Crop Module 6: Hands-on exercise

**Context**

Pakistan is among the most vulnerable regions to climate change impacts, in particular the agricultural areas found in the world’s largest contiguous irrigation system, the Indus River Basin (IRB). The inter-annual variability of agricultural value added to the GDP and its high dependency on weather suggests that the IRB is among the most vulnerable regions to climate risks worldwide1. The impact of climate change on agricultural production can manifest in different ways. For example, shifts in rainfall distribution2 intensification and more extreme weather events3, and changes in crop pests and diseases4.

Hence, there is a need to increase the understanding of future climate impacts on agricultural systems and implement measures to increase the efficiency and productivity of agricultural water use in response to climate change, growing demographic pressure and finite water resources5.

Understanding how climate change could affect agricultural production can inform local governments and allow the development of appropriate long-term policies, with the aim of reducing the adverse impacts of climate change on agriculture.

**Background for the hands-on exercise**

In this exercise, you are asked to assess the impact of climate change on wheat yields. In particular, you will try to understand whether projected changes in climate would require the implementation of a different irrigation management. In this exercise, you will use AquaCrop and [AquaCropPlotter](https://tntps.shinyapps.io/aquacropplotter/) to draw insights about the potential impact of projected climate change on wheat yields in Multan and the benefits of the adoption of different irrigation management.

**Task on AquaCrop**

After completing the exercise of Module 5 “Create project files (PRMs) and run simulations” you should have in your DATA folder four PRM files, named: Wheat\_Badin\_1Nov\_7d11mm\_45;Wheat\_Badin\_1Nov\_7d11mm\_85;Wheat\_Multan\_1Nov\_7d13mm\_45; Wheat\_Multan\_1Nov\_7d13mm\_85. If you don’t have them, please follow the steps in Module 5 to create the two PRMs only for the location of Multan.

This exercise consists in creating two new PRM files for the location of Multan (RCP4.5 and 8.5) by changing the irrigation file, from furrow irrigation: 13 mm every 7 days to 15mm every 8 days.

You will simulate crop yields under these different irrigation management and provide evidence of why changing irrigation management may be appropriate in the future.

**References**

1. TWB2016. The Indus Basin of Pakistan: the Impacts of Climate Risks on Water and Agriculture.

2. Mamalakis, A. et al. Zonally contrasting shifts of the tropical rain belt in response to climate change. Nat. Clim. Change 11, 143–151 (2021).

3. Teixeira, E. I., Fischer, G., van Velthuizen, H., Walter, C. & Ewert, F. Global hot-spots of heat stress on agricultural crops due to climate change. Agric. For. Meteorol. 170, 206–215 (2013).

4. Wang, C. et al. Occurrence of crop pests and diseases has largely increased iChina since 1970. Nat. Food 3, 57–65 (2022).

5. Richey, A.S., Thomas, B.F., Lo, M.H., Reager, J.T., Famiglietti, J.S., Voss, K., Rodell, M., 2015. Quantifying renewable groundwater stress with GRACE. Water Resour. Res. 51 (7), 5217–5238. Sandhu, S.S., Mahal, S.S.,