# Regression analysis of economic factors affecting the adoption of water conservation technologies in Semnan

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**Abstract:** This study was conducted to investigate economic variables affecting the adoption of water conservation technologies in Semnan with using a causal-regression and applied survey. Independent and dependent variables included economic factors (income increase, reduction of costs and scathes due to water shortage, increase of crops price and etc.) and adoption of water conservation technologies by Semnan's farmers, respectively. Multiple regression analysis indicated that economic factors explained 51.3 percent of total variance of the adoption ($R^2$=0.513). Rate of accessing to necessary inputs, as first variable inputting stepwise regression, explained 17.3 percent of the variance. In second step, variable of beneficiary of government's economic encouragements for applying water conservation technologies entered into regression. Also, this variable explained 11.9 percent of the variance. Finally in three steps, variables of rate of accessing to banking facilities, rate of income increase and reduction of costs explained 8.4, 6.6 and 4.1 percent of the variance, respectively. [Mohammad Sadegh Sabouri, Ali Nouri Emamzadeh**. Regression analysis of economic factors affecting the adoption of water conservation technologies in Semnan**. *Life Sci J* 2013;10(2s):312-316] (ISSN:1097-8135). http://www.lifesciencesite.com. 53

**Key words:** Economic factors, Water conservation technologies, Adoption, Farmers, Semnan

## Introduction

Human live in earth covered with 71 percent of water. But, high (97.41) percent of this water is salty. Only, its 2.59 percent belong to fresh water. However, 0.014 percent of fresh waters are retrievable and remainder is belonging to natural refrigerators and other waters (Miller 2001). On other hand, 98 percent of useful waters are related to underground waters (Bouwer 2000).On basis of FAO reports (2003), there is 1400 million $km^3$ water in world, including 35 $km^3$ (2.5 percent) fresh water. Increase of population is resulted in new requirement for using water resources and reduction of water per head. In the meantime, required water preparation for agricultural sector can be most an important necessity for programming by officials in this sector. Therefore, serious attention to optimum management of water usage in agricultural sector has high importance with respect to limitations due to geographic and weather conditions in Iran. In other words, management and programming for true operation of water resources is necessary because of limitations in the resources due to dry conditions in Iran and high cost of water reversibility of available resources and increasing day to day of water requirement for developing cultivated lands (Ehsani and Khaledi 2003). Afshar (2004) expressed limitation of water resources in world and using its major sector for producing agricultural crops has notified water sector's officials of tendency of water users in agricultural sector. Therefore, improving management of agricultural waters is important and effective step in optimum usage of water and increasing efficiency of irrigation and agricultural crops (Ehsani and Khaledi 2003). Water conservation technologies optimize water usage and prevent water loss in agricultural, human and other sectors. In other words, Water conservation has been noted improvement of managerial acts for reducing water usage or beneficial and purposive application of water (Vickers 2002; Geerts 2009). Iran, especially Semnan, is exposed to intensive water shortage and high water requirement. Therefore, attention to water conservation technologies might be has an important role in agricultural development. For this respect, objectives of this research are (i) to investigate the economic factors that affect the adoption of water conservation technologies in Semnan; (ii) to suggest objective and applied strategies in sector of water management.

## Materials and methods

The methodological approach in this research was a causal-regression and applied survey. Because, major objective of this research is analysis of effective economic factors in adoption of water conservation technologies by Semnan's farmers. In this research, independents and dependent variables included economic factors (income increase, reduction of costs and scathes due to water shortage, price increase of crops and etc.) and adoption of water conservation technologies by Semnan's farmers, respectively. The population included 14000 Semnan's farmers. A primary study on 30 farmers in another province was conducted in order to determine sample size ($n$) and variance of population. Then, using a proportional stratified sampling technique with Cochran formula 210 farmers in Garmsar was estimated; but, finally 212 of 220 collected questionnaires were analyzed. The content and face

validity of the instrument was specified after several times of review and correction by the faculty members of Agricultural Extension and Education of Azad University, specialists in the Ministry of Agriculture, graduates of agricultural extension and education and experts and local farmers in Semnan. The collected data were analyzed in two sectors of descriptive and deductive statistic by SPSS and a Cronbach's alpha value of 91% was obtained.

**Results**

Table 1 presents evaluation of status and rate of water for cultivated lands by Semnan farmers. Maximum frequency of farmers (105 persons; 49.5 percent) evaluated that status of water resources is intermediate. No farmers responded that the status is very suitable.

Table 2 indicates that minimum, mean and maximum ages of farmers are 20, 47.6 and 72, respectively. Maximum frequency of agricultural activity's background is related to age class of 21-30 that include 51.4 percent (109 persons) of farmers. The minimum and mean backgrounds of farming jobs are 1 and 26.8 years, respectively. Maximum frequency of income level (92 persons; 43.4 percent) in farmers is belonging to 3001-4000 $ class. Class of ≥4001 $ is subsequent frequency. Finally, class of ≤1000 $ includes least frequency (table 2). Additionally, 10 persons did not respond to income level.

Maximum frequency of the farmers' educational level is 48 percent related to degree of > diploma (table 2). Also, 28.8 percent of farmers (61 person) have unsuitable educational level (illiteracy and elementary). Mode of table is belonging to elementary degree.

In order to determine priority of economic factors affecting in adoption of water conservation technologies were considered seven statements in questionnaires. Results (table 3) indicate that rate of accessing to necessary inputs, reduction of costs and rate of income increase have first, second and third priorities, respectively. The latest priorities are belonging to increase of crops price, reduction of scathes due to water shortage, rate of accessing to banking facilities, respectively. High mean rank of economic factors indicates importance of the factors in adoption of water conservation technologies.

Correlation relationship between independent variables and adoption of water conservation technologies are presented in table 4. Correlation relationship between evaluating rate of water, rate of income increase, price increase of crops and accessing to banking facilities with the adoption is significant ($P<0.05$) with 95% confidence. Also, this relationship is significant ($P<0.01$) for agricultural activities' background, rate of accessing to necessary, reduction of scathes due to water shortage, reduction of costs and area of cultivated lands with 99% confidence. But, there is no significant correlation for age, major job of farmers, marriage status, distance of agricultural services centre, rate of water costs money.

Table 5 and 6 present results of entering significant independent variables to stepwise regression. The regression analysis shows that variables are significant. On basis of R square, 51.3% ($R^2=0.513$) of total variance of the adoption by farmers can be explained by these variables. But, 51.7 percent of the variance is not explained by the factors defined in this research.

Rate of accessing to necessary inputs, as first variable inputting stepwise regression, explained 17.3 percent of the variance. In second step, variable of beneficiary of government's economic encouragements for applying water conservation technologies entered into regression. This variable explained 11.9 percent of the variance. Finally in three steps, variables of rate of accessing to banking facilities, rate of income increase and rate of costs reduction explained 8.4, 6.6 and 4.1 percent of the variance, respectively.

Therefore, the regression equation (1) with using information of above table is:

$Y = \beta X1+\beta X2+\ldots+\beta xn$ (1)

$Y = (0.437)\ X1 + (0.361)\ X2 + (0.328)\ X3 + (0.298)\ X4 + (0.219)\ X5$

Y = Adoption of water conservation technologies in Semnan

β = Equation slope

X1 = Rate of accessing to necessary inputs

X2 = Enjoyment of government's economic encouragements due to application of the technologies

X3 = Rate of accessing to banking facilities

X4 = Rate of income increase

X5 = Rate of cost reduction

**Discussion**

Results indicated that age of farmers had no significant effect in adoption of water conservation technologies. This result is according to some research studies (Kohansal et al. 2009; Tenge et al. 2004); but, it was not confirmed by Omani and Chizari (2011). Mean agricultural activity's background was 26.8 that indicate high experience in farmers.

**Table 1. Evaluation of status and rate of water resources for cultivated lands by Semnan farmers**

| Evaluation type | Frequency | Frequency percent | Cumulative frequency |
|---|---|---|---|
| Very critical | 45 | 21.2 | 21.2 |
| Critical | 46 | 21.7 | 42.9 |
| Intermediate | 105 | 49.5 | 92.5 |
| Suitable | 16 | 7.5 | 100 |
| Very suitable | 0 | 0 | 0 |
| Total | 212 | 100 | 100 |

**Table 2. Frequency distribution of individual traits in Semnan's farmers**

| individual traits | Classes (year) | Frequency (person) | percent | Cumulative percent |
|---|---|---|---|---|
| Age: n=212 Minimum=20 Maximum=72 Mean=47.6 S.d=21.8 | 20-30 | 12 | 5.7 | 5.7 |
| | 31-40 | 41 | 19.3 | 25 |
| | 41-50 | 91 | 42.9 | 67.9 |
| | 51-60 | 48 | 22.6 | 90.5 |
| | ≥61 | 20 | 9.5 | 100 |
| Agricultural activity's Background n=212 Minimum=1 Mamimum=60 Mean=22.8 S.d=26.8 | ≤10 | 15 | 7.1 | 7.1 |
| | 11-20 | 59 | 27.8 | 34.9 |
| | 21-30 | 109 | 51.4 | 86.3 |
| | 31-40 | 19 | 9 | 95.3 |
| | ≥41 | 10 | 4.7 | 100 |
| Level of income n=212 Minimum=850 $ Maximum=25000 $ Mean= 3665 $ S.d= 1.0 | ≤1000 | 1 | 0.5 | 0.5 |
| | 1001-2000 | 23 | 10.8 | 11.3 |
| | 2001-3000 | 38 | 17.9 | 29.2 |
| | 3001-4000 | 92 | 43.4 | 72.6 |
| | ≥4001 | 48 | 22.7 | 95.3 |
| | No response | 10 | 4.7 | 100 |
| Educational degree: n=212 Mode: Elementary | Illiterate | 15 | 7.1 | 7.1 |
| | Elementary | 46 | 21.7 | 28.8 |
| | Guidance | 15 | 7.1 | 38.9 |
| | High school | 30 | 14.1 | 50.1 |
| | Diploma | 45 | 21.2 | 71.2 |
| | Associate degree | 45 | 21.2 | 92.4 |
| | ≥Bachelor of science | 12 | 5.7 | 98.1 |
| | No response | 4 | 1.9 | 100 |

**Table 3. Priority of effective economic factors in adoption of water conservation by Semnan's farmers**

| Effective factors | Mean Rank | C.V | Standard deviation | Priority |
|---|---|---|---|---|
| Rate of accessing to required inputs | 4.2 | 0.94 | 0.22 | 1 |
| Reduction of costs | 4.1 | 0.99 | 0.24 | 2 |
| Rate of income increase | 4.1 | 1.2 | 0.19 | 3 |
| beneficiary of government economic encouragement due to application of water conservation technologies | 4.1 | 1.3 | 0.21 | 4 |
| Increase of crops price due to more production | 4 | 1.3 | 0.25 | 5 |
| Reduction of scathes due to water shortage | 3.9 | 1.35 | 0.35 | 6 |
| Rate of accessing to banking facilities | 3.6 | 1.35 | 0.37 | 7 |

Significant correlation relationship between evaluation of water rate and adoption of water conservation technologies indicate direct effect of rate of accessing to water in adoption of the technologies, as reported by Karimi and Chizari (2007) and Tenge et al. (2004). Although, some authors (Kohansal et al. 2009; Calatrava et al. 2005) did not explain this relationship. Also, significant and positive correlation relationship between rate of accessing to necessary inputs and adoption of the technologies was reported by Omani and Chizari (2011), Khaledi et al. (2010), Zhou et al. (2008), and Moreno and Sunding (2005).

Economic factors especially rate of accessing to banking facilities and rate of income increase had significant and important role in adoption of water conservation by farmers, as confirmed by Omani and Chizari (2011), Khaledi et al. (2010), Wei et al. (2009), Kohansal et al. (2009), Bagdi et al. (2005), Moreno and Sunding (2005), and Rasouli Azar and Fe'li (2009). Insignificant effect of distance of agricultural services centre in adoption of the technologies in our research was reported by some studies (Bakhshudeh 2008; Motallebi et al. 2012).

**Table 4. Correlation relationship between independent variables and adoption of water conservation by Semnan's farmers**

| Independent variables | R | P |
|---|---|---|
| Evaluation of water rate | 0.159 * | 0.035 |
| Rate of accessing to required inputs | 0.397 ** | 0.000 |
| Age | − 0.19 | 0.421 |
| Education level | 0.099 | 0.362 |
| Area of cultivated lands | 0.301** | 0.000 |
| Agricultural activity's background | 0.191** | 0.000 |
| Distance of agricultural services center | 0.067 | 0.239 |
| Rate of water costs money | 0.101 | 0.149 |
| Rate of income increase | 0.163* | 0.018 |
| Rate of accessing to banking facilities | 0.145* | 0.035 |
| Increase of crops price due to more production | 0.149* | 0.028 |
| Reduction of scathes due to water shortage | 0.209* | 0.018 |
| beneficiary of government economic encouragement | 0.301** | 0.001 |
| Reduction of costs | 0.357 | 0.000 |
| Note: * Significant in level of 0.05 ($P$<0.05) ** Significant in level of 0.01 ($P$<0.01) | | |

**Table 5. The result of multiple regressions (stepwise method) to determine the role of independent variables in water conservation technologies by Semnan farmers**

| Independent variables | B | Beta | S.E | T | P |
|---|---|---|---|---|---|
| Constant | 12.364 | 1.328 | - | 7.059 | 0.000 |
| Rate of accessing to required inputs | 0.419 | 0.096 | 0.437 | 6.807 | 0.000 |
| beneficiary of government economic encouragement due to application of the technologies | 0.314 | 0.99 | 0.361 | 5.040 | 0.001 |
| Rate of accessing to banking facilities | 0.309 | 0.101 | 0.328 | 4.763 | 0.001 |
| Rate of income increase | 0.249 | 0.109 | 0.298 | 4.297 | 0.019 |
| Reduction of costs | 0.204 | 0.114 | 0.219 | 3.579 | 0.041 |
| Agricultural activity's background | − 0.431 | 0.192 | − 0.461 | 1.542 | 0.143 |
| Area of cultivated lands | 0.171 | 0.18 | 0.207 | 2.975 | 0.045 |
| Increase of crops price due to more production | − 0.104 | − 0.099 | 0.118 | 0.987 | 0.121 |

**Table 6. The role of independent variables in adoption of water conservation technologies**

| Regression mode | R | $R^2$ | Adj $R^2$ | F |
|---|---|---|---|---|
| Stepwise | 0.591 | 0.513 | 0.476 | 39.91 ** |

**Conclusions**

Multiple regression indicated that rate of accessing to inputs is most important economic factor in adoption of water conservation technologies. Therefore, suitable technologies should be presented for farmers with respect to condition of different areas and type of crops.

- The presented technologies should be suitable from view of technical, economic and social-cultural for farmers. Therefore, the technologies should be tested in each area; then the suitable technologies be suggested to farmers.
- With respect to importance of water management in agricultural development, each cost in this sector is worth and must be supported by financial centers such as agricultural bank.

Attention to reduction of costs and adaption of technologies with farmers' capital status is important

subject that must be attended by research and extension sectors.

-Enjoyment of government economic encouragements due to application of water conservation technologies is one of important economic factors. Therefore, officials of development must attend to this factor and encourage farmers adopted the technologies.

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