AF59 – Afar Rift Valley / Afar Triangle Aquifer

Geography

Total area TBA (km^2): 51 000

No. countries sharing: 3

Countries sharing: Djibouti, Eritrea Ethiopia

Population: 780 000

Climate Zone: Arid

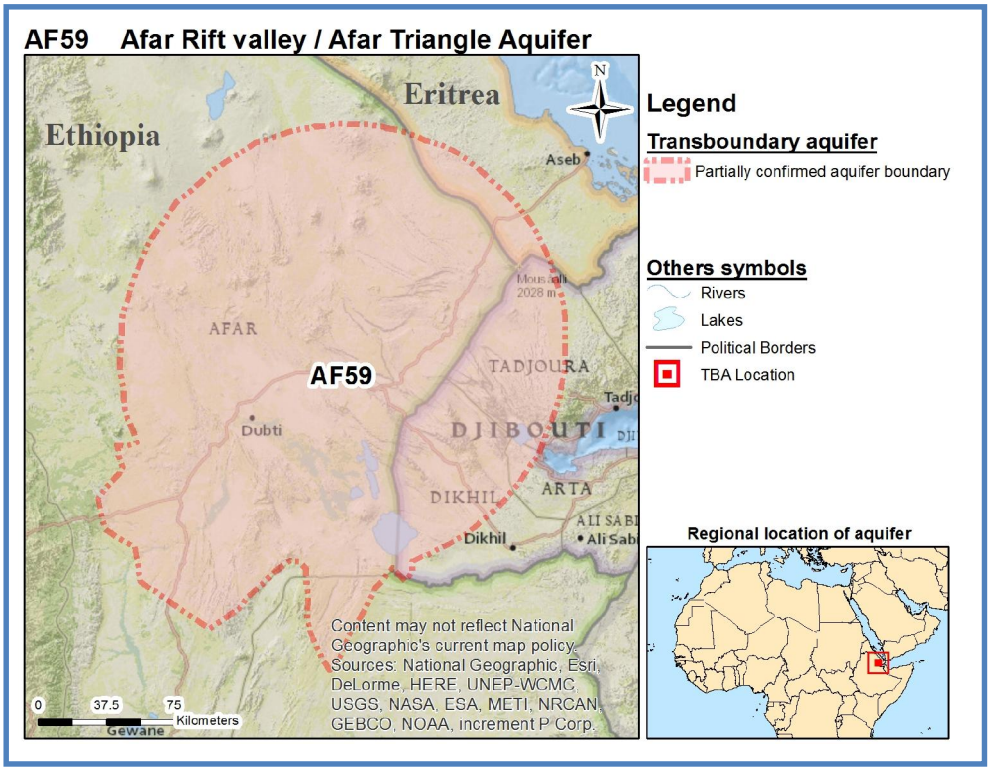
Rainfall (mm/yr): 220

Hydrogeology

Aquifer type: Multiple-layered hydraulically connected

Degree of confinement: Mostly unconfined, some parts confined

Main Lithology: Crystalline rocks - volcanics



No cross-section available

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate

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TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m^3/y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (Persons/km2)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Djibouti	2	240	35				7	20	D	C
Eritrea							8			
Ethiopia	4	260	35		0		17	<5	D	D
TBA level							**16**			

(1) Recharge: This is the long term average recharge (in m^3/yr) divided by the surface area (m^2) of the complete country segment of the aquifer (i.e. not only the recharge area).
(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.
(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).
(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.
(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).
(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).
X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

TWAP Groundwater Indicators from WaterGAP model

	Recharge, incl. recharge from irrigation (mm/yr)	Renewable groundwater per capita			Human dependency on groundwater (%)	Human dependency on groundwater for domestic water supply (%)	Human dependency on groundwater for irrigation (%)	Human dependency on groundwater for industrial water use(%)
		Current state (m^3/y/capita)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)				
Djibouti	120	8400	-28	-43	15	96	4	7
Eritrea	3	390	-12	-35	79	80	2	18
Ethiopia	81	4400	-28	-40	3	80	0	1
TBA level	**86**	**4900**	**-28**	**-40**	**4**	**83**	**0**	**7**

	Groundwater depletion (mm/y)	Population density			Groundwater development stress		
		Current state (Persons/km2)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)	Current state (%)	Projection 2030 (% point change to current state)	Projection 2050 (% point change to current state)
Djibouti	0	14	42	81	<1	0	2
Eritrea	0	9	54	110	4	2	25
Ethiopia	0	18	43	75	<1	1	3

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	Groundwater depletion (mm/y)	Population density			Groundwater development stress		
		Current state (Persons/km2)	Projection 2030 (% change to current state)	Projection 2050 (% change to current state)	Current state (%)	Projection 2030 (% point change to current state)	Projection 2050 (% point change to current state)
TBA level	**0**	**17**	**43**	**76**	<1	**1**	**3**

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Predominant type of porosity (or voids)	Secondary Porosity	Transmissivity (m^2/d)
Djibouti				Aquifer Mostly unconfined, but some parts confined	Crystalline rocks - volcanics	Low Primary porosity inter-granular porosity	Secondary porosity: Fractures	
Eritrea								
Ethiopia	12	<5	55	Aquifer Mostly unconfined, but some parts confined	Crystalline rocks - volcanics	Low Primary porosity inter-granular porosity	Secondary porosity: Fractures	1800
TBA level								

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Aquifer description

Aquifer geometry

This is a multiple-layered hydraulically connected system (2 layers within Ethiopia) that is mostly unconfined, but some parts are confined. The average depth to the water table is 12 m (Ethiopia). The average depth to the top of the aquifer is <5 m and the average thickness of the aquifer system 55 m in Ethiopia.

Hydrogeological aspects

The lithology, that comprises mainly crystalline rocks - volcanics with some granites, is characterized with a low primary porosity and with secondary porosity: fractures. It is furthermore characterized by a high horizontal and vertical connectivity. Transmissivity values reported from Ethiopia are high with an average value of 1800 m^2/d. The mean average annual recharge is 195 Mm^3/yr over an area in excess of 6300 km^2 (Djibouti, Ethiopia). The area is subject to cyclical droughts and the annual average amount of recharge decreases to 43Mm^3/yr within Ethiopia.

Linkages with other water systems

The predominant source of recharge is from surface water runoff, while discharge is mainly from the aquifer into the surrounding lakes.

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Environmental aspects

About 65 % of the natural water quality does not satisfy drinking quality standards due to natural salinity and high fluoride contents. Limited anthropogenic pollution, mainly due to nitrates from domestic sources, has been reported but the data is not available to determine the percentage of the aquifer area that has been affected.

Socio-economic aspects

Annual groundwater abstraction from the aquifer is in the order of 7.1 Mm^3 /yr (Ethiopia, Djibouti). Data is not available on the fresh water abstraction within the aquifer area.

Legal and Institutional aspects

No formal Transboundary Agreement has been made. Within Djibouti the National Institution has a full mandate and capacity whereas both of these are limited within Ethiopia.

Priority Issues

The main issue for this TBA is water quality and about 65 % of the aquifer has high natural salinity content. Excessive amounts of fluoride also are problematic in certain areas. The extent and frequency of water quality monitoring must be reviewed.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Greg Christelis	CHR Water Consultants	Namibia	gregchristelis@gmail.com	Regional coordinator
Ismael Elmi Habaneh	Ministère de l'agriculture, de l'eau, de la pêche, de l'Elevage et des ressources halieutiques	Djibouti	elmihabaneh@hotmail.fr	Lead National Expert
Dessie Habtemariam	Addis Ababa University	Ethiopia	dessienedaw@yahoo.com	Lead National Expert

Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.

2 of the 3 TBA countries contributed to the information. The information was adequate to describe the aquifer in general terms. Some quantitative information was also available, and this was sufficient for calculating some of the indicators with.

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

Colophon

This Transboundary Aquifers information sheet has been produced as part of the Groundwater Component of the GEF Transboundary Water Assessment Programme (GEF TWAP). **GEF TWAP** is the first truly global comparative assessment of transboundary groundwater, lakes, rivers, large marine ecosystems and the open ocean. More information on TWAP can be found on: www.geftwap.org . **The Groundwater component** of TWAP carried out a global comparison of 199 transboundary aquifers and the groundwater systems of 41 Small Island Developing States. The data used to compile this transboundary aquifer information sheet has been made available by national and regional experts from countries involved in the TWAP Groundwater project. For aquifers larger than 20 000 km2 and which are not overlapping, additional data are available from modelling done by the Goethe University Frankfurt (Germany) as part of TWAP Groundwater. All data were compiled by UNESCO-IHP and the International Groundwater Resources Assessment Centre (IGRAC – UNESCO Category II

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Institute). Values given in the fact-sheet represent an approximate guide only and should not replace data obtained from recent local assessments. The editors of this information sheet are not responsible for the quality of the data.

For more information on TWAP Groundwater and for more data, please have a look at the TWAP Groundwater Information Management System which is accessible via www.twap.isarm.org or www.un-igrac.org.

Request:
If you have additional data or information about this transboundary aquifer that can improve the quality of this information sheet and the underlying database, please contact us via email at info@un-igrac.org. If appropriate, the information will be uploaded to the database of transboundary aquifers and will also be used in new versions of this information sheet.

References:
- Population: Population has been calculated based on the aquifer map and grid information on population. Source population data: Center for International Earth Science Information Network - CIESIN - Columbia University, United Nations Food and Agriculture Programme - FAO, and Centro Internacional de Agricultura Tropical - CIAT. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Count Grid, Future Estimates. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H42B8VZZ. Accessed Jan 2015.
- Rainfall: Average rainfall per TBA has been calculated based on the aquifer map and grid data for precipitation. Source precipitation data: Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. Grid data download from www.worldclim.org (2015): Data for current conditions (~1950-2000), ESRI grids, 30 arc seconds, Precipitation.
- Climate: Climate indicates the major climate zone which occurs in the aquifer area. If more than 1 climate zone is present the zone with the largest surface area was selected. Source climate data: ArcGIS Online (2015), Simplified World Climate zones. Owner: Mapping Our World GIS Education. Original map: National Geographic World Atlas for Young Explorers (1998).
- All other data: TWAP Groundwater (2015).

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