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Research Article

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Determination of Suitable Irrigation Method by Using Some Soil and Topography Properties

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Abstract For optimal use of water and land resources, irrigation activities need to be tailored accordingly. The basic rule for good irrigation activity is the choice of irrigation method which is most suitable for the conditions. In this study, the possibilities of utilizing the Geographic Information System for selecting suitable irrigation method by using infiltration, available water holding capacity (AWHC), slope and texture data were investigated.

Keywords Suitable irrigation method, GIS, Soil properties, Topography

1. Introduction

Irrigation is an integral part of modern agriculture and forms one of the most important agricultural inputs in vegetable production. If irrigation is planned and applied according to its technique, it provides an increase in the efficiency of cultural practices such as fertilization, plant protection, pruning, and agricultural production. [1]. Irrigation methods, which are the forms of giving water to the root region of the plant, differ due to the different characteristics of each agricultural area [2]. In order to obtain the benefits expected from irrigation, it is necessary to select the most appropriate irrigation method for the conditions, to establish the irrigation system required for this method and to apply the amount of water that the plant needs in time [3]. Otherwise, adverse effects on the environment such as salinity, high ground water are being realized while being economically damaged due to improper irrigation activities. The requirement of rational and scientific methods and systems in the use and management of natural resources is a reality accepted by all the world societies increasingly important. In the 21st century, which is called information age, it is inevitable that both administrators and researchers should benefit from GIS as required [4]. Today, many disciplines working in large areas such as agriculture use Geographic Information Systems (GIS) applications.

In this study, suitable irrigation methods for sustainable agriculture and environment have been tried to be determined in irrigation areas of Orhangazi district of Orhangazi district of Bursa in consideration of soil and topography characteristics and some basic characteristics. The previously measured soil values were transferred to the ArcGIS program. Spatial analysis module was used to perform the necessary interrogation and analysis to determine the appropriate irrigation method.

2. Material and Method

2.1. Material

The research area is the Sölöz and Heceler neighborhood of Orhangazi district of Bursa province in the Marmara region. The size of the study area is 9091.2 in total. The research area in the southeastern part of the

Marmara Region mainly reflects the transitional type Marmara climate conditions of the Mediterranean and Black Sea climates [5].

The topographic structure of the study area is generally flat. As the lands left on the İznik lakeshore are formed with flat plain, the slope of the land is increasing as they move to the south

The entire research area is covered with olive trees. As many of the gardens in the study area have been planted in the past years, row spacing and intrarow are not uniform. Iznik Lake and a large number of probe wells have been using as the water source

2.2. Method

In order to determine suitable irrigation methods, some soil and infiltration parameters such as field capacity, fountain weight, usable water retention capacity and structure, which were previously determined in [6]at 83 points, have been used.

2.2.1. Transfer of soil analysis data to GIS environment

The values obtained from soil analysis laboratory were imported using European 1950 datum in "add x y data" module in ArcGIS program after processed in Excel environment and. Imported point data are generated continuously using IDW interpolation feature.

2.2.2. Determination of the inclination of the work area

Topographical properties of the study area were obtained from the 5m resolution contour lines obtained Ankara Field Crops Central Research Institute. TIN (Triangulated Irregular Network) model was created by using these curves. Then the slope map of the study area was created using the TIN model data.

2.2.3. Determination of suitable areas for irrigation methods

Soil properties such as soil type, available water holding capacity and infiltration rate have been taken into consideration in the selection of irrigation method (Figure 2.1).

In addition, [7] stated that the slope level of the land is also important in selecting the irrigation method.

Table 2.1: Limitations on irrigation method selection [7-8]

	Surface irrigation methods			**Pressurized irrigation methods**	
	Flooding irrigation	**Border irrigation**	**Furrow irrigation**	**Mini sprinkler irrigation**	**Drip irrigation**
Available water holding capacity	High	High	High	All	All
Infiltration rate	low	low	low	$I_u<I^*$	P>%30**
Slope (%)	0-0.5	0-2	0-3	All	All
Texture	Medium	Medium	Medium-Heavy	All	All

* I_u: Irrigation rate; I: Infiltration speed*; **P: Wetting area

3. Result and Discussion

The slope map constructed using the 5m altitude curves belonging to the study area is given in Figure 3.1. When the slope map obtained by using the contour curves is examined, it is seen that the slope increases from the north to the south. The area indicated by red in the study area shows the forest area with a high slope.

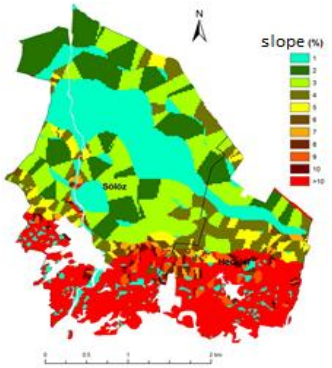

Figure 3.1: Slope of working area

In the study, effective factors in the selection of suitable surface irrigation methods were taken into account in slope and infiltration rates. According to the slope constraints, the flat areas in the northern parts of the region seem to be suitable for flooding irrigation methods. The furrow irrigation method, which is more tolerant than other surface irrigation methods, has the most applicable area in the study area (Figure 3.2).

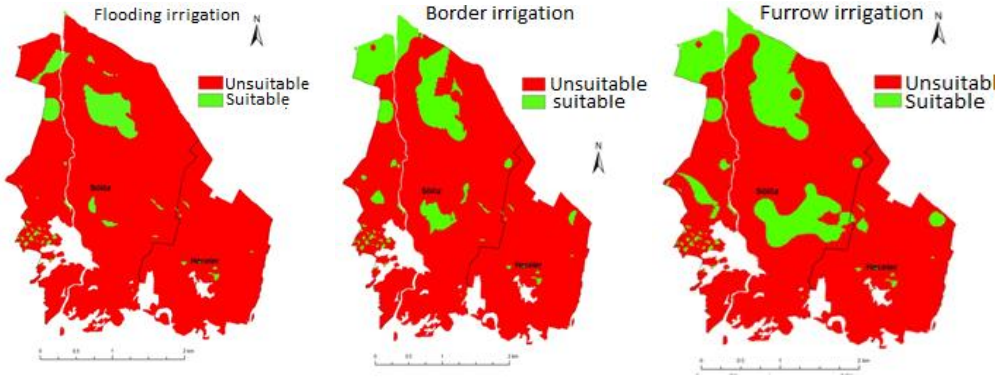

Figure 3.2: Surface irrigation methods that can be applied in the study area

The areas suitable for surface irrigation method are given in Table 4.1

Table 4.1: Suitable areas for surface irrigation methods

Irrigation methods	Suitable areas		Unsuitable areas	
	(da)	(%)	(da)	(%)
flooding irrigation	504.2	5.5%	8588	94.5%
border irrigation	1175.2	12.9%	7917	87.1%
furrow irrigation	1762.2	19.4%	7330	80.6%

As a result of this study, 504.2 (5.54%) of flooding irrigation, 1762.2 (19.38%) of furrow irrigation and 1175.2 (12.92%) of border irrigation method were determined in the study area. Furrow irrigation method was chosen as the most suitable method for irrigation in the field of experiment. The slope of the land has played a major role in determining suitable areas for surface irrigation methods. It was determined that 20% of the land as irrigable with the furrow irrigation method, which can be better adapting to the sloping land

Drip irrigation method

Suitable areas for drip irrigation from pressure irrigation methods are given in below (Figure 3.3-Figure 3.6).

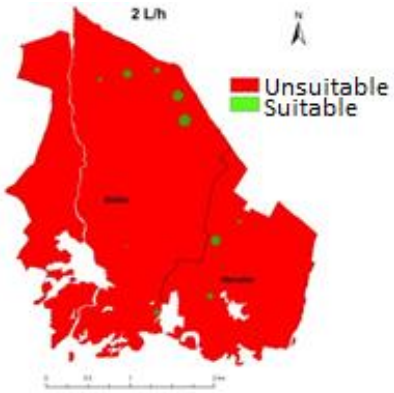

Figure 3.3: Suitable areas for drip irrigation method (2L / h)

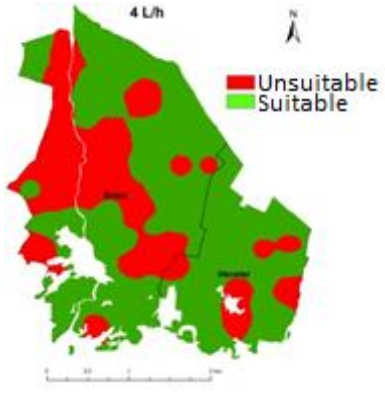

Figure 3.4: Suitable areas for drip irrigation method (4L / h)

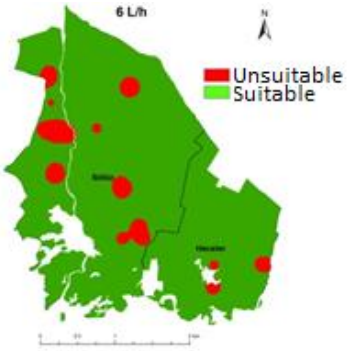

Figure 3.5: Suitable areas for drip irrigation method (6L / h)

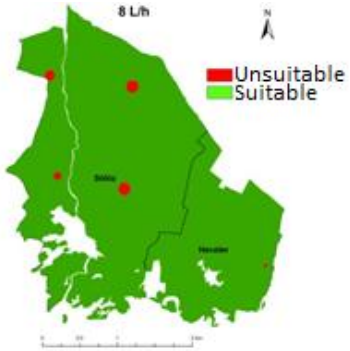

Figure 3.6: Suitable areas for drip irrigation method (8L / h)

The most effective criteria are sufficiency of wetting area in selection of drip irrigation method. For this reason, the wetting area ratio increases during the increasing of emitter flow rate so that the applicability of drip irrigation method in the working area increases.

Mini sprinkler irrigation method

Suitable areas for the mini-sprinkler irrigation method are given in Figure 3.7-3.10

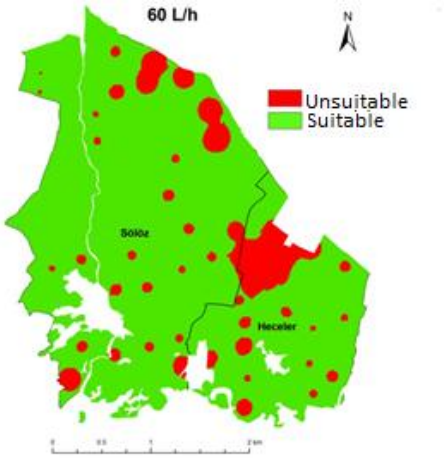

Figure 3.7: Suitable areas for mini sprinkler irrigation method (60L/h)

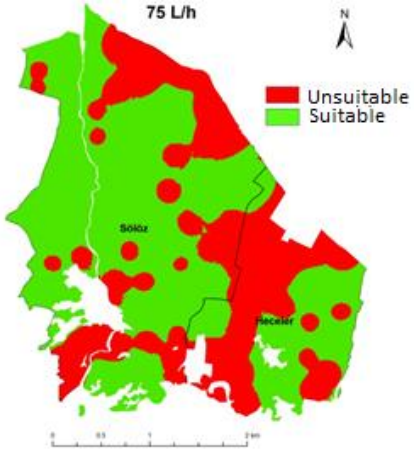

Figure 3.8: Suitable areas for mini sprinkler irrigation method (75L/h)

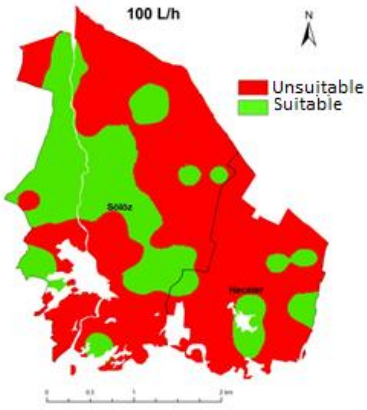

Figure 3.9: Suitable areas for mini sprinkler irrigation method (100L/h)

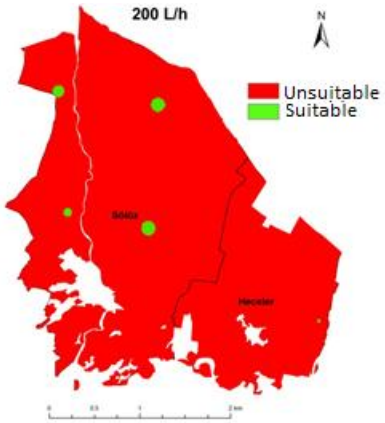

Figure 3.10: Suitable areas for mini sprinkler irrigation method (200L/h)

The factor affecting mini sprinkler applications is the difference between sprinkler discharge and infiltration. Since the infiltration rate of the study area is usually low, it is seen that the applicability of this method in the field of study is increased as the sprinkler discharge is lowered.

The areas suitable for sprinkler and drip irrigation method are determined according to the drip emitter and sprinkler discharge (Table 4.2).

Table 4.2: Areas suitable for pressurized irrigation method

Irrigation method	**Drip irrigation method**			
Emitter flow rate (L/h)	2	4	6	8
Suitable areas (da-%)	60.8 (0.7%)	5944.8 (65.4%)	8508.9 (93.6)	9027.4 (99.3%)
Unsuitable areas (da-%)	9031.4 (99.3%)	3147.4 (34.6%)	838.6 (9.2%)	64.8 (0.7%)
Irrigation method	**Mini sprinkler irrigation method**			
Sprink discharge (L/h)	60	75	100	200
Suitable areas (da-%)	8253.4 (90.8%)	6345.1 (69.8%)	2582.5 (28.4%)	60.2 (0.7%)
Unsuitable areas (da-%)	838.8 (9.2%)	2747.1 (30.2%)	6509.7 (71.6%)	9032.0 (99.3%)

It seems that the biggest limitation for drip irrigation method is wetting area. As a result, low-heading 2L / h heads were not found suitable because they could not reach adequate wetting range in the research area.

It has been determined that the infiltration rate is the main factor when it is specified in suitable areas for mini-sprinkler is another pressurized irrigation method. As can be seen from Table 4.2, as the sprinkler discharge increases, the amount of suitable area decreases due to research area has low infiltration value. In general, it has been determined that pressurized irrigation methods are suitable wider areas.

4. Conclusion

This study is a case study and it is suggested to carry out further studies using larger parameters in larger areas considering this study. It is thought that the results obtained from such studies can help to protect water, soil and plants on across to basin

Acknowledgments

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References

[1]. Yıldırım O. (2005). Design of irrigation systems. Ankara University Faculty of Agriculture Publication No: 1542. 348s. Ankara.

[2]. Apan M. (1981). Essential Factors to be considered in the Selection of Irrigation Systems Vol. 12, Number 2-3, 193-207.

[3]. Çetin Ö. Uygan D. Boyacı H. (2006). Effect of Drip Irrigation Method on Yield and Water Usage in Tomatoes of Different Lateral Space and Wetting Area Percentages. Project no: KHGM-03220E01. Eskişehir.

[4]. Sönmez N.K. Sarı M.(2004). Fundamentals of Geographical Information Systems and Application Areas. BATEM, Derim, 21(1), 54-68.

[5]. Akbulak C. (2009). Investigation of İznik Basin in terms of human and economic geography. Ankara

[6]. Özturk, E. and Sener, M. 2017. GIS Usage in Determining the Change of Soil Properties. Journal of Scientific an Engineering Research, 4 (5): 44-47.

[7]. Brouwer C. Heibloem M. (1986). Irrigation Water Management, Training Manuals - 3. Rome, Italy: Food and Agriculture Organization.

[8]. Güngör Y. Erözel Z. Yıldırım O. (2004). Irrigation. Ankara University Agricultural Faculty. ISBN No. 975-482-323-5. 292 s.