ENVIRONMENTAL RISK MANAGEMENT USING GEOGRAPHIC INFORMATION SYSTEM (GIS): DELIMITATION OF GROUNDWATER POLLUTION DUE TO WASTE WATER TREATMENT ISSUES

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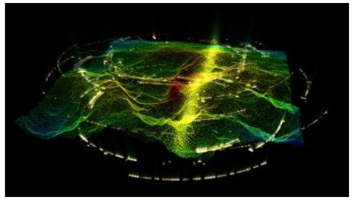
INTRODUCTION

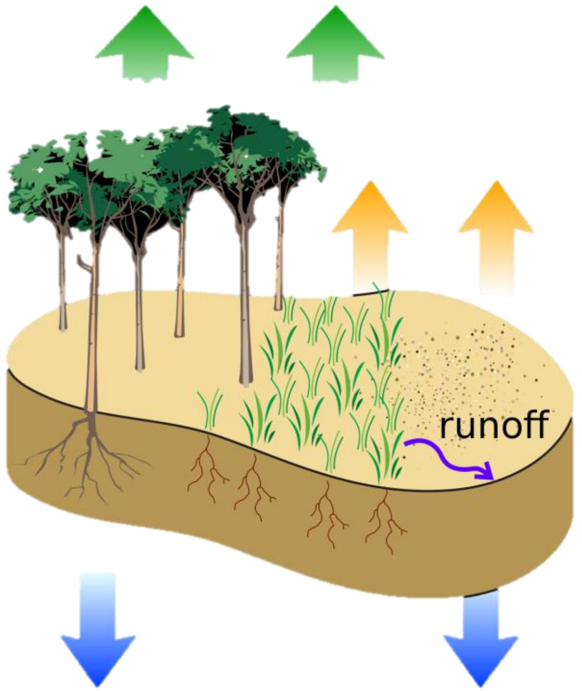
- the good governance of groundwater is at the heart of Sustainable Development Goals (SDGs) since it plays a crucial role in ensuring food security, sustainability of ecosystems and facing the challenges of climate change.



- Geospatial technologies such as Geographic Information System (GIS) and remote sensing could play a relevant role in the domain of environmental risk assessment.

- determine the zones that could be affected by the pollution caused by the bad treatment of wastewater
- propose a plan for risk management

FACTORS AFFECTING GROUNDWATER RECHARGE



Groundwater recharge is the process of water circulation from the top surface to the feed aquifers.

Factors affecting groundwater recharge:

1- Precipitation quantity

2- Soil

3- Geology

5- Land use

5- Topography

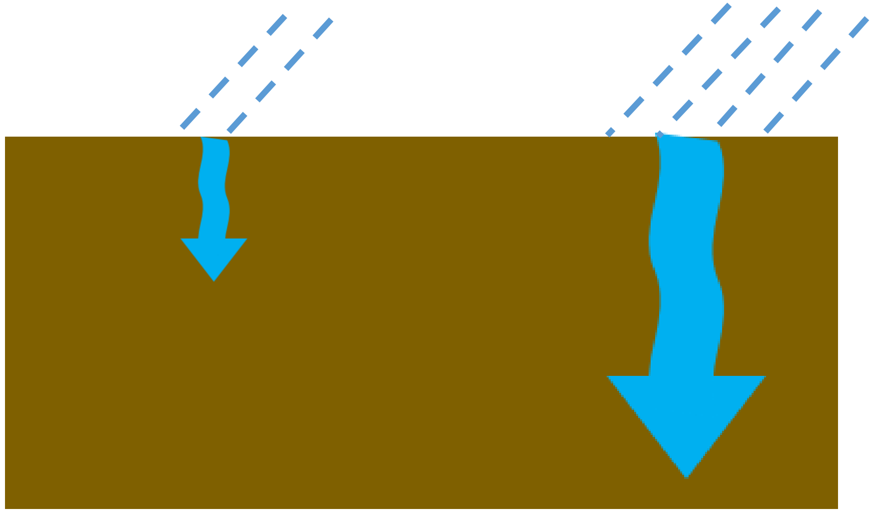
6- Lineament density

7- Drainage density

FACTORS AFFECTING GROUNDWATER RECHARGE

1- Precipitation

Rainfall is known to be the dominant source of groundwater recharge across all climatic regions



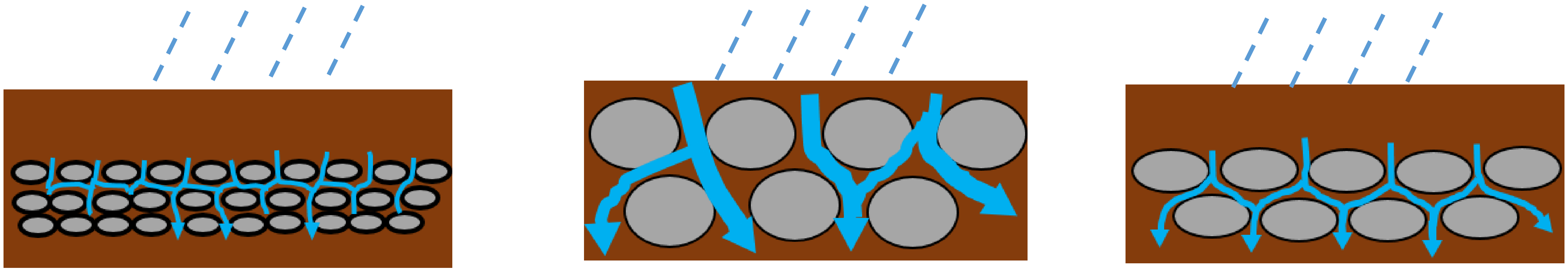
2- Soil

Soil type affects groundwater recharge. Some types could be considered more favorable for recharge than others.

FACTORS AFFECTING GROUNDWATER RECHARGE

3- Geology

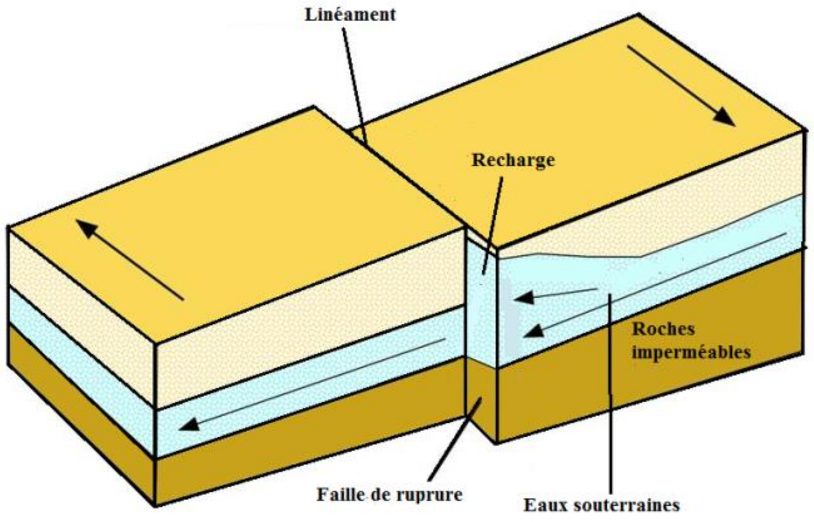
Geology affects the recharge process. Some geological features could be considered more favorable for recharge than others.



FACTORS AFFECTING GROUNDWATER RECHARGE

4- Lineament density

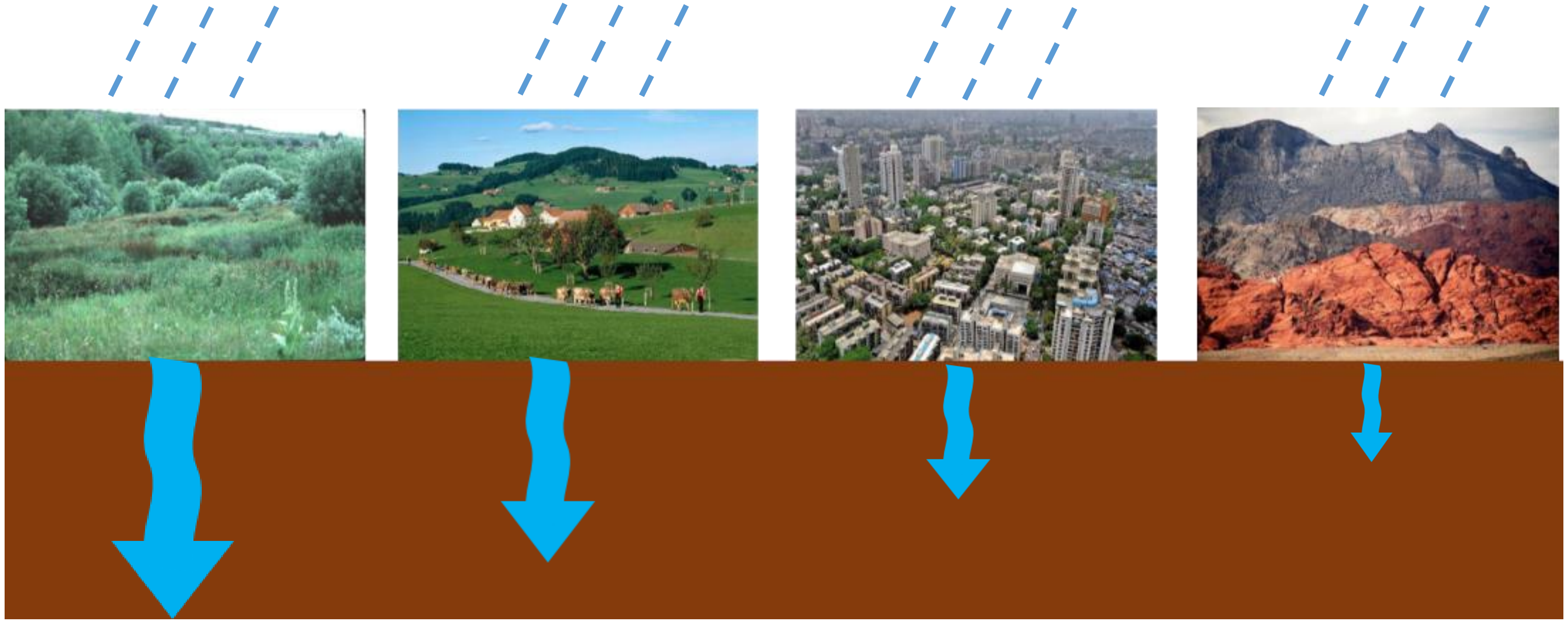
Lineaments are linear or curvilinear structures on the earth surface, which indicate the variation of rock′s resistance or the presence of fractures. These fractures promote the infiltration of water, so lineament features indirectly reveal the groundwater potential zones. As a result, areas with high lineament density are good for ground water potential zones.



FACTORS AFFECTING GROUNDWATER RECHARGE

5- Land use

Land use plays a significant role in the development of groundwater resources. It controls many hydrological processes in the water cycle such as infiltration, evapotranspiration, surface runoff etc.



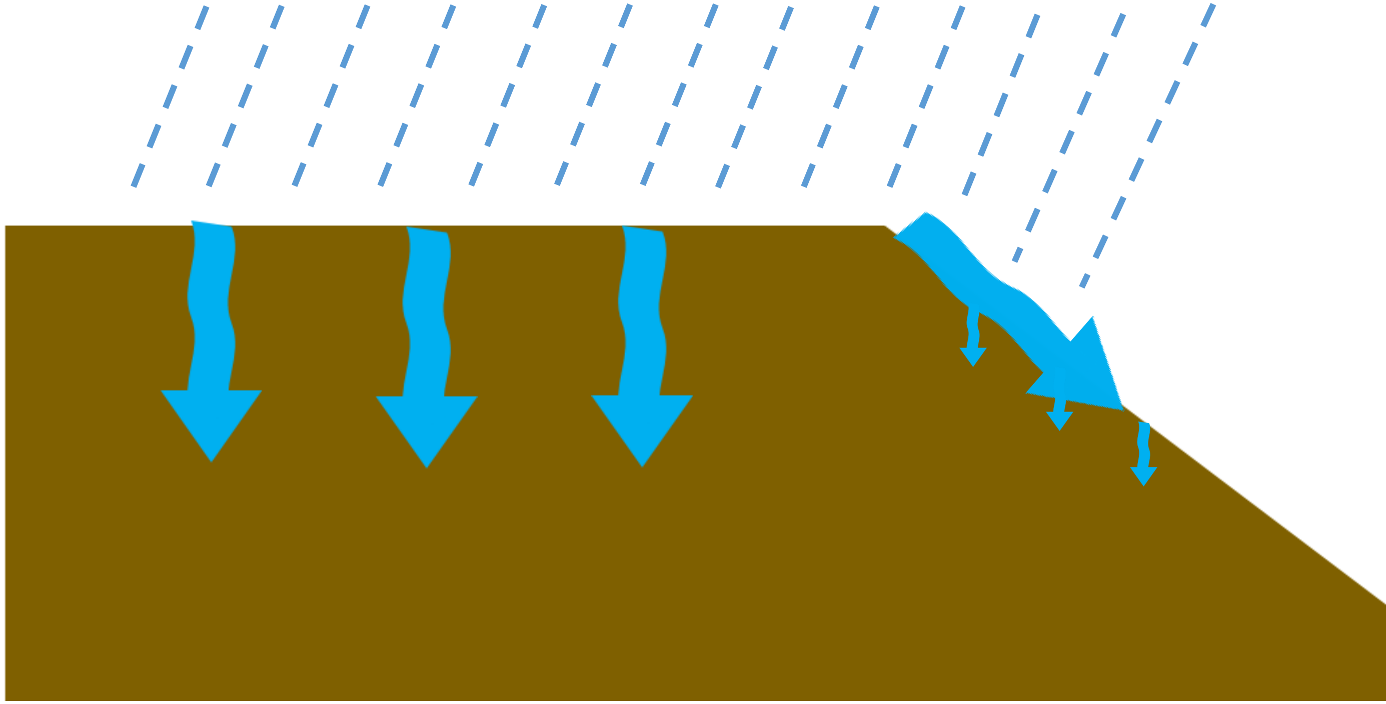
FACTORS AFFECTING GROUNDWATER RECHARGE

6- Slope

- Slope has an important role in precipitations‘‘ infiltration and then in groundwater recharge.

- High degree of slope results in rapid runoff and increased erosion rate with feeble recharge potential.

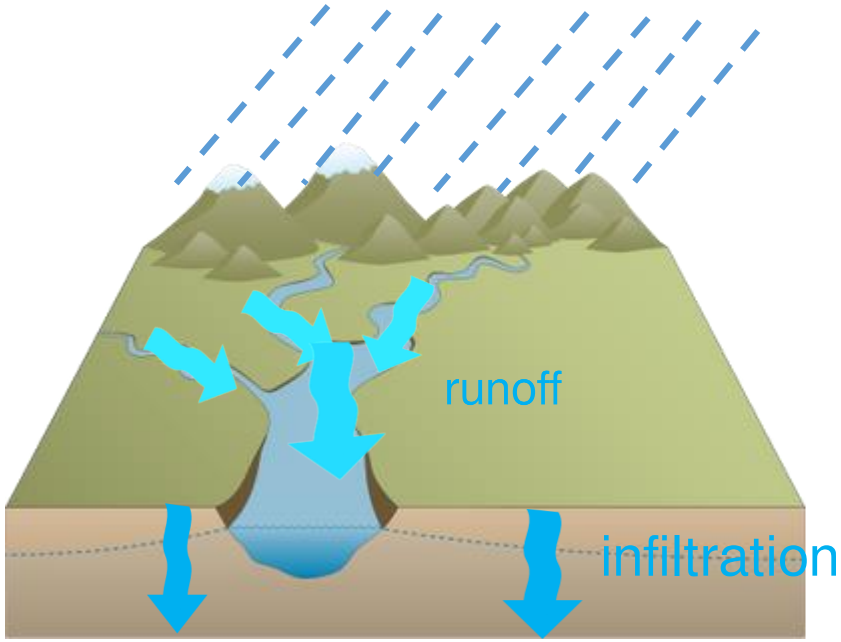
- Larger slopes produce a smaller recharge because water runs rapidly off the surface of a steep slope during rainfall, not having sufficient time to infiltrate the surface and recharge the saturated zone.



FACTORS AFFECTING GROUNDWATER RECHARGE

7- Drainage density

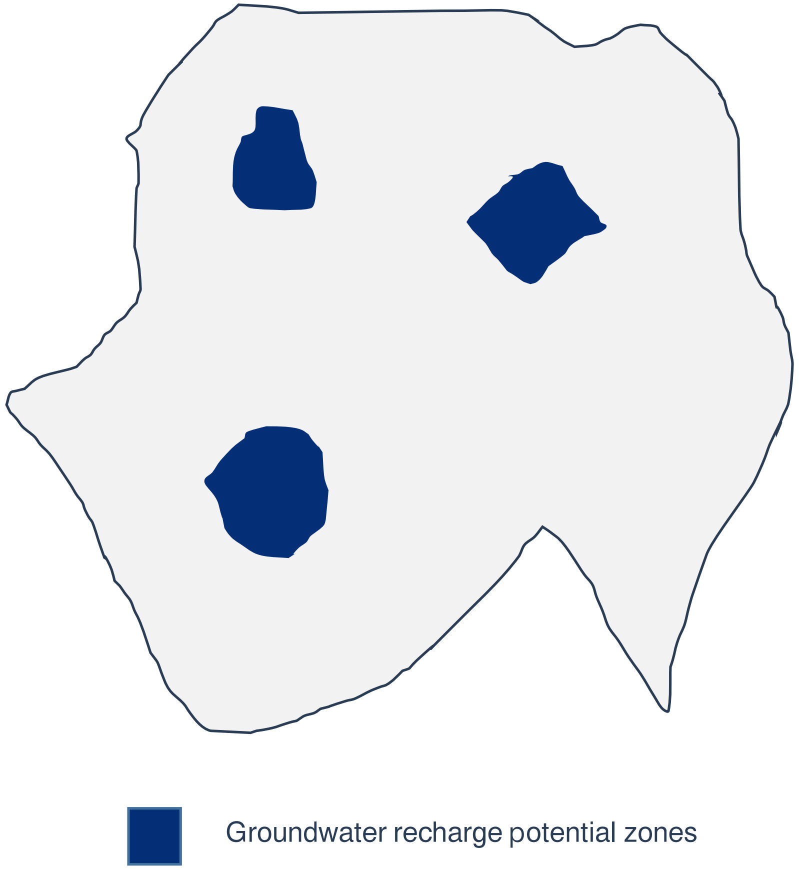
The structural analysis of a drainage network helps assess the characteristics of the groundwater recharge zone. It's defined as the closeness of spacing of stream channels and it's an inverse function of permeability. It is a measure of the total length of the stream segment of all orders per unit area.



RELEVANCE OF STUDYING GWRPZ

Determining groundwater recharge potential zones helps in:

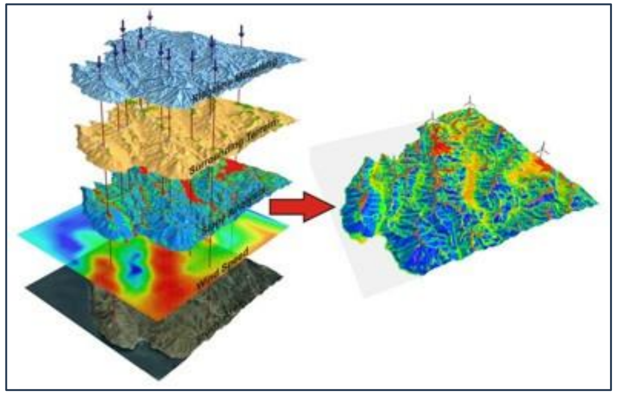
- Specifying zones that have to be protected from pollution in order to guarantee the sustainability of this resource.
- Orienting land use planning to conserve those zones.



GIS AND REMOTE SENSING IN GWRPZ DELIMITATION

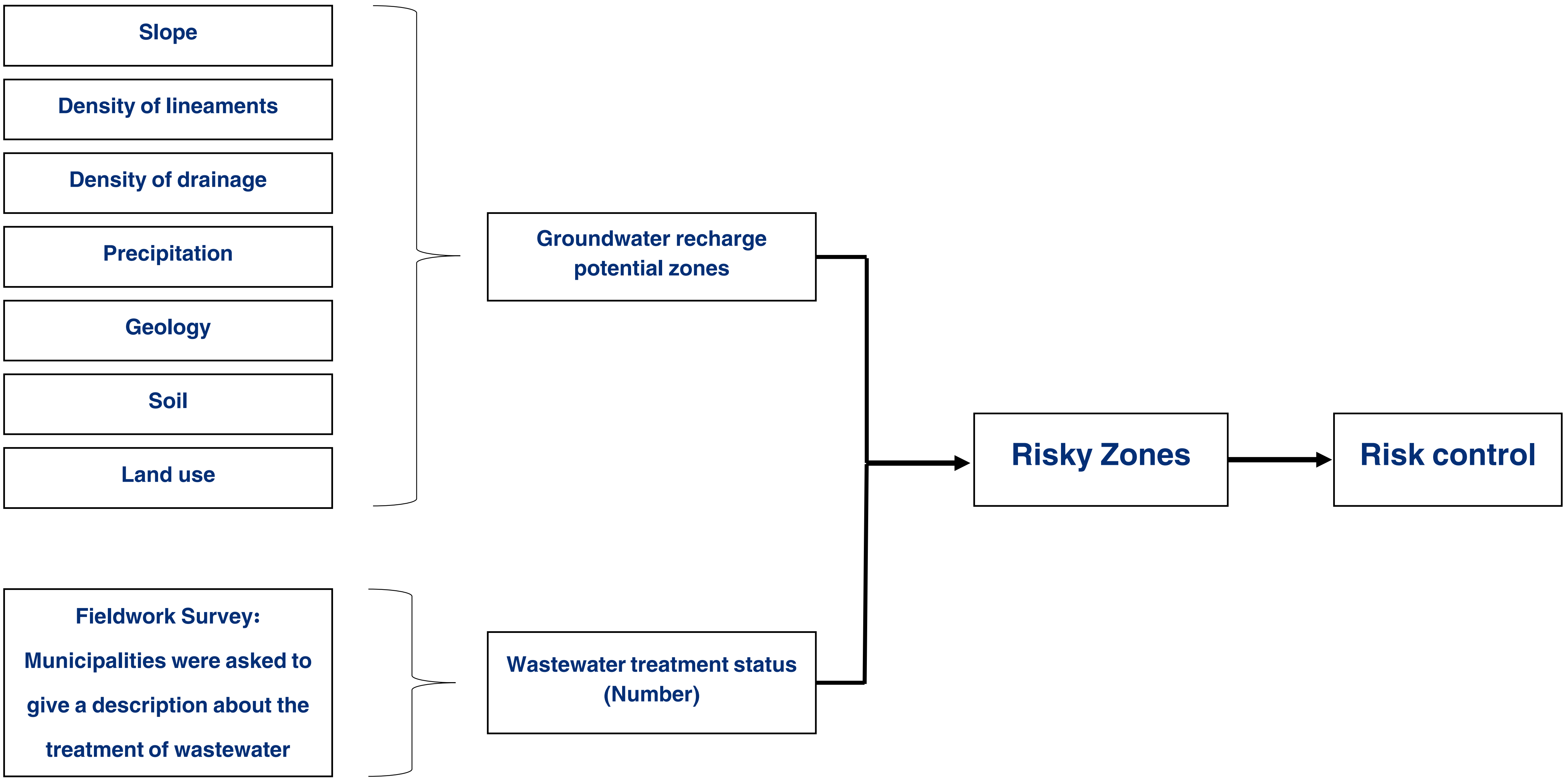
Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object. The term is applied especially to acquiring information about the Earth from satellites.

A geographic information system (GIS) is a framework for gathering, managing, and analyzing geospatial data.



Analyzing the data provided by satellite using Geographic Information System (GIS) could help in delimitating groundwater recharge potential zones.

METHODOLOGY



STUDY AREA

LOCATION

Nabatieh Caza is one of the four districts (*Caza*) of Nabatieh Governorate (*Mohafaza*), located on the southern border of Lebanon

GENERAL INFORMATION

304 square kilometers

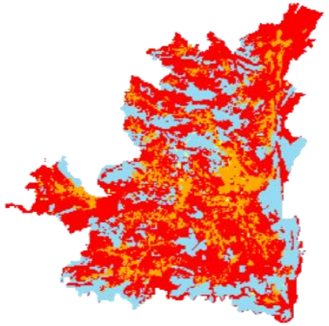
111,000 people

39 municipalities

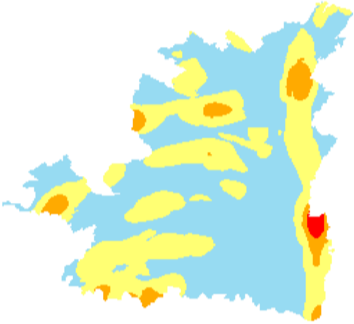
RESULTS: FACTORS MAPS

Remote sensing and data have been used to prepare maps about the already mentioned factors.

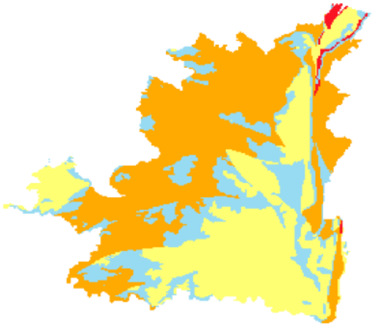
Maps have been classified according to their influence on groundwater recharge.



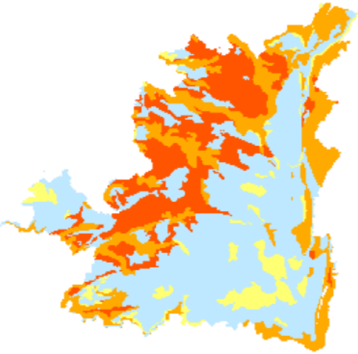
Land use



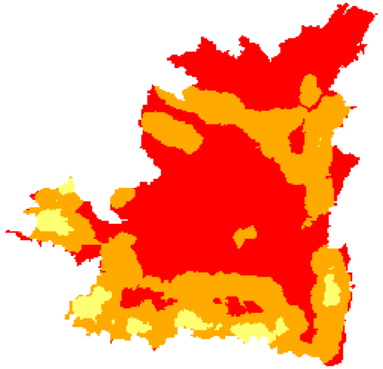
Lineament density



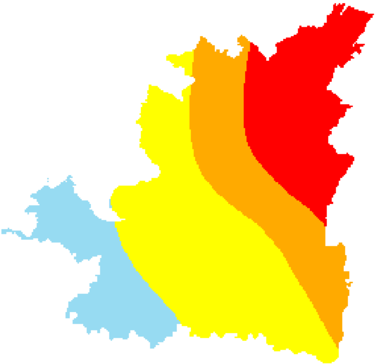
Geology



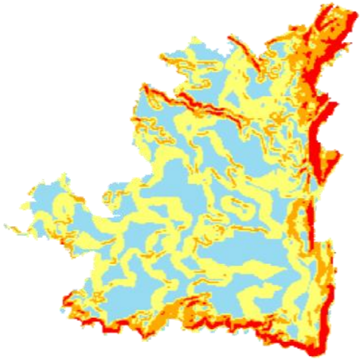
Soil



Drainage density



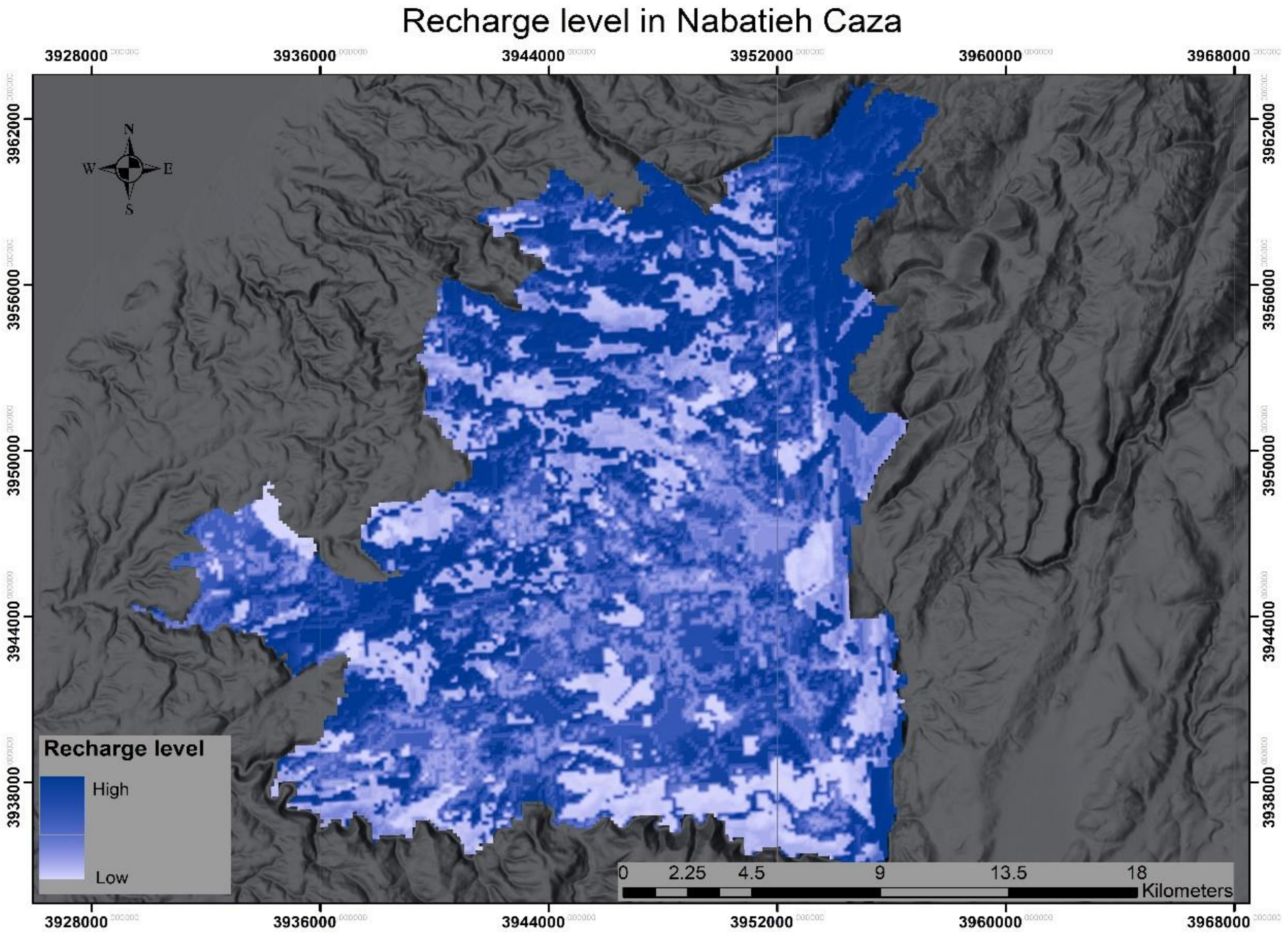
Precipitation



Topography

RESULTS: GROUNDWATER RECHARGE POTENTIAL ZONES

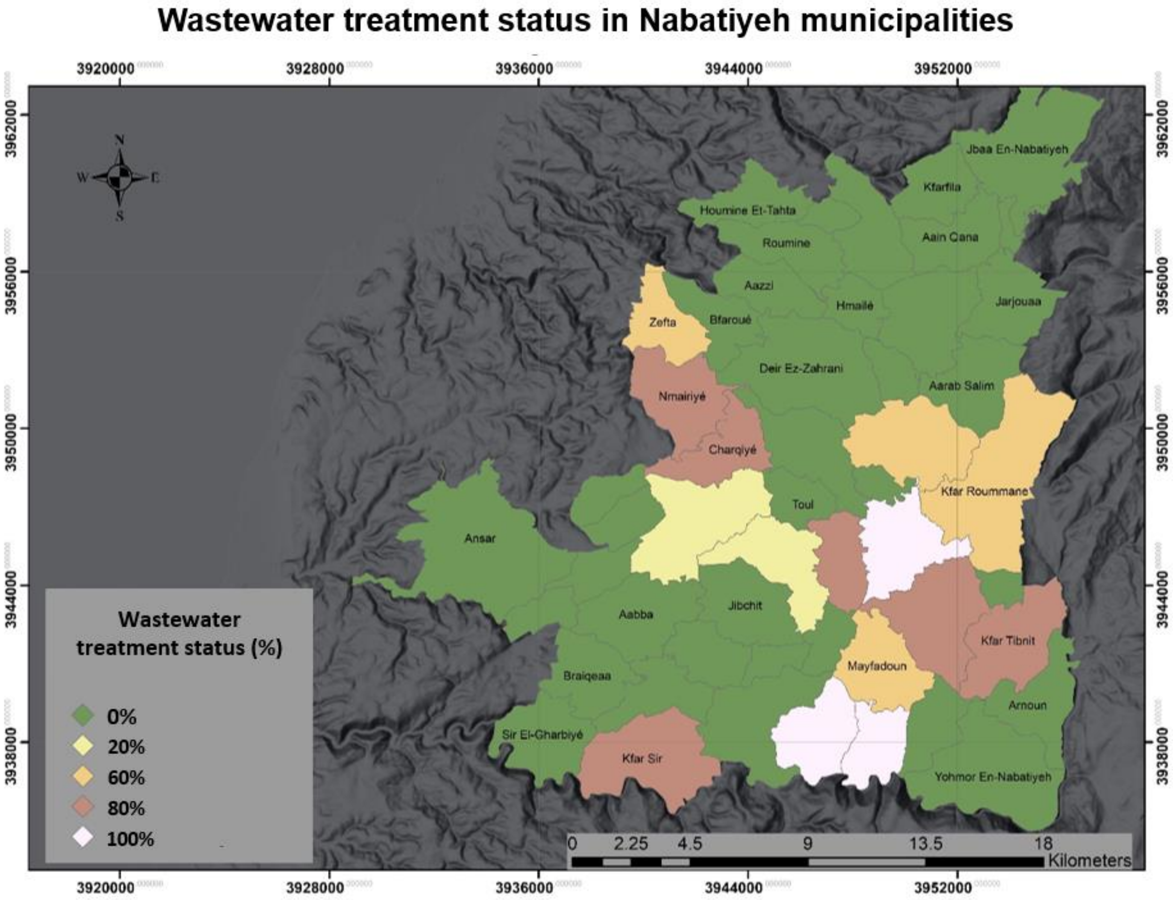
- The application of the model by combining the seven layers has generated the following map.
- High recharge area are distributed over the study especially in the northern parts.
- The map shows that 70% of the study area presents high recharge.



RESULTS: WASTE WATER TREATMENT STATUS

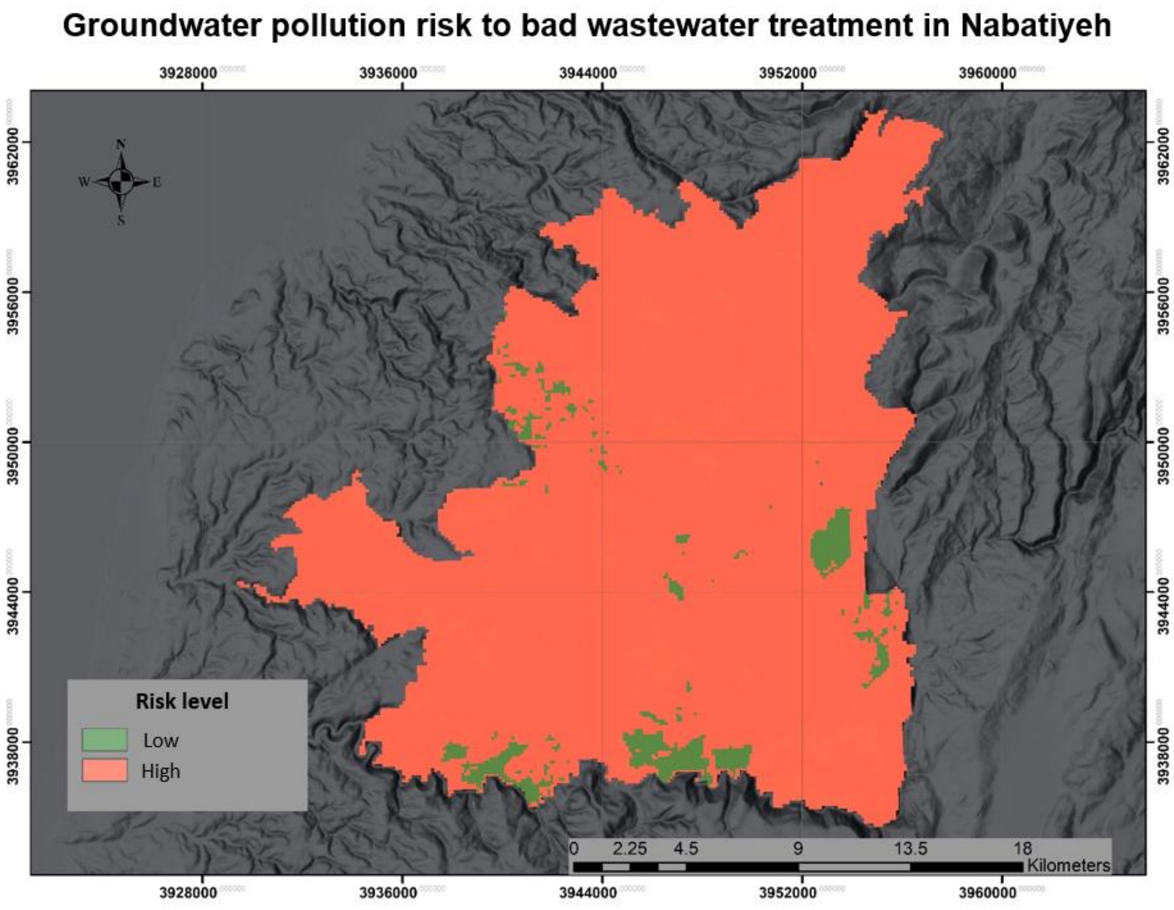
- As a result of the performed survey, the following map has been established which represents the status of water treatment in each municipality.

- The majority of Nabatiyeh municipalities have inconvenient wastewater treatment status.



RESULTS: RISK EVALUATION

The overlay between the groundwater recharge potential zones map and the map of wastewater treatment status has resulted in the following map which represents the risky zones.



RESULTS: RISK CONTROL

In order to control the risk caused by bad wastewater treatment, the following steps must be taken:

1- Development, and in some cases establishment, of wastewater treatment networks.

2- Protection of high recharge zones through the establishment of new plans respecting those zones.

3- Imposition of fines for not respecting the condition of wastewater treatment.

CONCLUSION

- The conservation of water resources, and especially groundwater, should be a priority.
- The use of Geographic Information System (GIS) and remote sensing technologies was efficient for the delimitation of groundwater recharge potential zones.
- The performed survey allowed the authors to evaluate the status of wastewater treatment and to quantify it.
- The combination of the map representing the recharge zones and the map representing the status of wastewater treatment was relevant to determine the zones who suffer from pollution risk due to the inconvenient wastewater treatment.
- It is necessary to take immediate measures related to the planning of the region and the establishment, and development, of wastewater treatment networks.

THANK YOU!

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