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# Estimation of Irrigation Water Demand for Barley in Iran: The panel Data Evidence

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**Abstract**

In most arid and semi arid regions, as in most parts of Iran, insufficient supply of water has become one of the most important constraints to economic development. In these areas, the main issue in water management is to fulfill the ever-increasing demand for water. The supply of water is usually limited, while the quantity of water demanded has increased mainly due to population growth. It is believed that a rationalized water pricing system would play a crucial role in the optimal allocation of water resources. Planning for efficient use of water is important when there is a severe limit to its availability. The demand elasticity for every good, service, or input determines how a change in price, ceteris paribus, affects users' quantity demanded. This study investigates the structure of irrigation water demand by estimating the derived demand for water on one particular crop, barley, in Iran. The analysis is based on deductive econometric method, and on total statistical and panel data. A demand function was estimated after performing the relevant statistical tests. The price elasticity of irrigation water demand and other elasticities were also computed. Data and information from 2001 to 2006 from 26 provinces in Iran was collected from secondary sources.

**Keywords:** Arid and semi arid areas, Derived demand function, Price elasticity, Panel data

## 1. Introduction

In the past few decades, increase in population, urbanization, and industrial expansion have contributed to increased demand for water (potable, agriculture, industry). In most of arid and semi arid areas like most parts of

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Iran, people are faced with insufficient supply of water. In these areas, the main problem in water management is to achieve equilibrium between supply and demand of water. Supply of water is always limited and quantity demanded is constantly going up.

Price plays an important role in equilibrium generation between supply and demand for water. Determination of water price per cubic meter and a suitable allocation of water resource between different activities such as agriculture, industry and urban use has always been one of the most fundamental problems that economists, policy makers, planners face in the water sector.

## 2. Scope of the study

This research will focus on irrigation water pricing in Iran. Iran is an arid and semi-arid country with a mean annual rainfall of about 250 mm. It is about 30% of the mean annual precipitation in the world. The increasing water demand has caused an alarming decrease in annual per capita renewable water resources. In Iran, even if water services are delegated to private operators, local communities still remain legally responsible for water supply. In this context, one of the most important tasks of regulatory authorities is to determine the appropriate pricing scheme for the services provided. In Iran, water pricing schemes have been recently affected by legal decisions of public authorities.

The main source of water in Iran is precipitation from both rainfall and snow (70 percent rainfall and 30 percent snow). Total precipitation is estimated to be about 413 billion cubic meters (bcm), of which about 71.6 percent (295 bcm) directly evaporates. By taking into account 13 bcm of water entering from the borders (joint border rivers), the total potential renewable water resources have been estimated at130 bcm (2005).

### *2.1 Agriculture in Iran*

Agriculture plays an important role in the Iranian economy. According to a report from Iran Statistics Centre in the year 2005, agriculture sector forms 11.5 percent ($170 billion) of the Gross Domestic Product (GDP), one third of non-oil exports (Around $55 billion).

Moreover, the sector employs about 23.4 percent of the labour force and provides more than 80 and 90 percent of the national food requirements and raw materials for domestic industries respectively.

Iran's agricultural sector is one of the most important economic sectors of the country. One-third of Iran's total area is suitable for agriculture. However, due to poor soil and lack of adequate water distribution most of the areas are not under cultivation. In fact, only about 20 percent of the total land area is under cultivation in the form of cultivatable land, gardens and etc. According to published statistics in the year 2003, about 8 million hectares of the cultivated area were irrigated; and about 9 million hectares were rain fed. The western and north western parts of the country have the most fertile soils.

### *2.2 Economic significance of barley in Iran*

Among all cereals in Iran, barley is the second most important crop after wheat. Barley production averaged 2,956,032 ton, with an estimated annual value of $ 473 million in 2006. Cultivated areas of barley amounted to 1567454 ha, and the average application of water for barley cultivation was 4.8 billion cubic meters in 2006.The total irrigated production in the same year was 1,972,399 tons, while 20,178,506 man days were employed.

The yield for barley in irrigated areas of Iran's provinces is between 1717 to 5359 kg/ha. As in the case of wheat, Fars province has the largest irrigated cultivation area (457695 ha) and highest production quantity (2,044,409 ton) for this particular crop.

In 2006, the water productivity for barley in Iran ranged from 0.2 to 0.82 kg/m$^3$. Meanwhile, the water productivity, average application of water, and yield in the aforementioned province for barley were reported to be about 0.51 kg/m$^3$, 8659 m$^3$/ha and 4467 kg/ha, respectively. Other important information on barley is presented in Table 1.

## 3. Significance of the study

Located in an arid and semi arid area, Iran is facing scarcity of water resource for agricultural activities. The universal per capita drinking water is about 8000 m$^3$ (Iran Water Resources Management Company), and the amount is less than 200m$^3$ in Iran now, and the amount is decreasing from year to year. On the basis of accomplished studies in Iran Water Comprehensive Plan, renewable water resource of Iran is about 130 billion cubic meters. It has been shown that at present from total renewable water resource of Iran, about 89.5 billion cubic meters is taken up for agriculture, mining, industry and house-made consumptions. About 83 billion cubic meters, and 5.5×109 m$^3$ are used in the agricultural sector and the household sector, respectively. In the past eighty year, high rates of population growth have been one of the most important factors in decreasing per capita of renewable water in Iran. Within a period of 80 years, population of Iran has increased as much as seven times.

Consequently, the annual amount per capita of renewable water in Iran has decreased from 13000 $m^3$ in 1921 to 1750 $m^3$ in 2006, and in the future the situation is expected to be worse. In terms of Falken Mark Index, Iran is categorized as in the threshold of water crisis, and in terms of Water Management International Institute Index and United Nations Organization, Iran is classified as in intense status of water crises as it uses about 69% of its renewable water.

Report of International Institute of Water Management consist for keeping the present situation until 2025 year, Iran should be able to increase about 112% of acquirable water resource that with reference to available equipment it seems impossible.

The worsening shortage of water in Iran coupled with the prevailing in efficient use of the resource in the agricultural sector makes it necessary for Iran to formulate a proper policy on its water resources. Price mechanism is known to balance production and consumption of economic goods and services and as water is an economic good price mechanism can be used to achieve balance between supply and demand for water in Iran.

The main objective of this paper is to investigate the efficiency of current prices and to estimate price elasticity of water demand for barley in Iran.

## 4. Review of the Literature

The vast majority of irrigation water value models use residual imputation. For example Howe (1985) who based his demand curve for water on the gross margin of individual crops, uses the idea that residual profits indicate the value of water. There are three alternatives to residual imputation. The first estimates a crop-water production function from field trials and then scales this physical production function by the price of the product (Colby 1989; Penzhorn and Marais 1998). The second approach is to estimate a demand function directly from water price data. Griffin (1985) presented an econometric model using panel data of irrigation prices in Texas. The third approach is to use Hedonic pricing methods to measure the contribution of water value to farm prices.

Hedonic price analysis is applied to land sales to reveal the implicit market price of water in irrigation. This provides price information which can facilitate reallocation of water supplies to meet growing demands (Faux and Perry, 1999). Estimating the irrigation water value using hedonic price analysis in Malheur County and Oregon, they estimated that the value of irrigation water in this location is estimated at $9 for an acre-foot on the least productive land irrigated, and $44 per acre-foot for the most productive land. Torell *et al.*(1990) estimated water in the Ogallala Aquifer to be worth between $\$0.0009 \cdot m^{-3} \cdot a^{-1}$ and $\$0.0077 \cdot m^{-3} \cdot a^{-1}$. Faux and Perry (1999) estimated the water value in Malheur County, Oregon, to be between $\$0.0073 \cdot m^{-3} \cdot a^{-1}$ and $\$0.0357 \cdot m^{-3} \cdot a^{-1}$. These studies also include models used to derive water demand functions. Two examples are notable insofar as they accurately represent observed crops. Louw and Van Schalkwyk (1997) estimated water demand for the Olifants River in the Western Cape that accounts for 95% of the irrigated area in the basin. Conradie (2002) modeled 50,000 ha of fodder crops and citrus orchards on the Fish-Sundays transfer scheme in the Eastern Cape.

### *4.1 Research on Irrigation Water Demand*

Estimates of the demand function for irrigation water and its price elasticities have commonly been based on the use of mathematical programming, especially linear programming. The early studies such as Moore and Hedges (1963) often intended to show that the demand is more price responsive than generally believed, and that even for low prices it is not perfectly inelastic as the U.S. Bureau of Reclamation had claimed in the past. Later studies have constructed sub-regional or regional demand functions from models of representative farms, and commonly calculated responsiveness by either arc-elasticity estimates along the stepped demand curve or by calculating elasticity after fitting continuous regression equations to the parametric data.

The results typically show either an inelastic estimate for the whole price range considered, or an inelastic estimate for the lower prices and a less inelastic or elastic estimate for the higher prices (Shumway *et al*. 1984). During the 1970s and early 1980s estimates of irrigation water demands and their shape have also been developed with statistical crop-water production functions based on data from field crops experiments conducted at state experiment stations Hexem and Heady (1978); Ayer and Hoyt (1981), and(Kelley and Ayer (1982). Demand functions were constructed using an output price and varying the cost of water. Elasticity estimates based on field experiments generally are relatively unresponsive to price changes.

Elasticities have also been estimated with econometric studies that use data of actual farmer behavior via Nieswiadomy (1992); Moore *et al.*(1994). Estimates calculated with econometric methods relying on secondary data tend to be more inelastic than suggested by mathematical programming models, but in some cases they are

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also very elastic. Overall, elasticity estimates vary widely not only between studies with different methods of analysis but also among them. A number of variables influencing the shape of the demand function as well as elasticity estimates have been identified in the literature, but there has been little systematic study on how and to what extent these variables influence the estimates and the policy recommendations based on them.

Zare (2006) estimated demand elasticity for groundwater input of Kerman by production function. He found that the marginal production of crops per unit of water was higher than the corresponding cost of pumping, and that excessive pumping of water would decrease in the social welfare rate of farmers. He also concluded that increasing the pumping costs would not lead to any significant impact on the rate of extraction, so that the best way to increase irrigation efficiency is to promote efficient irrigation methods. Schoengold *et al*. (2006) estimated a model of agricultural water demand based on the role of water in the farm production function. They then presented estimates of the parameters of the model using a unique panel data set from California's San Joaquin Valley. They also found that agricultural water demand is more elastic than shown in previous work on urban water demand, a result which has important implications for differences in the optimal design of policies directed at agricultural users of water as compared to urban users.

The predicted values of land allocation and irrigation technology choice are used as instruments in the water demand estimation. The direct own price elasticity, or the component due to better management of water resources, is in the range of -0.22 to -0.38, while the estimated indirect component of the total price elasticity (due to land reallocation and increased levels of fallow land) is -0.51. Sahibzada (2002) used an initial Cobb-Douglas production function for estimate the relationship between total aggregated farm output, fertilizer use, labor supply, tractor use, and irrigation water input. He found that irrigation water demand is price inelastic and that predicted water usage exceeds actual use across the sample.

Wang and Lall (1999) illustrated how to generate the value of marginal product and price elasticities for water demand using a translog specification. While they do this for industrial water demand in China, their study illustrates how to construct such estimates using a translog function. They also estimate a conventional Cobb-Douglas production function, which proved inferior to the translog specification. Their findings that the industry-wide price elasticity of demand is approximately equal to –1.0, suggests that price instruments may be an effective tool to encourage water conservation. Scheierling *et al*. (1997) propose that the correct specification of irrigation water use is not to model demand as a continuous variable, but to view the irrigation decision as discrete irrigation events of approximately equal volume. They utilize a crop simulation model, termed the van Genuchten-hanks model to estimate water-crop production functions for corn and dry beans in Northeastern, Colorado.

**5. Specification and estimation of the model**

*5.1 Economic model*

In the estimation of input demand and output supply, different approaches have been suggested and adopted, Timmer (1974), cited by Chembezi (1990), identifies two approaches, direct and indirect estimation. Indirect approaches include deriving demand functions from agronomic response functions and research. Direct methods include estimating demand functions directly from observed market data on input consumption and prices, and the prices or amounts of farm output. For the purpose of this study, the direct method approach will be used to estimate the water demand function associated with barley product.

Conditional factor demand is a function that gives the optimal demand for each of several inputs as a function of the output expected, and the prices of inputs. Conditional demand functions are obtained using the Shepard's Lemma where the cost minimization problem is the production of a specified level of output with the least expenditure on inputs (Arrigada 2004). Suppose that the production function is Cobb-Douglas:

$$q = k^{\alpha} l^{\beta} \tag{1}$$

Total costs for the firm are given by

$$\mathrm{T}C = wl + vk \tag{2}$$

The Lagrangian expression for cost minimization of producing $q^0$ is

$$L = vk + wl + \lambda(q^0 - k^{\alpha} l^{\beta}) \tag{3}$$

The first-order conditions for a minimum are:

$$\begin{aligned} \frac{\partial L}{\partial K} &= v - \alpha\lambda k^{\alpha-1/\beta} = 0 \\ \frac{\partial L}{\partial l} &= w - \beta\lambda k^{\alpha/\beta\text{-}1} = 0 \\ \frac{\partial L}{\partial \lambda} &= q^0 - k^{\alpha} l^{\beta} = 0 \end{aligned} \tag{4}$$

Dividing the first equation by the second gives us

$$\frac{w}{v} = \frac{\beta k^{\alpha} l^{\beta-1}}{\alpha k^{\alpha-1} l^{\beta}} = \frac{\beta}{\alpha} \cdot \frac{k}{l} = RTS \tag{5}$$

Estimating and substituting into the production function and solve for l, we will get

$$k = \frac{\alpha}{\beta} \cdot \frac{w}{v} \cdot l \tag{6}$$

$$l = q^{1/\alpha+\beta} \left(\frac{\beta}{\alpha}\right)^{\alpha/\alpha+\beta} w^{-\alpha/\alpha+\beta} v^{\alpha/\alpha+\beta} \tag{7}$$

A similar method will yield

$$k = q^{1/\alpha+\beta} \left(\frac{\alpha}{\beta}\right)^{\beta/\alpha+\beta} w^{\beta/\alpha+\beta} v^{-\beta/\alpha+\beta} \tag{8}$$

Now we can derive total costs as

$$C(v, w, q) = vk + wl = q^{1/\alpha+\beta} B v^{\alpha/\alpha+\beta} w^{\beta/\alpha+\beta} \tag{9}$$

Where

$$B = (\alpha+\beta)\alpha^{-\alpha/\alpha+\beta} \beta^{-\beta/\alpha+\beta} \tag{10}$$

Which is a constant that involves only the parameters α andβ.

Contingent demand functions for all of the firms inputs can be derived from the cost function. Shephard's lemma the contingent demand function for any input is given by the partial derivative of the total-cost function with respect to that input's price:

As mentioned earlier, the cost function is:

$$C(v, w, q) = vk + wl = q^{1/\alpha+\beta} B v^{\alpha/\alpha+\beta} w^{\beta/\alpha+\beta} \tag{9}$$

The cost function can be derived as follows:

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$$k^c(v,w,q) = \frac{\partial C}{\partial v} = \frac{\alpha}{\alpha+\beta} \cdot q^{1/\alpha+\beta} B v^{-\beta/\alpha+\beta} w^{\beta/\alpha+\beta}$$
$$= \frac{\alpha}{\alpha+\beta} \cdot q^{1/\alpha+\beta} B \left(\frac{w}{v}\right)^{\beta/\alpha+\beta} \tag{11}$$

The contingent demands for inputs depend on both inputs' prices

$$l^c(v,w,q) = \frac{\partial C}{\partial w} = \frac{\beta}{\alpha+\beta} \cdot q^{1/\alpha+\beta} B v^{\alpha/\alpha+\beta} w^{-\alpha/\alpha+\beta}$$
$$= \frac{\beta}{\alpha+\beta} \cdot q^{1/\alpha+\beta} B \left(\frac{w}{v}\right)^{-\alpha/\alpha+\beta} \tag{12}$$

Obtaining natural logarithm of the above we will have:

$$\ln l(\mathrm{v},\mathrm{w},\mathrm{q}) = \ln \mathrm{A} + \alpha_{\mathrm{y}} \ln \mathrm{q} - \alpha \ln \mathrm{W} + \beta \ln \mathrm{V} \tag{13}$$

Where $\alpha$ is water price elasticity, and, $\beta$ is cross – price elasticity of water demand and $\alpha_y$ indicates the elasticity of water use given changes in output quantity. Given that information on production was collected for every farmer included in this study, the conditional factor demand approach will be used to estimate the water demand.

### *5.2 Empirical Model*

The functional form for conditional factor demand can be derived consistent with an assumed production function, but in this study we are estimating a reduced form with no cross-equations restrictions. The water demand will be specified directly using a water demand function that includes output quantity, input prices, and fixed factors. The estimation of the water demand function using the methodology presented in the previous section will permit to identify the significant variables that explain its consumption. The empirical specification of the fertilizer demand is given by

$$\log Dw_{i,t} = \beta_0 - \beta_1 \log Pw_{i,t} + \beta_2 \log Pf_{i,t} + \beta 3 \log Rl_{i,t} + \beta_4 \log Ps_{i,t} + \beta_5 \log W_{i,t} + \beta_6 \log Q_{i,t} + \varepsilon i,t \tag{14}$$

Where $Dw_{i,t}$ is the amount of water demanded in ith region in year t (Cubic Meter);$Pw_{i,t}$ is the vector of input prices used in barley production in ith region in year t. (Cubic Meter/Toman); Pf is the vector of fertilizer prices used in barley production in ith region in year t (Kg/Toman); Ps is the vector of seed prices used in barley production in ith region in year t (Kg/Toman); W is wage (Man day/Toman); Q is irrigated production (Kg); Rl is land rent (Square Meter/Toman); $\varepsilon_{i,t}$ represents the effects of the omitted variables that are peculiar to both the individual units, and time periods.

i denotes the provinces of Iran and t indicate year.

i= 1, 2,…, 26 t = 2001, 2002, …, 2006

## 6. Result and discussion

The Cobb-Douglas production function was used to estimate of the water demand function for barley. The same water demand function for barley was estimated using equation (14). The water demand is a function of the current water price, fertilizer price, seed price, wage, land rent, and the amount of output.

The panel data corresponding to a total of 156 observations were obtained from 26 provinces for the period between 2001 and 2006. To achieve a suitable function, the Chow test was initially employed to choose between the Pool and Panel data approaches. In this study, the Panel data model was found to be better than the Pool data model, and for this reason, the Hausman's specification test was used to choose between the fixed effect, random effect and SURE. Finally, the fixed effect approach was found to be the best model for the irrigation water demand function of barley. These tests were conducted using econometric software STATA 10.

After conducting the data stationary test, co-integration test (by Levin, Lin & Chu $t^*$ statistic) and diagnostic checks, the best model was estimated. Table 2 shows these estimated parameters.

The estimated water price coefficient was found to be negative. This variable was found significant, but its value was almost zero, that is, water demand is infinitely inelastic. This finding indicates that farmers are less sensitive to the price of water since they consider this input as an essential input. However, based on these results, farmers tend to reduce the use of water when its price increases, but this is done only in a very small amount. Therefore, the obtained coefficients do not contradict with the first and second hypotheses of the research, which are related to the existence of a negative relationship between price of water and the amount of demand for it, and price of water is not efficient.

The coefficient of price of fertilizer and land rental was also found to be negative. One interpretation is that water with fertilizer and land are complementary inputs.

However, the coefficient on wage is positive. One interpretation is that water and labour force are substitute inputs, whereby a one percent increase in the labour force wage will cause water demand to increase by 0.038 percent. The positive sign of the above coefficient may stem from the fact that a fully-mechanized cultivation is not possible in certain regions of the country, and thus, most of the activities associated with cultivation, maintenance and harvest of barley are to be done by labour force. Indeed, after costs incurred by water use, labour force has the third highest cost share in barley production. The reason for this substitution relationship is due to the farmers' effort in enhancing efficiency of irrigation and in preventing wastage of available water. In this way, as more labour force is employed in farms during irrigation, the sooner the irrigation water will cover the irrigated area. This has finally led to a substitution relationship between labour force and consumption of water.

The estimated coefficient for the quantity of output is significant at 1% level. As elaborated in the previous chapter, the functional form used to estimate water demand is linear-logarithm. Meanwhile, the estimated parameter coefficient shows the elasticity of water use, provided that the changes in the quantity of output is 0.812, which indicates that a one percentage increase in the output (barley) quantity leads to a 0.81 percent change in the use of water. The R-square value for the regression model was *0.99*, indicating a nearly perfect fit. In any empirical research, when the data are improved from time series to panel data or from cross sectional to panel data, the number of observation increases. Hence, if the power of the model goes up, an expected explanation for this is that R-square has increased.

## 7. Conclusion

In this study we have investigated the structure of barley water demand in Iran. We estimated water demand by information related to 26 provinces of 1ran from 2001 to 2006. The main results of our analysis are that water has a very low price elasticity of demand for barley in Iran. Additionally, part of the reason is that there is no close substitute for water and that farmers allocate such a tiny fraction of their cost to water (Sloman 2003). This means that water price is very low, that is, each good or factor is totally inelastic as its price is very low. Respectively, the water price of barley in Iran is not efficient, because elasticities are near to zero.

On the other hand, the quantity of crops significantly influences water consumption. This relationship could be used to determine the impact of production quotas or other barley policies on water use. Schaible (1997) notes that under inelastic water demand elasticities, water price policy reforms can still be an effective water conservation tool.

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Table 1. Irrigated Area, Irrigated Production, Yield, Water Price Average, Average application of Water, and Crop Water Productivity of Barley Holdings by Province in 2006 Year

| Produced Provinces | Irrigated Area (ha)* | Irrigated Production (Metric tons)* | Irrigated Yield (Kg/ha)* | Average Application of Water ($m^3$/ha)** | Crop Water Productivity (Kg/ $m^3$)** |
|---|---|---|---|---|---|
| East Azarbaijan | 21611.9 | 63147.59 | 2921.89 | 6398.46 | 0.46 |
| West Azarbaijan | 14764 | 41187.59 | 2789.73 | 6563.14 | 0.42 |
| Ardabil | 22232 | 58602.24 | 2635.94 | 5924.93 | 0.44 |
| Esfahan | 48636.2 | 226054.5 | 4647.86 | 8805.34 | 0.53 |
| Tehran | 36179.5 | 144711.9 | 3999.83 | 7908.08 | 0.51 |
| CharMahal & Bakhtiari | 6512 | 20682.02 | 3175.99 | 7743.66 | 0.41 |
| khorasan | 171364 | 480079.9 | 2801 | 8789.19 | 0.35 |
| Khozestan | 25675 | 44628.62 | 1738.21 | 6921.26 | 0.25 |
| Zanjan | 5015 | 16999.44 | 3389.72 | 8430.22 | 0.40 |
| Semnan | 13460 | 46898.02 | 3484.25 | 7924.86 | 0.44 |
| Sistan & Baloshesta | 17409.5 | 23872.99 | 1371.26 | 9657.58 | 0.14 |
| Fars | 34716 | 109853.8 | 3164.36 | 8659.28 | 0.36 |
| Ghazvin | 27445 | 86059.16 | 3135.7 | 7341.02 | 0.43 |
| Ghom | 27374 | 102761.2 | 3753.97 | 9344.49 | 0.40 |
| Kordestan | 4905 | 15631.37 | 3186.82 | 6790.90 | 0.47 |
| Kerman | 18829.6 | 46306.09 | 2459.22 | 9419.84 | 0.26 |
| Kermanshah | 14118 | 74065.59 | 5246.18 | 6547.97 | 0.80 |
| Kohkiloyeh & Boyrahmad | 4013.5 | 11598.27 | 2889.81 | 6291.76 | 0.46 |
| Golestan | 8353 | 25544.77 | 3058.15 | 6088.48 | 0.50 |
| Lorestan | 8661 | 17737 | 2047.92 | 8450.14 | 0.24 |
| Mazandaran | 2328 | 3751.34 | 1611.4 | 3474.66 | 0.46 |
| Markazi | 36883 | 133180.9 | 3610.9 | 8571.31 | 0.42 |
| Hormozgan | 1315 | 2634.66 | 2003.54 | 7421.04 | 0.27 |
| Hamedan | 34204 | 132394.2 | 3870.72 | 7863.73 | 0.49 |
| jiroft & kahnoj | 9213 | 19694.01 | 2137.63 | 8019.84 | 0.27 |
| Yazd | 6277 | 17639.21 | 2810.13 | 10886.53 | 0.26 |
| country | 624491.2 | 1972399 | 3158.41 | 7417 | 0.42 |

Source: *Ministry of Keshavarzi Jehad, 2006. ** Based on research findings

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Table 2. Estimation of the water demand function for Barley

| Dependent Variable: LDWT | | | | |
|---|---|---|---|---|
| | | | | |
| Independent variable | Coefficient | Std. Error | t-Statistic | Prob. |
| | | | | |
| C | 4.596*** | 0.59 | 7.79 | 0.00 |
| LPW | -0.017** | 0.01 | -2.05 | 0.04 |
| LQ | 0.812*** | 0.03 | 23.52 | 0.00 |
| LRL | -0.067*** | 0.02 | -4.05 | 0.00 |
| LW | 0.038 | 0.03 | 1.27 | 0.21 |
| LPF | -0.118 | 0.07 | -1.57 | 0.12 |
| Cross-section fixed (dummy variables) | | | | |
| | | | | |
| R-squared | 0.92 | Adjusted R-squared | | 0.92 |
| F-statistic | 518.5 | Durbin-Watson stat | | 1.78 |
| Prob(F-statistic) | 0 | | | |
| * Statistically significant at the 10% level | | | | |
| ** Statistically significant at the 5% level | | | | |
| *** Statistically significant at the 1% level | | | | |