BRIEFING NOTES ON THE CIRCE RURAL CASE STUDIES: TEL HADYA

Summary

- *A succession of droughts and an increase in groundwater abstraction has left Tel Hadya (in northern Syria) with a scarcity of water resources.*
- *Wheat, the main crop of the drier areas of the region, is vulnerable to the effects of drought and high temperatures particularly in spring. Irrigation is only possible where there are sufficient water resources.*
- *Key research issues include water resource allocation, the combined effects of increasing temperature and CO_2 on wheat production, and the use of irrigation for future climate.*

1. Physical and socio-economic characteristics

Tel Hadya (the Aleppo plateau, Syria) is an area that covers approximately 70,000 km² with an elevation that ranges from 300 to 600 m above sea level. Average annual precipitation varies from 500 mm in the hilly northwest to 200 mm in the southeast (Figure 1). The climate is Mediterranean with rain occurring during the cold winter season (October to May) and almost no rain during the hot summer season. The main winter crops are wheat in the

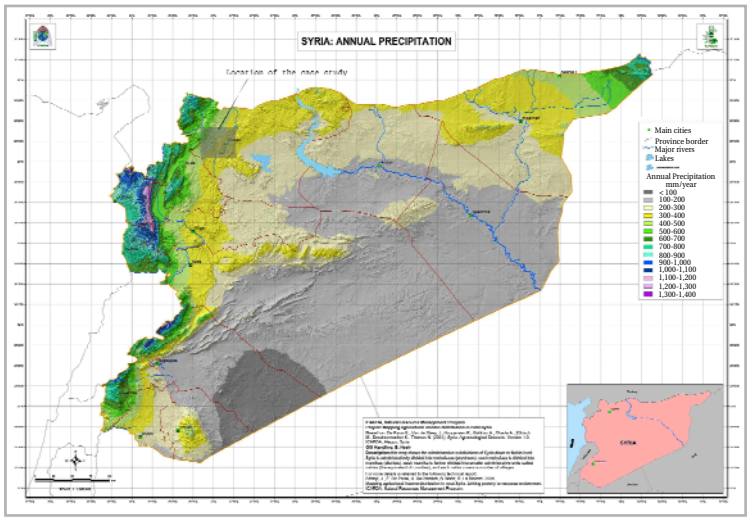

Figure 1: Map of Syria showing annual precipitation and the location of the study area (light grey shaded box)

wetter areas and barley in the drier areas. Wheat crops occasionally receive supplemental irrigation where water resources permit. The dominant agricultural soils are red Mediterranean clay soils, with calcareous parent material. These soils are often stony and their depth is highly variable. Because of the dry environment, groundwater resources in the region are scarce, and abstracting water for irrigation has caused a substantial decline in groundwater levels (Figure 2) and a number of wells have dried up. In some areas of the region, the salinity of groundwater varies widely from an electrical conductivity (EC) of 0.5 dS/m to 30 dS/m (salinity is measured as the EC expressed in units of deciSiemens (dS) per metre). Typical values of EC for irrigation water range from 1 to 4 dS/m; 1 being excellent quality and 4 low quality.

2. Justification

Vulnerability to climate change: During the last three decades, the region has experienced a sequence of drought and crop failures. This lack of rainfall has usually been accompanied by an increase in temperature, especially during spring which is the most sensitive period for wheat crops. Because of the high frequency of drought, water resources have become scarce and the amount of water allocated to irrigation has decreased. This trend is likely to persist in the future. Many climate projection studies and models have shown that the West Asia region including Tel Hadya will not only suffer a steady rise in temperature but also a decrease in average rainfall and a further decline in available water resources.

Atmospheric concentrations of CO_2 (a greenhouse gas contributing to global warming) have risen markedly since 1750, primarily due to an increased use of fossil fuels. Wheat, a C3 plant, should

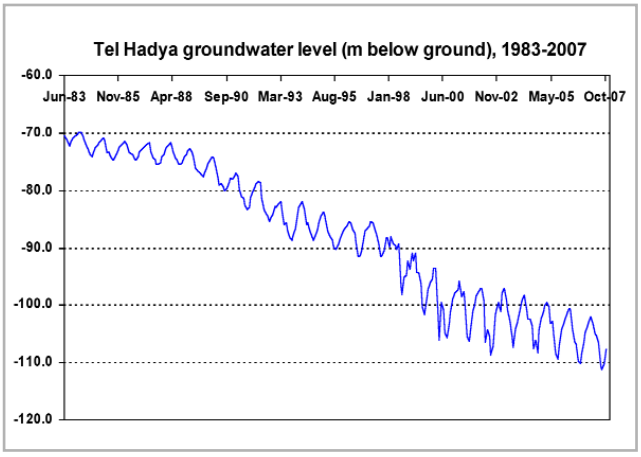

Figure 2: Groundwater levels in Tel Hadya, 1983-2007

theoretically benefit from the CO_2 'fertilization effect' (through an increase in photosynthesis).
Unfortunately, it seems that the harmful effects of temperature will outweigh the benefits of CO_2 enrichment especially when coupled with a deficiency in rainfall and water resources. Under such conditions it is expected that the livelihoods of poorer farmers will be negatively affected resulting in further degradation to natural resources.
However, supplemental irrigation can help reduce the pressure on water resources, increase yields for farmers and consequently alleviate the harmful effects of climate change. The typical soil moisture pattern for Mediterranean wheat is shown in Figure 3.

Availability of appropriate data: A wide range of research projects have been conducted in the region by the ICARDA (International Center for Agricultural Research in the Dry Areas) and other local institutions. In addition, ICARDA has conducted various on-farm trials and farmers' surveys in the study area, and participatory research is on-going in a number of villages.
Consequently, the centre is a repository for data on climate, crops, soils, water availability and agricultural and rural development (see Section 6 for more information).
Access to stakeholders, including decision and policy makers: the ICARDA has developed strong links with the key regional stakeholders and in particular, ministries of irrigation, agriculture and the environment. In addition, collaboration is underway with local authorities, the private sector, NGOs, universities and research centres.

3. Key research issues

Previous research in the region: To combat drought and climate variabi-

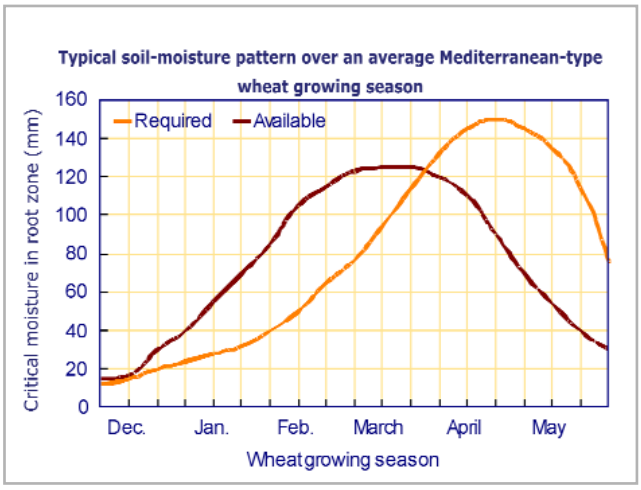

Figure 3: Variation in soil moisture for the Mediterranean wheat growing season

lity, the ICARDA has conducted many studies and experiments on techniques and technologies that increase and stabilize wheat yields and water productivity. Among these studies is the scheduling and management of supplemental irrigation, nitrogen management, and modelling supplemental irrigation. In addition, a regional study of the socio-economic impacts of supplemental irrigation at the farm level has been conducted. The Syrian national program has several research stations in the region (e.g., Syrbaia station) undertaking studies on various water and land management issues. NGOs such as the Farmers Union, are working mainly on socio-economic and policy issues particularly within communities.

Research issues relevant to CIRCE:

- Validate a crop growth model using existing data for supplemental irrigation;
- Simulate the impact of temperature and CO_2 increases on wheat production using the validated model;
- Simulate the impact of supplemental irrigation on different stages of wheat production for different scenarios of climate change.

4. Key areas of integration

The main area of collaboration within the CIRCE project will be with the *Agriculture and Ecosystems* research line. Key aspects of integration might include: changes in temperature and rainfall – drought – soil moisture deficits – availability of water resources – crop growth / production – use of irrigation – water resource allocation – socio-economic impacts in rural communities – policy implications.

5. Regional stakeholders, policy makers, institutions

- General Commission for Scientific Agricultural research (GCSAR)
- Syrian Farmers' Union
- Agricultural Extension Services
- Syrian Department of Climatology
- Aleppo University
- Tel Hadya village Council
- Local Irrigation Water Authority

Proposed contribution to policy development

The proposed study will help inform decision makers and water resource users and will contribute to the development of new policies concerning the use and management of scarce water resources. Linkages with policy makers will allow the development/modification of water and associated agricultural regulations to be more closely aligned with mitigation measures recommended for the projected climate change. The ICARDA has Syrian policy makers on its board of trustees and is engaged in policy dialogue regarding research output on an annual basis. Coordination mee-

tings between the ICARDA and national institutes are appropriate forums for discussing policy changes.

6. Data availability

- Climate data:
  ICARDA has two research stations in the area, Breda and Tel Hadya, with an average annual precipitation of 250 mm and 350 mm respectively. Figure 4 shows the annual precipitation series and precipitation deviations for Tel Hadya. Daily climate data, including reference evapotranspiration are available for the ICARDA stations in Tel Hadya (27 years), Breda (25 years), and Khanasser Valley (8 years). Longer term annual precipitation data are also available from various government meteorological stations in the study area.

- Water resources:
  Information on ground and surface water levels and water quality is available.

- Land use:
  As a well-equipped Agro-meteorological unit, the ICARDA has a land use database that can be accessed to study the evolution of land use through satel-

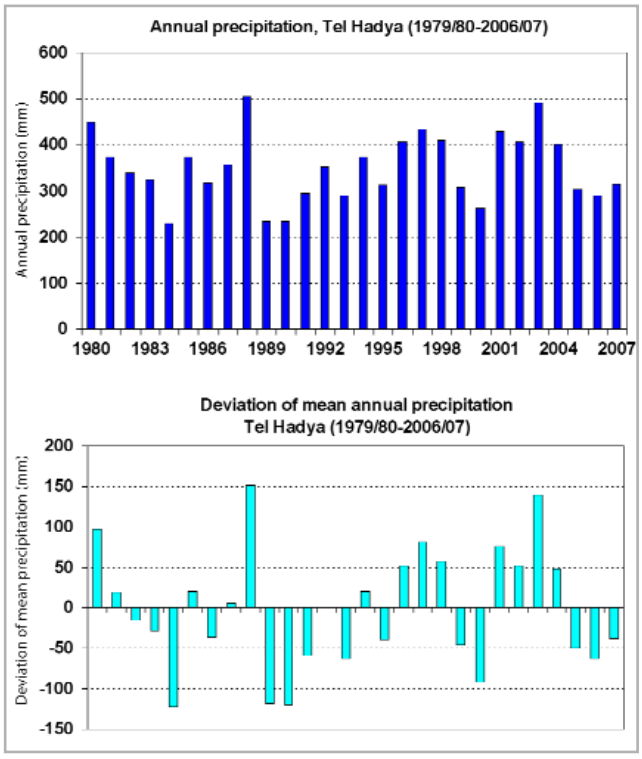

Figure 4: Annual precipitation for Tel Hadya (Top), and the annual deviation from the mean (bottom)

lite images. This will be exploited to identify land use changes in the targeted areas and for up-scaling the results.

- Agricultural crops: Historical data on yields, cultivated area and production are archived at a district level.

Acknowledgements

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Further reading

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