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The Nile River: A Historical Overview and Contemporary Challenges in Water Management

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THE NILE RIVER: A HISTORICAL OVERVIEW AND CONTEMPORARY CHALLENGES IN WATER MANAGEMENT

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CHAPTER WORKFLOW

HISTORICAL SIGNIFICANCE AND GEOGRAPHY OF THE NILE

- **The Nile** represents a historical & vital water artery for Egypt; it constitutes ~80% of Egypt water resources & ~90% of Egypt's water supply.

  ``***Egypt is gift of the Nile***" – Herodotus, Egyptian Historian

- The Nile is a **transboundary** resource of fresh surface water, sourced from the rainfall over Ehtiopian highlands.

- Geography of the Nile:
  - 6700 km long from Lake Victoria to the Mediterranean;
  - Shared between 11 riparian countries;
  - Accommodates 487 million inhabitants;
  - Represents 10% of the African continent.

This makes the Nile a complex geopolitical water resource with special characteristics and transboundary controls.

HISTORY OF THE NILE WATERS MANAGEMENT PROTOCOLS AND AGREEMENTS

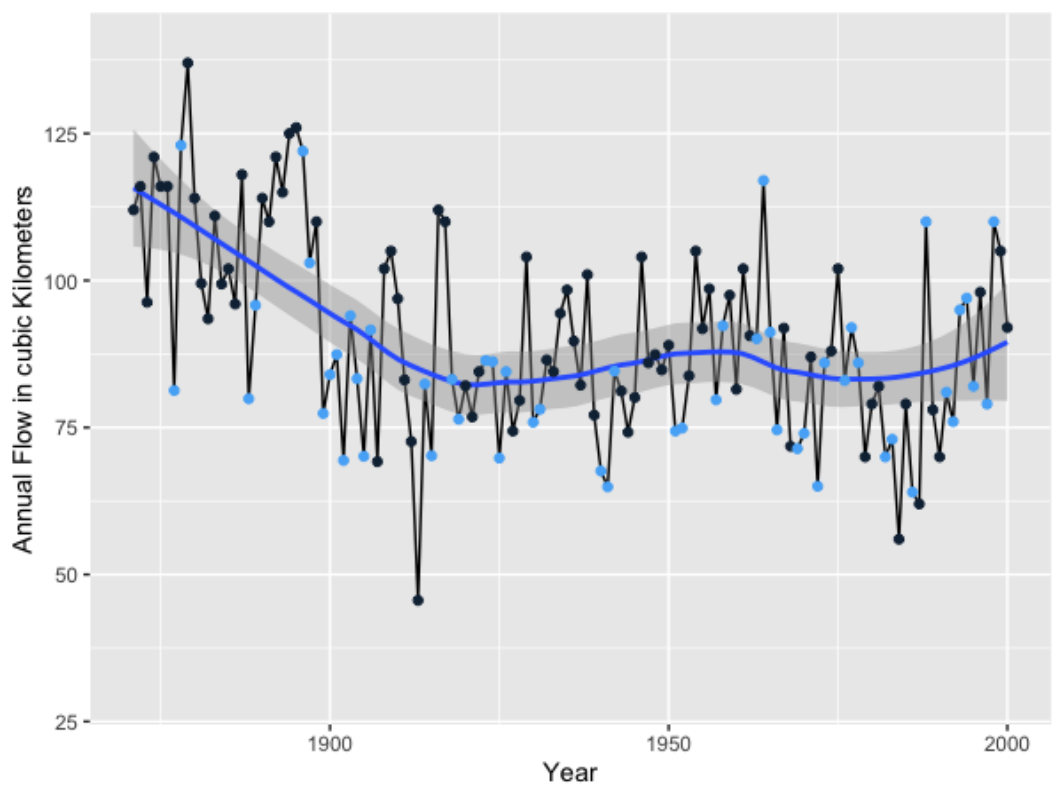
- **Rome protocol in 1891** – between Britain & Italy
- **Treaty of 1894** – between Congo & Britain
- **Addis Ababa Agreement in 1902** – between Britain & Ethiopia *(not to embark on any projects with repercussions on the Nile flow)*
- **Treaties of London in 1906** – between Britain, France & Italy *(safeguarding British interest in the Nile Basin)*
- **Treaty of 1920** – between Britain, Italy & Ethiopia
- **Memorandum 1926** – between Britain & Italy
- **Nile Waters Agreement 1929** – between Egypt & Britain (*grant Egypt veto power over projects affecting the Nile flow*)
- **Anglo-Egyptian memorandums 1949** – between Egypt & Britain (Uganda).
- **Egypt-Sudan Nile waters agreement 1959** – addressed the water rights of Sudan & Egypt. This constitutes the current legal framework for the Nile and confirms Egypt's right to **55.5 BCM** annually.
- **Nile Basin Initiative (NBI) in 1999** – between Nile Basin countries
- **Nile Basin Cooperative Framework Agreement (CFA) in 2010** – between upstream cs

THE CONSTRUCTION OF GERD AND ITS IMPLICATIONS ON EGYPT'S SHARE FROM THE NILE WATERS

- In 2011, construction of the **Great Ethiopian Renaissance Dam (GERD)** started.
- Although GERD is expected to be the largest hydropower facility in Africa, it initiated series of tension between Ethiopia, Sudan & Egypt.
- GERD construction & operation expected to significantly affect the Blue Nile flow downstream, esp. during droughts periods, posing risks to Sudan & Egypt water shares.
- Despite years of negotiations, **no agreement has been reached yet** on the dam's filling & operation.
- The relation between economic growth & water and electricity demand creates a feedback loop that shapes the economic & political dynamics of the region.

WATER TRENDS AND STRESS

- For long time, the Nile has provided sufficient clean water for variety of purposes and is key for Egypt to tackle multidimensional development challenges.
- Egypt faces now significant water scarcity with an **annual deficit** of **13.5 BCM**.
- This is a compound result due to **growing population**, **economy**, **pollution & environmental degradation**.
- IPCC have significantly increased concerns about widening gap between resource availability and water use with **changes in temperature, precipitation & sea level**.
- There is a clear **correlation** between Nile hydrology/flow & El **Nino events**, highlighting the river's vulnerability to climatic variability & change.
- Higher temperatures will increase demands for water for agriculture, domestic & industrial uses.

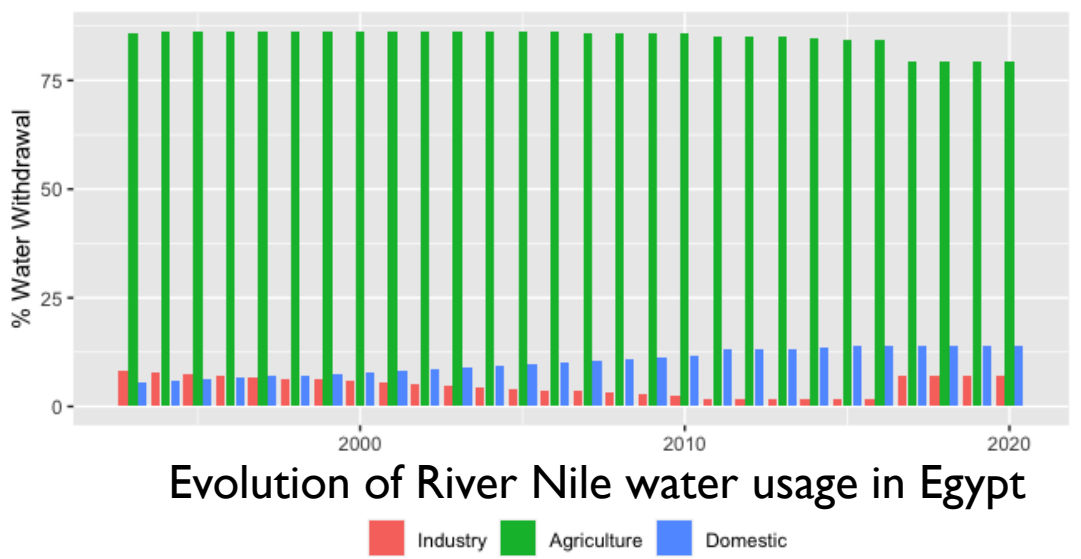


Annual flow of the Nile River at Aswan

The GERD will exacerbate the potentially vulnerable share of Egypt's Nile flow, especially if a multi-year drought coincides with its filling.

WATER USAGE TRENDS

- **Agriculture** accounts for most of water withdrawal.
- Highlighting the country and sector sensitivity to changes in Egypt's water share & the direct effect of over- or under-use of water in this sector on the other sectors.
- The **last 4 years marked a change** in the amount of water used in agriculture & **industry**, coinciding with new strategies to reduce cultivating water-intensive crops, adopting efficient irrigation methods & boosting the manufacturing sector.
- The **domestic sector** is increasing steadily simultaneously with population growth, representing one of the major challenges to water availability.

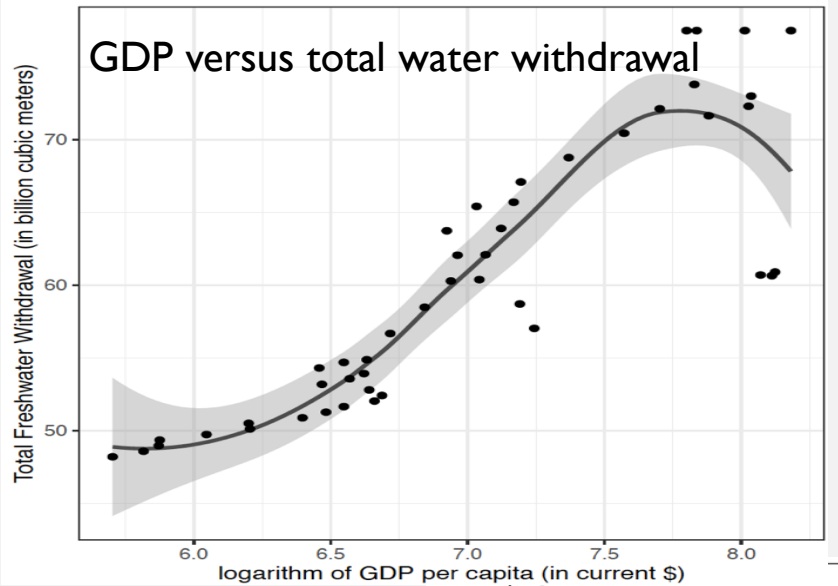


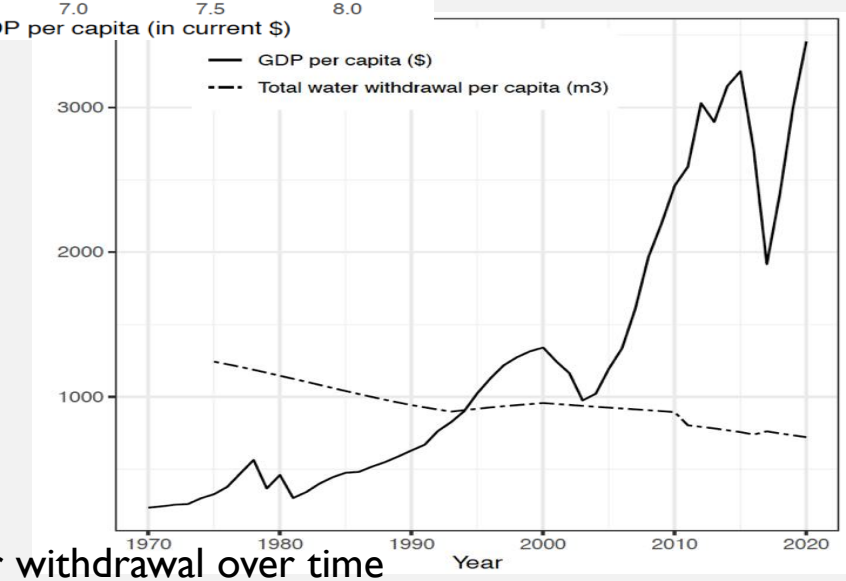
Evolution of River Nile water usage in Egypt

WATER USAGE TRENDS

- A **positive association** between economic growth & water consumption is evident, highlighting the importance of sustainable water management practices along with economic growth strategies.

- But, in recent years, there seems to be stabilization and perhaps a drop in total water withdrawal per capita, despite continued economic growth, suggesting potential for decoupling water use from economic development through improved integrated water management practices.





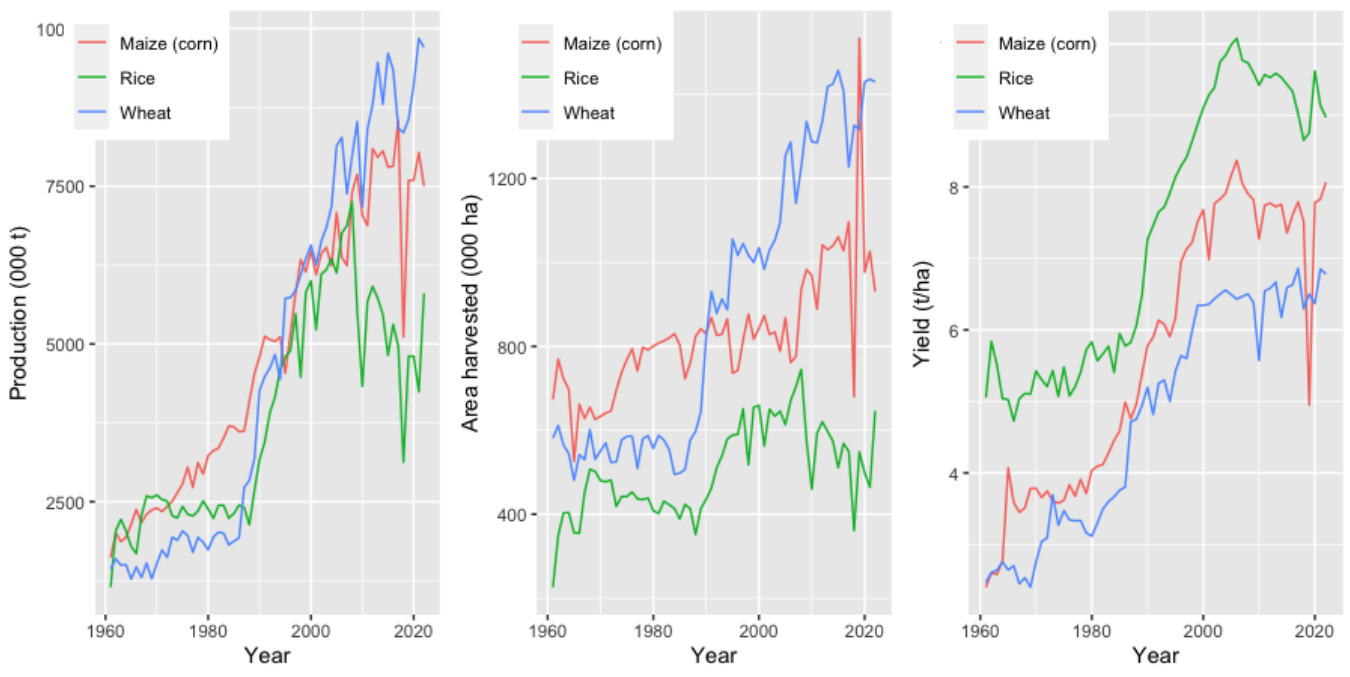
GDP & total water withdrawal over time

WATER AVAILABILITY CHALLENGES ACROSS SECTORS

Agriculture:

- Relies predominantly on irrigation from the Nile & is the main consumer with **~85%** of Egypt total waters.
- Changes in water flow due to CC, GERD and water management strategies can lead to water shortage, jeopardizing crop yields & farmers' livelihoods.
- Continuing population & economic growth increase water demand and exert further pressure on available waters for irrigation.
- All these factors raise concerns about water scarcity; and hence agricultural sustainability & Egypt's national food security.
- This is one of the main drivers for soil degradation in the Delta through salinization & waterlogging (**15% of the land has already been spoiled**) which has detrimental effects on the fertility of cropping areas.
- This has substantial implications on Egypt's national food security and on widening the gap between domestic production and consumption of wheat and other staple crops hindering the country's Sustainable Agricultural Development Strategy towards 2030 targets.

WATER AVAILABILITY CHALLENGES ACROSS SECTORS



- In the last 20 years, growth rate in cereal yields & land productivity have been declining due to water scarcity, increased soil salinity, CC, soil degradation, unsustainable agricultural practices, and limited investments in agriculture technology.

- Farmers are facing mounting challenges in maintaining sustainable agricultural practices & meeting the food demands of the growing population.

- **National Water Resources Plan 2017-2037** aims at enhancing water use efficiency while increasing soil fertility and crop yields, by increasing investments in modern irrigation techniques, promoting the adoption of water-saving technologies and practices, raising farmers' awareness, providing training, offering loans and incentives, water treatment plants, crop diversification, promoting less-water-intensive crops, agroforestry, …. However, persistent water shortages threaten these targets.

WATER AVAILABILITY CHALLENGES ACROSS SECTORS

- Water management requires water pricing, taxation & subsidy systems.
- In the 3rd century B.D., the **Nilometer** was constructed to monitor changes in Nile River water levels and forecast floods.
- This tool played a key role in predicting agricultural productivity & setting taxation levels based on expected harvests.
- Similarly, modern policies involving **input taxes or subsidies for crops** could help optimize water resource management e.g. taxing water-intensive crops and incentivizing the cultivation of high-value & less-water intensive crops.
- Another approach could involve a **land tax system** but, this can be regressive for low-income farmers, esp. those employing environmentally friendly cropping practices but operating on large areas of taxed land.

Nilometer at Rawda, Cairo, Egypt

WATER AVAILABILITY CHALLENGES ACROSS SECTORS

Population Growth and Urbanization:

- Egypt's population growth, now 2% per year, is associated with increased water demand.
- Egypt's population is projected to reach 147 million by 2037, leading to an increase in the **water demand** from **12.58 bcm in 2023 to 14.88 bcm in 2037** (Elsadek et al., 2023).
- Given the fixed annual share of Egypt from the Nile at 55.5 bcm, the **per capita share** of water will drop to **below 500 cm**, the threshold of absolute scarcity (Seada et al., 2016).
- This has adverse impacts on poverty especially among the rural communities leading to urban migration.
- Such trends are often associated with **increased wastewater disposal** causing deterioration of river quality adding more stress on the amount of available clean water in Egypt.
- Therefore, the Egyptian government must make significant efforts towards the equal provision of wastewater and **improved sanitation services to both rural & urban populations**. Now, the ratio is 47% to 92%.

WATER AVAILABILITY CHALLENGES ACROSS SECTORS

Industrialization:

- The industrial sector in Egypt is the 3rd major consumer of water, with **6%** of the country's total water use.
- Tourism is another consumer of Nile Waters with about **1%**.
- Egypt's industrial sector contributes with 31% of the country's GDP and with 29% of its labor force.
- Egypt's economic strategy for 2024-2030 involves augmenting the contribution of the manufacturing industries e.g. include textile manufacturing, food processing, and cement and fertilizer production to 20% of GDP by 2030.
- These sectors are **high water consumers** and **have the heaviest organic load of industrial wastewater**; and hence more stress on water quantity and quality.
- Efforts of the Egyptian government are diverse and necessary to avoid the deterioration of the Nile water quality associated with growth of the industrial, manufacturing and tourism sectors and to ensure sustainable operations of tourism-related business and foreign proceeds.

CLIMATE CHANGE AND WATER SCARCITY

- Egypt is an arid country, receiving an average annual precipitation ~33.3mm, mostly falling along the Mediterranean coastline. Over the past 30 years, Egypt has experienced increased periods of droughts and **significant reduction in the annual total precipitation by 22%** (WB, 2021).
- CC has altered the precipitation patterns, leading to shifts in timing, intensity, and distribution of rainfall in the NB.
- GCMs predict reductions in the summer precipitation (the rainy season) in the central Ethiopian Main Rift, which will negatively affect the water flow into the NB countries (Wondimu et al., 2022).
- On the other hand, rising temperature **accelerates evaporation**, hence increases crops water consumption & decreases water availability by up to 70% (WB, 2021).
- CC-induced water scarcity & variability & rising sea level pose significant challenges to water and land, threatening the agriculture sector & food security in Egypt.

CONCLUSION

- Egypt's profound historical connection with the Nile River underscores the critical importance of a **cooperative and inclusive transboundary water management** in shaping the nation's development trajectory.
- The Nile's vulnerability to climatic variability, population growth, and geopolitical dynamics, in addition to new projects affecting its flow like the GERD poses significant challenges to Egypt's water security and socio-economic development.
- Egypt faces significant challenges due to water scarcity mainly across the agriculture, industrial, and residential sectors. Throughout this chapter, we discussed the critical role of the Nile in sustaining each sector, , the impacts of water scarcity on each sector, how each sector contribute to water scarcity and what efforts can be done to enhance water efficiency in each sector.
- Addressing water availability challenges requires a **holistic approach** that integrates sustainable water management practices and regulatory oversight with economic instruments and climate change mitigation and adaptation strategies.