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The Effect of Sustainable Water Resources Management in Hot and Dry Areas to Reduce the Risk of Water Scarcity

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ABSTRACT

In this paper we study the sustainable water resources management in hot and dry areas, and its effect on water scarcity risk. Statistical population consisted of experts in civil organizations, agriculture and research centers in Shiraz, Iran, and using random sampling method, 50 participants were selected. This is a descriptive survey and data collection toll was a questionnaire. Impact of choosing suitable permanent plants in agricultural pattern; modifying pattern of cultivating agricultural products to prevent consuming underground waters; consuming organic fertilizers to prevent destruction of aggregates and helping water infiltration; determining optimal amounts of using rivers for different irrigation conditions and using underground dams for purpose of protecting and using underground resources optimally were examined for the purpose of reducing risk of water scarcity. Obtained results from the study showed that that choosing suitable permanent plants in agricultural pattern can affect reduction in the risk of water scarcity to 51%; modifying pattern of cultivating agricultural products can affect it to 69%; consuming organic fertilizers can affect it to 19%; determining optimal amounts of consumption can affect it to 28% and finally, using underground dams can affect this issue to 55%. In addition, 85% of changes in amount of reduction of water scarcity risk can be discriminated and predicted by the mentioned variables.

KEYWORDS: sustainable engineering management of water resources, hot and dry areas, reducing water scarcity risk

1. INTRODUCTION

Water is a precious commodity and the management of water resources is a major challenge of the global sustainability, especially considering increasing population and climate change (Bates et al. 2008).Assessing and managing water resources in developing and dry land regions are still fraught with difficulties. The typical tool chain of water resources management starts with the collection of data, subsequently processes and analyses the collected information within the natural and socio-economic setting, and finally generates end products that inform decision-making. However, several of these steps often turn out to be problematic when faced with development issues and severe strains on water resources (Buytaert et al., 2012).

Studying effect of increase in population on water resources and supply and demand chain of food is an important field of studies on evaluating impact of climatic changes. This is because about half of population of the world lives in Asia and there are many concerns for increase in malnutrition among poor people and immigrants and especially children in rural regions and population below the poverty line (IPCC, 2007). In a study conducted by World Meteorological Organization for purpose of evaluating fresh water resources around the world, it was found that in 1997, about one third of world population were living in some countries that face shortage of fresh water resources (WMO, 1997).

Iran has been located in a zone of the world that has various climates and whether changes. Average annual rainfall of Iran is about 240mm and less than one third of world average. Therefore, Iran has generally arid and semi-arid climate and vulnerable environment and has been located in level of poor territories in terms of rainfall and water resources. Hence, water and soil resources of Iran should be applied optimally. In management of soil and water resources, holistic view and different management levels in this field have not been considered significantly. For example, many irrigation projects and drainage problems have caused pollution of underground waters and environmental problems (Heidari, 2006).

The present study has attempted to investigate effectiveness of sustainable engineering management of water resources in hot and dry zones for purpose of reducing water scarcity risk with the aim of determining a comprehensive program for allocating resources properly to obtain desirable performance in terms of economic productivity in dry zones like Shiraz. In this regard, effect of choosing suitable permanent plants in agricultural pattern, modifying pattern of cultivating agricultural products to prevent consumption of underground waters, consuming organic fertilizers for purpose of preventing destruction of aggregates and helping influence of water

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in soil, determining optimal values of using rivers for different irrigations and using underground dams for preservation of underground waters for reducing water scarcity risk have been investigated in this study using SPSS software.

Water is the most important component of body of living things. Many physiologic activities such as heat disposal, milk production, waste material disposal and food digestion need water. In age of drought, even some animals, which are adapted to these conditions, may not be able to be survived. Some others may be also unable to have reproduction and many young animals may be also died in this age. Therefore, water scarcity in dry zones can be an important threat for wild life (Jafari Shalazari and Gholi Nejad, 2012).More than 95% of west of Asia and North of Africa has been covered by dry lands. Iran takes benefit of Mediterranean climate because of its specific geographical location and has been considered among arid and semi-arid zones with average annual rainfall of 240mm. invasion of flowing sands, qualitative and quantitative reduction of underground waters, reduction of soil productivity and increase in sensitivity of lands to erosion, land subsidence, salinization of lands, increase in flood and land nudity and famine and destruction of villages can be tangible outcomes of desertification phenomenon. The phenomenon has been introduced as an important challenge in 1977 by the UN in Desertification Conference of the UN (Zakeri Nejad et al, 2012).

Gautam (2006) believes that moving from crisis management toward risk management is an essential issue and preventive measures for reducing risk of drought in long-term can recognize relevant problems of destruction of the environment, irrigation and better understanding of effects of climatic change and manner of encountering them. Necessity of integrated management of water resources would be emerged when quality of consuming water is different in each district and also amount of waste waters in each region is different. 21st century has been named as century of fighting on water. In different regions of the world, especially in developing countries, relevant issues of water such as water scarcity, water pollution and increase in damages resulted from flood are existed. The problems can result in food shortage and spread of diseases. Hence, in some countries such as Iran that are faced to water scarcity, this issue can be implemented in form of integrated management of water resources (Taj Al-dini et al, 2012). Some methods and options that can cause increase in water productivity include 1) increase in tolerance of plants against tension of drought and salinization through applying methods of modifying species of plants 2) increase in function of producing products from water, rare use of irrigation, modifying time of cultivation for purpose of decreasing evaporation and increase in permeability of soil and 3) reuse of water and spatial analysis for purpose of maximizing products and minimizing evaporation (Kijne et al, 2003).

Importance of efficiency and saving water for arid zones facing drought is being increased. Due to significance of role of producing agricultural products, presenting some strategies for purpose of increasing productivity of products in situations of water scarcity is essential. In other words, the main objective is improving soil would be conducted for purpose of increasing capability of absorption and maintenance of water. Considering this issue that lack of organic materials can affect physical, chemical and biological properties of soil and can increase risk of erosion of arid and semi-arid zones and also due to poverty of soil in these areas in terms of organic materials, it would be important to use organic fertilizers for purpose of preventing aggregates and helping water penetration in soil.

Vegetation in a region can protect soil against erosion factors. Water erosion can have negative effect on agricultural production and natural resources, construction and quality of water in different scales. As a result of global warming, it is expected that water erosion level can be increased (Nearing et al, 2004). Groundwater is not only an important component of water resources but also a reliable source of fresh water for a variety of purposes including domestic, industrial and irrigational uses. Nowadays, with increasing population and life standards, there is a growing need for the utilization of groundwater resources. However, due to some anthropogenic causes such as unplanned urbanization and industrialization, the quantity of groundwater resources continues to decrease. Therefore, sustainable management strategies should be developed by decision makers to optimally utilize the groundwater resources. (Moharram et al., 2012)

A groundwater dam is is a structure that obstructs the natural flow of groundwater and stores water below the ground surface (Onder and Yilmaz, 2005). Under drought conditions and shortage of water resources, some products should be cultured that have low water consumption and high economic ability. In other words, change in cultivation in the region for purpose of planting vegetation with desirable mechanisms compared to drought is an essential issue.

The present study has been conducted with the aim of economic, efficient, technical and fair allocation of resources to investigate 5 hypotheses in regard with the mentioned subjects.

2. MATERIALS AND METHODS

2.1. Literature review

Jahantab et al (2009) have conducted a study to investigate section and management of strong plants against water scarcity for purpose of better consumption of water in arid and semi-arid regions. They have stated that one of the most important problems with arid zones is drought and water scarcity, which can affect growth of plants. Lack of presence of sufficient water and non-integrated scatter of it during the season of growth in arid areas has resulted in lack of supplying water need of cultivation and gardening and has made plants to be exposed to danger of water scarcity. At the present study, it has been attempted to present proper management for using suitable plants and suitable specifications of plants for adaptation in these regions.

Parvin et al (2011), have evaluated capacities and abilities of water resources of Khuzestan for purpose of achieving sustainable development. They have stated that water has gained attentions as the most important and basic factor for production in agriculture sector and is also the most limiting option in Iran and especially in arid and semi-arid areas. As Khuzestan Province has been located in arid zone, planning and proper use of water resources is an important issue. On the other hand, agricultural sector is the biggest consumer of water in the country and includes major part of water wastage. As efficiency of water in Khuzestan Province is low, qualitative and quantitative management of water resources for purpose of creating sustainable conditions to protect agriculture and vital affairs is an important and unavoidable issue. Hence, optimized management of water is one of the most important elements of achieving sustainable development.

Karamooz et al (2008) have considered evaluation of sustainability indices of water recourse development plans with engineering perspective. They have stated that today, considering effect of water on political, cultural, social, economic and environmental factors have changed water resource management to an important factor for achieving sustainable development. After investigation of role of water resource management in sustainable development, they have conducted a review on existing approaches of quantitative analysis of development plans of water resources with engineering perspective. Sustainability indices have been determined and measured and then, value index has been analyzed for each index in different plans of water resource development and have been investigated and compared with each other for purpose of evaluation of plans. At the present study, effect of each component of the system has been investigated to increase sustainability in total costs. Value index that is an index for ranking options in value engineering can be applied as an index for selecting a scenario that has most adaptation with sustainable development.

Gao et al (2014) examined the effects of five land uses (fallow, grassland, cropland, 3-year and 8-year jujube orchards) on soil water variations in a small catchment on the Loess Plateau. Results indicated that mean soil water profiles in different land uses varied with time, land use induced spatial variations of soil water but exerted negligible influence on soil water temporal patterns, and soil water content was of the greatest spatial variability with moderate means (approximately 20 %). Furthermore, Profile soil water for five land uses was different in various seasons, precipitation infiltration depth exhibited a positive correlation with precipitation, and the whole profile soil moisture (0–160 cm) was complemented following a 93×5-mm rainfall event.

Ragab et al (2015) focused on using data of tomato and potato from field experiments in Italy, Greece (Crete) and Serbia. Drip full irrigation, drip deficit irrigation, drip as partial root drying (PRD), sprinkler and furrow irrigation were used in the 3-yr experiment between 2006 and 2008. In drip-irrigated experiments, the drip line was 10–12 cm below the surface. Dry matter, final yield, soil moisture and soil nitrogen were successfully simulated. Their study showed that there is a great potential for saving water when using subsurface drip, PRD or drip deficit irrigation compared with sprinkler and furrow irrigation. Depending on the crop and irrigation system, the amount of fresh water that can be saved could vary between 14 and 44%. PRD and deficit drip irrigation have proved to be the most efficient water application strategies with the highest water productivity Díaz-Delgado et al (2014) calculated the emergy of groundwater and the inter-annual variation in emergy of surface water resources in basins that encompass the metropolitan areas of Toluca and Monterrey, Mexico;thatis, Upper Course of the Lerma River (UCLR) and the Santa Catarina River (SCR) basin, respectively. The transformation weighted mean of water resources due to chemical potential energy in the SCR basin was greater than in the UCLR basin. They also identified some strategies to improve the efficiency of the joint management of water resources.

Consoli et al (2014) imposed deficit irrigation strategies on a young orange orchard in Sicily (Southern Italy) with the aim to monitor and analyze crop physiological features, first yield and fruit quality data for possible negative effects. The orchard includes trees irrigated with drip and sub-drip irrigation systems. Irrigation strategies, based on deficit irrigation concepts, including regulated deficit irrigation (RDI) and partial rootzone drying (PRD), were adopted during the irrigation seasons 2011 and 2012, each supplying different percentages of the crop evapotranspiration (ETc). Several physiological indices indicative of plant water status were analyzed during the trial, including, stem water potential, stomatal conductance, canopy temperature, trunk diameter variations, leaf area index (LAI). The imposed DI strategies allowed maximum water saving of 41% (PRD treatment), without conditioning the first yield data. Fruit composition resulted positively affected by water restrictions. The impact of the imposed deficit on trees depends mainly on its degree of severity (i.e. lowering of stem water potential above the threshold of −1.3 MPa for citrus orchards). A certain growth reduction was observed in DI treatments causing WUE (plant water use efficiency) increase, in terms of reducing competition between vegetative and reproductive growth. Subsurface drip irrigation system, designed for supplying 75% of ETc allowed plant water status, yield and quality data quite comparable with those obtained in the control treatment, supplying 100% of ETc by surface drip irrigation systems. Overall, the obtained results show that the studied DI strategies were successfully applied in a young orange orchard allowing water saving without significant detrimental effect on trees. Liu et al (2008) described the main aspects of what has been learned in supporting sustainable water resources planning and management in the semi-arid southwestern United States by means of integrated modeling. Their results indicates that particular attention must be paid to the proper definition of focus questions, explicit conceptual modeling, a suitable modeling strategy, and a formal scenario analysis approach in order to facilitate the development of "usable" scientific information.

Dehghanisanij et al (2006) investigated application of the efficiency index of water consumption and performance function in determining cultivation pattern with the aim of increasing efficiency of consuming wheat and corn juice during 5years in Mashhad. They have stated that changes in efficiency of water consumption (WP) can be attributed to the type of climate, vegetation and irrigation management. Maximum WP of wheat was observed in Mashhad and under conditions of low use of irrigation during growth of the plants. However, maximum WP of corn was observed in Karaj and under conditions of complete irrigation of plants. Obtained results indicated that priority of planting wheat should be in some regions of Iran that can grow wheat through consuming water to 300mm and its efficiency should be about 5.1kg/m^2. Also, planting corn plant should be also performed in those regions that have water consumption to 600mm and its efficiency can be equal to 3.1kg/m^2.

Overton et al (2014) presented a method for implementing IWRM (Integrated Water Resources Management) and the EA (ECOSYSTEM APPROACH) to describe the linkage between environmental flow requirements and other water needs. According to them, environmental flows can form the basis for an integrated approach to water allocation and river operation.

Moharram et al (2012) proposed the groundwater resources management model based on the combined use of simulation-optimization models. In this model, MODFLOW is used as the simulation tool to model groundwater flow and Genetic Algorithm (GA) as the optimization tool. The performance of the proposed model is tested on groundwater management problem (maximization of total pumping rate from an aquifer at steady-state). The results showed that GA yields better solutions than the previous solution methods and may be used to solve management problems in groundwater modeling. Bodner et al (2015) provided an ecological approach to agricultural water management: They considered that a cropping system can be most efficiently improved when measures are based on a precise identification of the main yield limiting constraints in the climate, soil and plant subsystems. Crop ecology thereby integrates ecohydrological and ecophysiological knowledge into cropping system diagnosis Mahmoud et al (2011) suggested implementation of the scenario development framework towards critical water management concerns with respect to establishing stakeholder engagement.

2.2. Methodology

In order to investigate effectiveness of sustainable engineering management of water resources in arid areas for purpose of reducing water scarcity risk, filed and library studies and domestic reports and interviews with construction organizations and agriculture institute and research centers in Shiraz have been applied. The present study has been in kind of descriptive-survey study. Among the mentioned statistical population, 50 people of experts were selected randomly as sample of the research. Data collection instrument in this study has been structured questionnaire, which its reliability and stability has been obtained to 96%. Firstly, after determining participants of the study, the questionnaires were distributed among them and after data collection, hypotheses have been analyzed using SPSS software and two-variable regression test.

Hypothesis 1: selecting suitable permanent plants in agricultural pattern can affect reduction of water scarcity risk.

Hypothesis 2: modifying culture type of agricultural products for purpose of preventing wastage of underground waters can affect reduction of water scarcity risk.

Hypothesis 3: using organic fertilizers for purpose of preventing destruction of aggregates and helping water penetration in soil can affect reduction of water scarcity risk.

Hypothesis 4: determining optimal amounts of using rivers for different conditions of irrigation can affect reduction of water scarcity risk.

Hypothesis 5: using underground dams for protecting and optimal use of underground water resources can affect reduction of water scarcity risk.

Conceptual model of the research is shown in figure 1.

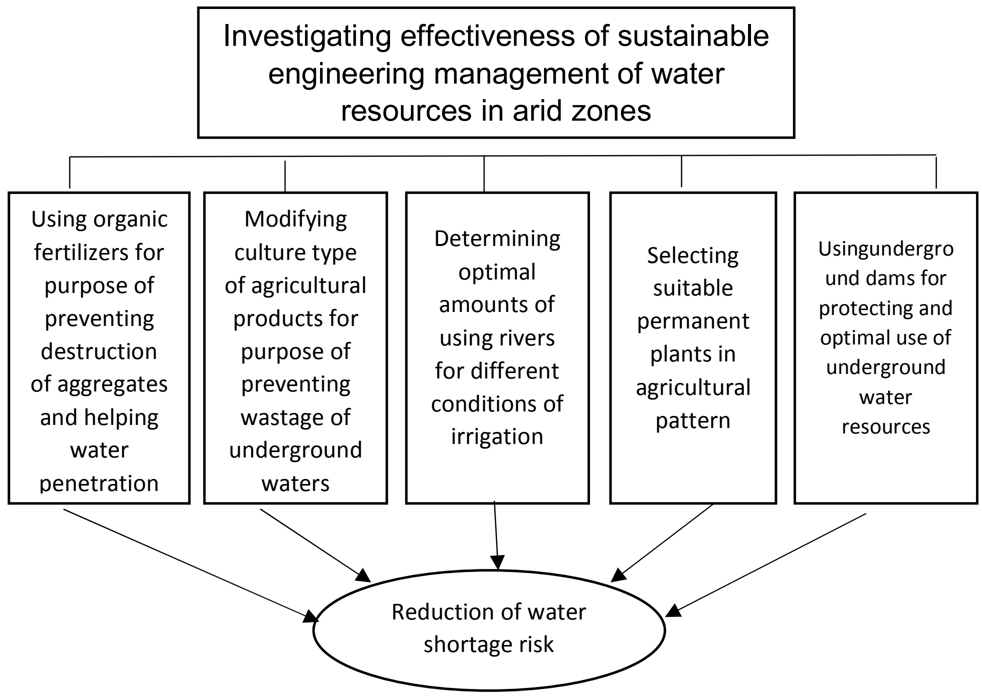

Figure 1. Conceptual model of the research

3. RESULTS AND DISCUSSION

3.1. Testing hypotheses

Hypothesis 1: selecting suitable permanent plants in agricultural pattern can affect reduction of water scarcity risk.

H0:selecting suitable permanent plants in agricultural pattern can't affect reduction of water scarcity risk.
H1: selecting suitable permanent plants in agricultural pattern can affect reduction of water scarcity risk

Table 1. regression analysis

	R^2	F value	p-value	Constant value	Beta
selecting suitable permanent plants in agricultural pattern in reduction of water scarcity risk	0.511	241.524	0.000	1.889	0.428

According to F values and p-value (p-value<0.05), it could be found that existence of the effect can be significant in confidence level of 0.99. In other words, selecting suitable permanent plants in agricultural pattern can have significant effect on reduction of water scarcity risk. Therefore, H0 has been confirmed and alternative hypothesis has been confirmed.

In addition, according to value of coefficient of determination, it could be claimed that selecting suitable permanent plants in agricultural plan can have direct effect to 51% on reduction of water scarcity risk. In other words, coefficient of determination of selecting suitable permanent plants in agricultural pattern for reduction of water scarcity risk is in average level. In other words, selecting suitable permanent plants in agricultural pattern can affect reduction of water scarcity risk to 51%.

Hypothesis 2: modifying culture type of agricultural products for purpose of preventing wastage of underground waters can affect reduction of water scarcity risk.

H0: modifying culture type of agricultural products for purpose of preventing wastage of underground waters can't affect reduction of water scarcity risk.
H1: modifying culture type of agricultural products for purpose of preventing wastage of underground waters can affect reduction of water scarcity risk.

Table 2: regression analysis

	R^2	F value	p-value	Constant value	Beta
modifying culture type of agricultural products for purpose of preventing wastage of underground waters in reduction of water scarcity risk	0.695	293.307	0.000	1.505	0.581

According to F values and p-value (p-value<0.05), it could be found that existence of the effect can be significant in confidence level of 0.99. In other words, modifying culture type of agricultural products for purpose of preventing wastage of underground waters can have significant effect on reduction of water scarcity risk. Therefore, H0 has been confirmed and alternative hypothesis has been confirmed.

In addition, according to value of coefficient of determination, it could be claimed that modifying culture type of agricultural products for purpose of preventing wastage of underground waters can have direct effect to 69% on reduction of water scarcity risk. In other words, coefficient of determination of modifying culture type of agricultural products for purpose of preventing wastage of underground waters for reduction of water scarcity risk is in high level. In other words, modifying culture type of agricultural products can affect reduction of water scarcity risk to 69%.

Hypothesis 3: using organic fertilizers for purpose of preventing destruction of aggregates and helping water penetration in soil can affect reduction of water scarcity risk.

H0:using organic fertilizers for purpose of preventing destruction of aggregates and helping water penetration in soil can't affect reduction of water scarcity risk.
H1:using organic fertilizers for purpose of preventing destruction of aggregates and helping water penetration in soil can affect reduction of water scarcity risk.

Table 3: regression analysis

	R^2	F value	p-value	Constant value	Beta
using organic fertilizers for purpose of reduction of water scarcity risk	0.190	9.701	0.002	2.882	0.173

According to F values and p-value (p-value<0.05), it could be found that existence of the effect can be significant in confidence level of 0.99. In other words, using organic fertilizers for purpose of preventing destruction of aggregates and helping water penetration in soil can have significant effect on reduction of water scarcity risk. Therefore, H0 has been confirmed and alternative hypothesis has been confirmed.
In addition, according to value of coefficient of determination, it could be claimed that using organic fertilizers for purpose of preventing destruction of aggregates and helping water penetration in soil can have direct effect to 19% on reduction of water scarcity risk. In other words, coefficient of determination of using organic fertilizers for purpose of preventing destruction of aggregates and helping water penetration in soil for reduction of water scarcity risk is in relatively low level. In other words, using organic fertilizers can affect reduction of water scarcity risk to 19%.

Hypothesis 4:determining optimal amounts of using rivers for different conditions of irrigation can affect reduction of water scarcity risk.
H0: determining optimal amounts of using rivers for different conditions of irrigation can't affect reduction of water scarcity risk.
H1:determining optimal amounts of using rivers for different conditions of irrigation can affect reduction of water scarcity risk.

Table 4: regression analysis

	R^2	F value	p-value	Constant value	Beta
determining optimal amounts of using rivers in reduction of water scarcity risk	0.283	38.732	0.000	2.189	0.360

According to F values and p-value (p-value<0.05), it could be found that existence of the effect can be significant in confidence level of 0.99. In other words, determining optimal amounts of using rivers for different conditions of irrigation can have significant effect on reduction of water scarcity risk. Therefore, H0 has been confirmed and alternative hypothesis has been confirmed.
In addition, according to value of coefficient of determination, it could be claimed that determining optimal amounts of using rivers for different conditions of irrigation can have direct effect to 28% on reduction of water scarcity risk. In other words, coefficient of determination of determining optimal amounts of using rivers for different conditions of irrigation for reduction of water scarcity risk is in relatively low level. In other words, determining optimal amounts of using rivers can affect reduction of water scarcity risk to 28%.
Hypothesis 5:using underground dams for protecting and optimal use of underground water resources can affect reduction of water scarcity risk.
H0: using underground dams for protecting and optimal use of underground water resources can't affect reduction of water scarcity risk.

H1: using underground dams for protecting and optimal use of underground water resources can affect reduction of water scarcity risk.

Table 5: regression analysis

	R^2	F value	p-value	Constant value	Beta
using underground dams for reduction of water scarcity risk	0.551	120.431	0.000	1.647	0.506

According to F values and p-value (p-value<0.05), it could be found that existence of the effect can be significant in confidence level of 0.99. In other words, using underground dams for protecting and optimal use of underground water resources can have significant effect on reduction of water scarcity risk. Therefore, H0 has been confirmed and alternative hypothesis has been confirmed.
In addition, according to value of coefficient of determination, it could be claimed that using underground dams for protecting and optimal use of underground water resources can have direct effect to 55% on reduction of water scarcity risk. In other words, coefficient of determination of using underground dams for protecting and optimal use of underground water resources for reduction of water scarcity risk is in relatively low level. In other words, using underground dams can affect reduction of water scarcity risk to 28%.

Table 6: Durbin-Watson Test result

	D-W
Model	2.351

Durbin-Watson test can be placed in range of 1.5 to 2.5. Here, the value of 2.351 has been obtained. Hence, the assumption of independence of errors has not been rejected and regression analysis can be applied. In addition, table 7 has presented residual statistics of regression; meaning that the difference between observed value of dependent variable and predicted value by the model has been analyzed.

Table 7: residual statistics of regression

	Min	Max	Mean	SD	Number
Std predicted value	-2.040	2.454	0.000	1.000	100
Std residual values	-2.290	2.188	0.000	0.974	100

Table 7 has presented residual values and predicted values. In general, residuals can be estimation of right deviations in the model it means that if the model is suitable for data, residuals should follow a normal distribution. In addition, standard predicted values and standard residuals should have mean value of 0 and SD of 1, which is true for this case.

Table 8: entered and exited variables

Model	Entered variables	Exited variables	Regression
First	Mentioned independent variables	-	ENTER

In the mentioned model, all desired variables have been entered to the model together and with no certain order or classification and have been then analyzed.

Table 9: estimating summary of regression model

Row	Model	Multiple correlation coefficient	Coefficient of determination	Adjusted coefficient of determination
1	First	0.927	0.859	0.852

In table 9, multivariate correlation coefficient of independent variables with variable of water scarcity risk is equal to 0.927. Therefore, 85% of changes in level of reduction of water scarcity risk can be determined and predicted by the mentioned variables.

Table 10: ANOVA analysis and determining significance level

Model	Sum of squares	df	Mean squares	F value	Sig
regression	7.036	5	1.407	114.951	0.000
Residual	1.151	94	0.012		
Total	8.187	99			

According to F value and significance level (sig<0.05), it could be found that the relationship can be significant in confidence level of 99%. In other words, there is a significant relationship between independent variables and reduction of water scarcity risk. Hence, H0 has been rejected and alternative hypothesis has been rejected.

Table 11: regression weighted coefficients

Model's factors	Non-Std B	Std B	t-value	Sig
Constant value	1.194		10.409	0.000
Selecting permanent plants	0.179	0.353	5.489	0.000
Modifying culture type	0.269	0.386	6.553	0.000
Using organic fertilizer	0.207	0.360	3.918	0.000
Determining optimized using levels	0.227	0.409	4.027	0.000
Using underground dams	0.120	0.176	2.697	0.008

According to standardized weighted values and t-value, which indicates that all factors can have significant effect on dependent variable (reduction of water scarcity risk), it could be found that the mentioned factors can be predictors of reduction of water scarcity risk. However, determining optimized level of using water resources with standard beta of 0.409 can have maximum prediction and significant effect on reduction of water scarcity risk. In addition, scatter diagram of dependent variable based on multiple independent variables would be as follows:

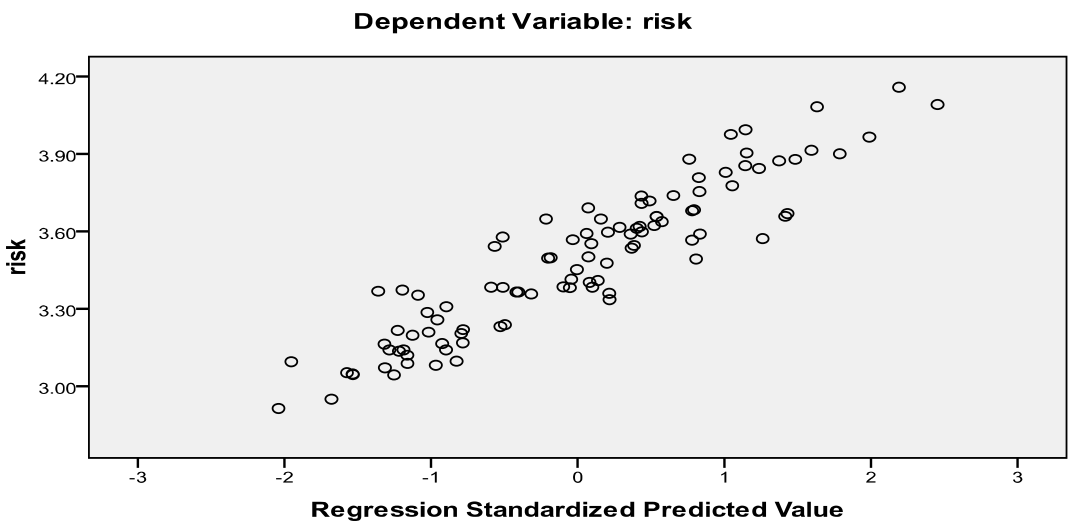

Figure 2: scatter diagram of dependent variable based on multiple independent variables

4. Conclusion

In this study we investigated the effects of sustainable water resources management in hot and dry areas to reduce water scarcity risk. 50 participants were selected for the study. we analyzed the effect of sustainable water resources management by testing 5 hypotheses. Hypothesis 1 has indicated that selecting suitable permanent plants in agricultural pattern can affect reduction of water scarcity risk. Results indicate that selecting suitable permanent plants in agricultural pattern can affect reduction of water scarcity risk to 51%.Hypothesis 2 has indicated that modifying culture type of agricultural products for purpose of preventing wastage of underground waters can affect reduction of water scarcity risk. Results indicate that modifying culture type of agricultural products can affect reduction of water scarcity risk to 69%.Hypothesis 3 has indicated that using organic fertilizers for purpose of preventing destruction of aggregates and helping water penetration in soil can affect reduction of water scarcity risk. Results indicate that using organic fertilizers can affect reduction of water scarcity risk to 19%.Hypothesis 4 has indicated that determining optimized values for using rivers for different conditions of irrigation can affect reduction of water scarcity risk. Results indicate that determining optimized values can affect reduction of water scarcity risk to 28%.

Hypothesis 5 has indicated that using underground dams for purpose of protecting and optimal use of underground water resources can affect reduction of water scarcity risk. Results indicate that using underground dams can affect reduction of water scarcity risk to 55%. According to standard beta of 0.409, it would be possible to present regression analysis of variable of reducing water scarcity risk based on dependent variables and constant value. Secondly, one can predict effect of each independent variable per 1 unit change in dependent variable.

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