

Groundwater quality issues and its management practice in Marginal and Central Main Ethiopian Rift Valley, Ethiopia.

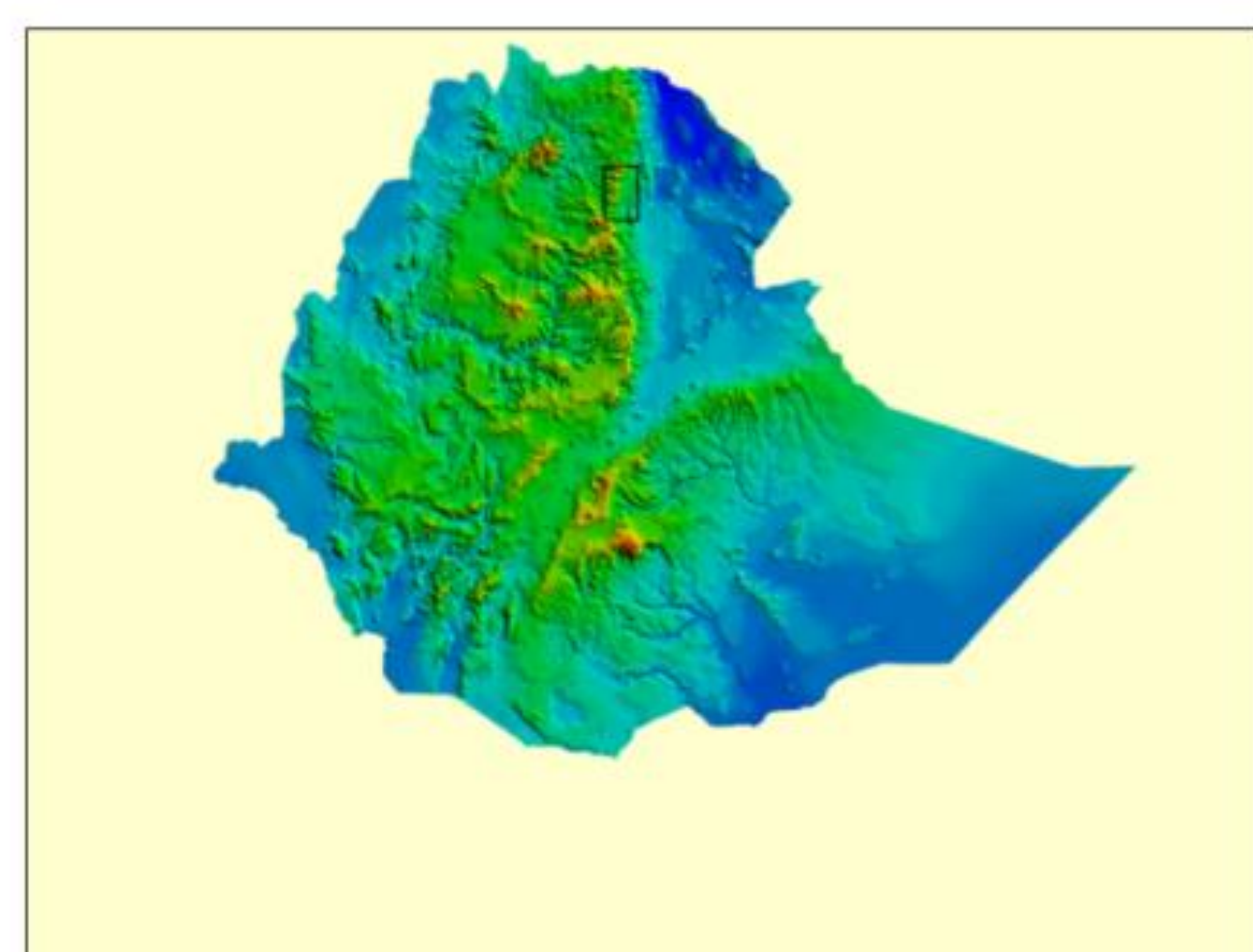
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Introduction:

- Water, especially groundwater, is becoming a “phenomenon” for most developing countries, including Ethiopia.
- In most part of Sub-Saharan countries the source of water is highly dependent on groundwater resource for irrigation, drinking, livestock watering and industrial uses. Groundwater plays an important role in poverty reduction and economic growth.
- Ethiopia is characterized by unimodal and bimodal precipitation pattern. Where the source of moisture is from Atlantic and Indian ocean. The climate condition in Ethiopia is highly controlled by geomorphology of the countries, there exist huge variation in the occurrence of water from humid area to semiarid area.
- Groundwater one of the best source of water for drinking, agricultural and industrial uses in Ethiopia. Big cities such as Dredawa (i.e., ~100%), Mekelle (100%), and Addis Ababa (i.e., ~60%) derive significant of their water supplies from groundwater.
- The occurrence of groundwater in Ethiopian aquifer is highly variable. Since, there exist large volcanic trap with complex hydrogeology, consolidated and unconsolidated sedimentary aquifer and low yielding basement complex.
- Groundwater have different dissolved geochemical species by which the excess and deficiency of these geochemical species can have health effects.
- The change in geochemical species in groundwater due to the natural and anthropogenic effect, can have effect in determine the uses of the water for drinking, agriculture and industrial use.
- Ethiopia has a significant potential for irrigation. Nearly 4 million hectares of land is irrigable. However, only 5% of this potential is believed to have been realized so far. Currently, here is high demand to uses groundwater for irrigation during short rainy seasons.
- Ethiopia has huge surface and groundwater resource, however, there is inadequate supply of water for domestic supply.

Figure1. Geomorphological map of Ethiopia.



- Much of the geochemical characteristics of groundwater is determine during infiltration, percolation and groundwater recharge time, under which rock/ water interaction enhance the amount of dissolved material.
- In Ethiopia, some of this dissolved solutes can be high concentration of fluoride (F) in groundwater causes dental and skeletal fluorosis. When it is dental fluorosis it cause dental discoloration, and high intake fluoride can cause skeletal flours is over time.
- The World Health Organization (WHO) guideline for F in drinking water is 1.5 mg/l. However, in Central Main Ethiopian Rift Valley, large number of population are affected by these diseases.
- The major causes is the enrichment of fluoride in acidic volcanic groundwater and in geothermal water as a result of high rock water interaction (Ayenew, 2008).
- Apart from the Main Ethiopian rift valley system, the groundwater has low fluoride, except slight enrichment of fluoride due local geology.

The Ethiopian Rift Valley and Adjacent regions	Minimum	Maximum	Average	Number of water points
Central Rift Valley (From Lake Ziway up to Chew Bahir)	Trace	45	1.49	94
Afar Rift (Kesem)	0.08	14	6.06	39
Raya Valley, Marginal Graben	0.12	6.5	0.83	95
Addis Ababa aquifer (multilayer aquifer)	0.00	27.6	1.29	231

Water Quality problems:

Sodium and salinity hazard in Irrigation water

- Now a days, in addition to rain water and surface water, groundwater is becoming an important source of water for irrigation in Ethiopia. However, the quantities of available groundwater resources remain uncertain in many locations.
- Some of the groundwater apart from sedimentary aquifer and in central main Ethiopian rift valley, the groundwater quality for irrigation is acceptable. However, high sodium and salinity hazard is a major factor that determine the groundwater potential.

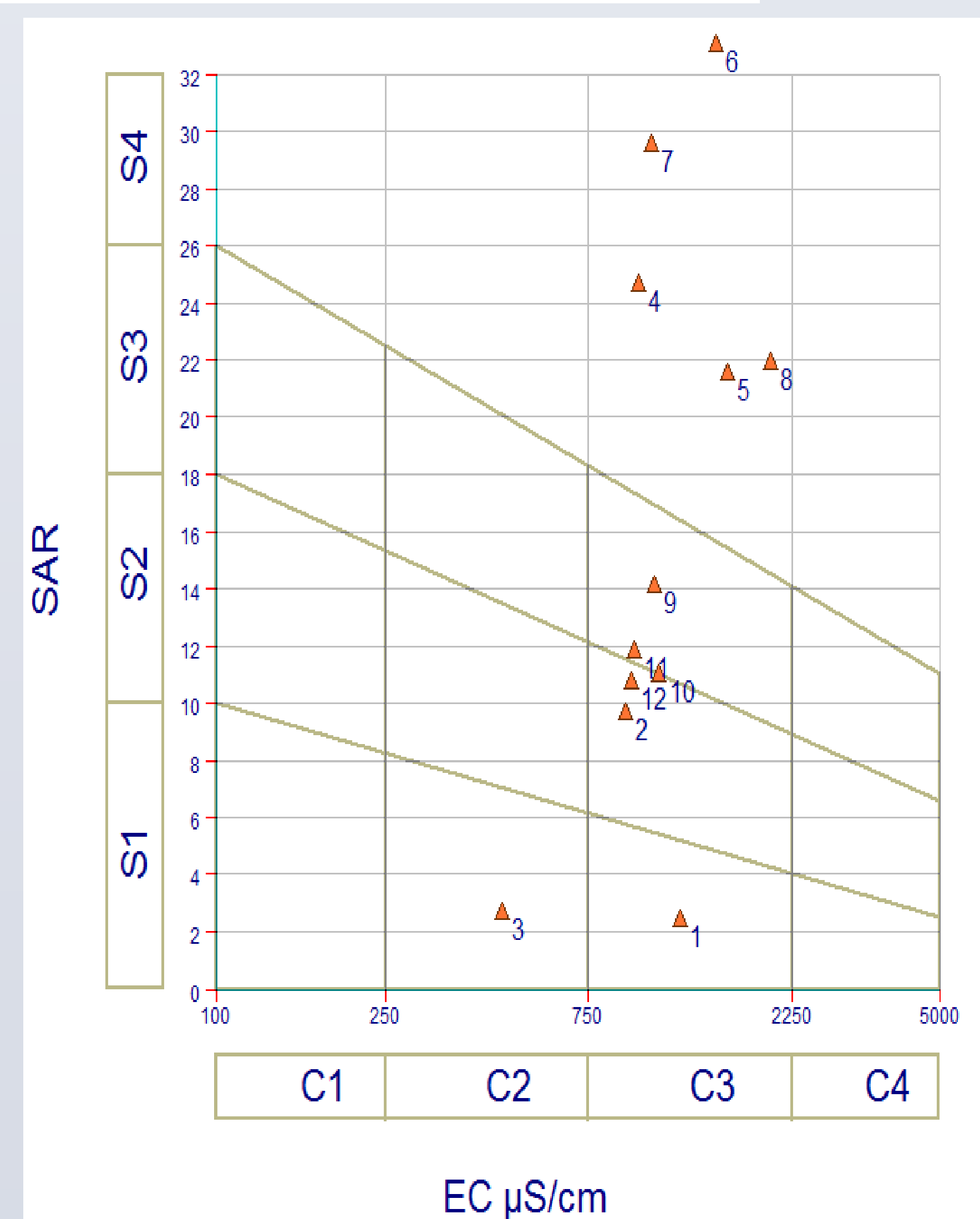
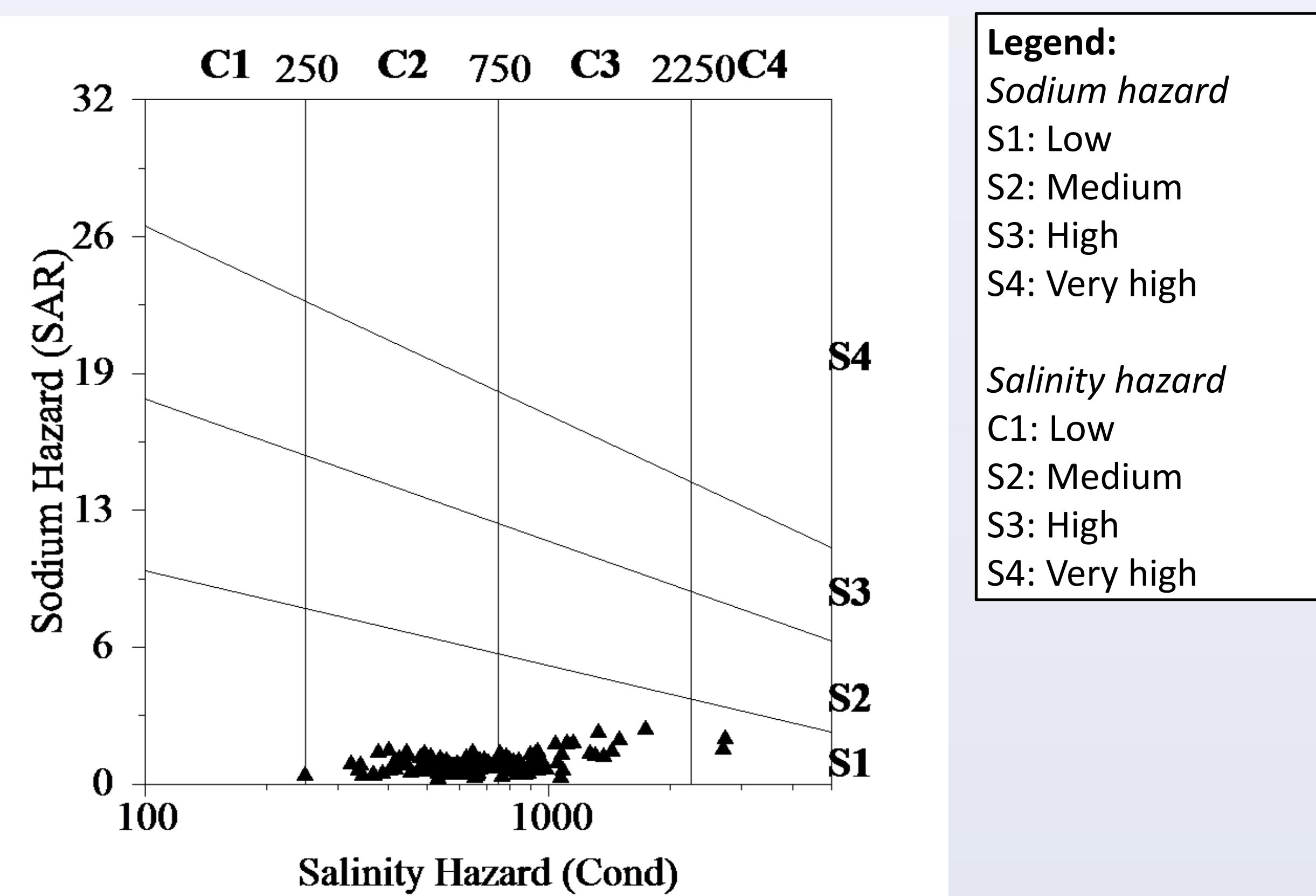


Figure 2. (Top) Shows groundwater samples from Western escarpment, where all sample characterized by low sodium hazard. With limited sample medium to high salinity hazard, the rest two are in zone very high salinity hazard. (Bottom) Groundwater and surface water sample shows high salinity and sodium hazard. Except the fresh lake (3) show medium salinity and low sodium hazard. (Seifu, et. al., 2012; Tenalem, et. al., 2013)

- Continued use of water with a high sodium hazard value leads to a breakdown in the physical structure of the soil caused by excessive amounts of colloidal absorbed sodium. This breakdown results in the dispersion of soil clay, causing the soil to become hard and compact when dry and increasingly impervious to water penetration (due to dispersion and swelling) when wet.
- Excess salt increases the osmotic pressure of the soil solution that can result in a physiological drought conditions. Even though the field appears to have plenty of moisture, the plants wilt because of insufficient water is absorbed by the roots to replace the lost from transpiration.

Groundwater quality management

- The groundwater potential is not only controlled by its quantity but also the quality of the groundwater is very important.
- Groundwater becomes mineralized due to rock water interactions resulting in the dissolution of certain minerals and chemical elements which remain in solution in the groundwater.
- The geochemical species in groundwater can have a health effect unless it has optimum dissolved material. If there exist excess or deficiency of dissolved solutes in groundwater, it might have health problem.
- In Ethiopia, the presence of excess fluoride, and low iodine in water have resulted serious health problem including dental and skeletal fluorosis, and goiter incidence respectively.
- In addition to the health problem the deteriorated groundwater can have negative effect for irrigation uses, by reducing soil fertility and precipitating salt.
- Water supply wells can be abandoned due to high iron content, high fluoride, and high salt content in the groundwater.

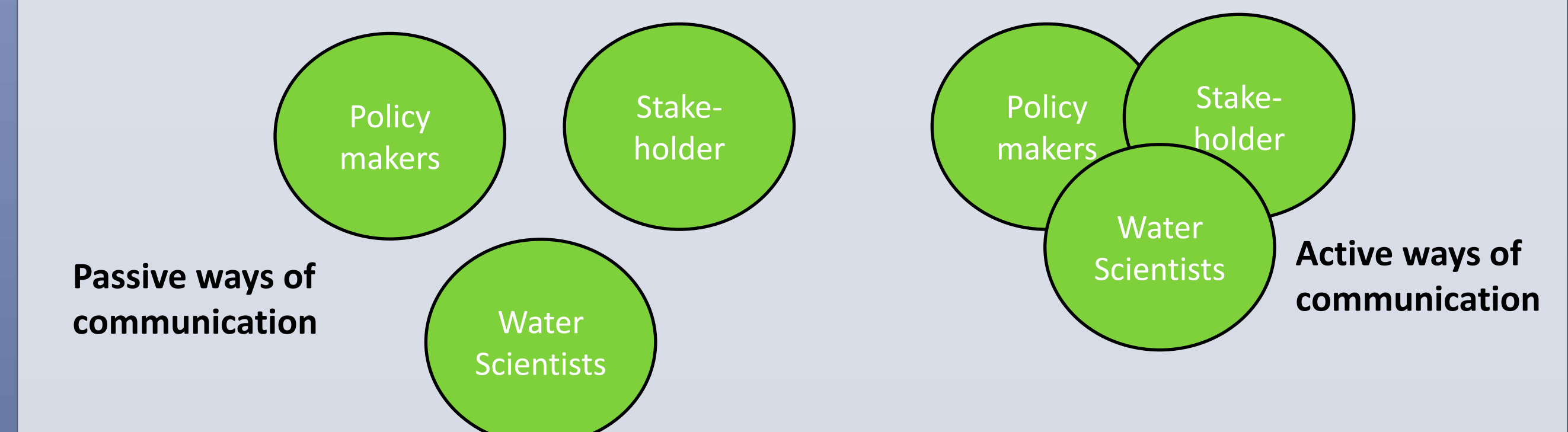
Table 2. Water scheme failure rate by Ethiopian region (Seifu Kebede, 2013)

Regions	All surveyed		Developed springs		Hand pumps		Boreholes	
	Total	Non Functional (NF)	Total	NF	Total	NF	Total	NF
Benshangul	125		67	9	0	116	72	0
Gambela	102		48	10	0	14	0	78
Somalia	56		34	0				56
SNNPRS	830		32	155	10	208	37	467
Oromia	2571		24	1305	16	856	27	410
Amhara	634		22	359	27	248	17	27
Tigray	686		18	45	27	208	24	433
Average	5004		26	1883	18	1650	29	1471

- Technical and maintenance issues
- Lack of hydrological and hydrogeological skills
- Water quality problem (Since the water potential is a components of groundwater quantity and quality).

Sustainable groundwater quality management:

- Sustainable groundwater quality is generally managed by protecting pollution and conducting appropriate remedial program. It must also have technical, institutional, policy and financial components.
- This is accompanied by active participation among participation among policy makes, communities and scientist.



Conclusions

- High fluoride groundwater in Ethiopia, especially, in Main Ethiopia Rift Valley is as a result of rock water interaction and it is causing serious health problem.
- High salinity in groundwater determines the viability of the groundwater resource for irrigation.
- Groundwater quality management requires active participation of government, scientists and local communities.

References

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Acknowledgement: We are thankful for the support provided by Water work design and supervision Enterprise, Japan International Cooperation agency, Ministry of Water and Energy. We would like to thank Tilahun Azagegn, Girum Admassu, Gadissa Deyassa and Scott Jasechko.