**GYGA methodology irrigated wheat in Egypt**

**Wheat Production in Egypt**

Egypt has a very arid climate, and agricultural production mostly relies on irrigation1,2). The area of agricultural land in Egypt is mainly confined to the Nile delta and valley. Arable land (% of land area) is around 3%3). The total population in Egypt was estimated at 96.2 million people in 2017, and employment in agriculture (% of total employment) is 25% in the same year. Wheat, maize, and rice are the major cereals cultivated in the country. Their productivity is high (see below Table)4), since they are grown under irrigated conditions and high input use5,6). However, today, water scarcity is a major concern in the country, and it dictates policy measures including the reduction in rice area.

**Harvested Area**

Harvested area of irrigated wheat in Egypt was retrieved from SPAM2010 v1.17).

**Weather data and reference weather stations (RWS)**

In total, 2 RWSs belonging to 2 different climate zones were selected following the GYGA protocols. The buffer zones of the designated RWSs cover 59% of the wheat national harvested area. Weather data for 10 years (2009-2019), including maximum and minimum temperatures, sunshine hours, wind speed, relative humidity and precipitation were collected from the 2 RWS. Weather data for the RWS in Kafr Elsheikh (Nile delta) were obtained from the Sakha Agricultural Research Station, part of the Agriculture Research Center (ARC) of the Ministry of Agriculture and Land Reclamation, Egypt. Weather data for the RWS in Luxor (Upper Egypt) was obtained from Central Laboratory of Climate, Ministry of Agriculture, Egypt.

**Actual yields**

Actual yields data from 2013 to 2019 were collected from the Wheat Research Department, Field Crops Research Institute, Agriculture Research Center (ARC) of the Ministry of Agriculture and Land Reclamation and from the extension advisory system from the Ministry of Agriculture and Land Reclamation.

**Model calibration**

The WOFOST crop growth model as implemented in the Python Crop Simulation Environment (PCSE8)) was used to simulate the wheat potential yield under irrigated conditions. Crop development was calibrated in the model using information about the duration of the different growth stages of a wheat crop in each of the RWS and information about sowing and harvest dates (Table 1). Parameters controlling translocation of biomass from leaves and stems to grains after anthesis, leaf dynamics and CO2 assimilation were also adjusted during model calibration independently of the RWS.

**Table 1. Window of sowing, anthesis and maturity dates considered for model calibration**

|  |  |  |
| --- | --- | --- |
| **Growth stages** | **Kafr Elsheikh**  **(Nile delta)** | **Luxor**  **(Upper Egypt)** |
| Sowing period | 10 Nov – 30 Nov | 01 Nov – 20 Nov |
| Anthesis period | 25 Feb – 10 Mar | 15 Feb – 25 Feb |
| Maturity period | 15 Apr – 10 May | 25 Mar – 15 Apr |

**References**

1. <http://www.fao.org/docrep/v9978e/v9978e0e.htm>
2. <http://www.fao.org/docrep/005/Y4632E/y4632e0c.htm>
3. <https://tradingeconomics.com/egypt/arable-land-hectares-wb-data.html>
4. <http://www.fao.org/faostat/en/>
5. Saito, K., Dieng, I., Toure, A., Somado, E.A., Wopereis, M.C.S. 2015. Rice yield growth analysis for 24 African countries over 1960–2012. Global Food Security 5, 62-69.
6. van Oort, P.A.J., Saito, K., Tanaka, A., Amovin-Assagba, E., Van Bussel L.G.J., van Wart, J., de Groote, H., van Ittersum, M.K., Cassman, K.G., Wopereis, M.C.S. 2015. Assessment of rice self-sufficiency in eight African countries in 2025. Global Food Security 5, 39-49
7. You, L., U. Wood-Sichra, S. Fritz, Z. Guo, L. See, and J. Koo. 2014. Spatial Production Allocation Model (SPAM) 2010 V1r1. [October 8, 2019]. Available from http://mapspam.info and on IFPRI’s Dataverse Site.
8. de Wit, A., Boogaard, H., Fumagalli, D., Janssen, S., Knapen, R., van Kraalingen, D., Supit, I., van der Wijngaart, R., van Diepen, K. 2019. 25 years of the WOFOST cropping systems model. Agricultural Systems, 168, 154 – 167.