Climate Change and Agriculture in the EGP

February 2019

Presentation Overview

- Provide an overview of projected changes to EGP climate over the period to 2050 and beyond
  - Temperature, precipitation, extreme weather events
  - Climate variability
- Identify potential impacts on agriculture in the EGP
  - Crop yields
  - Crop suitability
  - Carbon dioxide fertilisation
- Potential options for reducing climate risk

The Climate has already changed

- Over past 50 years the **region's climate has changed**
  - Mean annual temperatures have increase by 1°C (2°C+ in HKH)
  - Extreme weather intensity has increased (heat, rainfall intensity)
  - EGP mean rainfall has decreased slightly
  - Seasonal river flows have changed
- There have been **observed impacts on agriculture**
  - Length of growing season (slightly shorter Rabi)
  - Optimal crop planting dates/chilling hours
- **Impact on EGP have so far been modest** but will intensify

Projecting Future Climate Change?

- **Projecting future climate change is complex and subject to uncertainty**
  - But the underlying trends are clear
- **Global Circulation Models** (GCMs) used to project future climate
  - Good at a global/regional level but coarse at a local scale
  - Downscaling and regional models can increase granularity
- **Future emission scenarios** and **Concentration Pathways** (RCPs)
  - RCP 2.5 (low carbon) – RCP 8.5 (carbon intensive)
  - The difference not large in the medium term but very different in long term

Climate Projections for the EGP

- **Comparing projection results** across the literature can be confusing
  - Different models, base years, timeframe and emission scenarios used

- **Level of confidence in projections varies**
  - Good agreement on temperature, climate variability and extreme weather
  - Reasonable confidence on seasonal trends
  - Lower confidence on annual rainfall trends

- **Limited EGP specific modelling** and downscaling

Temperature Changes

- **High level of confidence in temperature projections**
- **Average mean temperatures in EGP**
  - 1°C-1.5°C higher by mid century (2°C+ in HKH)
  - 2.5°C - 4.0°C+ by 2100 (higher in western South Asia and HKH)
- Warming **more pronounced in winter** than summer
- **Night minimums increase more** than daytime maximums
- **Extreme heat days** increase in frequency and intensity
  - There is projected to be 30-40 more extreme heat days by mid century
  - 2°C of warming would result in a 2-3 fold increase in extreme heat days
  - 4°C of warming would result in a 10 fold increase

Precipitation Trends and Water Availability

- Subject to much **greater uncertainty - confidence levels are low-to-medium**
- **Mean annual rainfall** is expected to increase by around 5-10% by mid century
  - The higher the warming the higher the likely increase in rainfall)
  - At 4°C 20-30%+ increase in rainfall
- **Most of the increase will occur in the summer monsoon**
  - Rabi season may increase slightly for EGP but most of western South Asia/IGP get less
  - There is higher risk of drier winters
- **Potential evaporation** is projected to increase by 5-7% by 2050 (higher in winter)
  - Potentially offsetting any precipitation increases
- **Rainfall intensity** will increase – mainly during the summer monsoon
- **River flow regimes changes**: lower winter and early summer flows and higher early spring late summer flows

Climate Variability and Extreme Weather

- All models predict an **increase in climate variability**
  - Wetter years become wetter and dry years drier

- The **frequency and intensity of droughts and floods will increase**
  - In line with projections for rainfall intensity, temperatures and evaporation

- **Significantly increase in extreme heat days** and less extreme cold days

- **Sea level rise** – long slow process (century timescales)
  - 8-12cm by 2050
  - 40-70cm by 2100 (possibly 1m) – several metres of rise already committed

Projected Impacts on EGP Agriculture

- **Predicting future agricultural yields is subject to uncertainty** due to the complex mix of climatic, ecosystem and human variables
- Many of the **EGP crops are already at or beyond optimal conditions** areas
  - Projected increase in average mean temperatures will push crops to less optimal growth conditions
  - Each 1°C rise above optimal conditions reduces wheat yields 6%, rice 3% and maize 7% - declines in wheat and rice yields in EGP expected to be higher
- Higher average temperatures (and extreme heat) at critical stages of growth cycle reduce grain set, grain filling period and reduce fertilisation rates
  - Yields are expected to fall 10-15% by mid century
- **By late century the EGP likely to be unsuitable for current crops**

Impacts on EGP Agriculture (cont)

- **Livestock productivity decreases** as temperature rise but **inland fisheries may experience increased productivity**/breeding season
- **Risk of soil moisture deficits** (especially in winter) increases and amplify temperature effects
  - Evaporation and river flow regime changes may result in seasonal shortages
  - Access to reliable irrigation and careful use of groundwater esstential
- **Carbon dioxide concentrations** will impact plant productivity
  - **Fertilisation effect** will result in higher growth rates and yields (10-20%)
  - Increased **water use efficiency** will reduce water use/unit output
  - **Nutritional levels of crops tend to fall** at higher concentrations (zinc/iron/protein)
  - **Phosphorous** use efficiency falls and plant phosphorous demand increases
  - Impact on **insect/plant interactions**

Impacts on EGP Agriculture (cont)

- **Impact of changes to insect/pollinator/plant interactions** in EGP unknown and requires much more targeted research and analysis
  - Based on global studies the changes are expected to reduce yields
  - Not possible to draw definitive conclusions
- Overall the **impact of the expected changes are likely to be overwhelmingly negative on EGP agriculture**
  - This may result in reduced food security
  - Millions of rural livelihoods are at stake
- **Much more EGP specific climate change impact research is needed** to improve our understanding of the timing and magnitude of impacts

Measures to Reduce Climate Risks

- **Options exist to reduce the risks of future climate change** – or at least buy time
- **Measures include**
  - Introducing/developing more heat tolerant crops and cultivars
  - Improved farm level water efficiency
  - Rural income diversification strategies (including moves out of agriculture)
  - Improved flood early warning systems and farm infrastructure protection
  - Improved drought and seasonal forecasting/information dissemination
- Adopting **less carbon intensive production systems** (soil carbon)
- **CASI** approaches can help in this regard