

GROUNDWATER QUALITY IN RWANDA

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Introduction

- Groundwater is one of the major sources of freshwater to human society and has been considered to be a readily source of water for domestic, agriculture and industrial use.
- Most of the diseases that afflict Rwandans are waterborne. Thus, access to safe water is a precondition for improving environmental and personal health
- Water pollution is an old phenomenon, the rate of industrialization and consequently, urbanization has made worse its effect on the environment.
- Countrywide Around 353 samples from springs, boreholes and wells were analyzed in 2018 in Rapid Assessment of Drinking Water Quality done by RURA and in November-December a Groundwater quality monitoring was done by RWFA .

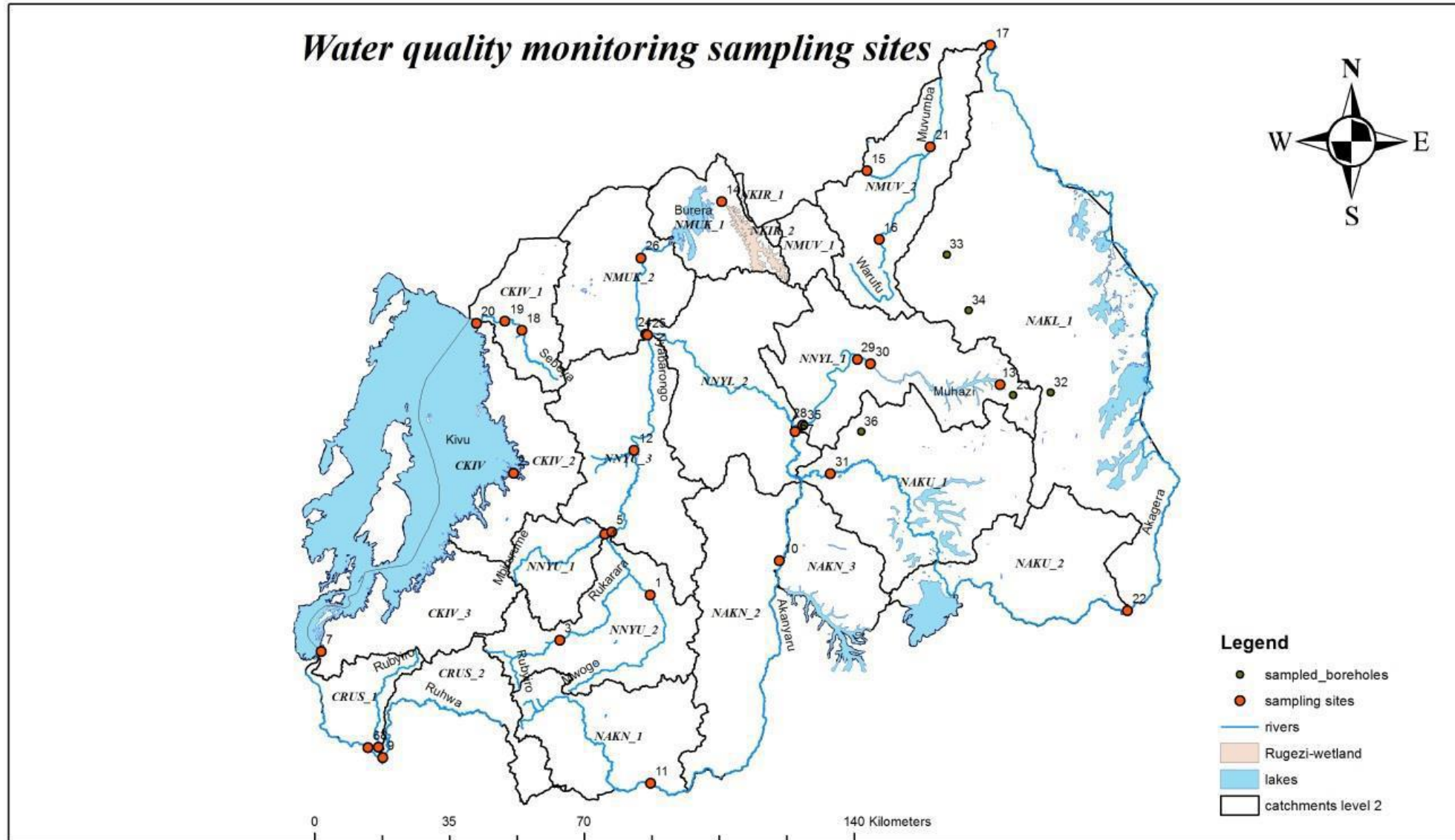
Why groundwater Quality?

- Groundwater provides a **potable** water supply for vast population
- Often **unprotected**
- **Pollution** threats are increasing
- Contaminants **persistent**

What causes degradation in groundwater quality ?

- Mineralized rocks
- disease-causing agents: Pathogens
- Nutrients: Nitrate, phosphate, sulphate
- organic compounds: hydrocarbons
- inorganic chemicals: toxic chemicals, Etc

Groundwater sampling sites (2018)



- **Physico-chemical parameters:** Bio-chemical Oxygen Demand BOD, Dissolved Oxygen (DO), Potential in Hydrogen (pH), Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Turbidity,
- **Nutrients parameters:** Nitrate (NO₃-), Total Nitrogen (TN), Total Phosphorus (TP), Total Dissolved Inorganic Nitrogen (DIN), Total Dissolved Inorganic Phosphorous (DIP) Chloride (Cl-), Sulfate (SO₄²⁻)
- **Biological parameters:** Faecal coliform (F.C) and *Escherishia coli* (E.Coli).

Parameters with 100% compliance for compared Natural potable water standards

- Total phosphorus (TP) and Total nitrogen (TN)
- Dissolved Inorganic Nitrogen (DIN)
- Dissolved Inorganic Phosphorus (DIP)
- Nitrate (NO₃⁻)
- Electro Conductivity (EC)
- Hydrogen potential (pH)
- Chloride (Cl⁻), and Sulphate (SO₄²⁻)

Parameters found to be out of acceptable range for natural potable water at some sites

- Dissolved oxygen (DO)
- Faecal coliform (F.C)
- Escherichia coli (E. coli)
- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)
- Turbidity

Ground Water Quality Assessment



In 2018 a Rapid Assessment of Drinking Water Quality (RADWQ) has been conducted by Rwanda Utility and Regulatory Authority (RURA)

samples size of 602 water samples were collected countrywide from boreholes, spring & tap water in rural area for quality analysis .



Sample size per water supply type and province (RURA, 2018).

| | Total | Kigali City | Northern | Eastern | Southern | Western |
|------------------------------------------------|--------------|--------------------|-----------------|----------------|-----------------|----------------|
| Sample size for water supply samples | | | | | | |
| Springs | 253 | 0 | 52 | 35 | 94 | 72 |
| Boreholes | 100 | 0 | 2 | 79 | 7 | 12 |
| Total | 353 | 0 | 54 | 114 | 101 | 84 |
| Sample size for household water samples | | | | | | |
| Springs | 119 | 0 | 25 | 15 | 47 | 32 |
| Boreholes | 54 | 0 | 1 | 42 | 4 | 7 |
| Total | 173 | 0 | 26 | 57 | 51 | 39 |

Drinking water quality parameters included in the RADWQ for rural areas of Rwanda and permissible levels as per Rwanda standard for treated potable water and for natural (i.e. untreated) potable water (FDEAS 12:2018)

| Type | Parameter | Rwandan Standard for treated potable water | Rwandan Standard for untreated potable water |
|----------------|---------------------|--------------------------------------------|----------------------------------------------|
| Microbial | E. coli | not detectable in 100 mL | not detectable in 100 mL |
| Physiochemical | Turbidity | < 5 NTU | < 25 NTU |
| | pH | 6.5 – 8.5 | 5.5 – 9.5 |
| | Electroconductivity | < 1,500 μ S/cm | < 2,500 μ S/cm |
| | Odour | not objectionable | not objectionable |
| Chemical | Arsenic | < 0.01 mg/L | < 0.01 mg/L |
| | Fluoride | < 1.5 mg/L | < 1.5 mg/L |
| | Nitrate | < 45 mg/L | < 45 mg/L |
| | Iron | < 0.3 mg/L | < 0.3 mg/L |
| | Manganese | < 0.1 mg/L | < 0.1 mg/L |
| | Lead | < 0.01 mg/L | < 0.01 mg/L |
| | Cadmium | < 0.003 mg/L | < 0.003 mg/L |
| | Mercury | < 0.001 mg/L | < 0.001 mg/L |

| Issues of High Concern | Issues of Moderate Concern | Issues of Low Concern |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><i>E. Coli</i> (41%) : This indicates that the water is contaminated with faecal pathogens. This leads to diarrheal diseases which are a leading cause for mortality among children below 5 years.</p> | <p>Fluoride (90%): the level detected, maximum 5.5 mg/L, is only moderately high. The population is at risk to develop dental fluorosis, which is not a major health concern.</p> | <p>Electroconductivity (100%): indicates the salinity of water. Salinity is not a concern in rural areas of Rwanda.</p> |
| <p>Turbidity (89%) : One-third have high or very high turbidity levels (above 5 NTU) which may impact user satisfaction and microbial quality.</p> | <p>Manganese (43%): standards is 0.1 mg/L. Adverse effects on learning in children caused by manganese are only expected if the concentration exceeds 0.4 mg/L.</p> | <p>Odour (89%): it is classified as minor concern because there is no direct health impact caused by odour.</p> |
| <p>pH (61%): More than one-third of the water supplies have a pH below 5.5. When pH is below 6.5, there is an increased potential for corrosion of metal pipes and fittings.</p> | <p>Mercury (74%): Risk of adverse health effects such as serious damage to the kidneys, brain, and nervous system.</p> | <p>Nitrate (97%): can be a serious health risk, especially to infants below one year. At that age infant are exclusively breastfeed, therefore the risk is minor</p> |
| <p>Arsenic (94%): The high levels of arsenic, above 10 µg/L, mean that this population is at risk of developing skin diseases and cancers.</p> | <p>Iron (85%): can have increased turbidity, discoloration and can affect taste. While there is no health risk for water containing iron, users often find the water unacceptable.</p> | <p>Lead (100%): is a developmental neurotoxicant associated with reduced cognitive development and intellectual performance in children, Cadmium (100%): causes kidney damage. Both HM are a minor issue in rural area of Rwanda</p> |

GW quality protection

- Well/well field protection
- Well spacing, pumping restriction
- GW zoning, land use planning/regulation
- Agrochemical (fertilizer/pesticide) use regulations
- Proper solid waste disposal facilities
- Proper sanitation and waste water treatment facilities
- Monitoring, early warning, trend analysis
- Public awareness raising

Conclusion & recommendation

- the groundwater quality in Rwanda is mainly affected by human induced factors like soil erosion from agriculture and mining activities, lack of wastewater treatment facilities, application of pesticides and fertilizers, etc.
- A continuous groundwater quality monitoring should be done and management of different possible pollution sources should be conducted in order to construct a solid database on groundwater quality in Rwanda.

THANK YOU!!!