

# Risks and opportunities: understanding climate change in the Nile Delta

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## What is the issue?

Among the world's river deltas, the Nile Delta is one of the most vulnerable to climate change and variability (IPCC, 2001). It is also the most fertile land in Egypt. The Delta is home to 50% of the population outside of Cairo, and is the source of 40% of the country's agricultural production, 50% of its fish catch and 60% of its industrial production. These vital contributions are under threat, however, from climatic impacts such as sea level rise and extreme weather events.

Despite the large potential impacts, research on climate change vulnerability and adaptation in the Nile Delta is scarce, dispersed and poorly coordinated. A general lack of understanding about the issues within various communities makes the situation more difficult. In particular, lack of knowledge about threats, including sea level rise, is hindering the design of preventative measures that could reduce harm in the long run. Communication gaps between researchers and government officials make planning more difficult.

## What did we do?

The Alexandria Research Center for Adaptation to Climate Change (ARCA) was established in 2011, with support from Canada's International Development Research Centre. As a policy-oriented centre for climate change adaptation research, ARCA's core work focuses on socioeconomic aspects of adaptation in the Nile Delta. This involves assessing the primary physical impacts of climate change and sea level rise, including their economic influence and their

## Key messages

- In the Damietta governorate (in Egypt's Nile Delta), salt-water intrusion due to sea level rise will significantly affect agriculture and lead to an estimated loss of US\$905 million by 2100.
- 60% of coastal cities and towns (11 out of 18) are susceptible to flooding by sea level rise.
- Some vulnerable coastal areas can be protected through low cost adaptation options, such as enriching coastal sand dunes to provide a natural barrier.
- Climate change will significantly disrupt livelihoods in the Nile Delta coastal area, with farmers facing particular challenges to crop productivity.
- Despite potential damage, flooding of coastal wetlands may lead to new opportunities, such as improving water quality and fish production.
- Proactive adaptation is essential even without sea level rise, since a general sinking of land in the Delta will lead to flooding of 15.6% of the land in six coastal governorates.

effect on communities. The Center also builds capacity with a wide spectrum of stakeholders including researchers, government officials, the private sector and the general public.

To accomplish its aims, ARCA has been building research capacity through scholarships and technical skill through workshops, including

training in remote sensing and geographic information systems (GIS). Some of these activities are demand-driven, based on requests from specific organisations such as the Egyptian Environmental Affairs Agency (EEAA).

ARCA focuses on policymakers' research needs and on articulating a policy-relevant research agenda. The Center also provides small grants to researchers from universities and research institutes, framed around the priorities of policymakers.

## What did we learn?

- In research and discussions so far, flooding has dominated the attention of researchers at the expense of salt-water intrusion into groundwater, which is another serious impact of sea level rise.
- About 2783 km<sup>2</sup> across six coastal Nile Delta governorates (15.6% of the total area) are exposed to flood risk due to land subsidence, even without climate change or sea level rise. Adaptation is therefore essential, regardless of other threats.

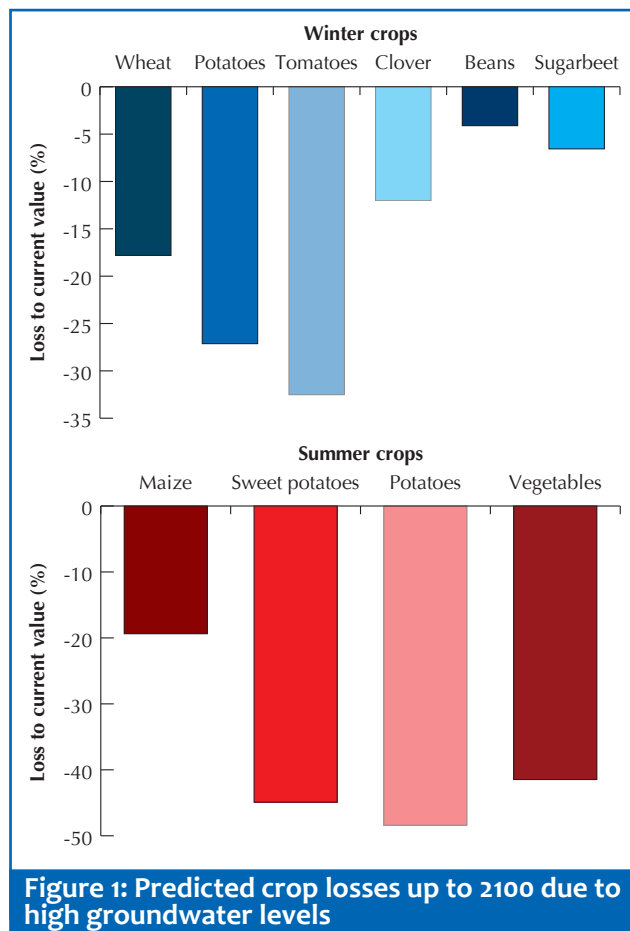


Figure 1: Predicted crop losses up to 2100 due to high groundwater levels

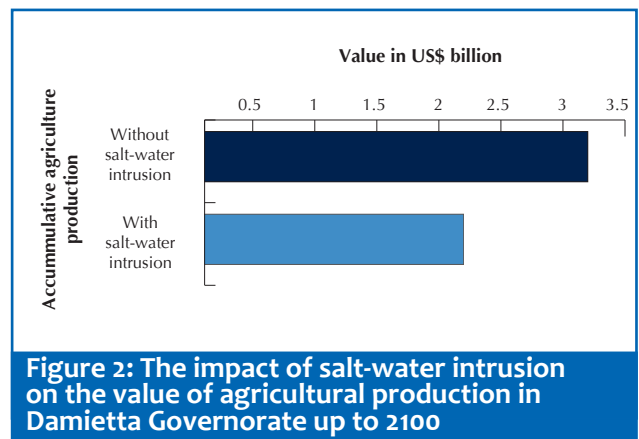


Figure 2: The impact of salt-water intrusion on the value of agricultural production in Damietta Governorate up to 2100

- Lack of knowledge among decision makers and policymakers about the vulnerability of the Nile Delta is hindering adaptation. Capacity building and research are helping to fill this void.
- Up to 41% of the area susceptible to flooding by sea level rise in the Nile Delta is actually wetland. In these areas, sea level rise may create opportunities such as increased fishing activity.
- Most work on climate change adaptation has focused on large-scale projects to reduce potential damage from sea level rise; however, smaller scale adaptation by individuals or communities is also important. For example, soil building by farmers can protect crops from higher groundwater.
- Large areas that are exposed to flooding can be protected through small-scale engineering works to protect weak points along the coastline. For example, 23-26% of the Alexandria area is susceptible to flooding by sea level rise and can be protected with a 4 km long sea wall.

## Stories of change

In the past, research on vulnerability and adaptation to climate change in the Nile Delta has been restricted to a small number of impacts and sectors; only 15 research papers on climate change issues have been produced during the last 25 years. Despite the wide range of climate change impacts, nearly all of these focused on the risk of flooding due to sea level rise.

Over the last three years, ARCA has focused on promoting multi-disciplinary research on climate change. This work has resulted in eight research papers, of which five are journal articles on



**Deterioration of drainage channels in the Delta may worsen the impact of high groundwater levels**

vulnerability and adaptation in the Delta; this alone has increased the existing literature by 25%. This work has generated knowledge on climate change vulnerability and adaptation in a wide range of disciplines, including marine biology, agricultural and livestock productivity, wetland ecosystems, health, environmental economics and urban resilience. ARCA is also publishing a quarterly working paper series that highlights research findings.

ARCA has organized 39 capacity building workshops for stakeholders including government officials, farmers, fishermen and school pupils. This has led to a Memorandum of Understanding between ARCA and the EEAA as a framework for collaboration. The EEAA has also established new climate change units in its regional branches. Several ministries, including the Ministry of Agriculture, have requested training for their officials.

## What are the policy implications?

### Ministry of Housing, Reconstruction and New Communities:

- 11 out of 18 coastal cities and towns will be exposed to the risk of flooding. Development plans in the coastal urban areas of the Nile Delta should assess and respond to this risk.
- Groundwater levels are expected to rise in the Nile Delta. To protect future building and infrastructure projects, revisions will need to be made to Egypt's codes and standards for construction.

- A zoning plan is needed to restrict development in areas that are highly susceptible to flooding by sea level rise.

### Coastal Governorates:

- Large areas of the Nile Delta are at risk of flooding due to land subsidence. Adaptation actions are therefore essential, even without sea level rise from climate change.

### Directorates of Agriculture in the Nile Delta coastal governorates:

- Sea level rise also causes salt-water intrusion, reducing agricultural yields. Plans to deal with high groundwater levels and salinity need to be developed.
- Adaptation policy should consider not only government-led adaptation actions, but also crucial measures that farmers can take.

### National Authority for Coastal Protection (Ministry of Irrigation and Water Resources):

- Many areas can be protected from flooding through a mixture of protective engineering works and 'soft' adaptation options, such as enrichment of coastal sand dunes.

### National Agency for Fisheries (Ministry of Agriculture):

- Coastal wetlands are susceptible to flooding by sea level rise. In-depth assessment of the impacts on wetland ecosystems can reduce potential damage and identify potential opportunities.



**Many activities in the Nile Delta, including fishing, are vulnerable to climate change**



## What next?

Additional research is needed to improve adaptive capacity in the Nile Delta. Below are some research questions that could guide future work in this area:

- What are the economics of various adaptation options in the coastal area of the Nile Delta?
- To what extent are urban areas in the Nile Delta coastal zone resilient to climate change and associated sea level rise? How can their resilience be improved?
- What are the main opportunities, in terms of livelihoods, associated with wetland flooding?
- To what extent will existing protective engineering works be effective in the event of higher sea levels? To what extent will coastal dynamics change in the future under higher sea levels?
- What are the future expected demographic and economic changes in the Nile Delta, and how will these affect human vulnerability to climate change? What are the implications of this?



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**Fishermen and other users of the Delta should be involved in developing an adaptation strategy for the area**

## Need more information?

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