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THE IMPACT OF CLIMATE CHANGE IN EGYPT

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ABSTRACT **Climate change has been identified as an environmental and human crisis of the 21st century, which led to public, political and academic attention being devoted to the issue of global warming and climate change. At the root of climate change is global warming caused by anthropogenic emissions of carbon dioxide, methane and other greenhouse gases (for example, burning of fossil fuels, like coal, petroleum and natural gasses and widespread deforestation). The warming occurs world-wide and temperatures are rising on the African land mass and in the surrounding oceans. A broad scientific and political consensus has been established that climate change poses a considerable threat to Africa, its ecosystems and many of its species. Concern over the negative impact of climate change has strengthened fears that environmental degradation and demographic pressures will displace millions of people in Africa and create serious social upheaval. Most scientists studying the potential impact of climate change have predicted that Africa is likely to experience higher temperatures, the drying up of soils, increased pest and disease pressure, shift in suitable areas for growing crops and livestock, increased desertification in the Sahara region, floods, deforestation, and erosion are all signs that cli mate change is already happening and represents one of the greatest environmental, social and economic threats facing Africa.**

KEYWORDS :Department of History Nigerian Army University Biu, Borno State,

INTRODUCTION

Climate change has been identified as an environmental and human crisis of the 21st century, which led to public, political and academic attention being devoted to the issue of global warming and climate change. At the root of climate change is global warming caused by anthropogenic emissions of carbon dioxide, methane and other greenhouse gases (for example, burning of fossil fuels, like coal, petroleum and natural gasses and widespread deforestation). The warming occurs world-wide and temperatures are rising on the African land mass and in the surrounding oceans. A broad scientific and political consensus has been established that climate change poses a considerable threat to Africa, its ecosystems and many of its species. Concern over the negative impact of climate change has strengthened fears that environmental degradation and demographic pressures will displace millions of people in Africa and create serious social upheaval. Most scientists studying the potential impact of climate change have predicted that Africa is likely to experience higher temperatures, the drying up of soils, increased pest and disease pressure, shift in suitable areas for growing crops and livestock, increased desertification in the Sahara region, floods, deforestation, and erosion are all signs that cli mate change is already happening and represents one of the greatest environmental, social and economic threats facing Africa.

Perhaps, Egypt is a typical example of a developing country that is highly vulnerable to climate change which exposes it to numerous threats to its economic, social and environmental sustainability. Climate change is also expected to add to the growing threats to national security fueled by a growing population and an increased demand on the already constrained resource

base. Egypt is highly vulnerable to climate change due to the dependence of its large and growing population on the Nile River for fresh water and its long coastline, which is already experiencing sea level rise. With 98% of its population living on 4% of its total land area in the Nile Valley and Delta, the largest oasis of the Sahara Desert, the future of Egypt is directly linked to the flow of the Nile River and its endangered delta.

This paper is poised out to examine the impact of climate change in Egypt, it further sheds light on the Egyptian Government adaptation strategy on climate change. This paper is a desk study, as the research was performed through an extensive review of academic and policy literature, these included reports of national, regional, and international organizations and relevant climate change published literature. The paper argues that climate change is happening and the evidence is all around us, unless we act, we will see catastrophic consequences including rising sea-levels, droughts and famine, and the loss of up to a third of the world's plant and animal species.

CLIMATE CHANGE AND EGYPT

There is no internationally agreed definition of the term 'climate change', which has resulted in differences of opinion on the issue. However, climate change refers to the long-term changes in average weather conditions covering all changes in the climate system, including the drivers of change, the changes themselves and their effects; or can refer only to human-induced change in the climate system.

Geographically, Egypt forms the north-eastern corner of the African continent with coasts on both the Mediterranean and the Red Sea. Part of Egypt's territory, namely the Sinai Peninsula, is located in Asia. The total area of Egypt is 1,001,450 km^2 with a coastline of 3,500km. The surface level ranges from 133m below sea level in the Western Desert to 2,629m above sea level in the Sinai Peninsula. According to Egypt's Second National Communication (SNC) to United Nations Framework Convention on Climate Change (UNFCCC), the general climate of Egypt is dry, hot and desert, with a mild winter season with rain over the coastal areas, and a hot and dry summer season. Data collected by the Egyptian Meteorological Authority and local universities for the period between 1961-2000 indicate a general trend towards a warming of the air temperature, with an increase in the number of hazy days, misty days, turbidity of the

atmosphere, frequency of sand storms and hot days (EEAA, 2010). The country has particularly good wind regimes with ideal sites along the Red Sea and Mediterranean coasts with an excellent potential to produce wind power. Egypt is a lower-middle income country with a population of about 90 million, of which nearly 56 % are living in rural areas. The population is estimated to reach 100 million by 2020, assuming the population growth rate remains unchanged. About 97% of the population in Egypt lives on the Nile Valley and the Delta, which represent about 4% of Egypt's total area. In 2009, the Gross Domestic Product (GDP) per capita was US$ 56731, and the average yearly economic growth rate for the period from 1990 to 2007 was 4.47%. Agriculture, which contributes nearly 14% of the annual GDP, remains an important part of the economy. An estimated 55% of the labor force in Egypt is engaged in agricultural activities and the sector consumes about 80% of the fresh water resources. There are a number of limiting factors for future agricultural growth in Egypt, which enhance the sector's vulnerability to climate change. These include:

1. Historically high reliance on low efficiency irrigation systems (30% or less), which poses increased pressure on water

resources,
2. Land degradation and desertification due to poor water management, poor agricultural practices, and intensive utilization of fertilizers and other agro-chemicals, and
3. Urban sprawl over agricultural land due to population growth and poor land use planning.

The industry and services sectors account for about 32% and 54% of the GDP

respectively.

Though attracting FDI is one of the major goals of the Egyptian development plans, it has been relatively low at 3.6% of the GDP. The current Egyptian exports are dominated by energy intensive and low-technology products. However, the vision of Egypt's "Industrial Development Strategy" is that by the year 2025, Egypt will be a leading industrializing nation in the Middle East and North Africa (MENA) region in terms of industrial performance as well as a main export hub for medium-technology manufactured products. The cement and fertilizers industries have intensively grown, and their impact on the GHG emissions in Egypt is remarkable. Though social indicators have improved over the last decade, the fight against poverty and illiteracy (about one third of the adult population) remains an important challenge to policy makers

(UNDP, 2011). Over the past decade, 22% of the Egyptian population was living on less than

1.25 USD a day (national poverty line). Egypt was ranked 113th according to the 2011 United Nations Development Program (UNDP) Human Development Report (HDR). Increasing rural- urban migration inevitably results in the mushrooming of slums and informal settlement with frequently inadequate services. Concentration of industry and transport in the capital means that Cairo is home to 40% of all industrial production sites, 32% of all vehicles and 25% of Egypt's population. As stated earlier, a combination of urbanization and general population growth enhance expansion of residential areas into valuable agricultural land and put strain on agricultural production. This is especially critical in view of the fact that Egypt is far from being food self-sufficient and relies heavily on food imports.

Egypt is highly vulnerable to climate change impact as noted in Egypt's Initial National

Communication (INC) to the UNFCCC (EEAA, 1999), in the UNDP Global HDR 2006 (UNDP,

2006) and in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (IPCC, 2007). Egypt has an emission ranking of 28 out of 215 countries and regions contributing about 0.60% of global GHG emission (Global Carbon Atlas (2016). For climate vulnerability Egypt has a ranking of 91 out of 181 countries in the ND-Gain Index. Egypt is the 87th most vulnerable country and the 73rd least ready country. Climate projections make it clear that current and future changes in climatic conditions constitute a major environmental risk that may jeopardize Egypt's development gains and poverty reduction strategies.

THE IMPACT OF CLIMATE CHANGE IN EGYPT

1. i. Coastal Zones

Climate change would cause serious damage to human settlements, to large parts of productive agricultural land and to industrial areas in the North Coast. Estimates show that 0.5m Sea Level Rise (SLR) would lead to the permanent submersion of 1,800 km^2 of cropland in low areas of the Nile Delta, and accelerate the trend of desertification in the form of increased soil salinity in the remaining land (EEAA, 1999). The IPCC estimates that the Mediterranean Sea will have risen by one meter by 2050 as a result of global warming, ending in the loss of one third of the most productive land in the Nile Delta (IPCC, 2007). Observations at various points along the Nile

delta shoreline indicate that sea levels have already been rising. This SLR is due to a combination of local factors that include coastal subsidence and reduced sediment loads due to the construction of the High Aswan Dam upstream. It is also associated with global warming and thermal expansion of the oceans and glacier melting (El Shennawy, 2008). Several studies on the vulnerability of Alexandria, the second largest coastal city in Egypt, indicated that a 0.3m SLR would inundate large parts of the city, resulting in billions of dollars' damage to infrastructure, displacement of over half a million inhabitants, and a loss of about 70,000 jobs. Such concerns about future SLR are well-reflected in Egypt's NCR to the UNFCCC. Along with the loss of populated and agricultural area, some industrial cities and important historic cities like Alexandria, Damietta, Rosetta, and Port Said would be victims of SLR. Furthermore, the expected SLR's effects include threats to food security, damage to the large investments in the tourism sector along the North West Coast, and the relocation of more than 10 million people to the already over populated Nile Valley. This will have a direct and critical effect on Egypt's entire economy.

1. ii. Agriculture

Agriculture contributes nearly 14% to the GDP, making it a key sector of the Egyptian economy. Egypt has a unique heavily irrigated agriculture system. Temperature rises due to climate change will likely reduce the yield of the major crops and increase their water requirements. The combined effect of temperature increase, SLR, water shortage and other environmental conditions would worsen agriculture productivity, and therefore Egypt's food security. Agriculture is also the main water-using sector in Egypt, using 80% of all fresh water that is mainly provided by the Nile River (USAID (2018). Egypt: Agriculture and Food security). The agricultural sector is dominated by small farms using traditional practices. About 80% of cultivated land is 'old-land' in the Nile Valley and the Nile Delta that has been irrigated and intensively cultivated for thousands of years. 'New-lands' that have been reclaimed from the desert relatively recently or are in the process of being reclaimed represent the remaining 20% of cultivated land (Climate Change Profile Egypt 2018). The Nile Delta region, that accounts for

30%-40% of Egypt's agricultural production, is subsiding and becoming less fertile since it is no

longer replenished each year by flood sediments from the Nile (Climate Change Profile Egypt

2018). There are two main cropping seasons a year - winter and summer cultivation seasons. Fruit trees are the most important perennial crops. Field crops cultivated include maize, rice, cotton and sugarcane as main summer crops, while alfalfa, wheat, barley, green bean, clover, and sugar beet are the main winter field crops (Climate Change Profile Egypt 2018). Agricultural production is at risk from the direct effects of climate change, including:

- Expected rise in temperatures and change of seasonal patterns as well as a change in

environmental agricultural zones;

- Marginal agricultural areas negatively affected and increasing desertification;
- Higher temperatures increasing water evaporation and water consumption;
- Decreasing water supplies reducing the availability of water for irrigation;Sea Level Rise (SLR) inundating coastal areas and increased salinization.

Projections suggest agricultural will experience the largest loss in the Egyptian economy due to climate change with a significant decrease in agricultural production (except for cotton). Because of the rise in temperature and the increase in the number of hot days and nights, water needs for all crops are projected to increase with reduction in water supplies further decreasing agricultural production (Smith, 2014). The potential impact of climate change could decrease national food production by 11 to 51% (range reflecting projections of low to high temperature models) (Climate Change Profile Egypt 2018). By 2050 it is expected that the productivity of two major crops in Egypt- wheat and maize- will be reduced by 15% and 19%, respectively. It is also anticipated that 12-15% of the most fertile land in the Nile Delta will be negatively affected by sea level rise and salt water intrusion. Climate change impacts in Egypt are not gender neutral. Agriculture employs about 45% of all women in the labor force (USAID (2018). Rural women in agriculture are usually seasonal workers with unstable earnings and vulnerability to food insecurity. Illiteracy rates for women are higher than those for men (one third of adult women are estimated to be illiterate compared to 15% of males) which means that up to 10 million women cannot read or write and have limited opportunities outside of the agriculture sector for employment. While a large percentage of the female labor is engaged in agricultural labor, a very

small percentage of women (5%) are agricultural land owners due to inheritance customs in Egypt. The vulnerability of Egypt's agriculture to climate change presents considerable risks to the fragile socioeconomic situation of many rural Egyptian women who are already facing the challenges of high illiteracy, little asset ownership and a weak capacity for economic mobility and adaptation (Kandeel, 2017).

iii. Water Resources

Egypt has just one major source of water supply, the Nile River, which supplies over 95% of the

country's annual water needs. The mean annual rainfall is estimated at 18 mm/year, ranging from

0 mm/year in the desert to 200 mm/year in the northern delta region. Non-renewable underground fossil water supplies are accessible outside the River Nile valley, especially in the scattered oases. Consequently, agricultural development is closely linked to the River Nile and its management, which would be impacted by climate change. Models have predicted that the annual Nile flow will vary between an increase of 30% and a decrease that can reach 70%. These two extremes can have serious implications in terms of increased flood risks or droughts that would lead to a decrease in food production and an increase in the number of lost jobs and water conflicts.

Climate change in the Nile Basin: since Egypt receives very little rainfall and is dependent on the Nile River for all but a small percentage of its freshwater, the flow of the Nile is of greater importance to Egypt than rainfall variability (World Bank Climate Knowledge Portal (2018). The Nile is one of the world's major rivers with a basin area shared among 11 countries: Burundi, Democratic Republic of the Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, United Republic of Tanzania and Uganda. The Nile Basin extends over five climatic zones — Mediterranean, arid, semiarid, subtropical and tropical with landscapes ranging from mountains, grasslands, forests and woodlands, wetlands, lakes and desert to a delta (UNEP (2013). The two main tributaries of the Nile River are the White Nile, with sources on the Equatorial Plateau and the Blue Nile originating in the Ethiopian Highlands. The Blue Nile contributes more than 60% of the total flow of the Nile (measured at the Aswan Dam) and the White Nile about 18%. The other major river systems (e.g. Sobat and the Atbara) contribute less

than 15% each (Regional Initiative for the Assessment of Climate Change Impacts). Since the Basin is sensitive to changes in rainfall and temperature, the potential impact of climate change on the Nile River regime is significant (NBI 2012). According to the NBI (NBI 2012), the vulnerability of the Nile River Basin to climate change is due to:

- High fragility of its natural systems: two-fifths of the basin is arid and semi-arid drylands;
- Rapidly growing population putting unprecedented pressure on the natural resource base;
- Poverty of the rural people in the upstream countries that limits diversification from agriculture,

fishing, and forestry into less climate-sensitive sectors;

- High exposure to natural disasters, including droughts and floods;
- High sensitivity of many of the Nile sub-basins to changes in precipitation;
- Agriculture sector in the downstream countries (e.g. Egypt) that is almost totally reliant on the

Nile-fed irrigation;

- High dependency on hydropower for energy across the basin.

Since the Blue Nile is its major contributor, the Nile is particularly sensitive to the variability of runoff from the Ethiopian part of the basin. Potential climate-change impacts on the smaller White Nile flows are mitigated by the Sudd in South Sudan and the other large wetlands in the White Nile Basin (NBI 2012). Changes projected for temperature, precipitation and related extreme events suggest an overall increase in temperatures with a continuing rise in temperature by 2100 for the Basin. For precipitation some models suggest an increase in precipitation for the Basin until 2040, followed by decreases in rainfall by 2100. A significant rise in temperatures increases the possibility of enhanced water losses from evapotranspiration which will reduce the stream flows and stored water (Climate Change Profile Egypt 2018). According to current estimates, evapotranspiration losses account for more than 70% of the water balance in the wettest areas of the Nile Basin, such as the Blue Nile and the equatorial lakes sub-basins, with even higher percentages in the drier areas, such as Egypt and the Sudan (Climate Change Profile Egypt 2018)

1. **i Drought and Flood**

Shifts in temperature and rainfall patterns due to climate change will also have an impact on the recurrence of extreme conditions (drought

and flooding), as well as contribute to changes in the river's flow (NBI 2012). The impact of climate change on the variability in the annual output of the Nile River is a major concern. The ability to predict the amount of the flow, especially the likely years of reduced flow, is of increasing importance, especially since the population of the Nile River Basin is expected to double by 2050. A recent well received study, using a range of global climate models and records of rainfall and flow rates over the last half-century, suggests an increase of 50% in the annual variation of the amount of flow this century (Siam and Elthahir (2017). The study bases its analysis on the increase in the intensity and duration of the Pacific Ocean phenomenon of the El Niño/La Niña cycle, which is strongly connected to annual rainfall variations in the Ethiopian highlands and adjacent eastern Nile basins which provides an estimated 80% of the Nile river's total flow. While the changing rainfall pattern is likely to lead to an average increase of the Nile's flow of 10-15% until 2040, there will be substantially fewer

'normal' years and many more extreme years with greater flows and more years of drought. Current water storage capacity and current plans for additional storage capacity in the Basin do not consider the projected enhancement of inter annual variability in the future flow of the Nile river. Both increased and reduced flows will have negative effects on Egypt and other countries in the Basin. In years in which the natural flow is considerably increased, the storage capacity of water systems might not be sufficient to accommodate these high flows, resulting in destructive floods. Also, of concern is the high probability that the conveyance and distribution network of Egypt's canals and drains might not be able to cope with the high flows. In years in which the opposite happens (natural flows are substantially reduced) Egypt and other basin countries such as the Sudan will face drought (UNEP (2013). Changing climatic conditions have the potential to impact the operational regimes of dams built on the Nile River and its tributaries, with effects on hydropower generation and low volumes to downstream countries (RICCAR (2017) As the most downstream nation of the Nile River Basin, Egypt is most at risk. Variability in Nile flows into Egypt is moderated by the High Aswan Dam, which has one year's worth of storage capacity

that helps in handling periodic drought. However, Egypt remains vulnerable to the multi-year droughts that are likely to occur (Climate Change Profile Egypt 2018)

1. **Conflict, migration and climate change**

Population growth, unemployment and climate change is anticipated to create a 'combustible mix' to its stability. Due to its geographic location, its large population, and its significant role in the politics of the Arab world, Egypt's stability affects the region as a whole. Contributing to Egypt's vulnerability is its lack of self-sufficiency in grain production -– a situation that will not change in future due to its growing population and decreasing agricultural land - and its dependence on the international commodity markets. From 2007-2017 Egypt was the world's largest importer of wheat (for 2018 it is estimated that Indonesia will be the largest with Egypt a close 2nd)
(https:/
/www.ft.com/content/a6545786-0da8-11e8-8eb7-42f857ea9f09).
Egypt's national system to supply the population with subsidized bread costs 3% of its annual GDP. While economically unsustainable, proposing changes to the subsidized bread system is politically volatile, as demonstrated by the bread riots in 2008 (http://www.world-grain.com/Departments/Country-Focus/Country-Focus-Home/Focus-on-Egypt.aspx). The reliance on the changing international commodity markets to meet domestic demand exposes Egypt to external forces, in particular fluctuations in wheat prices. In the past higher wheat prices influenced the cost and availability of bread in Egypt, motivated citizen protests, and indirectly led to regime change in Egypt (Sternberg (2013). Climate related flooding in the Nile Delta and the subsequent decrease in agricultural production will also push down employment in the agricultural sector. Scenarios conducted by the United Nations Environment Programme (UNEP) and other organizations suggest that a 0.5-meter rise in sea level could displace 2 to 4 million Egyptians by 2050 and encourage migration of people from the coastal zone to other areas (Climate Change Profile Egypt 2018)

1. **vi. Transboundary management of the Nile.**

The impact of climate change and climate variability will further complicate the management of shared water resources of the Nile River (RICCAR 2017). The riparian countries are members of the Nile Basin Initiative (NBI) established in 1999 and intended to transition to a Nile River

Commission after the signing of a cooperative agreement by its members. Currently, there is no cooperative agreement in place for the Nile Basin, primarily because of the opposition of Egypt and the Sudan. There are colonial-era treaties governing the Nile that predominantly benefit the downstream states, Sudan and Egypt, without much benefit to the upstream states. The effect of these treaties is to inhibit upstream projects so as to secure a continuous and undiminished flow of water to the Sudan and Egypt. Egypt has adopted a position consistent with the colonial-era treaties and an Egyptian-Sudan treaty of 1959 that stipulate that Egypt has an historical right to the full volume of the Nile and that upstream states may not disturb that right by impeding or otherwise affecting that flow (Gelil, 2014). Since Ethiopia announced its plan to build the Grand Ethiopian Renaissance Dam (GERD) there has been tensions and threats by Egypt over interference in the natural flow of the Nile. In 2015 Egypt, the Sudan and Ethiopia signed a mutual do-no-harm agreement (Climate Change Profile Egypt 2018). While there have been discussions by Egypt, Ethiopia and the Sudan (which supports the dam), a formal agreement for sharing the Nile resources has not been reached, in part due to the flare up of political tensions between Egypt and the Sudan over other issues (Sudan Vision (March 2018). The GERD, the largest dam in Africa, will have a reservoir that will ultimately store 74 billion cubic meters of Blue Nile water and will take an estimated 5 to 15 years to fill. During the period of fill, the Nile's fresh water flow to Egypt may be cut up to 25% with a loss of a third of the electricity generated by the Aswan High Dam and a potentially decrease in the availability of water for agricultural production (Climate Change Profile Egypt 2018).

EGYPT'S NATIONAL ADAPTATION STRATEGY TO CLIMATE CHANGE

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation to climate change as any "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2001). According to the UNFCCC 'Adaptation is a processes through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes. Adaptation also involves learning to manage new risks and strengthening resilience in the face of change. As late as April 2007, a report by

the IPCC warned that Africa was not acting quickly enough to stem the dire economic and environmental consequences of excessive greenhouse gas emissions (IPCC, 2007).

Logically, Egypt's national adaptation strategy primarily focuses on the most vulnerable sectors, namely: agriculture, water resources, and coastal areas. For agriculture, it is recommended to change crop patterns to stress-tolerant ones, to change farm systems and fertilization practices, to develop simple and low-cost technologies suitable for the local context, to establish a special adaptation fund for agriculture, to build scientific capacity, and to improve public awareness. It is also recommended to enhance the adaptive capacity of rural communities through social protection and economic diversification.

In terms of water resources, the country has been implementing the concepts and practices of Integrated Water Resources Management (IWRM). The national adaptation strategy recommends public awareness campaigns on impacts of climate change on water resources, the development of local and regional circulation models capable of assessing the impact of climate change on the Nile basin, building scientific capacity, and enhancing exchange of information among Nile basin countries. The strategy also promotes Integrated Coastal Zone Management (ICZM), recommends the creation of wetlands in low lying areas, building shore protection structures (including dams), and management of coastal lakes; raise public and policy maker awareness; and use of remote sensing in monitoring SLR (Gelil, 2014).

Several adaptation actions are planned and currently underway to minimize the potential adverse impacts of climate change. As a potential alternative to agriculture and living areas, the government of Egypt has developed a massive infrastructure project in Toshka in the south of the country, bordering Sudan. Toshka features one of the most powerful water pumps in the world that diverts water from the Nile to the desert for irrigation and living needs. Yet to date, there has been no relevant migration to Toshka, as was initially planned, due to the hot climate and inadequate social services. Several international organizations such as UNDP, the International Fund for Agricultural Development (IFAD), and the Food and Agriculture Organization of the United Nations (FAO) are collaborating with Egypt to assess vulnerability and adaptation of water, agriculture, and coastal zones to climate change. This collaboration also includes the

implementation of a communication strategy to increase awareness of climate change risks and promote the integration of adaptation measures into national development plans. The Agriculture Research Center in the Ministry of Agriculture and Land Reclamation collaborates with IFAD and FAO to assess existing agricultural policies and advocate the adaptation of climate-sensitive strategies and practices, develop stress-tolerant crops, along with the dissemination of knowledge on these crops, and enhancing optimized cropping patterns that cope better with global warming.

Another study, financed by the Global Environment Facility (GEF), on the needs and gaps to adapt to SLR has been prepared jointly by the Stockholm Environment Institute, Alexandria University (AU), and the Coastal Research Institute of the National Water Research Centre. The overall aim of the study was to enhance Egypt's resilience and reduce vulnerability to climate change impacts. The study concluded that an ICZM plan is a key element for adaptation along the coastal zones of Egypt. A combination of spatial planning and enhanced coastal defenses to manage the risk of SLR and storm surge is needed. Proactive adaptation requires more effective partnerships among different stakeholders to facilitate the transition towards safe urban development in large port cities and to implement effective disaster management in the event of flooding (Elshinnawy, 2010).

Egypt ratified the UN Framework Convention on Climate Change (UNFCCC) in 1994, the Kyoto Protocol in 2005 and the United Nations Framework Convention to Combat Desertification (UNCCD) in 1995. Egypt has prepared three National Communications to the UNFCCC (1990, 2010, 2016). The Second National Communication (SNC) addressed the vulnerability and adaptation of various sectors in Egypt to potential impacts of climatic changes. The Third National Communication (TNC) updated the vulnerability and adaptation assessment with a focus on health, tourism and biodiversity (Climate Change Profile, Egypt, 2018). Egypt signed the Paris agreement on climate change in April 2016 and ratified the agreement in September 2017. In Egypt, the Ministry of State for Environmental Affairs (MOE) is the responsible body for compiling the data needed for the National Climate Change Communications from the relevant ministries81. The National Council of Climate Change (NCCC) established in 2015 is leading the National Adaptation Plan (NAP) process. This Council replaces the National Committee on Climate Change, its predecessor, which was

established in 2007. Egypt has a climate policy framework, underpinned by the 2011 National Adaptation Strategy (NAS) and high-level political institutions consisting of line ministries which have the mandate for implementation. The strategy aims to increase the flexibility of Egypt to tackle the risks and negative impacts of climate change in various sectors. It also aims at strengthening the capacity to absorb and reduce the risks and disasters to be caused by such changes (Climate Change Profile, Egypt, 2018). Egypt has also developed a 'Sustainable Development Strategy (SDS) — Egypt's Vision 2030' which provides the roadmap for achieving the sustainable development goals. Among its priorities are: expanding the scope of sustainable growth, increasing real per capita GDP to reach the level of middle-income countries; and promoting the dynamics of sustainable and decentralization development (Climate Change Profile, Egypt, 2018). Projects identified in the SDS, which are climate change related include: sustainable agriculture, protection of coastal establishments, and the efficient use of water resources. The updating of the SDS 2030, which is underway, provides an opportunity to mainstream climate change into national strategies, which will lead to better national budget allocation across key development sectors.

CONCLUSION

Egypt proves to be highly vulnerable to climate change impacts according to IPCC reports. Egypt started to realize very early on the threat that climate change poses to its future development. Immediately after signing the UNFCCC in 1992 and with the support of international donors, the Egyptian scientific community started to assess the vulnerability of different economic sectors to the potential adverse impacts of climate change. Furthermore, some government research institutions have established specialized centers on climate change such as the "climate change research center" at the Water Research Institute, and the climate research center at the Agriculture Research Institute. e. As time passes, Egypt recognized, as well, the different opportunities offered by involvement in the global climate regime especially those related to transfer of environmentally sound technologies, financial support, and capacity building. Since the entry into force of the KP in 2005, Egypt has topped the list of Arab countries participating in the CDM with 14 registered projects and more than 100 projects in the CDM pipeline. The climate policy seems to be driven by national interests and is in line with the

energy policy aiming at improving energy efficiency, switching to low carbon fuels and promoting untapped renewable energy resources. Further, there is strong evidence that Egypt's positions have changed along with the emergence of a national climate policy framework that was induced by, among other things, a broader understanding of Egypt's own vulnerability to climate change, as well as the awareness that both long-term development will require some development of national energy policy and that the CDM of the KP can have numerous benefits.

Plan

Drought and Flood
Conflict, migration and climate change
Transboundary management of the Nile
EGYPT'S NATIONAL ADAPTATION STRATEGY TO CLIMATE CHANGE

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