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ARAB ENVIRONMENT·7
FOOD SECURITY
CHALLENGES AND PROSPECTS

Impact of Climate Change on Food Security in Arab Region

Ayman F. Abou-Hadid

expected impacts of Climate Change on global food security as identified in IPCC 5th Report (2014)

1. Based on many studies covering a wide range of regions and crops, ***negative impacts of climate change on crop yields have been more common than positive impacts.***
2. Climate change has negatively affected wheat and maize yields both regionally and globally.
3. Since the IPCC Fourth Assessment Report, several periods of rapid food and cereal price increases following climate extremes in key producing regions indicate a sensitivity of current markets to climate extremes, among other factors.
4. Risk of food insecurity and the breakdown of food systems linked to warming, drought, flooding, and precipitation variability and extremes, particularly for poorer populations in urban and rural settings. Risk of loss of rural livelihoods and income due to insufficient access to drinking and irrigation water and reduced agricultural productivity, particularly for farmers and pastoralists with minimal capital in semi-arid regions.

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5. Projected impacts vary across crops and regions and adaptation scenarios, with about 10 percent of projections for the period 2030-2049 showing yield gains of more than 10 percent, and about 10 percent of projections showing yield losses of more than 25 percent, compared to the late twentieth century. After 2050 the risk of more severe yield impacts increases and depends on the level of warming.
6. All aspects of food security are potentially affected by climate change, including food access, utilization, and price stability.
7. In Africa reduced crop productivity associated with heat and drought stress is expected with strong adverse effects on regional, national and household livelihoods and food security. Another expected impact is increased damage from pests and diseases, and flood impacts on food system infrastructure.
8. Without adaptation, any local temperature increase in excess of about 1°C above preindustrial is projected to have negative effects on yields for the major crops (wheat, rice, and maize) in both tropical and temperate regions.
9. These impacts will occur in the context of rising crop demand, which is projected to increase by about 14 percent per decade until 2050. Crop production to be consistently and negatively affected by climate change in the future in low latitude countries, while climate change may have positive or negative effects in northern latitude

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10. Changes in temperature and precipitation, without considering effects of CO2 will contribute to increased global food prices by 2050, with estimated increases ranging from 3-84 percent.
11. Under scenarios of high levels of warming, leading to local mean temperature increases of 3-4°C or higher, models based on current agricultural systems suggest large negative impacts on agricultural productivity and substantial risks to global food production and security.
12. Projected benefits of adaptation are greater for crops in temperate, rather than tropical or arid regions. Wheat-based systems are more adaptable than other crops.
13. Fluctuations and trends in food production are also widely believed to have played a role in recent price changes, with recent price spikes often following climate extremes in major producers. Moreover, some of these extreme events have become more likely as a result of climate trends (IPCC, 2014).

table 1 **Change in average temperature and agricultural output**

	Change in Average Temperature			Change in Output 2080	
	Present	Future	Change		
Country	1961-90	2070-99		Without carbon fertilization	With carbon fertilization
Algeria	22.67	27.81	5.14	–36.0	–26.4
Iran	17.26	22.63	5.37	–28.9	–18.2
Iraq	20.86	26.16	5.30	–41.1	–32.2
Saudi Arabia	24.57	29.3	4.73	–21.9	–10.2
Syria	17.48	22.19	4.71	–27.0	–16.0
Yemen	23.77	27.72	3.95	–28.2	–17.0
Morocco	17.43	21.91	4.48	–39.0	–29.9

Source: Cline (2007).

III. IMPACT OF CLIMATE CHANGE ON CROP PRODUCTION

The effects of elevated CO2 (without climate change) on plant growth and yield will depend on photosynthetic pathways, species, growth stage, and management regimes, such as water and nitrogen (N) applications.

Recent data analyses find that, compared to current atmospheric CO2 concentrations, crop yields increase at 550 parts per million (ppm) CO2 in the range of 10-20 percent for C3 crops and 0-10 percent for C4 crops.

Some studies use re-analyses of recent FACE (Free Air Carbon Enrichment) to argue that crop response to elevated CO2 may be lower than previously thought, with consequences for crop modelling and projections of food supply.

Temperature and precipitation changes in future decades will limit, direct CO2 effects on plants (high temperatures during flowering may lower CO2 effects by reducing grain number, size, and quality). Increased temperatures may also reduce CO2 effects indirectly, by increasing water demand .

Future CO2 levels may favour C3 plants over C4 , yet the opposite is expected under associated temperature increases; the net effects remain uncertain depending on percent of agricultural land use and type (forage vs agriculture, irrigated vs rainfed) where changes in ***precipitation will often shape both the direction and magnitude of impacts***

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The IPCC (2007a) reported that agricultural production in many African countries is projected to be severely compromised by climate variability and change. Yields from rain-fed agriculture in Africa could be reduced by up to 50 percent by 2020, and the projected sea-level rise will affect low-lying coastal areas with large populations which will require a total cost of adaptation that could amount to at least 5-10 percent of GDP.

The IPCC (2014a) moreover indicated that reduced crop productivity is associated with heat and drought stress, with strong adverse effects on regional, national, and household livelihoods and food security in Africa. Also expected are increased occurrences of pests and diseases and flood impacts on food system infrastructure. The same report indicates increased risk of drought-related water and food shortage causing malnutrition in Asia.

For the Arab world, the overall conclusion of most studies indicates a general trend of reduction for most major field crops.

Climate change could do severe damage to agricultural productivity if no adaptation measures were taken. Furthermore, CO2-temperature interactions are recognized as key factors in determining plant damage from pests in future decades, though few quantitative analyses exist to date. CO2-precipitation interactions will likewise be important

FIGURE 1:**Change percent in major crops production in Egypt by the year 2050 due to climate change.**

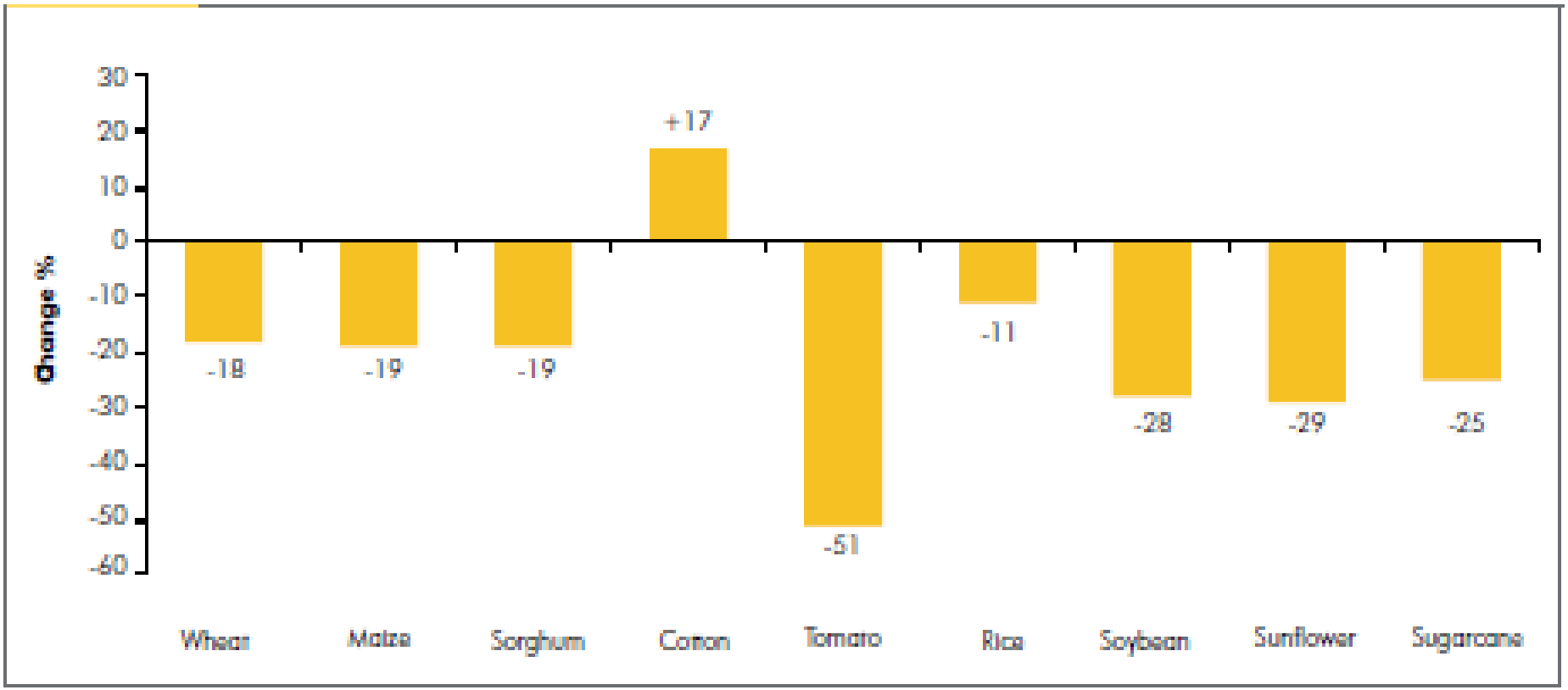
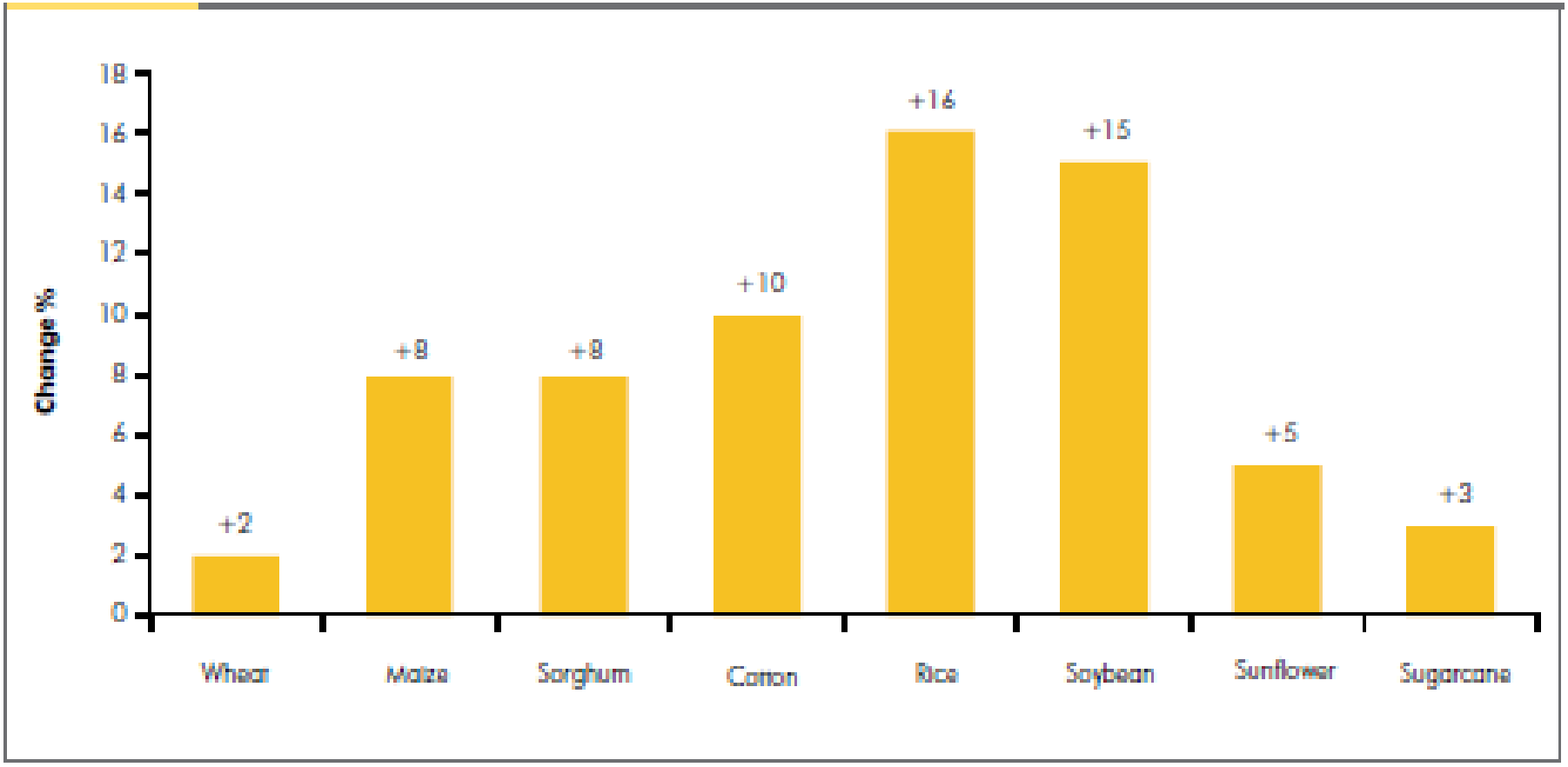


FIGURE 2 **Change percent in crop evapotranspiration for major crops in Egypt by the year 2050 due to climate change.**



IV. IMPACT OF CLIMATE CHANGE ON LIVESTOC K AND GRAZING

Pastures (grassland and rangeland ecosystems) occupy 33 percent of the total area of the Arab region. It faces risks due to events related to climatic variability (e.g. drought, floods) and desertification. Pastures and livestock production systems can be extensive pastoral systems with grazing , to intensive systems based on forage and grain crops, where animals are mostly kept indoors. The combination of increases in CO2 concentration with changes in rainfall and temperature is likely to have significant impacts on grasslands and rangelands, with production increases in humid temperate grasslands, but decreases in arid and semi-arid regions.

Animal requirements for crude proteins from pastures range from 7 to 8 percent of ingested dry matter, up to 24 percent for the highest producing dairy cows. Low Nitrogen status in pasture ranges under arid and semi-arid conditions, possible reductions in crude proteins under elevated CO2 may put a system into a sub-maintenance level for animal performance. The decline under elevated CO2 levels of C4 grasses, which are a less nutritious food resource than C3 ,may also compensate for the reduced protein content under elevated CO2. Generally, thermal stress reduces productivity and conception rates, and is potentially life-threatening to livestock. High temperatures put a ceiling on dairy milk yield, And could restrict breeding season

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Moreover, impacts on animal productivity due to increased variability in weather patterns will likely be far greater than effects associated with the average change in climatic conditions. Lack of prior conditioning to weather events most often results in catastrophic losses in confined cattle feedlots with economic losses from reduced cattle performance exceeding those associated with cattle death losses several fold.
In dry regions, there are risks that severe vegetation degeneration leads to positive feedbacks between soil degradation and reduced vegetation and rainfall, with corresponding losses of pastoral areas and farmlands . There is a strong relationship between droughts and animal death. Projected temperature increases, combined with reduced precipitation in North Africa would lead to increased loss of domestic herbivores during extreme events in drought-prone areas. With increased heat stress in the future, water requirements for livestock will increase significantly compared to current conditions, so that **overgrazing** near watering points is likely to expand .

V. IMPACT OF CLIMATE CHANGE ON FISHING AND AQUACULTURE

Aquaculture (terrestrial animal husbandry) shares many of the vulnerabilities and adaptations to climate change with natural aquatic ecosystems. Productivity is therefore vulnerable to climate change. Key negative impacts including (i) stress due to increased temperature and oxygen demand and increased acidity (lower pH); (ii) uncertain future water supply; (iii) extreme weather events; (iv) increased frequency of disease and toxic events; (v) sea level rise and conflict of interest with coastal protection needs; and (vi) uncertain future supply of fishmeal and oils from capture fisheries. Positive impacts include increased growth rates and food conversion efficiencies, increased length of growing season, range expansion, and use of new areas due to decreases in ice cover. Temperature increases may also affect fish populations at the upper end of their thermal tolerance zone. Increasing temperature interacts with other changes, including declining pH and increasing nitrogen and ammonia, to increase metabolic costs.

Changes in primary production and transfer through the food chain may be either positive or negative and the aggregate impact at the global level is yet unknown. However, climate change has been implicated in mass mortalities of many aquatic species, but a lack of standardized epidemiological data and information on pathogens generally makes it difficult to attribute causes.

VI. IMPACT OF CLIMATE CHANGE ON FOREST PRODUCTIVITY

Forests cover almost 928 thousand ha constituting 6.6 percent of the Arab world's physical territory. Approximately one third of this area is located in Sudan. Models suggest that global timber productivity will likely increase with climate change, regional production will exhibit large variability, similar to that discussed for crops.

Climate change will also substantially impact other services, such as seeds, nuts, hunting, resins, and plants used in pharmaceutical and botanical medicine and in the cosmetics industry.

Direct CO2 effects on tree growth may be revised to lower values than previously assumed in forest growth models. A number of FACE studies showed average net primary productivity (NPP) increases of 23 percent in young tree stands at 550 ppm CO2. However, in a 100-year old tree little overall stimulation in stem growth over a period of four years. Additionally, the initial increase in growth increments may be limited by competition, disturbance, air pollutants, nutrient limitations, and other factors , and the response is site- and species-specific.

There is a shift in harvest from natural forests to plantations. Although climate change will impact the availability of forest resources, the anthropogenic impact, particularly land-use change and deforestation, is likely to be extreemly important

VII. ADAPTATION OF AGRICULTURE IN THE ARAB WORLD

The high vulnerability of the agricultural sector in developing countries should place it at the top of priority lists of adaptation plans.

Although climate change is projected to have serious impacts on the agricultural sector in the Arab world, only modest efforts and steps are currently being taken in the areas of scientific research, mitigation, and adaptation. **Adaptations include**:

a. Technological adaptation responses (i.e. stress tolerant crop varieties, irrigation, and enhanced observation systems).

b. Enhancing smallholder access to credit and other critical production resources.

c. Strengthening institutions at local, national and regional levels to support agriculture

d. Agronomic adaptation responses (e.g. agroforestry and conservation agriculture).

e. More efficient use of water (i.e. improved agricultural practices, irrigation management, and resilient agriculture).

AFED (2010) indicated that strategic changes in water policies due to Climate Change have created a positive virtual water balance as water became imbedded in imported agricultural produce. This has prompted several GCC countries to seek acquirement of titles to land resources and even fishing rights in developing countries in Africa and Asia to secure food for their rapidly growing populations.

VIII. CONCLUSION AND RECOMMENDATIONS

Food security is a growing international challenge that is felt especially in the Arab world. The factors affecting food security in the region are ever growing population, the limited water resources, the unfavorable weather conditions, and political and economical instability. Climate change has added to this a major new challenge and uncertainty.

Adaptation to climate change is therefore highly needed. Adaptation strategies should build on a mix of local heritage and modern technologies.

The target of adaptation is improving water use efficiency, heat and stress tolerance, and reducing the energy inputs used for crop production.

Capacity building is a major prerequisite for climate change adaptation action

Awareness and advocacy are also needed to set the community priorities and establish appropriate policies. Community reaction to adaptation measures is a vital issue. Therefore, training and awareness programs should be carefully designed to improve timely implementation of the adaptation schemes.

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