Climate change, vulnerability and adaptation in agriculture: Egypt

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Central Laboratory for Agricultural Climate
Why Egypt is an exception in Mediterranean Region?

- Egypt is a developing country, has **scarcity of natural resources** associated with **extreme population expansion**.

- The expanding population concentrated in **narrow fertile bank of the Nile River and delta**, and the most of Egypt land areas is **hyper-arid lands**.
(Economical Crops)
- Summer season:
  - Rice.
  - Vegetables (small areas).
- Winter season:
  - Wheat.
  - Faba been.
  - Alfa alfa.
Basin Irrigation is the main irrigation system
Drainage System
- Agricultural management
- Agricultural mechanization
- Farm wastes
- Family business
- Hard to estimate the actual cost
- However, the larger the family, the higher the capability to increase the agricultural land.
Irrigation projects
Flow Diagram for Potential Production

Crop Model

- CO₂
- Photosynthesis Rate
- Interception Light
- Leaf Area
- Development Rate
- Temperature
- Assimilate
- Growth Respiration Rate
- Partitioning
- Shoot Dry Matter
- Root Dry Matter
- Development Stage
- Maintenance Respiration Rate
- Conversion Efficiency
- CO₂

Well trained labor
Integrated production and protection

Logical flow of the IPM

Logical flow of IPM system as a tool for minimizing the use of pesticides.
Escaping late blight in green beans

Planting date
Sept. 5

Planting date
Sept. 11
برنامج الري

出入 عداد برنامحو:

- البرامج الفنية
- العمر
- الصنف
- حجم الزراعة
- عامل المحصول

عمق الجذور وانتشاره

بيانات المنطقة

بيانات التربة

بيانات خاصة بنظام وشبكة الري

جودة المياه

بيانات المناخ الخاص بالمنطقة

مخرجات:

- البخور - نتاج المرجعي
- الاحتياج المائي بالـ م3 للفرد
- جدول العمليات الرئيسي

كمية المياه - الفترة بين الري - زمن التشغيل

مدخلات:

بيانات التربة

- العمر
- الصنف
- حجم الزراعة
- عامل المحصول

عمق الجذور وانتشاره

بيانات المنطقة
14 Protocol sections

1. Traceability
2. Record-Keeping and internal Audit
3. Varieties and Rootstocks
4. Site History and Site Management
5. Soil and Substrate Management
6. Fertilizer Usage
7. Irrigation
8. Crop Protection
9. Harvesting
10. Post-Harvest Treatments
11. Waste and Pollution Management, Recycling, and Reuse
12. Worker Health, Safety, and Welfare
13. Environmental Issues
14. Complaint form
Marketing chain
Agriculture in Egypt

Why Egypt is an exception in Mediterranean Region?

- Agriculture sector contributes about 17 to 20% of GDP, about 50% of the Egyptian population employment.

- The agricultural sector contributes to the overall food needs of the country and provides the domestic industry with agricultural raw materials.
- Agriculture helps in financing economic and social development (CAMS, 2002).
Agriculture in Egypt

Why Egypt is an exception in Mediterranean Region?

- Egypt is a limited water-resource country.
- 95% of the cultivated area is under fixed irrigation system.
- 85% from total available water consumed in agriculture.
- Low efficiency irrigation systems & poor irrigation management.
- The water gap in the future will increase (21.0 billion m$^3$ by the year 2025).
The correlation between wheat production and rainfall aggregated at the country level over a 40 year period is remarkably high in Tunisia and Morocco (over 40%) and almost non existent in Egypt (agricultural production is irrigated).

Generally

Egypt is highly vulnerable to climate change impacts, this due to the large and tightly packed population, and if climate change makes Egypt’s climate drier or warmer pressure on agriculture would intensify.

Also, competition -among the limited water resources States- for water could escalate (even without climate change) in addition to increased warming, droughts and evaporation, reduced flow in the Nile would further worsen Egypt’s problems, and the country could face an explosive situation (EEAA, 2002)
The high vulnerability of AGRICULTURAL SECTOR put it in the top of priority list of adaptation plans.

The adaptation science agenda should have two primary goals:

1] Generate and provide scientific knowledge, working in partnership with decision-makers and other stakeholders involved.

"climate change problem is a government problem"

&

“We can't do anything to face it".
MPC agricultures

Pressures and Vulnerabilities

- Climate variability.
- Extreme events
- Water Resources & Water Usage.
- Population.
- Irrigated areas & irrigation Techniques.
- Agricultural sector role in the national economy.
- Standard of life and development strategies.
- International trade.
- Political situation and stability.
Regarding to CLAC previous small-scale study aimed to:

**Investigate**

The role of the agricultural stakeholders in planning and developing agri-adaptation strategy

**Through**

Encouraging the involvement of the agricultural stakeholders in adaptation option planning, analyzing, and evaluating that could improve the criteria of the resulted options, and orient it in the directions of the actual local conditions.
CLAC have previous small-scale study aimed to:

Investigate

The role of the agricultural stakeholders in planning and developing agri-adaptation strategy

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Encouraging the involvement of the agricultural stakeholders in adaptation option planning, analyzing, and evaluating that could improve the criteria of the resulted options, and orient it in the directions of the actual local conditions.

The study description:

• Field surveys were conducted in three locations [Kafer El-sheakh, Bani-Souaf and Cairo]
• The survey covered 145 stakeholders [Researchers- agricultural administrators- extension advisors-farmers and agri. labor- other stakeholders in the agriculture.]
• One of the main sections of the questioner handled the concept of adaptation, and the possible adaptation options from the stakeholders point of view.
The suggested options were included under 4 categories:

[C1]: crops varieties and patterns changing.

[C2] management improvement.

[C3] environmental hazards reduction.

[C4] policies improvement.

Most proposed options Under C1: changing the current varieties (1), growing dates (3) and rearranging cropping patterns (4).

Remarkable high values introduced options under C2: Changing agriculture management practices, using highly controlled production systems, improving irrigation management.
Conclusion

- The stakeholders have a real initiative to act positively to reduce the impact of climate change.

- The involvement of the stakeholders in suggesting a number of adaptation plans may achieve the following benefits:
  - Enhancement of the scientific knowledge.
  - Introduce more practical adaptation options that meeting the actual conditions and readiness of agricultural sector, and from the core of the local society’s knowledge.
  - Give a fast and accurate feedbacks about the acceptable and unacceptable adoption options to policy makers.
  - Raise the degree of stakeholders feeling of responsibility towards climate change adaptation strategies.

- To enhance the involvement of the stakeholders in developing adaptation measures there is a need to increase awareness and improve the concept of climate and its relation to crop productivity. Through:
  - Simplify the scientific bases, facts and clarify the scientific terms.
  - The scientific message has to be simple and fit the current conditions
  - Effective source of information.
  - Rate of updated information.
Pressures & vulnerability

- Climate variability & CC
- Water resources situation
- Population pressure
- Competition between consumptive sectors
- Water Accessibility

Agricultural Water Use

- Irrigated area & Irrigation Tech
- Agriculture system (Rainfed/irrigated)
- Standard of life and development strategies
- International trade
- Political situation and stability
Pressures and Vulnerability of Agriculture Water-Use
Agriculture Water Demand (ETo):

- According to SRES scenarios (HadCM3 Model)
- Current and CC ETo (mm/day) [JJA-2050]

<table>
<thead>
<tr>
<th>ETo (mm/day) change rate(%) due to climate change</th>
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<tbody>
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<td>Δ (mm/day)</td>
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<td>Δ (%)</td>
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</table>

By 2050, the average water consumption change rate(%) due to climate change associated with cropped area in Egypt will be +7%.

Source: Al Taher, et al. (2006)
2- Water resources in Mediterranean Region

Turkey, France, Italy, Spain, Greece, Egypt, Albania, Morocco, Syria, Algeria, Tunisia, Lebanon, Israel, Cyprus, Libya, Malta.

Dependency Ratio %

Very sensitive to political conflicts
3- Population & water share (Water resources/capita/year)

Mediterranean region classification of the countries in hydro-geopolitical sub-units.

Source: Mediterranean Water Resources Planning and Climate Change Adaptation, IUCN Centre for Mediterranean Cooperation, 2002
### 3- Population & Water Share (Water resources/capita/year)

<table>
<thead>
<tr>
<th>Group</th>
<th>Population Change</th>
<th>Water resources/capita</th>
<th>Water demands/capita</th>
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<tbody>
<tr>
<td><strong>I-North:</strong> Spain, France, Italy, Bosnia-Herzegovina, Croatia, Slovenia, Albania, Greece</td>
<td>Stability or decrease</td>
<td>&gt; 3000 Stability &gt; 2000</td>
<td>Low to moderate (700-400) Slight increase or reduction</td>
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<td><strong>II-East:</strong> Turkey, Cyprus, Syria, Lebanon, Israel, Gaza.</td>
<td>Stability in Spain-increase in the other</td>
<td>&gt; 1000 Stability in Spain-decline in the other Spain: &gt; 3000 Other: &gt;1000</td>
<td>Moderate to high (300-1000) Spain, Cyprus, Morocco: Decrease. Turkey, Lebanon: increase</td>
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<tr>
<td><strong>III-South:</strong> Egypt, Libya, Tunisia, Algeria, Morocco, Malta</td>
<td>Moderate to High (increase)</td>
<td>&lt; 1000 More or less rapid decline 100-300 Egy: 600 Lyb: 50</td>
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**Source:** Mediterranean Water Resources Planning and Climate Change Adaptation, IUCN Centre for Mediterranean Cooperation, 2002
3- Population & water share (Water resources/ capita/ year)

- With or without climate change

Population Growth will add more stresses on water resources.
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<th>Forecast 2025 (m³/year)</th>
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Source: Mediterranean Water Resources Planning and Climate Change Adaptation, IUCN Centre for Mediterranean Cooperation, 2002
4- Water Usage and Competition between sectors

Source: FAO- AQUSTAT 2002
4- Water Usage and Competition between sectors.

**General Remarks:**

- Drinking water is the first priority in water allocation policies, with emphasizes irrigation.

- Agriculture is the second priority in water allocation:
  - Re-cycling drainage water.
  - Control of discharge every 15 days.
  - Laser leveling for sugar-cane lands.

- Global warming will increase consumptive water-use, especially due to the limited water resources, high population growth and high development rate.
Key factors of water accessibility in Egypt:

I- Water Quality.

II- Infrastructure.

III- Policies.
Currently, water quality of water resources in the Nile is affected by pollution (High Effect from fertilizers), Urbanization, and excessive water resources use (mix drainage with fresh water).

<table>
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<tr>
<th>Effect</th>
<th>primary and secondary impacts of CC</th>
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</table>
| increased temperature                       | • increases in lake and ground water salinity levels  
• lower dissolved oxygen levels in water                                                                                                                                                                                                                                                                                                                     |
| Lower canal flows, particularly in summer   | • higher pollutant concentrations in canals.  
• increased ground water contamination.  
• increased saltwater intrusion into delta and coastal aquifers (combine with sea-level rise)                                                                                                                                                                                                                                                                  |
| Pollution from intensified runoff in catchments and from urban areas | • Increased leaching of agricultural chemicals into groundwater  
• increased urban and livestock wastes discharging into streams, rivers and lakes                                                                                                                                                                                                                                                                                     |
| sea changes                                 | changes in temperature, salinity, organic matter content, concentration in CO₂, nitrates and phosphates.                                                                                                                                                                                                                                                                                                       |
II- Infrastructure key components to reduce pressures due to water shortage.
   - Water supply networks.
   - Groundwater discovering facilities.

III- Policy:
   - Canals and Mesqas water users associations.
Impacts of Climatic and Non-climatic Pressures on Agriculture Water-Use in Egypt
The Key points of the impacts of Climatic and Non-climatic Pressures on Agriculture Water-Use:

1- Irrigated areas & irrigation Techniques.
2- Agricultural sector role in the national economy.
3- Standard of life and development strategies.
4- International trade.
5- Political situation and stability.
1- Impacts on Irrigated areas & irrigation Techniques.

Almost 98% of food production is derived from irrigated farming systems.

Irrigation accounts for 88% of fresh water withdrawals.

Rice cultivation: is a must, and short duration cultivars are introduced to save water.

Current:
- More stable in Agri. productivity under current condition
- Low effect of climate variability.

CC:
- More water demands due to Eto increase.
- More competition between water key sectors
• Irrigation system selection depends on:
  - Water sources size & Type.
  - Crop.
  - Technology & knowledge level.
  - Infrastructure.
  - Agricultural investment.

• Using high-efficiency irrigation systems is one of the important adaptation options to reduce water used by agriculture.

• Switching from conventional irrigation systems to modern irrigation systems is one of the strategies to improve water management.

• High cost involvement.
2- Agricultural sector role in the national economy

Sensitive to changes in Agriculture sector due to changes in Agri-water share
Local Scale:
- the more water stress due to CC- especially in agriculture sector- will produce:
  - more food security problems.
  - more vulnerability of communities to natural hazards and external events.
  - more economical pressures.
  - Less development rates.
  - more internal immigration and bad demographic distribution.
  - civil conflicts & unstable political situation.
Thank You