Three Decades of Adoption and Diffusion Research in Nigeria: Lessons and Prospects

K. Adebayo

Department of Agricultural Extension and Rural Development, University of Agriculture, Abeokuta, Nigeria

ABSTRACT

Adoption of innovations is critical to the process of change in human societies. In Nigeria, the earliest adoption studies were conducted around 1970. The advent and proliferation of World Bank supported Agricultural Development Programmes (ADPs) in the 1980s however spurred off several adoption and diffusion studies, many of which are reviewed in this paper. The analysis showed that socio-economic factors are the most commonly considered variables in adoption studies in Nigeria. Several studies in the 1980s measured adoption rates of innovations, determined factors influencing adoption and identified differences in the characteristics of different client groups. By the 1990s, other issues such as types of innovations easily adopted and the time–lag in innovation adoption and diffusion were the foci of adoption and diffusion research in Nigeria. The findings of this study suggest that there is some difficulty in data collection in the conduct of adoption and diffusion research in Nigeria. It therefore recommended the use of Geographic Information System (GIS) data in the study of uptake of innovations by small farmers and standardization of scales for measuring several variables in adoption and diffusion research.

1.0 INTRODUCTION

The natural resource sector is very essential in the economic development of many countries. It contributes to the provision of food for the people, raw materials for industries, savings and tax revenue to support the development of other sectors of the economy, generation of foreign exchange and the provision of employment opportunities for the populace. The importance of this sector is more pronounced in the developing countries where it is the main thrust of national survival. But societies continue to require ideas, innovations and inventions emanating from others to improve the quality of life in their social systems.

The concepts of adoption and diffusion of innovations are central to the understanding of the process of change in human societies. Adoption of an innovation is commonly believed to have taken place when the innovation has been tried and accepted. For any social change to attain visible significance, some innovation concerning it must have been adopted and diffused through the social system. The study of adoption and diffusion of innovations has its root in a philosophical observation that "the number of any successful invention originating from any one society is always small. If every human group had been left to climb upward by its own unaided efforts, progress would have been so slow that it is doubtful whether any society by now would have advanced beyond the level of old stone age"(Anonymous). In studies about the concepts of adoption and diffusion of innovation, asking respondents whether a practice was acceptable has not been found to be very useful to the understanding of the processes involved (Franzel *et al.*, 1996; 2001). The literature on issues relating to the adoption of "improved" technologies in developing countries is voluminous. With the development and popularisation of the farming systems research and extension approach (FSR/E) in the 1980s (Zandstra *et. al.*, 1981; Norman *et. al.*, 1995).

In Nigeria, even though the earliest adoption studies were conducted around 1970 (Kidd, 1968; Patel and Anthonio, 1971), the advent and proliferation of Agricultural Development Programmes (ADPs) in the 1980s spurred off several adoption and diffusion studies, many of which are reviewed

in this study. Most of the studies were premised on the extensive time lag between the time farmers first hear about favourable innovations and the time they adopt them. They however assume that:

1. Such innovations are advantageous to all adopters and are thus concerned about low levels of adoption, rather than the process of developing the innovations.
2. Cross-sectional data gathering at one point in time is sufficient for the investigation of a process
3. Solely, the individual client rather than a visible or invisible group make innovation decisions.

Although, these assumptions may be true for many innovations, they are ready source of criticism for adoption and diffusion research. Therefore, the general objective of this study is to conduct a survey of adoption studies. Specifically, the study: examined the extent to which such studies have been carried out in Nigeria; established the key variables studied over the years; and explored the relationships established between these variables and adoption of innovations to form the basis for channeling the direction of future research in this subject area.

Understanding the Adoption and Diffusion Process

Research on agricultural technology adoption has been premised on the assumption that if the factors influencing it are known, then the reactions of farmers to the introduction of technological packages could be determined. The farm and household characteristics tested most frequently in adoption research for their association with testing and continued use of a practice included gender, level of formal education, household size, farm size and wealth level (Ladebo, 1999; Franzel *et. al.*, 2000). Sall *et. al.* (2000) points to government policy as an important factor in farm-level adoption of improved technologies. Furthermore, Hays and Raheja (1977) and Sall *et. al.*, (2000) have shown that farmers' perceptions of technology-specific characteristics, significantly influence adoption decisions relating to improved farm practices. Collinson (2001) identifies the process of technology generation as the main cause of the low adoption by small farmers in developing countries. Sinclair (2001) reviewed a series of studies in process-based research and concluded that the involvement of farmers in the technology development process is central for successes in the adoption of farm technologies. He however noted that in addressing longer-term sustainability issues, a predictive understanding of farmer adoption is needed. Arising from all these, models of the technology adoption process have been constructed in at least three ways. The first is a minimalist approach that assumes human behaviour is passive and unchanging, even in the face of significant global change. A second approach is bio-economic modelling, which confront the behavioural problem head-on and make very explicit assumptions about how people behave with respect to managing their resources. The third and most promising approach to modelling the adoption process is multiple, simultaneous regression models of human behaviour (Adebayo, 2002).

In order to explain the adoption process, Adebayo (1997) attempts to use models of interpersonal communication (Lasswell Formula, Lasswell, 1948), mass communication (Stimulus-Response Model, DeFleur, 1970), perception (Gebner's Model, Gebner, 1956) and psychology (Transactional Model, Jacques, 1984). It is clear that these models attempt to explain different components of the communication process that takes place in the technology adoption process. They however fail to take into cognition that the adoption process consists of a complexity of interactions between the people, their community and the prevalent social and economic conditions in the social system.

One model that gives impression to the complexity of the technology adoption process is the Rogers and Shoemakers (1973) paradigm of the innovation-decision process. The model was developed from a mass of empirical research on the diffusion of innovations. It was based on the assumption that there are at least four distinct steps in an innovation-diffusion process. These are knowledge, persuasion, decision and confirmation. It also identifies that diffusion of innovation normally involves different communication sources. Another very influential conceptualization of the technology adoption process is based on the work of Roling (1988) on the Agricultural Knowledge and Information Systems (AKIS) framework which posits that agricultural knowledge and information are dynamic entities which originate and move in a multi-directional manner among the various sub-systems of the complex AKIS.

3.0 METHODOLOGY

The population in this study is the adoption and diffusion studies in agriculture conducted in Nigeria. Two (2) Nigerian Universities were purposively selected as the base of the sampling exercise. These are the University of Nigeria, Nsukka, representing the conventional Universities' Faculty of Agriculture research and documentation system and the University of Agriculture, Abeokuta, representing the new generation Universities of Agriculture in Nigeria. From both Universities, a total of twenty-one (21) local and international agricultural and behavioural science journals were identified. These journals covered the period 1965 – 2000. A total of twelve (12) adoption and diffusion studies in Nigerian agriculture were identified. Supervised students' research projects, thesis and dissertations in the Departments of Agricultural Extension of both Universities were also examined. From these, eighteen (18) B.Sc. projects, five (5) M.Sc. theses and one (1) Ph.D. dissertation on adoption and diffusion of agricultural innovations in Nigeria were identified and selected for this study. By this process thirty-six (36) studies were selected and reviewed in this phase of the study.

The data retrieved from each of the selected study include:

1. Number and departmental affiliation of authors and Year of publication.
2. Geographical locations studied were described as: local (covering 1 or 2 Local Government Areas (LGAs) in a State). Zonal (covering 1or 2 agricultural extension zones in a State Agricultural Development Programme, ADP). State (covering a State of the Federation). Regional (covering one of the five agro – ecological zones of the country and national (spanning the entire Federation).
3. Innovations studied.
4. Data collection procedure adopted including sampling methods used, unit of data collection and the method of data collection
5. Procedure for data analysis adopted comprising the method and unit of data analysis.
6. Key findings established by each study.
7. Relationships (positive or negative) between adoption of innovations and any other variable established by each study.
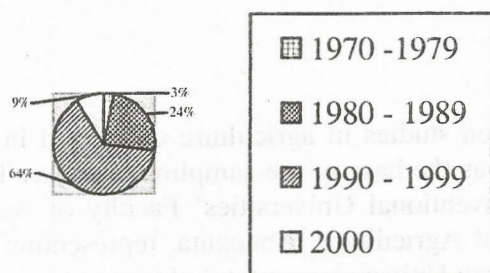
Each of the study reviewed in this paper was subjected to content analysis. The data obtained from the studies were sorted into tables using percentage distribution of the studies to indicate the relative prominence of each item in the variables measured. Pie charts were also used to present data on year of publication, description of study locations and general approach to research adopted. Lastly, the key findings and relationships established by the studies reviewed were aggregated into relatively homogeneous categories for ease of discussion.

4.0 RESULTS AND DISCUSSION

Key Variables in the Adoption of Recommended Practices in Smallholder Farming Systems in Nigeria

The analysis showed that adoption studies cover the period 1970-2000 in the country. As shown in Figure 1, most of the studies (64 percent) were conducted between 1990 and 1999. In fact, only 12 percent of the studies were conducted before 1980. This corroborates the position of Omotayo, *et. al.*, (2001) that adoption and diffusion research in agriculture bloomed in Nigeria when the extension services were revitalized with the World Bank supported Agricultural Development Programmes (ADPs).

Legend:
- ⊞ 1970 -1979
- ▨ 1980 - 1989
- ▧ 1990 - 1999
- ☐ 2000

Figure 1. The distribution of studies reviewed in stage 1 by year of publication

Furthermore, this study undertook to identify the variables measured in each of the studies reviewed. It was found that the 38 explanatory variables considered in the studies could be placed in six broad categories: (i) socio-economic factors, (ii) social system factors, (iii) extension agent and agency factors, (iv) macro-economic factors, (v) innovation characteristics and (vi) communication factors (Table 1). It can be seen from the table that socio-economic factors are the most commonly considered variables in adoption studies in Nigeria. Even so, age, education, farm size, family size and extension contact feature more prominently than other variables.

Research Focus and Trends in Adoption Studies in Nigeria

Table 2 shows that the foci of the studies reviewed became more diverse in the period between 1980 and 1999 than before. The interest of researchers in the 1970s was simply establishing clients' awareness of and interest in innovations. This interest spread to measuring adoption rates of innovations, determining factors influencing adoption and identifying differences in the characteristics of different client groups in the 1980s. By the 1990s, other issues such as types of innovations easily adopted and the time–lag in innovation adoption and diffusion were the foci of adoption and diffusion research in Nigeria.

Table 1. Key explanatory variables in adoption studies in Nigeria

I. Socio-economic factors

1. Age – Igbokwe, 1984; Iyere, 1985; Ngwu, 1989; Ozor, 1998; Okwoche *et. al*,1998; Akinola,1986a; Bello,2000; Adekoya and Ajayi,2000
2. Marital status – Adekoya and Ajayi,2000
3. Religion – Patel and Anthonio, 1971; Adekoya and Ajayi, 2000
4. Gender – Adebayo,1994; Adekoya and Ajayi, 2000
5. Ancestry – Adebayo, 1994
6. Education – Igbokwe, 1984; Iyere, 1985; Akinola, 1986a; Ngwu, 1989; Ogbodu, 1990; Onu, 1991; Agbamu, 1993; Adebayo, 1994; Ozor, 1998; Okwoche *et. al.*, 1998; Ladebo, 1999; Adekoya and Ajayi, 2000
7. Farm size – Patel and Anthonio, 1971; Iyere, 1985; Akinola, 1986a; Akinola, 1986b; Amotsuka, 1988; Onu, 1991; Agbamu, 1993; Okwoche *et. al*, 1998; Ozor, 1998; Ladebo, 1999; Adekoya and Ajayi, 2000
8. Number of plots owned – Amotsuka, 1988; Ngwu, 1989
9. Farming experience – Akinola, 1986b; Ozor, 1998; Bello, 2000
10. Income – Okwoche, *et. al.*, 1998; Ladebo, 1999
11. Resource endowment – Okwoche, *et. al.*, 1998
12. Land holding – Igbokwe, 1984
13. Attitude – Onu, 1991
14. Diversification factor – Akinola, 1986b

II. Social system factors

1. Family size – Patel and Anthonio, 1971; Igbokwe, 1984, Iyere, 1985; Ngwu, 1989; Adebayo, 1994; Okwoche *et. al.*,1998
2. Social position – Vabi *et. al.*, 1993; Adebayo, 1994
3. Social participation – Patel and Anthonio, 1971; Asifat, 1986; Ngwu, 1989, Onu, 1991; Ozor, 1998
4. Membership of organisations – Iyere, 1985; Akinola, 1986a; Okwoche *et. al.*,1998
5. Peer influence – Asifat, 1986
6. Number of previous adopters – Akinola, 1986b
7. Cultural support – Onu, 1985
8. Leadership – Agbamu, 1993

III. Extension agent and agency factors

1. Extension contact – Igbokwe, 1984; Iyere, 1985; Akinola, 1986a; 1986b; Amotsuka, 1988; Onu, 1991; Agbamu, 1993; Okwoche, *et. al.*, 1998; Adekoya and Ajayi, 2000
2. Teaching ability of extension agent – Amotsuka, 1988
3. Message packaging – Musa, 1998

IV. Macro-economic factors

1. Access to credit – Patel and Anthonio, 1971; Akinola, 1986a; Okwoche *et. al.*, 1998
2. Product prices – Akinola, 1986b
3. Quantity of inputs available for sale - Akinola, 1986b
4. Number of active selling points - Akinola, 1986b
5. Advertisement - Akinola, 1986b
6. Profit – Onu, 1985

V. Innovation characteristics

1. Innovation characteristics – Offiah, 1998
2. Ease of use of innovation – Onu, 1985, Ogbodu, 1990, Musa, 1998, Umeh, 1998
3. Difficulty in use of innovation – Asifat, 1986; Chukwu, 1995
4. Perceived usefulness of innovation – Umeh, 1998
5. Cost of innovation – Akinola, 1986b

VI. Communication factors

1. Period of awareness – Onu, 1985; Amotsuka, 1988; Agbamu, 1993; Umeh, 1998
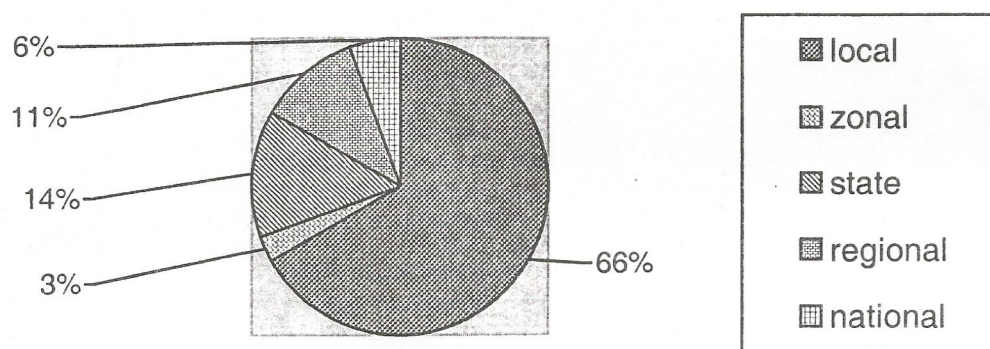2. Cosmopoliteness – Asifat, 1986; Agbamu, 1993; Adebayo, 1994; Ladebo, 1999

Table 2. Summary of the trend in the foci of adoption and diffusion studies reviewed

Period	Research focus
1970 –1979	• Establishing clients' awareness of and interest in innovations
1980 – 1989	• Establishing clients' awareness of and interest in innovations • Measuring adoption rate of innovations • Determining factors influencing adoption and diffusion of innovations • Identifying differences in the characteristics of different categories of clients
1990 –1999	• Measuring adoption rate of innovations • Determining factors influencing adoption and diffusion of innovations • Identifying differences in the characteristics of different categories of clients • Identifying the characteristics of innovations which clients easily adopt • Establishing the time – lag in the adoption and diffusion of innovations
2000	• Determining factors influencing adoption and diffusion of innovations

The geographical foci of the studies reviewed were described by the geo-political delineation of areas studied. Two-thirds of the studies were carried out at the Local Government Areas (LGA) level (Figure 2). In fact, only 6 percent of the studies have a national focus. This finding is indicative of significant local differences that researchers expect in and actually find in the adoption behaviour of clients. It is noteworthy however that these local differences when aggregated over time tend to draw out some general truth about the nature of farmers' adoption behaviour. It may also imply that funds available for adoption and diffusion research are so limited that very few researchers could afford a wider focus than the LGA.

Figure 2. Distribution of studies reviewed based on description of study locations

Relationships between Adoption and Key Independent Variables

Table 3 shows the dynamism that surrounds the relationship between some of the independent variables and adoption of innovations. This is a reflection of the great variations observed in the factors affecting adoption. Socio-economic factors like age, religion, marital status, gender, education and farm size may, at different times, locations and with different innovations bear positive or negative relationships with adoption. For instance, age could be highly correlated with farming experience and resource endowment, hence bear positive relationship with adoption (Okwoche et. al., 1998; Bello, 2000). Conversely, it may be highly correlated with traditional land management and diversification and thus bear a negative relationship with adoption (Akinola, 1986a; 1986b; Adekoya and Ajayi, 2000). Similarly, group factors such as household/family size, social position and membership of organizations may have either positive or negative relationships with adoption. For example, social position may be associated with leadership, thus conferring special advantages on the client with respect to access to innovations, thereby positively influencing adoption (Agbamu, 1993; Adebayo, 1994).

Nevertheless, a client's social position may place him/her at a disadvantage in access to innovations, hence, bearing a negative relationship with adoption. This is exemplified by the case of Fulani women adopting cattle production technologies (Vabi *et. al.*, 1993). The cases for extension contact and ease - difficulty in use of innovations may be similarly explained.

It can be concluded from Table 3 that a relatively under-studied group of factors is the national economic environment. The few studies that examined these factors established positive relationships between them and adoption of innovations. This study therefore included 11 such variables in its analysis of interrelationships among the factors influencing the adoption process in Nigeria.

5.0 MAIN LESSONS

Adoption of innovations has been shown to be critical to the process of change in human societies. However, the change achieved by the process of innovation adoption is not always positive. This study has established that what is needed to properly understand the adoption process is a dynamic and realistic representation of the process which should be able to provide some information on the process before costly investments are made. But the difficulty in collecting detailed data in Developing Countries such as Nigeria requires models that correspond to the types of data available or for which additional data can be readily obtained.

The findings of this study suggest that there is some difficulty in data collection in the conduct of adoption and diffusion research in Nigeria. This implies that some necessary machinery needs to be put in place, especially in Developing Countries to facilitate data gathering. Such effort should include the possibility of using data from Geographic Information Systems (GIS). In this regard, smallholder situations offer a special challenge because of its diversity. There is therefore a need for creating the right environment for access to necessary data for contextualising this diversity.

Table 3. Established relationships between adoption of innovations and some key variables

	Positive	Negative
Socio-economic factors		**Socio-economic factors**
Age	Igbokwe,1984; Okwoche et al,1998;Bello,2000	Age Adekoya and Ajayi,2000; Akinola,1986a; Iyere,1985; Ngwu,1989; Ozor,1998
Marital status	Adekoya and Ajayi,2000	
Religion	Adekoya and Ajayi,2000	Religion Patel and Anthonio,1971
Gender	Adebayo,1994	Gender Adekoya and Ajayi,2000
Ancestry	Adebayo,1994	
Education	Akinola,1986a; Ogbodu,1990; Onu,1991; Okwoche et al,1998; Ozor,1998	Education Ladebo,1999; Adebayo,1994; Igbokwe,1984; Adekoya and Ajayi,2000; Iyere,1985;Ngwu,1989; Agbamu,1993
Farm size	Iyere,1985; Akinola,1986a; Akinola,1986b; Amotsuka,1988; Onu,1991; Agbamu, 1993 Okwoche et al,1998	Farm size Adekoya and Ajayi,2000; Patel and Anthonio,1971; Ozor,1998; Ladebo,1999
Number of plots owned	Amotsuka,1988; Ngwu,1989	
Farming experience	Akinola,1986b; Ozor,1998; Bello,2000	
Income	Okwoche et al,1998; Ladebo,1999	
Resource endowment	Okwoche et al,1998	
Land holding	Igbokwe,1984	Diversification factor Akinola,1986b
Attitude	Onu,1991	
Group factors		**Group factors**
Family size	Patel and Anthonio,1971; Igbokwe,1984; Okwoche et al,1998	
Social position	Adebayo,1994	Household/family size Iyere,1985; Ngwu,1989; Adebayo,1994
Social participation	Patel and Anthonio,1971; Asifat,1986; Ngwu,1989; Onu,1991; Ozor,1998	
Membership of organisations	Iyere,1985; Okwoche et al,1998	Membership of cooperative Akinola,1986a
Peer influence	Asifat,1986	
Number of previous adopters	Akinola,1986b	
Cultural support	Onu,1985	Social position (Cultural positioning) Vabi et al.,1993
Leadership	Agbamu,1993	
Extension agent and agency factors		**Extension agent and agency factors**
Extension contact	Igbokwe,1984; Iyere,1985; Akinola,1986a; Akinola,1986b; Amotsuka,1988; Onu,1991; Agbamu,1993; Okwoche et al,1998	Extension Contact Adekoya and Ajayi,2000; Agbamu,1993
Teaching ability of Extension Agent	Amotsuka,1988	
Proper message packaging	Musa,1998	
National economic environment factors		
Access to credit	Patel and Anthonio,1971; Akinola,1986a; Okwoche et al,1998	
Product prices	Akinola,1986b	
Quantity of inputs available for sale	Akinola,1986b	
Number of active selling points	Akinola,1986b	
Advertisement	Akinola,1986b	
Profit	Onu,1985	
Innovation characteristics		**Innovation characteristics**
Innovation characteristics	Offiah,1998	Cost of innovation Akinola,1986b; Musa,1998; Umeh,1998
Ease of use of innovation	Onu,1985; Ogbodu,1990; Musa,1998; Umeh,1998	Difficulty in use of innovation Asifat,1986; Chukwu,1995
Perceived usefulness of innovation	Umeh,1998	
Communication factors		
Period of awareness	Onu,1985; Amotsuka,1988; Agbamu,1993;Umeh,1998	
Cosmopolitanism	Asifat,1986; Agbamu,1993; Adebayo,1994; Ladebo,1999	

Finally, it was established in this study that extension contact had fallen from above 60 percent in the 1990s to 40 percent in 2002. It has been argued that withdrawal of World Bank funds for the Agricultural Development Programmes (ADPs) is partly responsible for this. But the on-going debate on this issue centres around three key policy approaches. These are farmers' paying user service charge for extension services, private extension agencies and decentralisation of existing extension services by devolution, de-concentration or delegation. Whatever policy option is chosen will have to be guided by the need for an effective, efficient and sustainable extension and advisory services.

Prospects of Adoption and Diffusion Research

In order to channel the course of further research in adoption and diffusion in Nigeria, the following areas are worth noting:

i. Use of Geographic Information System (GIS) data in uptake of innovations by small farmers – The availability of reliable data is paramount in any modelling exercise. GIS provides a regular and dependable source of data on the spatial factors which influence the adoption and diffusion of innovations. This is more so when models are to be used over wide geographical areas which may vary in many characteristics to a large or small extent. It is clear from all the studies conducted in the past that spatial factors such as distance to input source, markets and major urban centres and roads were not thoroughly investigated.

ii. Standardization of scales for measuring several variables in adoption and diffusion research – One of the major findings of this study is the inconsistency amongst adoption and diffusion studies on the appropriate patterns for measuring key variables. Such inconsistencies often influence the interpretation of the results of such studies. It is considered important therefore that review studies reporting the variations in the measurement of key variables in adoption research and proposing standard ways, acceptable to adoption researchers.

iii. Studies to identify other key variables that influence the potential for adoption of innovations at the technology generation stage of the adoption process

iv. An investigation of optimal approaches to sustaining agricultural extension services – It is necessary that further studies be carried out to highlight the relationships amongst these sectors and how changes in one affect the others.

v. Modelling of extension impact – The study of the impact of agricultural extension services in Nigeria has been done for three decades by making *ex-post* evaluations of interventions. The study has demonstrated that the proposed models can be used to obtain *ex-ante* predictions. It is recommended that further studies in this regard be pursued by researches and development workers. First, such studies may be used to justify requests for funding of projects and secondly they provide researchers with the information that may further strengthen the technology development process.

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