

# Impacts of Climate Change on the Nile River Conflict: The Case of Egypt

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## Introduction

Egypt depends almost completely on the waters of the Nile, which supplies 95% of the total renewable water resources of the country (FAO 2010). From the natural Nile flow measured as 84 km<sup>3</sup>/yr at Aswan Egypt has an allowance of 55.5 km<sup>3</sup>/yr, based on the 1959 agreement with Sudan. Renewable groundwater makes up another 1.3 km<sup>3</sup>/yr. With a current water availability of 702.8 m<sup>3</sup>/capita/year (FAO 2010, data from 2008), Egypt is classified as water scarce (Falkenmark, et al. 1989), and future demographic trends indicate further aggravation of the water supply level. Water use is highest in the agricultural sector, reflecting dependence of this sector on irrigation due to the lack of precipitation and soil moisture (FAO 2010). Agriculture is concentrated in the Nile valley and the river delta.

Politically, Egypt, as the politically and economically strongest as well as highest developed country of the Nile Basin, has been called the “hydro-hegemon” of the basin, ensuring itself historic rights to 66% of the total Nile flow in the treaties over Nile water from 1929 and 1959 (Cascão 2009). In the past two decades, however, the upstream states have started to challenge this hegemony, demanding equitable use of the water and the right to implement their own water projects like dams and irrigation systems. This has led to cooperation in the Nile Basin Initiative, founded in 1999. However, a comprehensive river basin agreement is still not in place, largely due to fears in Egypt and Sudan of having to reduce their Nile water shares in favor of the upstream countries. This has led to a situation of cold conflict, with no near term solution in sight. The draft *Comprehensive Framework Agreement*, which was signed unilaterally by five of the upstream states in May 2010 without downstream approval, is currently more an expression of the conflict situation than a vehicle for cooperation.

Climate change is now emerging as a new challenge, adding to existing demographic and political ones, and Egypt is one of the countries most vulnerable to its effects. Due to cascading effects, altered climatic conditions can considerably influence the frequency and extent of possible conflicts both within Egypt and internationally between Nile Basin states or foster increased cooperation in this region. This paper discusses the possibilities of both such developments (for a more extensive discussion see Piontek 2010). The next section briefly outlines expected climate change impacts on Egypt and develops three scenarios of Nile River flow before addressing the possible international and internal effects in the subsequent sections.

## Expected impacts of climate change on Egypt

Over the 20<sup>th</sup> century, a warming of the African continent at a rate of 0.5°C/decade has been observed, with the most drastic warming occurring since 1970 (Hulme, et al. 2001). Climate models agree in predicting a continuation of this trend. Expected temperature increases in Egypt range from 1.5°C to 4°C by 2050, with a slightly higher rate of warming in summer than in winter (Agrawala, et al. 2004, Elshamy, et al. 2009).

Trends for precipitation are less clear. For Egypt, Agrawala et al. (2004) predict declines in annual mean precipitation, though those are not statistically significant. Since rainfall contributes little to Egypt’s available freshwater, changes in the headwater regions of the Nile – the Ethiopian highlands and the equatorial lakes region – are more important for Egypt’s water supply due to their influence on the flow of the Nile. The river flow is highly sensitive to precipitation changes, which is attributed to the combination of low discharge of the river and high evaporation rates (de Wit and Stankiewicz 2006). An example for this sensitivity is the change of inflow into Lake

Nasser between the periods 1993-2000 and 1980-1987. While total rainfall over the basin increased by only 10%, river flow increased by 40% (Kwadijk 2010).

For the Blue Nile and the equatorial lakes region climate models predict precipitation changes by 2070 between -34 and +24% and between -32 and +31%, respectively (Beyene, et al. 2010, A2 scenario)<sup>33</sup>. This large uncertainty is mirrored in other studies and reflects the difficulty of downscaling from global models to regional levels, but also indicates lack of understanding of phenomena like ENSO, which are important for the Eastern African climate.

In order to derive predictions for Nile River flow under climate change, the interaction of temperature, precipitation and evaporation has to be taken into account. For the upper Blue Nile the ensemble means of Kim and Kaluarachchi (2009) and Elshamy et al. (2009) are +4% and -15% respectively, with spreads between -60% and +80%. It is certain, that natural variability of rainfall will increase, which means an increase in frequency and strength of floods and droughts, and potential shifts in rainfall seasons (McSweeney, et al. 2010).

A prediction of the flow of the Main Nile has to consider changes in the flow of both the Blue and the White Nile and varies wildly in the literature (for example Elshamy et al. (2009b): -62% to +43% with ensemble mean of +1%, Beyene et al. (2010): -29% to +26% by 2040-2069). From this uncertainty it is clear that any discussion of climate change impacts on conflict has to take into account three scenarios: lower flow of the Nile River, higher flow, and unchanged overall flow with higher variability.

Climate change induced sea level rise also poses a large risk for Egypt since the Nile delta is highly populated, with the country's industrial centers located here, and agriculturally important due to high fertility of the land. The IPCC expects a global sea level rise between 0.19 and 0.58 m relative to 1980-1999 by 2100, while the actual change at a given location depends on regional variations in oceanic level, geological uplift/subsidence and human-induced subsidence and can differ significantly from the global mean trends, especially in deltas and for coastal cities (Nicholls, et al. 2007). According to Dasgupta et al. (2009), Egypt is among the top ten most impacted countries (among developing countries) in a 1-m sea-level rise scenario in terms of impacts on population, GDP, wetlands and especially agricultural land. For a 0.5 m sea level rise in the Alexandria Governorate alone more than 1.5 million people would be displaced and almost 200,000 jobs would be lost (Agrawala, et al. 2004).

### **Impact of climate change on the conflict over the waters of the Nile River**

The impact of climate change on the water supply of the countries in the Nile Basin interacts with the steadily increasing water demand due to population growth and economic and human development. Higher temperatures are likely to add to this demand, e.g. through higher energy needs for cooling. This happens at a time where the historic distribution of Nile water is challenged by upstream states, demanding higher water shares of their own.

Against this background, higher Nile flows have the potential to increase cooperation between Nile states, since the upstream countries could benefit from the additional water, while the volume allocated to Egypt and Sudan could remain at current levels. However, increased demand might cancel out possible increases in river flow. In case of lower flow, cooperation is even less likely. In that case it will become very difficult for Egypt to maintain its share in water consumption, and a chance for armed conflict arises if neither side is willing to make concessions. In the case of higher variability, especially times of prolonged droughts provide a

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<sup>33</sup> The same study finds smaller spreads when using the B1 emission scenario.

challenge to the basin. While the Aswan High Dam reservoir enabled Egypt to successfully mitigate the effects of the large drought in the 1980s, any event of higher severity will probably overwhelm this capacity (Gasser and Abdou 1989).

In all three cases, the benefits of cooperation are increasing. Already in the present situation, strong incentives for a basin-wide cooperation can be observed. A win-win situation could be generated when comparative advantages of each riparian country are utilized (e.g. Mason 2004, Whittington 2004, Wichelns et al. 2003): the hydro-electric power potential in Ethiopia, the agriculture potential in Sudan, financial capabilities of Egypt, reduced evaporation losses by storing water upstream in Ethiopia rather than downstream in Sudan and Lake Nasser, increased intra-basin trade in electricity, food and goods. However, despite the progress in the framework of the Nile Basin Initiative, basin-wide water management is still far from being implemented. Under climate change, even higher incentives for transboundary water management are created. Declining water resources in a low flow scenario would be utilized best when measures like dams and irrigation are realized in the locations with highest basin-wide potentials. Increased flows are a challenge for infrastructure – both existing and planned, if these changes are not taken into account in the planning process – and highest efficiency can be achieved only through cooperation. Finally, particularly the increasing variability makes basin-wide cooperation a necessity. Strong floods and droughts can only be managed on a basin-wide scale through coordinated dam operations.

Overall, climate change increases not only the challenges for Egypt but also the potential benefits Egypt from increased cooperation with the other riparian states. Depending on the scenario, it may be difficult to maintain the historic allocations, so there is potential for political and economic pressure or even armed conflict if no new agreement is found (Link, et al. 2010). Finally, especially in the case of more extreme events, Egypt's historic ally Sudan, which is highly vulnerable to floods along the rivers that originate in the Ethiopian highlands, could find stronger cooperation with Ethiopia more and more attractive in order to be able to mitigate these impacts. This could isolate Egypt in the Nile Basin in the long run, thus weakening its position.

### **Climate change and internal conflicts within Egypt**

In Egypt, almost the entire population is concentrated on only 4% of the area of the country, leading to a population density of 1435 people per km<sup>2</sup>, with little possibility of developing new areas for settlement<sup>34</sup> (Ibrahim and Ibrahim 2006). Continued population growth worsens this problem and is accompanied by increasing urbanization and increasing unemployment especially among young people. The fraction of population aged 0-14 is 32.5% and unemployment rates are at 23.3% for young men and 62.2% for young women (aged 15-24, data from 2005, World Development Indicators 2010). This already leads to inequalities and social frictions.

The current development will be amplified by increasing pressure on land and water resources caused by climate change. Decreasing water availability makes agriculture less viable, particularly due to the large share of irrigation. This is also influenced by decreasing yields and increasing crop water needs. According to Eid et al. (2006), national production of rice could decrease by 11%, of soybeans by 28%, of maize by 19% and of barley by 20% by 2050, while increases in cotton seed yield are possible. At the same time, considerable shares of agricultural land in the Nile delta might become unusable due to submergence or salt water intrusion caused by sea level rise. This will increase unemployment and movement to cities – exacerbated again by sea level rise, since large parts of the population live in coastal cities like Alexandria – and can potentially

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<sup>34</sup> Desert reclamation projects like the Toshka project in the south of the country or in northern Sinai so far have been of limited success. They also require large amounts of water and their economic viability is unclear (Lonergan and Wolf 2001).

lead to social tensions, especially related to lack of prospects, water and sanitation conditions in slums etc.<sup>35</sup>. However, also the urban environment can become the setting of conflicts brought in from the rural areas (Maninger 2000). Especially in Cairo, which is situated in one of the most fertile areas of Egypt, the extensive growth of the city intensifies a constant conflict between land use for agriculture and possible improvements of living conditions in the city.

The impact of climate change on agriculture also threatens food security in the country. Already, Egypt imports 40% of its food and even 60% of its grain (Al Masry Al Youm 2010). During the so-called “world food crisis” in 2008, Egypt was among the countries facing riots since people were unable to afford basic food supplies. This highlights the conflict potential in this area (Schneider 2008). Climate change can force the country to import even larger fractions of its food supply to ensure provision of the population, which requires good economic standing and a source of foreign revenue. Again, this need can be an incentive for cooperation with the other Nile riparians, using food trade as facilitator of cooperation.

Another potential for societal tension arises from possible adaptation measures to decreasing water availability as a consequence of climate change. Adaptation has to entail water saving measures, especially in the agricultural sector, but also intersectoral reallocations (Wichelns 2002). This leads to shifts in the labour force needed in large scale agriculture, which therefore severely affect poor subsistence farmers who can neither compete for the scarce water nor are qualified enough to find work elsewhere. Distribution conflicts between the different sectors are also possible, particularly when a developing industrial sector demands more water or contributes significantly to water pollution, or if water for agriculture is cut since it can be used more efficiently elsewhere. Currently, prices for water in Egypt are heavily subsidized (Abou-Ali 2003), and unrest could occur if a pricing policy is introduced as an incentive for saving water. Overall, in order to address water scarcity a clear strategy and water policy is needed (Mason 2004).

## Conclusions

This discussion shows clearly that an indirect link can be drawn from the primary effects of climate change on temperature, precipitation, and sea level rise via secondary effects on the Nile River flow and agriculture to the occurrence of intra- and interstate conflicts. Egypt, with its specific challenges of high population density, water scarcity and small areas of fertile and usable land, is especially vulnerable to these effects of climate change and to some adaptation measures. Integration of climate change into all planning strategies and development measures is of primary importance for the country. At the same time, the incentives for Egypt to cooperate with its neighbors will strongly increase through climate change. A basin-wide agreement is likely to be beneficial for Egypt and possible concessions with respect to water allocations will be alleviated, among other things, through higher stability and a better position to meet the challenges of climate change. Such an agreement, however, has to take the possible effects of climate change into account by being flexible enough to address changing flows and conditions while ensuring enforceability. Otherwise its stability cannot be guaranteed in an insecure future.

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<sup>35</sup> In Egypt the percentage of urban population living in slums is 17.1%, which is comparatively low. In other Nile Basin states, it is far over 50%. (United Nations 2010, data from 2007).

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