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EXTENDED ABSTRACT

Technical Evaluation of Classic Stationary Sprinkler Irrigation Systems with Travelling Sprinklers in Eghlid, Fars Province

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Introduction

Due to the climatic conditions of Iran, the limitations of irrigation resources, and low irrigation efficiency in traditional methods, on the one hand, and the existence of arenas for the development of blue land and the increasing need for food, on the other, application of pressurized irrigation methods as one of the most effective ways to optimally use existing water resources is inevitable (Baradaranhazave et al., 2006). In recent years, the methods of irrigation under pressure, especially the classic sprinkler irrigation with travelling sprinklers have, in general, been used in Fars province, and in the city of Eghlid, in particular. The purpose of the present study was to determine the efficiency of the system after the implementation of the system, the maximum irrigation efficiency of the system, and its difference with the amount available in field conditions.

Methodology

In this study, field operations were carried out in eight farms duringJuly, August, and September of 2015 in the first half of the day. After the visit, the initial data and farm measurements were obtained. Plant and climate parameters were collected from the nearest meteorological station and soil parameters were measured. Specifications of sprinkler irrigation systems are presented in Table (1). The indicators evaluated in this study are presented in Table (2).

Table 1- Specifications of under study sprinkler irrigation systems

System code	Village	System type	product type	Area	Water supply	Sprinkler distances	Sprinkler Model
GW_1	Shahrmiyan	Fixed classic	Clover	25	Agricultural wells	25*25	VYR155
GW_2	Khonjegesht	Fixed classic	Wheat	10	Agricultural wells	25*25	AMBOO
GW_3	Cheshmerana	Fixed classic	potato	5	Agricultural wells	25*25	VYR155
GW_4	Nezamabad	Fixed classic	Sugar beet	10	Agricultural wells	25*25	VYR155
GW_5	Hasanabad	Fixed classic	potato	8	Agricultural wells	25*25	VYR155
GW_6	Namdan	Fixed classic	Alfalfa	10	Agricultural wells	25*25	AMBOO
GW_7	Aspas	Fixed classic	Wheat	10	Agricultural wells	25*25	VYR155
GW_8	Sede	Fixed classic	potato	5	Agricultural wells	25*25	VYR155

Table2- The evaluated indicators

1. Christensen uniformity coefficien	4. Distribution uniformity of the whole system	7. Wind and evaporation losses	10. Application efficiency
2. Distribution uniformity	5. Potential application efficiency of low quarter	8. Deep percolation losses	11. Combination efficiency
3. Christensen uniformity coefficient of the whole system	6. Actual efficiency of low quarter	`9. Adequacy irrigation in low quarter	

Results and Discussion

Table (3) shows the parameters of Christensen uniformity coefficient, uniformity of water distribution in the low quadrant, potential efficiency, and actual efficiency of low quarter in the test block and irrigation system. The highest uniformity and uniformity distribution coefficients in the experimental block were found for GW_2 irrigation systems. The reasons can be the right distances between sprinklers, the type of sprinkler, and the proper weather conditions (wind and temperature). The means of potential efficiency and actual efficiency of low quarter application in the test block were calculated to be 58.44 and 55.95, respectively.

The parameters of the operating pressure used in irrigation systems are presented in Table (4). Among the irrigation systems examined, only the GW_1 irrigation system had a suitable pressure and the rest were of low average pressure and less than the design value. The difference in pressure in the GW_8 irrigation system reduced the uniformity of the distribution, resulting in reduced efficiency of application's potential. In this irrigation system, water losses in the pipe paths, especially at the joints, caused friction.

Fig. (1) shows the adequacy of irrigation in the fourth quarter in the eight irrigation systems. As noted earlier, the efficiency of irrigation at the bottom quarter in the GW8 irrigation system is more than 100 %, and the difference from 100 points indicates that the farm has received more water than it needed. Therefore, field management can reduce the amount of deep penetration by reducing the duration of irrigation and increase the actual efficiency of the application to the efficiency of the quadrant potential. (irrigation time in this irrigation system was 3 hours). Mikhakbayranvand et al. (2014) achieved similar results in Khorramabad.

Tabel 3- Summary of results of evaluation parameters in classic stationary sprinkler irrigation systems with travelling sprinklers

System code	Actual efficiency of Low Quarter	Potential Application Efficiency of Low Quarter	Distribution Uniformity	Christensen Uniformity Coefficient	Actual efficiency of Low Quarter	Potential Application Efficiency of Low Quarter	Distribution Uniformity	Christensen Uniformity Coefficient
	System(%)				Test block(%)			
GW_1	63.97	63.97	68.73	75.19	66.64	66.64	70.52	76.48
GW_2	57.67	57.67	72.99	81.77	62.44	62.44	76.47	84.33
GW_3	66.90	66.90	62.88	74.71	70.13	70.13	64.80	76.22
GW_4	58.46	58.46	63.11	70.59	61.18	61.18	64.95	71.95
GW_5	59.34	59.34	67.76	81.48	62.66	62.66	76.41	83.36
GW_6	46.42	46.42	68.99	79.43	49.61	49.61	71.97	81.68
GW_7	30.94	30.94	33.44	56.38	35.55	35.55	41.48	64.74
GW_8	34.98	52.4	56.65	67.4	39.4	59.35	61.39	71.05

Tabel 4- Pressure changes in classic stationary sprinkler irrigation systems with travelling sprinklers

System code	Reduction efficiency	Pressure changes (%)	Minimum pressure (bar)	Maximum pressure (bar)	Maximum pressure (bar)
GW$_1$	0.04	20	4.2	5.1	4.5
GW$_2$	0.076	38	3	4.3	3.4
GW$_3$	0.046	23	3.2	4	3.47
GW$_4$	0.044	22	5	6.2	5.4
GW$_5$	0.053	26	3.1	4	3.4
GW$_6$	0.064	32	2.5	3.4	2.8
GW$_7$	0.13	50	3	4.8	3.6
GW$_8$	0.12	59	3.2	3.8	2.73

Figure (2) shows irrigation losses. The evaporation and winding losses in the GW$_6$ irrigation system were higher than other evaluated irrigation systems, which can be attributed to very high temperatures.

Figure (3) shows the combined efficiency and application in eight irrigation systems. Due to high irrigation losses in the GW$_8$ irrigation system, the combined efficiency and utility efficiency show small values.

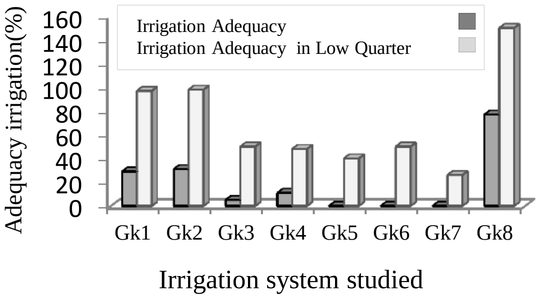

Fig. 1- Irrigation adequacy in evaluated irrigation systems

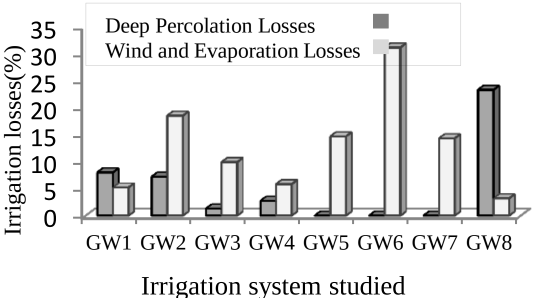

Fig. 2- Irrigation losses in evaluated irrigation systems

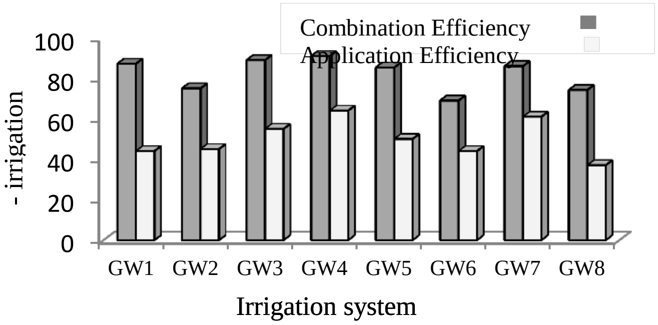

Fig. 3- Irrigation efficiency in evaluatedirrigation systems

Conclusions and Recommendations

The reason for low uniformity coefficients in the evaluated systems can be the simultaneous use of a large number of sprinklers, the operating pressure less than the expected level, and the great distance between them. Reduced combined efficiency and application efficiency in some systems came from depth tolls, evaporation, and winding. Reducing the length of the irrigation pipes, paying attention to the position and height from the ground, and eliminating the problem of water leakage at joints can reduce the pressure variation and increase the efficiency of irrigation. By reducing losses and preventing pressure changes, we can expect better potential efficiency indexes. Based on the results of this research, it is recommended that irrigation systems be evaluated at the early stages of operation in order to identify the problems at the outset.

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