Evaluation of Water in Iran's Agriculture: A case study of Dashtenaz of Sari-Iran

Foad Eshghi [1], Seyed-Ali Hosseini-Yekani [2]

[1.] MS Student, Department of Agricultural Economics, Tarbiat Modares University, Tehran, Iran
[2.] Assistant Professor, Department of Agricultural Economics, Sari Agricultural Sciences & Natural Resources University, Sari, Iran
s.a.hosseiniyekani@gmail.com

Abstract: Today's world faces serious population increase. On the other hand, limited available resources for the man have resulted in an intensive competition and challenge between various economical sections and parts. One of the main and limiting factors of the Iranian agriculture section development is the water entry. Thus, optimized exploitation management which is achieved through establishment of balance between supply and demand of this scare commodity is the only solution. There are factors in agriculture which may not be clarified with a potential distribution, though there have been made several efforts to consider risk in agriculture economical models, but it will be possible to do so when there is established is compiled mathematical relation. On the other hand, in many of the third world countries, the limited capital and available agriculture entries may limit the farmers available options. Hence, it is required in these countries to apply precise analytical tools, so that not only the plans made as per the current realities may be chosen, but also the policies which consider the recommended social objectives may become possible. In these countries, the general problem of lack of statistical data requires that the programming models are designed so that they are mean in using such data. This study tries to use a modern method for Dasht Naz of Sari in different states from the respective productivity (here normal linear programming program) to achieve the shadow price of water. The water economical value (water shadow price) in summer is Rls 1030. This parameter for spring and autumn becomes zero. The LIndo6 software package has been used for this study.
[Foad eshghi, Seyed-Ali Hosseini-Yekani. **Evaluation of Water in Iran's Agriculture: A case study of Dashtenaz of Sari-Iran**. Life Science Journal. 2012;9(1):449-452] (ISSN:1097-8135). http://www.lifesciencesite.com. 66

Keywords: Water Evaluation; Agriculture; Linear Programming; DashteNaz of Sari; Iran

1. Introduction

Any life species depends on water. Apart from that, water is of vital importance in industrial, agricultural, metabolism, etc. applications. Thus, lack of such substance is considered as a huge challenge for the mankind and also the natural scenes, electricity production, swimming, rowing, etc. also require water.

Today's world faces serious population increase. On the other hand, limited available resources for the man have resulted in a intensive competition and challenge between various economical sections and parts.

While the communities face the increased populations and also the water reserves seem not to be enough to provide the needs of such population, there are suggested a variety of solutions for such reserves, while two general methods of the same may be named as follows:

1. increased available reserves
2. increased productivity in using such reserves

Concerning the first case, due to limited reserves, the limited scope of such process is tangible, i.e. such process is impracticable to some extent. The second procedure seems more logical and it is likely that applying practical methods may increase reserves exploitation productivity and take benefit maximum from the same (Keramatzadeh, 2006).

The highest water consumption in Iran is in the agriculture section. The water consumption figure in this sections is about 90% (Amirnejad, 2006). As Iran is placed in the dry and semi-dry region and the problems of lack of water indicate the requirement to more consideration of the issue of water and especially the water consumed in the agriculture section.

Also, whereas Iran is located in the dry and semi-dry region, lack of the water required for irrigation intensifies considering high population growth, development of economical activities, improvement of public living level, increased public tendenct towards welfare, etc.

By increasing the demand as well as the heavy water exploitation costs and making the same available, the water reserves management shall seem quite important. By water demand management we mean establishment the balance between the fixed economical water supply/demand. Whereas water economical water means the available water with certain quality, in certain time and location for certain consumption, but its physical supply is always limited. Thus, in order to establish the balance, the water economical demand side which is related to the level of benefit or appropriateness of the water consumer shall be emphasized. In establishing the balance between the water supply/demand such as any other goods and substance, the respective price or value plays a major role. In case such price is determined correctly, then it is expected that the current issues in water management are rectified (Gibbons, 1987).

Whereas the study region subject hereto is Sari Dashtenaz region, water assignment to the products with higher economical value and manner of its optimized assignment in different reasons in the way that the optimized cultivation model in the aforementioned region is achieved shall be the purpose of this study.

This study, which is based on water resources demand management, tries to estimate the water economical value in Dashtenaz of Sari region, so that by achieving available water resources economical management, the dissipation of this valuable entry and its optimized allocation are made possible. One of the common methods to determine the water shadow price is using the linear programming technique. Heady et al. 1973, used the linear programming technique to estimate 51 west US regions agriculture water demand and optimized corps distribution. The results of this study indicate that water final value have been zero in many regions and thus, the scholars consider the water price increase on water demand for corps cultivation as different in different regions. (Chaudhry. & Young , 1989) used the linear programming model to evaluate the Pakistani Punjab Province agriculture water and concluded that the answers of the linear programming method almost indicates the agriculture water final value and the price of the same depends on available water. in Colorado, (Houk.& Taylor,2000) categorized agriculture in five types and used the linear programming method to find the water price at each region for alfalfa cultivation. The results of this study show that the shallow waters shadow price is between 4.38~ 15.44 USD (Acre-Ft). (Abubakr.et al .,2009) used the linear programming and compiled the optimized cultivation model for the four regions of Helfa, Dangoula, Oldba and Moraveh in northern Sudanese province for 2003-2004 agricultural year. The results indicate that the farmers net income under optimized cultivation will increase with respect to the current conditions for 73.3%, 73%, 49.4% and 121%. Also, wheat in commercial production for Dangoula region may be increased up to 4.04 tons/hectare.

2. Material and Methods

There are a variety of methods to estimate the water shadow price. In this study the simple linear programming method has been used. the linear programming model mathematical relation may be expressed as follows: $\max\ z = \sum_{j=1}^{n} c_j x_j$ (1)

$$s.t: \sum_{j=1}^{n} c_{ij} x_j \le b_i \quad for \quad i = 1,2,3,\dots,m \qquad (2)$$

$$x_j >= 0 \qquad j = 1,2,3,\dots,n \qquad (3)$$

In the aforementioned model, the relations (1), (2) indicate the objective function and constraints and relation (3) indicates the non-negative constraint nature of the activities.

The variable of this model shall be defined as follows:

Xj: indicates the available various cultivated and garden products cultivation activities in the region

Cj: indicates the net productivity of various corps which may be cultivated in the region.

Z: indicates the planned productivity and gross profit of the farmers of each region

Bi: i[th] reserve contents of the region

Cij: technical factors, which indicates the i[th] substance content required to produce each unit of the j[th] product.

The main activities made in the region include: wheat, colza, grained corn, fodder corn, soybean and rice, while i variable associated to the aforementioned activities shall be as follows:

Soybean i=1, grained corn i=2, rice i=3, fodder corn i=4, wheat i=5, colza i=6, and j is the variable related to spring, summer and autumn, during which the company cultivates the corps, so that spring j=1, for summer j=2, and autumn j=3.

Objective Function

The objective function is designed to maximize the net income, which is defined as follows:

$$Max \sum_{i=1}^{6} \sum_{j=1}^{3} c_{ij} x_{ij} \qquad i \ne j \qquad (4)$$

Model Constraints

Whereas Dashtenaz Sari Cultivation and Industry requires to assign certain area of land for the activities of each season, we shall consider certain constraints for each of the seasons:

$$s.t:$$

$$\sum_{j=1}^{n} a_{ij} X_{ij} \le b_j \qquad (5)$$

Spring j=1, summer j=2, autumn j=3; the Lindo6 software package has been used in this study.

3. Results and discussions

Table (1) indicates the current level of activities in the cultivation and industry, under which the total income of the cultivation and industry shall be Rls 25596120268.

Table 1: activities current level in calibrated model

Product	Variable	Quantity (hectares)
Soybean	X11	667.45
Grained corn	X21	602.52
Rice	X32	568.68
Fodder corn	X42	329.52
Wheat	X53	1106.66
Colza	X63	1127.33

Table (2) indicates the activities optimized level in cultivation and industry. In such conditions the total income of the cultivation and industry shall be increased to Rls 38502270000. Comparing these two situations indicates the areas under cultivation of soybean, maize, and wheat and the increased area under cultivation of corn, sweet-corn and colza in the optimized model in comparison to the current situation. Also, the income shall be increased for about 50%.

Table 2: activities optimized level (in hectares)

Product	Variable	Quantity (hectares)
Soybean	X11	819
Grained corn	X21	399
Rice	X32	179
Fodder corn	X42	745
Wheat	X53	1234
Colza	X63	553

The first two columns values of table (3) indicate a range of numbers between two upper and lower constraints (Allowable Increase and allowable Decrease figures), between which the activities (decision variables) or in other words the optimized answers shall be identical.

Due to taking benefit from the public donations as well as being located in one of the regions with the high raining average, Dashtenaz Cultivation and Industry faces excessive inventory for most of its required entries; in other words, in most of the entries the same faces with wasted reserves. In the other hand, certain corps cultivation appears as a limit for different seasons.

Table 3: allowable Increase and allowable decrease figures in objective function factors (in Rls1,000)

Variable	Current Coefficient	Allowable Increase	Allowable Decrease
X11	1891.01	303	738
X21	2194.33	1407	303
X32	29482.9	83194	13839
X42	6016.75	5322	4442
X53	7216.14	933	3956
X63	8149.08	9891	932

One of the targets of this study is to compile the optimized cultivation model for cultivation and industry. Due to the results of the current cultivation model study, the cultivation in Sari Dashtenaz Cultivation and Industry is not optimized and in case of optimization, the company income may be increased. This study shall consider the seasonal limitations for the given model. Such limitation is arisen as the Dashtenaz Cultivation and Industry shall cultivate soybean and corn in spring, rice and maize in summer, and wheat and colza in autumn. Thus, this study gives a unique cultivation model for each of the aforementioned cultivations. Based on the results of the linear programming technique in case of using the optimized cultivation model, the company shall face highly increased income. Thus, in case the soybean, maize, and wheat cultivation areas are decreased for 18.5, 55 and 10.3%, and also in case the corn, rice and colza cultivated areas increased for 51, 210 and 103%, then the company's income shall increase about 50%. Thus, the cultivation model to be optimum is refused.

4. Summary and Concluding Remarks

1. Using optimized cultivation model results in an increase of about 50% in the company's net income. Thus, it is suggested that the company directors change the cultivation model and approach the optimized cultivation model.
2. The results indicate that water in summer season one of the most important production factors, during which notwithstanding the high rainy nature of the region, the company faces lack of water, which also shows that that the company's income may be increased by water reserves optimized management.
3. The water shadow price in summer is quite higher than the than the received water prices. Thus, increasing the water prices and approaching the same to the level of the shadow price will result in assignment of this important substance, and avoids water wasting.

4. Apart from water, the spring land, summer land, summer labor, and spring machinery will face lacking in the company, and the directors shall provide the company with increased income through land lease or purchase, machinery supply and hiring more labor.

5. Using the optimized cultivation model at the company by the directors will result in increased employment and eventually increased income of the company.

Corresponding Author:
Dr. Seyed-Ali Hosseini-Yekani
Department of Agricultural Economics
Sari Agricultural Sciences & Natural Resources University, Sari, Iran
E-mail: s.a.hosseiniyekani@gmail.com

References

1. Abubakr, I.S., El-Houri, A. and Babiker, I. 2009. Optimum winter cropping pattern in the northern state, Sudan. Agricultural Economics, 10:77-86.
2. Amirnejad, H. 2007. Natural Resources Economics, 109-128.
3. Chaudhry, M.A., and Young, R.A. 1989. Valuing irrigation water in Panjab province, Pakistan: A linear programming approach, Water Resources Bulletin, 25(5), 1055-1061.
4. Gibbons, D.C. 1987. The economic value of water. Resources of the future, inc., Washington D.C., USA.
5. Keramatzadeh, A., Chizari, A.H., and Balali, H. 2005. Shirvan Barzo Dam: A Case Study. Optimal Allocation of Water and Priority of Different Region in its Usage, 17-34.
6. Heady, E.O., Madsen, H.C., Nicole, K.J., and Hargrove, S.H. 1973.
7. Houk, E., and G. TayloR. 2000. Valuing the characteristics of irrigation water in the platte, Western Agricultural Economics Association Annual Meeting (On-line), 29. Available on the WWW:url:http: // agecon.lib.umn.
8. Soltani, G.R., Zibaei, M. and Babiker, AA. 1999. Application Of Mathematical Programming In Agriculture.
9. Souri, A., and Ebrahimi, M. 2006. Natural Resources And Enviromental Economics, 157-172.

2/6/2012