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# Comparative analysis of factors in the adoption of traditional and recommended soil erosion control practices in Nigeria

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**Abstract**

In developing countries, there is a general dearth of empirical information on the socio-economic and agronomic variables needed for planning environmental management programmes. Much of the existing evidence on the adoption of soil erosion control practices come from the advanced countries and concentrate on the recommended ones which are not usually easily adopted by farmers. Using cross-sectional data from a sample of 125 small farmers in highly erosion-prone Anambra State of Nigeria, this paper attempts the isolation of the major factors influencing farmers' adoption of traditional and recommended soil erosion control practices. Multiple regression results show that income, farm size and risk attitude were the most important factors in the adoption of recommended practices while employment, farm output prices and interest rate influenced the adoption of traditional practices most. Also a chi-square test rejects the hypothesis of significant difference between factors determining the adoption of both clusters of practices. It is recommended, among other things, that it is these implicated variables that should be focused on in erosion control practice adoption programmes. 

*Keywords:* Comparative analysis; Adoption; Traditional; Recommended; Soil erosion control practices

## 1. Introduction

Soil erosion is by far the most severe hazard affecting the lands of Nigeria (Ofomata, 1984). Prominent among the recommendations for combating it are contour strip

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cropping, terracing, fertilizer use, tie ridging, stop wash lines, controlled livestock grazing, tree planting, detention dams and wind breaks (Anyanwu, 1991; Okafor, 1991). However, evidence shows that recommended soil erosion control practices (RSECPs) fail to significantly meet farmers' erosion control objectives. For instance, Anderson and Thampallai (1990) observed, as formalized in Todaro's 'False Paradigm' model (see Todaro, 1977), that some of the recommended technologies do not suit tropical agricultural regimes, are not adapted to the socioeconomic and climatic conditions of the tropics (Roose, 1977); they have high establishment and maintenance costs (Napier, 1988); and they are incompatible, in the perception of farmers, with the small size of their plots (Anyanwu, 1991). Onu's empirical work in neighboring Imo State yielded very low adoption rates for the RSECPs (see Onu, 1991).

Our interest in the factors influencing the adoption of (SECPs) in Nigeria stem from the need to reduce the reliance of Nigerian policy makers on findings of adoption research in the advanced countries. Also, research on adoption of innovations is methodologically and theoretically lacking with regard to environmental innovations (Pampel and van Es, 1977). We think that small farmers' differential response to RSECPs and traditional soil erosion control practices (TSECPs) is sufficient justification for a comparative analysis of the factors responsible for such differences.

In this paper, we identify the factors influencing farmers' adoption of SECPs and ascertain whether there are some differences in the ways they influence the adoption of TSECPs as opposed to the RSECPs.

## 2. Literature review

In the literature, we find no rigid definition of, or classification of erosion control practices as, 'traditional' or 'recommended'. Factors that affect the adoption of new technology include attributes of the adopter, aspects of the technology, character of the economy, features of the environment at the farm level, and risk and uncertainty (Napier, 1988). Factors that are positively associated with soil conservation include income, on and off-farm employment, access to low-cost credit, low discount rate or a long planning horizon, a high level of education, access to sound technical advice, and secure land tenure (Anderson and Thampallai, 1990).

While Akinbode and Clarke (1968), Norman (1972) and many others report no significant positive relationship between age and adoption, Ross (1966) found age to be negatively correlated with adoption of new farm practices. Most farmers are averse to risk (Dillon and Scandizzo, 1978). A farmer's expectations about future income influences his or her adoption of soil conservation practices through conditioning the discount rate (Solow, 1974). In developing countries, the planning horizon is held to be short and the discount rate high (Dasgupta and Pearce, 1978).

Government policies that directly affect farm incomes may cause soil erosion in addition to hindering the adoption of soil management practices consistent with lower rates of degradation (Battie and Sappington, 1986). Level of education is positively correlated with adoption of innovations in general (Voh, 1982). 'Social participation', which captures aspects of traditional enculteration and non-formal education, might be a

better variable to use than 'education', and has been found to be positively related to adoption (Alao, 1971).

Insecure or limited tenure dissuades farmers from acquiring credit to carry out conservation activities (Nafziger, 1984). Farm income, representing both the scale of operations and the ability to invest in agricultural technologies (Carlson et al., 1981) is expected to vary positively with level of investment in soil conservation.

## 3. Data and methods

Data for this study were gathered in Anambra state in South Eastern Nigeria which includes some of the most erosion-prone locations in Nigeria, including the famous Agulu–Nanka erosion complex. A random sample ($N = 125$) was chosen of farmers who had at least 0.45 hectares of farm land, the average in the area (Okafor, 1991), who planted either cassava, yam or cocoyam, or a combination of two or more of them. These farmers were selected from the most severely eroded local government areas of the state, based on published records of erosion gully counts by the Anambra State Task Force on Soil Erosion Control (ASTFSEC). Our sample frame for community-level farmer selection was the report of the Anambra State Agricultural Development Project's (ADP's) baseline survey of farm families in the various communities.

Field work done during the cropping season in 1994 consisted of personal interviews and participant observation. Information was obtained on farmers' socio-economic characteristics, farm structure and sizes, cropping patterns, land tenure, erosion control practices, types and sources of material inputs, sources of farm information on soil management practices, nature and contents of inter-farmer and farmer-extension information exchanges and innovation, and ethnohistorical information regarding techniques employed by farmers in the past for handling specific environmental problems.

In an attempt to isolate the factors that determine the adoption of SECPs and the specifically important factors in the adoption of TSECPS and RSECPs, an adoption model was developed and estimated with ordinary least squares (OLS) techniques for two clusters of SECPs, one regarded as traditional and the other as recommended. The use of such clusters for better explaining differences in the adoption of TSECPs and RSECPs has been suggested by Gross and Taves (1952).

The general form of the implicit linear model for TSECPs used in the analysis is as follows:

$$Y_t = a + bX_{t1} + bX_{t2} + bX_{t3} + bX_{t4} + \cdots + bX_{t11} + e$$

while that for RSECPs is

$$Y_r = a + bX_{r1} + bX_{r2} + bX_{r3} + bX_{r4} + \cdots + bX_{r11} + e$$

where $Y_t$ and $Y_r$ are aggregate indexes of use of TSECPs and RSECPs, respectively.

$X_1$ = age of farmer in years.
$X_2$ = annual farm income in Naira.
$X_3$ = level of education in years.
$X_4$ = farm size in hectares.

$X_5$ = farm input prices in Naira.
$X_6$ = farm output prices in Naira.
$X_7$ = off-farm employment measured 1, if available and 0, otherwise.
$X_8$ = loan interest rate (%).
$X_9$ = innovativeness index.
$X_{10}$ = index of attitude towards conservation.
$X_{11}$ = index of risk bearing.

The independent variables $Y_t$ and $Y_r$, the aggregate indexes of use of TSECPs and RSECPs, respectively, are measured as

$$Y_t = \sum Y_{ti}/Z \text{ and } Y_r = \sum Y_{ri}/Z$$

estimated for each sample point and then aggregated, where $Y_t$ or $Y_r$ are the use of TSECPs respectively RSECPs within all major cropping patterns in the study area; $Y_{ti}$ or $Y_{ri} = 1$ if $i$-th TSECP respectively RSECP is used, and 0 otherwise; $i$ = soil erosion control practice; $Z$ = maximum number of SECPs under consideration.

The TSECPs included in the cluster are use of tree trunks, use of cover crops, use of diversion pits, mulching, and use of big mounds and ridges. The RSECPs in the cluster are zero tillage, minimum tillage, contour strip cropping, not burning field and tree planting. The resulting figures are shown in Table 1.

Summary independent variables for the regression analyses were chosen on the basis of prevailing knowledge of factors influencing adoption generally, and on the basis of those likely to be particularly pronounced in the study area.

1. Age ($X_1$) was hypothesized to be negatively correlated with adoption of RSECPs but positively correlated with the adoption of TSECPs. The assumption here is that younger persons were more receptive to change and would easily reject utilitarian orientations of the older generation, while older people were more set in the ways of their forefathers. Missing data were given the appropriate sample mean.
2. Income ($X_2$) was measured in naira as estimated annual receipts from farming. It was expected that level of income from farming would reflect ability of farmers to afford RSECPs most of which require relatively higher outlay of funds to establish and maintain than TSECPs.
3. Education ($X_3$), measured with a direct question asking for the level of schooling completed and the number of years of formal education was calculated from there.

Table 1
Indexes of use of TSECPs and RSECPs[a]

| TSECP | Index of use | RSECP | Index of use |
|---|---|---|---|
| Cover crops | 4.86 | Zero tillage | 3.93 |
| Dead tree trunks | 4.33 | Minimum tillage | 3.53 |
| Diversion pits | 3.27 | Contour stripping | 4.03 |
| Mulching | 3.00 | Not burning field | 2.73 |
| Big mounds/ridges | 2.67 | Tree planting | 2.60 |
| Aggregate (cluster) index | 18.13 | | 16.82 |

[a] Source: computed from field data, 1994.

One year of apprenticeship was equated to two years of formal education. Education was postulated to be positively associated with the use of RSECPs and negatively associated with TSECPs.

4. Farm Size ($X_4$) in hectares measured the size of farmland cultivated by the farmer.
5. Farm Input Prices ($X_5$) in Naira, measured as estimated average prices of selected last season's farm inputs. The inputs considered for this calculation are those that are commonly used in the area and include hoes, cutlass, rake, seed yam, cassava sticks, maize seeds, cocoyam, yam stakes, insecticides (vectored by Aldrin dust), herbicide, fertilizer, poultry manure, cost of labor. Transportation costs, dues, rates, and taxes are assumed to have been absorbed in the prices of the above items.
6. Farm Output Prices ($X_6$) in Naira, measured as estimated average prices of last season's major farm produce. Those outputs considered were yam (large, medium, small); cassava, per heap of approximately 200 medium sized tubers; cocoyam, per heap of approximately the size of a standard head pan; maize, per 50 kg bag; vegetables (vectored by *Amaranthus* spp. and *Telferia* spp., per smallest wrap size prevailing in markets in the study area).
7. Employment ($X_7$), is a dummy variable measuring engagement of farmers in non-farm occupations and scored 1 if so, and 0 otherwise. Access to non-farm employment may mean reduced likelihood of controlling erosion on the farm and the abandonment of badly eroded lands. On the other hand, earnings from non-farm employment could empower a farmer to spend on measures to control erosion.
8. Interest rate ($X_8$) measured as average interest rate on credit used by the farmer. That is, total of interest rate on loans from various sources divided by the number of sources.
9. Innovativeness index ($X_9$) was measured with a 6-item summated Likert-type format and assigned weights according to responses as follows: Agree—3, Undecided—2, Disagree—1. We used the 'method of summated ratings' (Edwards, 1957). The constituent scale items are as given in Table 2.

Table 2
Discrimination index for six attitude statements selected for the innovativeness scale, 125 small scale farmers

| Statement | Response (weight) | | | Discrimination index ($r$) |
|---|---|---|---|---|
| | Agree | Undecided | Disagree | |
| a ''It is necessary to learn new ways of controlling erosion on our farms.'' | 3 | 2 | 1 | 0.62 |
| b ''If the extension agent invites you to a talk, would you attend?'' | 3 | 2 | 1 | 0.49 |
| c ''Would you like to work for wages away from your village?'' | 3 | 2 | 1 | 0.53 |
| d ''It is wise to borrow money.'' | 3 | 2 | 1 | 0.55 |
| e ''Do you think you would be able to control the erosion problems on your farm in the near future?'' | 3 | 2 | 1 | 0.51 |
| f ''If government provides you an erosion-free alternative piece of land elsewhere, would you move?'' | 3 | 2 | 1 | 0.63 |

Table 3
Discrimination index for five statements selected for the scale of attitude towards conservation, 125 small scale farmers

| Statement | Response (weight) | | | Discrimination index ($r$) |
|---|---|---|---|---|
| | Agree | Undecided | Disagree | |
| a ''Soil erosion is a natural thing. We need not worry much about it.'' | 1 | 2 | 3 | 0.67 |
| b ''Government should make the use of erosion control measures compulsory for farmers.'' | 3 | 2 | 1 | 0.54 |
| c ''Soil conservation is a foreign idea designed to make farmers buy foreign products and adopt foreign cultures.'' | 1 | 2 | 3 | 0.42 |
| d ''I need some subsidy from government if they want me to spend money to control erosion.'' | 1 | 2 | 3 | 0.49 |
| e ''I would like farmers in my village to form groups to tackle erosion problems.'' | 3 | 2 | 1 | 0.58 |

10. Index of Attitude Towards Conservation ($X_{10}$) was measured by means of five questions on the respondent's felt need for conservation in general. This measure is independent of actual change behavior. The scaling method was the same as for $X_9$ but the assignment of weights was reversed (Agree—1, Undecided—2, Disagree—3) in respect of numbers 'a', 'c', and 'd' of the attitude statements given in Table 3.
11. Index of Risk Bearing ($X_{11}$) measured a farmer's readiness to take risks in terms of the adoption of SECPs to which they are not familiar (regarding mainly the RSECPs). See Table 4. Weighting of the six responses in this index was as for $X_9$ except numbers 'd' and 'e' which were reversed as for numbers 'a', 'c', and 'd' of $X_{10}$. The attitude statements for each of the above indexes were selected on the basis of item analysis of 12 statements. Statements with a discrimination index less than

Table 4
Discrimination index for six statements selected for the scale of risk bearing, 125 small scale farmers

| Statement | Response (weight) | | | Discrimination index ($r$) |
|---|---|---|---|---|
| | Agree | Undecided | Disagree | |
| a ''Investing in soil erosion control could increase farm incomes in future.'' | 3 | 2 | 1 | 0.59 |
| b ''Farmers should readily change their farming practices if that will help check soil erosion.'' | 3 | 2 | 1 | 0.66 |
| c ''The extension agent does not have to demonstrate a practice before I can adopt it.'' | 3 | 2 | 1 | 0.57 |
| d ''A steady or regular job is good for a man.'' | 1 | 2 | 3 | 0.44 |
| e ''A man's future is in the hands of God.'' | 1 | 2 | 3 | 0.68 |
| f ''Rather than have palm fruits waste for lack of male labor, women should be allowed to harvest them.[a]'' | 3 | 2 | 1 | 0.41 |

[a] Harvesting of palm fruits in the study area is culturally prohibited as a taboo but is becoming less strictly adhered these days.

0.40 were dropped. In constructing the three indexes, the scores for the various items were added for each individual and expressed as a percentage of the possible score.

The hypothesis of no difference between the level of adoption of TSECPs and RSECPs was tested with the $\chi^2$ statistic.

## 4. Results and discussion

### *4.1. Demographic characteristics of respondents*

Most of the farmers are male with an average age of 48 years (Table 5). Primary literacy is very high among them. The mean annual farm income is 16 397.12 Naira or about US$200 and each of them had a mean farm holding of almost 1 hectare.

### *4.2. Response of the adoption indexes to changes in independent variables*

Table 6 presents summary statistics for the regression of the indexes of use of TSECPs and RSECPs on 11 independent variables hypothesized to influence them. Least squares estimation procedures were used to calculate the normal response of adoption to the independent variables. The discussion of the results deal with proportional changes, and says nothing about differences in levels of use of either group of practices. This information is contained in the intercepts which need not equal zero and which reflect the quantitative importance of omitted variables. The higher value of the TSECP intercept relative to that of RSECP is probably also due to the fact that the use of TSECPs reflects, and is in fact dependent, more than the use of RSECPs, on the cultural carryovers from the past than the contemporary factors embodied in the independent variables. It also demonstrates that TSECPs are the dominant SECPs in the study area.

Table 5
Summary of demographic characteristics of respondents

| | |
|---|---|
| Percentage male | 73.0 |
| Percentage female | 27.0 |
| Mean age of farmers (years) | 48.2 |
| Modal age of farmers (years) | 55.0 |
| Median age of farmers (years) | 48.0 |
| Percentage with no schooling | 12.0 |
| Percentage with primary schooling | 34.4 |
| Percentage with secondary schooling | 39.6 |
| Percentage with teacher training | 9.0 |
| Percentage with tertiary training | 11.2 |
| Percentage with apprenticeship training | 4.0 |
| Mean annual farm income (Naira) | 16,397.12 |
| Mean farm size (ha) | 0.98 |

Table 6
Multiple regression results on the determinants of use of erosion control practices[a]

| Eq. | Const. | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | $X_9$ | $X_{10}$ | $X_{11}$ | Pooled stats |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *TSECP* | | | | | | | | | | | | | |
| *B* | 4.485 | 0.176[b] | −0.135[b] | −0.274[b] | 0.100 | 0.619[b] | −0.937 | −2.241[c] | 0.139[b] | −0.780[b] | −0.117 | −0.116 | |
| | | (1.45) | (−0.675) | (−21.07) | (0.76) | (187) | (−234.3) | (−1.996) | (16.6) | (−2.34) | (−0.43) | (−0.428) | |
| $R^2$ | | 0.012 | 0.012 | 0.014 | 0.015 | 0.036 | 0.064 | 0.095 | 0.117 | 0.121 | 0.123 | 0.125 | 0.125 |
| $R^2$ change | | 0.012 | 0.00002 | 0.001 | 0.001 | 0.021 | 0.028 | 0.031 | 0.022 | 0.004 | 0.002 | 0.001 | |
| *F*-ratio | | 2.086 | 0.413 | 0.045 | 0.579 | 3.429 | 5.154[b] | 3.978[b] | 2.749 | 0.055 | 0.184 | 0.185 | 1.462 |
| *RSECP* | | | | | | | | | | | | | |
| *B* | 3.001 | 0.305[b] | 0.487[b] | −0.104[b] | 0.110 | 0.144[b] | −0.228[b] | −1.336 | −0.172 | −0.822[b] | 0.104 | −0.179 | |
| | | (2.77) | (24.350) | (−8.667) | (0.924) | (48) | (−57) | (1.315) | (−0.227) | (−2.721) | (0.421) | (−0.776) | |
| $R^2$ | | 0.00005 | 0.077 | 0.079 | 0.084 | 0.085 | 0.088 | 0.101 | 0.101 | 0.103 | 0.103 | 0.107 | 0.107 |
| $R^2$ change | | 0.00006 | 0.077 | 0.002 | 0.004 | 0.001 | 0.003 | 0.003 | 0.0002 | 0.0002 | 0.00002 | 0.004 | |
| *F*-ratio | | 0.076 | 6.56[b] | 0.787 | 0.847 | 0.228 | 0.372 | 1.727 | 0.051 | 0.001 | 0.002 | 0.533 | 1.230 |

[a] *T*-ratios are in parentheses. $R^2$ change figures may contain rounding errors. Source: Field data, 1994.
[b] Significant at 0.05 level.
[c] Significant at 0.01 level.

### 4.3. Socio-economic factors

The adoption of TSECPs responds most, though, as expected, negatively but significantly to $X_7$ (availability of off-farm employment or occupation). This implies, from our figures, that the level of adoption of TSECPs will decrease by 22% for a 10% increase in the availability of off-farm employment. However, this increase is likely to occur pari pasu with, or as a result of, abandonment of farmlands. The dilemma embodied in this finding has to do with the high tendency for farmers in this area to take to commerce as a secondary (or even primary) occupation thereby reducing or abandoning farming (and traditional practices) while at the same time not using their improved wealth positions to invest in RSECPs. The overall effect is rapid and continuous degradation of farmlands. A similar negative effect is implied in the RSECP equation for $X_7$ but with only a 13% decrease in the level of their use. This is expected since the level of adoption of TSECPs is from beginning higher than that of RSECPs. What we cannot establish here is whether the relative decrease in the levels of adoption of TSECPs and RSECPs in response to availability of off-farm employment is proportionate to the difference in the level of use both in the absence of off-farm employment in the area.

In both equations, input and output prices ($X_5$ and $X_6$, respectively) have significant coefficients but with signs opposite of a priori expectations. For both variables, however, the use of RSECPs exhibited a much stronger response than the use of TSECPs. That a unit increase in aggregate input prices would positively influence the use of TSECPs by up to 6.2% and that of RSECPs by 1.4% may be plausible if the purpose of increasing investments in SECPs is to protect valued resources from the vagaries of soil erosion. It is, however, difficult to explain how improvements in output prices could dissuade the use of SECPs as could be implied from our results (Table 6). It would appear that RSECP adoption depends more on interest rate ($X_8$) changes than TSECPs adoption. And, whereas a rise in interest rates significantly increases the use of TSECPs, it does reduce the use of RSECPs but the RSECPs coefficient is not significant at either the 0.01 or 0.05 levels. It could in fact be inferred from these coefficients that the use of RSECPs is more dependent on borrowings than the use of TSECPs. We do not have any grounds in theory to explain the positivity of the sign of the interest rate coefficient in the TSECP equation.

### 4.4. Ecological factors

It is surprising that the adoption of TSECPs responded least to farm size ($X_4$). Although the a priori sign is correctly predicted, the coefficient is significant at both the 0.01 and 0.05 levels. On the other hand, the RSECPs adoption responded to farm size more than TSECPs. It is probably the case that within the limits of the average farm size in the study area of 0.98 ha, farmers use less of RSECPs but would increase their adoption as farm size increases to commercial size holdings.

### 4.5. Attitude factors

Further on Table 6, the coefficients of the innovativeness variable ($X_9$) in both equations are significant at the 0.05 level. While it is likely that an increase in the

innovativeness index would be accompanied by a reduction in adoption of TSECPs and RSECPs as our results tend to portray, that can only be possible if the expression of innovativeness by the farmers is in the development and use of SECPs other than TSECPs and RSECPs. In other words, when modifications of any or both of them are used. Another surprising result is that on attitude towards conservation ($X_{10}$). An improvement in attitude towards conservation is supposed to stimulate the application of erosion control practices but that is not supported by our findings. However the influence of attitude towards conservation as measured in this study is not significant in both equations.

Part of the explanation for this is that for small scale farmers and in the traditional African context, innovativeness in erosion control is more likely to be diffused among numerous integral agronomic and cultural practices than in the singular act of applying a measure specifically for soil erosion control. Such expression of innovativeness can hardly be captured with a measure specifically directed at 'soil erosion control' per se. As such we cannot treat innovativeness in traditional settings as a unidimensional concept.

Pampel and van Es (1977) tried to demonstrate this view by distinguishing between commercial and environmental innovations. Commercial innovations involve the input of new techniques, skills, or activities with the goal of higher efficiency for the farm through stronger relationships between the farmer and the market system while environmental innovations have as a first objective the preservation of existing resources. We would like to suggest that one key reason why some level of bias is inevitable in estimates of the consequences of farmers' innovativeness orientations is our inability to disentangle these two categories of innovation in farmers' behavior.

Our results indicate that a higher disposition to take risks (say by 10%) reduces the use of TSECPs by 1.2%. Farmers exhibiting this behavior are those who would experiment with new tillage, crop and residue management practices which action could effectively shift them away from use of TSECPs and perhaps towards RSECPs. Such individuals are also more likely to take the risk of modifying TSECPs. The TSECP coefficient could be interpreted in two ways: that a 10% reduction in risk aversion (or 10% level improvement in risk bearing disposition) reduces adoption of RSECPs by 1.8% provided the use of RSECPs is perceived as being more risky than the use of TSECPs. We did not ascertain this possibility however. In any case, the coefficients of risk bearing orientation in both equations were not significant.

## 5. Evaluation of model estimation results

### *5.1. Explanatory power of the models*

As can be seen from Table 6, the robustness of both the TSECP and RSECP equations is very low with the TSECP being a little better than RSECP. Only 12.5% of the variation in the adoption of TSECPs and 10.7% in the adoption of RSECPs were respectively explained by the independent variables operating jointly, leaving unexplained 87% and 80.3%, respectively. But since their prediction accuracies, measured by

the standard errors of estimate (Table 6) at 1.496 (TSECP) and 1.353 (RSECP), are relatively low, we can only conclude that there is need to include more of the relevant explanatory variables in the models.

### 5.2. Relative contributions of the independent variables to explanation of adoption

The incremental contributions to $R_2$ of each independent variable, '$R^2$ change', are depicted on Table 6. They were obtained by decomposing the explanatory sum of squares into components attributable to each independent variable. From the table, we find that in the adoption of RSECPs, income is the most important variable, contributing 0.077 or 72% of the explanatory power followed by farm size and risk bearing orientation (each with 0.04 or 37.3% of the total explanatory power). In contrast, the most important variables in the adoption of TSECPs are employment, farm output prices and interest rate with 0.031 or 25%; 0.028 or 22%; and 0.022 or 18%, respectively, of the total explanatory power of the variables in the model.

### 5.3. Significance of the regression coefficients

Statistical tests to ascertain how much confidence to place on the estimated coefficients of the independent variables were carried out on the $R^2$ change for each variable. We essentially tested whether the coefficients are non-zero. It is also a test to decide how much confidence can be placed in the signs of the regression coefficients. The *F*-ratio was employed for this purpose using the standard regression testing method.

Comparing the calculated *F*-ratios for each independent variable (Table 6) with the critical $F$ for 1 and 113 degrees of freedom shows that only the coefficients for output prices and employment in the TSECP equation are significant at the 0.05 level while none is at the 0.01 level. Of the explained variation in the TSECP index (0.125), we can estimate the quantity due to the explanatory variables by summing the '$R^2$ changes' and subtracting from 0.125 to leave the proportion of the explained variance not attributable to any of $X_1$ to $X_{11}$ which is equal to $0.125 - 0.123 = 0.002$. For the RSECP equation it is $0.107 - 0.098 = 0.009$.

## 6. Test of hypothesis

The hypothesis tested is that there is no significant difference in the levels of adoption of TSECPs and RSECPs. From our data, each of the 5 practices that make up the TSECPs cluster and each of those that make up the RSECPs cluster had a maximum possible chance of being selected of 125 (the sample size). So the five practices in each cluster could be selected a maximum of 625 times. Using this information, the calculated $\chi^2$ of 61.08 was found to be highly significant at the 0.01 level (Appendix A). The null hypothesis is therefore rejected and we conclude that there is significant difference between levels of adoption of TSECPs and RSECPs.

## 7. Recommendations and conclusion

From our results, the most important contextual variables in the adoption of the TSECP are employment, farm output prices and interest rate. Action Agencies in the promotion of SECPs should concentrate on these variables. Policy should aim at selective promotion of those types of off-farm employment that cause the least diversion of resources from investments in TSECPs. Interest in the adoption of TSECPs cannot be sustained unless returns to the farmers are high enough to satisfy their basic needs and replace capital items.

On the other hand, to encourage the use of RSECPs, the most important variables to manipulate are farm income, farm size and farmers' disposition to taking risks, in that order. However, we see a situation where a combination of policy options will be more rewarding than the pursuit of these in isolation. As such, the tying of credit to farm size and the use of other incentives to encourage the more risk-loving farmers with regard to the application of RSECPs is suggested. We note that cause and effect relationships among various policy actions are multifarious and far reaching, which suggests that the tracking of the impact of economy-wide macro-economic policies and determining how they touch on farm-level decisions on the use of SECPs should necessarily complement the planning of erosion control technology use.

Future studies can refine the measures used in this study and go further to introduce new culturally relevant variables in order to have better predictive models. The issue of SECPs should be made a priority on the agenda of farming systems research and extension in such agencies as the Anambra ADP, the TFSEC the FEPA. There is need for collaborative research linkages between these and other concerned institutions on one hand and farmers on the other. More research attention should be focused on the less well understood aspects of benign forms of farm-level soil erosion.

## Appendix A. Calculation of $\chi^2$ statistic

Observed frequencies:

| | TSECPs | RSECPs | Both |
|---|---|---|---|
| No using | 367 | 229 | 596 |
| No not using | 258 | 396 | 654 |
| Total | 625 | 625 | 1250 |

Expected frequencies:

| | TSECPs | RSECPs | Both |
|---|---|---|---|
| No using | 298 | 298 | 596 |
| No not using | 327 | 327 | 654 |
| Total | 625 | 625 | 1250 |

$$\chi^2 = \Sigma\left[\frac{(f_o - f_e)^2}{f_e}\right] = 61.08.$$

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