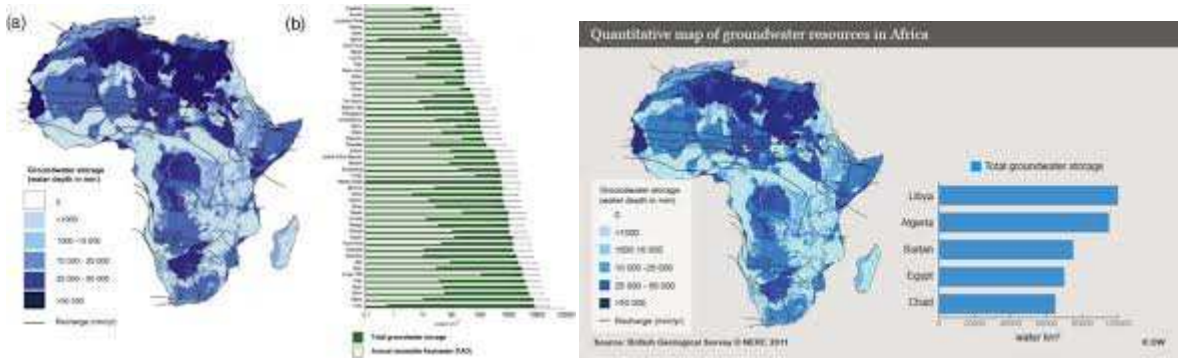
Egypt's Groundwater Resources

Habtamu Abay abay_habtamu@yahoo.com Addis Ababa, Ethiopia April 10, 2014

Following the successful diversion and commendable foundation concreting works of the Ethiopian Great Renaissance Dam (GRD), the Egyptian media hype is at its peak. A presidential hopeful for the May 2014 elections went on in so far as proposing force to stop the construction, if he so beats the Field Marshal. This is all said for reasons of 'presumed Nile water flow reduction' following the completion of GRD. Though farcical to common sense (even to contemplate let alone to believe) that a hydropower plant consumes water, most Egyptian politicians and the media accept it that way. As has been repeatedly said, in their attempts to bridge the polarized political thoughts and to garner support, Egyptian politicians have no other sensational issue than Nile water (at least in the short term). The long term issue is far more intricate and has more to do with hydro and geopolitics in this region.

Does Egypt really lose water due to the construction of GRD? What will happen to Egypt when Ethiopia consumes water for irrigation purposes? What alternative fresh water resources does it have?

Only common sense tells that GRD, a hydropower project, does not consume water. What worries Egypt more is the economic might Ethiopia will have following GRD in embarking upon more water consuming projects, irrigation to be specific. Yes, that worries them. But, if there are good intentions, there are ways out for that. As briefly elaborated by the writer of this article in three parts under the title **"Nile by 2050: the case of Ethiopia, Sudan and Egypt"** there are a number of alternative solutions that benefit all the three countries [1, 2, 3]. Additionally, recent studies from the British Geological Survey have indicated that Egypt and Sudan have vast underground water reserves from beneath [4]. This huge resource should be utilized towards addressing any perceived and/or implied water shortages in the years to come.



i) GW map of Africa with best estimates ii) the five GW rich countries

Figure 1: Groundwater (GW) map of Africa (from Wikipedia)

In the study, it is discussed and succinctly presented that under best estimate, Africa's ground water resources are around 0.66 million km^3. Referring studies (by New M, Hulme M and Jones P, 2000; Shiklomanov and Roda, 2003 and FAO, 2005 and UNEP 2010), the paper presents the following.

Africa's annual rainfall…… 0.02 million km^3
Fresh water in African lakes…… 0.03 million km^3
Annual groundwater recharge…….. 0.004 million km^3
Africa's groundwater reserve total at best estimate……. 0.66 million km^3

Only five countries in North Africa namely Libya, Algeria, Sudan, Egypt and Chad account 0.36 million km^3 (nearly 55% of the continent's reserves) reaching equivalent water depth of 75m. Except, Sudan and Egypt, other Nile riparian states including Ethiopia have insignificant groundwater reserves (Table 1).

Table 1: Groundwater resources of selected African countries

Country	**Ground Water Storage (km^3)**		
	Range		**Best Estimate**
Libya	**64,600**	**234,000**	**99,500**
Algeria	**56,000**	**243,000**	**91,900**
Sudan*	**37,100**	**151,000**	**63,200**
Egypt	**36,000**	**130,000**	**55,200**
Ethiopia	4,340	39,300	12,700
Eritrea	94	1,120	333
Chad	**26,000**	**112,000**	**46,000**
Uganda	73	1,270	339
Kenya	4,090	23,300	8,840
Tanzania	2,040	17,900	5,250
Somalia	5,210	34,500	12,300

Source: Extracted from [4]
** May include that of South Sudan.*
Note: One Cubic kilometer of water ($1km^3$) is equal to One billion cubic meters ($1bm^3$)

A trio comparison of Egypt, Ethiopia and Sudan, is shown in the graph below.

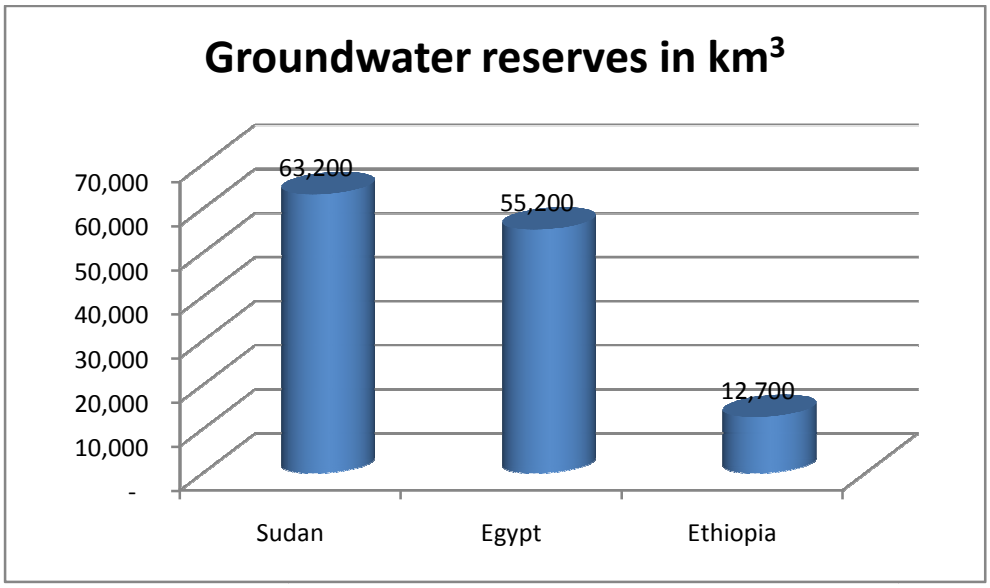


Figure 2: Groundwater Reserves (extracted from Table 1 above)

The above indicated ground water reserves are quite big when one compares it with the annual flows of Nile. If one compares it with the 1959 bilateral Nile water quota of Egypt and Sudan, i.e, 55 and 18.5bm^3 per annum respectively, their groundwater potentials correspondingly equate to the sum of flow of Nile water share of ***1,000 and 3,400 years***.

For further explaining the relevance of the figures, let us assume that both Egypt and Sudan will continue to have their bilaterally arranged Nile water shares for millennia. Let us also assume that the whole quantity of this best estimate groundwater is both extractable and fresh. Then this literally means that if Nile water flow dries up by some inexplicable natural and/or man made factors, the two nations can lead life for millennia without change to present water usage. *(Here, it has to be noted that following the secession of South Sudan, Sudan's groundwater may be slightly lower but it can by no means be less than that of Egypt.)*

Let us also closely look Table 2 for a combination of surface and ground water potentials of the three countries. For the case of Ethiopia, since its rivers are transboundary, the maximum it can annually arrest by 2050 is calculated to be 66.5bm^3 [2, 3]. The reader should be aware that the share of Nile water indicates here is based on Ethiopia's Nile flow contribution alone. For easy understanding, it is assumed that the share of Sudan and Egypt from the White Nile will be treated separately.

Table 2: Surface and ground water reserves based upon a 2050 proposed share

Country	Possibly available surface water per annum (bm3)		Surface Water 1,000 years cumulative on 2050 proposed share basis (km^3)	Groundwater reserves (km^3)	Total Surface and groundwater reserves (km^3)	Remarks
	Nile basin	Other basins				
Egypt	32	0	32	55,200	55,232	
Ethiopia	40	22.5	66.5	12,700	12,766	
Sudan	15	0	15	63,200	63, 215	

Table 2 above and Figure 2 below clearly show that even a thousand year cumulative flow of the Nile cannot bring change to the differences in groundwater reserves. This clearly shows us that both Egypt and Sudan are blessed in fresh water reserves than Ethiopia is. Their combined groundwater potential (0.118 million km3) is about 18% of Africa's total groundwater reserves in a stark contrast Ethiopia's nearly 2%.

Some technical issues of concern with regard to groundwater extraction particularly the following are important to note.

i) Groundwater reserves may not be fully extractable. It is usual to take some 50% of the reserves for reasons of salinity, economy and the like.

ii) Shortage of precipitation in the Sahara desert makes groundwater recharge almost unlikely, unless earth wobbles and brings back the climate of 5,000years.

iii) Groundwater extraction may be costly. Given its huge reserves in Egypt and Sudan, it will for sure pay back whatever is spent upon it.

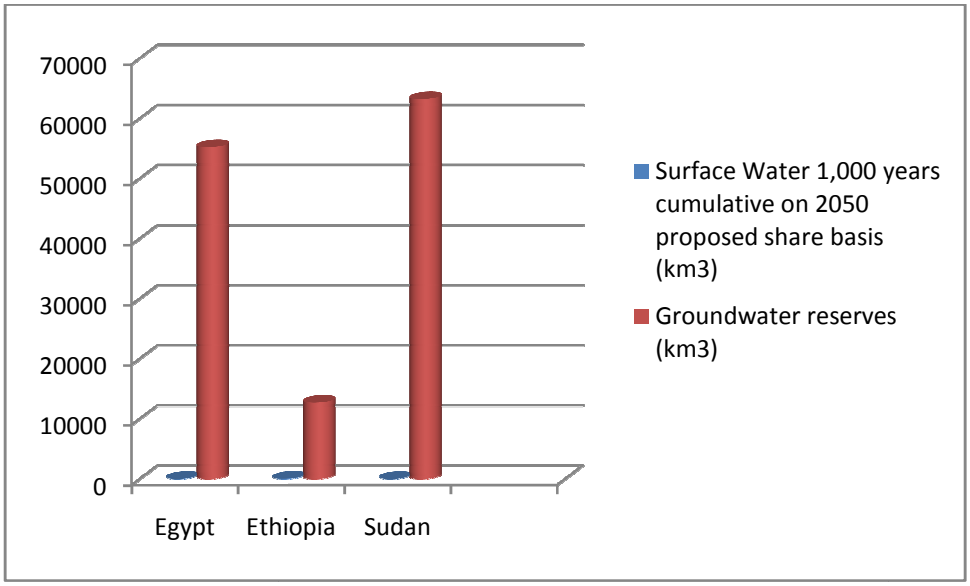


Figure 3: Ground and surface water reserves comparison by country

In a nutshell, Egypt's underground water reserves are so huge that its dependence on Nile water will gradually dwindle. It is hoped that more research will be done in the years to come on the freshness of the water as well as on economical extraction of this vast reserve. When Egypt starts extracting the underneath water, let us hope that the whole Nile region will enjoy peace and tranquility.

God bless the children of the Nile!

References

1. Nile by 2050: the case of Ethiopia, Sudan and Egypt, Habtamu Abay, Part I, July 2013, www.aigaforum.com
2. Nile by 2050: the case of Ethiopia, Sudan and Egypt, Part II, Habtamu Abay, July 2013, www.aigaforum.com
3. Nile by 2050: the case of Ethiopia, Sudan and Egypt, Part III, Habtamu Abay, July 2013, www.aigaforum.com
4. Quantitative maps of groundwater resources in Africa, MacDonal A M and et.al, iopscience.iop.org