Economical valuing of Water in Irrigation and Drainage Lattice in Khuzestan Province (1979-2013)

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Abstract

Since early times water has always been considered as the most important factor in development and applying the new, has played the vital part in obtaining the goal of food supply for the world's growing population. The shortage of sweet water in recent years has become a global problem and particularly in Iran due to water shortage the efficient consumption of agricultural water has achieved significant importance. Therefore water pricing policy has been applied in order to improve agricultural irrigation and determine certain approaches to improve irrigation efficiency. This study has adopted the Ramsey pricing method and time serial data throughout (1979 – 2013) years to present the model. ARDL model was used to estimate demand and supply functions. Cobb Douglas function was taken into consideration in order to present water supply function. Pricing capacity and final production costs were calculated according to demand function and production function and Ramsey water price for agriculture section was determined by these two variables by the help of MATLAB software. According to the results of this study, the estimated prices on the base of Ramsey pricing policy are higher than current prices. In fact the comparison between actual price (86 Riyal per qm in 2013) and Ramsey price (96 Riyal) shows that the amount of money paid by the farmers is less than the economic (Ramsey) value of water. This absence of conformity between the numbers indicates great loss for water and sewage companies and on the other hand low elasticity of water demand (-0.06) has resulted in more water consumption.

Keywords: Economic Valuation, Ramsey Pricing (second best), Consumer Surplus, Khuzestan Province.

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1-Introduction

In present, water is not distributed appropriately in ratio of time and places of world. Indeed because of climate problems- population growth and so on, more than 3 billion individuals have problem of water lacking till 2025. Regarding to exports of water management, those countries that are confronting with drought, can be optimistic to future if had some plans to increase water efficiency, such as those that leads to increase efficiency during green revolution. These programs that called water revolution, would increase the consumption efficiency of water especially in agriculture (Storm, 2010: 1-21). But about economic value, water is known as key of constant development that this made clear the economic role of water as a monopoly good (Ward, 2002: 423-4). Regarding to this, it can't be consider water as a general and gratuitous good, but it must be looked in an economic view. Indeed economic value of water and its pricing was discussed in international level during some decades, and by increasing limitation of water and its scarcity in some areas such as Iran, discussion of pricing and its method is more serious in recent years. Indeed water pricing is an important part of politics and programming of water sources and management of water demanding and its adherents believed that this politic improves the water management and fundamentally securing the costs of water services, and provide the reasonable use of water by effect on costumer behavior, and other role of water is price is create motivation to saving water and prevent of its consumption. Because accessibility and free of cost of water leads to increase in water consumption and decrease the motivation to prevent and economic use of it (Water Economic Office, 2006: 26). Economic value of water is equal to cost that a rational consumer of water sources pay to official or private sources. Four dimensions in appointment of economic value of water: constant volume- clear quality- constant time and constant place. Because it is possible that water consumption not be limited, but its economic factor is show it's consuming in various dimensions that is always limited and its saving is requiring great costs (Tsur and Yacuve, 2002: 175). Country of Iran is a dry and semidry country and its rainfall is one third of its average in world, also because of demand increasing and water challenge in country, competition among consumers became more serious, so water management and allocation water from various sources to different consumptions specially part of agriculture is a necessary subject, because this part is largest and most important consumer of water in country, so to prevent of damages and help to part of agriculture, we should prepare some conditions that this part be more considered. If role of water in development of country not be considered, certainly feeding security would been at risk. So increase the optimal water management is only factor to part of agriculture and its pricing is necessary (Shajari, et al., 2000: 56). So main purpose of present research is economic pricing of irrigation using coding pricing method or second optimal method, is allocate this important factor in part of agriculture. In this method by considering both sides of demand and product – economic price of water in part of agriculture and in case study to Khuzestan province and subdivided farms is confirmed. A research was done by Hamidreza Mirzaee Khalilabadi and Hamid Abrishami titled (role of water in development of agriculture mechanism), that used linear and input-output methods to analyzing, and various dimensions of subjects were studied in a major view, and share and role of water in agriculture part were distinguished including: extra value- direct and indirect employment- before and after unions- efficiency and potential of agriculture. results of this research show that part of water is one of the basic and fundamental parts of country that work as motor of growth in economic and is cause to growth in other parts, specially part of agriculture and its dependent activities. Indeed every unit of investing (one million Riyal in 2000) leads to 0.029 direct and indirect employment,

also before and after computes show that part of water in after unions is in rank of 11 and in before unions is in rank of 6, this show that part of water is one of the key parts in economic.in another research by Ali Yousefi et al (2012) titled (study the importance of water in Iran economic using general equality pattern), the general equality pattern to study the role of water in development mechanism of country was been used. Regarding to results of this research, they argued that share of water in macroeconomic is consider low. Major reason of it, is not considering water value in national computations and lack of range and distinguish the value of water sale in national accounting. Regarding to importance of water in in economic and social development of country, it is necessary that management of water be toward union management of water. Hugo- Storm et al (2010) in their research titled (estimate demanding to water of irrigation an Moroccan Drrâ Valley using conditional valuing method) used conditional evaluation to valuing water of irrigation in Moroccan Drrâ Valley of Africa. This method is standard tools to measurement that show the willingness of individuals to payment. Results show that proposed plan is an appropriate one to valuing irrigation water and optimal management of water. Regarding to a research by Richard Hewitt et al, (2010) titled (an economic plan of agriculture and plan in California and useable in all of state) use SWAP method for equalize the economic costs of water in California that create a critical condition, this model is a positive mathematical of PMP. this study appoint a price to water- and formulate configuration of agriculture model, Indeed this paper indicate an analyzing and practical method to estimate the impacts of specific politics related to water and dryness of agriculture. In a research by Mohammadreza Lotfalipoor titled (pricing the natural gas in company of big Khorasan using coding method) introduces good pricing and production services by government as most important economic discussion; because any change of price has effect on consumer wealth and in other word made poor the quality of productions and services. In this paper optimal prices of natural gas was been calculated to various economic parts, Result of this research is that coding pricing is based on ascending output, and one of the its hypothesizes is natural monopoly, to compute the wealth and also to saving purposes in other economic parts, he uses coding pricing method, and he proposed that price in other parts must be toward coding prices to maximize the wealth impacts to country.

Theoretical factors of coding pricing method:
There are number of methods to economic pricing of water (hedonic-volume- area- pricing-2 cost pricing- multi pricing- final efficiency- coding and …) (Fallahi, et al., 2009: 38). in a research calculate the economic value for water of Khuzestan using coding pricing; If pricing performed by other methods, for example if we want assume that water price is equal to final cost, its leads to loss. Because disorders (unreasonable monopolies- external factors and …) are in economic, pricing politics must be based on this hypothesize that always there exist a disorder. For example assume that subsidy in electricity- water or water (or any good in economic) be in way that its price be lesser than final cost and in political way, removing this subsidy is impossible. In this condition it is inappropriate witch water pricing be in way that be equal to final cost, Water price must be in a form that be lesser than final cost; Indeed subsidy in wards of electricity and water means that regarding to limitations of technology-assets and … in economic, this can't be in an optimal condition. So in this condition, choose the first optimal is remove and pricing is based on second optimal (p= mc)[3]. This factor is true in other economic parts (Lee yard, 2008: 209). the formulation of this problem show that in

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[3] - Marginal Cost, Price

this condition all things would change and relative price are not a reflection of relative costs, and also price computation of second optimal is possible to limit numbers, Because some costs and monopoly are unavoidable and are different from final cost And in peak of these limitations, there is inequality of government budget witch must pay more attention to it. This pricing also called pricing under income limitation, and it, concept of accurate pricing is used to getting economic efficiency and general institutions don't need to profit, so we can consider third purpose, to reach third purposes, we can consider a factor that is incoming limitation in a way that income of producer be more than its constant costs. These results are known as coding pricing and it must be considered that this type of pricing is use in natural monopoly and since some industries are in this field, coding pricing can be an appropriate method show real value of that industry. Accepting prices (PS and CS) are appointed based on conditions of institution and indeed access to real income is impossible. In this condition, best of second or coding method is appointed in a way that error percent of final cost is be reflection of pricing entice, if all of them be equal , then prices must be dependent on final cost. (Goldman, 1986). This legislation have some bases of micro economic that systematically derived from solving problem of consumer surplus maximizing (CS) and producer surplus maximizing (PS):

(1) $CS - \int_p^\infty \sum_{i-1}^m Q_i dp_i - U(Q_1, Q_2, \dots, Q_m) - \sum_{i-1}^m p_i Q_i$

(2) $PS = \sum_{i=1}^m P_i Q_i - C(Q_1, Q_2, Q_3, \dots, Q_m)$

In above relations, **P** is price of good (water) **Q** is amount of consumption, **U** is degree of quality, **C** is cost and **i** is various groups of demands (household, agricultural, industrial). By using Lagrange method we have:

(1) $P_i - Mc_i + \Lambda (MR_i - Mc_i) = 0 \quad =>$

(2) $\frac{P_i - Mc_i}{(MR_i - Mc_i)} = Q\Lambda$

(3) $P_i - Mc_i + \Lambda (MR_i - Mc_i) = 0 \quad =>$

(4) $\frac{P_i - Mc_i}{(MR_i - Mc_i)} = Q\Lambda$

Regarding to initial conditions of (F.O.C) P maximum of quality base on Q. and MR and MC are final income and final cost. Regarding to equation: $MR = P\left(1 + \frac{1}{\varepsilon}\right)$

And time derivative of the Lagrange function with respect to the amounts used in the various sectors will, we have:

7) $\frac{P_i \, MC}{MC \, P_i\left(1 + \frac{1}{\varepsilon_{ii}}\right)} = \frac{P_j \, MC}{MC \, P_j\left(1 + \frac{1}{\varepsilon_{jj}}\right)} = \frac{P_k \, MC}{MC \, P_k\left(1 + \frac{1}{\varepsilon_{kk}}\right)}$

The indices i and j, and k represents the water consumption in the household sector, industry and agriculture. These relations can rewrite as following:

8) $\left(\frac{P_i - MC}{P_i}\right) \cdot \varepsilon_{ii} - \left(\frac{P_j - MC}{P_j}\right) \cdot \varepsilon_{jj} - \left(\frac{P_k - MC}{P_k}\right) \cdot \varepsilon_{kk} - \left(\frac{\Lambda}{1 + \Lambda}\right)$

Ramsey optimal prices from the above equations, the condition of the various uses of a known MC and ε represents every sector - will. Also included $\left(\frac{\Lambda}{1 + \Lambda}\right)$, is called the Ramsey number. Therefore, to calculate Ramsey prices need to estimate the demand function (knowing ε) on various costs and calculate the final cost is. The estimated price elasticity and marginal cost,

given equal numbers in each section of Ramsey, Ramsey prices will be extracted (LotfaliPoor, 2010: 48).

Data and research information:
In this study, the statistical community has Khuzestan Water and Sewage Company of sample volume of water used for agriculture is in Khuzestan province, Information needed to estimate demand models include: the quantity of water use in agriculture, Value and price in the sector to achieve the required data on pricing water supply and water demand are included subsets, Requiring data to estimate model are: amount of water consumption in ward of agriculture- number of commons- extra value and water price that collecting method of these data is: direct going to research center of water and electricity organization of Khuzestan province and agriculture organization- statistic site of Iran and site of power organization. Information and data are derived from documents reports and magazines. Statistics including: amount of water production- human force of water industry- investing of electricity and water organization and rainfall of province. Related data as we said achieve from programming office of electricity and water organization of Khuzestan power organization and climate center.

Using patterns to estimate the models of demand and supply:
First factor of water demands in ward of agriculture is derived by descriptive method and ARLD. Time series of demand model include data (1979-2013) and estimate of both demands of water consumption and production use of those descriptive method by using Microsoft software. Time series of this estimate model is includes data of time series in its time duration (1979-2013).

Estimate the demand and production of water in ward of agriculture: Estimate the demand of agriculture water:
In empirical works, choose of appropriate form is dependent of quality and factor of demands in unsystematic motion or unique (Ramsey, 1927: 61). Dependent the unique demand has not the limitations of demand dependents in unsystematic and also it is not necessary that access a particular quality in maximizing condition. Its access is in this way that first base on theory, estimate a dependent relation between demand of a good and its price and price of one or several goods of complete and other demands and other factors. It can be show a unique demand dependent in various forms of: logarithm-linear-tabulated-and semi logarithm (Khaleghi, 2006: 63-65). Here unique demand or single equation is used to estimate the dependent of agriculture water demand. Because of that main purpose of estimate the demand dependent to various wards of demand prices, so the logarithm form of dependent was used to estimate dependents. So regarding to important factors that have effect on demand of agriculture water and by using present information and statistics, model of demand to agriculture water is as following:

LNW: logarithm of agriculture water,
LNP: logarithm of agriculture water price,
LNAV: logarithm of extra value in agriculture,
N: number of individuals in ward of agriculture.
Here the variable of extra value is used as successor of incoming variable. Result of using model to estimate demand of agriculture ward is as followed:

$$LNW = C + \alpha_1 LNp_w + \alpha_2 LNAv + \alpha_3 LNN + \varepsilon$$

To identifying time series stability from time series instability, the test of ADF is used. Most important part of this test is the choose optimal length that in it remained sentences have features of none coefficient that it better to use the Bayesian in observations with volume of less than 100.results of dickey fuller test are shown in table 1: results show that logarithm of water price in agriculture ward and logarithm of extra value in stable level and consumption variable in subtract of second stage and community number are in first stage of stability. Regarding to this that variables of this pattern are stable in different levels, best method of this research is ARDL, that based on this, first method of short term impacts is studied that is shown in table 2. After study the stability of variables, ARDL is used to estimation. Regarding to statistics F and R^2, it confirmed the accuracy of regression and description power of above model. Now to study, the long term relation between variables of agriculture ward t statistic was computed:

$$t = \frac{\sum_{i\ I}^{m} \hat{\beta}_i - 1}{\sum_{i\ I}^{m} S\hat{\beta}_i} = \ 1.68$$

In it $\hat{\beta}_i$ is total coefficient by pause in dependent variable and $S\hat{\beta}_i$ is standard deviation. By comparing the calculated comparison (1.68), assumption 0 is based on long term relationship. So here just short term model is not considered (lotfalipoor, 2010: 32-33).

Table (1): study the stability of variables

variable	Dickey fuller statistic	probability	conclusion
Logarithm of water consumption agriculture ward	- 10.83654	0.0001	I(2)
Logarithm of water price in agriculture ward	-2.969379	0.0595	I(0)
Logarithm of community numbers of Water in agriculture ward	-3.892835	0.0053	I(1)
Logarithm of extra	-2.653028	0.0078	I(0)

Table (2): estimate the pattern in short term

Variable	Coefficient	t statistic	Probability	Conclusion
Logarithm of water price in agriculture ward	-0.06	-1.76	0.08	1
Logarithm of community numbers of	2.62	4.41	0.0001	1
Logarithm if extra value	0.73	6.10	0.0001	1
	$R^2 = 0.90$	DW=2.01	F= 92.494	

 Then estimate of long term impacts are shown in table 3:

Table (3) estimate the pattern in long term

Variable	Coefficient	t statistic	Conclusion	Probability
Logarithm of water price in agriculture ward	-0.06	1.76	1	-0.08
Logarithm of community numbers of	1.65	16.33	1	0.0001
Logarithm if extra value	0.60	9.57	1	0.0001

Table (4): estimate the pattern in ECM

variables	coefficient	t Statistic	probability
Subtract of water pricing	-0.06	-1.76	0.08

in agriculture ward			
Subtract of water commons in agriculture ward	0.97	1.56	0.12
Subtract of extra value	0.73	3.55	0.001
ECM(-1)	-0.27	-2.31	0.02

Results of estimation using ECM show a low percent and in other word if a shock is on research variables and equation is out of long term, every 27 percent is modified that government by accurate politics can equal this factor.

Estimate the produce Function of agriculture water:

Estimate the dependent of production, so in this stage we analyze the water production in Khuzestan province and to estimate the production dependent, the Cobb Douglas was used that is as followed (Falahati, 2013: 138):

$$y = AL^{\alpha} K^{\beta} R^{\gamma} e^{u}$$

That in it: **Y** production rate based on million meter m3, **K**: capital volume in Million Riyal, **L**: workforce volume, **R**: rainfall rate and **e**: is random error that shape is a logarithm as follow:

$$LNY = LNA + \alpha LNL + \beta LNK + \gamma LNR + \varepsilon$$

In this pattern the time series data were indicated. First, stability of research variables was studied that are in table 5 and it show that production and variables and workforce are stable and variables of rainfall and capital are in first step of stability and since variables of this pattern are in different levels of stability, the best method of this research is ARDL. That based on this, first short term effects:

variable	Break	dickey fuller statistic	probability	Conclusion
Production	1	-2.973490	0.0568	I(0)
Human force	1	-3.673266	0.372	I(0)
Capital	1	-7.618473	0.0001	I(1)

Rain fall rate	1	-5.657997	0.0001	I(1)

Table (5): study the stability

Table (6): estimate the pattern in short time

variables	coefficient	t Statistic	probability
Logarithm of production with a pause	0.87	10.79	0.0001
Logarithm of human force	0.29	2.31	0.09
Logarithm of capital	0.04	3.21	0.003
Logarithm of rainfall	0.1	2.53	0.03
	DW= 1.8	$R^2 = 0.90$	

t Statistic of variables table has positive impact on water that impact of capital variable and production one is more than other. Then it estimates the pattern of water in long term to produce water in Khuzestan province:

Table (7): estimate pattern in long term

variables	coefficient	t Statistic	probability
Logarithm of work force	0.25	5.41	0.0001
Logarithm of capital	0.36	1.78	0.08

Logarithm of rainfall	0.86	2.67	0.01

In dependent of cabb douglas production δ = α+β show the output of scale, and this index in short time is equal to: 0.33 = 0.4+0.29, that show the descending output in short term and in long term is 0.71= 0.36+0.35 and it is also descending in water industry of Khuzestan province.

Table (8): estimation pattern in ECM

variables	coefficient	t Statistic	t Statistic
Human force subtract	0.29	1.91	1.91
Capital subtract	0.04	3.21	3.21
Rainfall subtract	0.1	2.53	2.53
ECM(-1)	-0.12	-2.54	-2.54

Regarding to error modifying in model of ECM, we can indicate that equal rapid is toward equality and long term. In other word if a shock be in variables and equation be out of long term, it be modifying every 12 percent of error and standard deviation. That government can increase the ward of agriculture in long term.

Computing the Ramsey prices in agriculture ward:

Now, regarding to price changes of demands (-0.06) and also to compute the final cost, we can compute the optimal prices of coding in agriculture ward. Regarding to this that final cost is a base to pricing, first we estimate the total cost and we can derived the final cost from it. Regarding to double discussions, there is cost variable to every production variable:

$$LnTc = LnB + \frac{1}{\delta}y + \frac{\alpha}{\delta}Lnr_l + \frac{\beta}{\delta}Lnr_k$$

So regarding to above dependent, final cost is equal to:

$$MC = AC. \frac{1}{\delta}$$

That **MC** indicate the final cost, **AC** indicate the average cost and $\boldsymbol{\delta}$ is ratio of output to production scale. Therefor amount of average cost that indicates by company of areal water of Khuzestan is equal to 86 Riyal to one m3. Regarding to this average cost and amount of Q, cost of final production is as following:

MC= 86(0.1* 71) =121.126

Regarding to budget and above relations, price of every ward can be computed as following:

$$Pj = \frac{Pi\,\varepsilon_j MC}{Pi\left(\varepsilon_j - \varepsilon_i\right) + MC\,\varepsilon_i}$$

$$P_k = \frac{P_i\varepsilon_k\,MC}{P_i\left(\varepsilon_k - \varepsilon_i\right) + MC\,\varepsilon_i}$$

Due to budget constraints and the relationship between the prices of a unit (in agriculture) can be calculated from the following equation:

$$P_iQ_i + \frac{P_i\varepsilon_j MCQ_j}{P_i\left(\varepsilon_j - \varepsilon_i\right) + MC\,\varepsilon_i} + \frac{P_i\varepsilon_k MCQk}{p_i\left(\varepsilon_k - \varepsilon_i\right) + MC\,\varepsilon_i} = B$$

That in it, **P** is price of water, **ε** is change of demand cost MC is final cost of water production, **Q** is amount of water in agriculture ward and (AC*Q)B is amount of budget in industry of water. By solution above equation, coding price of water in 2013 was computed that its result is as followed:

Table (9): optimal price of water in agriculture ward

Section	Price of 2013	Ramsey Pricing	Ratio of current price to coding price
agriculture (P_k)	86	99	86

Conclusion:

Results of estimate by ECM method show a low percent and in other word if a shock be inter to research variables, in equation be out of long term, any 12 percent of analyzing error be modified from long term relation that government by accurate politics can equalize this factor and increase the production of agriculture ward. Also in present price and cost that paid by farmers is not its real value and is less than its real cost to production and distribution. As it observed, coding price of water in 2013 is higher than current price, it means that in Khuzestan province, payment of farmers is less than its economic value (Ramsey). Regarding to these results and comparing current price (86 Riyal), and Ramsey price, Water Company without help of general budget, can't equal the financial accounts and it leads to major loss. In other word, demand to water in Khuzestan province is (-0.06), it means that commons motivate to more water consumption. Also variable of water price in case studies is effective to water demand, because regarding to t statistic, variable of price is effective to water demand, and it means that politic of pricing to water is effective in decrease at consumption.

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