Africa have been investigated by several authors. Olayemi (12) categorized factors affecting food security at the household level into three; these are the supply-side factors, demand-side factors, and stability of access to food. According to him, the stability of access to food hinges on household food and non-food production variability; household economic assets; household income variability; quality of human capital within the households; degree of producer and consumer price variability and household food storage and inventory practices.

In this study, the Probit regression result indicated that household size, cost of hired labour, participation in project and non-agricultural income have significant effects on the food security status of the households (Table 3). Household size had a negative and significant effect ($p \leq 0.05$). This indicated that households with large sizes had higher probabilities of being food insecure than those with smaller sizes, and vice versa.

The hired labour variable measures the amount of extra labour investment made by a given household, as expected it had a positive and significant effect of food security ($p \leq 0.05$). Amaza (1) reported that farmers that use more hired labour in food crop production tend to have the objective of profit maximization. In his opinion, the users of hired labour are also relatively more efficient in terms of allocative and economic efficiency, therefore, they are likely to be more food secure. However, farmers that rely only on family labour have the primary objective of production for subsistence.

Having additional income sources from non-

Table 3
Estimated coefficients of different factors affecting household food security

Variable	Effects on food security status	Marginal effects on food security status
	Estimated coefficients	Estimated coefficients
Size of household	-0.214** (-10.97)	-0.085
Cost of hired labor	0.00001** (2.26)	6.67e-06
Sudan savanna zone	-0.288 (-1.65)	-0.113
Northern Guinea savanna zone	0.142 (0.98)	0.056
Participation in project activities	0.4703** (2.86)	0.181
Years of farming experience	0.0082 (1.51)	0.003
Farmers' organization membership	0.271 (1.91)	0.108
Education level of household head	-0.0430 (-0.52)	-0.017
Gender	-0.310 (-1.83)	-0.123
Total area of the household farm	0.046 (1.22)	0.018
Access to credit	-0.137 (-0.84)	-0.054
Access to extension	-0.0645 (-0.44)	-0.026
Distance to nearest input shop	0.003 (0.92)	0.0011
Household assets	0.235 (0.73)	0.091
Remittances	1.16e-06 (0.52)	4.62e-07
Non-agricultural income	4.26e-06* (2.00)	1.69e-06
Constant	0.801 (1.80)	na
Number of observations	600	
LR chi2(16)	212.47	
Log likelihood	-309.53	
Pseudo R-Square	0.255	

Source: Survey data analysis, 2009.

Notes:
1. Numbers in parenthesis are Z values for each coefficient.
2. ** indicates statistical significance at 0.01 and * indicates statistical significance at 0.05.
3. na= not available.

agricultural activities also had a positive and significant effect ($p \leq 0.1$) on food security of the household.
This variable is also a proxy for household ability to purchase inputs such as inorganic fertilizers and improved seeds which are critical for increased agricultural production.
Participation in project activity also had a positive and significant effect on household food security ($p \leq 0.05$). This variable measured household participation in the technology development and training activities of the project and revealed that participating households are more likely to be food secure than others.
This suggested that the project activities such as farmers' training on crop management practices, marketing, the adoption of improved crop varieties by farmers and linking them to inputs and output markets made a positive contribution in enhancing their probability of being food secure.
Furthermore, it was estimated from the marginal effects equation that participating in project activity increased the probability of being food secure by 18%. However, increase in household size reduced chances of being food secure by about 8%. This indicated that households with large sizes had higher probabilities of being food insecure than those with smaller sizes and vice versa.

Conclusion

The multi-stakeholder project was successful in increasing adoption of new technologies and crops yields in the communities where it was implemented. The following empirical observations and policy recommendations are made to reduce food insecurity on a larger and sustainable scale. First, a large household was observed to be more food insecure in both project and non-project communities. Therefore government should give adequate priority and attention to policy measures directed towards the provision of better family planning. In view of this, education encompassing training which brings about behavioural changes is important for households in the study area. Second, having additional income from non-agricultural activities also had a positive impact on food security of the households. This additional income increased households' ability to purchase inputs such as inorganic fertilizers and improved seeds, which are critical to increased agricultural production. Hence, policy should facilitate improved household access to micro-credit to facilitate input purchase. Third, outcomes from the project's training activities revealed that participating households are more likely to be food secure. This suggested that capacity building activities including the use of participatory approaches to support farmers in solving their own problems with improved links to inputs and output markets should be encouraged to promote food security.

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