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Extreme hydrometeorological events and the role of reclamation works and irrigation - drainage systems in the era of climate crisis

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Introduction

Nowadays, there is prevalent concern regarding recorded and further expected climate changes, referred to as climate emergency or climate crisis (UN 2019), considering that adaptation measures need to be taken to mitigate the consequences of adverse climate conditions and extreme events (floods, droughts, heatwaves, etc.). Such events used to be typically perceived as a main problem of developing countries, due to climatic causes (e.g., arid or semi-arid environments) coupled with limited resources (economic, social and political) for reducing system vulnerability and combating the impacts. Nonetheless, during the last years there is strong evidence that extreme events are also an active and major issue for developed regions, as well, requiring close attention.

The field of water and food security is particularly sensitive to the above matters, while extensive supply deficits may occur (Fraser et al. 2013). Thus, proper management including proactive and structural measures are essential for decreasing the vulnerability of the systems to extreme events (Tigkas et al. 2020). To this end, reclamation works and irrigation – drainage systems may play key role for enhancing the water-land-food nexus under a climate change perspective (Iglesias et al. 2019). In this paper, the aforementioned role is examined towards managing insecurities and strengthening the interrelated systems against the anticipated impacts of hydro-meteorological extremes, taking into account potential conflicts between water uses and other limitations and factors related to sustainability goals.

Materials and methods

The positive aspects of reclamation works including irrigation and drainage systems for mitigating the impacts of extreme hydro-meteorological events are examined considering the anticipated adverse effects of such events due to climate change on the design principles of structural and institutional matters. Further, the contradictory issues that may arise among different sectors (agricultural production, urban water supply, environment, etc.) are also investigated based on international cases and paradigms.

Results and concluding remarks

There are several indications that the frequency and the severity of extreme events have increased during the last years. In Europe, severe and prolonged droughts and heatwaves occurred during the past decade in several regions, causing significant losses of crop yields with consequent widespread economic impacts. Also, intense storm events and cyclones leading to floods have caused damages in the agricultural sector, either directly (crop damages, yield reduction, etc.) or indirectly (damages on irrigation and drainage networks, etc.). Due to the above, increasingly more international policies lean towards measures in various sectors for adapting to climate crisis. For instance, the European Union has declared adaptation as a clear objective of the common agricultural policy for 2021-2027, providing opportunities for implementing a variety of measures to enhance water security and improve resilience against climate extremes (EEA 2019).

It is a fact that adequate infrastructure for water storage, management and distribution of irrigation

water is critical for reducing the vulnerability of agricultural systems to water scarcity due to drought, that may include design and construction of new projects, as well as proper operation and maintenance of existing networks. Also, well designed and properly maintained drainage systems, apart from retaining suitable soil conditions for crop development, can also contribute to reducing the damages of flood events.

Planning decisions upon the above are not straightforward, e.g. based mainly on financial criteria, but a complex task that should be carefully prepared and follow an established driver-pressure-state-impact-response (DPSIR) framework (Hettelingh et al. 2001). Indicatively, the common belief, that modern irrigation systems certainly lead to a more sustainable use of water, has been questioned by several studies (Perry et al. 2017). It is important to carefully define the objectives of any intervention, whereas understanding and considering the underlying hydrological and biophysical principles and mechanisms, in connection to socio-economic and environmental factors, can clearly point up the pros and cons of each project.

Recent cases in various areas of the globe show that, despite infrastructural improvements in the agricultural - water sector, unfavourable effects may come of, if adequate policy measures are not envisaged for maintaining proper management. Such adverse outcomes may include the deterioration of water quality, the misapprehension of the “lost” water concept leading to environmental impacts, conflicts between water users, etc. (e.g., Al-Faraj et al. 2016; Berbel et al. 2019; Nyam et al. 2020; Van der Kooij et al. 2017). To this end, water utilities supported by users’ participation can play critical role for applying the appropriate measures and maintaining optimal operational schemes, while sufficient and well-informed personnel should be available to supervise and put into practise scientific and technological advancements.

Based on the above, it can be argued that infrastructural development is a major asset, though not panacea for water and food security. It is important to keep up sustainable solutions and integrated planning, balanced with the social, economic, cultural and environmental conditions of a region, while adopting appropriate strategic and institutional measures. The development schemes of a region, including the construction and operation of agricultural and water-related infrastructure, need to be carefully prepared, considering cost-benefit analyses according to established socio-economic and environmental criteria and follow a DPSIR framework. Such an approach ensures the creation of robust and sustainable systems, smoothly fitted within the existing and anticipated conditions of the region. Additionally, public participation in decision making is crucial for addressing issues raised by all interested parties and enhancing collective understanding and acceptance of the implemented measures.

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