

# **GEOSPATIAL INFORMATION FOR SUSTAINABLE GROUNDWATER MANAGEMENT**

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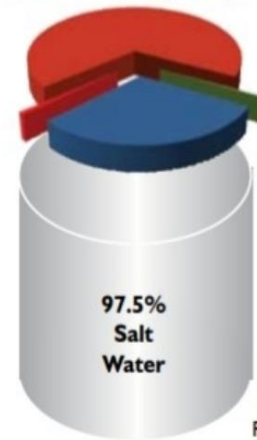
# introduction

- Geospatial information is data referenced to a place, a set of geographic coordinates which can often be gathered and displayed in real time.
- Geospatial information describes the location and names of features beneath, on or above the earth's surface.

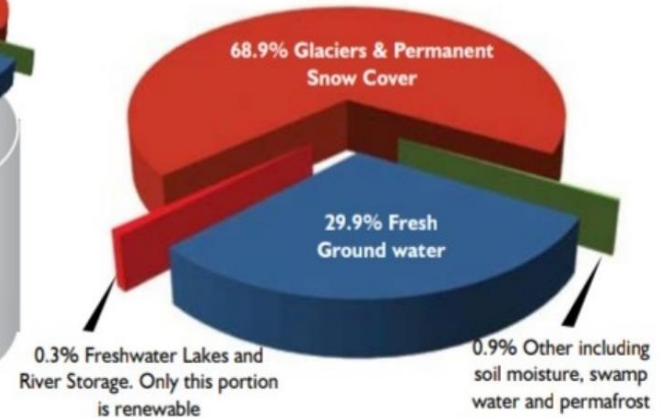
# Introduction cont.'

- Groundwater is a considerable component of the total global fresh water.
- It represents 29.9% of the Earth fresh water resources
- The “starting point” for groundwater management is to map the location of available groundwater.

TOTAL GLOBAL (Water)



2.5% OF TOTAL GLOBAL (Freshwater)



# Why groundwater resources management?

- ❖ For sustainable development of the resource for various users,
- ❖ balancing the available resources with the increasing demands of water use,
- ❖ balancing groundwater recharge against abstraction,
- ❖ groundwater protection from pollution.

# Pressure on groundwater development



- Rapidly increasing demand for urban water-supply provision
- Expansion of groundwater use for irrigation.
- Water provision for dispersed rural communities.

# Information needed for groundwater management

- The extent (boundaries) of the aquifer system;
- The aquifer properties;
- The sources of recharge to the system;
- The discharges from the system (incl. extractions from bores);
- Changes of these characteristics with time

# Information needed for groundwater management cont.'

**The information on the GW system characteristics comes from:**

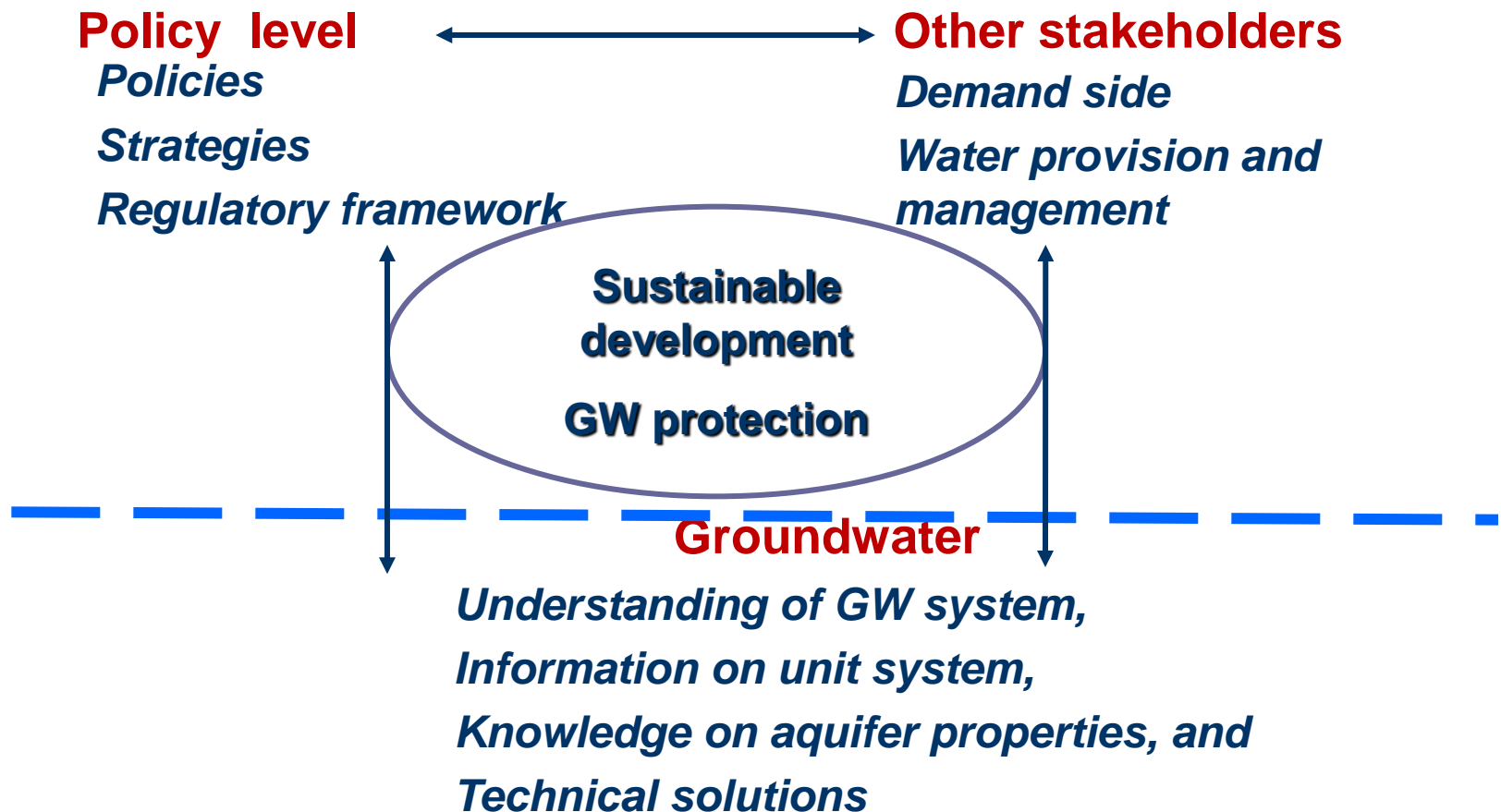
- Hydrogeological investigations;
- Analysis of pump test data;
- Data on surface water hydrology (rainfall ,
- Records of groundwater levels in boreholes, and
- Records of groundwater extractions.





What is the suitable format to present groundwater information to decision makers?

# The needed interaction to provide suitable GWR information



# Groundwater monitoring

- Groundwater monitoring and groundwater data acquisition are essential for any effective management of groundwater resources.
- **Monitoring include:**
  - the quality and availability of the resource itself,
  - compliance with abstraction and disposal regulations and permits.

# Groundwater monitoring, cont.'

## Fundamental types of monitoring

- **resource monitoring :**

- considers the changes in quality and quantity of the groundwater resource over time.

- **compliance monitoring :**

- assesses the behavior of the groundwater stakeholders/users and the impact of their activities on the resource.

# What do we need to consider?

1. **Geological and Hydrogeological mapping**
2. **Aquifer thickness/Extent** : apply geophysical methods, analyse lithological logs
3. **Aquifer parameters**: Specific yield, porosity, transmissivity, storativity
4. **GW quality** : geochemistry, ions, metals
5. **Recharge amount** : apply water balance methods
6. **GW storage** : apply water balance methods
7. **Recharge history** : Environmental isotopes
8. **GW yield** : conduct pumping test (constant and step drawdown)
9. **Water use** : GW dependent communities and ecosystem

# Prevention of Groundwater Pollution

- legislating adequate controls at waste disposal sites
- installing appropriate monitoring and leachate collection structures at such sites.
- **Education must form part of the prevention campaign**
- Policing of waste sites and illegal dumping

# Groundwater management challenges

- GW is invisible and there is often limited data on its physical distribution and aquifer characteristics.
- GW flow in the aquifer systems is difficult to ascertain due to:
  - Natural discharge and recharge
  - Climate change, etc
- Lack of sufficient groundwater professionals on permanent basis: Hydro geologists

# Types of data required for groundwater management

TYPE OF DATA	BASELINE DATA (From Archives)	TIME VARIANT DATA (from field stations)
<b>Groundwater occurrence and aquifer properties</b>	<ul style="list-style-type: none"> <li>● Water well records (hydrogeological logs, instantaneous groundwater levels and quality)</li> <li>● Well and aquifer pumping tests</li> </ul>	<ul style="list-style-type: none"> <li>● Groundwater level monitoring</li> <li>● Groundwater quality monitoring</li> </ul>
<b>Groundwater use</b>	<ul style="list-style-type: none"> <li>● Water well pump installations</li> <li>● Water use inventories</li> <li>● Population registers and forecasts</li> <li>● Energy consumption for irrigation</li> </ul>	<ul style="list-style-type: none"> <li>● Water well abstraction monitoring (direct or indirect)</li> <li>● Well groundwater level variations</li> </ul>
<b>Supporting information</b>	<ul style="list-style-type: none"> <li>● Climatic data</li> <li>● Land use inventories</li> <li>● Geological maps/ sections</li> </ul>	<ul style="list-style-type: none"> <li>● Riverflow gauging</li> <li>● Meteorological observations</li> <li>● Satellite land use surveys</li> </ul>



# Stakeholder participation in groundwater management

## Why the need of Stakeholders participation?

- Management decisions taken by the regulatory agency without social participation are often hard to implement,
- The integration and coordination of decisions relating to groundwater resources, are made possible through stakeholder cooperation.

# Conclusion and recommendation

## **Management aspect**

- ✓ Develop detailed national scale groundwater availability maps and reports
- ✓ Develop groundwater monitoring program: Abstraction, recharge, quality
- ✓ Develop strategy on the groundwater use based on the demand.
- ✓ **Introduce water demand management techniques to minimise loss**

# Conclusion

- ✓ Geographical Information Systems (GIS) use the powers of a computer to display and analyze spatial data that are linked to databases.
- ✓ When a specific database is updated, the associated map will be updated as well. Thus by continually updating data captured from monitoring, updated maps are available.
- ✓ for stakeholders to view, GIS databases can include a wide variety of information such as population and borehole sites, pollution hotspots, etc.

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***THANK YOU !!!***