



Pan African University
Institute of Water
and Energy Sciences

Project Name :

Artificial groundwater recharging zones mapping using a GIS-based fuzzy logic approach: a case study in Bechar's region, Southwest of Algeria

Authors

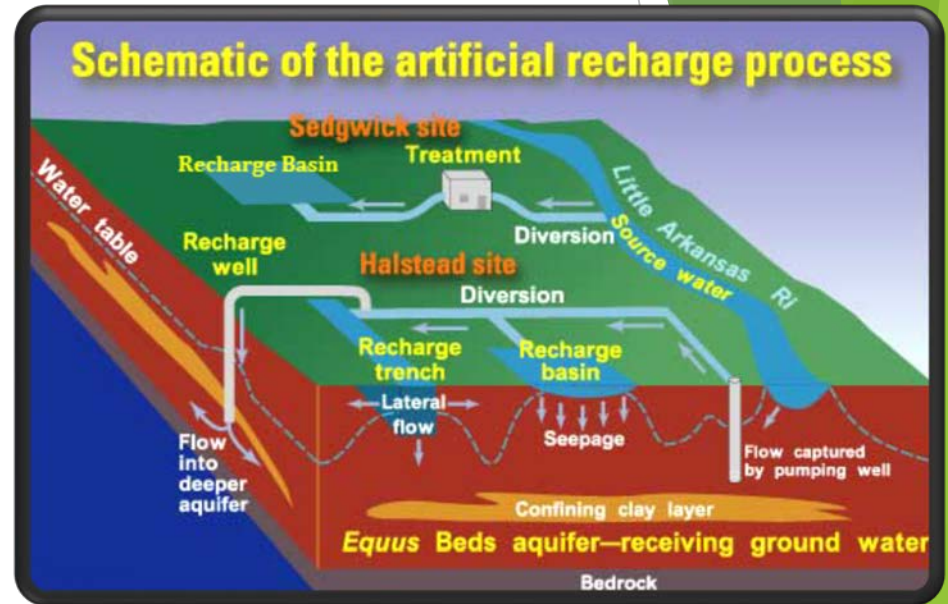
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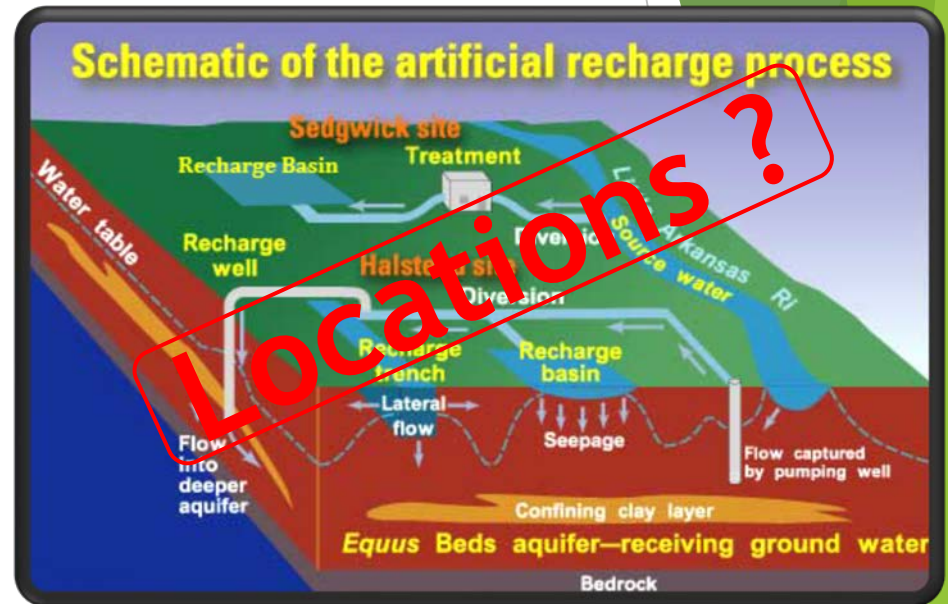
Problematic

Artificial recharge is an effective and practical technique to use the excess water from the winter season for the raising of groundwater level in the aquifer. A variety of methods have been developed to recharge groundwater, using conventional water sources characterized in excess storm water and nonconventional water sources such as treated wastewater.



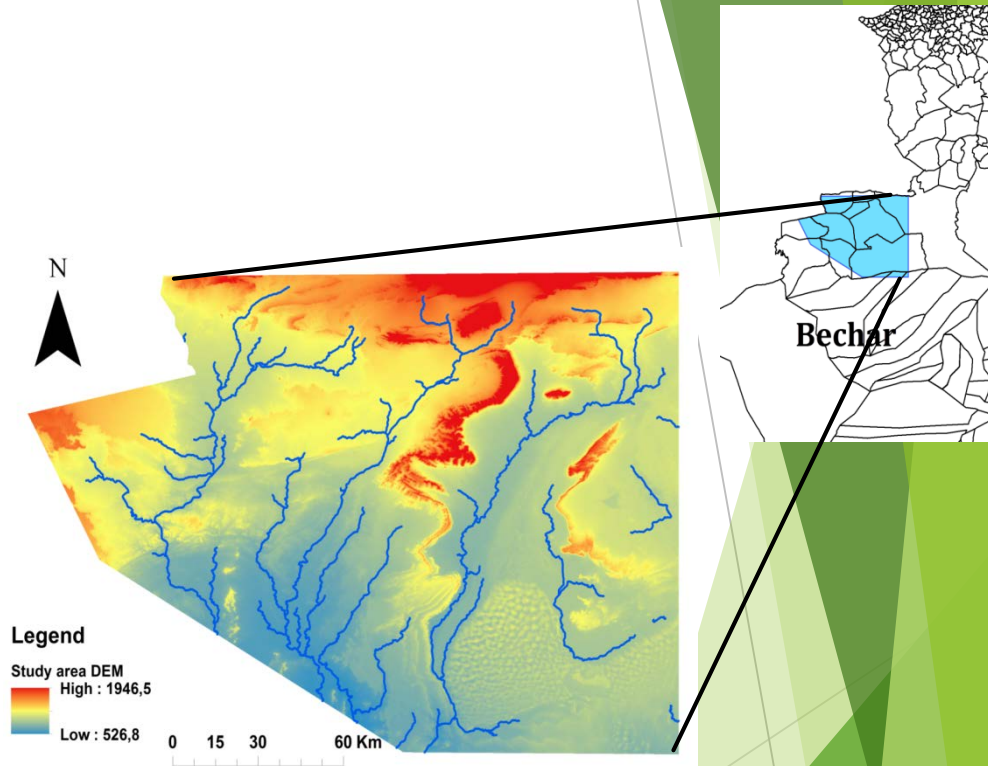
Objective

The main objective of the present study is to identify suitable groundwater recharge sites in the Bechar's region using geographic information system (GIS) based on fuzzy logic model



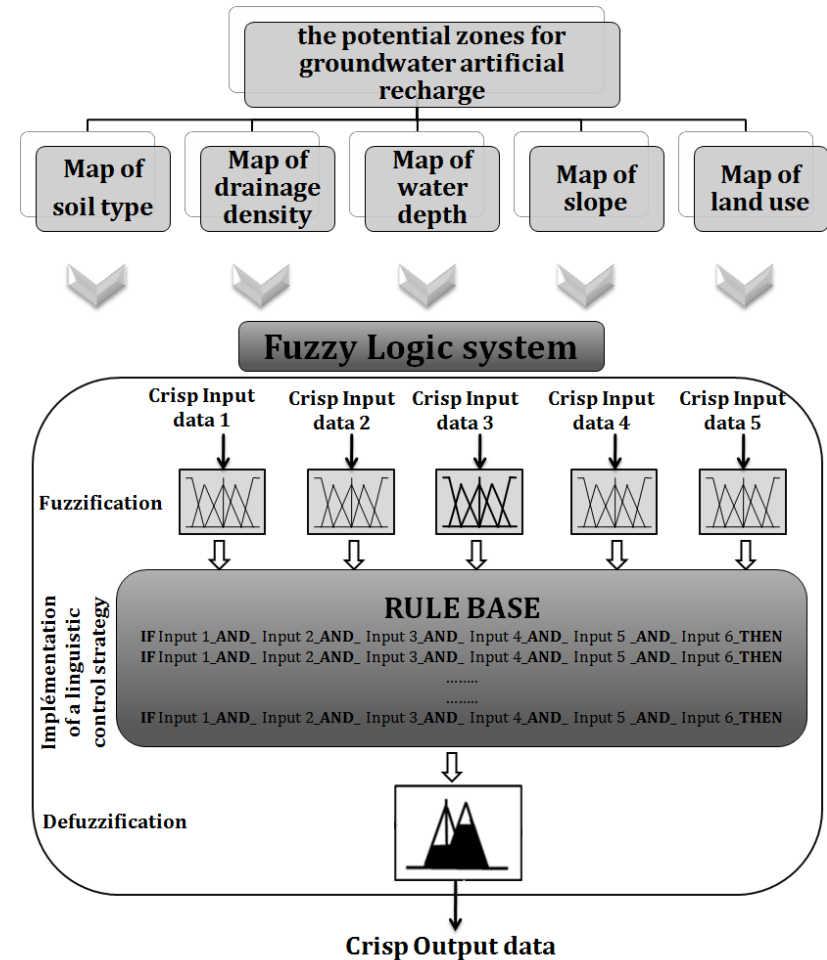
Study Area

Bechar is located in the Southwest of Algeria, characterized by an arid to semiarid climate regime, with an area of about 162,000 km² and variable topographic features. The mean annual precipitation ranges from <40 mm to more than 100 mm in the northeastern part of the region (Samira boufeldja 2013).



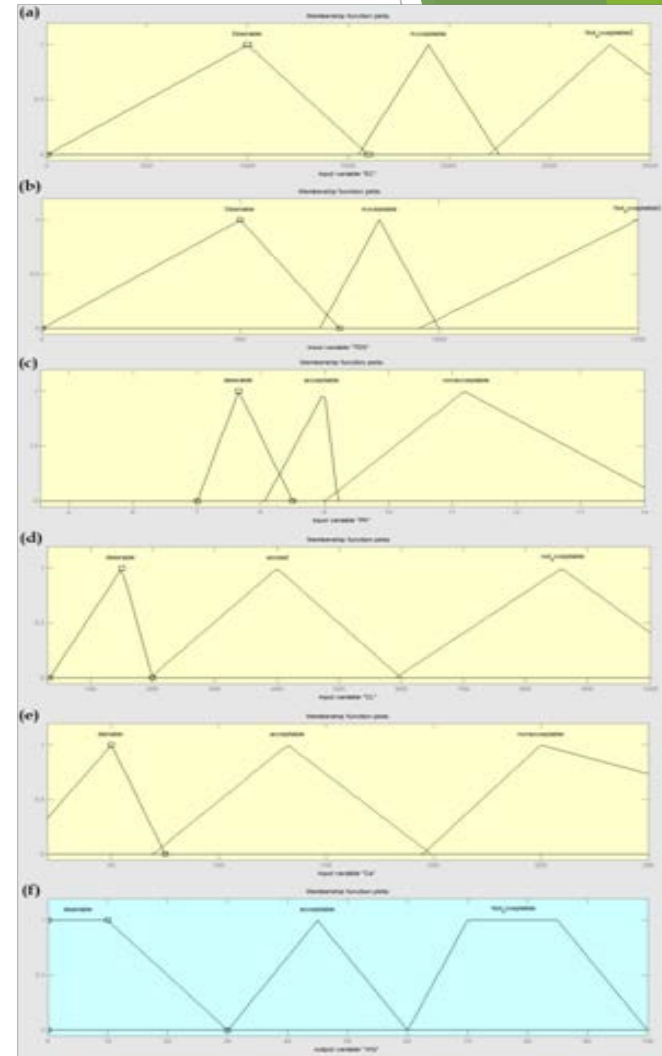
Materials and methods

The followed technique is to prepare representative maps for each parameter extracted as thematic layers and integrated in GIS after processing in the Fuzzy logic system (Zadeh,1965) for the purpose of combining all the studied parameters to conclude the final map of the most suitable zones for the groundwater artificial recharge

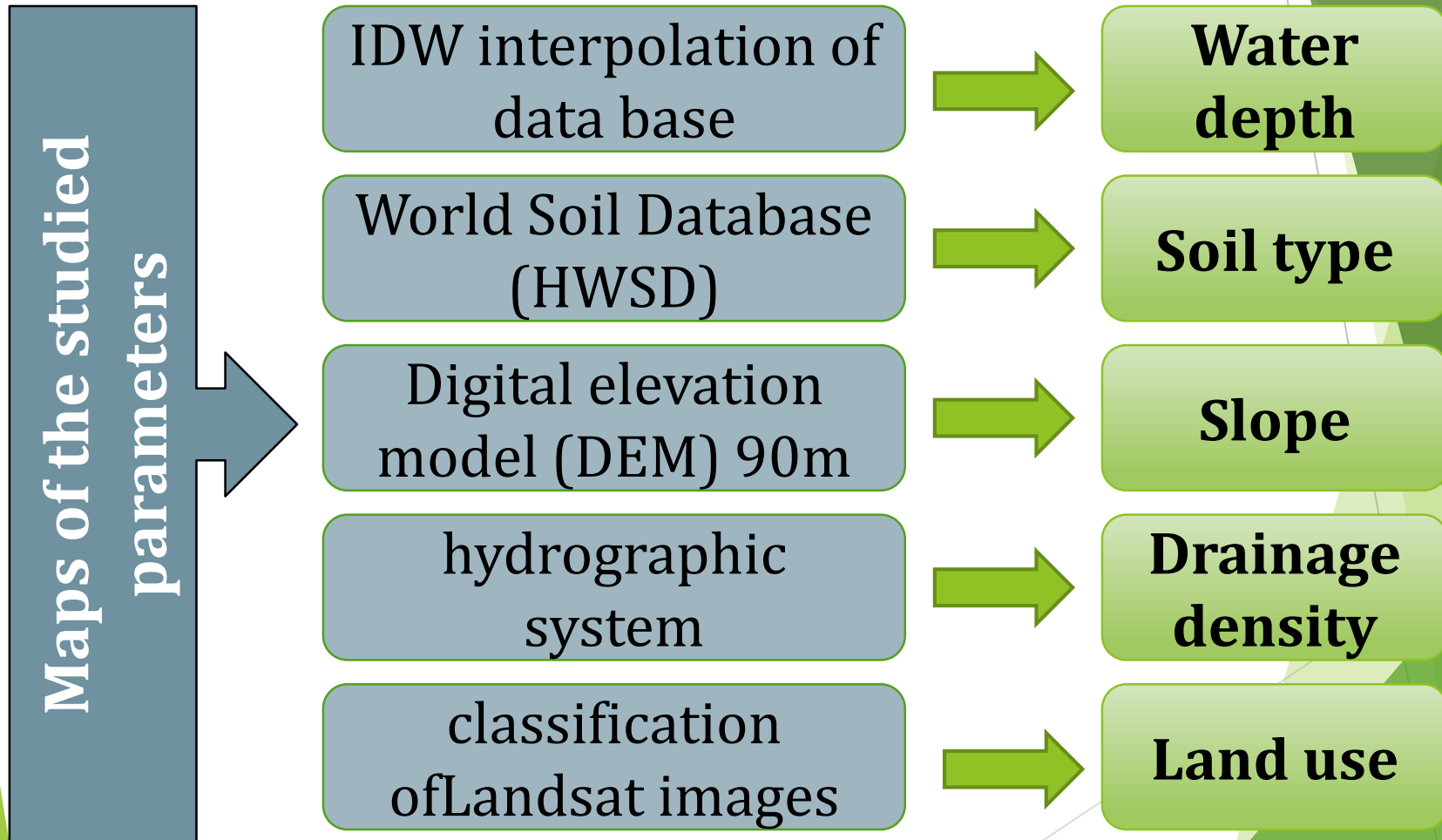


Materials and methods

- Fuzzy Logic elements must be in the middle of a classical set (crisp set) (**1 or 0**);
- Fuzzy set characterizes a level of having a place by a **membership function (MF)**;
- Fuzzy inference algorithm executes **IF-THEN fuzzy rules** in a wide range of common sense questions;
- Fuzzy rules must be created by a processed domain expert using **AND/OR connectors**

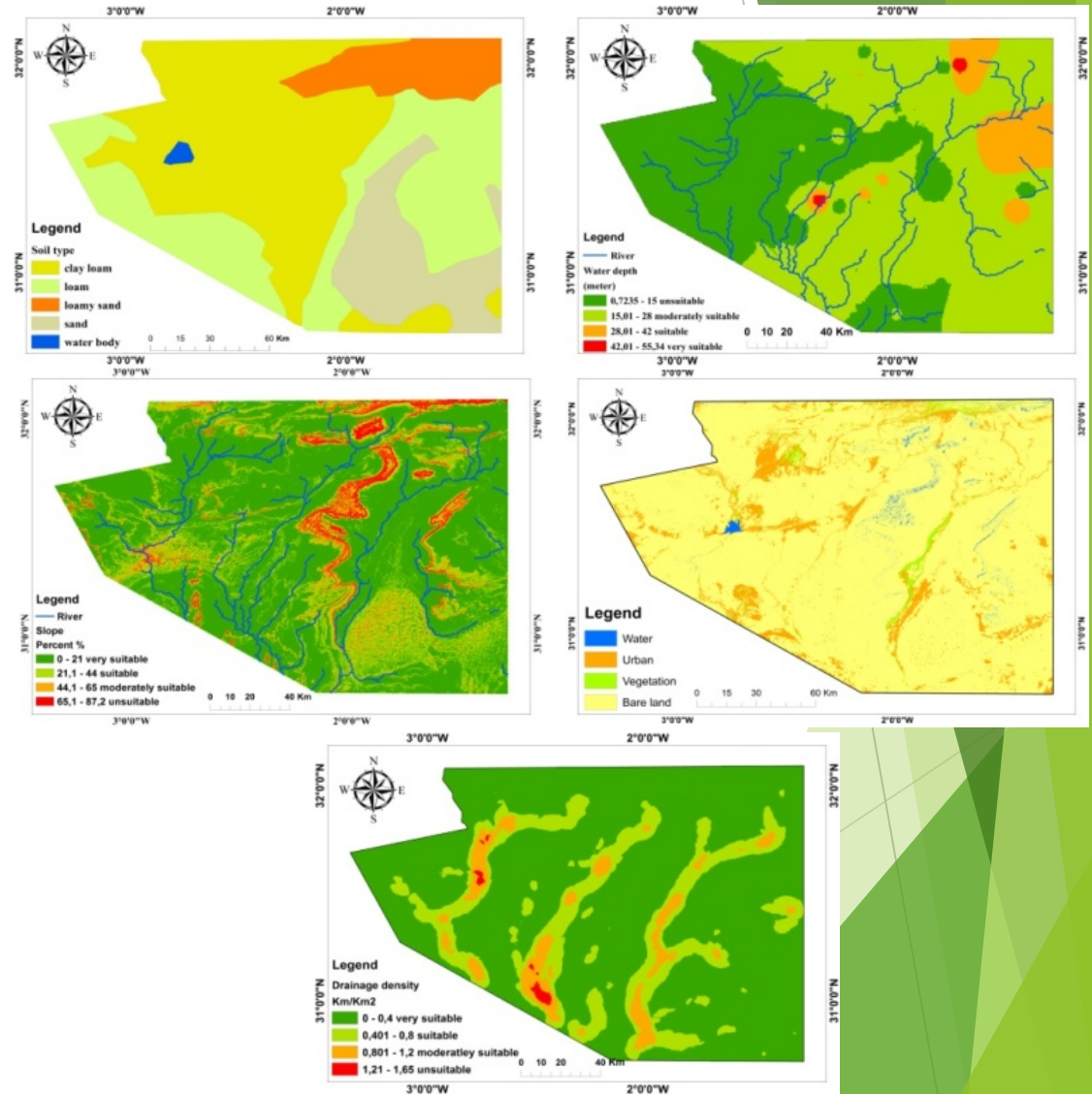


Materials and methods



Results

As a result of the application of the described process,



Results

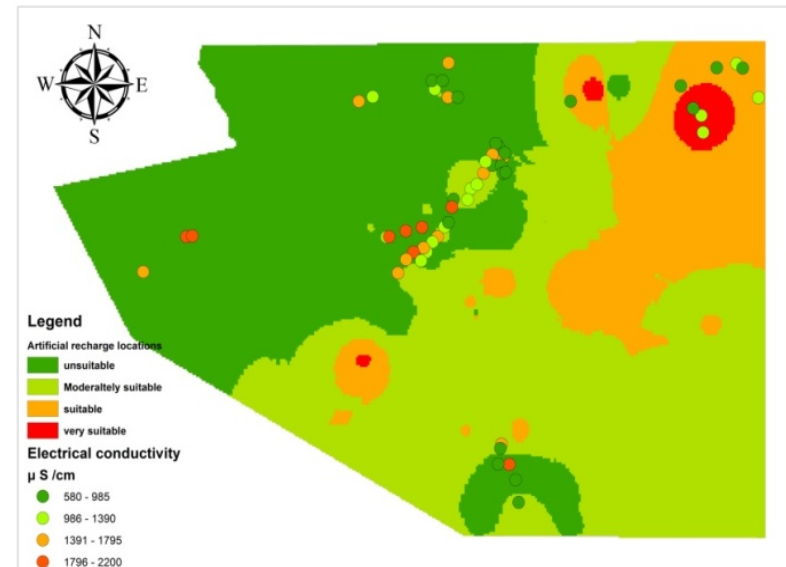
As a result of the application of the described process,

Parameter	Range	Class	Area (km ²)
Water depth (m)	0.7235 - 15	unsuitable	60 969,85
	15.01 - 28	moderately suitable	88 997,38
	28.01 - 42	suitable	11 585,74
	42.01 - 55.34	very suitable	447,0182
Soil type	clay loam	unsuitable	24 238,11
	loam	moderately suitable	52 169,96
	loamy sand	suitable	70 211,97
	sand	very suitable	15 379,94
Slope (%)	65.1 - 87.2	unsuitable	6 300,12
	44.1 - 65	moderately suitable	117 338,78
	21.1 - 44	suitable	27 065,40
	0 - 21	very suitable	11 295,67
Drainage density (km/km ²)	1.21 - 1.65	unsuitable	408,57
	0.801 - 1.2	moderately suitable	7 587,93
	0.401 - 0.8	suitable	125 509,75
	0 - 0.4	very suitable	28 493,74
Land use	urban	unsuitable	14 274,66
	bare land	moderately suitable	144 483,58
	vegetation	suitable	2 162,94
	water	very suitable	1 078,80

Results

The distribution of the results of the suitability classes in the study area showed that just - 1.3 % of the area is **very suitable** which is equal to 2208 km²;

- 15.6 % **suitable zones**;
- 42.47 % **moderately suitable** for the groundwater artificial recharge;
- 40.5 % classified as unsuitable zones.



Conclusion

- ▶ The parameters of (**soil type, drainage density, water depth, slope, and land use**) have been adopted to identify the most suitable zones of groundwater artificial recharge in the **region of Bechar**, Southwest of Algeria
- ▶ **Fuzzy logic system**, has been considered as a model of assessment with the combination of geographic information system (**GIS**),
- ▶ the derived results shows derived, **the most suitable zones** for groundwater artificial recharge are located in the Northeast of the study area by a rate of **1.3 %**. In the Northwest and West part of the study area, we identified the **most unsuitable zones** for artificial recharge by a total rate of **40.5 %**.
- ▶ As a result of use electrical conductivity (EC) as an indicator of acceptance of the obtained results , we could distinguish **43% of similarities** between the both classes of the **suitable zones** and **electrical conductivity** index .