Evaluation of Suitable Pressurized Irrigation Systems by Using Analytical Hierarchy Process (AHP) and GIS for Izeh plain area of Iran

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Abstract: The present study describes an innovative methodology to evaluate susceptible regions for pressurized irrigation systems by using Analytical Hierarchy Process (AHP) based on Geographic Information System (GIS) where the Izeh plain (Iran) is selected as the considered area. The results of this study were shown as GIS maps by using AHP. Localize irrigation system, Gun irrigation system and Linear irrigation system were found to be the best selections for this region, respectively.

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Key words: AHP, GIS, Iran, Localize irrigation system.

Introduction

The present study aims to establish an innovative methodology to determine the susceptible region for the pressurized irrigation systems. It integrates AHP method into a GIS model to select the most susceptible regions for pressurized irrigation systems according to final weight of each system gain by weighting and GIS maps. The methodology uses easy-to-get data from Khuzestan official institutions of Water and Power Authority (KWPA) and available satellite images.

Materials and method

The study area corresponds to the Izeh plain. It is located at 'Khuzestan' province at the Southwestern part of Iran northeast of the city of Ahvaz capital of Khuzestan province. It covers 11080.5 km^2 of surface.

Pressurized irrigation systems such as Solid Set, Gun Sprinkler Irrigation System, Linear Irrigation System, Localized Irrigation System were evaluated for selection of the best irrigation method for Izeh plain. The proposed criteria and sub-criteria indicators include: socio-economic: relative acceptability of an irrigation system (Ras), technical support requirements (T sr), system costs (S ec) and labor skills (L ls).

Table 1. The results of computations & Global Weights of irrigation systems

criterion	sub-criterion		Localized	Linear	Gun	Solid Set
socio-economic	Tsr		0.0313	0.0625	0.0333	0.0179
	Lls		0.0313	0.0208	0.0333	0.0163
	Cost		0.1563	0.0625	0.0333	0.0942
	Ras		0.0313	0.0208	0.0667	0.0383
physical	Topography	L ad	0.0375	0.0996	0.0975	0.1494
		Slope	0.0375	0.0996	0.1463	0.0498
	Climate	C re	0.0563	0.0498	0.0786	0.0498
		W ws	0.0188	0.1494	0.0786	0.1494
	Water	Wna	0.02232	0.0191	0.0175	0.0191
		Wcl	0.02232	0.0191	0.0175	0.0191
		Waw	0.01166	0.0071	0.0066	0.0071
		Wsm	0.09842	0.0071	0.0066	0.0071
		Wbm	0.09842	0.0053	0.0049	0.0053
		EC	0.09842	0.0191	0.0175	0.0191
		PH	0.09842	0.0191	0.0175	0.0191
	Soil	I ir	0.0188	0.0996	0.1037	0.0996
		AW	0.0563	0.0996	0.1037	0.0996
	Crop	C cd	0.0250	0.0349	0.0341	0.0349
		P pk	0.0250	0.0220	0.0215	0.0220
		P pd	0.0251	0.0831	0.0811	0.0831

Physical: Topography, Water, Climate, Soil, Crop; Which the Sub-criteria of physical criterion are classified in: Topography: height difference (L ad), land slope (L so); Water: suspended materials (W sm), sodium concentration (W na), chloride concentration (W cl), biological materials (W bm), availability of water (W aw), EC, PH; Climate: climate of the region (C re), wind speed (W ws); Soil: infiltration rate (I ir), Available water in the soil (AW); Crop: crop density (C cd), crop type (P pk), crop pest (P pd). The pairwise comparison employed a semantic 9-point scale for the assignment of priority values were 1, 3, 5, 7, and 9 correspond respectively to equally, moderately, strongly, very strongly and extremely important criterion when compared with another. 2, 4, 6 and 8 are intermediate values. The assignment of preference values is based upon experts consulting and reviewing technical documents and of international published guidelines.

Results and Discussion

Table 1 shows the results of computations and global weights for different irrigation systems.

GIS maps obtained from table10 as results of this Pressurized irrigation systems:

The maps are showing the results of evaluating for pressurized irrigation systems (Figure1 to 4).

Table 2 was obtained from GIS maps. Table2 shows that Localize irrigation system has the highest final value and is the best irrigation system for this region.

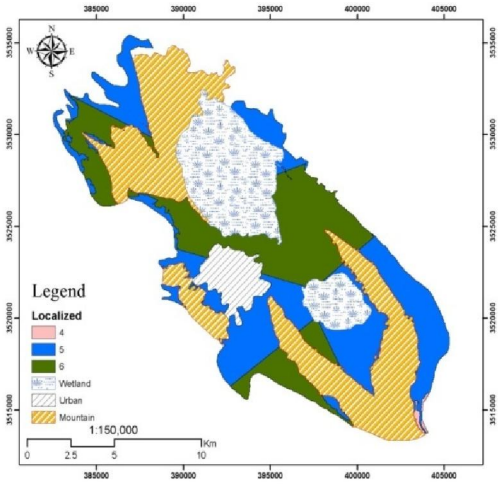

Figure 3. Result map of final value of Localize irrigation system

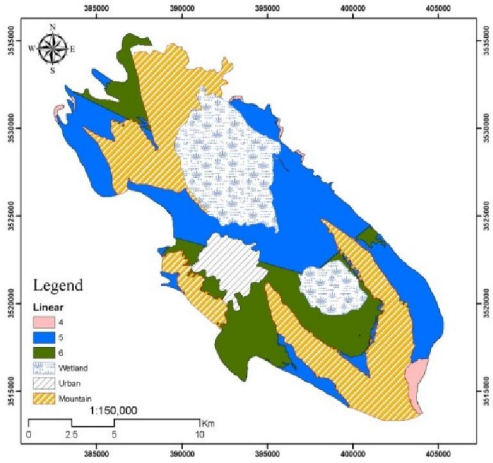

Figure 4. Result map of final physical value of Linear irrigation system

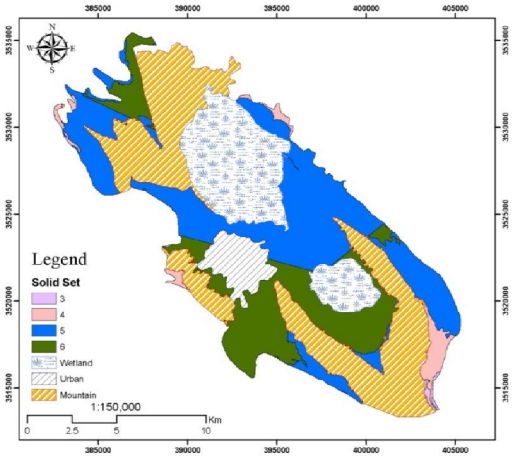

Figure 5. Result map of final value of Solid Set irrigation system

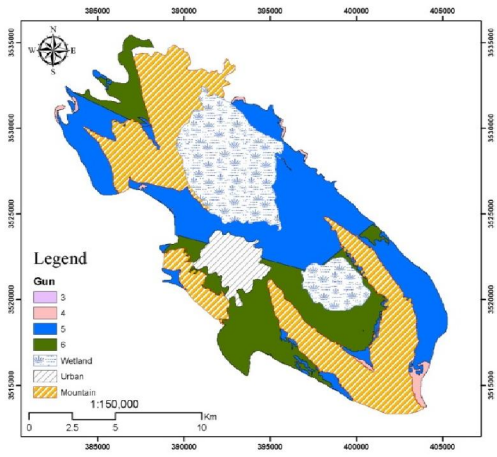

Figure 6. Result map of final value of Gun irrigation system

Table 2. Final results of pressurized irrigation systems

irrigation method	value	percentage	final value
Localized	4	0.478	5.44
	5	54.263	
	6	45.26	
Linear	4	3.20	5.31
	5	62.10	
	6	34.70	
Gun	3	0.23	5.32
	4	3.30	
	5	60.39	
	6	36.08	
Solid Set	3	0.47	5.27
	4	6.01	
	5	59.07	
	6	34.45	

Conclusions

In the present work, a single-objective AHP integrated with a GIS was carried out to identify susceptible regions for pressurized irrigation systems in the Izeh plain. Two main criteria were selected, physical and socio-economic.

Evaluation of susceptible regions for pressurized irrigation systems, using AHP integrated in a GIS, reveals that the best irrigation systems are Localize irrigation system, Gun irrigation systems and Linear irrigation system already were installed and used in the study region.

Considering the effective parameters on the performance of irrigation projects and determining the local weight in pair-wise comparisons, the effectiveness of each aspect and indicator in the irrigation system can be provided. As the proposed methodology can identify the effects of major factors and overcome the problem of uncertainty related to the quality parameters affecting the performance assessment, one can apply the methodology as a comprehensive and decision-making approach with the aim of improving the performance of susceptible regions.

This work constitutes a helpful technical support for decision makers for a better integrated water management in the Izeh plain.

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