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Full Length Research Paper

Hi-tech potential in plantain and banana improvement system in Nigeria

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The stakeholders were classified into five major groups according to their actions in the system; the groups include research agency, government agency, technology transfer agency, marketers and plantain and banana farmers. Four states which are zonal headquarters of Plantain Resource Training Centre, Abia, Akwa Ibom, Edo and Ogun states were selected and sampled for data collection. A total of 95 respondents were sampled for data collection. Percentages, means and factor analysis were used in data analysis and presentation. The research and technology transfer groups contributed over 90% of the technological capability in plantain and banana innovation system IITA, NIHORT and NSPRI were revealed as the major technology generating agencies in the plantain and banana innovation system. The study concluded that constant interactions and exchange of ideas among stakeholders encouraged learning and optimization of technological capability in the plantain and banana innovation system

Key words: Banana, plantain, stakeholder, technological capability, innovation system.

INTRODUCTION

Innovation systems represent a significant change from the conventional, linear perspectives about agricultural research and development (R and D). It involves the analysis of complex relationships between innovative processes that are generated among multiple agents, social and economic institutions. The concept refers to the system where all stakeholders are involved in the generation, diffusion, adoption and use of knowledge. However, contemporary thinking on the production and use of knowledge suggests that institutional factors are a central component of capacity development (Edquist, 1997; Oyelaran-Oyeyinka, 2005). It is apparent that there is a generic problem with capacity development approach that focus on research components only to produce knowledge, with failure to develop complementary structures to put that knowledge into use within the economy (Hall, 2002; Chataway et al., 2005). Learning and capacity development in a contemporary sense is a multidimensional concept that requires skills or contributions contributions from both scientific and non-scientific sources. The problem remains that technologies in plantain and banana hitherto are fragmented with no support base from complimentary organisations. Relationship has been more of competition rather than cooperation which has affected the development of the crop and underplays its important in food security in Nigeria. The capability to interact, acquire, adapt and utilize this knowledge in plantain and banana innovation system in Nigeria is what this study set out to examine.

Objective of the study

The general objective of the study was to examine the technological capabilities of stakeholders in the banana and plantain innovation system in Nigeria. Specifically, the study:

1. Examined the learning and technological capabilities of selected key actors in banana and plantain innovation system.
2. Established the contribution of each stakeholder in technology availability and use.

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METHODOLOGY

Study area

The study was carried out in the banana and plantain belt in southern Nigeria (Figure 1) made up of 11 states (Abia, Akwa-Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ogun, Ondo, Oyo and Rivers). The sampling states were classified into 4 zones on the basis of agro-ecological, socio-political and socio-cultural homogeneity. Each zone has a zonal headquarters known as Plantain Resource Training Centre (PRTC). The zonal headquarters (Abia, Akwa-Ibom, Edo and Ogun) which serve as the main hub of technology validation and dissemination for IITA (main source of banana and plantain technology) and training centre for banana and plantain production, utilization and marketing were selected. For the purpose of this study the population consisted of stake-holders from a general list of participants that were part of banana and plantain innovation system compiled from a review of literature on banana and plantain innovation system in Nigeria. The list was revised and the agents in the innovation system were classified according to their activities within the system. The classifications included research group (6) (IITA Onne, NIHORT Ibadan, RMRDC Abuja, NSPRI Port Harcourt, FIIRO Oshodi and universities faculties of agriculture Nsukka, Ibadan, Umuahia); governmental agencies group (5) (Federal Department of Agriculture (FDA) Abuja, Federal Ministry of Commerce (FMC) Abuja, Plantain and Banana Development Program (PBDP) Ibadan and National Food Drug Administration and Control (NAFDAC) Abuja and National Biotechnology Development Agencies (NABDA) Abuja and technology transfer group (7) (state' ADPs - zonal headquarters of PRTC) in the plantain-growing belt (Abeokuta, Benin, Uyo, Umuahia), Food for All International (FFAI) Port Harcourt, Agriculture and Impact Assessment Centre (AGRICPACT) Port Harcourt, Plantain and Banana Growers Association west and their eastern counterparts Shagamu and Ughelli, Nigeria Agip Oil Company (NAOC) Port Harcourt and Shell Development Company Port Harcourt (SPDC), and agricultural departments. Other stakeholders group includes Farmers (60) and marketers (20) related to plantain and banana.

The plantain and banana sections of the research institutes and the faculty of agriculture of universities in the plantain-growing belt were taken as a population. Furthermore, governmental and non governmental agencies with related activities to plantain and banana as well as plantain and banana farmers and marketers were sampled.

A total of ninety five respondents were sampled (Table 1) and responses from the most senior and experienced officers working on plantain and banana in these agencies were recorded and analyzed, because they are better able to recall with consistence practices over a long period of time, particularly the study period of 2001 - 2006. For farmer's and marketer's groups fifteen farmers and five marketers were sampled in each of the four zonal PRTC state. However, data from 1 of the marketer respondents cannot be used because of observed inconsistencies (the recall ability of the respondents was in doubt, with many missing information).

A validated structured questionnaire and interview schedule was used for primary data collection. Data were collected on technological capabilities, learning and learning alliances among stakeholders in the innovation system. The variables measured include manpower resources (number of BSc, MSc, PhD and other staff categories available to each stakeholder group); trainee profiles (number of BSc, MSc, PhD and other trainee categories handled by each stakeholder group).

Land available to stakeholders was measured in hectares while percentage land available for banana and plantain research was calculated as land for *Musa* research/total land available × 100. Number of laboratory owned by the stakeholders and workshop attendance were measured and presented in percentages. The statistical package for the social sciences (SPSS, 10) was used for data analysis.

RESULTS AND DISCUSSION

Availability of skilled resources for technology generation

Five major groups of stakeholders were identified in the review of policy acts and initiatives in plantain and banana innovation system (Faturoti et al., 2007). The stakeholders include farmers, marketers, research and technology transfer agents and government agencies.

Table 2 reveals the categories and academic levels of staff in the various organizations that comprised the stakeholders' groups in banana and plantain innovation system. A break down of staff and categories revealed that IITA (20.1%) had the highest number of workforce engaged in plantain and banana among the stakeholders, followed by Akwa-Ibom ADP in the technology transfer group (12.1%). Other stakeholders also contributed various categories of workforce as shown in Table 2. Contribution of the research group to the workforce was 43.1%, technology transfer group 47.1%, while the government agencies involved in plantain and banana innovation system contributed 9.8% of the total workforce in the innovation system. Assessment of the resource availability in terms of innovation generation and development, recorded by data in Table 2, revealed that the research agencies had the highest number of staff with PhD (61%). These are capable of stimulating, designing and generating innovations on plantain and banana. The percentage of staff with PhD in the system from technology transfer group was 26% while government agencies contributed 13%. The result reveals that there is high potential for new technologies to originate from research into the system. The result though expected, will need to be applied with caution to avoid the pitfall of on farm technology delivery system characterized by top-down approach (Hall et al., 2001). Innovation system requires the interaction and cooperation of all stakeholders from the stage of generation to the diffusion of technologies.

Therefore, a network of scientists and other stakeholders in the innovation system to assess felt need and target technology generation should be established and adequately funded. The population of middle level manpower, that is, technical personnel with BSc and MSc degrees in the innovation system were highest in the technology transfer group (61%). The research group had 31%, while government agencies that are involved in innovation generation and dissemination had 8%. This group also assists in the interpretation of scientific information for end-users. From the results, there is the need to strengthen the technology transfer unit of the system so that new innovations can be promptly delivered to end users The technology transfer agents were identified to play a pivotal role in ensuring cohesion between technology generators and consumers in the innovation system

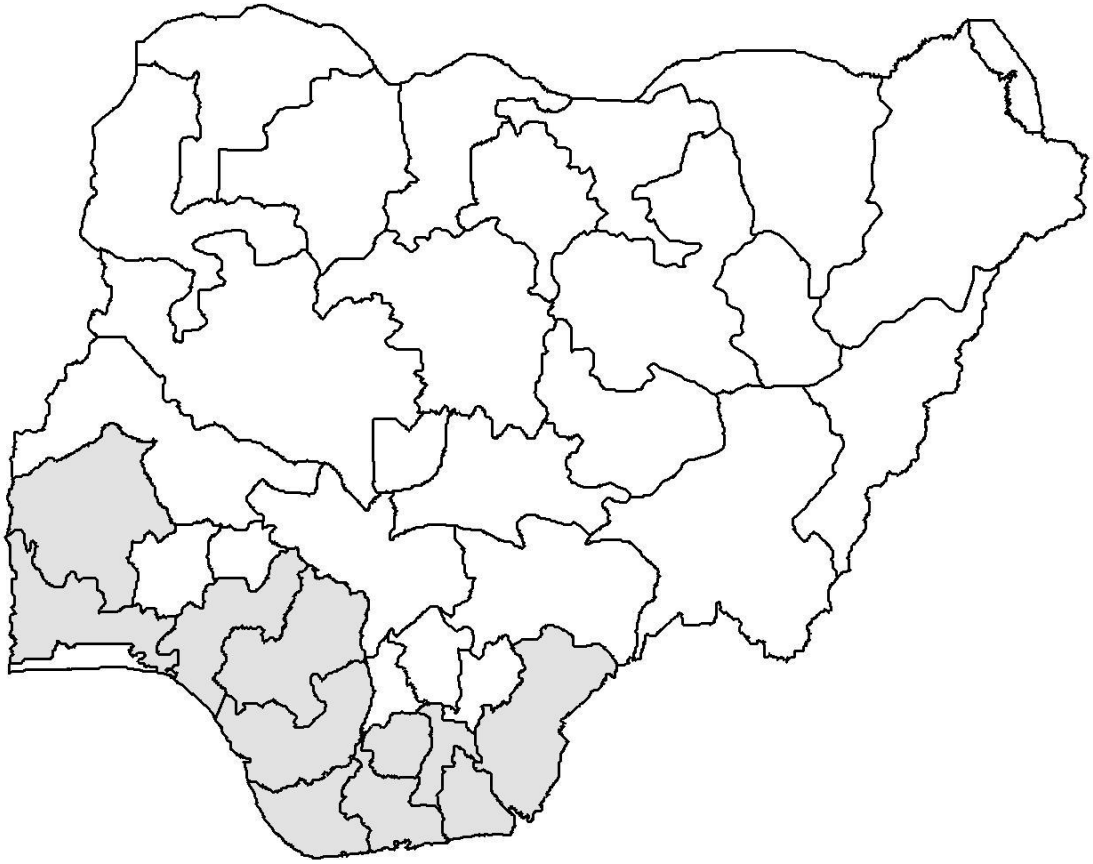

Figure 1. Map of Nigeria showing the eleven study states.

Table 1. Composition of population and sample.

Institution	Total population	Number sampled per institution/ individual
Research	6	6
Government Agencies	5	3
Technology Transfer	8	7
Farmers	110	60
Marketers	20	19
Total	149	95

(Adesina and Baidu-Forson, 1995; Mongeet al., 2008) For other categories of staff in the system, research agencies provided 67.5%, technology transfer 20%, while government agencies provided 12.5%. IITA contributed 47% of the total workforce in the research group, which included 29% of the scientist in the system and 50% of staff in the middle level manpower group. The higher percentage contribution of staff in plantain and banana innovation system by IITA may not be unconnected with the high level of funds available to the Institute and its international status which gives it the global recognition for plantain and banana work in tropical Africa. Also, the need to justify donor's funds and mandates contributed to the Institute's leading role in the innovation system and technological capability (Ortiz, 1997).

In terms of capacity building in the innovation system, Table 2 reveals that a total of 2191 trainees of different categories were trained in plantain and banana innova-tion system from 2001 to 2006. Research stakeholders accounted for 4% of the trainees and government agencies had no trainee. This might not be unconnected with their traditional role of policy formulation. However, technology transfer agents were responsible for training 96% of the trainees on plantain and banana. The high number of trainees contributed by technology transfer agents ahead of other stakeholders might not be uncon-nected with her closeness to end- users (farmers) who are in the majority of those trained by the technology transfer

Table 2. Distribution of respondents according to technical capability and capacity building.

No.	Institute	BSc	Staff profile						Trainees profile						
			MSc	PhD	% PhD	Others	Total staff	% total staff	BSc	MSc	PhD	% PhD	Others	Total Trainee	% Trainee
1	IITA ®	10	7	4	17.4	14	35	20.1	0	8	2	67	2	12	1
2	MOCA ®	1	1	1	4.35	2	5	2.9	0	0	0	0	4	4	0
3	RMRDC ®	0	1	1	4.35	3	5	2.9	0	2	1	33	0	3	0
4	UI ®	4	0	2	8.7	0	6	3.4	0	0	0	0	0	0	0
5	NIHORT®	3	2	3	13	8	16	9.2	35	10	0	0	17	62	3
6	UNN ®	2	3	3	13	0	8	4.6	2	3	0	0	0	5	0
Total ®		20	14	14	60.9	27	75	43.1	37	23	3	100	23	86	4
7	NABDA(G)	0	3	1	4.35	0	4	2.3	0	0	0	0	0	0	0
8	PBDP (G)	2	3	0	0	2	7	4.0	0	0	0	0	0	0	0
9	NAFDAC (G)	0	1	2	8.7	3	6	3.4	0	0	0	0	0	0	0
Total G		2	7	3	13	5	17	9.8	0	0	0	0	0	0	0
10	Abia ADP (T)	4	1	0	0	1	6	3.4	0	0	0	0	5	5	0
11	Agripact	4	1	1	4.35	0	6	3.4	0	0	0	0	5	5	0
12	Akwa Ibom ADP	19	1	0	0	1	21	12.1	130	0	0	0	875	1005	46
13	Edo ADP	3	2	0	0	2	7	4.0	20	0	0	0	980	1000	46
14	Ogun ADP	0	9	0	0	1	10	5.7	5	0	0	0		5	0
15	FFAI	11	0	3	13	0	14	8.0		0	0	0	45	45	2
16	NAOC	11	2	2	8.7	3	18	10.3		0	0	0	40	40	2
Total T		52	16	6	26.1	8	82	47.1	155	0	0	0	1950	2105	96
Gran Grand total		74	37	23	100	40	174	100	192	23	3	100	1973	2191	100
% Re Research contribution		27	38	61	61	68	43	43	19	100	100	100	1	4	
Con Government contribution		3	19	13	13	13	10	10	0	0	0	0	0	0	
%Tec Tech transfer contribution		70	43	26	26	20	47	47	81	0	0	0	99	96	

Source: Field survey, 2007.

agents. This is in agreement with some authors who asserts that extension personnel are better placed for technology transfer and delivery (Conley and Udry, 2001; Dinar et al., 2007).

The implication of these is that for optimum farmers' integration and technology adoption, technology transfer agents need to be strengthened/empowered as they have the largest reach with farmers (end users). A breakdown of trainees' categories reveals that research was responsible for 100% of the trainees in the scientist's category (PhD level). This is not unexpected as research had the highest number of staff in that category and thus the technical capability to handle trainees at that level. For the middle level manpower trainees, research contributed 28%, while technology transfer agents contributed 72% of trainees in the category. The paucity of high level trainees (0.13%), in the study (Table 2), suggests the need for improvement in the development of high level manpower in the plantain and banana innovation system. This deserves attention so that technology generation can be sustained in the system. Hall et al. (2003)

Table 3. Resources available for plantain and banana technology validation.

No.	Institute	Total land (ha)	Land for *Musa* (ha)	% land for *Musa*	No. of on-farm trials	No. of laboratory	Workshop attendance
1	IITA (R)	100	10	10.00	22	3	4
2	MOCA ®	300	2	0.67	3	1	3
3	NIHORT®	350	3	0.86	3	2	2
4	RMRDC®	3	0	0.00	0	1	0
5	UNN®	20	1	5.00	1	2	2
		773	16	2.07	29		
6	Abia ADP(T)	4	1	25.00	1	0	
7	AGRIPACT(T)	2	1	50.00	1	0	3
8	AIbom ADP(T)	155	3	1.94	144	0	2
9	EDO ADP (T)	8	2	25.00	6	0	3
10	FFAI (T)	3	1	33.00	2	0	3
11	NAOC (T)	27	1	3.70	3	0	2
12	Ogun ADP (T)	50	2	4.00	3	0	2
	Total	249	11	4.42	160	0	3
	Grand total	1022	27	2.64	189	8	

Source: Field survey, 2007.

had earlier reported that innovation systems are sustained by high turn over of trainees facilitated by technology transfer agents who are trained by the research group.

Capabilities for technology validation

The total land available to stakeholders for research was 1022 ha out of which only 27 ha (2.64%) was dedicated to plantain and banana research and technology validation work in the innovation system (Table 3). Research organizations contributed 773 ha (76%) of land to the innovation system; out of this only 2.07% was dedicated to plantain and banana research. IITA committed 10% of its total land holding to banana and plantain research while other stakeholders also had negligible area of land available for plantain and banana research. MOCA had 0.66%, while NIHORT with national mandate for fruits and vegetables committed only 0.86% of its land to plantain and banana. All the research stakeholders had laboratories, where plantain technologies were developed and validated for further dissemination.

All the research stakeholders except UI and RMRDC had on-farm trials where research results were further validated, but the number of on-farm trials varied from one institute to the other. IITA had 22 sites, MOCA and NIHORT had 3 each and UNN had one site. Research stakeholders had 15.3% of on-farm trial in banana and plantain; the remaining 84.7% of the on-farm trials were contributed by technology transfer stakeholders in the system. Altogether there were 189 plantain and banana on-farm trials spread across 12 states of Nigeria, technology transfer agents alone had 160 on farm trials (84.7%). This result is not a deviation from the long held belief that technology transfer agents are catalyst to technology delivery and can stimulate social interactions needed to foster innovation promotion (Monge et al., 2008). Also the high number of on farm trials by the technology transfer agents was as a result of learning acquired through various workshop interactions among the stakeholders and principal technology generators (research) in the system. Only 50% of research stakeholders had been invited by other research stakeholders to participate in technology development while, RMRDC, UI and UNN had never been invited by other stakeholders to participate in technology development. All but 8.3% had attended banana and plantain workshops. T he paucity of intra stakeholder exchange of ideas, knowledge and interactions is a limitation to knowledge sharing and interactive learning needed to make produc-tive use of knowledge as observed by Hall and Dijkman (2006).

Farmers learning and technology adaptation

Results from the sixty farmers sampled (Table 4) revealed a narrow base of technology awareness by primary farmers, that is farmers involved in on-farm trials. The major source of awareness and learning common to all the sampled farmers was field day, which is a program organised to showcase a technology. The innovations are displayed, explained and then operated by participants. Okunade (2007) had reported that field day demonstration of innovations and technologies is the most effective extension teaching methods in acquiring knowledge, skills and attitude.

Table 4. Farmers awareness and adoption of technology.

No.	State	No of primary farmers	Source of awareness	No farmers with technology sampled	Two main Sources of awareness	Total farmers sampled
1	Abia	5	ADP/IITA/field day	10	Field day/ farmers	15
2	Akwa-Ibom	5	ADP/IITA/field day	10	Field day, farmers	15
3	Edo	5	ADP/IITA/field day	10	Field day/ farmers	15
4	Ogun	5	ADP/IITA/field day	10	Field day/farmers	15
Total		20		40		60

Source: Field survey, 2007.

Table 5. Technology development, awareness, and dissemination/adoption status.

No	Innovations developed	Institution of development	Dissemination Year	Main agency of dissemination	Main Year of awareness	Aware-ness %	Adoption status (%)	Adoption/ Awareness ratio
1	New varieties	IITA	1999	Extension	2001 - 2007	85	82	0.96
2	Planting time	NIHORT	1999	Extension	2001 - 2007	67	32	0.48
3	Type of sucker	NIHORT	1997	Extension	2001 -2007	92	50	0.54
4	Hot water treatment	IITA	1999	Extension	2001- 2007	92	27	0.29
5	Spacing	NIHORT	1999	Extension	2001 - 2007	82	56	0.68
6	Pruning	IITA	2000	Extension	2001- 2007	72	62	0.86
7	Mulching	UNIVERSITY	2000	Extension	2001 - 2007	73	35	0.48
8	Fertilizer	UNIVERSITY	1999	Extension	2004 - 2007	38	29	0.76
9	Post harvest	IITA	2000	Extension	2004 - 2007	58	30	0.52
10	Weeding	UNIVERSITY	1996	Extension	2004 - 2007	35	15	0.43
11	Sucker Multiplication	IITA	2003	Extension	2004 - 2007	68	47	0.69
12	Debudding	IITA	2000	Extension	2004 - 2007	55	48	0.87
13	Desuckering	IITA	2000	Extension	2004 - 2007	55	28	0.51
14	Herbicide	UNIVERSITY	2000	Extension	2004 - 2007	52	35	0.67
15	Staking	NIHORT	1996	Extension	2004 - 2007	50	45	0.9

Source: Field survey, 2007.

Identification and examination of the levels of adoption of technology developed in plantain and banana innovation system in Nigeria

A sample of innovations developed and disseminated (Table 5) revealed that 15 technologies were developed and widely disseminated among the stakeholders in the innovation system.

The data also revealed the innovations developed, institution of development, year of first dissemination, year of awareness, awareness status and adoption status as well as aware/adoption ratio. The results in Table 5 revealed that there was a time interval between innovation development, dissemination and awareness; it also showed marked difference in awareness and adoption status.

Furthermore, the result revealed that extension

(ADP/NGO) was the highest disseminating agents of these technologies. This result is in agreement with many authors on the facts that technology goes through a period of acquisition, adaptation, dissemination, adoption and diffusion; it also confirms the stepwise nature of adoption (Longo, 1990; Lindner et al., 1979; Rogers and Kincaid, 1981).

Conclusion

The study concluded that various stakeholders have different technological capability and resources that can be better harnessed through formal and informal interactions as it was through workshop in the study. The fifteen technologies identified, disseminated and used in the innovation system emanates from different actors and are complimentary to each other, as proper use of one enhances the productivity of another. Learning is thus enhanced when stakeholders saw the operations of a technology with another stakeholder, this unimpeded interaction, knowledge exchange and adaptation removed the hitherto unhealthy competitive interaction among stakeholders as technology becomes the commonwealth of the innovation system that can be used by stakeholders without hindrance. The high adoption status of the technologies recorded was attributed to the complimentary roles of agents in the innovation system during the intervening years between awareness and adoption of innovations in the study.

However the paucity of high level trainees (0.13%) in the study is not supportive of plantain and banana innovation system and thus deserves attention if technology generation will have to continue in the system. IITA and NIHORT were identified as the major technology generating agencies in the plantain and banana innovation system, while the extension (ADP) was the main disseminating agents of the technologies.

Recommendations

There will be need to develop a framework for analysing plantain and banana innovation system using the model of plantain resource training centres discussed in this study.

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