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Full Length Research Paper

International institute of tropical agriculture plantain and banana programme: An insight into the contributions of farmer-to- farmer extension paradigm

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Dissemination of research results by the International Institute of Tropical Agriculture (IITA) had been a major challenge to the Institute as inappropriate dissemination mechanism was revealed as a major constraint to her earlier efforts in disseminating cooking banana technologies between 1990 and 1994. A public-private technology delivery approach (research-farmer-to-farmer extension approach), which allows farmers to play the major role in dissemination of IITA plantain and banana based technologies was undertaken in three states of Nigeria. This study provides an insight into the contributions of this paradigm shift. The results show that farmer-to-farmer dissemination accounted for 26.6% awareness and 35.7% source of solutions to problems encountered in technology adoption at no direct cost to research and extension. Average plantain and banana hybrid adoption in the three states was 50.7%. Correlation analysis revealed that household size, ever questioned about plantain production problems, frequency of extension visits and trial experience had significant relationships with adoption. The regression analysis indicated that trial experience was the only variable with predictive value for plantain and banana hybrids adoption (R = 0.21). We concluded that free flow of information among all stakeholders is the panacea for sustained adoption and diffusion of the IITA plantain and banana based innovations.

Key words: Farmer-to-farmer extension approach, adoption, diffusion, plantain and banana hybrids, Nigeria.

INTRODUCTION

Smallholders' production of food staples plays a critical role in the livelihoods of the rural poor. Production of food staples provide the rural poorest with most of their work, income and about 70 – 80% of calorie needs (IFAD, 2001). Plantain and banana are staple food for rural and urban consumers as they provide an important source of rural income, particularly for smallholders who produce them in compound or home gardens (Nweke et al., 1988).

Banana is the world's second most important fruit crop after oil palm. It is grown in 130 countries worldwide. World production stands at 71 million metric tonnes while plantain is grown in 52 countries with world production of 33 million metric tonnes (FAO, 2004). However no African country is ranked among the top 10 countries for banana production in the world while eight African countries are among the top world producers of plantain with Nigeria ranking as the fifth highest producer of the crop (FAO, 2004). Presently, plantains are of less importance than banana in terms of world trade in the genus but in West and Central Africa about 70 million people are estimated to derive more than one quarter of their food energy requirement from plantains (Robinson, 1996)

Important threats to plantain and banana production in Africa include black Sigatoka disease, weevils and nematode attack as well as low propagation rate (planting materials) and its perishability. Black Sigatoka has reduced the yields to less than half what they were before its arrival and spread. IITA began research on plantain and banana in 1973 and has made progress in the areas of host plant resistance to black Sigatoka, through the

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development of improved hybrids, improved cropping systems, diversified post harvest utilization and micro and macro-propagation techniques of rapid planting materials. Evaluation of earlier dissemination of cooking banana by IITA revealed inappropriate dissemination mechanisms as a major constraint to the adoption of the hybrids by farmers (Tshiunza et al., 2001). This led to the integration of farmers, researchers and extension workers in a pluralistic information flow system as against the traditional linear top down approach.

IITA plantain and banana improvement program and USAID from the year 2000 initiated a public-private technology delivery project which seeks to reverse the supply-driven orientation by placing emphasis on farmer-induced delivery approach (FIDA) which promoted participatory action research and an integrated team approach with the public extension system (Agricultural Development Programme), national agricultural research system and non-governmental organizations on plantain and banana technology delivery project. FIDA used participatory action learning process to facilitate farmers' group institutional development, and plantain banana agro enterprise selection and skill building for farmers.

The farmer induced delivery approach (FIDA), allows a direct interaction among farmers, research and extension with farmers playing a major role in innovation (plantain and banana varieties) selection process. The hallmark of the approach was the constant training and retraining of farmers, extension and other stakeholders. Field days on farmers' fields were also encouraged to showcase to other farmers, results from their colleagues as farmers believe more in results from their fellow farmers as regards new technologies (Faturoti, 2001).

Theoretical perspectives

According to Bunch (1996) governments of developing countries can rarely afford to have professional extensionists working with all their farmers. Few of them have extensionists working with more than one out of every four farmers, and even then the frequency of farm visits is low as to be largely ineffective (Saravia, 1983). The result of this lack of resources is that governments often target those areas of high agricultural potential, with the result that problems of poverty and inequality become even more severe (IFPRI, 1995).

The only conceivable way of meeting this challenge successfully is the enlistment of farmers' own efforts in solving their problems of low productivity (Bunch, 1996). In other words, technology development and dissemination process can be more effective when the enhancement of farmers' capacity to develop and diffuse new technologies themselves (farmer-to-farmer extension) is accepted as the foundation for sustainable agricultural development. Bunch (1996) further asserted that farmers can fulfill three major roles (and many minor ones) in furthering their own agricultural development which includes the following: establish and manage experiments in order to modify those technologies already known and develop new ones; spread knowledge of useful technologies from one farmer to another; and carry on, by themselves if necessary, the processes of agricultural investigation and extension, once they have learned them, thereby continuing to increase their yields.

To attain success, dissemination needs to be interactive allowing feedback from all possible stakeholders in the programme in a cyclical model of communication flow. According to Dimelu and Igbokwe (2001) farmer-to-farmer extension is a participatory tool in which farmers rather than extensionists act as the principal agent of change. They further asserted that farmer-to-farmer extension is not a new phenomenon in the conventional extension service. The contact farmer strategy used in the Training and Visit (T and V) management system is to trigger and facilitate farmer-to-farmer extension. However in the T and V system, this tool operates under the transfer of technology model, a top-down model of technology generation and dissemination in which farmers' participation is not handled with the expected level of importance. However, farmer-to-farmer extension is enshrined in farmer-led participatory approaches to research and extension, which is also termed "Farmer First". According to Miller and Curtis (1997) participatory development approaches are recognized as effective in assisting rural communities identify issues of concern, determine their needs and draw on resources available to enact social and environmental changes. Most participatory approaches have in common the methods to facilitate peasant farmer "ownership" of the technology-testing process and of farmer-to-farmer dissemination of proven innovations. Farmer-to-farmer extension thus forms part of the framework for participatory extension approach (PEA) and the major social carrier for participatory technology development (PTD).

According to Ashby and Sperling (1994) involving users or clients in research and development is an important principle of successful innovation. In other words farmer participation in agricultural R and D is now perceived as an essential feature of sustainable agricultural innovation (Bhatnagar and Williams, 1992). Ashby and Sperling (1994) further asserted that decentralized client-driven technology development requires both applied researchers and farmers to perform new functions which suggest that the "pipeline" or transfer of technology model must give way to a client relationship which is highly interactive, evolving through time, and in which farmers participate early in R and D. Such farmer involvement generates important feedback for the design of prototype-technology, which is tested and adapted to fit local circumstances and may stimulate further applied research in response to farmers' specifications.

Burke's model (1999) of communication flow recognizes the need to consider horizontal communication between peer groups at grassroots and decision making levels, as well as upward and downward communication routes which allow the flow of information between groups. He asserted that a clear understanding of the target audiences' needs, skills and resources both to successfully receive information and to use it is central to effective dissemination. This study focuses on dissemination of research outputs by researchers to the main target farmers, through the network of extension outfits allowing farmer-to-farmer information sharing.

Objectives of the study

The general objective of the study was to ascertain the contributions of farmer-to-farmer extension approach to farmers' adoption of plantain and banana based technologies in three southern states of Nigeria. Specifically, the study sought to:

1. ascertain the major sources of awareness of IITA plantain hybrid technologies among the farmers and regularity of institutionalized extension visits;
2. examine the adoption of the IITA plantain hybrid technologies and factors that influenced adoption ;
3. determine the contribution of the different stakeholders in the IITA plantain innovation system in overcoming adoption problems and
4. document factors motivating plantain and banana hybrid technology adoption among the farmers.

METHODOLOGY

Study area

The study was carried out in Nigeria. Three states from the plantain and banana-growing belt of Nigeria were selected on the basis of the plantain operating zonal headquarters established by IITA to facilitate easy dissemination of plantain and banana hybrid based technologies. The selected states represented three geo-political zones of Nigeria plantain belt; the states were Abia, Edo and Ogun states representing south–east zone, south–south zone and south-west zone, respectively.

Population and sampling procedure

The population for this study comprised two sets of banana and plantain hybrids growing farmers, the pilot farmers (direct project farmers) and the secondary farmers (farmers who benefited from the pilot farmers and other information sources). At the initial stage of the project which commenced in the year 2000, twenty-five pilot banana and plantain farmers from five different villages in each state were involved in the study. The twenty-five pilot farmers per state were selected from a list of banana and plantain-growing farmers in the existing agricultural zones as delineated by each state's Agricultural Development Programme (ADP) based on the following criteria: availability of land resources; membership of farmers' group; and strategically located site along an axis of high human traffic. Hence, in each state a total of 25 pilot farmers were involved in the project. It was expected that the technology would have spread to other farmers in the villages within each state between year 2000 (project initiation) and 2006 (study period). Specifically, the project expected that each pilot farmer would have introduced the new banana and plantain technologies to between 30 and 50 other interested farmers within their different localities. In other words, within 5 years of the existence of the twenty-five pilot farmers in each state, 750 - 1250 secondary farmers should have been reached in each of the three study states as a result of farmer-farmer dissemination.

For the purpose of this study 5 pilot farmers were randomly selected from each of the three states. This process led to the selection of fifteen pilot farmers. To select the secondary farmers, each of the pilot farmers selected was asked to make a list of farmers he/she thought would have benefited from the banana/plantain improvement programme through him. A list of twenty-five secondary farmers per village were collated, from each of these lists, ten secondary farmers were selected through simple random sampling technique, giving a total of fifty secondary farmers per state and a total of one hundred and fifty secondary farmers for the study. In all, a total of one hundred and sixty five respondents participated in the study. However, only data from one hundred and fifty-four respondents were analyzed to assess the contributions of farmer-to-farmer dissemination of information on awareness, adoption and solving of problems encountered in the adoption of plantain hybrid technology.

A carefully designed and validated structured interview schedule was used for primary data collection Data were collected on adoption level, mode of awareness and dissemination as well as the personal and socio-economic characteristics of the farmers related to technology transfer. Percentages, charts, mean scores and standard deviations were used to analyze the data generated. Also, correlation and regression analyses were carried out to establish those variables that influenced technology transfer and adoption. The linear regression model used was:

$$Y = a + bx,$$

Where Y = new hybrid adoption (Dependent variable), a = constant, b = regression coefficient, and X = independent variables (X_1, X_2, X_3, X_4); X_1 = size of household. X_2 = ever questioned about plantain and banana production problems, X_3 = frequency of extension visits, and X_4 = trial experience.

RESULTS AND DISCUSSION

Personal characteristics of the respondents

The respondents' personal characteristics (Table 1) reveal that there were more farmers in the productive class as 77.9% respondents were between the ages of 31 - 60 while 22.1% were in the age bracket of 61 - 70 (retired or dependant age). There were more male (83.1%) respondents than females (16.9%), with 66.9% of the respondents being single. The household size revealed a relatively high frequency for households with more than 5 members. Household size of 5 - 10 people was 66.9% while 1 - 4 people were 33.1%. There were 95.4% educated respondents, though majority (79.2%)

Table 1. Personal characteristics of the respondents (n = 154).

Personal characteristics	Percentage	Mean
Age		
31-60	77.9	51
61-70	22.1	
Gender		
Male	83.1	
Female	16.9	
Marital status		
Married	33.1	
Single	66.9	
House hold size		
1-4	33.1	6.0
5-10	66.9	
Type of Education		
No formal education	4.5	5.7
Primary school education	51.3	
Secondary school education	27.9	
Tertiary education	16.2	

had only primary and secondary education. These characteristics have implications for adoption and consequently on technology transfer (Faturoti et al., 2006).

Sources of awareness of plantain and banana hybrid technology

Table 2 revealed five sources of technology awareness, the highest source was extension agents (29.9%), and this was followed by combination of all sources (27.9%), fellow farmers (26.6%), research (9.1%) and radio (6.5%). This result is not unexpected, extension is primarily commissioned to spread technology and link research with farmers. The higher score for combination of all sources may have been as a result of the stepwise nature of adoption where respondents sought to double check before venturing into adoption, however farmer to farmer dissemination also had implication, this is because farmers believed in their peers more than 'strangers' (extension and research) (Asiabaka, 1994). A breakdown of the result state by state showed that in Abia state a combination of all sources and fellow farmers accounted for 71% source of awareness, while in Edo state extension source and fellow farmers ranked highest with 60% source of awareness in the state. A similar result was recorded in Ogun state where extension and fellow farmers accounted for 61% source of awareness (Figure 1). This result showed that the influence of fellow farmers in the adoption process cannot be wished away (Ninatubu et al., 2001).

Frequency of extension visits

Data on Table 3 reveal the frequency of extension visits to the farmers, fortnight visitation was (50%), monthly (14.9%), quarterly (13.6%) and no visit (21.4%). Technology transfer demands constant and regular monitoring to aid adoption and solve constraints that may arise as a result of technology practice. A no visit by extension may lead to reverse adoption as "farmers do what is inspected and not what is expected" (Faturoti et al., 2006). However the frequency of extension visits by state on the recommended fortnight interval, revealed that Edo state (65.5%) had the highest extension support for technology transfer, while Ogun state and Abia state had 47.7 and 36.4%, respectively. This might have accounted for the higher adoption level of plantain and banana hybrids observed in Edo state.

Adoption level of IITA plantain and banana hybrid technology

The levels of adoption of the IITA plantain and banana hybrid technology revealed a slightly above average adoption of the new hybrids, average adoption was 50.7%. Abia state had 39%, Edo 63% and Ogun 50% adoption respectively (Figure 2). A comparative look at the adoption levels across the three states and the frequency of extension visits tend to show lower adoption levels for states with lower extension agents visitations. According to Asiabaka et al. (2001), technical assistance is one of the factors necessary for adoption of new technologies. In other words, lack of assistance from national extension systems is often major reasons why farmers do not adopt farming innovations (Agwu and Afieroho, 2007). The adoption of the new hybrid is evolving and therefore still needs the efforts of extension, peer groups (farmer-to-farmers) and research to ensure an increased and sustained adoption since the varieties are disease resistant and high yielding. Market opportunities also need to be expanded to stimulate increased production.

Factors influencing IITA plantain and banana hybrid adoption

Correlation analysis was done to establish the factors that influenced the adoption of plantain and banana hybrids in the three states. Only four variables had positive significant relationship with the adoption of new hybrids. The four variables were size of household (0.319), frequency of extension visits (0.178), ever questioned about plantain and banana production problems (0.288) and trial experience (0.365). The relationship explained that, with increased household size, there is

Table 2. Source of awareness of IITA plantain and banana hybrid technology.

State	Parameter	Source of awareness					Total
		Extension	Radio	Research	Fellow farmers	All combined	
Abia	Count	10	3	3	17	22	55
	% Within state	18.2	5.5	5.5	30.9	40	100
	% Within source of awareness	21.7	30.0	21.4	41.5	51.3	35.7
Edo	Count	20	5	7	13	10	55
	% Within state	36.4	9.1	12.7	23.6	18.2	100.0
	% Within source of awareness	43.5	50.0	50.0	31.7	23.3	35.7
Ogun	Count	16	2	4	11	11	44
	% Within state	36.4	4.5	9.1	25.0	25.0	100.0
	% Within source of awareness	34.8	20.0	28.6	26.8	25.6	28.6
Total	Count	46	10	14	41	43	154
	% Within state	29.9	6.5	9.1	26.6	27.9	100.0
	% Within source of awareness	100.0	100.0	100.0	100.0	100.0	100.0

Source: Field data 2006.

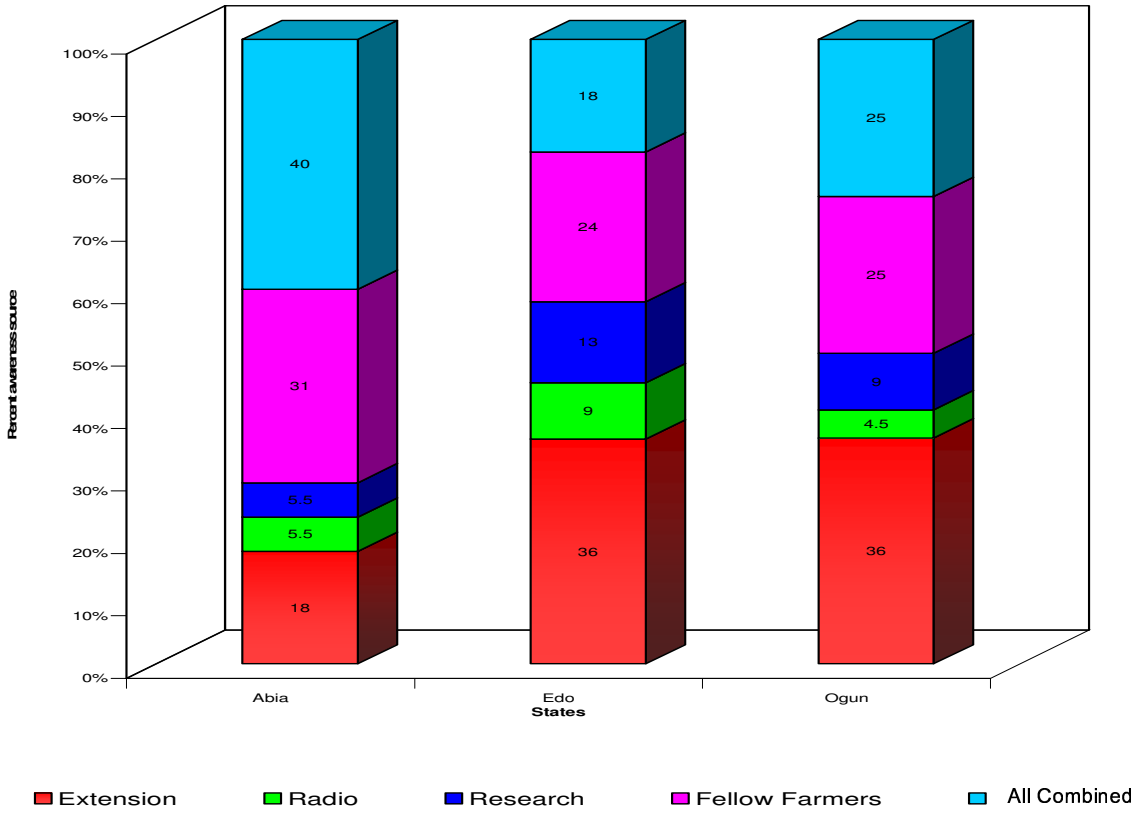

Figure 1. IITA plantain and banana awareness source. *Source:* Field data 2006.

increased possibility of adoption of IITA plantain and banana hybrid. This may not be unconnected with the need to feed more mouths, the influence of food security needs and the availability of more labour. In the same vein, the frequency of extension visit and questioning about production problems might have influenced adoption in that extension visits provided the needed technical backstopping for the farmers.

However, the influence of trial experience may be explained by the fact that adoption is a stepwise process,

Table 3. Distribution of farmers by frequency of extension visits.

State	Parameter	Frequency of extension visits				Total
		Fortnightly	Monthly	Quarterly	No visit	
Abia	Count	20	4	9	22	55
	% Within state	36.4%	7.3%	16.4%	40.0%	100.0%
	Frequency of visit	26.0%	17.4%	42.9%	66.7%	35.7%
Edo	Count	36	8	9	2	55
	% Within state	65.5%	14.5%	16.4%	3.6%	100.0%
	Frequency of visit	46.8%	34.8%	42.9%	6.1%	35.7%
Ogun	Count	21	11	3	9	44
	% Within state	47.7%	25.0%	6.8%	20.5%	100.0%
	Frequency of visit	27.3%	47.8%	14.3%	27.3%	28.6%
Total	Count	77	23	21	33	154
	% Within state	50.0%	14.9%	13.6%	21.4%	100.0%
	Frequency of visit	100.0	100.0	100.0	100.0	100.0

Source: Field data 2006

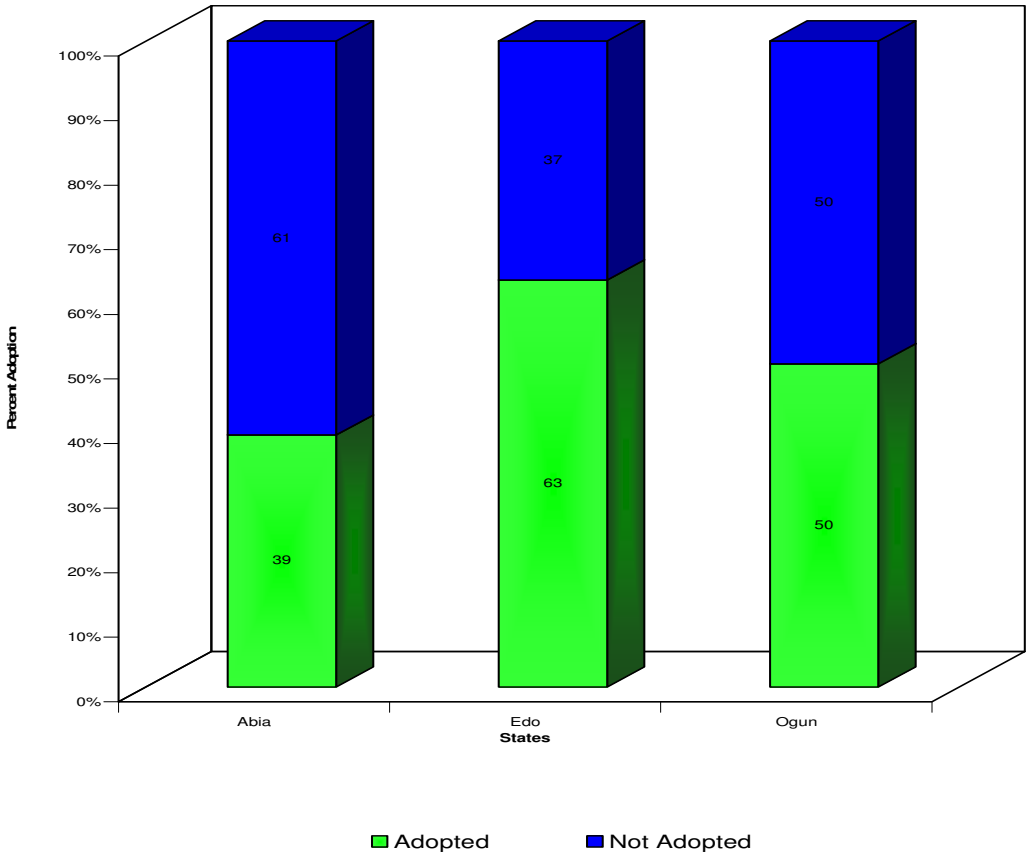

Figure 2. Adoption level of IITA hybrid. *Source:* Field data 2006.

in which positive trial result will lead to adoption, whereas if, negative, adoption will be discontinued. The four variables were also subjected to regression analysis to establish their predictive effects on adoption in the three states.

The regression analysis showed that the four variables, size of household (X_1), ever questioned about plantain and banana production problems (X_2), frequency of extension visits (X_3), and trial experience (X_4), explained 21% of new hybrids adoption ($R^2 = 0.21$), though only

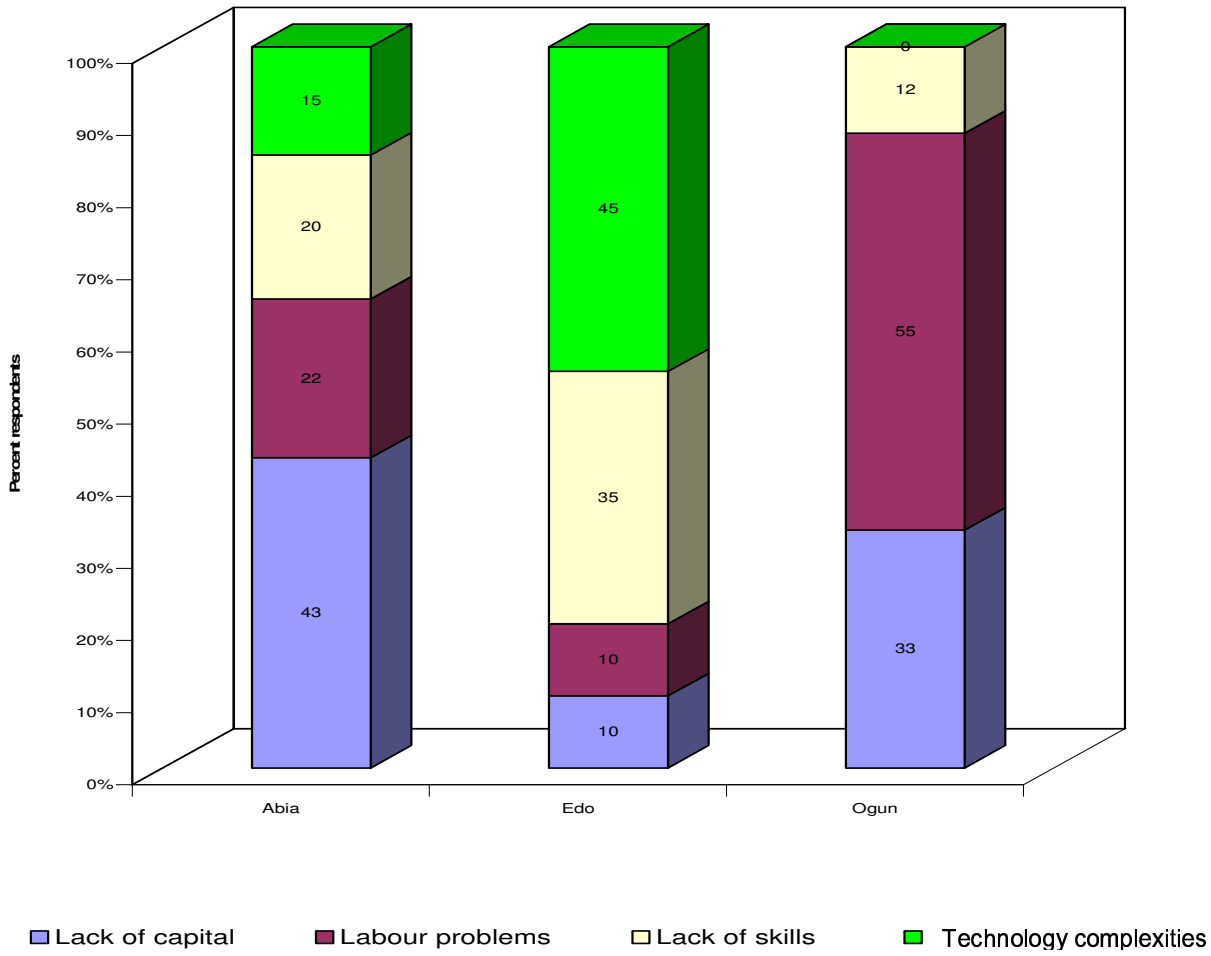

Figure 3. Problems encountered in technology adoption. *Source:* Field data 2006.

one of the variables (trial experience) had statistical significant association with the adoption of the new hybrids. Hence, since adoption is stepwise and known for spill over effects, a positive trial result will foster progress in utilization, which ultimately led to adoption of the new IITA plantain and banana hybrids.

Problems encountered in technology adoption

Four major sources of problems against adoption were identified (Figure 3), though this varied from state to state. In Abia state, lack of capital (43%) ranked highest as constraint to adoption, while other constraints include labour problems (22%), lack of skills (20%) and technology complexities (15%). Also in Edo state the constraints were ranked in the following order, technology complexities (45%), lack of skills (35%), labour problems (10%) and lack of capital (10%). In Ogun state labour problems (55%), lack of capital (33%) and lack of skills (12%) were the major constraints. These problems have implications for technology delivery and adoption since they are capable of holding technology transfer static if not removed thus, preventing adoption and leading to wastage of research and donor resources. However, if the profit inherent in the technology were made visible, then, the constraints may be turned to motivations for adoption (Faturoti et al., 2006).

Overcoming adoption problems

Table 4 revealed various sources of solution to problems encountered in technology delivery and adoption as identified by the respondents. Extension agents source had (37%), fellow farmers source (35.7%), government source (14.3%) and research (13%). A slightly different picture was revealed when the identified solution sources were examined state by state (Figure 4). Abia state had fellow farmers as the highest source of solution to problems encountered (49%), Edo and Ogun states had extension source as the highest with 42 and 45% respectively. Ogun state recorded no research intervention in solving encountered problems. This result corrobo-

Table 4. Sources of solution to problems in IITA plantain and banana hybrid adoption.

State	Parameter	Who solved the problem				Total
		Extension	Fellow farmers	IITA	Government	
Abia	Count	14	27	2	12	55
	% Within state	25.5	49.1	3.6	21.8	100.0
	% Within source of awareness	24.6	49.1	10.0	54.5	35.7
Edo	Count	23	12	18	2	55
	% Within state	41.8	21.8	32.7	3.6	100.0
	% Within source of awareness	40.4	21.8	90.0	9.1	35.7
Ogun	Count	20	16		8	44
	% Within state	45.5	36.4		18.2	100.0
	% Within source of awareness	35.1	29.1		36.4	28.6
Total	Count	57	55	20	22	154
	% Within state	37.0	35.7	13.0	14.3	100.0
	% Within source of awareness	100.0	100.0	100.0	100.0	100.0

Source: Field data 2006.

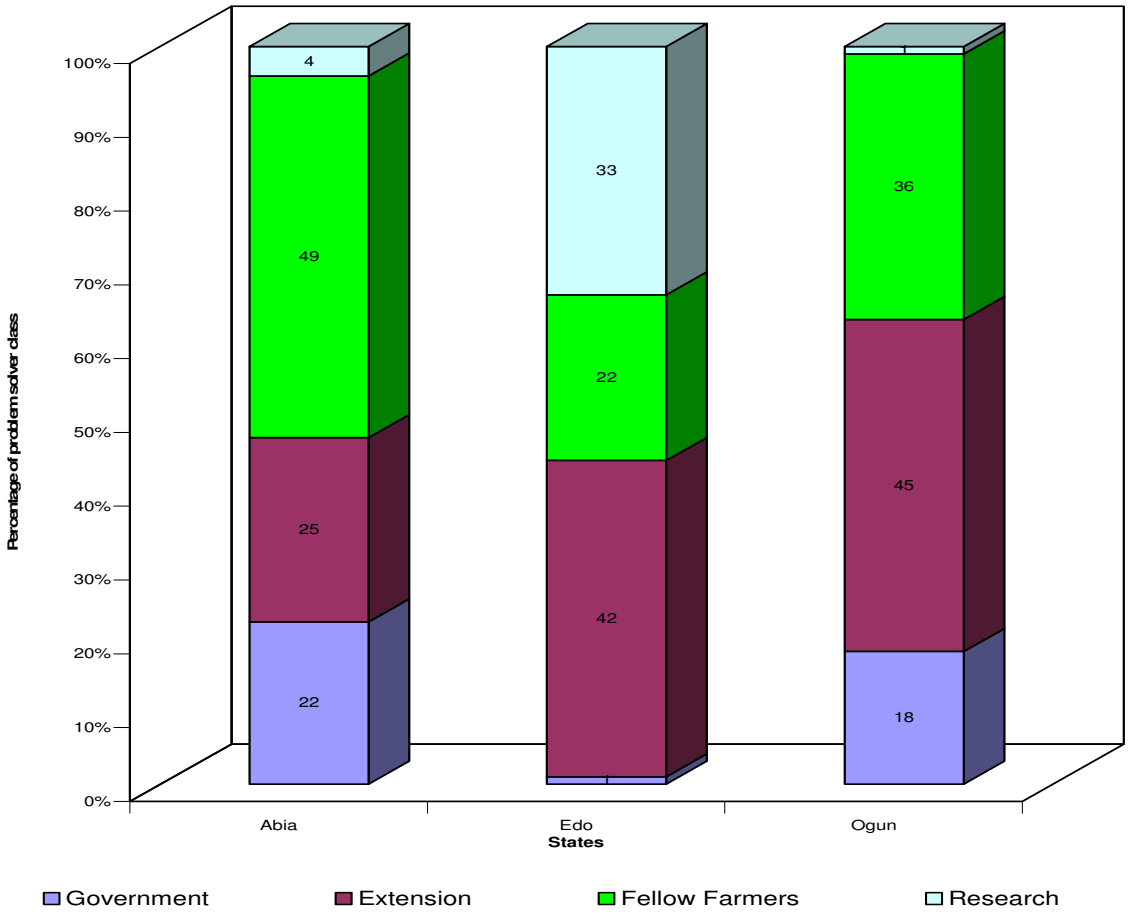

Figure 4. Respondent's source of solution. Source: Field data 2006.

rates the assertion of Timmer (1990) that increasing the productivity of agriculture and enhancing its contribution to economic growth requires re-investing resources extracted from agriculture into research, extension and infrastructure as well as incorporating farmers into the development stream.

Table 5. Motivation factors for IITA plantain and banana hybrid adoption.

State	Parameter	Innovation motivation						Total
		Increased income	Family decision	Food security	Result of other farmers	Disease prevalence	All combined	
Abia	Count	12	5	17	21			55
	% Within state	21.8	9.1	30.9	38.2			100.0
	% Within source of awareness	36.4	71.4	27.9	48.8			35.7
Edo	Count	3	2	38	7	2	3	55
	% Within state	5.5	3.6	69.1	12.7	3.6	5.5	100.0
	% Within source of awareness	9.1	28.6	62.3	16.3	66.7	42.9	35.7
Ogun	Count	18		6	15	1	4	14
	% Within state	40.9		13.6	34.1	2.3	9.1	100.0
	% Within source of awareness	54.5		9.8	34.9	33.3	57.1	28.6
Total	Count	33	7	61	43	3	7	154
	% Within state	21.4	4.5	39.6	27.9	1.9	4.5	100.0
	% Within source of awareness	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Field data 2006.

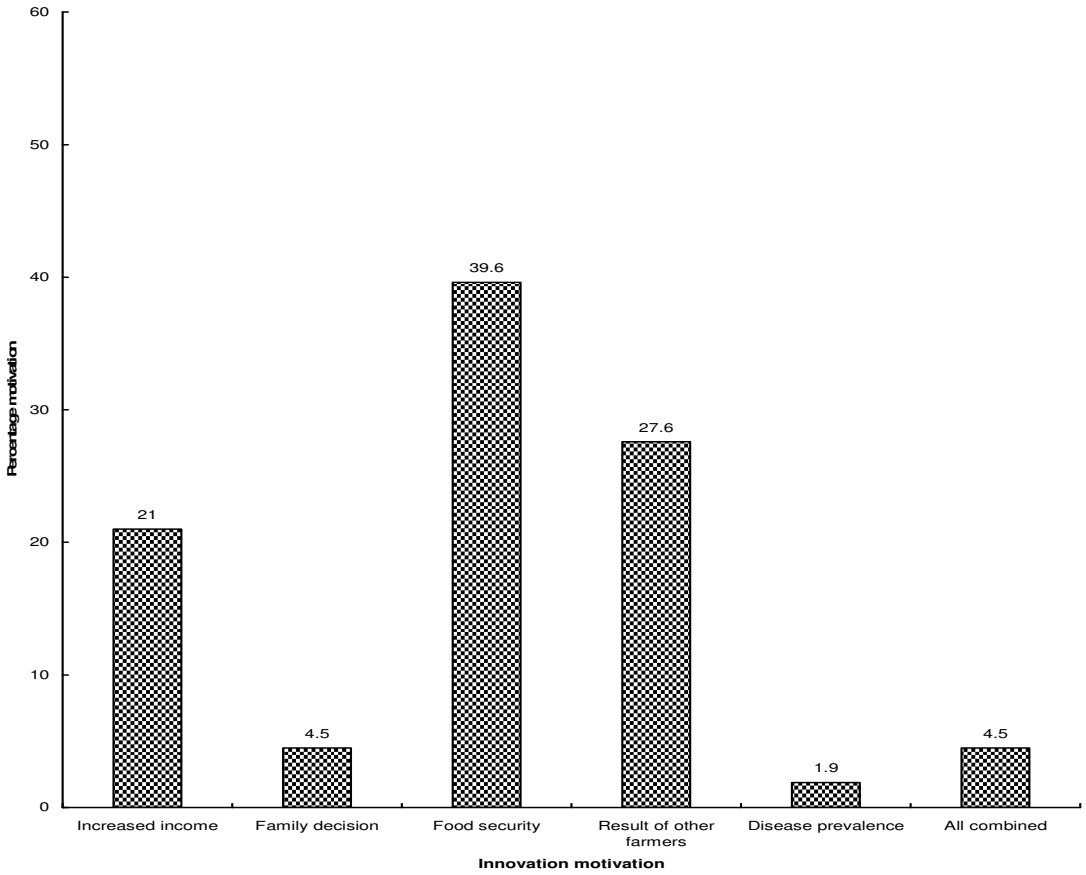

Figure 5. Respondents' technology motivation factors. *Source:* Field data 2006.

Factors motivating plantain and banana hybrid technology adoption

Maslow (1943) stated that there is no action without motivation; this management theory also applies to agricultural innovation system. Many factors were found to motivate technology adoption by the respondents (Table 5 and Figure 5). These factors include food security

(39.6%), results from other farmers (27.9%), increased income (21%), family decision (4.5%), combination of all factors (4.5%) and disease prevalence (1.9%). These factors propelled acceptance, trial and adoption of plantain and banana technology disseminated to the farmers. The spillover effect from farmer-to-farmer technology dissemination as established by 27.9% of the respondents is expected to foster diffusion and consequently internalization of the technology into the farmers' knowledge system.

Conclusion

The study found that trial experience determines a continuation or discontinuation of adoption. The farmer-to-farmer extension approach fostered a rapid and sustained spread and utilization of the technology as only 9.7% (15 pilot farmers) of the respondents had initial interaction and training with research. This 9.7% had through the farmer-to-farmer extension approach influenced effectively 26.6% of the respondents at the awareness stage. Also, 35.7% of the respondents asserted that they sourced for solutions to problems encountered in technology adoption from fellow farmers at no direct cost to formal research and extension. A major lesson from the study was the free flow of information among the stakeholders; this was established in the catalogues of problems encountered in technology practice and the various solution sources in the study, unlike in the traditional technology transfer system (TOT) where research is the only voice of reasoning. The study further concluded that adoption entails copying and adapting knowledge from pioneers, therefore technology delivery must be approached in a visibly profitable and comprehensive manner such that the potential obstacles are made clear and possible solutions proffered upfront, this entails a close knitted relationship of stakeholders at the trial stage. Finally technology delivery should target peers' support rather than relying on external influence of research and extension that is not sustainable and lacks proximity to the end users.

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