

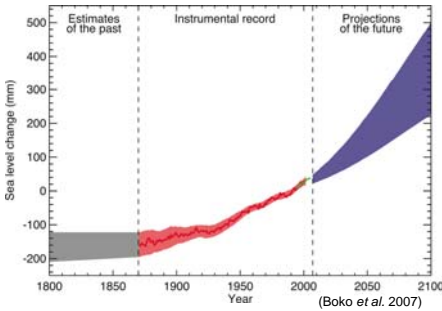
# Impacts of accelerated sea level rise on the coastal zones of Egypt

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## Sea level rise scenarios in the 21<sup>st</sup> century



The extent of sea level rise is influenced considerably by several factors: the thermal expansion of the oceans as a consequence of global warming, the melting of glaciers and ice sheets in Greenland and the Antarctic which store vast amounts of fresh water, as well as other terrestrial sources of water such as high mountain glaciers and rivers. Simulations have led to estimates of an increase in global mean sea level between 18 and 59 cm by the end of the 21st century. However, the regional amounts of sea level rise can vary substantially.

The coasts of Egypt, which extend over more than 3500 km, can be considered to be exceptionally vulnerable to the impacts of sea level rise. More than 40% of the Egyptian people live along the coastlines of the country, mostly in the Nile River Delta between Alexandria and Port Said. This region covers less than 4% of the entire Egyptian land but is nearly Egypt's only area that can be used for agriculture.



## Ecological and economical consequences

Simulation results indicate that the Nile River Delta is one of the regions that would be most affected worldwide by a rise in sea level of 1m (Dasgupta et al., 2011). Vast areas of the directly exposed parts of the coastal zone would be flooded.



If the sea level only rose by 0.5 m, more than 1800 km<sup>2</sup> of agricultural land would be lost affecting approximately 3.8 million people (FitzGerald et al., 2008). If the sea level rose by 1 m, the number of people that would need to leave their land would increase to more than 6 million (Dasgupta et al., 2009a), as approximately 4500 km<sup>2</sup> of land become uninhabitable.

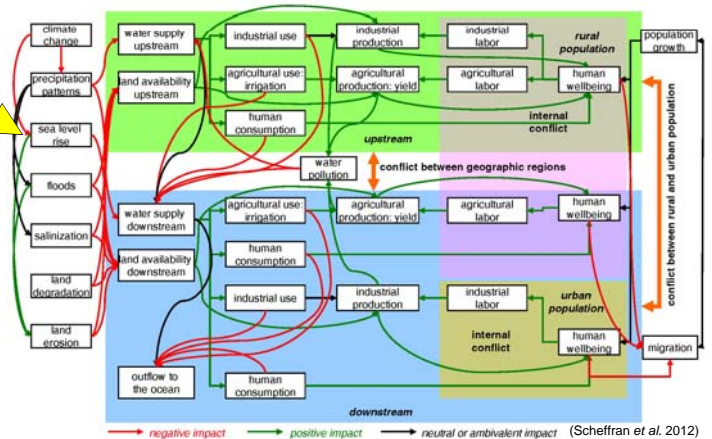
Degeneration of fresh water sources over such a large area is likely to have a substantial negative impact on agricultural production in this area.

Assessments of the economic consequences of sea level rise highlight the necessity of artificial coastal protection in Egypt on a large scale because even the economic losses incurred by an increase in sea level by only 0.5m without any adaptation measures would be considerable. More than 1.5 million people only in the vicinity of the city of Alexandria would have to be relocated. The damage to land and infrastructure, e.g. due to the abandonment of the harbor of Alexandria would amount to more than US\$ 30 billion.

If the sea level rose by 1m, the GDP would decline by almost 6.5% with the agricultural sector being hit disproportionately strong with a decline by 12.5%. Such a development is a direct threat to food security for the rapidly growing population, as the needs for fundamental food crops could be fulfilled to a far lesser degree than at present. Also declines in fish catches in the lakes and lagoons in northern Egypt are likely, which in turn leads to the abandonment of the fisheries by many fishermen and the subsequent decline in Egyptian GDP.

## Impacts on societal stability

Sea level is just one of several environmental factors that may be altered considerably by climate change. It may have strong long-term impacts on the most downstream country of the Nile. A reduction in the amount of agricultural land available for food production and a decline in fresh water availability can cause migration and may increase the conflict potential within the Egyptian population and thus contribute to a destabilization of the society as a whole.



Interactions between the various actors in the Nile River Basin and in this case particularly in Egypt are the basis of a model that has been developed at the Research Group Climate Change and Security (CLISEC) at the University of Hamburg (Scheffran et al., 2012). It looks at the consequences of (climate change induced) environmental change for societal stability and considers the complex interactions between climate change, environmental impacts, resource availability, individual human wellbeing and societal stability.

Sea level rise is one of the factors directly influenced by climate change that has to be considered in this context as it aggravates the already difficult situation to adequately supply the Egyptian population with fundamental resources such as drinking water and fundamental crops.

## Strategies to deal with sea level rise

There are already a number of measures taken to protect the Egyptian coast against the consequences of sea level rise. Already, more than US\$ 300 million have been spent to install sea walls along the most severely threatened parts of the coast. In particular, the outer parts of the promontories where the Nile River meets the sea are protected by seawalls. In these areas, erosion has declined considerably near the seawalls or has in some instances even changed to sand accumulation. However, in the areas adjacent to these protective structures erosion has intensified in the downstream direction of the seawalls. First efforts to reduce the adverse impacts of sea level rise on water resources by implementing a National Improvement Plan are supposed to reach their targets by 2017. However, these plans have been criticized for mainly protecting tourism infrastructure.

If Egypt aims at successfully adapting to the consequences of sea level rise, it needs to abandon the business-as-usual protection strategies of the coasts and to implement a "revolutionary sea wall" (Malm, 2012: 23) that includes the raising of public awareness and public participation which includes the whole society.



Boko, M. et al. (2007): Climate Change 2007: Impacts, Adaptation and Vulnerability, in: Parry, M.L. et al. (eds.), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 433-467.

Dasgupta, S. et al. (2009): The impact of sea level rise on developing countries: a comparative analysis. *Climatic Change* 93: 379-388.

Dasgupta, S. et al. (2011): Exposure of developing countries to sea-level rise and storm surges. *Climatic Change* 106: 567-579.

FitzGerald, D.M. et al. (2008): Coastal Impacts Due to Sea-Level Rise. *Ann. Rev. of Earth and Planetary Sciences*, 36: 601-647.

Malm, A. (2012): Sea Wall Politics: Uneven and Combined Protection of the Nile Delta Coastline in the Face of Sea Level Rise. *Critical Sociology* 1-30.

Scheffran, J., Link, P.M. and Schilling, J. (2012): Theories and models of climate-security interaction: Framework and application to a climate hot spot in North Africa, in: Scheffran, J. et al. (eds.), *Climate Change, Human Security and Violent Conflict*, Berlin, Springer Verlag, Hexagon Series Vol. 8, pp. 91-132.