Iran Agricultural Research 14:39-62 (1995)

MODELS OF SOIL CONSERVATION TECHNOLOGY ADOPTION IN DEVELOPING COUNTRIES: THE CASE OF IRAN

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(Received: December 20, 1994)

ABSTRACT

This paper examines the predictive power of diffusion, farm-structure, and multiplicity models in adoption of soil conservation technologies in developing countries. The data for the study were collected from 265 farmers in a highly erodable area of Fars province, Iran. The multiplicity model, which takes a perspective that combines the variables of diffusion and farm structure models, has proved to be the most powerful model in explaining the farmers' soil conservation adoption behavior. The most important variables in explaining the adoptions of soil conservation practices are: yield of wheat crop, farmers' awareness of soil erosion problems, hectares of wheat cultivated, cost of farming and knowledge gained from different sources, illustrating the complementary role of diffusion and farm structure variables. Finally, policy implication of findings, and suggestions for further sociological research to the problem of soil erosion in developing countries are discussed.

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تحقیقات کشاورزی ایران

(۱۳۷۴) ۶۲-۳۹: ۱۴

مدل های پذیرش تکنولوژی حفاظت خاک در کشورهای در حال توسعه: مطالعه موردی ایران

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چکیده

این مقاله توان مدل های نشر، ساختار مزرعه و چندگانه را در پیش بینی پذیرش تکنولوژی حفاظت خاک در کشورهای در حال توسعه مورد بررسی قرار داده است. داده های این مطالعه از ۲۵۶ نفر کشاورزان یک ناحیه دچار فرسایش شدید خاک در استان فارس جمع آوری شده است. مدل چندگانه که از تجمع و ترکیب متغیرهای مدل های نشر و ساختار مزرعه حاصل می شود قدرتمندترین مدل برای توضیح رفتار پذیرش روش های حفاظت خاک توسط کشاورزان شناخته شد. مهمترین متغیرها در توضیح رفتار مربوط به پذیرش روش های حفاظت خاک شامل عملکرد گندم، آگاهی کشاورز از مسائل فرسایش، سطح زیر کشت گندم، هزینه مزرعه و دانش کسب شده از منابع مختلف است، که نشان دهنده نقش تکمیلی متغیرهای مدل های نشر و ساختار مزرعه می باشد. کاربرد یافته ها در سیاست گزاری و پیشنهادات برای پژوهش های اجتماعی آتی در زمینه مسئله فرسایش خاک در کشورهای در حال توسعه مورد بحث قرار گرفته است.

INTRODUCTION

More than five decades of research efforts have produced volumes of information about the biophysical elements that contribute to soil erosion and the technology to reduce it. However, these research efforts are of little benefit if these conservation techniques are not adopted by farmers. Despite considerable knowledge available on how to conserve soil, erosion has continued to be a universal problem. Even in the developed world soil erosion has continued to be a threat to future agricultural productivity (26). Reports of soil erosion damage are available from different parts of the developed world (6,10,23,24,25).

Asia probably has suffered more from human-induced soil erosion than any other continent (7). In developing countries where resources for research and policy programs for soil conservation are scarce and poverty reduces the priority of environmental issues, soil erosion is more problematic. Damage caused by soil erosion is not only significantly different from one country to another but also within a country there are differences from one region to another. High level of soil loss has been reported in India (32,39), China (19,35), Korea (41) and Nepal (16).

Although no data are available on the erosion-productivity relationship in Iran (7), observation by Iranian and foreign nationals provide seemingly overwhelming evidence of soil erosion (8,17). Lowermilk (20), one of the first to describe the impact of erosion on early civilization, noted the extensive damage in Iran. According to Dregne (7), reasonably well-confirmed instances of permanent soil productivity loss resulting from human induced water erosion can be found in different Asian countries, including Iran. He perceives the situation to become worse as population increases and cultivation continues to expand.

Much attention has been paid to technical research to find conservation techniques in attempts to overcome soil erosion problems. While considerable resources are devoted to research for developing conservation techniques, it can easily be demonstrated that failure to prevent soil erosion is not a problem of lack of effective mechanical or agronomic soil conservation methods. However, the lack of adoption of these techniques by farmers is rather an important factor. Napier (27) concludes that if it is expected to bring about widespread adoption of soil conservation practices in developing societies, less efforts should be directed toward the creation of new soil conservation techniques and development of additional information programs to introduce these innovations to farmers and at the same time more emphasis should be given to efforts to overcome institutional barriers to adoption. It should be recognized that soil erosion is a socio-technical problem. Therefore, to design successful soil conservation programs, research in socio-economic aspects of adoption of soil conservation techniques is essential.

The most important contribution of social scientists is development of models that can predict the soil conservation behavior of farmers. These models, if proven to have a certain degree of validity, could be a heuristic device in designing soil conservation programs, regulation and services, which would bring about greater adoption of soil conservation practices. There is little evidence of attempts to develop such models in developing countries. A study in the Dominican Republic demonstrated that socio-economic factors were very poor predictors of adoption of soil erosion control practices, but diffusion-type factors were shown to be relatively good predictors of adoption (13). Examination of the literature focused on the adoption of soil conservation practices in Asia strongly suggests that macrosocial factors and microsocial factors affect adoption decisions at the farm level (29). Macrosocial refers to structural factors beyond the control of the land owner. Microsocial refers to individual and farm enterprise factors.

However, theoretical and empirical aspects of these models are investigated to some extent in the developed countries (31,33). Napier, one of the leading researchers in the area of modeling soil conservation behavior of farmers, has consistently shown that farm structure and policy factors have been the best predictors of adoption of soil and water conservation practices at farm level. However, the amount of explained variance in his studies have shown that all models assessed are inadequate to predict adoption behaviors (28,30,31)

The theoretical soil conservation adoption models which will be used in this study include the diffusion model, the farm-structure model and multiplicity models, each of which will be briefly explained.

The Diffusion Model

The diffusion model is the most widely used perspective for adoption of agricultural innovations (36). Perceived need and awareness of innovations are the first steps in the diffusion process. Next, farmers should be able to obtain valid agronomic and economic information to evaluate potential consequences. Individuals will assess perceived costs and benefits associated with alternative actions and develop attitudes towards each option. Following this model, once favorable attitudes are developed, individuals will try the innovation and later adopt it on a large scale. Variables which will be selected for this study based on the diffusion model and the reason for their selection will be briefly discussed.

Awareness is perceived as an essential condition for adoption of innovations in the diffusion model. It is assumed that farmers will not adopt new farm practices unless they become aware that the use of existing farm practices is creating a problem. Therefore, farmers' awareness of soil erosion problem was included in the study as a variable that based on the diffusion model could significantly relate to adoption behavior. Another necessary condition for adoption is a favorable attitude toward conservation practices.

Therefore, it is hypothesized that farmers' attitudes toward soil erosion control will be significantly related to adoption behavior. McSweeney and Kramer (22) observed that farmers' receptiveness depends on their beliefs about the short and long term net returns associated with conservation practices. Perception of environmental problems may be influenced more by the resources available to solve the problems than the extent of the actual problems (12).

Soil conservation knowledge gained through access to different information sources is posited to be an important determinant of adoption behavior. Proponents of the diffusion perspective argue that once farmers are informed of the advantages of using specific practices they will adopt the innovation. Therefore, knowledge gained from different sources about soil erosion and conservation was included in the model to determine its power in explaining the adoption of soil conservation behavior. Higher rates of adoption of soil conservation practices are reported to be associated with more contact with information sources (18,34). Anderson and Thampapillai (1) suggest that the key role of government is to transfer information on soil problems and possibilities.

Furthermore, the diffusion model asserts that adopters' characteristics are important determinants of adoption behavior. Given this argument, it is hypothesized that measure of farmers' education, farmers' age and years of farming experiences is associated with adoption. The influence of education on attitudes to soil conservation has been investigated in the developed and developing countries (5,9,15). Hoover and Wiitala (15) concluded that adoption of conservation practices were more common among young, well-educated farmers. Since some of the consequences of erosion are difficult to observe, further education is required if it is to be perceived as a problem. The general conclusion regarding age is that younger farmers tend to be more concerned about the environment (2,3,40).

The Farm-Structure Model

The farm-structure model (31) which is also called the economic constraint model (14), has been offered as an alternative explanatory model to the diffusion model, and is based on the premise that economic barriers prevent the traditional diffusion model from operating effectively. The farm-structure model argues that although a person may have a strong desire to adopt a technology, he may not be able to act consistently with his attitude due to economic constraints. An individual may be prevented from acting due to the following: the inability to access economic resources, past commitments of resources and specialization of farming activities (31).

The farm-structure model emphasizes access to material resources as predictive variables of adoption behavior (4). If farmers do not have access to necessary resources for implementing a conservation plan, the adoption of many conservation practicies is not possible. Given these arguments it is hypothesized that measures of socio-economic status will be significantly related to adoption of conservation practices. The farmers' economic status variables used in this study include cost of farming (last year), hectares of wheat cultivated, total hectares of land managed and yield of wheat per hectare. Although research findings regarding the influence of farm size and income are not consistent (1), some indicate that these variables positively influence the adoption of soil conservation (5,9,15,34,38). Green and Heffernan (12) concluded that the operators of large farms are more likely to adopt soil conservation practices and to adopt them at an earlier stage. They perceived soil erosion to be increasingly a problem for small-scale farmers.

The planning horizon seems to be important in adoption of conservation practices. However, Ervin and Ervin (11) found that the length of the planning period, defined in terms of transferring property to children, to be insignificant in influencing adoption of conservation measures. The general consensus in developing countries, is that the length of the planning horizon is short (21). This short planning horizon means that if soil conservation practices are perceived to be effective only in the long term, their adoption remains unlikely. Given these arguments, if the farm is to be transferred to children or the probability of continuing farming is high the present land owner should be more concerned about future value of the land resources and be more willing to consider adopting practicies that will preserve the land. Therefore, measures of intergenerational transfer of land and probability of continuing farming are expected to relate to adoption behavior.

Multiplicity Model

This paper introduces a new label for an alternative conceptual model - the multiplicity model - which should help to identify the determinants of adoption of conservation practices in developing countries more comprehensively. The multiplicity model which takes a perspective that combines the perspectives of the diffusion and the farm-structure models has been used by other researchers to explain adoption behavior (31). This model argues that, in explaining the adoption of conservation behavior, the variables included in the diffusion and farm-structure models are not alternative groups of variables, but rather are complementary. Thus in the multiplicity model, all variables of the diffusion and farm-structure models are loaded into the equation. Since in reality a farmer adopting soil conservation practices depends both on his attitude and his ability to act, it is expected that this model should provide a better explanation of the adoption of such practices.

THE OBJECTIVES AND METHODS

In the light of severe and accelerating soil erosion in developing countries and a lack of conceptual models to explain farmers' adoption of soil conservation practices in these countries, the objective of this study is to explore the ability of the three models outlined above (diffusion, farm-structure and multiplicity) to predict the adoption of soil conservation practices in developing countries. Data from Iran will be used in this study to test the above research question. It is clear that the above objective cannot be evaluated by testing a null hypothesis. Thus the relative explanatory power of each model in explaining the adoption of different soil conservation practices will be used as the criteria to make an assessment of each model. Furthermore, the usefulness of each independent variable will be evaluated, based on the number of times they are entered in the equations and the step they are entered in the stepwise regression models.

Sample and Population

The data for this study were collected in the watershed area of *Doroodzan* dam in Fars province, Iran. This area was selected because the experts consider it to be one of the most erodable croplands in the province. A two-stage cluster sampling technique was used to collect data from villages with more than 10 households. From the 18 villages randomly selected in the first stage, a 20 per cent simple random sample was selected. Final interviews with 265 randomly selected farmers were completed in 1992. An initial interview questionnaire was pre-tested and findings were incorporated into the revised interview schedule.

Measurement of Variables

The dependent variables in this study were the adoption of soil conservation practices including crop residue left on the land, gully control, crop rotation, application of animal manure, application of green manure, conservation tillage, cross slope ploughing, counter bounds, control of stream bank erosion, land levelling and a general adoption index. The adoption of these practices was measured by asking the respondents to indicate how frequently they have used the practices on their farms. The responses consisted of "always used", which received a value of 2, "occasionally used", which received a value of 1 and "never used", which received a value of 0. The pilot study indicated that terminology used for conservation practices by experts is different from that used by farmers and was a source of ambiguity. Therefore, whenever a reference was made to a practice during the interview, its picture was shown to the farmers in order to overcome this difficulty. This technique was limited to more uncommon practices. The general adoption index was developed by adding the adoption score of the above 10 conservation practices together. The three models were examined for their ability to predict the adoption of these conservation practices.

The independent variables consisted of components of the diffusion model and farm-structure model, and the combination of variables of these two models represented the multiplicity model. Six diffusion model variables were used in this study. Awareness of soil erosion problems was measured on a 3 point scale. The attitude of farmers towards soil erosion control was measured using a scale ranging from "yes", indicating the respondents perceive the problem of erosion to be serious and control measures were necessary, which received a value of 2, to "undecided", which received a value of 1. "No", which indicated that respondents did not perceive the problem to be serious and did not favor control practices, which received a value of 0. Knowledge gained or access to information was measured in terms of frequency of items of information about soil erosion problems and conservation practices which were received by farmers during the past year from extension agents, radio, television, extension publications and other farmers. Farmers' education was measured in terms of the general education level they had completed. Farmers' age and years of farming experiences were also recorded.

The independent variables selected to represent the farm-structure model were cost of farming, hectares of wheat cultivated, total hectares of land managed, hectares of land owned, yield of wheat per hectare, transfer of farm to children and probability of continuing farming. Due to difficulties in measuring income from agriculture in developing countries, the cost of farming in the last year prior to the interview was measured as an alternative estimate of income and wealth. Farm size was measured in different ways, each method of measurement having its meaning in terms of soil conservation. Total hectares of land managed determine the size of agricultural operation by the farmer but the farmer may not own all of the land he manages as part or all of the land may be rented.

The other variable measures the hectares of land owned by a farmer, which could be detrimental in soil conservation practices. Since irrigation water is a bottleneck and a farmer may be able to cultivate only a small portion of his land, hectares of wheat cultivated was measured and included in the model. Yield of wheat was included to provide the measure of quality of land. A farmer may own a large farm but the quality of land may be poor. Thus inclusion of yield variables, when used with measures of farm size in the model, could be detrimental. Transfer of the farm to children was measured by asking the farmers if they intended to transfer their landholdings to their children. The response ranged from "yes", which received a value of 2, to "no", which received a value of 0. An undecided response received a value of 1. The probability of continuing farming was measured by asking the farmers to indicate what is the probability that they may continue farming. The response ranged from "very likely", which received a value of 4, to "highly unlikely", which received a value of 1.

RESULTS AND DISCUSSION

The findings for the examination of the three models are presented in Table 1. The regression findings are presented in standardized partial

Table 1. Stepwise multiple regression on conservation technologies in different models.

	Diffusion Model	Farm Structure Model	Multiplicity Model
Y_1- Crop residue left on the land	Y_1=.207X_1+.162X_2 R=.28 R^2=.07 Sig.F=.00	Y_1=-.22X_7+.18X_8-.36X_9+.03X_{10} R=.35 R^2=.12 Sig.F=.00	Y_1=-.23X_7+.17X_1+.17X_2+.14X_8 R=.38 R^2=.15 Sig.F=.00
Y_2- Gully control	Y_2=.26X_1+.20X_3 R=.34 R^2=.13 Sig.F=.00	Y_2=.16X_{11} R=.16 R^2=.03 Sig.F=.01	Y_2=.24X_1+.21X_3+.14X_{11} R=.38 R^2=.15 Sig.F=.00
Y_3- Crop rotation	Y_3=-21X_4+.15X_3+.14X_1 R=.28 R^2=.08 Sig.F=.00	Y_3=.35X_{11}+.32X_8-.23X_7+.11X_{12} R=.58 R^2=.33 Sig.F=.00	Y_3=.37X_{11}+.32X_8-.22X_7 R=.56 R^2=.32 Sig.F=.00
Y_4- Application of animal manure	Y_4=.16X_3 R=.16 R^2=.03 Sig.F=.00	Y_4=.28X_8-.27X_7+.16X_{11} R=.43 R^2=.18 Sig.F=.00	Y_4=.28X_8-.27X_7+.16X_{11} R=.43 R^2=.18 Sig.F=.00
Y_5- Application of green manure	Y_5= no variables entered	Y_5=.24X_{11}-.14X_{12} R=.26 R^2=.07 Sig.F=.00	Y_5=.22X_{11} R=.22 R^2=.05 Sig.F=.00
Y_6- Conservation tillage	Y_6= no variables entered	Y_6= -.22X_{11} - .16X_{10} - .20X_{12} + .14X_7 + .15X_{13} R=.37 R^2=.14 Sig.F=.00	Y_6= -.22X_{11} - .16X_{10} - .20X_{12} + .14X_7 + .15X_{13} R=.37 R^2=.14 Sig.F=.00
Y_7- Cross slope ploughing	Y_7=.16X_2 - .05X_1 R=.20 R^2=.04 Sig.F=.01	Y_7= -.21X_{11} - .14X_8 R=.27 R^2=.07 Sig.F=.00	Y_7= -.21X_{11} - .14X_8 R=.27 R^2=.0 7 Sig.F=.00
Y_8- Counter bounds	Y_8= .17X_3 R=.17 R^2=.03 Sig.F=.01	Y_8= .24X_{11} R=.14 R^2=.06 Sig.F=.00	Y_8= .24X_{11} + .18X_3 R=.30 R^2=.09 Sig.F=.00
Y_9- Control of stream bank erosion	Y_9=.19X_1 R=.19 R^2=.03 Sig.F=.00	Y_9=.13X_{11} R=.13 R^2=.02 Sig.F=.03	Y_9=.19X_1 R=.19 R^2=.03 Sig.F=.00
Y_{10}- Land levelling	Y_{10}=.24X_4 R=.24 R^2=.06 Sig.F=.00	Y_{10}=-.28X_{11}-.23X8+19X_7 R=.43 R^2=.19 Sig.F=.00	Y_{10}=-.26X_{11}-.21X_8+.18X_7+16X_4 R=.46 R^2=.21 Sig.F=00
Y_{11}- Total adoption index	Y_{11}=.28X_3+.24X_1 R=.40 R^2=.16 Sig.F=.00	Y_{11}=no variables entered	Y_{11}=.28X_3+.24X_1 R=.40 R^2=.16 Sig.F=00

(Table 1.,Continued)

Diffusion Model Variables:	Farm Structure Model Variables:
X_1-Farmers' awareness of soil erosion problem	X_7-Cost of farming (last year)
X_2-Farmers' attitude toward soil erosion control	X_8-Hectares of wheat cultivated (last year)
X_3-Knowledge gained from different sources about soil erosion and conservation	X_9-Total hectares of land managed
	X_{10}-Hectares of land owned
X_4-Farmers' education	X_{11}-Yield of wheat per hectare
X_5-Farmers' ago	X_{12}-Transfer of farm to children
X_6-Years of farming experiences	X_{13}-Probability of continuing farming

regression coefficient form.

The findings with regard to the diffusion model indicate that for adoption of gully control and general adoption index the diffusion variables explained 13 and 16 percent of variability, respectively. For the rest of conservation technologies the explanatory power of the diffusion model reduced even further to 8 per cent or less. The inability of diffusion variables to explain the adoption of soil conservation technology is consistent with findings reported by Napier (31) in Ohio. However, these findings contradict the findings by Nowak (33), who concluded that diffusion of information variables plays an important role in the adoption of conservation technologies. Furthermore, the results of evaluation of the diffusion model in Table 1 indicate that there is no difference in explanatory power of diffusion variables for conservation practices with short-term benefits (e.g. application of animal manure) and long-term benefits (e.g., counter bounds). Table 2 indicates that in no case the diffusion model is the best (in terms of R^2) in explaining the variability in adoption of soil conservation technologies when compared with the farm-structured model and the multiplicity model. The diffusion model has the same R^2 as the multiplicity model in only two cases, which were the control of stream bank erosion and the general adoption index.

The farm structure model variables entered into stepwise regression equations were cost of farming the year prior to the interview, hectares of wheat cultivated in previous year, total hectares of land managed, hectares of land owned, yield of wheat per hectare, transfer of farm to children and probability of continuing farming (Table 1). The farm structure model explained about 12, 14, 18, 19 and 33 percent of variability in crop residue left on the land, conservation tillage, application of animal manure, land levelling and crop rotation, respectively. These findings, compared with the diffusion model, indicates that the farm structure model is relatively a more powerful model of explaining variability in soil conservation technologies.

The data presented in Table 2 indicate that for 18.2 per cent of cases, the farm structure model was more powerful than both the diffusion and the multiplicity models in predicting the variability in the adoption of soil conservation technologies. In fact, the farm structure model explained 33 and 7 per cent variability in the adoption of crop rotation and application of green manure, respectively, which was better than the other models. The above findings support the results reported by Napier and Camboni (28) and Nowak (33). It should be noted that the conclusion of both Napier and Camboni (28) and Nowak (33) are based on research in the United States and not in the developing countries.

Table 2. Evaluation of the three models based on the relative explanatory power of the models.

	BEST MODEL		AS GOOD AS MULTIPLICITY	
Models	Frequency	Per cent	Frequency	Per cent
Diffusions	0	0.0	2	18.2
Farm-structure	2	18.2	3	27.3
Multiplicity	4	36.3	-	-

The findings indicated that the multiplicity model explained about 14, 15, 15, 16, 18, 21 and 32 per cent of variability in adoption of conservation tillage, crop residue left on the land, gully control, general adoption index, application of animal manure, land levelling and crop rotation, respectively. Therefore, when compared with the predictive power of the diffusion and farm structure models, these findings indicate the superiority of the multiplicity model in explaining the adoption of conservation technologies. As data in Table 2 illustrate, in 36.3 per cent of cases, the multiplicity model is the best model in terms of R^2 explained and in 45.5 per cent of cases it is as good as the other two models. Thus, in about 82 per cent of cases the multiplicity model is better, or at least the same as the diffusion or farm structure models in explaining the adoption of soil conservation technologies.

The results of the evaluation of variables based on the frequency and relative step of their entrance into the stepwise regression equation of the three models are presented in Table 3. These results show that according to these criteria the yield of wheat (X_{11}), farmers' awareness of soil erosion problems (X_1), hectares of wheat cultivated (X_8), cost of farming (X_7) and knowledge gained from different sources (X_3) which entered into 51.5, 30.3, 30.3, 30.3 and 24.2 per cent of equations at different steps, were the best independent variables in explaining the variability of dependent variables. The interesting point about the above findings is the fact that the best variables are not only from the diffusion model or the farm structure model , but represent a combination of key variables of both models or, in other words, the multiplicity model. These findings support the theoretical perspective for the multiplicity model. Three variables, farmers' age (X_5), years of farming experience (X_6) and probability of continuing farming (X_{13}), were not entered into any equation. It should be noted that the probability of F to enter was set at 0.05 and the tolerance level at 0.01. The lack of predictive power of age as a variable may be explained by the fact that even classical diffusion studies show no relationship between age and adoption of innovations (37). In addition, there is high correlation in developing countries between age and farming experience, because options for other occupations are very limited. Therefore, experience and age can be treated as one variable. The limited opportunity to have other occupations makes the continuation of farming a must, which means the variability in this factor is very limited. This lack of variability makes the probability of continuing farming (X_{13}) an ineffective variable in the explanation of adoption of soil conservation technologies.

Table 3. Evaluation of variables based on the frequency and the step they entered in the stepwise regression models.

Independent		ENTRANCE			TOTAL ENTRANCE	
Variable	Step 1	Step 2	Step 3	Step 4	NO.	Per cent
X_{11}†	14	0	3	0	17	51.5
X_1	5	4	1	0	10	30.3
X_8	2	7	0	1	10	30.3
X_7	2	2	4	2	10	30.3
X_3	4	4	0	0	8	24.2
X_{12}	0	1	2	1	4	12.1
X_4	2	0	0	1	3	9.0
X_2	1	1	1	0	3	9.0
X_{10}	0	2	0	1	3	9.0
X_9	0	0	1	0	1	3.0

† For description of variables see the footnote of Table 1. Variables X_5, X_6 and X_{13} were never entered in any equation.

CONCLUSIONS

The developing countries are suffering from severe and accelerating soil erosion. While the technical aspects of soil conservation are important, at the present stage, it seems that the lack of understanding of conservation adoption behavior by farmers is a bottleneck in promoting soil conservation in developing countries.

This paper evaluated the explanatory power of diffusion, farm structure and multiplicity models in adoption of soil conservation practices in Iran. It can be concluded that while the farm structure model is relatively better than the diffusion model, in general both are ineffective as predictive models. The multiplicity model, which takes a perspective that combines the variables of diffusion and farm structure models, is a relatively more powerful predictive model for soil conservation adoption behavior in developing countries. The most important variables in explaining the adoption of soil conservation technologies are yield of wheat crop, farmers' awareness of soil erosion problems, hectares of wheat cultivated, cost of farming and knowledge gained from different sources, which illustrate the complementary role of the diffusion and farm structure variables.

As far as policy implication is concerned, the findings indicate the need for a dual approach with extension programs which aim at increasing farmers' awareness, knowledge and interest in soil erosion and conservation, and economic policies, which aim at providing greater incentives and opportunity for farmers to adopt soil conservation practices.

This paper provides some guidelines which could be effective in designing the policy programs for soil conservation in developing countries. However, the magnitude of explained variance in the models suggests that alternative theoretical explanations must be explored in future research on adoption of soil conservation practices in developing countries. There is need to examine the multiplicity model in other areas and situations and to pay more attention to the measurement and application of variables which have proven to be effective in this study.

Finally, in the past soil conservation adoption research has been concerned only with optional adoption decisions. Future research should also explore the authority adoption decisions which, considering the cultural bases, may provide interesting findings for soil conservation policies in developing countries.

ACKNOWLEDGMENTS

The field work for this study was supported by a grant from the Research Council of Shiraz University. Comments are gratefully acknowledged from Dr. H. Stuart Hawkins and Dr. T.L. Napier on a draft of this paper.

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