PhD School on Agriculture, Environment and Bioenergy

(http://sites.unimi.it/dottorato_aab/)

(XXXIX cycle, 2023-26)

Project draft

1.Field of interest

AGR/08

2.Project title

Innovation of irrigation practices through the use of measurements, models and automatic water distribution and delivery systems.

3.Tutor (membro del Collegio dei Docenti)

Claudio Gandolfi

- Eventually: co-tutor/s

Daniele Masseroni

4.Relevance of the topic and state of the art:

The consequences of climate change are being experienced globally (Ison 2010), and one of the main areas affected by changes in temperature and precipitation leading to an increase in drought events is irrigated agriculture (Esteve et al. 2015). Irrigated agriculture is particularly vulnerable in areas historically characterized by an abundance of freshwater (e.g. Padana Plain which is the largest irrigated area in EU) (Worqlul et al. 2019). Despite the increasing number of droughts, irrigation practices in these areas (e.g., surface, sprinkler, drip irrigation) are still managed with the awareness that they are applied in areas that did not suffer from water scarcity in past, and it has recently been demonstrated that a significant margin of improvement in water savings can be achieved for each of them (Zapata et al. 2023). Therefore, the objective of this PhD project is to study how, through in-field measurement, modeling, and automation, it might be possible to improve the management, operation, and planning of irrigation systems and practices to increase crop profitability and water savings from field to irrigation district.

5.Layout of the project (draft)

5.1. Materials & Methods:

The PhD student will be involved in one of the multidisciplinary projects of the Agricultural Water Management group of the University of Milan, covering one or more of the following topics: (i) traditional, new and transitional technologies and sensors for the management, control and actuation of irrigation at different spatial scales; (ii) remote and proximal sensing to address irrigation problems; (iii) integration of climate change scenarios and weather forecasts into agro-hydrological models and decision support systems; (iv) use of marginal waters in irrigated agriculture and their impact on crops and

the environment; (v) adoption of precision irrigation technologies and methods to improve the sustainability of irrigated systems; (vi) new agricultural extension services to connect farmers and institutions aimed at promoting knowledge sharing and use of updated irrigation technologies/techniques.

The student at the end of the PhD program will be able to: (i) describe, model and measure hydrological processes in soil-vegetation-atmosphere systems at different spatial scales; (ii) use instruments for monitoring agro-hydrological variables (e.g. irrigation flows, soil water content, evapotranspiration, etc.); (iii) design and manage experimental sites; (iv) accompany and support farmers, irrigation specialists and authorities in the planning, management and control of irrigation.

5.2. Schedule and major steps (3 years):

The doctoral activity is divided into three macro steps. In general, the first one (1 year) is dedicated to the definition of the main objective of the doctoral project in collaboration with the tutor and co-tutor. During the first year, the student will analyze the scientific literature, get in touch with the local realities, identify the field of study. The second year (2 years) will be dedicated to on-field experiments, data acquisition, modeling simulations, while the third year (3 years) will be dedicated to data elaboration, statistical analysis and writing the thesis. A stay abroad is planned as part of the doctoral project.

6. Available funds

IrriSuS – Sustainable Surface Irrigation – Total funding Euro199.298 € (UniMi funding Euro 100.984)

INCIPIT-INTEGRATED COMPUTER MODELING AND MONITORING FOR IRRIGATION PLANNING IN ITALY, PRIN 2017 – Total funding Euro 855.515 (UniMI funding Euro 191.236).

7. Literature:

Esteve, P., Varela-Ortega, C., Blanco-Gutiérrez, I., & Downing, T. E. (2015). A hydro-economic model for the assessment of climate change impacts and adaptation in irrigated agriculture. Ecological Economics, 120, 49-58.

Ison, R. (2010). Systems practice: how to act in a climate change world (pp. I-XVI). London: Springer.

Worqlul, A. W., Dile, Y. T., Jeong, J., Adimassu, Z., Lefore, N., Gerik, T., Srinivasan, R., & Clarke, N. (2019). Effect of climate change on land suitability for surface irrigation and irrigation potential of the shallow groundwater in Ghana. Computers and electronics in agriculture, 157, 110-125.

Zapata, N., Bahddou, S., Latorre, B., & Playán, E. (2023). A simulation tool to optimize the management of modernized infrastructures in collective and on-farm irrigation systems. Agricultural Water Management, 284, 108337.