

Factors associated with the adoption of fertilizer application in Yenagoa Local Government Area of the Rivers State, Nigeria.

A. A. JIBOWO and T. M. FRANCIS

Abstract

An investigation was conducted to identify the personal, social, economic, psychological and physical factors associated with the adoption of fertilizer application practices in Yenagoa Local Government Area, Rivers State of Nigeria. Data were collected from 78 adopters and 68 non-adopters of the practice in October and November 1988. Significant associations were found between adoption and literacy, membership in organization, contact with extension agents, income, attitude toward fertilizer application and other factors. Farmers with the identified characteristics would be expected to respond more favourably to a fertilizer campaign than their counterparts with less of these attributes.

Introduction

Many developing countries have focussed on the agricultural sector in their development efforts as the majority of their working populations are still farmers. These countries also believe that their industrial take-off must be preceded by agrarian development to serve as its base. Nigeria has adopted this approach. Hence, since the inception of the "Operation Feed the Nation" campaign by the former Federal Military Government of Nigeria in 1976, and the "Green Revolution" programme by the civilian government which came to power in 1979, as well as the establishment of the Directorate of Foods, Roads, and Rural infrastructures (DFRRI) by the present military government, the country has embarked upon large-scale annual importation of fertilizers for soil enrichment to boost food production through the programmes.

Fertilizers were first introduced into Yenagoa area by the Ministry of Agriculture and Natural Resources (M.A.N.R.) in 1966 on a small scale. With huge expenses incurred by the government in importing and distributing this input, it became necessary that the adoption behaviour of the farmers, who are the users, was understood. Furthermore, preliminary discussion with the officials of the Ministry of Agriculture in charge of the area studied revealed that the rate of adoption had not been as high as expected. Understanding the adoption behaviour and factors associated with it should lead to suggesting policies to facilitate increased adoption. The objective of this study, therefore, was to determine some innovator and community factors associated with the adoption of fertilizer application in the Yenagoa Local Government Area (YELGA). To attain this objective, the null hypothesis that there was no significant relationship between personal, social, economic, and psychological characteristics of the farmers and their farms, and adoption of fertilizer application, was tested.

Professor A.A. Jibowo is Head, Department of Agricultural Extension and Rural Sociology, Obafemi Awolowo University, Ile-Ife, Nigeria

T.M. Francis was a former student, Department of Agricultural Extension and Rural Sociology, Obafemi Awolowo University, Ile-Ife, Nigeria.

Factors associated with adoption of innovations

The factors which are associated with the adoption of an innovation can be categorized into: (i) innovation characteristics, (ii) innovator characteristics, (iii) community characteristics, and (iv) change agent characteristics. While previous adoption studies have examined several, and by no means all, dimensions of innovator characteristics, studies on how innovation, change agent, and community characteristics are associated with innovation adoption, are rare to come by, particularly on the developing parts of the world.

The characteristics of the innovation which influence adoption are: relative advantage, compatibility, divisibility, complexity and communicability (Rogers, 1965). Innovations which are perceived by the potential adopters as having greater relative advantage, over the one which they are replacing, such as greater profit, less cost relative to profit, greater yield, more appealing appearance and other advantages, are likely to be more quickly adopted than one which has less to these characteristics. A new idea which is perceived as compatible with the potential adopters' need, values, norms, past experiences and practices, ensures greater security and meaning to them, and is more likely to be adopted than an innovation which is lacking in these attributes. An innovation which is perceived as complex or difficult to understand and use by the potential adopters scares them and hence not as readily adopted as one which is easy to understand and use. Innovations which are divisible or could be tried on limited scale are more rapidly adopted than those which cannot. Innovations whose results are visible and can be communicated to others are more rapidly adopted than those which possess less of these attributes.

The innovator characteristics include his personal, social, economic, and psychological attributes. Examples are age, family size, years of education, farming experience, literacy; social participation, source of information, contact with extension agents; income, access to credit facilities, cost of innovations as perceived by the farmers; attitude towards agricultural practices, knowledge of the importance and technique of agricultural practices, respectively. Personal characteristics such as literacy in English, number of children and number of wives of farmers, were found to be associated with adoption of farm practices like cocoa and poultry farming among some Nigerian farmers (Alao, 1971). It was also found that literacy in "Yoruba" local language and age were not significantly related. Among Togolese farmers, Francis (1974) found positive associations between variables such as age, rotation of crops, sale of crops for cash income, and adoption of farm practices such as raising peanuts, cotton, and use of chemical insecticides.

Positive and significant correlations were found between adoption of farm practices and total number of dependents, material possession, experience abroad, communication index, social participation, farm size, value of farm sales, knowledge of farm practices, contact with extension agents, and adoption of farm practices in Western Nigeria by Kidd (1968). Professional orientation toward farming, an attitudinal construct, was found to be associated with high adoption rates in Kansas by Copp (1956).

Alao (1973) found that community structure was associated with innovativeness. Physical characteristics such as topography, and ecological characteristics, the effect of which will be expected to reflect through the type of vegetation, will also be expected to influence adoption. For example, farmers whose farms do not suffer from

prolonged water logging, severe erosion, rugged topography and dense vegetation cover, would be expected to adopt fertilizer use more than their counterparts whose farms had the characteristics.

Possession of high job commitment, many years of working experience, high motivation, means of transportation and the use of local leaders by change agents should facilitate innovation adoption.

Methodology

Data were collected from all the ten small settlements in YELGA consisting of seven villages, namely, Ajudama-pie, Biogbolo, Agbura, Ukubie, Ikolo, Okolobiri, Ogboloma, and three small towns, namely, Oporoma, Zarama, and Kaiama, in October and November, 1988) with an interview schedule. Small settlements with populations of less than 3,000 inhabitants were regarded as villages, those with 3,000 to 10,000 were regarded as small towns. The total estimated population in all the villages was 29,253 out of which all the 78 adopters of fertilizer use, constituting 0.27% were interviewed. The 62 non-adopters interviewed were selected by cluster sampling in each town or village. This sample represented 0.21% of the total population estimate. While 7 to 9 adopters were identified and interviewed in each settlement, 6 to 7 non-adopters were also interviewed for comparative purpose.

The adopters were identified from the fertilizer sales record in the office of the M.A.N.R. Yenagoa and through interviews with extension workers and adopters who were asked to name other adopters, and non-adopters who were also asked to name the adopters.

The interview schedule sought information on personal, social and economic characteristics of the farmer such as age, farm size, education, income, membership in organisations and others; ecological characteristics of farm such as soil wetness and vegetation; topography of land; psychological characteristics, namely, attitude toward fertilizer application, knowledge of importance of fertilizer application.

While all other variables were measured with direct questions which ensured face validity through careful design and pretesting, the attitude statements were specially validated through the use of "judges". Twenty-five statements were gathered from farmers and extension workers on feelings normally expressed toward fertilizer application by farmers. Five judges, including two agricultural extension agents, one school teacher, one soil scientist and one farm-leader of a farmers' cooperative association, were asked to indicate whether each statement was very appropriate, appropriate or inappropriate, in measuring attitude of farmers towards fertilizer application. Thirteen of the statements which were judged as very appropriate by 75—100% of the judges, and nine which were judged as appropriate by 50%, were chosen for the study. The remaining three were discarded. The 22 statements used consisted of 8 positive and 14 negative expressions on attitude towards fertilizer application. An example of positive statements was, "To grow vigorously, crops need the application of fertilizers". An example of negative statements was, "Fertilizers burn crops".

The respondents were asked to indicate whether they strongly agreed (SA), agree (A), were undecided (U), disagreed (D), or strongly disagreed (SD) to each statement. Scores of 5, 4, 3, 2, 1 were assigned to SA, A, U, D, SD, to the response for each respective positive statement, and vice-versa for negative statements. Total attitude

score was computed for each respondent as the addition of the scores for all the statements. Respondents who scored 56—77 were classified as having a neutral attitude. Their scores fell between the mid-points of the intervals between the maximum possible scores of 44 for disagree and 66 for neutral, and the maximum possible scores of 88 for agree and 66 for neutral, when positive statements were considered. Those who scored 22—55 and 78—110 were classified as having unfavourable and favourable attitude, respectively. It should be noted that the least possible unfavourable attitude score was 22, and the greatest possible favourable score was 110. Chi-square analysis was employed to test the hypotheses. The contingency coefficient C, was calculated for each chi-square value with the formula

$$\frac{x^2}{N + x^2}$$

where N is the number of subjects, to show the strength of relationship. The C value also represents the correlation coefficient, r between each variable and fertilizer application (Hays, 1963).

Results and Discussion

The summary of the results of the chi-square analysis for testing the hypotheses relating personal, social, economic, psychological and physical characteristics to adoption of fertilizer application can be seen in Table 1. Almost all the chi-square values which were significantly associated with fertilizer application showed strong relationships with contingency coefficient, C values of 0.3 to 0.47.

Personal Characteristics and Adoption

Three personal characteristics, namely, literacy in local language, years of farming and years of schooling, were significantly associated with adoption. Detailed analysis showed that most (83.3%) of the adopters were literate, 16.7% were illiterate. Majority of the non-adopters (67.7%) were illiterate, 32.3% were literate. Adopters had more years of schooling than non-adopters. Majority (62.8%) of adopters spent 1—6 years, 30.8% spent 7—11 years, 6.4% did not go to school. The respective figures for non-adopters were 59.7%, 3.2% and 37.1%. The mean years of schooling of 5.3 for adopters was higher than 1.9 for non-adopters. A greater percentage of adopters than non-adopters were therefore literate. Similarly adopters spent more years at school than non-adopters. However, non-adopters had more years of farming experience than adopters. The means were 20.25 and 14.31 years, respectively.

Age, marital status and place of birth were not significantly related to adoption. Percentages of adopters and non-adopters in the various age categories were similar. The mean age of 48.62 and 49.9 years for adopters and non-adopters respectively, were close. This lack of significant relationship was unexpected because several previous studies have shown adopters of farm practices to be younger than non-adopters.

1: Summary of the results of testing the hypothesis relating personal, social economic, psychological characteristics of respondents and physical characteristics of their farms to adoption of fertilizer application

<i>Characteristics</i>	<i>Chi-square Value</i>	<i>Degree of Freedom</i>	<i>Contingency Coefficient C</i>
<i>Personal</i>			
Age	2.75	2	0.14
Literacy	39.366**	1	0.47
Years of schooling	33.08**	2	0.44
Years of farming	18.95**	3	0.35
Marital status	0.48	1	0.06
Place of birth	3.04	1	0.15
<i>Social</i>			
Membership in organisation	25.39**	2	0.39
Contact with extension agents	33.04**	1	0.44
Number of visits by extension agents to respondents	14.25**	2	0.30
<i>Economic</i>			
Annual income	18.13**	2	0.34
Access to credit facilities	7.15**	1	0.05
Number of articles of convenience possessed	15.64**	2	0.32
Number of wives assisting in farm work	2.29	3	0.13
Total size of farm-land cropped	13.39**	2	0.30
Size of farm-land planted with Permanent crops	5.41	2	0.14
Size of farm-land planted with annual crops	8.448*	2	0.24
Distance of farthest farm from home	0.00	1	0
Distance of nearest farm from home	6.47*	2	0.21
<i>Psychological</i>			
Attitude toward fertilizer application	14.30**	2	0.09
Knowledge of importance of fertilizer	30.60**	2	0.42
Knowledge of fertilizer application techniques	20.50**	3	0.34
<i>Ecological</i>			
Duration of water logging of farm-land	1.27	2	0.10
Major vegetation of farms land area	1.07	2	0.09
<i>Topographical</i>			
Fraction of farm-land affected by erosion	1.95	2	0.12
Land undulation	0.52	1	0.12

Most adopters (92.3%) and non-adopters (95.2%) were married; 7.7% and 4.8% respectively, were single. As marriage has been a popular occurrence among the adult population in general, it could not be used to differentiate between adopters and non-adopters. Similarly, local birth was a popular feature, and hence was non-significant. Majority (76.9%) of adopters and non-adopters (87.1%) were born within the YELGA; 23.1% and 12.9% respectively, were born outside the YELGA

Social Characteristics and Adoption

All the social characteristics, namely, membership in organisations, contact with the extension agents, and number of visits by extension agents to respondents were significantly associated with adoption. Most adopters (84.6%) belong to 3-4 organisations, while 61% of non-adopters fell into this category. Only a few (3.8%) adopters belong to 1-2 organisations while a larger percentage (35%) of non-adopters were in this category. Adopters who belong to five or more organisations were 11.6%; non-adopters were only 4 percent. Adopters therefore more frequently belonged to social organisations than non-adopters.

A greater percentage (73.1%) of adopters than non-adopters (22.6%) had met the extension worker in charge of their area; 26.9% and 77.4% respectively, had not. Contact with extension worker was therefore more widespread among adopters than non-adopters. In accordance with expectation, adopters enjoyed a high frequency of visits by extension agents than non-adopters to discuss farm problems.

A greater percentage (44.9%) of adopters than non-adopters (16.1%) were visited once by the extension agent during the previous one year; 6.4% of adopters and 1.6% of non-adopters enjoyed two visits. Many non-adopters (82.3%) and 48.7% of adopters were not visited during the same period. It should be noted that the means of 3 visits and 1 visit in five years paid by extension workers to adopter and non-adopters respectively, were too few to allow any effective extension work.

Economic characteristics and Adoption

There was a significant relationship between several economic characteristics, namely, annual income, access to credit facilities, number of articles of convenience possessed, total size of farm-land cropped, size of farm-land cropped with annual crops, distance of nearest farm from home and adoption. Thirty-one percent of adopters and only 6.5% of non-adopters earned annual incomes of ₦1,001 and above, 16.7% and 40.3% respectively earned the low incomes of ₦1-500; 48.7% and 41.9% respectively earned ₦501-100. The mean incomes were ₦1,207.44 and ₦706.54 for adopters and non-adopters, respectively. Adopters therefore were richer financially than non-adopters. The higher income of the adopters than non-adopters must have enabled them to procure farm inputs such as fertilizers more than non-adopters.

Adopters also had a greater access to government farm credit in cash and kind such as fertilizers and pesticides than non-adopters. While 35.9% of adopters had access to credit facilities, only 16.2% of non-adopters had access; 64.1% of adopters and many non-adopters (83.8%) had no access. The greater access to government

credit by adopters than non-adopters must have contributed to adoption of the farm input by the farmer, as cash was needed to purchase the input.

Adopters had a greater number of articles of convenience such as radio, tap-borne water, electricity supply, wrist-watch, iron-bed, wooden-bed, bicycle, touch-light than non-adopters. Forty-six percent of adopters and 16.1% of non-adopters, respectively, had 7—9 articles; 52.6% and 72.6% had 4—6; 1.3% and 11.3% had 1—3 articles, respectively. The means were 6 and 5 respectively. The greater income of adopters must have enable them to purchase a greater number of articles than non-adopters.

Adopters cropped greater sizes of farm-land than non-adopters. Thirty percent of adopters and 10% of non-adopters cropped 6—10 hectares; 65% and 90% respectively, cropped 1—5 ha.; 5% of adopters and none non-adopters cropped 11 ha. and above. The means were 5.85 ha. and 3.83 ha.; respectively. These findings suggest that although adopters had less years of farming than non-adopters, the former had cultivated more land than the latter. This further suggests that the more important factor associated with adoption is not how long the period of farming experience has been, but how much farming activities have taken place during the period.

Adopters planted greater sizes of land with arable crops than non-adopters. Twenty-two percent of adopters and 4.8% of non-adopters planted 6—10 ha.; 77% and 95.2% cropped 1—5ha., one adopter and none of the non-adopters planted 11ha. and over. The means were 4.35 ha. and 2.96 ha. for adopters and non-adopter, respectively.

However, no significant relationship was found between size of permanent crops planted and adoption. This might be because majority of the adopters (65.4%) and non-adopters (51.6%) did not cultivate permanent crops. Some (30.8%) adopters and non-adopters (48.4%) cultivated 1—5ha.; 3.8% of the adopters and none of the non-adopters cultivated 6—10 hectares. The means were 1.54 ha. and 0.07 ha. for adopters and non-adoptes, respectively.

The distances of the nearest farms of the adopters from homes were a bit further than those of non-adopters. The nearest farm of most of the adopters (66.6%) and 48.4% of non-adopters were about 3km. from their homes. For some (24.4%) of the adopters and non-adopters (27.4%), the distance was 2km.; for 9% of adopters and 24.2% of non-adopters, it was about 1km. The means were 2.8km and 2.4km for adopters and non-adopters, respectively. This relationship was contrary to expectation, because adopters' farms would normally be expected to be nearer home than non-adopters'. No significant relationship was found between the distances of the farthest farms from home of the two categories of respondents and adoption. In fact, the means of 5.8km and 5.3 km were similar.

The relationship between number of wives assiting in farm work and adoption was not statistically significant. The practice of relying on wives' assistance on the farm was not different for adopters and non-adopters..

Psychological Factors and Adoption

Statistically significant relationships were found between psychological factors, namely, attitude toward fertilizer application, knowledge of importance of fertilizers, knowledge of fertilizer application techniques, and adoption. Most adopters (97.4%) had a favourable attitude toward fertilizer application, while most non-adopters (80.6%) had an unfavourable attitude. Only 8.1% of non-adopters had a favourable attitude. No adopter had an unfavourable attitude.

Knowledge of fertilizer application techniques and importance of fertilizer application was more widespread among adopters than non-adopters. Most of the adopters (75%) and 40% of the non-adopters knew the ring technique; 21% and 5% knew the row technique; 4% of the adopters and none of the non-adopters knew the broadcasting technique. Majority of the non-adopters (55%) did not know any technique. Similarly, many adopters (82.1%) knew that fertilizers increase crop yield; 12.8% and 6.5% respectively, knew that fertilizers increase plant food; 5.1% and 6.5% respectively, knew that fertilizers increase plant vigour. While 30.6% of non-adopters were ignorant of the importance of fertilizers, no adopter exhibited such ignorance.

The more widespread favourable attitude, greater knowledge of application techniques and importance of fertilizer among adopters than non-adopters might have been the outcomes of adopting the practice by the adopters. However, the majority of the non-adopters who correctly stated that fertilizers increase crop yield must have had other reasons for non-adoption beside ignorance of the importance of the input.

Physical Factors and Adoption

No significant statistical relationship was found between physical factors and adoption. Physical factors were represented by ecological characteristics, namely, duration of water-logging on farms, major vegetation of farm-land area; and topographical characteristics, namely, fraction of farm land affected by erosion and land undulation.

The percentages of adopters and non-adopters who had water-logging on their farms for various durations were similar. For one month, they were 28.2% and 29% for adopters and non-adopters, respectively; for 2 months, 60.3 and 64.4; for 3 months, 11.5 and 6.5 percentage. The mean period of waterlogging was 1.8 months for both categories of respondents.

Since adopters and non-adopters belonged to the same geographical zone, the major vegetation of most of their farms was evergreen forest, as indicated by 83.3% and 88.7% of adopters and non-adopters, respectively. Some (14.1%) adopters and 9.7% of non-adopters indicated secondary forest, while 2.6% and 1.6% respectively indicated, shrub.

About 27%, 40% and 33% of the adopters indicated that one-quarter, one-third and none of their farms, respectively, was affected by erosion. The corresponding figures for non-adopters were 18%, 39% and 43 percent. Although majority of adopters (67%) and non-adopters (57%) indicated that one-quarter to one third of their farms were affected by erosion, it was noteworthy that this condition did not influence their fertilizer adoption behaviour.

Thirty-two percent, and 68% of adopters indicated that their land undulations were rugged and level, respectively. The corresponding figures for non-adopters were 37% and 63 percent. It was similarly note worthy that land undulation was not associated with their fertilizer adoption behaviour.

Conclusions and Implications

Adopters of fertilizer application were more frequently literate, with greater number of years of schooling, but less years of farming experience, than non-adopters. Literate farmers with more years of schooling should respond more to the fertilizer campaign aspect of food production programmes than their illiterate counterparts. A fertilizer campaign policy of focussing on literate farmers, if adopted by agricultural extension workers, should guarantee initial success, which could act as a motivating force for the non-literate. Age, marital status and place of birth, were not significantly different between adopters and non-adopters. Farmers of varying age, single or married, and those who were born within or outside YELGA, are likely to respond similarly to a fertilizer application campaign.

Adopters excelled non-adopters in social characteristics, namely, membership in organisation, contact with extension agents, and number of visits by extension agents to respondents. Adoption of fertilizer application could be encouraged among non-adopters if their social characteristics such as increased organisational membership and contact with extension agents, are enhanced.

Economic characteristics, including annual income, access to credit facilities, number of articles of convenience possessed, total size of cropped farm-land, and size of farmland planted with annual crops, were possessed by adopters more than non-adopters. Fund is needed to purchase fertilizers, hence the policy of extending credit facilities to non-adopters by the government agricultural credit agencies in the area should be facilitated by the extension workers. When increased farm credit is spent to acquire farm inputs such as fertilizer, and when these are combined with other appropriate factors of production, increase in annual income of the farmer is likely to result from increased farm productivity. Increased income could be spent to open up more farm land, procure inputs such as fertilizers, to boost production. It could also be spent to purchase articles of convenience such as radio, from which knowledge of improved farm practices such as fertilizer application techniques could be gained.

The significant relationship between adoption and size of land planted with annual crops, and the lack of such relationship with size of land planted with permanent crops, suggested that the annual crop farmers have responded to fertilizer campaign aspect of food production programmes, or the extension workers have directed the fertilizer campaign activities to the farmers who planted mainly annual crops, more than those who planted mainly permanent crops, or both reasons might have applied. The policy implication is that extension agents should not ignore permanent crops' farmers in fertilizer campaign to boost crop production. This is to avoid future neglect of tree crops. Simultaneous attentions should therefore be given to both classes of crops nation-wide.

Adopters were more psychologically inclined toward fertilizer as a farm input than non-adopters. Adopters more frequently had favourable attitude toward fertilizer application, had a greater knowledge of importance of fertilizers, and knowledge of fertilizer application techniques, than non-adopter. The implication for extension work is that extension agents should, through their educational ef-

forts, assist non-adopters in particular, to develop these attributes so as to facilitate adoption.

Physical characteristics including duration of water-logging, major vegetation of farm-land (ecological), and fraction of farm land affected by erosion, land undulation (topographical), were not significantly associated with adoption of fertilizer application in YELGA. These physical characteristics could therefore not be used to discriminate between adopters and non-adopters of the input in YELGA because of their uniform occurrence. A future study which compares an area with pronounced degree of these community physical factors with another area with less presence of the factors might discover significant associations between the factors and adoption of fertilizer application.

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