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Sustainable management of water resources in Yazd province: challenges and solutions

Sadati, S.A.*, Rostami, F. and Fami, H.S.

Department of Agricultural Extension and Education, Faculty of Agricultural Economics and Development, Tehran University. Iran.

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Water has been recognized, as the most important and limiting input of agricultural production. The water resources of Earth planet are facing with crisis and worrying challenges such as shortage of water, mismanagement and lack of integrity in management networks of water resources, existence of decreasing trend in allocated financial resources, and non existence of awareness among decision makers and farmers. Provision and development management of water resources, on the other hand, has emerged as dynamic and influential factor with regard to policy-making, planning, and providing necessary facilities for tapping water resources since long time ago And, its' attention has been mostly paid to development of water resources and environmental, political, legal, and organizational issues. Agriculture sector, as the largest consumer of water resources, play special role with regard to the planning and policy-making.

Key words: water resources, sustainable management, challenges, solutions, Yazd Province

Introduction

Water is one of the investments that do not have any alternative. However, the agriculture sector is the main consumer of water. Distribution of water is not consistent with the needs of this section in terms of time and place. Water is the most important limiting factors for development agricultural sector in the world, especially in arid and semi arid regions and. Iran is the one of the arid areas of world because its average annual rainfall is 250-300 mm (Bagheri and Malekmohammadi, 2005; Caswell and Zilberman, 1986).

Despite the restrictions water, Researches showed that about 67% of water is used in agriculture section and it is amazing that this amount is about 90% in developing countries like Iran (Earth Day Network, 2003), but use of water in the agricultural sector is not optimal. Methods of irrigation often dependent on surface methods that water efficiency is low in these

*Corresponding author: Sayyed Abolhassan Sadati; e-mail: abolhasan_sadati@yahoo.com

methods and reaches to 60 percent at extreme (Ebrahimi, 1998; Arvin, 2006; Bagheri and Malekmohammadi, 2005). Some experts mentioned that first step to prevent of water crisis is increasing in water efficiency and believe that agricultural water use could be reduced by 40-50 percent (Caswell and Zilberman, 1986; Bagheri and Malekmohammadi, 2005). This indicates the necessity of presenting mechanisms for effective management of agricultural water. The third thousandth anniversary goals to decrease the poverty, hunger and making a sustainable environment, without agricultural water management, will not be accomplished (Molden, 2007). Nowadays, sustainable management of water and land resources is considered as a point of agreement and also an international duty (Barthle *et al.*, 2005).

In majority of countries, Optimum use of water resources is the main programs. Preservation of sustainability in water systems needs to be more accurate and incorporate planning principles in arid and semi arid countries. Management of water resources is one part of development planning in all countries and every country is considered to it based on the amount of water resources available and exerts specific strategies and programs for optimal utilization of water resources. Today, management of water resources management use in two parts: water supply management and demand management. Great pressure on water resources has caused that will more attention in the optimal management in demand management, in Iran (Keshavarz and Sadeghzadeh, 2001; Albertson and Bower, 1999; Caswell and Zilberman, 1986).

According to manifest World Water Council in 1998, the most important challenges in water resource management were; water shortage, reduced water quality and fragmentation in water management works. Other challenges that there are in water management and can be referred to are: problem's that create due to lack of ownership in water resources (Abdollahi and Ezatabadi, 1999), lack of proper management in irrigation and land drainage (Zehtabian, 2005; Foroughi *et al.*, 2006), lack of land grading (Abdollahi and Ezatabadi, 1999; Zehtabian, 2005), lack of proper irrigation networks (Zehtabian, 2005), low efficiency of irrigation (Jafari *et al.*, 2002; Sedighi and FarzandVahi, 2004), using of traditional systems irrigation and lack of education and extension systems for training about optimize use of agricultural water resources to farmers (Kardovani, 2005).

Water has vital role in agriculture and effects can be accord due to water shortage can easily receive the best option for the future, efficient use of water to allow the world food security is improved to ensure the future security. Water management in agriculture undeniable seems, because the fact that the highest water is in this sector the optimal management of water can be used not only in the agriculture sector improve but also its use in other sections and concerns about water shortages is more less.

Therefore, for sustainable management of water resources in agriculture, farmers have to learning how to proper use of water and

programming culture (Mahdavi, 2005; Davarpanah, 2001; Farshi, 2005; Jin and Yong, 2001) and farmers have had participation in programming patern about water distribution (Ehsani and Khaledi, 2003; Nazemi *et al.,* 2005; jahani, 2005; Haydari *et al*., 2005; Assareh *et al.*, 2006; Zehtabyan, 2005). Coordination between related agencies water sector is another factor that can play an important role in the sustainable management of water (Farzampuor, 2001; Davarpanah, 2001). Consolidation of land can also prevent of waste water and increased efficiency of agriculture water (Farshi, 2005; Zehtabian, 2005; Arjomandi *et al*., 2000; Hamadan Regional Water Company public Relationships Report, 2006). Approval, implementation and follow rules and regulations to protect water is a solution by government that legal pressure to induct into water consumers, especially in the agriculture sector, and will be effective (Davarpanah, 2001; Ehsani and Khaledi, 2003; Jahani, 2005; Farzampour, 2001; Arvin, 2006). Economic solutions such as appropriate pricing of water in different parts such as the agricultural sector (Farshi, 2005; Jahani, 2005; Pereira *et al*., 2002) and attention to education, research and extension about increasing productivity water (Ehsani and Khaledi, 2003; Zehtabian, 2005; Arjomandi *et al*., 2000; Arvin, 2006; Pereira *et al*., 2002) and utilization of agricultural residue water (Farshi, 2005; Ehsani and Khaledi, 2003; Jahani, 2005; Pereira *et al*., 2002; Jin and Yong, 2001; Koh *et al*., 2002) are other ways of applying sustainable management in the agriculture sector.

The main purpose of this study is to present necessary solutions for sustainable management of water resources in Yazd province through identifying and priority setting of constrains, problems, and challenges of water resources management in this province. Experts of agricultural Jihad management water affaires and service centers of province and counties of Yazd are considered as statistical population of the study. And, all of them were surveyed.

Materials and methods

Study area

Yazd province in central Iran (Fig. 1) and any provinces of the country are dry desert and the average annual raining province about 100 to 110 mm, that this amount of raining is not balanced distribution in province. level average annual rainfall in the highlands Shirkooh about 350 mm and annual average rainfall in Bafgh county sometimes to less than 50 mm and this issue seems more important because of warm and dry province of annual evaporation is 30 times the rainfall (Anonymous, 2000, 2008). The dry, almost Yazd Province have no permanent rivers and the highest harvest water is from groundwater sources that qanat have special role.

Currently in Yazd province, annually through 8200 spring, wells and qanat, 1.594 million cubic meters of ground water is removed, thus underground water in different regions annually between 13 and 120 cm below and addition to decrease water, its quality has also deteriorated severely and degradation in quantitative and qualitative of ground water. Stability in the utilization of water resources and soil will lead to population sustainability in each region, so how utilization of these resources is very important. Wells and qanats are important water resources in Yazd as about 40 percent of agricultural water is supply from qanats, which annually about 500 million cubic meters of water is harvested of qanats in Yazd province. According to statistics, the numbers of qanats in province are about 3300 field (about 10% of all of qanats in Iran) (Anonymous, 2008). Since qanats are major resources for supply water of agricultural in Yazd province and life of human, animals and plants in this region is dependent on this vital matter and the other hand, according to successive droughts in recent years, necessity of attention to sustainable utilization of resources is undeniable. Therefore purpose of this study was:

Proriety setting of effective factors on the water shortage in region

Analysis of challenges facing of sustainable management of water resources

Analysis of solutions for sustainable management of water resources

Fig. 1. position of Yazd province.

Selection of sample

Experts of agricultural Jihad management water affaires and service centers of province and counties of Yazd are considered as statistical population of the study, that they were 57 experts. To collect data, a questionnaire was designed. The questionnaire contained three sections: section 1 pertained to ranking the problems of water shortage in region, which consists of eight items. section 2 was designed to identify challenges facing of sustainable management of water resources that this section consisted of 16 variables. Section 3 was designed to identifying the solutions for access to sustainable management in water resources that formed of 20 items. These three sections are rated on a five point continuum

ranging; strongly disagree, disagree, No opinion, agree, and strongly agree. The questionnaire was found to have content and face validity by a panel of experts. Questionnaire reliability was tested using Cronbach alpha, which is derived from the average correlations of all the items on the scale (Rodriguez, 2006). The results indicated that the reliability coefficient was acceptable that visible in Table 1. SPSS version 11.5 was used for data analyses.

Table 1. Cronbach alpha for research variables.

Factor	Number of variable	Cronbach alpha
Effective factors on water shortage	8	0.701
Challenges facing of sustainable management	16	0.812
Solutions for sustainable management	20	0.710

Results and discussion

Proriety setting of effective factors on water shortage in Yazd Province

For priority setting of effective factors on water shortage was used of the coefficient of variation. For this purpose, eight items was presented to respondents and asked them about your rate of each of these items giving a score from 0 (lowest effect) to 10 (highest rate effect) take Lykrt scale. According to research findings "Drought and rainfall deficiency", "excessive exploitation of groundwater resources" and" Waste water in supply ditches" were of high priority (Table 2).

Analysis of challenges facing of sustainable management of water resources

A series of exploratory factor analyses using the 16 variables with Varimax as a rotation method and Eigen values greater than 1 as a cut-off point for the number of factors extracted. The analyses eventually resulted in the selection of three-factor challenges based on out of the 16 initial variables. These factors accounted for 74.896 percent of the total variance explained by the model. Items in these three-factor challenges loaded higher than 0.40 on each factor. KMO value was 0.72 and Bartlet statistic was 864.58 significant at 1% level, which implies appropriateness of extracted variables for factor analysis. Extracted factors, Eigen value, variance percentage and Cumulative percentage were shown in Table 3. The three Factors, Which Extracted, Are as Follows:

Factor 1: 29.697 percent of the total variance explained, comprising the following four variables: Lake of access to extension services; lack of time for using of extension classes; lack of coordination between extension classes time with season crop; Distance and lack of equipment for the visit

of service centers. This factor is named "informational challenges" and Loadings ranged from 0.501 to 0.561 (Table 4).

Factor 2: 27.918 percent of the total variance explained, comprising the following five variables: low level of household liquidity for using of modern irrigation systems; lack of timely payment and insurance facilities to farmers; administrative problems in the use of agriculture credits; high costs of using modern irrigation systems; and lack of payment for maintenance and reparation to irrigation canals. This factor is named "Economical challenges" and Loadings ranged from 0.834 to 0.912 (Table 5).

Factor 3: 17.281 percent of the total variance explained, comprising the following seven variables: being non-leveling lands in region; Land fragmentation; lack of clear ownership in water resources; lack of integrity between NGOs related to water resources management; lack of coordination between laws related to water management; destruction of water networks due to lack of management; and low level of moral farmers participation. This factor is named "Infrastructural challenges" and Loadings range from 0.503 to 0.671(Table 6).

Table 2. Ranking of appropriate setting for effective factors on water shortage.

Variable	Mean	S.D.	C.V.	Rank
Drought and rainfall deficiency	8.55	2.016	0.236	1
excessive exploitation of groundwater resources	8.41	2.015	0.239	2
Waste water in supply ditches	8.28	2.100	0.254	3
Use of traditional methods of irrigation	7.83	2.152	0.274	4
Lack of farms grading	7.74	2.133	0.275	5
Lack of Isolation of supply ditches	7.59	2.167	0.285	6
Warm weather and lots of water evaporation	7.58	2.410	0.318	7
Distance between water resources and farms	7.54	2.470	0.327	8

Analysis of solutions for sustainable management of water resources

For identifying solutions for sustainable management of water resources, 20 variables were selected for the analysis. To determine the appropriateness of data and measure the homogeneity variables, the Kaiser-Meyer-Olkin (KMO) and Bartlett's test measures were applied. These statistics show the extent to which the indicators of a construct belong to each other that ordinary were 0.680 and 1256.25.

In present study, 20 components were significantly loaded into four factors. These factors explained 63.324 percent of total variance. However, the Kaiser criterion was utilized to arrive at a specific number of factors to extract. Based on this criterion, only factors with Eigen values greater than

one were retained. Accordingly, four factors with Eigen values over one were extracted. Eigen values drive the variances explained by each factor. Sum of squares of factor's loadings (Eigen value) indicates the relative importance of each factor in accounting for the variance associated with the set of variables being analyzed. Eigen values for factor 1 through 4 are 4.067, 3.953, 3.733 and 2.455, respectively. The percentage of variance explained by each of the four factors is also shown in Table 7. The traces for factor 1 through 4 are 27.573, 14.695, 12.462 and 10.914 respectively. The total percentage of the trace indicates how well a particular factor solution accounts for what all the variables together represent. This index for the present solution shows that 65.644 percent of the total variance is represented by the variables contained in the factor matrix.

Table 3. Extracted Factors, Eigen value, variance percentage and Cumulative percentage of challenges facing of sustainable management of water resources.

Extracted factors	Eigen value	Variance Percentage	Cumulative percentage
1	7.438	29.697	29.697
2	6.710	27.918	57.615
3	5.420	17.281	74.896
KMO: 0.72	Bartlett: 864.58	Sig: 0.000	

Factor 1: the first factor accounts for 27.573 percent of variance and 7 variables were loaded significantly. These variables were presented in Table 8. A relevant name for this on loading's pattern is “Structural solutions”. Eigen value of this factor is 4.067, which is placed at the first priority among the solutions for sustainable management of water resources in Yazd province**.**

Factor 2: The second factor is contains four variables and associated mostly with the variables related to biological solutions. Thus, this factor can be named as “Biological solutions”. The Eigen value for this factor is 3.953, which explain 14.695 percent of the total variance (Table 9).

Factor 3: The name assigned to the third factor is “Extensional solutions”. This factor with Eigen value of 3.733 explains 12.462 percent of the total variance of solutions for sustainable management of water resources and consists of five variables (Table 10).

Factor 4: The fourth factor contains four variables relating to “Managerial solutions”. The Eigen value for this factor is 2.455, which explain 10.914 percent of the total variance (Table 11).

Table 4. Variables loaded in the first factor using varimax rotated factor analysis.

Name of factor	Variables loaded in the factor	Factor loadings
Informational challenges	Lake of access to extension services	0.501
	lack of time for using of extension classes	0.512
	lack of coordination between extension classes time with season crop	0.542
	Distance and lack of equipment for the visit of service centers	0.561

Table 5. Variables loaded in second factor using varimax rotated factor analysis.

Name of factor	Variables loaded in the factor	Factor loadings
Economical challenges	low level of household liquidity for using of modern irrigation systems	0.912
	lack of timely payment and insurance facilities to farmers	0.901
	administrative problems in the use of agriculture credits	0.944
	high costs of using modern irrigation systems	0.847
	lack of payment for maintenance and reparation to irrigation canals	0.834

Table 6. Variables loaded in the third factor using varimax rotated factor analysis.

Name of factor	Variables loaded in the factor	Factor loadings
Infrastructural challenges	being non-leveling lands in region	0.510
	Land fragmentation	0.503
	lack of clear ownership in water resources	0.512
	lack of integrity between NGOs related to water resources management	0.520
	lack of coordination between laws related to water management	0.671
	destruction of water networks due to lack of management	0.501
	low level of moral farmers participation	0.511

Table 7. Extracted Factors, Eigen value, variance percentage and Cumulative percentage of solutions for sustainable management of water resources.

Factors	Eigen value	Percentage	Cumulative percentage
1	4.067	27.573	27.573
2	3.953	14.695	42.268
3	3.733	12.462	54.730
4	2.455	10.914	65.644
	KMO: 0.680	Barttlete: 1256.25	Sig: 0.000

Table 8. Variables loaded in the first factor using varimax rotated factor analysis.

Name of factor	Variables loaded in the factor	Factor loadings
Structural solutions	land grading and consolidation	0.516
	infrastructural development for using of modern irrigation systems	0.511
	expanding winter water storage pools	0.503
	ditches coverage and isolation	0.474
	Making pounds under qanats for collect extera water	0.471
	expansion water shed on above of qanats	0.478
	creation and repair qanats	0.407

Table 9. Variables loaded in the second factor using varimax rotated factor analysis.

Name of factor	Variables loaded in the factor	Factor loadings
Biological solutions	Selection of plants resistant to stress and water shortage	0.676
	matching cultivation with climate in the region	0.781
	using the seeds resistant arid	0.739
	maximum use of soil moisture with using mixed cropping	0.538

Table 10. Variables loaded in the third factor using varimax rotated factor analysis.

Name of factor	Variables loaded in the factor	Factor loadings
Extensional solutions	exploiters notification about traditional irrigation systems problems	0.724
	Provide nessasery infrastrutural for exploiters for access to service centers and water experts	0.673
	Extension of modern irrigation systems	0.643
	Extension of responsibility toward to maintenance of modern irrigation systems	0.521
	Extension of participation in water resources management	0.506

Table 11. Variables loaded in the forth factor using varimax rotated factor analysis.

Name of factor	Variables loaded in the factor	Factor loadings
Managerial solutions	development of NGOs in water resources management	0.847
	performance water management laws and regulations by relevant organizations	0.863
	valuation of water as an economic- social product and reduction of water subsidies	0.745
	set and implement rules regarding insurance about drought problems	0.575

Based on the results of priority causes water shortage, is recommended that to be formed water crisis management at national, regional and local levels to cope with drought conditions to engage organizing Affairs in the region area (World Bank, 1995) and to do planning for faced with drought in order to pre-knowledge, repair and fight (Knutson, 1998). Recommended that authorities provide required facilities for land consolidation this is in agreement with the findings of (Alizadeh, 2001; Arjomandi *et al*., 2000; Mahdavi, 2005). Most of the farmers did not use drainage and using the agricultural weakest-water to irrigate, Therefore it is suggested that more attention be paid to drainage and using agricultural weakest-water (Izuno, 2002; Jahani, 2005; Jin and Yong, 2001; Koh *et al*., 2002). Increasing farmers' management knowledge and skills is the most important mechanism. It is recommended that brochures, radio, TV programs and training classes be applied to increase farmers' knowledge and skills and recommended that more attention be paid to training and Extension factor which will lead to effective management of agricultural water (Assareh *et al*., 2006; Farshi, 2005, Haydari *et al*., 2005). Due to land fragmentation, amount of water loss is high and then to access optimal consumption of agricultural water, should use management mechanisms such as land consolidation and integration. For access to this propose, recommended that government has to support farmers in financial and credit manner.

In the other hand, farmers' participation in different affairs such as channels maintenance and development is necessary to prevent the water loss during the transfer. The water that is extracted with so many difficulties and reach the farms should be utilized effectively via a powerful management. Regarding the dryness problem in the Iran, especially in Yazd province, which is a dry region because of its low rainfall average, the maintenance and replacement of underground waters as agricultural fresh water resources are so important. Therefore, artificial feeding of underground waters is one of solutions which should be persuaded by authorities.

References

Albertson, M. and Bower, H. (1999). Future of Irrigation in Balanced Third World Development. Agricultural Water Management, 21:33-44.

Alizadeh, A. (2001). Drought and need to increase water productivity, dryness and drought publication, No. 2, pp: 3-8.

Anonymous. (2008). Report of soil and water management of Yazd. Avilable at: http://www.farsnews.net/newstext.php?nn=8502040091.

Anonymous. (2000). Agriculture Organization of Zanjan province. Management of Planning and schem.

Arjomandi, R., GHaysardehi, F. and Nagafi, A. (2000). The effect of agricultural exploitation systems changes on water management. Proceeding of the Article Collection of Technical Workshop on Farmers Participation in Irrigation Network Management, Proceeding of the 27th Aban Season, pp: 1-4. http://www.irncid.org/ workshop/pdf/W15pdf/3arj mandi.pdf.

Arvin, M. (2006). Water crisis in Fars province. Agricultural Articles Center. Available on site: http://alonefarmer.blogfa.com/post-1684.aspx.

Assareh, A., Motamedi, B. and Illkhaszadeh, H. (2006). To compare of integrated and nonintegrated farms irrigation efficiency in Dez irrigation network. Proceeding of the Conference on Iranian National Committee on Irrigation and Drainage, the University of Ahvaz Shahid Chamran, Water Sciences Engineering College, Ahvaz, Iran. http://www.irncid.org/Articles.Aspx?ZID=28.

Bagheri, A. and Malek Mohammadi, I. Adoption behavior of Sprinkler Irrigation among farmers Ardebil. (2005). Journal of Iran Agricultural Science, Volume 36, Number 6, pp: 1479-1488.

Barthle, R. *et al*. (2005). Comparison of tools for integrated assessment and management of groundwater resources in different river basins with special regard to sustainability. http://www.cosis.net/abstracts/EGU05/03162/EGU 05-J-03162.pdf.

Castilla–La Mancha, Spain, Agricultural Water Management, An International Journal, Elsevier, Vol. 77, issues 1-3, pp. 82-95.

Caswell, M.F., Zilberman, D. (1986). The Effect of Well Depth and Land Quality on the Choice of Irrigation Technology. American Journal of Agricultural Economics.67: 798-811.

Davarpanah, G.H. (2001). Investigating the most important of economical and social effects of drought and government assistant mechanisms to reduce these effects. Proceeding of the Conference on Investigating Mechanisms to Dominate with Water Scarcity, Zabol University, Sistan and Baluchestan province, Iran. http://www.esnips.com/ SharedFolderAction.ns;jsessionid=69E29FC1C1482CBE83D8CED1FCC4914C.

Ebrahimi, H. (1998). Investigating selection of irrigation methods: application of AHP. MSc thesis, Faculty of Agriculture in Shiraz University.

Ehsani, M. and Khaledi, H. (2003). Agricultural water productivity. Iranian National Committee on Irrigation and Drainage Press, Tehran, Iran. http://www.adinebook. com/gp/product/9646668496.

Earth Day Network. (2003). Water and agriculture. Avilable at: http:www.earthday.net. media. earthday.pdf.progra ms.water-agriculture.pdf.

Farshi, A. (2005). The optimal consumption of agricultural water. Proceeding of the 1st Conference on Investigating Drainage, Irrigation Network Challenges and Agricultural Water Optimal Consumption, Tehran, Iran. http://www.esnips.com/ SharedFolderAction.ns.

Farzampour, A. (2001). Investigating challenges of Iran water recourses management. Budget Prog. J., 6: 8-12.

Hamadan Regional Water Company public Relationships Report. (2006). To strengthen of groundwater aquifers. Payam-E-Ab Pub., 4: 29-30.

Haydari, N., Eslami, A., Firoozabadi, A.G. Kanooni, A., Esmaeel, A.M. and Khajeabdollahi, M. (2005). Water consumption efficiency of agricultural production in Iran different regions (Kerman, Hamadan, Semnan, Golestan and Khoozestan provinces). Proceeding of the Article Collection of Iranian National Committee on Irrigation and Drainage Conference, Water Sciences Engineering College, Ahvaz, Iran. http://www.irncid.org/Articles.Aspx?ZID=28.

Izuno, F.T. (2002). Principles of on-form water management. Florida Cooperative Extension Services, Institute of Food and Agriculture Sciences, University of Florida. http://edis.ifas.ufl.edu/pdffiles/AE/AE09900.pdf.

Jafari. M., Azarinvand, H., Zehtabian, G. and Jamshidi, A. (2002). Ivestigation role of the quality of irrigation water on the agricultur lands in the Damghan desert margins. Journal desert, 7 (2), pp: 121-128.
Jahani, A. (2005). Water security and demand management. The article collection of 10th conference of Iranian National Committee on Irrigation and Drainage, Tehran, Iran. http://www.irncid.org/seminars/10.htm.
Jin, L. and Yong, W. (2001). Water use in agriculture in China water policy, vol. 3: pp: 215-228.
Kardovani, P. (2005). Challenges facing of water resources in midel east. Proceeding of the international Seminar of cultural viewpoint to jeographi. pp: 62-102. Tehran.
Keshavarz, A. and Sadegh-Zadeh, K. (2001). Water management in the agriculture sector. Tehran: Institute for Publishing Research and Agricultural Engineering.
Anonymous. (2006). Report of Yazd Province Meteorological. Available on site: http://www.farsnews.net/newstext.php?nn=8502040091.
Knutson, Mike Hayes, Tom Philips. (1998). How to Reduce drought Risk. Montero Riquelme.
Koh, M.H. (2002). Status of agricultural water in Korea: water use and water quality. National institute of agricultural science and technology (RDA). Korea.
Mahdavi, M. (2005). The role of management in irrigation water optimal consumption. Proceeding of the 10th Conference on Iranian National Committee on Irrigation and Drainage, Tehran, Iran. http://www.irncid.org/seminars/10.htm.
Molden, D. (2007). Water for food-Water for life, A Comprehensive Assessment of Water Management in Agriculture. Published by International Water Management Institute, pp: 688. http://www.earthscan.co.uk/?tabid=627.
Nazemi, A. (2005). Water resourses sustainabale development, integrated management aspects, investigating mechanisms to dominate with water scarcity conference. Zabol University, Sistan and Baluchestan province, Iran. http://www.esnips.com/web/rahkareaab?docsPage=1#files.
Pereira, L.S., Oweis, T. and Zairi, A. (2002). Irrigation Management under water scarcity. Agricultural water management, vol.57: 175-206.
Rodríguez, E. (2006). El Mercado de alimentos orgánicos. Producción y consumo de los principales productos argentinos. Elsa M. Rodríguez (Comp.). Prólogo. En: Editorial Universitaria de Mar del Plata (EUDEM). Serie Tramas. ISBN-10: 987-544-195-3 ISBN-13: 978-987-544-195-3.
Sedighi, H. and Farzandvahi, J. (2004). Attitude of the farmers utilizing Sprinkler Irrigation irrigation systems in the Kermanshah province. Journal of Agricultural Science, Volume 35, Number 3, pp: 679-689.
Walker, T. (1986). Management of water for drought conditions. Virginia Research Center Water.
World Bank. (1995). towards sustainable management of water resources. AH translation argument. Publishing Research Institute of Agricultural Engineering.
Zehtabian, G.H. (2005). The causes of low irrigation efficiency in Varamin region. Proceeding of the 7th Seminar of Iranian National Committee on Irrigation and Drainage. Tehran, Iran.http://www.irncid.org/seminars/7.htm.

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