Seawater intrusion in coastal agricultural regions: a global review

Aurora Ghiardelli¹, Eugenio Straffelini¹, Edward Park², Vincenzo D’Agostino¹, Roberta Masin³, and Paolo Tarolli¹

¹Department of Land, Environment, Agriculture and Forestry, University of Padova, Legnaro (PD), Italy
(aurora.ghirardelli@unipd.it; paolo.tarolli@unipd.it)
²Earth Observatory of Singapore (EOS), National Institute of Education (NIE) and Asian School of the Environment (ASE), Nanyang Technological University (NTU), Singapore
³Department of Agronomy, Food, Natural Resources, Animals and Environment, University of Padova, Legnaro (PD), Italy

Coastal agriculture is key in sustaining food production for the growing global population. Due to highly fertile soils and water availability, lowlands located in the proximity of river mouths often represent the backbone of coastal agricultural activities. However, over the past decades, anthropogenic-related processes are reducing yield increases. Climate change has rapidly become a major threat, with sea-level rise (SLR) and extreme weather events such as prolonged droughts and record-breaking temperatures. In addition, deltaic areas are often densely populated, and intense human activities undermine the resilience of coastal agro-environments. In this context, seawater intrusion (SWI) is one of the most damaging processes affecting agriculture through soil salinization and the depletion of irrigation water resources. This leads to crop damage, huge yield losses and permanent harm to soil fertility. Despite the relevance of the topic worldwide, to this date, there is a lack of global synthesis on the impact of SWI on coastal agriculture and an insufficient consideration of the phenomenon in local surveys. To fill this research gap, we present a systematic review of the global distribution and impact of SWI in coastal agriculture of river deltas, focusing on the main hotspots and prevalent drivers, related to climate change, natural processes, and local human activities such as dam construction, dredging or groundwater overexploitation. Moreover, the global study helps to highlight the areas where data is insufficient and compares patterns of SWI across different regions. Additionally, the study assesses the global distribution of rural regions potentially impacted by SWI and the main crops characterizing the economies of river deltas. Finally, we delve into the future implications of demographic growth and SLR projections in deltaic regions, discussing the possible scenarios of coastal agriculture regarding water management, agronomic practices, and relative sustainability.