Typologies of groundwaters in basins shared between Ethiopia-Kenya, Ethiopia-Sudan and Ethiopia-Djibouti and their trans-boundary implications

Seifu Kebede, Yves Travi, Jaludin Mohammed, Mumtaz Razak, Chiekh Gaye, Eule Ngata, François Pinard, Tesfaye Taddesse.

The implementation of laws relating to transboundary aquifers necessitates field knowledge so that the laws can be coincident with reality on the ground. The definition of 'shared aquifer' is more complex than the mere physically-shared body of groundwater flowing from country A to country B. The border between Ethiopia and Kenya is characterized by low-volume groundwater storage and low transboundary flows. However, groundwater has visible environmental, social and economic functions. The characteristics of groundwater flow and storage in aquifers shared between Ethiopia and Kenya are different from those used in setting the foundation of the international legal framework on shared aquifers. By describing the characteristics of the groundwaters that are shared between Ethiopia and Kenya, this work demonstrates that the international legal framework is inadequate when applied in this region. The main inadequacies are: a) international law does not specify the minimum volume of transboundary flow in an aquifer for it to qualify to be treated under the law, and b) the physical aspects of water get more emphasis than the functions of groundwater. A more adequate international legal framework would be one that considers specific types of groundwater and local needs.

Prominent geologic and geomorphic features of the Ethiopia and Kenya border and bordering regions are domal uplifting centered over Ethiopia and Kenya, rift valley traversing the Ethiopian and Kenya domes, and accompanied volcanism and sedimentation. These prominent tectono-geomorphic features are responsible for the regional drainage pattern. The border between Ethiopia and Kenya is approximately located at the intersection (foot) of the Ethiopian and Kenyan domes. This makes the border region generally a site of drainage convergence from the Kenyan and Ethiopian highlands.

The hydrography of the basins is a direct reflection of the geology and structures and is characterized by complex networks of primary and captured drainages. Though localized in the great East African Rift, which is otherwise the site of volcanism and tectonism, the major parts of the region straddling Ethiopia and Kenya are underlain by Precambrian metamorphic rocks, Mesozoic sediments, Tertiary volcanics, and thick Miocene to Quaternary sediments.

In the shared basins of Ethiopia and Kenya the basement rocks are characterized by the lowest storage potential. Unlike many parts of central Africa where the basement rocks are overlain by up to a few tens of meters of thick regolith (Chilton and Foster 1995) the basement aquifers of southern Ethiopia and northern Kenya are characterized by only thin (in the order of 2 to 3 m) regolith thereby hampering groundwater storage.

While the rift structures are favorable for regional groundwater flows, the fact that the shared borders of Ethiopia and Kenya are located at the foot of two regional highlands favors surface-water discharge near the common borders. The low storage and hydraulic conductivity properties of the aquifers of the region limit the volume of transboundary flows across the Ethiopia-Kenya border.

The term 'transboundary groundwater' commonly implies to a body of groundwater intersected by a political border with potential threat of dispute over a shared resource and this kind of definition is inadequate to describe situations in southern Africa (Cobbing et al. 2008). This definition is inadequate at the Ethiopia-Kenya border as well. Approximately 80% of the Ethiopia-Kenya border is underlain by low-yielding aquifers and low cross-border groundwater flows, but water demand for socio-economic functions is high. The concept of transboundary groundwater must necessarily include aquifers where little cross-border flow occurs, but where cross-border cooperation will help to ensure sustainable socio-economic cooperation in the utilization of shared aquifer resources. From the information on groundwater flow and the aquifers investigated under the current study, the existing list of types of transboundary aquifers can be updated:

1. 'Ideal ' systems, under which the international law of transboundary aquifers or the international law of water courses and the definition of transboundary aquifer can readily be applied (eg. models of Eckstein and Eckstein (2005) or types of system described by Barberis (1986))
2. System under which the common definition of the transboundary aquifer cannot be readily applied because the flux of groundwater is low or 'insignificant' and the resource use is minimal, such as the basement aquifers of southern Africa (Cobbing et al. 2008)
3. Other systems, such as where an aquifer is shared by more than two states, or where states share more than one aquifer contained in one basin and the role of the states varies depending on which aquifer they are dealing with, or where there is no accurate boundary demarcation of the aquifer (Scheumann and Alker, 2009)
4. System under which the definition of transboundary aquifer or the applicability of the law of transboundary aquifers is vague because the flux and storage of groundwater is 'insignificant' but groundwater is the sole source of water supply for socio-economic activity. This is the typical case of the Ethiopia-Kenya shared groundwater resource.

International law which considers groundwater as a mere physical entity may fall short of serving the purpose of bringing about better management and protection of the scarce groundwater resources in the region. Therefore management of shared aquifers and groundwater resources should consider all socio-economic issues rather than considering the groundwater as a mere physical entity. A concerted effort may be needed to investigate and map the linkage between groundwater and cross-cutting issues such as environment, climate change, ecosystems, and socio-economics in the region. Encouraging cross-border socio-economic interaction, enhancing the roles of cross-border boundary commissions and water management committees, or establishing grass-roots institutions, give a better management outcome than the mere ratification of the draft law alone.

References

Barberis, JA (1986) International ground water resources law. Food and Agricultural Organization Legislative Study 40, 67pp

Cobbing JE, Hobbs PJ , Meyer R, and Davies J (2008) A critical overview of transboundary aquifers shared by South Africa, Hydrogeology Journal, 16: 1207–1214

Puri S, Appelgren B, Arnold G, Aureli A, Burchi S, Burke J, Margat J, Pallas P, (2001) Internationally Shared (Transboundary) Aquifer Resources Management, Their Significance and sustainable management. A framework document. IHP-VI, Series on groundwater No., 1. 71pp. UNESCO, Paris

Scheumann W, Alker M (2009) Cooperation on Africa's transboundary aquifers – conceptual ideas. Hydrological Sciences Journal 54: 793-802