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Determinants of Participation in Watershed Development Projects in Khorasan, Iran

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ABSTRACT

Study of factors affecting farmers' participation in watershed development is crucial for planners to ensure that projects fit local beliefs, values, and conditions. A cross sectional survey was conducted to identify factors influencing farmers' participation in watershed development projects in the Khorasan region of Iran. A two-stage random sampling technique was employed to select a representative sample. A total of 139 farmers (76 participants, *vs.* 63 non-participants) from 65 project villages were selected and interviewed with the aid of a pre-tested interview schedule containing open-ended as well as closed questions. The discriminant analysis indicated that such variables as legal title to dry lands, hectares and value of dry lands, age, technical knowledge, level of education, visiting of the model farmers, and the horizon of watershed planning, could correctly classify about 80 percent of watershed farmers as participant *vs*. non-participants. For better understanding of these determinants, a multiple regression analysis was also carried out which indicated that "*technical knowledge*" and "*hectares as well as value of dry land*" were the key determinants of farmers' participation in watershed development projects.

Keywords: Discriminants analysis, Iran, Participatory approach, Watershed development.

INTRODUCTION

The vastest parts of Iran are semi-arid, with an average annual precipitation of 250 mm (30% of global mean precipitation) (Karami and Hayati, 2005) and water is increasingly becoming scarce worldwide (Foltz, 2002; Keshavarz *et al*., 2013). Recent studies have indicated that the total annual precipitation in Iran is about 430 billion m^3 of which about 20 percent is lost in flash floods to the seas (Foltz, 2002; Mohamadnia and Kowsar, 2003). Therefore, water resource development is imperative as regards sustainable agriculture in Iran (Forouzani and Karami, 2011; Sharifzadeh *et al*., 2012).

Watershed Development Programs (WDPs) are considered as effective in addressing the challenges of water scarcity. They consider a holistic approach for controlling and optimizing the use of surface water and recharging groundwater (Ninan and Lakshmikanthamma, 2001). WDPs have been initiated to improve and sustain productivity as well as the production potential in dry and semi-arid regions, through adoption of appropriate production and conservation techniques. Currently, WDPs have been accorded high priority among all the developmental plans in Iran.

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In recent years, rural development programs have dramatically shifted from centralized state managed programs towards individual-managed programs with greater participation by non-governmental organizations as well as and local communities (Yercan, 2003). Policy-makers and stakeholders widely accept the need for local involvement in planning of watershed developmental programs (Nature, 2000; Wondolleck and Yaffee, 2000; Webler and Tuler, 2001). Furthermore, many countries have adopted such reform policies as transferring the rights and responsibilities of watershed systems from government agencies to farmers and to private institutions. In some several countries, farmers' participation in WDPs has been encouraged to reduce financial burden on governments and to optimize the use of water resources (Hope, 2007). Farmers' direct participation in WDPs is widely believed to be an effective means of improving their knowledge of irrigation practices and efficiency of water use (Qiao *et al*., 2009; Omid *et al.,* 2012). It is deemed to help ensure the sustainability of the system, to reduce the public expenditure and to improve efficiency, equity and as well the standards of services (World Bank, 2006).

A determination of the factors affecting farmers' participation in WDPs is crucial for helping planners, project proponents, and decision makers to ensure that projects are designed to fit local beliefs and values as part of an inclusive democratic process in which ownership is ensured through public participation (Vanclay, 2002; Ahmadvand *et al*., 2011).

A number of studies reveal that some dispositional, demographic and situational factors are significant in determining farmers' participation in land and water management or watershed development activities (Faham *et al*., 2008). Education and information regarding the projects are particularly important. Several studies on farmers' participation in developmental projects have reported that highly educated respondents participate to a vaster extent than their lesser educated counterparts (Azizi Khalkheili and Zamani, 2009; Damianos and Giannakopoulos, 2002; Faham *et al*., 2008; Qaio *et al*., 2009). The general explanation for this relationship is that education exposes people to a broader range of ideas and beliefs and thus encourages a more liberal perspective (McMillan *et al*., 1996).

Some scholars have investigated the effect of age on farmers' participation and yielded contradictory results. Zarafshani *et al*. (2008), Motevali (2002), Omid *et al*. (2012) and Dolisca *et al*. (2006) found out that age had a positive effect while Khalighi and Ghasemi (2004) reported a negative impact. In general, young people are more likely to participate in developmental activities than the older respondents (McMillan *et al*., 1996). Literature also indicates that family size is an important determinant as small families participate more in developmental projects than larger ones (Azizi Khalkheili and Zamani, 2009; Dolisca *et al*., 2006; Faham *et al*., 2008). Land holding size is strongly associated with farmers' participation (Zarafshani *et al*., 2008; Sharma and Sisodia, 2008; Omid *et al*., 2012) as is income (Damianos and Giannakopoulos 2002; Ben-Ayed, 2002). People with higher agricultural income participate and support agri-environmental projects more often than other people in the same communities (Salam *et al*., 2005). Therefore, households with higher quality of life tend to participate in agri-environmental projects more than households with lower quality of life. Several studies have also found that level of participation in previous projects influences participation in new ones in the same area (Faham *et al*., 2008; Zarafshani *et al*., 2008).

In summary, literature indicates that participation in rural development programs is affected by: (1) economic factors (farmers' income, expectation of profit from a new occupation); (2) project related factors (variety of activities, revolving funds, availability of consultants, continued support and follow-up); (3) relationships between farmers and development workers (positive

perceptions, trust, friendliness, and frequent visits); (4) social factors (persuasion by a friend or neighbor, good relationships with other community members and friendship with project workers); and finally (5) personal factors (age, education, family size and level of information regarding developmental projects).

Purpose and Objectives

The main purpose of this study was to identify the key determinants of farmers' participation in WDPs in the Khorasan region of Iran. The specific objectives were to compare the characteristics of farmers who either do or do not participate in WDPs and develop a model to make a distinction between them.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in the Khorasan region, northeast of Iran, one of the country's largest (313,000 km^2) and most thickly populated (more than 6 million) regions which is presently divided into three provinces, *viz*., North, South, and Razavi Khorasan (Its capital, Mashhad is a holy city of Shi'ite Islam, housing the shrine of the 8th Imam, Reza). With 150,000 hectares of arable land, Khorasan is one of the leading regions in agricultural production and is ranked first in the world as regards saffron production. Many other crops are produced here, and although recently challenged by water scarcity, its northern mountainous regions enjoy a relatively rich and flourishing agricultural as well as pastoral economy.

Research Method

The study was conducted as a cross-sectional survey with a sample of farmers chosen from Khorasan region. The statistic population of the study consisted of all the farmers in the region. A preliminary study of the area indicated that there were two groups of farmers namely: participant and non-participants in WDPs. Participant farmers are the ones who had taken part in at least one watershed project during the previous years. Therefore, two strata of sample were selected to correspond to the two types of farmers. Over the previous few years, WDPs had been implemented in 26 out of 31 counties and in some independent regions of Khorasan. Out of this, 21 counties as well as independent regions were selected as statistical sample employing Patten Sampling Size Table (Patten, 2002). A list of all project villages in each of the WDP regions was prepared and finally, 65 project villages were selected. In a second step, 76 participants and 63 non-participants were chosen from these 65 project villages.

Primary data was collected through personal interview with the respondents, and by means of a pre-tested interview schedule (questionnaire) containing both open-ended and closed questions. A panel of experts confirmed the validity and reliability of the questionnaire, as determined by using Cronbach's α Test through a pilot study of 29 farmers from a village outside the study area. Table 1 presents the definitions and assessments of the study variables as well as figures related to Cronbach's α, a measure of internal consistency, *viz.* how closely a set of items are related as a group. The statistical analyses were carried out using SPSS package (Version 10.00 for Windows) and Excel (version 1997 for Windows). They included reliability measures as well as *t*-test, correlation, regression and discriminant analyses.

RESULTS AND DISCUSION

Profile of the Respondents

The first objective sought was to compare the characteristics of previously member

Table 1. Definition of variables used in the study and their Cronbach's α coefficients.

Variable	Definition and evaluation	Cronbach's α
Age	How old a participant is in years.	-
Education	Years of farmers' education.	-
Technical knowledge	A scale measuring farmer's knowledge regarding soil conservation techniques: summation of response to 22 yes/ no items. (0= False and 1= True).	0.65
Males per household	Number of men above 15 years old per household.	-
Urban contacts	Degree of farmer's contact with urban areas.	-
Local authority	If farmer had formal position and authority in his/her village or region (0= No and 1= Yes).	-
Farm size	Total hectares of land owned by a farmer.	-
Hectares of dry lands	Total hectares of dry land owned by a farmer.	-
Initial watershed value	Price in Touman (1050 T= 1USD at the time of the study) of farmers' dry lands before watershed development project).	-
End Watershed value	Price in Touman (1050 T=1 USD at the time of the study) of farmers' dry lands after watershed activity.	-
Legal title to dry lands	If farmer has an official document of dry land ownership (0= No and 1= Yes).	-
Watershed planning horizon	Future plans and willingness of farmer to consider a watershed development, measured using a Likert-type scale (1= Highly disagree to Highly agree= 5); responses to 5 items were summarized.	0.67
Visit	If farmer has visited a model watershed farmer l (0= No and 1= Yes).	-
Support	If Jihad-e-Agriculture Organization supported a farmer's watershed activities (0= No and 1= Yes).	0.73
Loan	Amount of money a farmer had obtained during the previous year.	-
Average	Intermediate interest rate on loans received by a farmer.	-
Climate	Climatic conditions, measured using De Marton's technique.	-
Rainfall	Level of annual precipitation in mm $year^{-1}$.	-
Attitude toward Jihad-e-Agriculture Organization	A scale measuring farmers' ideas toward the performance of Jihad-e-Agriculture Organization: summation of responses to 4 items (1= Very low to Very high= 5), summarized.	0.53
Attitude toward watershed development	Response to 5 items designed to measure farmers' ideas toward watershed activities and the consequences of watershed development projects (0= Neutral; 1= No, 2= Yes) were summarized.	0.69
Spiritual and religious beliefs	A 9 item scale asked from local religious leaders regarding farmer's religious and spiritual manners.	

participants *vs.* non-previously member participant farmers, using *t*-test. No significant statistical differences (t= 0.61, P= 0.54) were observed between previously member participants ($\bar{x}$ = 52.63, SD= 12.91) *vs.* non-previously member participants ($\bar{x}$ = 51.24, SD= 13.8) with regard to age (Table 2). Previously member participants had more years of formal education ($\bar{x}$ = 5.57, SD= 4.72) than non-previously member participants ($\bar{x}$ = 3.06, SD= 3.44). Education is believed to provide the expansion of ideas and beliefs, and thus encourages more participative behavior. Many researchers report the positive influence of education on a farmer's participation in developmental activities (Azizi Khalkheili and Zamani, 2009; Damianos and Giannakopoulos, 2002; Faham *et al*., 2008; Qaio *et al*., 2009), corroborative of the present findings. The local authorities coming from participant farmers' ($\bar{x}$ = 1.31, SD= 1.29) villages were significantly higher in number than the local authorities from non-participants' villages ($\bar{x}$ = 0.33, SD= 0.74; t= 5.54, P= 0.0001). There was no statistically significant difference observed between participant and non-participants with regard to the number of their urban contacts (t= 1.27, P= 0.20).

Previously member participant and non-member participant farmers did not significantly differ in terms of number of family male member per household (t= 1.22,

Table 2. Comparison of participants and non-participants with respect to their socio-economic standings.

Factor	Participant farmers (n= 76)		Non-participant farmers (n= 63)		*t*	*P*
	Mean	SD	Mean	SD		
Age (Year)	52.63	12.90	51.24	13.80	0.61	0.543
Education (Year)	5.57	4.72	3.06	3.44	3.61	0.0001
Local authority	1.31	1.29	0.33	0.74	5.54	0.0001
Urban contacts	135.94	169.96	101.82	138.79	1.27	0.20
Males per household	3.22	2.20	2.82	1.65	1.22	0.224
Technical knowledge	11.69	3.00	6.50	2.91	10.28	0.0001
Attitude toward Jihad-e-Agriculture	12.39	3.14	10.83	4.34	2.36	0.02
Watershed planning horizon	16.64	3.22	14.25	3.40	4.22	0.0001
Farm size (Hectare)	41.55	43.93	24.38	20.26	11.13	0.003
Watershed value before (Toumans)	169053	391507	167581	205905	0.03	0.97
Watershed value after (Toumans)	818092	1157544	384823	809108	2.58	0.011
Attitude toward watershed development	9.81	0.66	9.54	1.27	1.49	0.139
Spiritual and religious beliefs	4.05	2.46	4.73	2.31	1.51	0.135

Note: 1050 Toumans= 1 USD at the time of the study, $p \leq 0.05$

P= 0.22). This finding is not consistent with previous studies showing that small rural families participated to a larger extent in developmental projects than the larger ones (Azizi Khalkheili and Zamani, 2009; Dolisca *et al*., 2006; Faham *et al*., 2008).

Technical knowledge regarding soil and water conservation was compared through *t*-test (t= 10.28, P= 0.0001) with a significant difference observed between participants ($\bar{x}$ = 11.69, SD= 3.00) and non-participants ($\bar{x}$ = 6.50, SD= 2.91). Attitude towards watershed activities was assessed, employing a scale of 5 items. Although the attitude did not differ significantly with regard to the watershed developmental activities (t= 1.49, P= 0.139) yet, between the two groups, the attitude of participant farmers toward the performance of Jihad-e-Agriculture Organization as regards watershed affairs was more positive than that of non-previously member participant farmers (t= 2.36, P= 0.02). It was observed that farmers' attitude towards watershed programs and government plans is the most important variable affecting and determining their participation. Farmers' levels of religious and spiritual beliefs towards the matter were also investigated but no significant difference was observed (t= 1.51, P= 0.135).

A comparison of farm sizes showed conspicuous differences (t= 11.13, P= 0.003) where participants undertook ($\bar{x}$ = 41.55, SD= 43.93) more responsibilities than non-participants did ($\bar{x}$ = 24.38, SD= 20.26). Zarafshani *et al*. (2008), and Sharma and Sisodia (2008) found that landholding size was the variable most strongly associated with farmers' participation in developmental programs.

As depicted in Table 2 the participant farmers ($\bar{x}$ = 16.64, SD= 3.22) selected a more extensive watershed planning horizon in their agricultural activities than non-participant ones ($\bar{x}$ = 14.25, SD= 3.40, t= 4.22, P= 0.0001). A hectare of dry land (before watershed development) was valued at 169,053 and 167,581 Toumans (1050 Toumans=1 USD at the time of the study) for participant and non-participant farmers, respectively, whereas after watershed developmental activities, the values significantly differed (t= 2.58, P= 0.011), with the dry lands belonging to participants being worth more. This finding is consistent with studies by Ninan and Lakshmikanthamma (2001) and as well by Ahmadvand and Karami (2009), attesting to

the economic benefits of watershed projects to farmers in India and Iran.

Predictors of Farmers' Participation in WDP

Discriminant Analysis (DA) was considered the best method to determine which set of variables could best predict the probability of participation of farmers in a WDP. Based on stepwise selection, some variables were eliminated since their tolerance levels were too low (below 0.001) to permit further computation. Eight variables were included in the analysis namely: age, education, legal title to dry lands, technical knowledge, visiting of the model farmers, watershed planning horizon, hectares of dry land, and the value of dry lands prior to the watershed developmental activities. Multi-collinearity between discriminating variables was not considered a problem since the correlations in between were relatively small.

Tables 3 and 4 present the results of the discriminant analysis. The relatively low Wilks' Lambda (0.54) and high canonical correlation (0.678) as well as significance level (0.0001) suggest that the selected variables extracted the discriminating information to a considerably maximum extent (Table 3).

Furthermore, the Canonical correlation (0.678) demonstrated high consistency between discriminant scores and the two farmers' groups. Standardized coefficient for the eight discriminating variables was listed according to their relative contributions to the overall discriminant function. The hectares and value of farmers' dry lands before watershed development activities had negative impacts on participation. In contrast, the standardized coefficient shows the positive contribution of age, education, legal title to dry lands, technical knowledge, visiting of the model farmers, as well as watershed planning horizon. The mean, in

Table 3. Summary results of discriminant analysis [a].

Discriminating variables	Participant farmers (n= 74)	Non-participant farmers (n= 60)	Standardized canonical discriminant coefficients
Age	52.63	51.24	0.50
Legal title to dry lands	0.36	0.17	0.06
Technical knowledge	6.21	3.32	0.77
Visiting of the model farmers	0.65	0.40	0.32
Watershed planning horizon	16.64	14.25	0.36
Education	5.58	3.06	0.50
Hectares of dry lands	27.97	14.46	-0.16
Value of land before watershed programs	3425571	192626	-0.09

[a] Canonical Correlation Coefficient= 0.678; Wilks' Lambda= 0.54; Chi-square= 81.31, Significant level of significance= 0.0001.

Table 4. Summary results of predictive accuracy of the discriminant function[a].

Actual group	Number of cases	Predicting group membership	
		Participant farmers	Non-participant farmers
Participant farmers	76	62 (81.6%)	14 (18.4%)
Non-participant farmers	62	13 (21%)	49 (79%)

[a] Percent of all cases correctly classified= 80.43, Eigen Value= 0.852.

these variables is higher among participant farmers than that among non-participants. Standardized discriminant coefficient revealed that farmers' technical knowledge is the most affecting discriminator of all the eight variables followed by age, educational level, watershed planning horizon and visit to the model farmers. These findings confirm that knowledge and level of formal education significantly contribute to the farmers' likelihood to participate in WDPs.

It was sought a model to be developed as based upon the standardized coefficient of the discriminant function for all the discriminating variables. Specifically, a linear discriminant analysis was used to determine if a linear combination of the eight significantly correlated variables could predict a farmer's participation in WDPs. Based on the results the model was fitted as:

D= 0.503 AGE+0.121 LEGA+0.773 KNOWLEDGE+0.354 VISIT+0.406 ORIZON+0.486 EDUC-0.192 DRYLAND-0.104 VALUE

Wilks' Lambda= 0.54 Sig.= 0.0001

Chi-square= 81.31

Table 1 presents the definition and evaluation of the variables made use of in the study. Percentages of correct classification and Eigen Value were employed to determine the effectiveness of the discriminant functions. The Eigen Value (0.852) suggests that the discriminating function successfully distinguished previously member participant farmers from non-previously member participants. The Canonical correlation is 0.678. Therefore, these eight variables account for almost 35 percent of the variance in participation. Another measure is the potential of the discriminant function to correctly classify farmers in the two groups. Of the 75 farmers who participated in WDPs, 62 (81.6%) were correctly classified (Table 4). Of the 63 non-participant farmers, 49 (79%) were classified correctly. Overall, about 80 percent of the cases were correctly classified through the discriminant function.

A multiple regression model was used to obtain information that would identify capable farmers with the results presented in Table 5. The dependent variable consisted of the watershed activities (size variable), assumed to be a criterion for farmers' participation in watershed development. Independent variables included in the model were the ones described above. The hypothesis that β for all the independent variables is zero was rejected (F= 44.80, Sig. F= 0.0001), which means that at least one of the independent variables significantly contributed towards farmers' participation in watershed development. The model is powerful enough through which the dependent variable be predicted. It did explain about 88 percent of the variability of

Table 5. Regression coefficients for determinants of farmers' participation in WDPs[a].

No.	Independent variables	*B*	*SE. B*	*Beta*	*Sig.*
1	Technical knowledge	216.099	91.796	0.018	0.022
2	Support	59.130	127.955	0.021	0.646
3	Loan	0.0004	0.000	0.052	0.304
4	Average	-33.566	71.635	-0.022	0.641
5	Climate	22.726	130.241	0.010	0.862
6	Legal title to dry lands	127.217	425.341	0.014	0.766
7	Education	16.206	43.887	0.018	0.713
8	Hectares of dry lands	-3.215	4.235	-0.35	0.451
9	Value before watershed development	0.004	0.000	0.881	0.000 1
10	Visiting of the model farmers	423.655	403.327	0.046	0.298
11	Rainfall	-5.776	4.215	-0.075	0.175

[a] *F*= 44.80; Sig. *F*= 0.0001; *R*= 0.945; R^2= 0.893; *Adjusted* R^2= 0.875, *Std*. Error of the Estimate= 1543.2879.

the dependent variable (R^2= 0.893). The most conspicuous variables were found to be value of dry land prior to watershed program and technical knowledge. The βs associated with them were 0.88 (Sig.= 0.0001) and 0.01 (Sig.= 0.02), respectively (Table 5), which indicates that with one standard deviation change in technical knowledge, and in value of dry lands, farmers' participation in watershed development activities will increase by 0.881 and 0.018 standard deviations, respectively. The other variables like support, loan, average climate, legal title to dry lands, hectares of dry lands, visiting of the model farmers, as well as rainfall-did not significantly contribute to farmers' participation in watershed programs.

CONCLUSIONS

Although farmers' participation in watershed development is influenced by a highly complex set of factors that are by no means well understood in all situations, the discriminant function employed in this study made it possible to correctly distinguish participants from non previously member participants. It indicated that the eight variables of: legal title to dry lands, age, technical knowledge, visiting of the model farmers, watershed planning horizon, level of education, as well as hectares and value of dry lands, were able to correctly classify 80 percent of farmers as either participants or non-participants. This level of accuracy indicates that discriminant model adopted could be used to screen farmers for the likelihood of their involvement in watershed development policies and programs. Through the regression model it became possible to explain about 88 percent of variance of the dependent variable, i.e. extent of watershed developmental activities.

To improve farmers' participation in watershed developmental programs and projects, the following interventions are recommended:

It was finally confirmed that education contributes significantly to farmers' decisions to participate in watershed development activities. General education of farmers should not be viewed as the only contributing factor to literacy, but also must be considered the involvement of a farmer in watershed developmental activities. Since level of education is a discriminating factor, care should be taken to improve farmers' access to the indispensable information on WDPs.

The study also revealed that technical knowledge plays a main role in farmers' participation; therefore, increasing their knowledge conserning every watershed project since its initiation is suggested. Furthermore, specialized watershed development training programs should be initiated and accredited by the Jihad-e-Agriculture Organization of Iran.

The feeling of ownership could reduce risk in watershed development. Therefore, the government should give farmers legal permissions and titles to the use and management of dry lands.

Since the value of farmers' dry lands before the project is a key factor in determining participation, watershed developmental activities should explicitly consider the value and condition of the land to guarantee and enhance the long-term benefits and increase the size of the watershed.

Access to credits and loans encourages farmers to more actively participate in watershed activities, so the government should take into account more financial support for watershed management activities.

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تعیین‌کننده‌های مشارکت در پروژه‌های توسعه‌ی آبخیزداری در خراسان، ایران

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چکیده

شناسایی تعیین کننده‌های مشارکت کشاورزان در پروژه‌های آبخیزداری کمک شایانی به برنامه‌ریزان و طراحان در تمرکز بر علایق، باورها و شرایط مردم محلی می‌نماید. بنابراین؛ هدف از انجام این پیمایش مقطعی، شناسایی سازه‌های مؤثر بر مشارکت کشاورزان در پروژه‌های توسعه‌ی آبخیزداری در منطقه‌ی خراسان در ایران بود. از فن نمونه‌گیری طبقه‌ای دو مرحله‌ای برای انتخاب نمونه‌ی کشاورزان استفاده شد. در مجموع ۱۳۹ کشاورز (۷۶ نفر مشارکت‌کننده و ۶۳ نفر غیرمشارکت‌جو) از ۶۵ روستای خراسان مورد مصاحبه قرار گرفتند و با کمک پرسش‌نامه حاوی سؤالات باز و بسته اطلاعات لازم گردآوری شد. روایی پرسش‌نامه مذکور توسط پانل متخصصان و پایایی آن با انجام یک مطالعه‌ی پیش‌آهنگ مورد تأیید قرار گرفت. تحلیل ممیزی برای تشخیص و تمایز کشاورزان مشارکت‌کننده و غیر مشارکت‌جو به کار گرفته شد. یافته‌ها نشان داد، سازه‌های اسناد قانونی، ارزش و مقدار مرتع، سن، دانش فنی، سطح تحصیلات، ملاقات کشاورزان نمونه، و منطقه‌ی طرح آبخیزداری توانایی طبقه‌بندی درست ۸۰/۴۳ درصد از کشاورزان مشارکت‌کننده و غیر مشارکت‌جو را دارند. برای درک بهتر تعیین-کننده‌های مشارکت از تحلیل رگرسیون چندگانه استفاده شد. نتایج نشان داد «دانش فنی» و «اندازه و ارزش زمین دیم» دو تعیین‌کننده کلیدی مشارکت کشاورزان در پروژه‌های توسعه‌ی آبخیزداری می‌باشند.