

## Climate Change: Impacts and Responses for Sustainable Agriculture in Egypt

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Climate change poses a major challenge to Egyptian agriculture because of the complex role agriculture plays in rural and national social and economic systems. Climate change has the potential to both positively and negatively affect the location, timing, and productivity of crop, livestock, and fishery systems at local, national, and global scales. It will also alter the stability of food supplies and create new food security challenges by 2050. Agriculture exists as part of the national economy and agricultural exports have outpaced imports as part of the overall balance of trade. However, climate change will affect the quantity of produce available for export and import as well as prices (El-Ramady et al. 2013). Egypt has a population of 91.76 million (2016-04-15), increased from 58 million in 1990 (CAPMAS 2016).

The population, land-use and agriculture and economic activity of Egypt are all constrained along a narrow T-shaped strip of land along the Nile and the coast around its delta. There is a possibility of significant decline in Nile streamflow under climate change. Nile water availability is likely to be increasingly stressed due to higher water demands and evaporative losses resulting from higher temperatures in the semi-arid region, which are projected consistently across various climate models. Coastal zone and water resource impacts also have serious implications for agriculture: sea level rise will adversely impact agriculture: sea water intrusion and increased demand by crops in warmer climate. Extreme weather events are increasingly threatening the farmers as heavy rains hit the delta last October 2015 causing serious damages to more than a million acres, mainly was devoted for wheat cultivation.

Concerted efforts for adaptation to climate change must be undertaken at all levels to increase the resilience of Egyptian societies and economies to the many extra challenges. Major efforts are made in the field short duration crop varieties in order to save 30% of irrigation water. The anticipated crops are: rice, wheat corn and barley. Egypt represented Africa in the UN Climate Change "COP21" in Paris where Africa needs the international support whether technically or financially to combat climatic change impacts.

As the representative of the African Nations at the UN Climate change summit, Egypt presented the two African initiatives the world countries. The first initiative aims at promoting renewable energy in Africa and the other initiative endeavors to support our continent on adaptation.

Egypt's assist that the agreement should also be legally binding as long as it encompasses clearly defined commitments for the developed countries to provide the developing world with the adequate support in terms of financing, capacity building, and advanced technology, in order to enable the African and other developing countries to adapt and transform our economies to achieve sustainable development, in addition to a clear commitment in the agreement that the increase in temperature does not exceed 1.5 degrees, and to avoid shifting the burden of mitigation from the developed to the developing countries.

According to Egypt's vision to COP22, developing countries need the transfer of technology, capacity building, and funding. "Developing countries should not be responsible for advocating this kind of support as they are not responsible for the current climate change phenomena. Several sections in the COP21 agreement state there should be shared responsibility in achieving the 2 degree target. This is represented in the creation of the Green Climate Fund and the Intended Nationally Determined Contributions (INDC).

Despite global momentum to improve climate change settings worldwide, the submitted INDCs indicate worldwide average temperatures could increase to 2.7 or even 3 degrees by 2100, instead of staying well below the 2 degree limit agreed upon in Paris, according to the UNFCCC synthesis report. Egypt's efforts seem ineffectual for the moment, as several obstacles still lie ahead. These obstacles are not only related to foreign funding, but increasingly, to local endeavors. The Egypt INDC was also widely criticized for its lack of definitive data and figures.

Egypt attended the 4 Per 1000 Initiative, which took place at the International Agriculture Show in Meknes, Egypt, is intended to set the framework for the international governance structure of the initiative and determine what the next actions should be before the COP22 international climate conference which will take place this November in Morocco.

### **Overview of agriculture sector**

Egyptian agriculture is almost entirely dependent on irrigation. More than 90 percent of Egypt is desert. The agricultural land base totals about 3.5 million ha (8.4 million feddan) which represented about 3.5% of the total area in 2007 of this agricultural land, 3 276 000 ha (7.8 million feddan) lie within the Nile Basin and Delta, and the remaining 210 000 ha (500 000 feddan) are rainfed or in the oases. Agriculture is a major component of the Egyptian economy, contributing up to 14.5 percent of GDP and 28 percent of all jobs (CAPMAS 2015). The agriculture sector in Egypt is dominated by small farms, which use traditional practices that do not comply with internationally recognized standards. As a result, farmers experience increased production costs, reduced yields, decreased soil fertility, and limited marketing opportunities. They are further constrained by lack of cold storage infrastructure, transportation systems, and market information (USAID 2016). The Egyptian economy has relied heavily on the agricultural sector for food, feed, fibre and other products. It provides livelihood for about 55% and employs 30% of the labour force.

### **Current challenges**

*Problems determined predominantly by natural resources*

Egypt has little effective rainfall, at most 200 mm and unequally distributed and on limited areas. Mostly it has vast areas of poor rangeland, estimated at more than 10 million ha. Agriculture characterized by the predominance of smallholders, Egypt's agriculture sector is currently witnessing greater investor interest. Constraints on Egypt's agriculture sector over 2015 include evolving subsidy reforms (beginning in July 2014), which has meant a rise in fertilizer prices of between 33% and 50%.

However, high-quality exports are expected to lead the way. The agriculture export sector has come out healthy following the political unrest beginning in January 2011 and is still standing on its feet (Agriculture Export Council 2015). Egypt has only one main source of water supply, the Nile. The availability of a reliable water supply from the High Dam in Aswan is governed by the water-sharing treaty with the countries of the Nile Basin under which 55.5 billion m<sup>3</sup> per annum is allocated to Egypt. Additional water could become available with the completion of the Jonglei Canal.

### *Difficulties related to socio-economic concerns*

Agriculture plays important role in social structure of rural areas in Egypt, and it is responsible of social stability in these regions. The impact of climate change is most likely to hit the rural communities in the country severely, due to the fragile socioeconomics of the rural people. Any further pressures due to climate change may cause unrecoverable damage. The vulnerability of the Agriculture in Egypt to climate change is mainly attributed to both biophysical and socio economical parameters. Egypt is very dependent on natural resources that are vulnerable to climate change. A large portion of the arable land is in the Nile Delta and is particularly vulnerable to sea level rise. Crop yields and crop water use could be affected by climate change. Impacts of climate change on population, the occurrence of this emphasizes of climate changes will associate with doubling the Egyptian population to be 160 million by the middle of the century (2050). Such association between climate change and population increase will lead to many unfavorable demographic, geographic and economic factors.

### **Impact and vulnerability of current water resources in agriculture**

A number of papers have looked at the implications of fluctuations in Nile flows for water resources in Egypt, particularly since a prolonged period of low flows during the 1970s and 1980s. Abu-Zied and Biswas (1991) and Conway and Hulme (1993) considered the implications of climate fluctuations for water management with emphasis on the Nile. They stressed the uncertainties involved in predicting future climate change and that existing planning processes and hydrologic methodologies need to be improved to deal with such challenges. They also emphasized the importance of fluctuations in river flow over the historical period for managing water resources.

The impact of climate change on some major crops in Egypt as a summary of several local studies. These changes in crop productivity are mainly attributed to the projected temperature increase, which affect the grain filling periods and have detrimental effects on sensitive development stages such as flowering, thereby reducing grain yield and quality. Crop-water stress is the other factor causing productivity reduction under climate change. Pests and disease remain important factors affecting negatively the crops productivity. The impact of climate change on the pests and disease in relation to crops productivity, is studied in limited scientific trials, but not yet well studied at the national level under Egyptian conditions.

### Identification of adaptation measures and options

#### *Assumptions for water share in agriculture*

Total available water resources are estimated at 73.8 billion m<sup>3</sup> annually. Total of water use is about 62.6 billion m<sup>3</sup>. Agriculture's share of the water budget is about 81% and increased to 85% in 2006. According to SADS (2009) per capita fresh water is expected to decline from 711.0 m<sup>3</sup> in 2008 to 550 m<sup>3</sup> in 2030. Recorded share from cultivable land was about 504 m<sup>2</sup> per inhabitant in 2006. The on-farm irrigation performance in Egypt is the overall result of climatic and environmental conditions, irrigation technology, on-farm irrigation practices, and investment availability. Attaher and Medany (2008) concluded that the crop water requirements of the important strategic crops in Egypt are going to increase under all IPCC SRES scenarios, ranging from 5 to 13% at 2100s.

#### *Measurement used for adaptation*

National plan are being drafted and a national committee for climate change has been set up following steps:

- Providing information and training for farmers on the topics of effective and resource-efficient farming and irrigation methods, selection of the right crops, fertilizer use and crop rotation;
- Facilitating knowledge transfer and disseminating information to improve planning and management of adaptation processes;
- Raising general awareness about adapted sustainable waste management and the responsibility to use water more efficiently and maintain water quality.

- Increase water productivity by means of adapted, improved farming and irrigation measures while simultaneously protecting the soil and water resources;
- Promote the monitored reuse of treated drainage water.

### Adaptive capacity in agriculture sector

Studies concluded that changing sowing dates and management practices were among the important adaptation measures oriented to ameliorate the harmful impact of the climate change on the crop yield. Simulation studies in Egypt (Abou-Hadid, 2006) showed that 10-day delay in wheat sowing date at the North Nile Delta might mitigate the negative impacts on crop productivity by 10%. Changing sowing dates could increase the flexibility of the farming system to face temperature and water requirements increase due to climate change, as a single factor effect.

This adaptation option is facing some implementation difficulties related to the overall crop calendar arrangements, and it may be limited by the marketing opportunities, which may not match the new harvesting dates, especially for cash crops. The acceptability of changing planting date option needs further studies regarding the conflict with other existing crops as the Egyptian cropping system is based on 12-month cycle (El-Marsafawy S. M. 2006). Medany et al. (2009) concluded that changing cultivars and changing crop pattern are the most promising adaptation measures that should be applied at the national level, to overcome the harmful impacts of climate change in crop production.

### Suggestions for follow-up

#### *National policy level*

In designing agricultural and climate change policy in Egypt, more robust collaboration among stakeholders for evolving innovative approaches and adaptive measures for the climate change phenomenon in the region is advocated. Lastly, adequate investment in research and capacity building is imperative in building resilient adaptation to climate change impacts in the rural communities of Egypt.

Designing and applying of national adaptation strategy for the agriculture sector is facing a group of barriers and limitations of existing scientific, information and policy perceptions, poor adaptive capacity of the rural community, lack to financial support, and absence of the appropriate institutional framework.

#### *Scientific research & generated knowledge of climate change*

Support a collaborative effort with broad social participation. Special attention be given to vulnerable sectors and populations. The Scientific research aims to:

- Establishment of a strong information dissemination system regarding climate change and its impacts on agriculture targeting all growers in order to assist them in developing their appropriate adaptation measures.
- Reduce the science-policy gap.
- Paving the road for future cooperation initiatives to be taken in terms of joint and collaborative scientific efforts.

#### *Institutional aspect concerned with climate change*

The provision and flow of information are of the biggest and most important obstacles facing the implementation of impact assessment on the agricultural sector. In addition, it might be an important hindrance that Egypt has to deal with to fulfill its international obligations. Therefore, Climate Change Information Center and Renewable Energy (CCICRE) has been established for studying climate change and the agricultural sector, in order to provide the accurate data necessary to the research sector and eliminate the exchanging barriers, and to support regional countries in their adaptation and mitigation efforts. It is responsible for studying the effects of climate changes on the productivity of the main crops, water requirements, and the agricultural communities in the different agricultural systems in Egypt.

#### **Egypt in COP 21 and the way forward to COP 22**

Egypt's President represented the country as well Africa in the UN Climate Change "COP21" in Paris where he spoke about the need of international support whether technically or financially to combat climatic change impacts.

As the representative of the African Nations at the UN Climate change summit, the Egyptian president presented the two African initiatives of the world countries. The first initiative aims at promoting renewable energy in Africa and the other initiative endeavors to support our continent on adaptation. Egypt, on behalf of African Group, said the historic Paris Agreement had "far reaching consequences" for sustainable development and asked the COP 21 Presidency to convene consultations on Africa's special circumstances at SB 44.

Egypt's assist that the agreement should also be legally binding as long as it encompasses clearly defined commitments for the developed countries to provide the developing world with the adequate support in terms of financing, capacity building, and advanced technology, in order to enable the African and other developing countries to adapt and transform our economies to achieve sustainable development, in addition to a clear commitment in the agreement that the increase in temperature does not exceed 1.5 degrees, and to avoid shifting the burden of mitigation from the developed to the developing countries.

The issues of financing, capacity building and technology should not be viewed as merely negotiating positions but a strong necessity and a main indicator on the seriousness of the international community to face climate change challenges. A recent report of the United Nations Environment Programme indicated that Africa needs between 7 and 15 billion dollars annually until 2020 for adaptation, and needs between 50 to 100 billion dollars annually until 2050, and that the financing which our continent can only provide would not exceed 3 billion dollars annually, which means that there will be a financing gap not less than 12 billion dollars annually until 2020 and will keep increasing after 2020 by much higher rates. So it was imperative that the agreement reflects a commitment to provide 100 billion dollars annually to the developing countries by 2020, to be doubled beyond 2020. This is the framework in which the African states took the lead by developing two initiatives.

According to Egypt's vision to COP22, developing countries need the transfer of technology, capacity building, and funding: *“Developing countries should not be responsible for advocating this kind of support as they are not responsible for the current climate change phenomena; Rather it’s the developed countries’ responsibility.”* Several sections in the COP21 agreement state there should be shared responsibility in achieving the 2 degree target. This is represented in the creation of the Green Climate Fund and the Intended Nationally Determined Contributions (INDC). *“Working on voluntary initiatives should not replace developed countries’ main responsibility towards developing countries”, “Nevertheless, Africa, which contributes the least amount of greenhouse gas emissions, has undertaken several voluntary initiatives including the Renewable Energy Initiative (AERI).”*

Despite global momentum to improve climate change settings worldwide, the submitted INDCs indicate worldwide average temperatures could increase to 2.7 or even 3 degrees by 2100, instead of staying well below the 2 degree limit agreed upon in Paris, according to the UNFCCC synthesis report.

Since the beginning of the COP21 negotiations, Egypt has been advocating for adaptation measures, as well as placing responsibility on developed countries. This is attributed to the fact that, according to government officials, Egypt is vulnerable to climate change effects. Throughout 2015, hundreds of people died and others were displaced due to unprecedented weather conditions.

Egypt’s efforts seem ineffectual for the moment, as several obstacles still lie ahead. These obstacles are not only related to foreign funding, but increasingly, to local endeavors. The Egypt INDC was also widely criticized for its lack of definitive data and figures. Egypt attended the 4 Per 1000 Initiative, which took place at the International Agriculture Show in Meknes, Egypt, is intended to set the framework for the international governance structure of the initiative and determine what the next actions should be before the COP22 international climate conference which will take place in November 2016 in Morocco.

The high-level meeting was brought the initiative to an operational phase with the goal of giving it a transparent, inclusive and efficient governance process and a road map for the months ahead. In this context, the meeting was particularly targeted the following objectives:

- Adopting a convention that institutes the consortium of the 4 per 1000 Initiative, establishing the governance process for the entire initiative and its objectives;
- Adopt a general road map for the Initiative from May 2016 until the COP 22;
- Create an exchange on possible contributions and the expectations of different types of members in the framework of the Initiative.

Organic matter in soil, composed primarily of carbon, provides four large services to the ecosystem: providing resistance to soil erosion, water retention, fertility, and biodiversity. Even a small increase in carbon stored in soils has major effects, for both agricultural productivity and for helping in the global greenhouse gas cycle. It is necessary to engage all actors toward a new form of agricultural production based on an adapted management of soil that helps to create jobs and revenue and that carries us forward toward more sustainable development.

In 2050, global agriculture will have to produce a sufficient amount of food for a planet composed of 9.5 billion people in the context of climate change. Faced with this challenge, we must keep our soils alive because agricultural production is strongly correlated with soil health. Increasing carbon stored in soils is one of the major levers to respond to the triple challenge of food security, the adaptation of food systems and populations to disruptions linked to climate change and reducing greenhouse gas emissions. The 4 per 1000 Initiative aims to tackle these challenges by proposing an annual increase of carbon stored in soil of 0.4%, which scientists have determined would make up for annual human carbon emissions.

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