AF17 - Shire Valley Alluvial Aquifer

Geography

Total area TBA (km^2): 5500

No. countries sharing: 2

Countries sharing: Malawi, Mozambique

Population: 490 000

Climate Zone: Tropical Dry

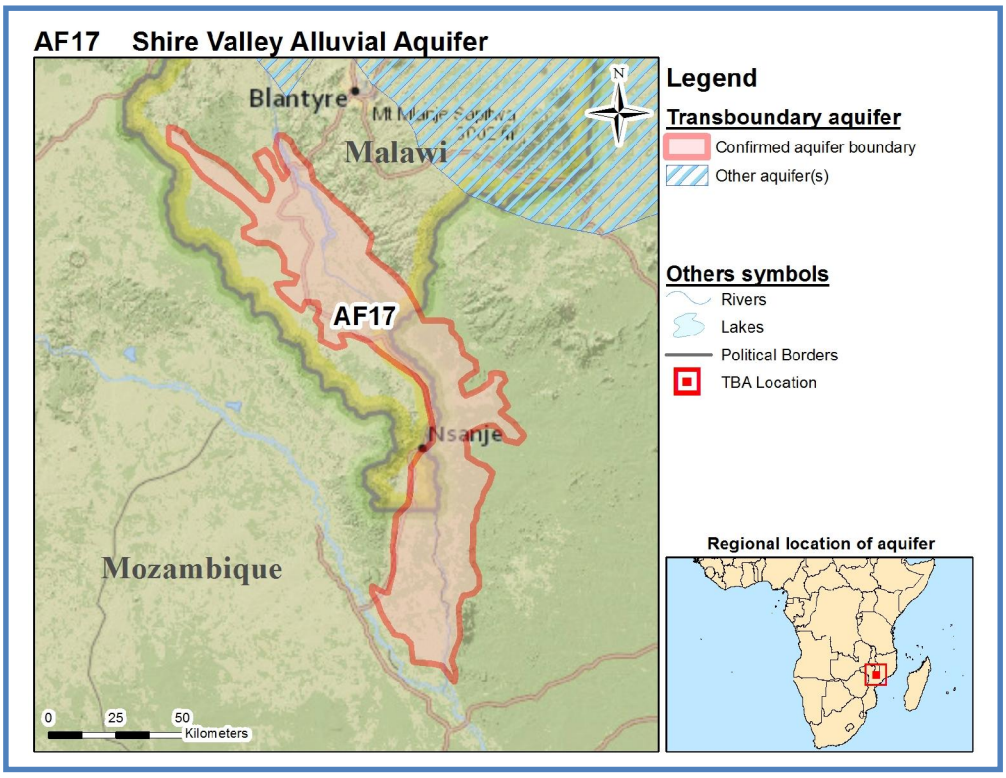
Rainfall (mm/yr): 860

Hydrogeology

Aquifer type: Single-layered system

Degree of confinement: Unconfined to semi-confined

Main Lithology: Sediments - sands and gravel



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)
Malawi	23	180	80	100	X	B	130	310	D	D
Mozambique							51		D	D
TBA level							**90**		**D**	**D**

(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.

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)
Malawi	6	12	45	Aquifer mostly semi-confined, but some parts unconfined	Sediment - Sand	High Primary porosity fine/ medium sedimentary deposits	Secondary porosity: Fractures	50
Mozambique				Aquifer mostly semi-confined, but some parts unconfined	Sediment - Sand	High Primary porosity fine/ medium sedimentary deposits	Secondary porosity: Fractures	
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.

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Aquifer description

Aquifer geometry

The aquifer is a single-layered system that is unconfined to semi-confined. The average depth to the water table is 6 m within Malawi. The average depth to the top of the aquifer is 13 m and the average thickness of the aquifer system is 45 m (in Malawi).

Hydrogeological aspects

The predominant lithology is Tertiary to Quaternary and Recent alluvial sands and gravels that overlie Cretaceous age sandstones within the southern continuation of the Nyasa Rift graben. It is characterized by a high primary porosity with secondary porosity fractures and with a low horizontal and high vertical connectivity. The average transmissivity value is in the order of 50 m^2/d but these do range across the system up to a maximum of 300 m^2/d (Malawi). The total groundwater volume is 6km^3 (Malawi portion). The mean annual recharge, that is 100 % due to natural conditions, is estimated at 61 Mm^3/yr over an area of about 6 900 km^2 (Malawi). There is a significant difference across the years with extreme events, but the average amount needs to be verified.

Linkages with other water systems

The predominant source of recharge is through seepage from the main river channel especially during occasional floods, but precipitation over the aquifer area is also an important mechanism for recharge. The predominant discharge mechanism is through evapotranspiration and through spring discharge.

Environmental aspects

Within Malawi around 20% of the aquifer is not suitable for drinking water mainly due to high salinity over significant parts of the aquifer. Within the Lower Shire valley in Mozambique some large areas of mineralized waters occur regardless of the lithology. North of the Zambezi valley, the coarse-grained arkosic Sena Sandstones have a low permeability and may contain brackish water with a total dissolved solids mineralization content of up to 8500 mg/l. Within Malawi <5% of the aquifer has been polluted (anthropogenic) within the superficial layers. Data is not available on shallow groundwater and groundwater dependent ecosystems.

Socio-economic aspects

During 2010 the annual groundwater abstraction on the Malawi side was 189 Mm^3. There is no additional fresh water abstraction over the aquifer area. This information is based on a summation on data from a database and/ or a dedicated study.

Legal and Institutional aspects

There is no Transboundary Groundwater Agreement in place. The national institutions have a limited mandate with limited capacity.

Emerging Issues

There is little prospect for transboundary groundwater flow as the river (and political boundary) is the main source of the groundwater. As it acts as both source and constant head, interference from pumping is unlikely to propagate beneath the river and border. From the assessment it shows a high use relative to the mean annual recharge that is occurring. It has a relatively high population density and seems to be showing signs of over-abstraction. This must receive further attention.

Contributors to Global Inventory

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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.

Only 1 of the 2 TBA countries has provided information. This information was sufficient to calculate the groundwater indicators. The quantified amount due to extreme recharge events must be reviewed.

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 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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