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DIBI BROU

Elaboration of a cartographic model of favourable areas for boreholes establishment : Case of the watershed of Ehania, south-east of Ivory Coast.

PROBLEMATIC

Groundwater is the largest source of fresh water in the world and provide a buffer of risk to support the requests of critical water during dry periods (Assaf and Saadeh, 2008).

The exploitation of these aquifers is became very difficult because of the complexity of underground hydrogeological transfers .

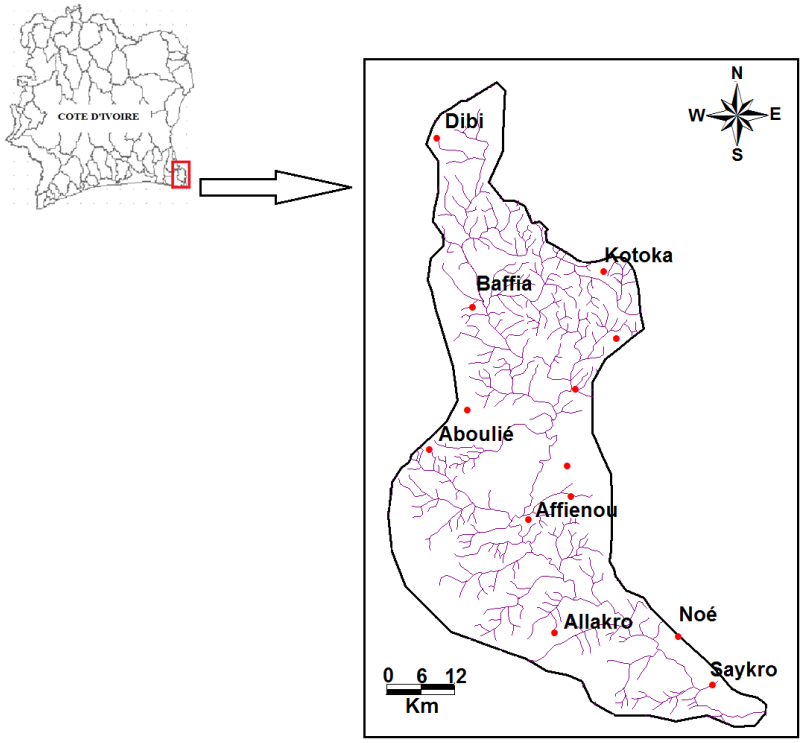
This complexity requires the use of several methods including the recent developed geophysical method (Magnetic Resonance Sounding (MRS)) (Wyns et al., 2004) for groundwater exploration.

The modeling of groundwater potential areas has already been the subject of several studies (Perrin et al., 2012; Barrat and Gutierrez, 2015). However, these studies remain limited by the choice of parameters.

MATERIAL AND METHODS

Presentation of the study area

The watershed of Ehania is located in the extreme south-east of Ivory Coast, between longitudes 2°45 W and 3°05 W and the latitudes 5°10 N and 5° 45N. It covers 342 km^{2}.



The geological formations are dominated by schists with the appearance of a few shreds of granites.

The hydrographic network which is considered as an indicator of recharge of aquifers is very dense in the North and less in the South.

MATERIAL AND METHODS

Materials

- The field material include a potentiometric probe, a GPS;
- Maps and alphanumeric data, boreholes data;
- Hydroclimatic data;
- Softwares;
- Satellite and digital elevation images.

Methods

Intrinsic characteristics of aquifer

Slopes have been generated by digital elevation model and varie from 0 to 30%.

Saprolite is obtained by using bed rock model coupled to the saprolite thickness that ranges from 2.25 to 68 m.

MATERIAL AND METHODS

Methods

Intrinsic characteristics of aquifer

The density of fracturing has been developed from the map of fracturing alaborated from satellite images of Landsat 7 of February 2000.

Characteristics related to the presence of water

Recharge has been calculated from the combination of infiltration and drainage density.

The static levels indicate the level of water in aquifers. In our study area, its varies from 1.96 to 63.8 m.

MATERIAL AND METHODS

Methods

Calculation of weighting coefficients

Calculating weighting coefficient is made from the method of Saaty (1977) based on the comparison in pairs developed by El Morjani (2003).

Verbal expression of the relative importance of a criteria	Ratings
Less important	1/3
slightly less important	1/2
Same importance	1
slightly more important	2
Most important	3

$$V_{p_i} = \sqrt[n]{\prod_{i=1}^{n} Ni} \quad \text{and} \quad W_i = \frac{V_{p_i}}{\sum_{i=1}^{n} V_{P_i}}$$

With Vpi = eigen vector of each factor; = Ni Value of each factor or criterion and (Wi) the weighting coefficient (Wi) of each factor

MATERIAL AND METHODS

Material

Calculation of weighting coefficients

Criteria	Coef.
Intrinsic characteristics of aquifer	
Slope	0.38
Saprolite	0.34
DF	0.28
Characteristic presence of water	
Recharge	0.6
Depth	0.4

Elaboration of the map of potential areas

$Ip = W_cCi + W_rRe$

Criteria	Coef.
Intrinsic characteristics of aquifer	0.6
Characteristic presence of water	0.4

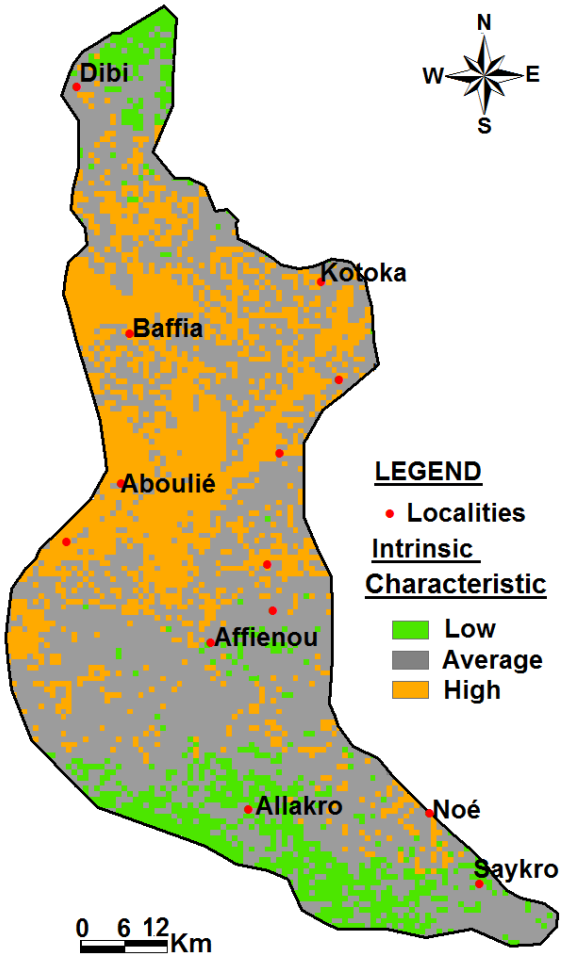
$Ip = 0.6Ci + 0.4Re$

These results obtained are validated by using datas of yield of borehole those are higher than $5m^3/h$ which indicate the presence of fracture.

RESULTS AND DISCUSSION

Results

Intrinsic characteristics of the aquifers



This factor remain dominated by average conditions of water available that is found on the whole extent of the study area.

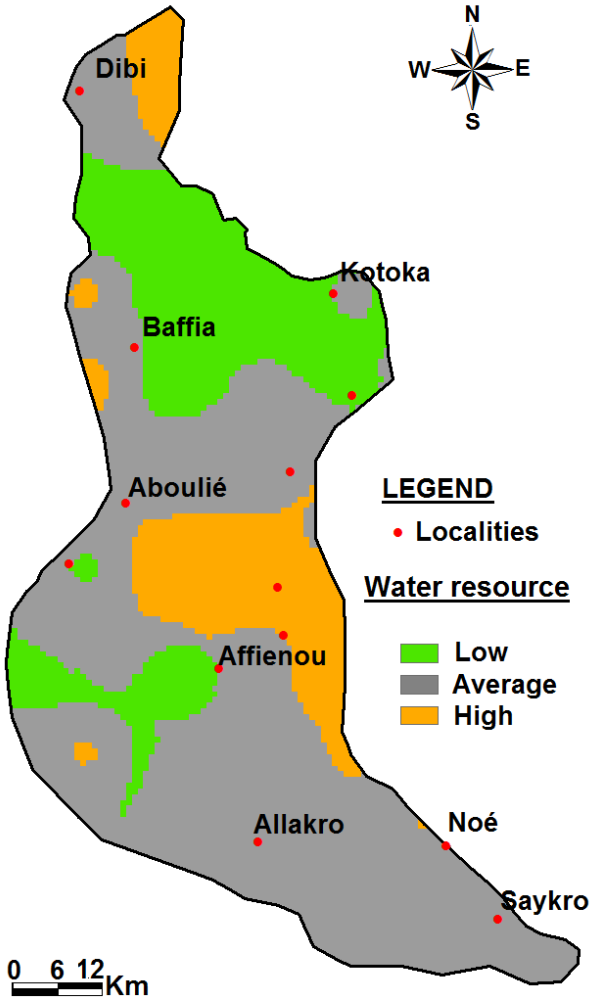
High availability which covers 25% of this zone is observed in the central areas with smalls zones in the southern and northern parts of the study area.

The quality of these results could be justified by the fact that more than 60% of greater yield are overlap to the high zone.

RESULTS AND DISCUSSION

Results

Characteristics related to the presence of water



This results indicate that the most important zone are covered by average presence of water which is found on the whole extent of the study area.

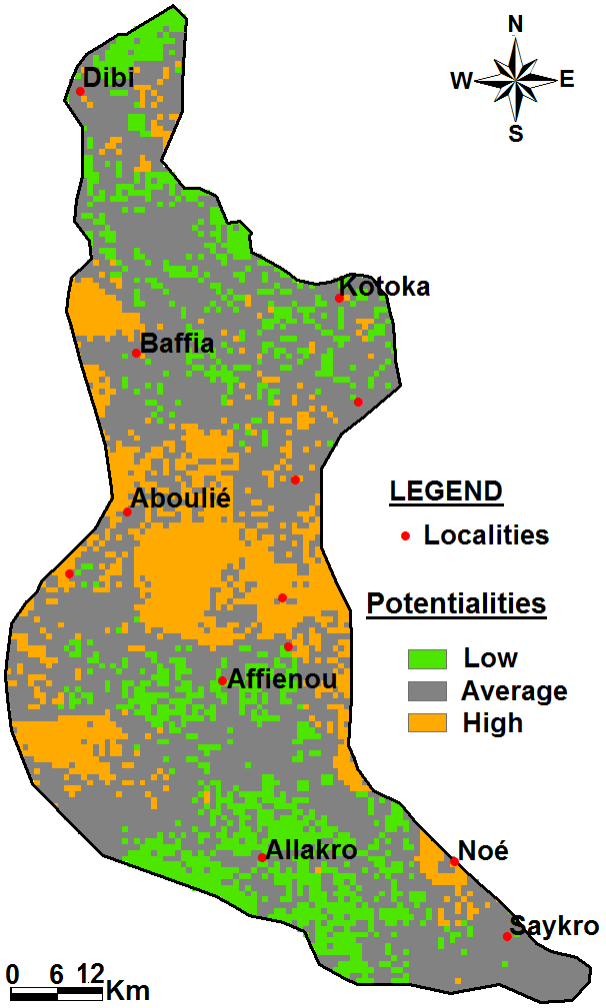
High availability which represented 14 % of this zone is observed in the central areas with smalls zones in the northern parts of the study area.

The superposition of the high yield of exploitation to this map shows that only 40% overlap to the high zone.

RESULTS AND DISCUSSION

Results

Potentialities of groundwater



Ehania watershed, the high zone which is looking for is presented in the centre with small zone on all parts of the watershed.

High zone that represent 25% is observed in the central part and with few apparition in the north and south.

High zone is observed where slopes are generally weak with high recharge and saprolites have high porosity.

RESULTS AND DISCUSSION

Discussion

the study area remains dominated by the Areas of average potentiality whose presence could be justified by an alternating of average available associated to area with high water resource.

The different zones observed show the importance of the three parameters that are slope, recharge and saprolite according to its nature and thickness.

The combination of three criteria for the modeling groundwater potentiality has already been successfully adopted by Dickson et al. (2015).

The weakness of high zone could be also justified by existence of less granitoids formations of different sizes that are indicated by Hirdes et al (2004).

CONCLUSION

Modeling of potential in groundwater using GIS and MCA has been a success and would constitutes an important contribution in the exploration of groundwater.

The use of the main parameters that characterize the site really produce very interesting results could reduce the failure rate in boreholes.

The high potentialities zones are observed where slopes are generally weak with high recharge and saprolites have high porosity.

THANK YOU FOR YOUR ATTENTION