

# **Design of a groundwater monitoring network in Uganda**



**by**

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## Why monitor GW resources?

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- ❖ Major source of domestic water supply
- ❖ Increasing water demands
  - ▶ Population growth; rate 3.3%
  - ▶ Agricultural & Industrial productivity
  - ▶ MDG 7; Access to safe drinking water
- ❖ Development unparallel to effective management & protection plans
- ❖ Finite source & can be degraded



# History of GW monitoring in Uganda

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- ❖ Initiated in 1998, support from Danish govt
- ❖ Coverage: National
- ❖ Initial GW network
- ❖ Reviewing of Initial Network
- ❖ Improved GW Network



## Initial National GW Network

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- ❖ Comprised of 15 wells
- ❖ Strategy for network establishment
  - ▶ Identify abandoned/existing borehole atleast in every geological formation
  - ▶ Cleaning/rehabilitation, and pumping test
  - ▶ Equipment Installation
- ❖ Reviewing of initial network
  - ▶ Recommendations of reviews about suitability of several stations, data quality, further expansion



## Constraints - Initial GW network

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- ❖ Insufficient coverage
- ❖ Inappropriate locations
- ❖ Insufficient borehole information,
- ❖ Insecurity in northern Uganda
- ❖ Vandalism



# Improved GW network

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## ❖ Strategy for expansion

- ▶ Drilling and Rehabilitation
- ▶ Based on WR Issues; Address key issues
  - ❖ Defn: Water resource issues are basic problems that affect the water users directly.
- ▶ Participatory process; Involvement of technical staff and key stakeholders

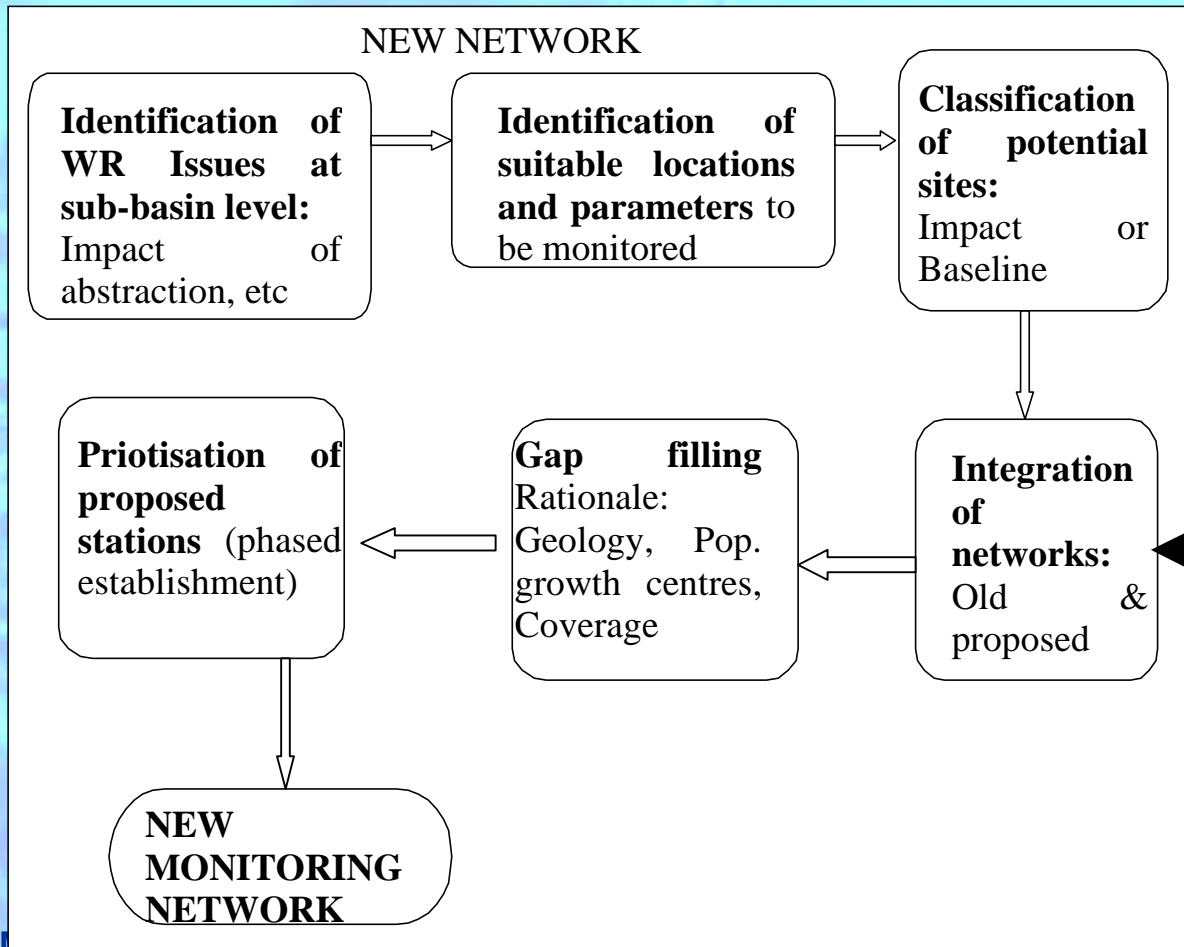
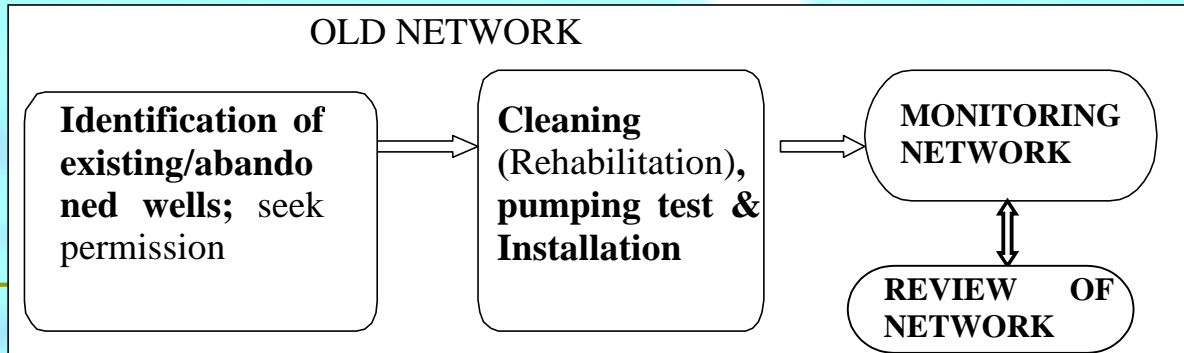


# Approach to Network design

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## ❖ Guiding principles

- ▶ Accommodate comments/recommendations of previous reviews.
- ▶ Facilitate integration of WRM activities to improve synergy and reduce cost.
- ▶ Be developed through a systematic, continuing process as priority of WR issues is bound to change; review a continuous process .



Approach to network design



# Identification of Water Resources Issues at basin level

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- ❖ WR issues as foundation for network expansion.
  - ▶ Impact of abstraction, long-term climatic change, seasonal variations, poor water quality, pathogenic contamination, pesticide pollution, nitrate pollution, and state of water resources.




## Selection of locations for monitoring and parameters to be monitored

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- ❖ Appropriate location(s) and parameters to be monitored in relation to WR Issues
  - ❖ Logical experience from staff
  - ❖ Maps (water quality, geological/hydrogeological etc)
- ❖ Geo-referencing - topo maps (1:50,000), Arc View, & GPS
- ❖ Parameters: Basically water level, (occasionally Hydrochemistry)

# Classification of stations

 <b>Type</b>	<b>Objective</b>	<b>Purpose</b>
Impact station	Monitor changes of GW levels and chemistry due to abstraction	<ul style="list-style-type: none"> <li>. Meet research aspects.</li> <li>. Early warning system</li> </ul>
Baseline	To monitor background situation	<ul style="list-style-type: none"> <li>. Determine natural conditions not impacted by humans,</li> <li>. Natural GW behavior and long term trends due to natural processes; effects of climate.</li> <li>. Establish relation between rainfall and GW levels</li> </ul>



## Integration of Old and proposed network

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- ❖ Identification of gaps (geographical & geological) and redundancies.
- ❖ Evaluation of Initial network of 15 wells
  - ▶ Replacement/deletion; 2 replaced, 1 deleted
- ❖ Incorporation of review conclusions/recommendations
- ❖ Frequency of monitoring: Daily
- ❖ Total = 47 wells (12 old & 35 new)



# Prioritisation of proposed monitoring stations

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## ❖ Rationale

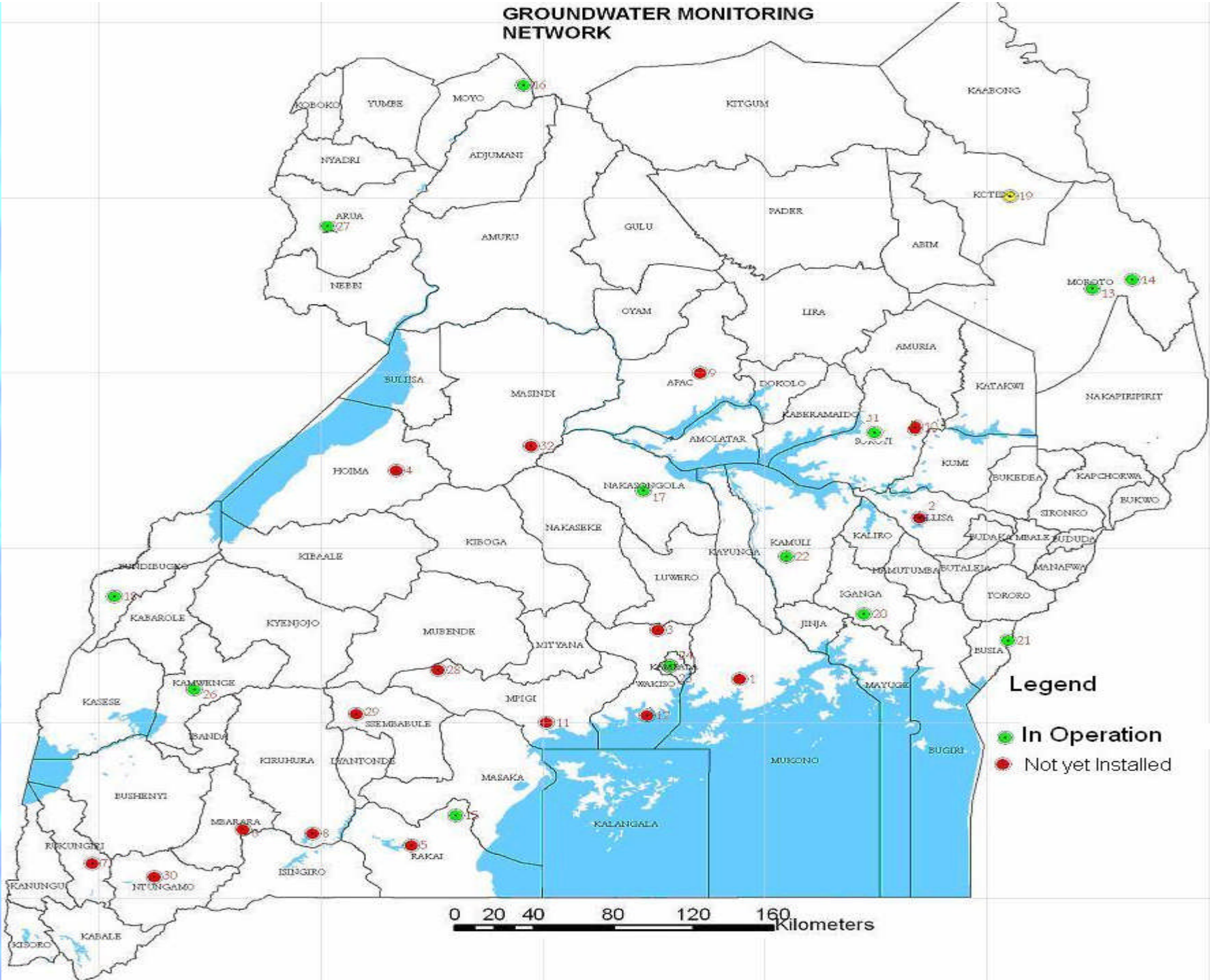
- ▶ Budget limitations

## ❖ Methodology:

- ▶ Weighting system based on 3 factors; WR issues, geology and spatial distribution.
- ▶ Assessment of factors and scoring

## ❖ Target: network expanded to 32 out of 47 proposed wells

# GROUNDWATER MONITORING NETWORK



- Legend**
- In Operation
  - Not yet Installed

0 20 40 80 120 160 Kilometers



# Construction and installation of monitoring wells

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- ❖ Where to drill or use existing borehole??
- ❖ What equipment to install & where??



# Where to drill or use existing well??

Drilling	Existing bh
<ul style="list-style-type: none"> <li>❖ At most specific locations to target optimum locations in relation to pumping well</li> <li>❖ Absence of existing boreholes.</li> <li>❖ Narrow geological formation that be easily missed.</li> </ul>	<ul style="list-style-type: none"> <li>❖ At most basic stations where there is no disturbance from pumping.</li> <li>❖ Availability of existing borehole</li> <li>❖ Where the targeted geology is broad.</li> </ul>



# What equipment to install & where?

Divers	AWLR R16	Manual (Water Level meter)
<ul style="list-style-type: none"> <li>•At most specific stations</li> </ul>	<ul style="list-style-type: none"> <li>•At most basic stations.</li> </ul>	<ul style="list-style-type: none"> <li>•Absence of divers &amp; AWRL16</li> </ul>
<ul style="list-style-type: none"> <li>•Critical / sensitive areas e.g. high variation of water levels and /or EC</li> </ul>	<ul style="list-style-type: none"> <li>•Security and accessibility is good</li> </ul>	<ul style="list-style-type: none"> <li>•Good security /accessibility for regular visits</li> </ul>
<ul style="list-style-type: none"> <li>•Small changes in water level with time</li> </ul>		<ul style="list-style-type: none"> <li>•At all stations for calibration measurements</li> </ul>
<ul style="list-style-type: none"> <li>•Simultaneous measurement of water level, temperature and EC</li> <li>•High risk of vandalism</li> </ul>		
<p>Insecurity &amp; poor accessibility</p>		



## Challenges

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- ❖ Heterogeneous hydrogeological conditions,
- ❖ Emerging WR Issues
- ❖ Network density (1 well / 6241 km<sup>2</sup>) is still low, not effective.
  - ▶ Challenge to ensure that an effective network is established and general coverage is improved.



## Conclusion and Recommendations

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- ❖ Sustainable political commitment and prudent investment is the way forward to make incremental improvements in GW management.
- ❖ Partnership with private sector:  
To improve GW monitoring, NGOs and other stakeholders should be mobilised to make contribution



# END

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Thanks for your attention