Dynamics of technology adoption in rural-based cassava processing enterprises in South-West Nigeria

Adebayo, K.
Cassava: Adding Value for Africa (C:AVA) Project Office, Natural Resources Institute,
University of Greenwich, Chatham Maritime, Kent ME4 4TB, United Kingdom
E-mail: k.adebayo@greenwich.ac.uk; kolawole_adebayo@hotmail.com

Abstract: This study explores the intricacies of technology adoption in rural based cassava processing enterprises in southwest Nigeria. Primary data were obtained from 265 rural based cassava processors selected through a multistage sampling procedure and 37 purposively selected researchers/extension personnel. The data were collated and presented with the use of descriptive statistical tools and other descriptive frameworks. The data obtained on the key factors influencing the technology adoption process were used to test the two null hypotheses tested in the study. The results show that most of the cassava processors (57.74%) have adopted the cassava grater. Other cassava processing innovations that they are aware of are the improved method of cassava processing to *gari*, *fufu*, flour, chips and starch. Adopters and non-adopters of the cassava grater differ significantly in most of their social, economic and innovation related characteristics. The two exceptions are the estimated value of cassava processing enterprise (Naira) and the average distance regularly traveled (km/week). The adopters perceive the use of the innovation as less complex than existing practice and have been in contact with the innovation for longer than non-adopters. There were significant relationships between the adoption of the cassava grater and processors' household size, number of groups affiliated to, average distance regularly traveled, the relative advantage from using the grater, its compatibility with existing practice and the processors' attitude to adopting the grater. The research subsystem dominated the technology development processes of cassava processing sector. The study concluded that approaches for promoting cassava processing interventions need to be flexible to accommodate the intricacies in the system. It then proposed three complementary approaches for promoting cassava processing innovations in southwest Nigeria.

Keywords: Adoption, Cassava, Processing, Technology, Rural

Acknowledgement: This work was supported by a research grant provided by the International Foundation for Science (IFS) - S/3612.

INTRODUCTION

Nigeria produces more than half of total world cassava. But most of the cassava is traditionally consumed by processing the fresh roots into *gari*, *fufu*, and flour (Adebayo *et al*., 2003a; Adebayo *et al*, 2003b). The crop gained national prominence as a potential foreign exchange earner for the nation following the pronouncement of a Presidential Initiative on Cassava in 2002. But this cannot be achieved without the uptake of key innovations that tend toward higher levels of commercialisation in cassava production and processing. Since, traditional cassava processing takes place

predominantly in rural areas, it is important that rural people adopt appropriate cassava processing technologies along with cassava production technologies for any meaningful impact to be made on the food system.

The study of adoption and diffusion of innovations are central to understanding the process of change in human societies. But, approaches to exploring the adoption process have changed over time. While early studies have simply focussed on measuring the awareness of innovations (Ryan and Gross, 1943; Patel and Anthonio, 1971, Obibuaku and Hursh, 1974), the focus in the 1980s and 1990s was on establishing relationships between various 'independent' factors and the adoption of new innovations (Chikwendu *et al*., 1995; Arene, 1994; Apantaku and Apantaku, 1998; Onu, 1991). More recent studies are using various kinds of dynamic models to explore the adoption process, both from predictive and evaluative perspectives (Siegmund-Schultze and Rischkowsky, 2001; Sinclair, 2001; Adebayo, 2002; Neupane *et al*., 2002). The current study adopts a synthesis of methods involving the use of a predictive model and a more participatory data gathering and analysis using multi-framework models as in the works of Grassi (2003) and Garforth *et al* (2003). It is important however that as new post-harvest technologies emerge, adoption and diffusion researchers need to re-evaluate existing assumptions and models about the technology adoption and diffusion process. Against this background, this study explores the intricacies of technology adoption in rural based cassava processing systems with a view to contributing to a greater understanding of the process. Furthermore the study tested a null hypothesis that: there are no significant differences between the socio-economic characteristics of adopters and non-adopters of selected cassava processing technologies.

METHODOLOGY

Southwest Nigeria is bounded in the north and east by the Kwara and Kogi States of Nigeria; in the West by the Republic of Benin and in the south by the Atlantic Ocean (Figure 1). The 3 main agro-ecological zones in the area are the swamp, on the Atlantic coast; tropical rainforest, in the middle; and guinea savannah in the north. Cassava is grown widely in all three zones. ADPs are responsible for field level agricultural extension services in Nigeria. This area is also home to the International Institute of Tropical Agriculture, (IITA) Ibadan; the University of Agriculture, Abeokuta, eight (8) conventional Universities with faculties of agriculture and four (4) National Agricultural Research Institutes. A random sampling technique was used to select 3 rural locations from each of these agro-ecological zones, from the village listing available with the Agricultural Development Programmes (ADPs) operating in the area.

In each of the nine (9) locations selected for this study, a systematic sample of 30 rural based cassava processors were selected from a list purposively compiled for this study. The study thus interacted with 270 rural based cassava processors. Of these, only 265 responses were complete and therefore considered valid for further analysis. An interview schedule was used to facilitate interviews with the selected rural based processors. The interview schedule was administered by 3 trained enumerators. However, more detailed participant observation and focus group discussions were held

in 3 locations (Oja-Agbe, Iseyin in the savannah; Igbatoro, Akure in the forest and Ibiade, Ogun Waterside in the swamp) to obtain qualitative data that provided detailed insights into technology adoption and non-adoption amongst cassava processors. The study also systematically selected a sample of 50 researchers and extension personnel from the staff list of some of the research and extension institutions in Southwest Nigeria. Of these, only 37 respondents made up of 15 extension personnel and 21 researchers returned the mailed questionnaires.

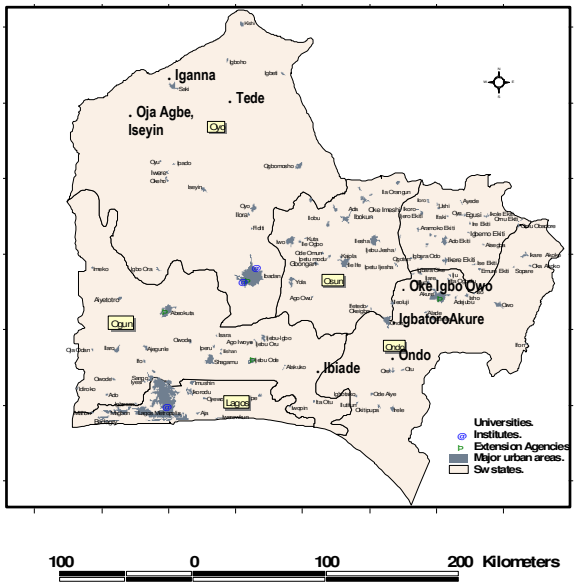

Figure 1: Map of southwest Nigeria showing the relative position of study locations

Both descriptive and inferential statistical tools were used in this study. The descriptive tools (means, percentages, ranking, and charts) were obtained using Microsoft Excel® while the inferential tools analysis (students' t - test and Spearman (rho) rank correlation) for testing the null hypothesis were obtained using the Statistical Package for the Social Sciences (SPSS) version 10.0. Furthermore, the framework described by Garforth *et al* (2003) was used to explore the process of development of selected cassava processing technologies and determine the extent to which the process predisposes the technologies to adoption. The multi-framework model used in characterising food processing innovations has been used by Grassi (2003).

RESULTS AND DISCUSSION

Description of cassava processors

Most (97.36%) of the cassava processors interviewed were between 21 and 60 years old. The majority in the rainforest zone (61.18%) are younger than those in the Guinea savannah and the swamp zones (Table 1). While most (96.67%) of processors in the guinea savannah are females, over half (50.6% and 55.6% respectively) of the cassava processors in the rainforest and swamp zones are males. This finding corroborates the findings of some earlier studies in the region indicating that as cassava processing gets capital intensive, the proportion of men involved in the business tend to surge (Adebayo *et al*., 2003a). In all, over 80% of the cassava processors are married (Table 1). The modal household have between 3 and 6 persons, even though a wider spread is observed in the swamp agro-ecological zone. This finding is similar to that of Adebayo *et al* (2003b) in Ogun State of Nigeria where the average household size was found to be 7 persons. Most of the respondents claim to occupy the first or second position within their households. This signifies the relative position of income from cassava processing within the selected households in southwest Nigeria. The involvement of heads of households (first position) and their immediate lieutenants (first wife or first sons) in an economic activity is an indication of the role of that activity in sustaining the livelihood of members of that household (Fabusoro, 2005). Table 1 also shows

that the possession of a secondary education is common amongst the cassava processors interviewed. In fact, some of the cassava processors hold higher degrees in the formal education system. This may be due to recent focus of national policy on the cassava post-harvest sector as a key industrial and export sector under the Presidential Initiative on Cassava.

Unlike in the Guinea savannah, where there is a clear dominance of natives in cassava processing, almost two-fifth and one-quarter of the respondents in the rainforest and the swamp zones respectively are non-natives. While there are more Muslims in cassava processing in the guinea savannah and the swamp zones, Christians dominate in the rainforest. In addition, most of the respondents travel less than 40km/week. Fabusoro (2005) noted that regular trips of more than 5km are an indication of low level of livelihood diversification. In this case, it seems that the cassava processors' activities is mainly focussed on cassava processing with little diversification. Finally, Table 1 shows that except in the Guinea savannah, group membership is unpopular among the cassava processors. This is similar to the findings of Adebayo *et al* (2003a). In the Guinea savannah, it seems that the activities at Oja-Agbe (Farmers' Market) in Iseyin are a strong force for keeping cassava processors more active in group membership than other zones. Almost all the cassava processors interviewed in the Guinea savannah belonged to *Gari Gbayi*, the umbrella association for all cassava processors in the zone. Other groups found in the study are various forms of cooperatives in the rainforest and swamp zone are the farm settlements' farmers' group at Ibiade in Ogun Waterside as well as various farmer's groups and cassava growers' associations.

Table 1. Some characteristics of cassava processors interviewed in the study

Variables	Zones			Total
	Guinea savannah (N = 90)	Rainforest (N = 85)	Swamp (N = 90)	(N = 265)
Age (years)	21-40 (56.7)*	21-40 (61.2)	41-60 (77.8)	21-40 (44.5) 41-60 (52.8)
Sex	Female (96.7)	Male (50.6)	Male (55.6)	Female (63.8)
Marital status	Married (60.0)	Married (84.7)	Married (96.7)	Married (80.4)
Household size (persons)	3-6 (71.1)	3-6 (78.8)	3-6 (33.3)	3-6 (61.1)
Position in household	2nd (54.4)	2nd (38.8)	1st (52.2)	2nd (44.5)
Education	Primary (17.8) Secondary (56.7)	Primary (32.9) Secondary (42.4)	Primary (30.0) Secondary (35.6)	Primary (26.8) Secondary (44.9)
Ancestry	Native (97.8)	Native (54.1)	Native (72.2)	Native (76.2)
Religion	Islam (52.2)	Christianity (65.9)	Islam (53.3)	Christianity (49.1)
Average distance regularly travelled (km/week)	Less than 40km (80.0)	Less than 40km (50.6)	Less than 40km (34.4)	Less than 40km (55.1)
Membership of groups	2 or more groups (56.7)	No groups at all (70.6)	(68.9)	No groups at all (52.1)

Source: Field survey, 2006
*Figures in parentheses are percentages

Description of research and extension personnel

Research and extension personnel have a mean age of about 40 years. They are mainly (89.25%) male, married (94.6%) and with more than 18 years of formal education consisting of 24% Higher National Diploma (HND) holders and 43.2% Master of Science Degree (MSc) holders (Table 2). They have attended an average of 2.4 training sessions on cassava processing and have organised an average of 1.7 training sessions on cassava processing. Their mean income is N38,773.48 (about ($388) per month and over 60%

have less than 10 years experience in cassava research and extension. They belong to an average of 7 professional associations and are mainly natives of their areas of activity. They are mainly (64.9%) Christians and more than half travel more than 200km regularly (Table 2). All these seem to indicate some homogeneity amongst the cassava processors and extensionists and researchers interviewed. According to the theories of message reception and processing, these similarities in the socio-economic characteristics of participants in a the communicative processes leading to the adoption of cassava processing innovation may mean that effective information exchange in terms of shared meaning would take place, but does not guarantee visible change in the either group at the end of the communication exercise (Littlejohn, 1999; Ostrom *et al*, 1994; Krippendoff, 1993).

Table 2. Some characteristics of research and extension personnel interviewed in this study (N = 37)

Variable	Mean/Mode	Standard deviation
Age (years)	40.41 years	4.01 years
Sex	89.2% Male	n.a.
Marital status	94.6% Married	n.a.
Level of formal education (years)	18.3 years	6.7 years
Highest educational qualification	HND (24.3), M.Sc. (43.2)	n.a.
Number of cassava training attended	2.4	2.4
Number of training organized	1.7	2.6
Income (Naira/month)	N38,773.48	N29,509.45
Experience in cassava res. and extension (yrs)	Less than 10 years (64.9)	n.a
Number of professional bodies belonged to	7	5
Ancestry	Non-native (35.1)	n.a.
Religion	Christianity (64.9)	n.a.
Average distance regularly travelled (km)	Less than 200 Km (47.4)	n.a.

Source: Field survey, 2006

Cassava processing technologies adopted by rural-based cassava processors in Southwest Nigeria

Cassava processing in the rural areas of Southwest Nigeria has gone through several changes over time. This is more evident in the range of technologies found in the cassava processing systems. They vary from completely manual processing systems to partially and fully mechanical cassava processing systems. In this study, extension officers and researchers ranked the cassava processing technologies they have worked with over time. The cassava grater emerged the most prominent with 13 out of 37 respondents ranking it as first. This finding may explain the variety of cassava graters available to cassava processors in southwest Nigeria. Other cassava processing technologies on which extension personnel and researchers had worked are the processing of cassava tuber into chips and flour for industrial use; drying of cassava products; processing of cassava root into high quality starch and odourless *fufu* as well as improved packaging and storage technologies. This group of technologies are particularly favoured by the Presidential Initiative on Cassava which seeks to facilitate industrial use of cassava to diversify the economic base of the nation and promote foreign exchange earning opportunities from the export of high quality cassava products from Nigeria.

Similarly, most of the cassava processors interviewed have tried the use of the cassava grater at least once in their processing experience. As

such, in this study, the cassava grater was selected for the purpose of describing adopters and non-adopters. Adoption of the cassava grater was measured in terms of the length of time the cassava processors devote to the use of the technology and adopters are considered as at least devoting some of their time more than zero to the use of the technology. Of the 265 cassava processors whose responses were subjected to analysis in this study, 153 (57.74%) adopted the cassava grater (Table 3). The reasons for the widespread adoption of the technology were explored during the focus group discussions. Five major themes emerged during the discussions. These are that "they require less labour"; "they are easy to practice", "they give good quality products", "they are faster than the old method and compatible with existing practice". These reasons are consistent with characteristics of a good innovation as evident in the literature (Adebayo and Adedoyin, 2005; Adebayo, 1997; Adams, 1988)

Table 3. Innovations adopted by cassava processors interviewed

Practices adopted	Zones			Total
	Guinea N = 90	Rainforest N = 85	Swamp N = 90	N = 265
Cassava grater	86.67	41.18	44.44	57.74
Screw press	11.11	14.12	10.00	11.70
Improved method of processing *gari*	0.00	8.24	15.56	7.92
Frying machine	0.00	3.53	6.67	3.40
Steel frying pot	0.00	0.00	7.78	2.64
Processing cassava flour	0.00	2.35	3.33	1.89
Processing cassava to starch	0.00	5.88	0.00	1.89
Hygienic methods of processing	1.11	0.00	2.22	1.13
Curumbus grinder	0.00	0.00	3.33	1.13
Mechanical peeler	1.11	1.18	0.00	0.75
Others	0.00	9.43	1.11	3.41
None	0.00	14.12	5.00	6.42

Source: Field survey, 2006

Test of hypothesis

The null hypothesis that there are no significant differences between the social, economic and innovation related characteristics of adopters and non-adopters of the cassava grater was tested. The descriptive analysis results show that adopters of cassava grater are older, with larger household sizes and stayed longer in school than the non-adopters. They also have longer cassava processing experience and run larger cassava processing enterprises where more persons are also employed. The adopters travel more widely than non-adopters and consider the innovation more compatible to their existing practices perceives the use of the innovation as less complex than existing practice and have been in contact with the innovation for longer than non-adopters.

Table 4 presents the results of the Student's t-test for the hypothesis. All the listed characteristics of the adopter-non-adopter respondents are significantly different but two exceptions are the estimated value of cassava processing enterprise (Naira) and the average distance regularly travelled (km/week). This finding suggests that the savings in labour use occasioned by the adoption of the cassava grater are not converted to higher outputs from the

processing enterprises. This may be due to the dominance of traditional institutions in the marketing of traditional food commodities (including most cassava products) with strong influence in the control of quantities that each processor is allowed to supply on a given market day (Adebayo, 2005).

Studies have shown that the factors influencing technology adoption can be social, economic, innovation related, process related or exogenous (Chickwendu *et al*, 1995; Collinson, 2001; Agbamu, 1995, Adebayo *et al*., 2002).

Table 4. Results of test of difference of means

Independent variables	t	df	p (2-tailed)	Decision*
Age (years)	-8.311	264	0.00	Reject Ho
Household size (persons)	-28.563	264	0.00	Reject Ho
Education (years)	-27.239	255	0.00	Reject Ho
Number of cassava training attended	-32.820	264	0.00	Reject Ho
Income (N/month)	10.591	262	0.00	Reject Ho
Cassava processing experience (years)	-23.456	264	0.00	Reject Ho
No. of employees in cas. processing ent. (pers.)	-25.607	264	0.00	Reject Ho
Est. value of cassava processing ent. (Naira)	1.801	244	0.07	Accept Ho
Number of groups affiliated to	-33.011	264	0.00	Reject Ho
Average distance regularly travelled (km/week)	1.741	261	0.08	Accept Ho
Relative advantage index	-33.099	264	0.00	Reject Ho
Compatibility index	-33.048	264	0.00	Reject Ho
Risk level	-33.156	264	0.00	Reject Ho
Complexity index	-33.193	264	0.00	Reject Ho
First contact with innovation (years)	-25.871	264	0.00	Reject Ho
Attitude score	16.122	264	0.00	Reject Ho

* = Decision criterion is reject null hypotheses when $p > 0.05$ df = Degrees of freedom

The process of development of selected cassava processing technologies

During the focus group discussion with some researchers, they were asked to describe the research process they utilised in their chosen cassava processing technology. The processes described varied from 'laboratory-based controlled experimental situations later demonstrated to processing groups' to 'in-situ study of existing local technologies for "modelling and upgrading" to more farmer-oriented approaches involving technology adaptation and adoption'. Furthermore, data obtained from the questionnaire survey of researchers and extension personnel was used to rate the processes of developing cassava processing technologies mentioned by the respondents. As shown in Table 5, the dominant research process is demand-driven, target specific, locally funded, easily adaptable, compatible with local practices and cheap to adopt. This finding suggests a close interaction between cassava processing technologies developed and promoted in southwest Nigeria and processors' needs. It however implies that the high level of local relevance of the technologies may impinge on the regional or wider relevance except possibly for any basic science output from the process.

Table 5. Rating of the process of developing cassava processing technologies

Criterion	Very high	High	Moderate	Low	Very low
Demand driven	10	13	10	2	2
Target specific	10	16	5	4	2
Locally funded	9	17	3	3	5
Easily adaptable	16	12	6	0	3
Compatible with local practices	19	10	7	1	0
Cheap to adopt	13	12	7	2	3

Adapted from: Grassi (2003)

The researchers and extension personnel interviewed in this study were asked to rank the dominant extension and advisory approaches adopted for cassava processing innovations in southwest Nigeria. The result presented in Table 6 adapted from the work of Garforth *et al* (2003) shows that the focus of the advisory approach is business rather than social policy goals; client specific. The advisory service sought to promote a specific view (possibly influenced by researchers' and institutional goals) rather than helping clients to achieve their own objective. The objective of technology promotion exercises is mainly technology transfer rather than sustainably influencing the process. Technology management decisions are made at the individual entrepreneurial level and the scope of advice offered is for information and does not include financial incentives; in fact clients are sometimes required to pay for the advisory service. Respondents agree that the process is essentially top-down and delivered by the public sector (mainly the ADPs) and are short-term in nature given on one-to-one basis. This characterisation suggests that the extension and advisory services in southwest Nigeria are essentially traditional and dominated by the research sub-sector. They provide top-down services with individual enterprises as their targets and aims mainly to transfer technology "developed" by the research sub sector.

Table 6. Rating of the extension or advisory approaches for cassava processing technologies

Dimension	One extreme	Rating					The other extreme
Focus	Business	**X**					Social policy goals
Specificity of clientele	Narrow target category		**X**				Broad or unspecified target
Means of influence	Promote specific view		**X**				Help client achieve own objectives
Programme objectives	Technology transfer	**X**					Process oriented
Scale of decision	Individual management unit	**X**					Group, community or area (collective decision)
Scope of advice	Information and advice	**X**					Financial incentives within the scheme
Payment for service	Clients pay		**X**				Free to clients
Direction of information flow	Top-down	**X**					Bottom-up
Information delivered by	Public sector	**X**					Private sector
Duration	Short term campaign		**X**				On-going
Intensity	No one-to-one advice		**X**				All one-to-one advice

Adapted from: Garforth *et al* (2003)

In this study, three complementary approaches are proposed; "innovation mapping", communication and "meeting the expectations" approach.

The innovation mapping approach is based on the observed level of cosmopoliteness among researchers and extension personnel interviewed in this study and the spatial distribution of innovative centres (universities, research institutes and extension organisations) in relation to locations where cassava processors are residents. Most of the researchers and extension personnel studied travel regularly. This suggests that information flow within the cassava processing system in southwest Nigeria can benefit from a system which allows innovative centres within the geographical bounds of southwest Nigeria to freely share information on what each entity in the technology subsystem in working on, with whom are the innovations being tried, what are its prospects and it failures?

The communication approach is based on the assumption that communication is intertwined with all aspects of human life. Much of people's communication experiences are shaped by the sources of their information and the sources of information they regularly use. In this study, cassava processors' main sources of information about cassava processing innovation are the radio, extension agents, colleagues and friends, research institutes and television. The implication of all these is that when efforts are applied at technology dissemination to provide information about cassava processing on radio, through extension agents and television, more personal sources such as colleagues and friends can facilitate their further spread within the technology utilisation subsystem. This position is corroborated by the fact that most cassava processors, irrespective of the agro-ecological zone, will adopt cassava processing innovations from known sources of information. Such a feeling could be put to good use in the promotion of cassava processing innovations. Sources perceived as "good" offers ample fora for the conscious use of information dissemination to influence the opinion of cassava processors.

The "meeting the expectations" approach is based on the assumption that in a learning process, interest is essential for learning, memory and use of what is learnt. One of the key motivators for keeping the interest of adult learners is meeting their expectations. In this study, cassava processors look for equipment that will reduce the drudgery associated with each stage of cassava processing. At the same time, they expect cassava processing innovations to be "available at affordable prices", "require less labour and save time". They expect researchers to organize training workshops for extension personnel and cassava processors on new innovations, develop affordable innovation and to concentrate on research on innovation that could be utilized locally. Their expectations from government are to provide fund and make processing equipment available at subsidized rate, assist processors in getting the equipment for new innovation, fund the technology developing process and provide fund for all people involved in processing innovation. They expect consumers of cassava product to be ready to buy the products emerging from new innovations, desist from discriminating against machine produced goods and offer suggestions or observations. One key advantage of this approach is that it provides all key actors in the rural-based

cassava processing systems to know exactly what to provide to attain an excepted goal of the cassava processors.

CONCLUSION AND RECOMMENDATIONS

Cassava processing methods are many and processed products are diverse. As such, the approaches for promoting cassava processing intervention must be flexible enough to accommodate the diversity and intricacies in the system as well as produce sustainable response to promotional efforts.

REFERENCES

Adams, M. E. (1988) *Agricultural Extension in Developing Countries*. Longman

Adebayo, K. (1997) *Communication in Agriculture.* Greenlinks International. 102p.

Adebayo, K. (2005). "Traditional institutions and information uptake in the conduct of cassava *fufu* market". In: Porter, G., Lyon, F. and the Nigerian Food Marketing Network (2005). *Investigations on building a Food Marketing Policy Evidence Base in Nigeria*. Briefing Report. Department for International Development, United Kingdom. pp. 102-120

Adebayo, K. (2002) Simulation models of the adoption process in smallholder farming systems in Nigeria. PhD Thesis. University of Agriculture, Abeokuta

Adebayo, K. and Adedoyin, S. F. (2005). "Communication and advocacy strategies in extension". In: Adedoyin, S. F. (ed.) *Agricultural Extension in Nigeria*. Agricultural Extension Society of Nigeria. pp. 21-27

Adebayo, K., J. L. White, M. J. Morris, A. O. Dipeolu, I. A. Ayinde, T. S. Wandschneider, L. O. Sanni, O. B. Oyewole, K. Tomlins and A. Westby (2003a) "Innovativeness and stakeholdership in the *fufu* processing systems in Southwest Nigeria". *International Journal of Agricultural Sciences, Science, Environment and Technology* Series A, 3 (4):15-27

Adebayo, K., Anyanwu, A. C. and Osiyale, A. O. (2003b) "Perception of environmental issues by cassava processors in Ogun State, Nigeria – implications for environmental extension education." *Journal of Extension Systems.* 19: 103-112

Adebayo, K., Omotayo, A. M., Garforth, C. J. and Awotunde, M. (2002). "Small farmers' perception of the charateristics of new farm practices in Ogun State, Nigeria." *Journal of Extension Systems*. **18:** 79-93

Agbamu, J. U. (1995). *Analysis of farmers' characteristics in relation to adoption of soil management innovations in Ikorodu area of Nigeria*. Japanese Journal of Tropical Agriculture. 39(4):213-222

Apantaku, S. O. and Apantaku, F. S. ((1998). "Compatibility, relative advantage and cost characteristics: a study of factors influencing acceptance of soybean". *Acta Univ. agric. Et silvic. Mendel. Brun. (Brno).* Vol. XLVI, No 1, pp. 145-149

Arene, C. J. (1994). "Factor analysis of some quantitative attributes of smallholder rice farmers towards innovative behaviour in

Nigeria". Journal of Rural Development and Administration. 26(1):16-23

Chikwendu, D. O., Chinaka, C. C. and Omotayo, A. M. (1995). "Adoption of minisett technique of seed yam production by farmers in Eastern forest zone of Nigeria". Discovery and Innovation. 7(4):367-375

Collinson, M. (2001). "Institutional and professional obstacles to a more effective research process for smallholder agriculture". Agricultural Systems. 69(1-2):27-36

Fabusoro, E. (2005). "Analysis of socio-economic and spatial factors in livelihood diversification in Ogun State Nigeria." PhD Thesis, University of Agriculture, Abeokuta.

Garforth, C; Angell, B; Archer, J and Green, K (2003). "Improving farmers' access to advice on land management: lessons from case studies in developed countries". Agren Network Paper No. 125. 19p.

Grassi, de, A. (2003). *Genetically modified organisms and sustainable food security in sub-Saharan Africa: An empirical assessment of evidence to date*. Paper presented at the Foodafrica Meeting, held in Cameroon, 5-9 May, 2003.

Krippendorff, K. (1993). "The past of communication's hoped-for future." *Journal of Communication*. Vol. 43, pp. 34-44

Littlejohn, S. W. (1999). *Theories of Human Communication*. 6th ed. Wadsworth Publishing Company. 409p.

Neupane, R. P., Sharma, K. R. and Thapa, G. B. (2002). "Adoption of agroforestry in the hills of Nepal: a logistic regression analysis." *Agricultural Systems*. Vol. 72, pp 177-196

Obibuaku, L. O. and Hursh, G. D. (1974). "farmer practice adoption in the Eastern States of Nigeria." *Agricultural Administration*. Vol. 1, No. 2, pp. 115-123

Onu, D. O. (1991). "Factors associated with small-scale farmers' adoption of improved soil conservation technologies under intensified agriculture in Imo State, Nigeria". PhD. Dissertation, University of Nigeria, Nsukka

Ostrom, T. M., Skowronski, J. J. and Nowak, A. (1994). "Cognitive foundation of attitudes: It's a wonderful construct". In: Devine, P. G., Hamilton, D. L. and Ostrom, T. M. eds.) *Social Cognition: Impact on Social Psychology.* Academic, San Diego pp. 196-258

Patel, A. U. and Anthonio, Q. B. O. (1971). "An analysis of selected factors that influence the adoption of improved practices among tobacco farmers in Western State". *The Nigerian Agricultural Journal* 8(2):123-131

Ryan, B and Gross, N. C. (1943). "The diffusion of hybrid seed corn in two Iowa communities". *Rural Sociology*. 8:15-24

Siegmund-Schultze, M. and Rischkowsky, B. (2001). "Relating household characteristics to urban sheep keeping in West Africa". *Agricultural Systems*. 67(3):139-152

Sinclair, F. L. (2001). "Process-based research in sustainable agricultural development: integrating social, economic and ecological perspectives". *Agricultural Systems.* 69(1):1-3