

# Studying Appropriate Agricultural and Garden Pattern by Considering Centrality of Water and Sustainable Development

Maryam Bakhshi

Master of Science in Plant Breeding, Kashmar, Iran

Email: maryam.bakhshi@rocketmail.com

**Abstract** – The concept of sustainable development related to optimum utilization from all sources in the modern world has been addressed. Given to arid and semiarid climatic conditions of Iranian plateau, sustainable use of water sources is the most essential part of developing mentioned plans. Unavailability of sufficient and appropriate water for agricultural and developmental plans has caused soil and water sources management and the necessity of their conservation become very important issues, because inappropriate planning results in degradation, erosion, salinity and ponding of soils and desertification. On the other word, in such regions the appropriate water management results in sustainable development in that region. Therefore, in this research the selection of agricultural pattern proportional to the region climate with the highest economic of scale was studied. In appropriate agricultural pattern, we should consider two important factors including amount of water consumption and high income. In order to access a sustainable agricultural pattern, water demand of main crops in Southern Khorasan was studied to obtain gross profit per hectare against one cubic meter water consumption. The results showed that some crops like corn forage, barberry, saffron, cumin and maybe sugar beet considering amount of consumptive water and obtained income are economical for farmers and are suitable for the climate of this region. Some crops including wheat, barley and alfalfa due to low economic income and high consumptive water must delete from agricultural pattern of Southern Khorasan and the other crops with low water demand and high economic of scale must be substituted. In the agricultural pattern of this province, cotton is not placed because of high water expected value.

**Keywords** – Sustainable Development, Agricultural Pattern, Centrality of Water, Climate.

## I. INTRODUCTION

Sustainable agriculture is a system that its sources are conserved in balance, its production, profitability and the other cases are sustained not only for agriculture but also for society and farmers (Gold, 2007). The concept of sustainable development in modern world related to optimum utilization from all sources has been addressed; and considering arid and semiarid climatic conditions of Iranian plateau, sustainable use of water sources is the most essential part of developing mentioned plans (Budget and program organization, 1994). Iran with the mean annual precipitation of 250mm against 750mm mean annual global precipitation is one of the arid and semiarid countries of the world. The spatial and temporal distribution of precipitation in Iran is very inappropriate and due to special atmosphere conditions has faced

drought in the most past years (Keshavarz, Sadeghzadeh, 2001). Most of country provinces currently face high water shortage. In the eastern region of Iran, there is the highest level of drought and this matter requires more attention to the water management and the better use of it (Seyedan, 2001). The first consequence is the increase and centralization of population and then incorrect management of sources, decrease of agricultural products quality and sources qualitatively and quantitatively (FAO, 2004, Girid Hary and Depa, 2004). Following the decrease of sources quality, there are loss of occupational opportunities and poverty and undevelopment of societies (Lefroy et al, 2000, Key et al, 2000). Some researchers believe that 10 to 50% consumptive water in agriculture can be decreased without main goal sustains a loss (Postel, 1994). Based on new international indices, each country which uses more than 40% of its renewable water sources has entered water stress stage. So Iran has passed water stress stage for many years and has entered water crisis stage. About 93% of recovery waters is allocated to agricultural uses (Water sources organization, 20020). Among this, the issue of sustainability and management of water sources as a very vital source from a minor subject has transformed into a very important and major subject (Mahmoodi, 1998). Here agriculture as the biggest water consumer plays a special role in this planning and policy-making to approach sustainable development (Ghasemzadeh mojaveri, 1997). Agriculture with 85% water global consumption as the biggest consumer of this source plays an important role in trade-off of water amount between the other uses (Golhan and Kowanba, 2004). In the future decades, irrigation-based agriculture will be responsible to supply more than two-thirds of increasing supply of necessary food for developing population of the world (English et al, 2002, Aljavayedi, 2009). It is predicted that demand for agricultural water will be twice in 2050 (Fister et al. 2011). According to the studies and discussions about the subject of water as one of the most important components of sustainable development, unstable, inefficient and weak management of water and not physical real restrictions of supply is responsible of the above-mentioned issues (UNESCO, 2006, World bank, 2009. Straton, 2008, Angeles, 2011). so appropriate organization by sustainable demand management and regulation of water consumption pattern solves the problem of trade-off in the water loss (Brim Nejad and Yazdani, 2004).

So we can address this hypothesis that in the agriculture water sources don't sustainably use. In this research we

attempt to obtain a strategy for optimization of water consumption management In order to sustainable use of this component in the agriculture of Southern Khorasan. Southern Khorasan has an arid and desert climate and its mean annual precipitation in the statistical time of 20 – year is 131mm which is in the form of rainstorm and disperse. In the desert regions precipitation decreases about 50 mm and in the mountains increases about 250mm. Mean precipitation in Birjand is about 159mm (Economic and asset affairs organization of Southern Khorasan). Given to previous subjects, formulation of agricultural pattern that addition to optimum water use provides a specified income for farmers, will play an important role in the agricultural water demand in the region studied. Based on this, maximum gross output of utilizers and optimum water consumption are the major objectives of the present research.

Using multi- objective program and compromise programming, Ali and Fransisco (2006) studied resource allocation in the Manila farms, Filipina. Sarker and Ray (2009) formulated the problem of agricultural planning in the form of a multi – objective optimization pattern and using three various optimization solution solved it. Zeng et al. (2010) emphasized on the important role of regional agricultural planning in agricultural water management and fuzzy multi-objective linear programming (FMOLP) in order to determining optimum agricultural pattern. Inside of Iran, some subjects including determination of dominant strategies to select and determine farmers program output (Rokmany and Saboohi, 2007), explanation of agricultural planning (Saboohi and Alvanchi, 2008) and utilization management of underground waters (Fathi and Zibaie, 2010) using multi-objective model have been studied. Falahi et al. (2013) studied the optimization of agricultural pattern emphasizing on limited water sources in faroogh – Seydan plain, Marvdasht. Ashgar Toosi (2003) has emphasized on change in the agricultural pattern in Ghoochan and Shirvan plain in order to compatibility to drought increasing cultivation of grains, summer crops, melon ground, cereals and decreasing forages, sugar beet, and fruits gardens. Studying Dargaz city in Khorasan and division of it into three climatic regions, Zarea et al (2005)

investigated change in the agricultural pattern considering several scenarios and all animal, agricultural and garden activities and modeling the relationship between these parts with each other and with commercial activities, optimum agricultural pattern and change in the present pattern and provided the final results in the pattern to change in these parameters with analysis sensitivity to variable parameters.

## II. METHOD

To achieve a sustainable agricultural pattern, the gross profit ratio and dried material production to consumptive water ratio were calculated. Then considering amount of water consumption and obtained income level, agricultural pattern of the region was studied.

## III. CONCLUSION AND RECOMMENDATIONS

Table 1: Comparison of costs and production incomes of staple crops in Southern khorasan

Crop Name	Production Gross Value	Total Production Costs	Gross Profit
Wheat	623280	286522	336758
Barley	547536	238945	308591
Cotton	1292400	704229	588171
Sugar Beet	1135157	601293	533864
Corn Forage	1648304	476360	1171944
Alfalfa	769032	462188	306844
Barberry	4989400	1292255	3967145
Saffron	2148300	135429	7948710
Cumin	*495880	355050	140830

\*reason of lower gross profit crop cumin in hectare because is no real price cumin this year.

This table shows the comparison of comparison of costs and production incomes of staple crops in Southern khorasan which among them corn forage and cotton as agricultural products and saffron and barberry as garden products have the highest incomes, respectively.

Table 2: Comparison of products economic value against 1m3consumptive use in Southern Khorasan

Crop Name	Consumptive Use (m3)	Consumptive Use	Consumptive Use (kg)	Efficiency
Saffron	6290	5.5	0.0009	36000
Barberry	9650	8410	0.87	33060
Cumin	3620	506	0.14	17400
Corn Forage	9828	29434	2.99	1674
Sugar Beet	11650	26399	2.27	976
Barley	5490	2928	0.53	991
Wheat	6100	2968	0.47	987
Cotton	10050	2154	0.21	1260
Alfalfa	15160	5826	0.38	703

As table 2 shows some products like sugar beet and corn forage have the highest dried material production against consumptive use.

Some products including saffron, cotton, caraway, alfalfa, wheat, barley and barberry have the lowest dried material production against consumptive use. These comparisons show that corn forage due to high dried material production against consumptive use and its high gross profit is an appropriate cultivar for the region of Southern Khorasan and can be stable in its agricultural pattern.

Sugar beet has a high dried material production against consumptive use but because of mean gross profit can be stable in province agricultural pattern with a little discount. Although some products such as Caraway, saffron and barberry have a low dried material production against consumptive use but due to very high income and economic of scale must be preserved in the agricultural pattern of Southern Khorasan. Some products like wheat, barley and alfalfa due to low economic income and high consumptive use must be deleted from the agricultural pattern of Southern Khorasan and replaced by the other products with low water demand and high economic scale.

Cotton, however, with mean economic of scale but because of high water expected value is not placed in its agricultural pattern. At present agriculture department as the biggest water consumer has allocated 92% water sources to itself. Speakingly, efficiency of agriculture is about 40%. Thus the correction of consumption pattern in this part is very important and has huge influences. For example it has been specified that in the regions with water shortage paddy is not cultivated. For example water is moved to Isfahan and Yazd with many problems, then with this water some farmers cultivate paddy and consider their own action as a self-sufficient one; but they don't consider the costs paid for this work. Currently it is observed that water is extracted from the well of the depth of 400m and its cost of power is global and its water cost is free but farmers cultivate some crops without any economic justification and logic. For instance farmers cultivate cucumbers in Yazd, while it can be cultivated in the other regions with the lowest cost and water consumption. At present 65 billion m<sup>3</sup> water of underground sources is consumed in agriculture parts and with a little saving a remarkable amount of water is stored. It is said that wheat is a strategic item and we must be self-sufficiency in this product. This perspective should be criticized, if we cultivated wheat as the second cultivar in Fars, our underground water sources severely decreased. At present most of Fars plains have been prohibited. Is it worth we become self-sufficiency but damage underground water sources? we should consider sustainable self-sufficiency.

## REFERENCES

- [1] Angeles, G. L. G. Sustainable water management in Ciudad Juarez. Ph.D dissertation. Arizona State University.2011.
- [2] Al-Juaidi, A. E. Water allocation for agricultural use considering treated wastewater, public health risk, and economic Issues. Ph.D dissertation in civil and environmental engineering. School of Graduate Studies, Utah State University.2009.
- [3] Ashgar Toosi, sh. Prediction of drought in Khorasan and optimization of agricultural pattern for compatibility to it. Thesis for M.A degree, Ferdosi university of Mashhad. 2003.
- [4] Brim Nejad, and Yazdani, s. Analysis of sustainability in water sources management using fractional programming, case study of Kerman. research and construction in agriculture and gardening.2004. 16-2.63
- [5] English, M. J., Solomon, K. H. and Hoffman, G. J. A paradigm shift in irrigation management. *Journal of Irrigation and Drainage Engineering*. 128(5). 2002. 267-277.
- [6] FAO. Carbon sequestration in dryland soils word soils resources report 102, NRCS. 2004. Rome.
- [7] Falahi, A. Khalilian, S. Ahmadian, M. Optimization of agricultural pattern emphasizing on water sources restriction. case study : Seyedan – Farough Plain, Marvdasht. *Journal of agricultural economic researches*. vol. 5. No. 2. 2013. 91-115.
- [8] Fathi, F. Zibayi, M. The efficient factors in utilization management of underground waters using multi- objective programming model : case study of Firoozabad Plain. *Journal of agriculture sciences and natural resources, soil and water sciences*. 14 (52). 2009. 155-164.
- [9] Francisco, S. R. and Ali, M. Resource allocation tradeoffs in manila's peri-urban vegetable production systems: An application of multiple objective programming. *Agriculture Systems*. 87. 2006. 147-168.
- [10] Ghasemzade Mojaveri, F. Water economy : precondition of green economy.2000.
- [11] Giridhari, S. P., and Thapa, G. B. Impact of social, institutional and ecological factors on land management practices in mountain watersheds of Nepal. *Applied Geography*, 24. 2004. 35-55.
- [12] Gold, M. V. Sustainable Agriculture: definitions and terms. Special reference briefs series no. 2007. 99-02.
- [13] Gollehon, N. and Quinby, W. Irrigation resources and water. USDA Economics Research Service.2004. URL: <http://www.ers.usda.gov/publications/AREI/EIB16/Chapter2/2.1/>.
- [14] Muralidharan, D. Microeconomics of water management: spatial dynamics and sustainability. Ph.D dissertation in economics. University of California, Riverside.2008.
- [15] Mahmoodi, S. Demand management and water supply management as two major subjects of sustainable development in water division, water and environment. 18. 1999. 6-9.
- [16] Keshavarz,A. Sadeghzade, K. Water consumption management in agriculture division, *Journal of Shekarshekan*, No. 57. 2001. 32-38.
- [17] Key, N., Sadoulet, E., and De Janvry, A. Transactions costs and agricultural household supply response. *American J. of Agricultural Economics*, 82. 2000. 245-259.
- [18] Lefroy, R. D. B., Bechstedt, H. D., and Rais, M. Indictors for sustainable land management based on farmers surveys in Vietnam, Indonesia and Thailand agriculture. *Ecosystem and Environment*, 81, 2000. 137-146.
- [19] OECD (Organization for Economic Co-operation and Development). *Managing water for all: an OECD perspective on pricing and financing*. OECD, 2009. Paris. URL: <http://www.oecd.org>.
- [20] Plan and budget organization. Documents of the first and second program of economic- social and cultural development, Islamic Republic of Iran.1994.
- [21] Pongkijvorasin, S. Stock-to-stock externalities resources in renewable resource economics: watersheds, conjunctive water use, and mud. Ph.D dissertation in economics.2007. University of Hawai'i.
- [22] Pfister, S., Bayer, P., Koehler, A. and Hellweg, S. Projected water consumption in future global agriculture: scenarios and related impacts. *Science of the Total Environment* (Article in press).2011. URL: <http://www.ScienceDirect.com>.
- [23] Postel, S. The last unit, water as source of life, translated by Vahabzade and Alizade. 1994. Mashhad, university Press.
- [24] Saboohi, M. Alvanchi,M. Application of compromise multi-objective programming in agricultural planning : case study of Khorasan Razavi. *Journal of agriculture sciences and natural resources*. 15(3). 2008. 1-15.
- [25] Stratton, S. E. Groundwater management with heterogeneous users: political and economic perspectives. Ph.D dissertation in agricultural and resource economics.2008. University of California, Berkeley.
- [26] Schaible, G. and Aillery, M. Irrigation water management. USDA Economic Research Service.2006. URL: <http://www.ers.usda.gov/Publications/AREI/EDS16/Chapter4/4>.

- [27] Sarker, R. and Ray, T. An improved evolutionary algorithm for solving multi-objective crop planning models. *Computers and Electronics in Agriculture*. 68. 2009. 191-199.
- [28] Seyedan, H. Water supply to arid regions, *Khorasan Journal*. 2001.
- [29] Torkamani, G. Saboohi, M. Determination of dominant strategies considering risk in the multi – objective programming method : case study of farmers in Fasa. *Journal of agricultural sciences and natural sources*. 15(1(b)). 2006. 461-472.
- [30] Water sources affairs office, Planning and Management organization, Comprehensive program of compatibility to climate. 2002.
- [31] World Bank. Water Supply and Sanitation. 2009. URL: <http://web.worldbank.org/>.
- [32] UNESCO (United Nations). Water: a shared responsibility. 2006. URL: <http://www.loc.gov/catdir/toc/fy0710/2006299804.html>
- [33] Zarea, Sh. et al. Agricultural pattern of Dargaz, Center of agricultural research and natural resources of Khorasan. 2005.
- [34] Zeng, X., Kang, S., Li, F., Zhang, L. and Guo, P. Fuzzy multi-objective linear programming applying to crop area planning. *Agricultural Water Management*. 98. 2010. 134-142.