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PERCEPTION OF FARMERS ON IRRIGATION WATER MANAGEMENT IN SEMI-ARID REGION IMPACTED BY CLIMATE CHANGE-A CASE STUDY OF SOUTHERN DEAD SEA AREA, JORDAN

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Abstract

Changing in climatic pattern is one of the core universal environmental challenges facing all sectors. The challenge of irrigation water scarcity has been intensified with agricultural expansion, increasing population, and climate change. A decline in water supply and availability due to climate change and decrease in precipitation rate accompany with increase in temperature presents significant and unique challenges to agricultural sector in Jordan. Water resources in southern part of the Dead Sea (DS) area are limited and are almost confined to side stream wadi base and flood flows. This study is significant, particularly in irrigation water management, in several ways. It is investigating the water users' perceptions regarding irrigation water management, in DS region. Moreover, it is investigating the current water status and the water management options under climate change in semi-arid region. The study aims to explore the farmer's perception, in irrigation water management. To investigate the current irrigation water status in the study area. Also, the possible mean from farmers perspective to adapt to climate change and variability in semi-arid region-southern part of DS area-Jordan. Hence, there is yet study to investigate the irrigation water management practice and strategies under climate variability and change in southern part of DS area, from farmer's perspectives. A quantitative research design method was used. Moreover, the questionnaire was developed mainly based on the literature review. Statistical analysis was performed using Statistical Package for the Social Sciences for Windows (SPSS). The results show that the educational level of the respondents has a significant effect on the irrigation water management under climate change. Moreover, there is a water shortage, quality, quantity problems. Additionally, there is distrusting relationship between the water users and the organizations controlling the water sectors. This study recommended that an effort should be launched to maintain and enhance the education system in the study area. This study will help the decision makers to develop and modify the legislation regarding irrigation water in the study area.

Keyword: Water Management, Irrigation Water, Climate Change, Dead Sea Region, Jordan.

1. INTRODUCTION

Change in climatic conditions are one of the main global environmental challenges facing all sectors of human activities especially agriculture in water deficient regions (Fahad et al., 2020). Agriculture sector uses a major share of the available water resources with water consumption share of more than 70% globally (Rao et al., 2020, Iglesias and Garrote, 2020). Moreover, water scarcity and demand for additional supply are projected to increases resulting from climate variability and change in arid and semi-arid regions (Gebretsadik and Romssad, 2020, Sutcliffe et al, 2021). In water scarce region, irrigation water management is imperative for the sustainability of the agriculture sector (Khalkheleili and Zamani, 2009).

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Irrigation water scarcity challenges have been intensified with agricultural expansion, increasing population, and climate change. (Kidane et al., 2019).Hence, it is expected that the water shortage will become a serious issue especially in arid-semiarid regions (Rao et al., 2020). Consequently, irrigation water supply is becoming ever more difficult to meet a rising demand in globally (Gebretsadik and Romssad, 2020).Agriculture is the main sustaining factor of livelihood and employment opportunities in rural populations (Fahad et al., 2020). Thus, irrigation water management is an important mean for ensuring food security in water scarce regions. Itis becoming an increasingly complex endeavor involving multiple causes and varying effects (Yohannes et al., 2017, Iglesias and Garrote, 2020).

Irrigation water management isan important component in environmental policy basis in semi-arid regions (Pluchinotta et al., 2018). Proper irrigation water management is one of the most efficient climate change adaptation as it enhances productivity and production under limited water resources (Gebretsadik and Romssad, 2020).

Jordan is arguably the second poorest countries worldwide in water resources. Influx of refugees and arid climate led to very limited share of water resources (MWI, 2020). The demand for water in the Jordan exceeds the available resources(Carr et al., 2011).A decline in water supply and availability resulting from decreasing precipitation rate compounded by increase in average temperature presents great challenges to the agricultural sector in Jordan (Ammari et al., 2013, Al- Omari et al., 2015). Accordingly, much efforts and investments have been done in Jordan to increase the irrigated areas and to increase agriculture productivity (Yohannes et al., 2017).

Irrigation associations and farmers' union play a crucial role in the process of supplying, conveying and distributing of irrigation water (Vafael et al., 2021). However, the water users associations (WUAs) in southern Jordan have been influenced by lack of corporations with other related institutions. Farmers prefer WUAs because they are helpful in gaining access to patronage and water. WUAs could break the vicious cycle of tension and distrust between farmers and the government (Omide et al., 2012,Movik,2013,Jun Hu et al., 2014, Mustafa et al., 2016,Abdelgalil and Bushara, 2016,Bulasubramanya,2019).However, public-private partnership for delivery of water for irrigation could be economically feasible, even in poor country. Appropriate water-pricing policy could improve water productivity and also reduce water usage. Moreover, water prices can be expected to raise overall economic efficiency by motivating farmers to adopt higher value crops and Improve technology. (Doppler et al., 2002 ,Molle et al., 2008, Zhou et al., 2015, Tabih et al., 2015,Aydogdu,2016, Kassahun et al., 2016, Knapp et al., 2018, Isselhorst et al., 2018Brent et al., 2019, Kidane et al., 2019,Zamani et al., 2021).

Water management in Jordan faces many challenges. The gap between supply and demand would increase until year 2050(Oroud, 2015). In Jordan, there is a need to adopt some emerging technologies and appropriate methodologies for improved irrigation management as irrigated agriculture is threatened by progressively increasing soil salinity (Am Al-Nakshabandi et al., 1997, Abu-A wwad, 2001, Zubi, 2007, Al-Omari et al., 2013, Omide et al., 2013, Al-Omari et al., 2015).

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Jordan started its irrigation development as early as 1940, the establishment of irrigation scheme, along the Jordan Valley bed utilizing natural streams and surrounding major springs through the construction of hydraulic structure (Al Zoubi,2007). Irrigation facilities were implemented and expanded by the governments (MWI, 2014). Drip irrigation, green houses, plastic mulch, fertilizer, new crops verities and cheap labor from neigh boring countries were the modern irrigation and cropping measures adopted by farmers (Molle, et, al., 2008).

Water resources in southern part of the Dead Sea (DS) area are limited mostly confined to side stream wadi and flood flows. This fact places the agricultural sector under constraints and water is identified as the limiting factor for agricultural development as well as industrial activity (MWI, 2020). Water scarcity produces other problems as well such as the lack of commitment by farmers to over use the quantity of water allocated to each farm unit, the lack of commitment by farmers to adhere to agricultural pattern and these are made worse by the unavailability of policy and strategy to help the farmers in the water management process (Zubi, 2007, Al-Omari et al., 2013).

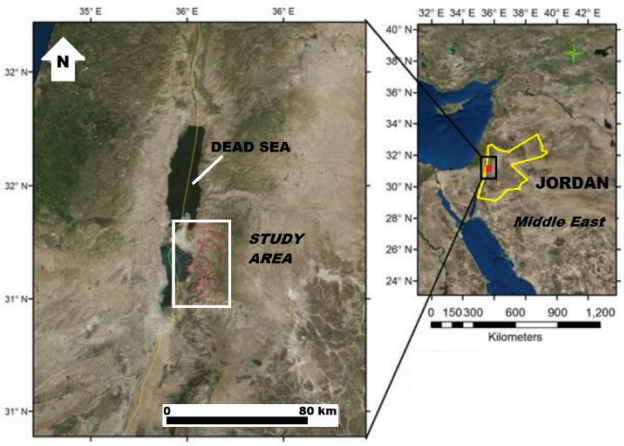
With the above view, this paper investigated water users' perceptions regarding irrigation water management in DS region. It investigated the current water management status and options under climate change phenomenon in semi-arid region of southern Dead Sea area.

2. METHODOLOGY

2.1. Study Area

The study area lies between coordinate 31° 18' 45″N, 35° 26´ 15″E, which is a part of the DS basin, near to the eastern shore and south of the DS(Figure 1).

Figure 1: The location of the Study area (Source: modified after MWI, 2014)



According to Jordan Valley Authority (JVA) the agricultural lands of the study area are distributed in 8 development areas called basins as shown in Figure 2.

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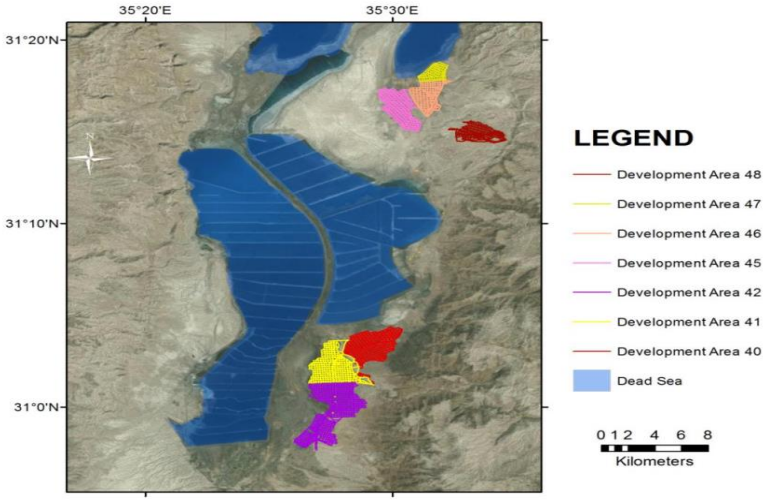
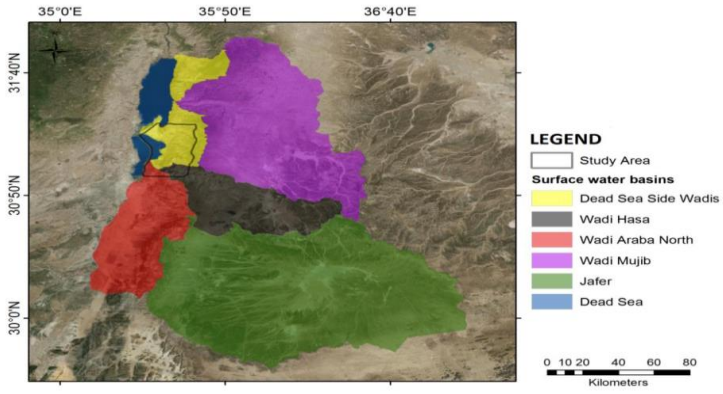
Figure 2: Development areas in the study area (Source: modified after MWI, 2014)



The Jordan Rift Valley has a hot and dry climate in summer and temperate in winter (Miebach et al., 2015).The climate in the study area is semiarid with higher temperature and lower rainfall than the high land (Oroud et al., 2015).Precipitation occurs mostly between November and March (Oroud et al., 2015).

The Jordan Valley is the most irrigated land inJordan (Al-Omari et al., 2015).Springs are important sources of water in the basin catchments area for domestic and agricultural uses (Siebert et al., 2014).The springs are located mostly below the upper part of the upland, and on the upper reaches of the wadis (ephemeral rivers). It is considered as the second source of water (Wade et al., 2011).Hence, it is used mainly for agricultural purposes (JVA, 2015). The surface water basins in the study area isshown in Figure 3.

Figure 3: Surface water basin in the study area (Source: modified after MWI, 2014)



The main wadis contribute to the freshwater discharge enter the DS from eastern scarp slope of the Jordanian plateau shown in Figure 4.

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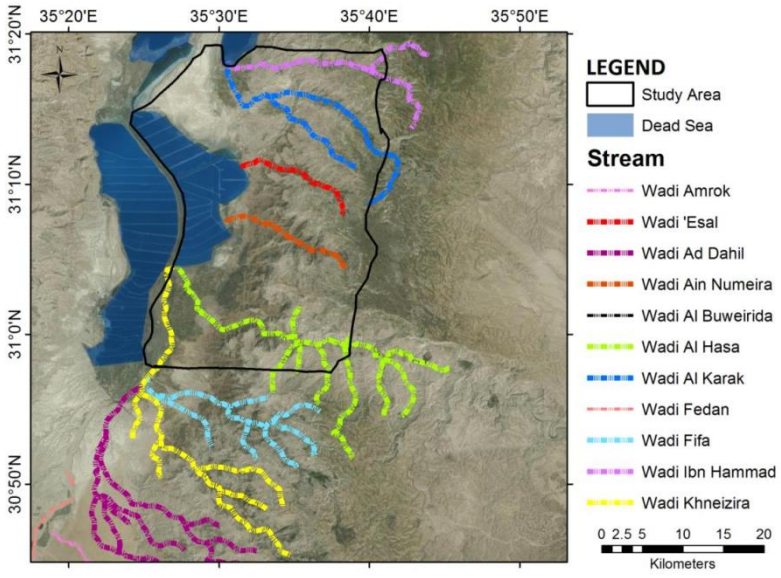
Figure 4: Streams in the study area (Source: modified after MWI, 2014)



The study area characterized by a heterogeneous farming system such as family farmer, inter perennial farmers and absentee investors (Molle et al., 2008). Cultivated area is around (1371) units, approximately 3hectares each (MWI, 2015).

2.2 Research Design

A quantitative research design method was used in this study. The study was conducted in the southern part of the DS area. Respondents were farmers selected through simple random sampling technique. Four hundred and twenty farmers were randomly chosen from four farming communities in a southern part of DS region. Structured questionnaire was used with both open-end and close-ended questions. The questionnaire was developed mainly based on literature review. The researcher interviewed farmers, local residence, decision makers, and community leaders at the wadis. For the purpose of validity assessment, the original draft of the questionnaire was submitted to 5 experts at the University of Jordan. The experts were two professors, three senior lecturers and five water management experts. The experts indicated that the questionnaire was valid. Appropriate modifications were made according to their comments.

The questionnaire (measures) demonstrated high-reliability coefficient, ranging from 0.86 to 0.92.ACronbach's Alpha value of 0.70 is acceptable according to Sekaran and Bougie (2003).All the constructs passed the reliability test with the Cronbach's Alpha values for all the constructs above the recommended standard value of 0.70.As for Kaiser-Meyer-Olkin (KMO), if it is around 0.50 it is measurable and below this is considered unacceptable. The measures ranged from 0.92 to 0.95 and thus factor analysis was found appropriate.

The structured questionnaire consists of: first part, demographic characteristics such as gender, age, and years of farming experience, level of education, farmer type, land-owning type, and

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land size under cultivation. The 2nd part consisted of 9 questions to measure the farmers 'perception of irrigation water management. The 3rd part consisted of 9 questions to measure the current irrigation water status. The 4th part, consisted of 14 Question to measure the irrigation water quality, quantity, and price. The 5th part consisted of 20 Questions measure the irrigation water options.

Statistical analysis:

Statistical analysis was performed using Statistical Package for the Social Sciences for Windows (SPSS version 22, 0; IBM Corp, Armonk, NY, USA). The descriptive analysis is expressed as frequency, percentage, mean, and standard deviation. A p-value of <0.05 will be considered to be statistically significant in all analyses.

3. RESULTS AND DISCUSSION

Table 1: The demographic characteristics of the respondents

Items	Location	Respondent N	%
Place	Safi	153	52.8%
	Mazraa	44	15.2%
	Hadithah	37	12.8%
	Draa	55	19.2%
Total respondents		**289**	**100%**
Items	**Category**		
Gender	Male	266	92%
	Female	23	8%
Total respondents		**289**	**100%**
Age (years)	16-25	25	8.6%
	26-35	59	20.3%
	36-45	71	24.5%
	46-55	57	19.7%
	≥56	77	26.9%
Total respondents		**289**	**100%**
Education level	Illiterate	81	28%
	Primary	125	43.3%
	Secondary	59	20.4%
	Diploma and above	24	8.3%
Total respondents		**289**	**100%**
Years of farming experience	1<- ≤5	17	5.9%
	6<- ≤10	92	31.8%
	11<- ≤15	45	15.6%
	16<- ≤20	39	13.5%
	20 ≥ 21	96	33.2%
Total respondents		**289**	**100%**
Type of farmer	Owner	118	40.8%
	Worker	37	12.8%
	Rental	78	27%
	Quota worker	56	19.4%
Total respondents		**289**	**100%**
Types of landowning	Absentee	74	25.6%
	Yearly rental	54	18.7%
	Quota rental	26	9%
	Seasonal rental	47	16.3%
	Owner	88	30.4%
Total respondents		**289**	**100%**
Size of land under cultivation (Dunum)	1<- ≤10	11	3.8%
	11<- ≤20	75	26%
	21<- ≤30	139	48%
	31<- ≤40	19	6.6%
	>40	45	15.6%
Total respondents		**289**	**100%**

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A total of 425 questionnaires were distributed but only 318 returned, a response rate of 74.8% which can be considered a good response rate. After screening for incomplete and incomprehensible responses, a total of 289 or 68% of the forms were used for analysis.

Basic information, of the respondents shown in Table 1.

Data are expressed as number of respondents (N), and percentage (%).

The results in Table 1 shows that the majority of the respondents 52.8% were from the Safi area. The majority of the population lives in the central part of the study area. 92% of the respondents are males and 8.0% of the respondents are females. That indicates the agricultural area is dominated by males. However, in some cases the women were not allowed to give their opinion without the presence of their male kin. Female respondents indicated that their genders have no role in dealing with the JVA staff and other farmers. This implied the over whelming male respondents would not cause gender bias in the analysis.

Majority of the respondents were above 56 years old which is 26.9% of the total. This showed that the respondents are at advanced age in term of awareness to water uses and more importantly about how to manage their water in the current water status and on how sustainable management will affect their future.

43.3% of the respondents had primary education, 8.3% attained diploma and higher education. Hence, majority of the respondents only received primary level of education. Moreover, the result showed that 33.2% has farming experience above 20 years.

The majority of the respondents, i.e. 40.8% were landowners. Therefore, they try to understand the current water status and the importance of water management options. Hence, they try to manage the water quantities allocated to each farm units. Furthermore, the result shows that the majority of the respondent's 48% managing their land which is between 20 and 3 hectares in size. Moreover, the results indicated that the majority of the respondents managed their units according to JVA classification.

Table 2: Descriptive statistics of all constructs in the instrument

Construct	Mean	%	SD
Farmers' perception on water management	1.9	0.46	0.53
Current irrigation water status	1.9	0.47	0.72
Irrigation water quality, quantity, and price	3.3	0.66	0.90
Irrigation water management options	2.75	58%	0.90

The descriptive statistics regarding mean and standard deviation, for each construct are shown in Table 2. It shows that the mean ranged from 1.9 to 3.4, respectively. Likewise, the standard deviation for each construct ranged from 0.53 to 1.0.

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Table 3: Farmers perceptions on water management* (Water management practices)

Item	Never	Rarely	Sometimes	Often	Always
How frequently do you maintain the irrigation system on your farm	2	30	12	129	116
	.7%	10.4%	4.2%	44.6%	40.1%
How frequently do you apply 'Cold hour' irrigation in your farm	3	10	12	136	128
	1.0%	3.5%	4.2%	47.1%	44.3%
Do you cultivate drought-resistant crop on your farm	149	114	6	20	0
	51.6%	39.4%	2.1%	6.9%	0.0%
Do you use crop rotation system on your farm	31	94	8	143	13
	10.7%	32.5%	2.8%	49.5%	4.5%

*Based in number of respondents and percentage.

Table 3, shows that the farmer's perceptions of water management. There are four questions used for measuring perception of water management (water management practices), for the first question "How frequently do you maintain the irrigation system on your farm". This study found that there are 129 respondents or 44.6 % often maintain the irrigation system on their farm. Further, 40.1 % respondents always maintain the irrigation system. The result indicates that most of the farmers often maintain the irrigation system in their farm. Additionally, in the second question, "How frequently do you apply 'Cold hour' (Applying irrigation water during night time) irrigation in your farm" 47.1 % of the respondents often frequently apply 'Cold hour' irrigation in their farms. In the third question, "Do you cultivate drought-resistant crop in your farm," 51.6 % respondents never cultivate drought-resistant crop in their farm. In the fourth question, "Do you use crop rotation system on your farm," 49 % of the respondents often used crop rotation system on their farm.

Table 4: Farmers knowledge's on water management

Item	Poor	Fair	Good	Very Good	Excellent
How do you describe your knowledge in irrigation water management	5	137	8	130	9
	1.7%	47.4%	2.8%	45.0%	3.1%

*Based in number of respondents and percentage.

Table 4, shows that perceptions of water management the questions 47.4 % respondents have fair knowledge in irrigation water management and 8 respondents or 2.8 % have good knowledge in irrigation water management. The result indicated that most of the farmers have a fair knowledge in irrigation water management. That means they need more training and advice in the irrigation water management.

Table 5: Farmers knowledge on water management*

Item	Fodder	Vegetable	Fruits	Grains	Others
What kinds of crops do you cultivate	4	261	22	2	0
	1.4%	90.3%	7.6%	.7%	0.0%

*Based in number of respondents and percentage.

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Table 5, shows that 90.3 % respondents cultivated vegetables. There are four respondents, or 1.4 %that cultivate fodder. The result indicated that most of the farmers cultivate vegetables in the study area. That leads to use the same cultivation practice among them.

Table 6: Farmers perceptions on water management (Cooperation)

Item	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
Do you agree to cooperate with your community to improve water management	12	103	165	7	2
	4.2%	35.6%	57.1%	2.4%	.7%
Do you support the formation of WUAs	85	105	77	11	11
	29.4%	36.3%	26.6%	3.8%	3.8%

*Based in number of respondents and percentage.

Table 6, shows perception of water management, in terms of cooperation. For the first question "Do you agree to cooperate with your community to improve water management". This study found that there 57.1 % respondents have no opinion, whether to cooperate with their community to improve water management or not. In comparison, the second question, "Do you support the formation of WUAs" due to biases, corruptions, and distrust among farmers only3.8 percent strongly agree to support the formation of WUAs.

Table 7: Farmers perceptions of water management* (Training)

Item	Never	1 Time	2 Times	3 Times	4 Times and above
Have you ever participated in water management training	263	7	14	5	0
	91.0%	2.4%	4.8%	1.7%	0.0%

*Based in number of respondents and percentage

Table 7, shows that 91% respondents had never participated in water management training. That means there is a severe lack in training and obviously more training in water management is required.

Table 8: Current irrigation water status*

Item	Never	Rarely	Sometimes	Often	Always
Are there any water shortages during cultivation season	21	43	10	78	137
	7.3%	14.9%	3.5%	27.0%	47.4%
Have you experienced any transfer of your water quota to another farm by JVA	242	22	10	11	4
	83.7%	7.6%	3.5%	3.8%	1.4%
Is there any favoritism, in transferring of allocated water by JVA	63	76	7	113	30
	21.8%	26.3%	2.4%	39.1%	10.4%
Have you faced any problems with the water allocation	123	81	6	64	15
	42.6%	28.0%	2.1%	22.1%	5.2%
Have you ever faced any technical problems related to irrigation water	48	120	7	96	18
	16.6%	41.5%	2.4%	33.2%	6.2%
Did you experience any problems with JVA staff	194	67	7	20	1
	67.1%	23.2%	2.4%	6.9%	.3%
Are you get support if you have any irrigation water problems	260	17	3	8	1
	90.0%	5.9%	1.0%	2.8%	.3%

*Based in number of respondents and percentage.

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Table 8, shows that, 83 % respondents never experienced any transfer, of their water quota, to another farm by JVA. Further, the response indicated that most of the farmers always faced a shortage of irrigation water during the cultivation season.

Moreover, in the third question, "Have you faced any problems with the water allocation", 42.6 % respondents never faced any problems and 28% rarely with the water allocation despite the shortages indicated above. This imply a problem in availability rather than the effectiveness of supply system. In addition to that, in the fourth question, "Have you ever faced any technical problems related to irrigation water," 41.5 % of the respondents rarely faced technical problems related to irrigation water and 2.4 % sometimes faced technical problems related to irrigation water.

Table 9: Current irrigation water status* (Quantity)

Item	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
The quantity of irrigation water supplied in winter less than in summer	9	91	1	166	22
	3.1%	31.5%	.3%	57.4%	7.6%

*Based in number of respondents and percentage.

Table 10, shows that, 57.4% respondents agreed, that the quantity of irrigation water supplied, in winter less than in summer. Only 3.1%strongly disagreed that the quantity of irrigation water supplied in winter is less than in summer.

Table 10: Irrigation water quality, quantity and price*

Item	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
The irrigation water is drinkable	11	114	0	155	9
	3.8%	39.4%	0.0%	53.6%	3.1%
Do you agree that the irrigation water quality affect the marketability of product	3	27	0	223	36
	1.0%	9.3%	0.0%	77.2%	12.5%
Do you agree that the water quantity supplied fluctuate through time	0	19	241	28	1
	0.0%	6.6%	83.4%	9.7%	.3%
Do you agree that the water quality changes through time	4	38	4	216	27
	1.4%	13.1%	1.4%	74.7%	9.3%
Do you agree the irrigation water tariff is high	7	147	25	80	30
	2.4%	50.9%	8.7%	27.7%	10.4%
Are you willing to pay more for more water quota	10	21	1	179	78
	3.5%	7.3%	.3%	61.9%	27.0%
Does quantity of water affect the productivity of the farm	4	30	2	133	120
	1.4%	10.4%	.7%	46.0%	41.5%
Is there a frequent water shortage problem on your farm	2	88	2	162	35
	.7%	30.4%	.7%	56.1%	12.1%
Do you agree that JVA is to be blamed for water shortages	1	37	7	172	72
	.3%	12.8%	2.4%	59.5%	24.9%
Do you agree that JVA should allow drilling of private wells	2	46	27	137	77
	.7%	15.9%	9.3%	47.4%	26.6%
Do you agree that JVA should allow the treatment of brackish water	0	33	19	177	60
	0.0%	11.4%	6.6%	61.2%	20.8%
The water shortage problem could be reduced by the blinding of the water from land drainage system	9	94	19	145	22
	3.1%	32.5%	6.6%	50.2%	7.6%
Reclamation of water is effective for crops cultivation	10	23	3	140	113
	3.5%	8.0%	1.0%	48.4%	39.1%

*Based in number of respondents and percentage.

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Referring to Table 10, there are thirteen questions used for measuring Irrigation water quality, quantity, and price. Results indicated that83.4 % of the respondents have no opinion if the water quantity supplied fluctuate through time. In comparison, the second question, "Do you agree that the water quality changes through time" Indicated that 47.4 % of the respondents agree that the water quality changes through time. This suggests that farmers were more aware about water quality aspect. Concerning price, 50.9 % of the respondents disagree that the irrigation water tariff is high. Interestingly, most farmers, i.e. 89% are willing to pay a higher price for water. In addition to that, 48.4 % of the respondents agreed that the reclamation of water is effective for crops cultivation. Furthermore, 39.1 % strongly agreed.

Table 11: Irrigation water management practices

Item	Never	Rarely	Sometimes	Often	Always
Have you ever applied water for soil leaching (salinity reduction)	212	35	9	30	3
	73.4%	12.1%	3.1%	10.4%	1.0%

*Based in number of respondents and percentage.

Table 11, shows that, 73.4 % respondents, never applied water, for soil leaching. This is due to the shortage of irrigation water.

Table 12: Irrigation of water management options*

Item	Never	Rarely	Sometimes	Often	Always
Do you blind the irrigation water with drainage system water	235	17	8	22	7
	81.3%	5.9%	2.8%	7.6%	2.4%
Have you ever consulted any person or organization working on water management to improve your water management options	228	43	8	7	3
	78.9%	14.9%	2.8%	2.4%	1.0%
Did you experience any contention with JVA staff on water allocation issue	226	45	10	8	0
	78.2%	15.6%	3.5%	2.8%	0.0%
Did another farmer ever illegally use water from you	255	19	5	8	2
	88.2%	6.6%	1.7%	2.8%	.7%
Offering gifts (bribes) to the JVA staff may affect water allocation	42	64	5	120	58
	14.5%	22.1%	1.7%	41.5%	20.1%
Did you request for extra water quota during farming season	88	65	6	118	12
	30.4%	22.5%	2.1%	40.8%	4.2%
How often did you purchase water from other sources	244	23	6	11	5
	84.4%	8.0%	2.1%	3.8%	1.7%

*Based in number of respondents and percentage.

Table 12, shows that the irrigation of water management options. There is seven question used for measuring current irrigation water status. It was found that88.2 % of the respondents never experienced other farmers illegally used irrigation water allocated to them.

Additionally, 84.4 % of the respondents never purchase water from other sources. Whereas, 8.3 % of the respondents rarely purchase, from other sources. Moreover, 40.8 % of the respondents requested for extra water quota during farming season. These indicated that there

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is an irrigation water shortage. However, in the line allocation system, farmers cannot request for extra irrigation water, due to technical problems.

In addition to that, question about "Offering gifts (bribes) to the JVA staff may affect water allocation." 41.5 % of the respondents often offered gifts (bribes) to the JVA staff, which may affect water allocation equity and could management options dysfunctional.

Table 13: Irrigation of water management legislations

Item	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
Government incentives are necessary to promote on-farm water management	12	27	1	161	88
	4.2%	9.3%	.3%	55.7%	30.4%
Do you agree that JVA and WUAs should jointly allocate irrigation water	122	75	5	78	9
	42.2%	26.0%	1.7%	27.0%	3.1%
Do you agree that payment system for irrigation water needs to be changed	7	137	37	87	21
	2.4%	47.4%	12.8%	30.1%	7.3%
The FTA limiter size should be changed to a larger size on your farm.	1	36	2	71	179
	.3%	12.5%	.7%	24.6%	61.9%
The water allocation system is biased	8	98	3	147	33
	2.8%	33.9%	1.0%	50.9%	11.4%
The JVA irrigation network should be modified	2	65	1	193	28
	.7%	22.5%	.3%	66.8%	9.7%
The penalty and punishment for water misuse should be more effective	0	10	0	53	226
	0.0%	3.5%	0.0%	18.3%	78.2%
The legislation regarding irrigation water use should be modified	0	8	79	171	31
	0.0%	2.8%	27.3%	59.2%	10.7%
Do you agree that JVA defined crops pattern is not fair	6	96	49	108	30
	2.1%	33.2%	17.0%	37.4%	10.4%
The JVA is capable of handling the irrigation water system	9	66	1	205	8
	3.1%	22.8%	.3%	70.9%	2.8%
The JVA staff are qualified enough to handle the water sector	2	83	5	194	5
	.7%	28.7%	1.7%	67.1%	1.7%
Do you agree that the response of JVA for water problems is effective	30	109	1	139	10
	10.4%	37.7%	.3%	48.1%	3.5%

*Based in number of respondents and percentage.

Referring to Table 13, fourteen questions were used for measuring irrigation water management legislations. 78.2 % of the respondents strongly agreed that the penalty and punishment for water misuse should be more effective. This is due to the illegal misuse of irrigation water by some farmers. Additionally, 70.9 % of the respondents agreed that the JVA is capable of handling the irrigation water system. Moreover, 42.2 % of the respondents strongly disagreed that the JVA and WUAs should jointly allocate irrigation water. That is due to distrust between farmers and WUAs. That leads to the fact that the WUAs concept not activated.

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In addition to that, the question "Do you agree that JVA defined crops pattern is not fair" 37.4 % of the respondents agreed that the JVA defined crops pattern is not fair. This mean that the agricultural pattern needs to be discussed, by the authorities and the farmers.

3.4 Inference Statistics

Table 14: Farmers' perception on water management by gender

Variable	Gender	N	Mean	Std. Deviation	F	Sig.	T	df	Sig. (2-tailed)
Farmers' perception on water management	Male	266	2.6	.35	6.1	.01	-2.2	31.6	.03
	Female	23	2.7	.23					

Regarding water management perception differences by gender. This study used an independent sample t-test. Based on Table 14, this study found that mean of farmer's perception of water management for females is larger than males, i.e. 2.79 compared to 2.67. Further, using Levens test equality of variance, this study found that ($F = 6.103$; $p = 0.014$) there was significant difference in farmer's perception of water management by gender.

Table 15: Farmer's regarding water management by place

Variable		Sum of Squares	df	Mean Square	F	Sig.
Farmers' perception on water management	Between Groups	1.6	3	.53	4.5	.004
	Within Groups	33.2	285	.11		
	Total	**34.8**	**288**			

For testing the differences perception farmer regarding water management by locations, this study found that there is a significant different related to farmer's perception of water management by place.

Table 16: Multiple comparisons perceptions farmer's regarding water management by place

Dependent Variable: Farmers' perception on water management						
LSD						
Place		**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Safi	Mazraa	-.17*	.058	.003	-.29	-.06
	Hadithah	-.12*	.062	.04	-.25	-.005
	Draa	-.13*	.053	.01	-.23	-.02
Mazraa	Safi	.17*	.058	.003	.06	.29
	Hadithah	.04	.076	.52	-.10	.19
	Draa	.04	.069	.51	-.09	.18
Hadithah	Safi	.12*	.062	.04	.00	.25
	Mazraa	-.04	.076	.52	-.19	.10
	Draa	-.003	.072	.95	-.14	.13
Draa	Safi	.13*	.053	.01	.02	.23
	Mazraa	-.04	.069	.51	-.18	.09
	Hadithah	.003	.072	.95	-.13	.14
*. The mean difference is significant at the 0.05 level.						

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It was also found that Safi and Mazraa, Safi and Hadithah and lastly, Safi and Draa (P< 0.05) showed significant difference (Table 16).

Table 17: Current irrigation water status by place

Variable		Sum of Squares	df	Mean Square	F	Sig.
Current irrigation water status	Between Groups	2.7	3	.90	5.0	.002
	Within Groups	50.9	28	.17		
	Total	53.7	28			

Table 17, it was that found that Safi and Mazraa, Safi and Hadithah and lastly, Safi and Draa (P<0.05) showed significant difference status.

Table 18: Multiple comparisons current irrigation water status by place

Place		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Safi	Mazraa	-.19*	.072	.008	-.33	-.04
	Hadithah	-.25*	.077	.001	-.40	-.10
	Draa	-.10	.066	.10	-.23	.02
Mazraa	Safi	.19*	.072	.008	.04	.33
	Hadithah	-.06	.094	.50	-.24	.12
	Draa	.08	.085	.33	-.08	.25
Hadithah	Safi	.25*	.077	.001	.10	.40
	Mazraa	.06	.094	.50	-.12	.24
	Draa	.14	.089	.10	-.03	.32
Draa	Safi	.10	.066	.10	-.02	.23
	Mazraa	-.08	.085	.33	-.25	.08
	Hadithah	-.14	.089	.10	-.32	.03

*. The mean difference is significant at the 0.05 level.
Dependent Variable: Current irrigation water status.

Table 18, found that the differences were significant between Safi and Mazraa, Safi and Hadithah and lastly, Safi and Draa (P < 0.05).

Table 19 Irrigation water quality, quantity and price by place

Variable		Sum of Squares	df	Mean Square	F	Sig.
Irrigation water quality, quantity, and price	Between Groups	2. 34	3	.78	9.16	.000
	Within Groups	24.24	285	.08		
	Total	26.58	288			

Table 19, Safi and Mazraa, Safi and Hadithah and lastly, Safi and Draa (p< 0.05) showed significant difference in terms of price by place for water quality and quantity. Their multiple comparisons that indicated significant difference is shown in Table 20 whereas Table 21, showed the similar results for water management options. Similar results were also found for drinking water quality and quality (Table 22)

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Table 20: Multiple comparisons irrigation water quality, quantity, and price by place

Dependent Variable: Irrigation Water Quality, Quantity and Price.						
Place		**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Safi	Mazraa	.11*	.049	.02	.018	.21
	Hadithah	.04	.053	.37	-.05	.15
	Draa	.23*	.045	.000	.14	.32
Mazraa	Safi	-.11*	.049	.02	-.21	-.01
	Hadithah	-.06	.065	.29	-.19	.05
	Draa	.11*	.058	.04	.001	.23
Hadithah	Safi	-.04	.053	.37	-.15	.05
	Mazraa	.06	.065	.29	-.05	.19
	Draa	.18*	.062	.003	.06	.30
Draa	Safi	-.23*	.045	.000	-.32	-.14
	Mazraa	-.11*	.058	.04	-.23	-.001
	Hadithah	-.18*	.062	.003	-.30	-.06
*. The mean difference is significant at the 0.05 level.						

Table 21: Irrigation water management options by place

Variable		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Irrigation water management options	Between Groups	.27	3	.09	1.68	.171
	Within Groups	15.2	285	.05		
	Total	15.5	288			

Table 22: Drinking water quality& quantity by place

Variable		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Drinking Water Quality& Quantity	Between Groups	.95	3	.31	4.8	.003
	Within Groups	18.68	28	.06		
	Total	19.63	28			

CONCLUSION

This research was conducted in the southern part of DS region. It aimed to study the perception of farmers on irrigation management under climate change in a semiarid region. The results showed that the educational level of the respondents has a significant effect on the irrigation water management. Moreover, there is a water shortage, quality and quantity problems. Additionally, there are mistrusts, between the water users, and the organizations controlling the water sectors. Despite that, most of the respondents disagree to privatize the water sector due to socioeconomic factors. This study recommends that an effort should be launched to maintain and enhance the education system in the study area. Furthermore, maintenance and development of irrigation water distribution infrastructures are crucial. Likewise, more enforcement to curb irrigation water misuses, installations of sewer network and desalination

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plants are needed. Cooperation between irrigation water users and water distributions authorities must be enhanced. However, the competent authority should provide training courses, brochures and workshops regarding irrigation water management to the irrigation water users.

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