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Assessment of the Surface and the Pressurized Irrigation According To a Parametric System in Chenaran Plain

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Abstract **– The aim, of this research is to make a comparison between two methods of irrigation: surface and the pressurized irrigation, according to a parametric system which was done in Chenaran plain in an area of 29113 hectares. The land properties (the Slope and the Drainage,) and the physical and chemical properties of the soil (lime, salinity, Alkalinity,) were considered as the base for parametric assessment, and after the analysis with the use of the geographic information system (GIS) the assessment was made. The results showed that 58.34% of the land is relatively suitable (S_2) for surface irrigation, and 50% of the land is relatively suitable (s_2) for the purpose of pressurized irrigation. 16.6% of the land is not suitable for surface irrigation, neither for the pressurized one. In general the result indicated that the suitability of the land for two methods of irrigation is approximately the same. Since the choice of a suitable method of irrigation could results in an increase in production efficiency of the land, but it must be noted that the main limiting factors which determines the method of irrigation in each region are the texture of the soil, salinity, Alkalinity, Drainage, calcium carbonate and the slope and topography of the land. This research also showed that GIS has an important role in assessment of the lands suitability for different methods of irrigation.**

Keywords **– Surface Irrigation, Pressurized Irrigation, Land Assessment, Parametric Method, GIS.**

I. INTRODUCTION

Nowadays the crisis of water has made lots of troubles in preparation of the required water for human societies all around the world. For example 26 countries of the world are considered as the low water countries. Among these 26 countries 9 of them are located in the Middle East. Since Iran is located in a dry and semi dry region of the world, the use of the irrigation methods that bring the highest yield, is inevitable. According to this problem and also the increasing importance of water in the agriculture of Iran, the Iran's government has made huge and extensive investments, and credits in order to extent the Water-based technologies such as the pressurized irrigation for optimized use of the water resources. These technologies can have the considerable results in the rural societies. But unfortunately, the spread and the development of the pressurized irrigation systems have faced various problems which have caused the farmers not to accept or continue the application of this system. For this aim, first the resources of the land must be identified, and its talents and capabilities for different application should be investigated. In another words the first and the most important step for programming the optimized use of the land is the land assessment
(Azami Amir, Zarafshani K Dehghani Sanich H, 2011)

In many of the regions, due to more limitation of water supplies, it is essential to use the new and highly efficient systems of irrigation, in order to irrigate the agricultural products. In this way in addition to saving more water, there are more advantages to benefit from such as uniform distribution of water, the capability of irrigation in the lands with disordered topography. By use of these new methods of irrigation, it is possible to increase the area under cultivation several fold with the same amount of water (in comparison with the surface or traditional irrigation methods), because these methods have higher levels of efficiency. Or even by applying lee amount of water in comparison with the conventional methods of irrigation, obtain much more amount of product. The method of the pressurized irrigation has several advantages in comparison with the surface irrigation method, these advantages are:

- By using the pressurized method of irrigation it is possible to correctly irrigate the lands or soils with different series, textures and properties such as layer by layer lands or Laminated
- Lands.
- It is also possible to irrigate the lands with shallow soils without the need to surface activities (Delavari l Gholami A Hosseini 2011).

Sys et al (1991) suggested the parametric method of assessment for the methods of irrigation whose base was to present a quantitative method for determining the fields' potential for the irrigational aims, according to profile properties. Since the final goal of the irrigation is to produce the crops and the growth of the plants, the selected factors in this method are related to the plants' lodgment, the water absorption and the Nutrients. The properties of the field under investigation include the topographic characteristics and the soil. The topographic characteristics include the slope and the soil properties are the soil depth, the texture of the soil, salinity, Alkalinity, and the Drainage (Albaji M Papen P Boroumandnasab S, 2008).

1.1 Literature Review:

Bienvenue (2003) during his research, made an assessment on the fields located in the Diz region of Senegal for the surface and Drip irrigation, and prepare the maps of the fields suitability for surface, drip and local irrigation. By using the parametric method of Science, he got to the conclusion that 20.24% of the fields are

relatively suitable (s_1) 22% of the fields have the critical suitability and 57.66% are not suitable (N) for the surface irrigation method. The most important limiting factors for the surface irrigation are the Drainage and the texture of the light soil. Also in the case of the drip and local method of irrigation, 25% of the fields are completely suitable (s_1), 45% are relatively not suitable (s_2) and 23.72% of the fields have the critical level of the suitability (s_3), and only 5.83% of the fields are not suitable (N). The most important limiting factors for the drip and local irrigation are the low depth of the soil and the light soil texture with gravels and rubbles, and the Drainage. Regarding the mentioned results, and the fact that the region is dry and the water supply shortage, he found that only the drip method of irrigation is suitable for the region (Bienvenue, Js. Ngardeta and M. Mamadou, K., 2003).

Dengiz, O (2005), according to parametric assessment, investigated the different methods of irrigation of the fields in the experimental farm of the research center in the south of Ankara. By analyzing the physical properties of the soil, topography, the salinity, the Alkalinity, and the Drainage, and also by application of the geographic information system (GIS), he concluded that 13.1% of the fields are completely suitable (s_1) for the surface irrigation, and 51.2% of the fields are completely suitable (s_1) for the drip and local irrigation. Finally he recommended the drip and local irrigation as the best method of irrigation for more than half of the field under study (Dengiz, O., 2006).
Albaji et al (1387) investigated the qualitative assessment of the field suitability for the surface and the pressurized method of irrigation. In this research 15831 hectares of the field located in the region of Gargar in Khuzestan province were studied. The results of this study showed that the present suitability of the fields is the same for both methods of irrigation. This indicated that the fields of this region are relatively suitable (s_2) for both of the surface and the pressurized method of irrigation (Albaji, M., Landi.A.Boroomand Nasab, S., and KASHKULI, 2008).

Nasseri et al (2009) assessed the suitability of the fields in Dasht Bagh region of the Khuzestan Province for the surface and the pressurized method of irrigation. In their assessment they used the parametric method and they investigated the quality of the soil of7000 hectares of the mentioned fields. The obtained results showed that only the 27.51% of the fields are highly suitable (s_1) for the rain irrigation, while there are no highly suitable fields for the surface and the pressurized method of irrigation. The comparison of the different methods of irrigation also showed that the rain and the drip method of the irrigation, in comparison to the surface irrigation, are more effective for the field improvement. In addition, the most important limiting factors for the drip and the surface irrigation are the soil texture and the Drainage and the alkalinity, and in the case of the drip irrigation method, the limiting factors are the amount of the lime, the Drainage, the salinity and the alkalinity (NASERI A.A., REZANIA A.R., ALBAJI M, 2009).

II. Methods and Materials

The region under study includes the fields of Chenaran plains located in 55 kilo metes distance from northwest of Mashhad, Khorasan Razavi province of Iran. This area is located in 58 degree and 39 minute of east/ west longitude and the latitude of 59 degree and 39 minutes of north/ south. According to the Bioclimatic map of Iran with the Mbrzhh method, this area has the semi dry cold climate. The altitude of the city from the sea level is 1176 meters, and the average amount of annual rainfall of the region is 226 mili meters. The average of the maximum temperature in the month is 20 degree centigrade, and the minimum temperature in the month is 6.4 degree centigrade. The city of Chenaran has more than 29113 hectares of the fields under the irrigated cultivation, and 11300 hectares of the lands under dry farming, and 520000 animal units, which product more than 545706 tons of agricultural crops and livestock products. There are 23959 farmers in the city who act in the field of farming, and livestock. In this region, there are 415 deep wells and 33 semi deep wells and 160 Aqueducts, and 35 springs and 8 rivers. From these water supplies 543.01 million cubic meters of water is exploited that is applied for cultivation. The present methods of irrigation are surface irrigation (Advanc Irrigation stack, Cereti,Tape) and the pressurized methods of irrigation (drip or rainfall). 10000 hectares of the fields are under the pressurized irrigation which is20% to 25% of the total fields. The crops which are irrigated by surface methods are wheat, barley, onion and canola, while those which are irrigated by pressurized methods include sugar beet, Forage maize, potato and tomato.
In this research total 12 series of different soils were used in order to determine the soil properties from the experiments done on the control profiles. Figure 1 show the map of the field units which is prepared by GIS method.

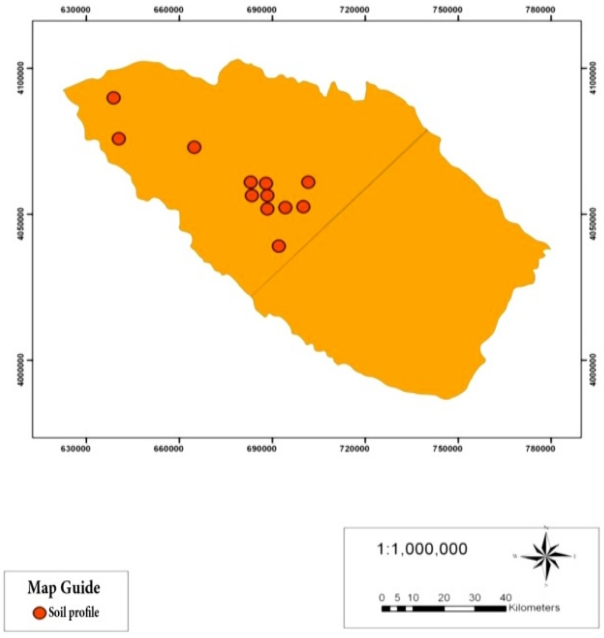

Fig.1. Map of the fields units.

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In order to assess the suitability of the fields for the surface and pressurized irrigation, the parametric assessment of Science (1991) was used. This method is based on determining the level of different soil characteristics and fields properties. These properties are the soil texture, the depth of the soil, the amount of lime, electric conductance, the slop and the drainage. The levels of properties were obtained base on the related standard tables and then the index of irrigation capability was calculated for each of the field units based on the below equation (FAO Soil Bull. NO.23, 1976)

$Ci= A\times B/100\times C/100\times D/100\times E/100\times F/100$

In this equation the amount of A, B, C, D, E and F are relatively related to amount of the soil texture, the depth of the soil, the amount of lime, the salinity, the alkalinity, the drainage and the slop.

Table 1: The classes of suitability for irrigation capability indices

Capability Index	Definition	Suitability Class
>80	Highly suitable	S_1
60-80	Moderately suitable	S_2
45-59	Marginally suitable	S_3
30-44	Currently not suitable	N_1
<29	Permanently not suitable	N_2

III. Results and Discussions

Final results of the qualitative assessment of different fields for the pressurized and the surface irrigation are presented**:**

Table 2: The amount of Ci and the classes of suitability for surface and pressurized irrigation in the plain of Chenaran.

Surface Irrigation		Pressurized irrigation		Profile
Capability of Irrigation(ci)	Class and under-Class Lands	Capability of Irrigation (Ci)	Class and under-Class Lands	
75.57	S_2s	75.57	S_2s	14
76.50	S_2s	80.10	S_1	30
78.52	S_2s	79.42	S_2s	31
49.40	S_3	57.00	S_3	32
76.50	S_2s	76.50	S_2s	34
89.06	S_1	93.81	S_1	35
70.68	S_2s	75.28	S_2s	36
35.10	N_1	49.90	S_3	42
38.70	N_1	44.69	S_3s	46
70.20	S_2s	72.90	S_2s	55
62.10	S_2s	62.10	S_2s	61
46.57	S_3s	46.57	S_3s	62

Table 3: The classes of suitability for different field units

Surface Irrigation			Drip irrigation	
Suitability	Land Unit			
------	------		------	
S_1	35	8.30		
S_2	14,30,31,34,36,55,61,62	58.400	14,30,31,34,36,55,61	50.10
	32	16.60	32,42,46,	33.30
N_1	42,46	16.70		-
N_2	0	-		-
Total		100		

In suitability assessment of fields for the surface irrigation based on the parametric method, it was indicated that the unit of 35 with the area of 2416.84 hectares (8.3%) is highly suitable (S_1), the units of 30, 31, 34, 36, 55, 61 with the area of 15574.8 hectares (58.34%) are relatively suitable (S_2), and the units of 32 and 62 with the area of 1846.22 hectares (16.6%) have the critical level of suitability (S_3) and the units of 42 and 46 with the area of 1539.74 hectares (16.7%) are not suitable (N_1), in the present situation. The N_2 suitability does not exist in the region under the study (Table 3).

Also in suitability assessment of fields for the pressurized irrigation based on the parametric method, it was indicated that the units of 30 and 35 with the area of 1611.78 hectares (16.6%) is highly suitable (S_1), the units of 14, 31, 34, 36, 55, 61 with the area of 14556 hectares (50%) are relatively suitable (S_2), and the units of 32, 42, 46 and 62 with the area of 4848.48 hectares (33.3%) have the critical level of suitability (S_3), The N1 and N_2 suitability does not exist in the region under the study. The field units of 42 and 46 have the suitability of N_1 in the assessment for the surface irrigation, while their suitability in the assessment for the pressurized irrigation was S_3 also the unit of 30 has the suitability of s_2 in the assessment for the surface irrigation, while its suitability in the assessment for the pressurized irrigation was s_1. Figure 2

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shows the map of the field's suitability for the surface irrigation. Figure 3 shows the map of the fields' suitability for the pressurized irrigation.

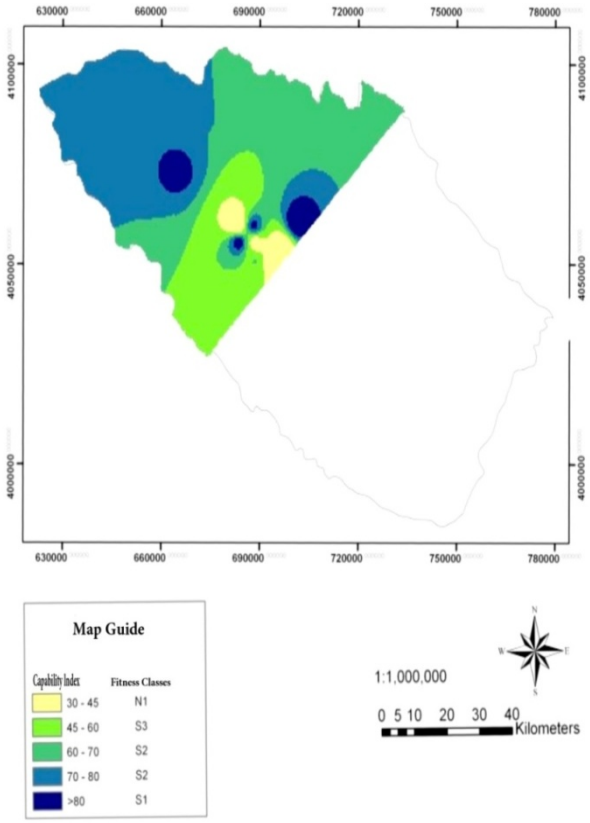

Fig.2. The map of the fields' suitability for the surface irrigation

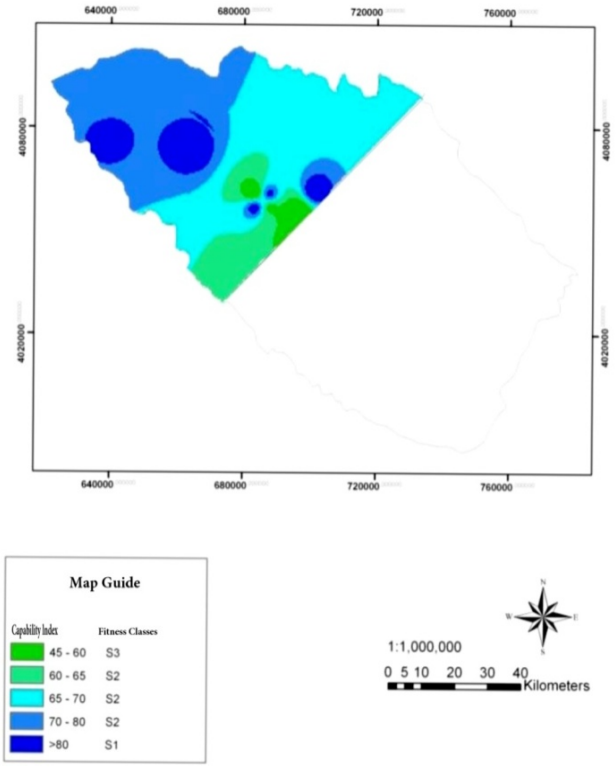

Fig.3. The map of the field's suitability for the pressurized irrigation

IV. Conclusion and Suggestions

According to the obtained results it was indicated that in the plain of Chenaran, the use of the pressurized irrigation system has the higher class of suitability in comparison with the surface irrigation systems. The results of this study showed that the highly suitable region (S_1) for the surface irrigation is only the field unit of number 35, while for performance of the pressurized method of irrigation, the units of 30 and 35 are highly suitable (S_1). Although both of the irrigation methods, (the surface and the pressurized irrigation) have high scores in parameters such as the slop, the drainage, the amount of lime, and the salinity, but they suffer from the limitations in the parameters like the soil texture and the depth. Since the water and the soil supplies are limited, it is essential to use the modern methods of irrigation in order to increase the efficiency of the soil and water usage. In order to achieve this goal, it is highly recommended to find the highly potential regions for application of different irrigation methods according to irrigation suitability assessment. These tries must be followed continuingly. Also they must be considered as the priorities for the water and soil research centers. In this way it is possible to achieve to a comprehensive map of the potential lands, in order to obtain the best result from the existing facilities.

References

[1] Azami Amir, K. Zarafshani, H .Dehghani Sanich, "studying the educational need of the pressurized irrigation users in province of Kermanshah", the journal of the water and the soil, volume 25 no. 5, 2011.

[2] .Albaji M Papen P Boroumandnasab S, , " investigation of the fields suitability for the flood irrigation and the pressurized irrigation in Gargar region of Khoozestan province 2nd National congress on the irrigation networks and the drainage management, faculty of the water science engineering, Shahid Chamran university of Ahvaz, 2008.

[3] Albaji,M.,Landi.A.Boroomand Nasab,S., and KASHKULI, ,Comparison of Different Irrigation methods Based on the parametric Evaluation Approach In Molasani Plain, Iran,j. of Agronomy, ISSN 1812-1900, 2008.

[4] Bienvenue, Js. Ngardeta and M. Mamadou, K.Land Evaluation in the province of THES. Senegal 23rd course professional Master. Geometrics and Natural Resources Evaluation. 8 Nov 2002 – 20 June 2003, IAO, Florence, Italy, 2003.

[5] Delavari Gholami & Hosseini , "The assessment of the two methods of the surface irrigation and the pressurized irrigation according to the parametric system", 1st National congress of the approaches to obtain to a sustainable cultivation, Payam Noor University of Khoozestan, 2011.

[6] Dengiz, O. Comparison of Different Irrigation methods based on the parametric Evaluation Approach. Department of soil science. Agricultural Faculty Ondokuz Mayis University. Turk. J. Agric. (TUBITAK). , 2006.

[7] FAO. A framework for land evaluation. FAO Soil Bull. NO.23, 1976.

[8] NASERI A.A., REZANIA A.R., ALBAJI M. Investigation of soil quality for different irrigation systems in Lali Plain, Iran. Journal of Food, Agriculture & Environment, 2009.

[9] www.intechopen.com/download/pdf/31506.

[10] http://scialert.net/abstract/?doi=rjes.2012.51.61.

[11] www.isfae.org/scientficjournal/2009/issue3/pdf/environment/15.pdf.

[12] journals.tubitak.gov.tr/agriculture/issues/tar-10.../tar-34-5-9-0905-39.pdf.

[13] www.futurewater.nl/wp-content/.../NBI_IrrPot_Inception_v08_150.pdf