



Water Vulnerability Map

Analytical Framework

Lukas Ruettinger and Achim Maas

With financial support from

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How to use the analytical framework

The purpose of this analytical framework is to support the development of a Water Vulnerability Map as defined by the African Dialogue Forum on Climate Change and Security (ACC&S).¹ The analytical framework has been designed to follow the **harmonised structure** of all vulnerability maps. Table 1 shows how the sections of the analytical framework correspond to the harmonized structure:

Table 1: Connecting the Analytical Framework and Harmonized Structure of ACC&S

Section of analytical framework	Harmonised structure
1. Water security: understanding the complexities	1. What are the overall complexities of your vulnerability? (4-5 points)
2. Understanding continental dynamics in Africa and identifying geographic hotspots	2. What are the complexities of your vulnerability to continental Africa? (3-4 points)
	3. Identify the five geographical hotspots
3. Identifying needs, initiatives, and potential partners	4. Identify the needs of your five hotspots
	5. Identify ongoing local, regional and international initiatives aimed at meeting these needs
	6. Identify potential partners and important actors related to your vulnerability
	7. List key documentation related to your vulnerability

Each section follows the same structure, providing a short thematic overview followed by a set of guiding questions.

The annexes of the analytical framework provide additional information on key indicators, organisation websites and further reading.

¹ For further information on the ACC&S process, please contact Eckhard Volkman of the German Federal Ministry for Economic Cooperation and Development.

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1 Water security: Understanding the overall complexities

This section of the analytical framework will provide you with the background information to answer **question 1** “**What are the overall complexities of your vulnerability?**” of the ACC&S harmonised structure.

It contains definitions of the main concepts and describes key risk multipliers. This part will also provide the background for the selection of indicators to identify the geographical hotspots in the next section. You can also find additional information to answer question 1 in the commented further reading list at the end of this chapter.

1.1 Defining water security

Water and security are primarily linked in two ways:

1. Resource conflicts can arise over water.
2. Water scarcity can impact human security and thus lead to instability, migration and increased resource competition (Houdret et al. 2010).

Water can also be used as a military tool; however, this topic will not be addressed in this analytical framework, as it is relatively uncommon.

Conflicts around water can arise between and within countries. The dynamics, nature and actors of internal water conflicts differ considerably from international water conflicts. Thus, we will separate internal from international conflicts and analyze them by using different sets of indicators and guiding questions.

1.2 Risk multipliers

Identifying risk multipliers — factors that, together, impact the likelihood of water conflicts and water scarcity — are crucial to assessing risk and conflict potential. Water scarcity depends on **water availability and/or access** which, in turn, are primarily impacted by three linked sets of factors:

1. Water management and infrastructure;
2. Human impact on the environment;
3. Climate change.

Water management institutions and infrastructure have an obvious and direct impact on water availability and access. Their technical, managerial, and financial capacities are crucial for allocation and sustainable use. Governance decisions can favor certain water users. For example, developmental decisions can lead to

prioritising large-scale farmers over small subsistence farmers to improve exports. Bad governance, like corruption, can negatively affect water availability and access (Richards 2002; UNDP 2006; Transparency International 2008).

Humans can impact water resources directly by **pollution or overuse**. Driven by population growth, both pollution and water use can increase to the point that the resource is overused. Additionally, economic growth and urbanisation often lead to changes in consumption patterns and increased affluence, both of which can increase water use and pollution (Sachs 2009). But humans can also impact water availability and access indirectly – by impacting ecosystems that perform important functions in the water cycle, like forests, which among others act as water storage and filters and prevent desertification (Millennium Ecosystem Assessment 2005).

Climate change will likely intensify the earth's water cycle leading to substantial changes in precipitation patterns, intensity and extremes. This may lead to an increased number of extreme weather events, like droughts, floods and storms. Higher surface temperatures will accelerate snow and ice melting and contribute to rising sea levels. The impacts of climate change on water availability and access can be direct, like less rainwater or more run-off from melting glaciers. Sometimes climate change can also trigger a series of events that impact water availability and/or access. For example, a river can flood because of glacier melt and pollute the groundwater. Different ecosystems can reduce vulnerability to climate change, like coral reefs, wetlands, mangroves reducing the impacts from floods. The degradation of those ecosystems can thus exacerbate the impacts of climate change. This shows that it is important to understand the interaction between environment, human impact, and climate change (B.C. Bates et al. 2008; Ludwig et al. 2009; Gleick et al. 2009).

Insufficient water availability and/or access translates into water scarcity. This normally means increased resource competition. Competition over water can happen between countries and between different groups within countries. The factors influencing the likelihood for this competition to turn into conflict differ for internal and international conflicts.

At the internal level, conflicts between different groups within a country with unequal water availability and/or access affecting **marginalised groups and communities** seems to be a major risk multiplier because it can feed into underlying tensions and grievances. The reasons for marginalisation can be many (religion, culture, caste, tribe, etc.) and it manifests in different ways. Often, marginalised groups differ in their socio-economic status—they are often impoverished, have limited access to education and the job market, as well as government services. Economic marginalisation often translates into political marginalisation, meaning they have less political power and are excluded from decision-making processes (Gehrig and Rogers 2009; Houdret et al. 2010; Houdret 2008; Richards 2002).

International water conflicts can occur when water sources cross borders. These water resources are not limited to rivers and lakes but also include groundwater aquifers. The likelihood of international water conflicts is affected by the water dependence of the countries on the transboundary resource. Another important risk multiplier is large and rapid change, like the construction of a dam, an irrigation scheme or territorial realignment—especially if there are no institutions in place for

common water management and conflict resolution or if those institutions cannot cope with the pace of change. While common management institutions often prevent conflict, they can also be risk multipliers, for example if these institutions are politicised and reflect asymmetrical power relations and inequalities (Houdret et al. 2010). Looking back in history, successful cooperation has overwhelmingly surpassed conflicts over water between countries (Priscoli and Wolf 2010).

In addition, there are also a number of risk multipliers that affect both the potential for international and internal water conflict. A history of past or ongoing (water) conflicts in the country or region increases the potential for conflicts in both cases, since they not only generate grievances and lead to stronger group identities but also often include refugee flows and lead to the proliferation of small arms (Smith 2004).

Another common factor influencing the potential for conflict is cooperation patterns and institutions. Institutions for water management, but also non-water related conflict management mechanisms can decrease conflict potential, but only if they are transparent, representative and legitimate (Lederach 1995, Bloomfield et al. 2006, Means et al. 2002).

Further reading:

For information on the impacts of climate change on water, see the Intergovernmental Panel on Climate Change's report, which includes a regional chapter on Africa:

- Bates, B. et al. 2008: Climate Change and Water, Geneva: IPCC Secretariat.

For the link between water and security, see these three reports:

- WBGU 2007: World in Transition. Climate Change as a Security Risk. Retrieved September 1, 2010, from http://www.wbgu.de/wbgu_jg2007_engl.pdf
- Houdret, A., A. Kramer and A. Carius, 2010: The Water Security Nexus: Challenges and Opportunities for Development Cooperation, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ).
- OECD 2005: Water and Violent Conflict. Issue Brief, OECD (DAC). Retrieved September 1, 2010, from http://waterwiki.net/images/d/dc/Water_and_Conflict_OECD_issues_brief_2005_.pdf

For the link between marginalisation and unequal water access and availability see:

- UNPD 2006: Human Development Report 2006: Beyond Scarcity - Power, Poverty and the Global Water Crises, United Nations Development Programme.

2 Understanding continental dynamics in Africa and identifying Hotspots

This section covers two points of the harmonised structure, and will help you to answer question 2: “What are the complexities of your vulnerability to continental Africa?” and question 3: “What are the geographical hotspots in your area?”

For each hotspot, provide a short description of the water conflict potential and dynamic. This part of the framework will also include guidance to write descriptions and appropriate indicators. The identification of geographical hotspots is a two-step-process:

- In the first step, all continental African countries should be analyzed by using a set of maps and indicators of continental Africa that may support visualizing quantitative data linked to the above identified risk multipliers. Cross-referencing these maps will help identify a first set of regions.
- In a second step, analyse the regions by using a set of guiding questions to understand the complexities and dynamics of the water conflict potential and risk. This analysis will help to choose the five hotspots and provide a base for the description of the water conflict potential and dynamic of each hotspot.
- Based on the overview of risk multipliers in continental Africa gathered in step 1 and the analysis of those risks and how they create conflict (potential) in step 2, question 2 can be answered. If you need further information, there is also additional reading at the end of the first step, highlighting key documents.

2.1 First step: Maps and indicators of risk multipliers

The following set of maps and indicators cover those risk multipliers identified in the first section that can be quantified. Cross-referencing these maps should help you to identify the regions and countries in Africa where most risk multipliers converge. To be classified as a hot spot, the country or region should be experiencing:

- serious problems with water availability and/or access;
- environmental problems;
- low human development and security;
- expected or existing impacts of climate change; and
- effects of a history of ongoing conflict.

You may find indicators and maps for these themes in Annex 1 of the framework. Based on the culmination of these risk multipliers a preliminary list of hot spots should be chosen. Ideally, this would include those countries in which all the

requirements mentioned above are met. This list will be analysed in more detail in the second step to choose the final five hot spots.

Further reading:

A quick overview of issues around water in Africa:

- WWF 2002: The Facts on Water in Africa. Retrieved September 1, 2010, from <http://assets.panda.org/downloads/waterinafricaeng.pdf>

This United Nations Environment Programme (UNEP) report gives a good overview of the impact of climate change on water availability and access in Africa (especially useful is the table in Appendix A that includes assessments of the water resource, socio-economic status of local communities, institutional capacity, climate change impacts and risks):

- UNEP 2009: Assessment of Transboundary Freshwater Vulnerability in Africa, UNEP Water Research Commission. Retrieved September 1, 2010, from http://www.unep.org/dewa/assessments/Ecosystems/water/Assessment_of_Transboundary_Freshwater_Vulnerability_revised.pdf

This UNEP report provides a comprehensive overview of the impact of environmental change on water availability and access in Africa:

- UNEP and WRC 2008: Freshwater Under Threat: Vulnerability Assessment of Freshwater Resources to Environmental Change – Africa. Retrieved September 1, 2010, from http://www.unep.org/dewa/assessments/Ecosystems/water/Freshwater_under_Threat_Africa_Pub_72dpi.pdf

2.2 Second step: Analysis of conflict dynamics and potential

Quantitative indicators are a good starting point to identify possible hotspots but since conflict dynamics and risk multipliers are dynamic and interact in complex ways, a qualitative analysis of the chosen regions or countries is necessary. A set of qualitative questions will help you to get from the preliminary list of regions and countries identified by cross-referencing the maps, to the five final hot spots and their analysis.

Choosing and analysing the five hot spots:

While the cross-referencing of the maps above gave you a good idea of quantitatively measurable risk multipliers, it is necessary to better understand conflict dynamics and potential. The central question is: How do the risk multipliers interact and create conflict (potential)? To understand this, the following questions are important:

For internal conflicts:

1. How do the three sets of factors (water management, human impact and climate change) impact water availability and/or access?
2. How do the different sets of factors reinforce each other?

3. How are certain factors leading to unequal availability and/or access for certain population groups?
4. Are these population groups marginalised?
5. How are other risk multipliers—like history of conflict, refugee flows and small arms proliferation--affecting the conflict potential?

For international conflicts:

1. How do the three sets of factors (water management, human impact and climate change) impact transboundary water resources?
2. How (economically) dependent are the countries on the shared water resource?
3. Are there common water management institutions?
4. Can the common water management institutions—if they exist—cope with change and how are they perceived (legitimate, fair, transparent, etc.)?
5. Is there a history of conflict between the countries sharing the water resource?

After answering all the questions for all hotspots on the preliminary list, five hotspots need to be chosen. Choosing the five hot spots will be done based on the analysis of the conflict potential and dynamics, as well as the judgment of the researcher. Generally, however, the more negative the answers are to the above mentioned questions, the more likely the country will be a hotspot. The short description of the conflict potential and dynamic for each of the five hotspots should be possible on the basis of the already answered guiding questions above and the overall question: How do the risk multipliers interact and create conflict (potential)?

The Water Vulnerability Map is also a tool to raise awareness for water, climate change and security, thus the selection may also cover different identified global and continental vulnerabilities and different conflict dynamics, as well as different geographic regions.

3 Identification of needs, initiatives and potential partners

As part of the Water Vulnerability Map, the **main needs of the five hot spots** should be identified. This can be done on the basis of the analysis from the previous section, which will provide you with the main risk multipliers and an understanding of how they interact to create conflict (potential).

The following guiding questions can help you to identify the main needs:

1. How can the main risk multipliers be reduced?
2. How can impacts on water availability and/or limited access be reduced?
3. How can vulnerable and marginalised communities adapt to the impacts of climate change?
4. Are there any cooperation or conflict prevention activities that might prove fruitful?

Based on the list of main needs a **list of local, regional and international initiatives addressing these needs** with short descriptions should be added. It is advisable to proceed as follows:

- Name the initiative and add a short description of how it would address one or more needs.
- On the international level, check for initiatives of the major donors like the EU, UN organisations and agencies and World Bank.
- On the regional level, check for initiatives of the African Union and the regional African organisations like the South African Development Community (SADC), the Economic Community of West African States (ECOWAS), the East African Community (EAC) and the African Development Bank (AfDB).
- On the local level, check for initiatives by African national governments and NGOs.

Based on the risk multipliers and complexities identified in sections 1 and 2, **identify potential partners** that address these vulnerabilities. This list should include donor and development organisations, international organisations and NGOs on the international level, regional organisations, national governments, academic organisations and local NGOs.

To cover the last point of the harmonised structure, **list key documentation** you used during your research and that provides good background information on the topic.

Annex I: Maps and Indicators

Water resources:

- Freshwater resources
http://maps.grida.no/go/graphic/renewable_freshwater_supplies
- Wetlands, dams and Ramsar sites in Africa
<http://earthtrends.wri.org/text/environmental-governance/map-257.html>

Water access and availability:

- Percentage of people without sufficient water access or availability
<http://maps.grida.no/go/graphic/access-to-safe-drinking-water>
- Water, economy and livelihoods
<http://maps.grida.no/go/graphic/freshwater-use-by-sector-at-the-beginning-of-the-2000s>
- Water stress
<http://ocid.nacse.org/tfdd/index.php>
- Water availability in Africa (with projections until 2025)
http://maps.grida.no/go/graphic/water_availability_in_africa

Aggregated data, combining human security and water availability and access:

- Water poverty (includes environmental stress and management, access to water, resources, population growth, use and human development indicators)
<http://maps.grida.no/go/graphic/water-poverty-index-by-country-in-2002>
- No shelter - refugees, sanitation and slums
<http://maps.grida.no/go/graphic/no-shelter-refugees-sanitation-and-slums>

Human Impact:

- Population growth
http://na.unep.net/globalpop/africa/Appendix_6e.html
<http://indexmundi.com/map/?t=0&v=24&r=af&l=en>
http://earthtrends.wri.org/maps_spatial/maps_detail_static.php?map_select=278&theme=2
- Rapid urbanisation
http://na.unep.net/globalpop/africa/Appendix_8.html#

- Economic growth
<http://data.worldbank.org/country>
- Poverty level
<http://data.worldbank.org/country>

Ecosystem degradation and environment:

- Biodiversity loss
<http://maps.grida.no/go/graphic/biodiversity-loss-state-and-scenarios-2006-and-2050>
- Forest cover loss
<http://maps.grida.no/go/graphic/changing-global-forest-cover>
- Land degradation
<http://maps.grida.no/go/graphic/degraded-soils>
- UNEP Atlas of our changing environment Africa
<http://www.unep.org/dewa/africa/africaAtlas/PDF/en/Chapter1.pdf>

Climate change:

- Climate change vulnerability:
http://maps.grida.no/go/graphic/climate_change_vulnerability_in_africa
<http://maps.grida.no/go/graphic/fifty-million-climate-refugees-by-2010>
<http://maps.grida.no/go/graphic/projected-changes-in-cereal-productivity-in-africa-due-to-climate-change-current-climate-to-2080>
<http://maps.grida.no/go/graphic/vulnerability-of-national-economies-to-potential-climate-induced-changes-in-fisheries>

Environmental conflicts in Africa 1980-2005:

- Water conflicts:
http://www.wbgu.de/Images/jg2007_en/Fig_3_2-3.pdf

History of conflict:

- Ongoing or past conflicts (international and internal)
<http://www.pcr.uu.se/gpdatabase/gpregions.php?regionSelect=2-Southern%20Africa>
- Refugees
<http://www.unhcr.org/4ad7312a6.html>
- Small arms availability
<http://www.smallarmssurvey.org/files/portal/spotlight/country/africa.html>

- International water conflict
<http://www.environmental-expert.com/Files%5C5302%5Carticles%5C5877%5C2.pdf>

General stability:

- Failed States Index
http://www.fundforpeace.org/web/index.php?option=com_content&task=view&id=99&Itemid=140
- Human Development Index
http://hdr.undp.org/en/statistics/data/hd_map/
- Economies at risk: disasters, poverty and agricultural dependence
<http://maps.grida.no/go/graphic/economies-at-risk-disasters-poverty-and-agricultural-dependence>

Further resources:

- <http://www.unep.org/dewa/vitalwater/index.html>
- <http://earthtrends.wri.org/> (many watershed maps for Africa)
- <http://maps.grida.no>

Annex II: Literature

- Bates, B. et al. 2008: *Climate Change and Water*, Geneva: IPCC Secretariat.
- Bloomfield, D., M. Fischer and B. Schmelzle, 2006: *Social Change and Conflict Transformation*, Berghof Research Center for Constructive Conflict Management. Retrieved September 1, 2010, from http://www.berghof-handbook.net/documents/publications/dialogue5_sochange_complete.pdf
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Transparency International, 2008: Global Corruption Report 2008: Corruption in the Water Sector 1st ed., Cambridge University Press.

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WWF 2002: The Facts on Water in Africa. Retrieved September 1, 2010, from <http://assets.panda.org/downloads/waterinafricaeng.pdf>