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# Agro-ecological impact assessment of irrigation canal rehabilitation scenarios under different hydrological conditions in the upper Mekong Delta, Cambodia

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The Cambodian part of the Mekong Delta, is characterized by specific irrigation infrastructures, namely Prek channels. These trapezoidal earthen channels traditionally connect the Mekong's mainstream to low-lying floodplains by breaching the elevated river banks. They act as vectors for both flooding and drainage during the annual Monsoon inundations. Furthermore, they fulfil a diverse set of ecosystem services for local communities, from providing dry season irrigation water to channelling nutrient-laden sediments to increase the fertility of agricultural plots. Given the recent shifts in the hydrological regime of the Mekong River - mainly due to climate change, hydropower construction, and land use changes - the role of Preks in the sustainable management of the floodplain agroecosystems becomes a crucial issue. For this reason, various initiatives by local stakeholders as well as national ministries and international development agencies have aimed to rehabilitate Prek channels in recent years and restore functionalities that have become impeded due to erosion and sediment clogging. However, there are different ways in which to rehabilitate Preks, and numerous potential project sites to choose from.

The aim of this study is to build a method to assess the impact of different Prek rehabilitation scenarios on the local agroecosystem, under different hydrological framework conditions. In order to do so, an eco-hydrological model has been constructed in Python. It depicts a case study area of 43 km², comprising 10 Preks, located approximately 70 km South of the Cambodian capital Phnom Penh. The model is based on the results of remote sensing analyses combining Sentinel-1 and -2 images to determine land use and land cover (LULC) evolution, as well as the spatial and temporal distribution of seasonal inundations. It also takes into account the results of field surveys and interviews with local stakeholders to make explicit the link between the hydrological processes catalysed by Preks and the ecosystem services from which local communities benefit, especially the provision of irrigation water during the dry season.

Subsequently, this model was used to compare different rehabilitation scenarios - different canal excavation depths (called shallow and deep calibration), and the rehabilitation of different numbers of Preks in the case study area. In addition, the simulations were carried out for three different hydrological scenarios, based on past observations - one in which the annual Monsoon flood peak is lower than average, one in which it corresponds to the long-term mean, and one in which it is higher than average. This helps account for the likely long-term impact of delta- and basin-wide developments like LULC change, climate change, and hydropower construction, on local hydrological conditions such as the timing and duration of inundations. Initial results indicate that Prek rehabilitation, especially using deep calibration, has a significant impact on agricultural production through irrigation water provision. For instance, simulations show that, even in below-average hydrological years, blanket deep calibration of Preks in the study area could increase agricultural production by 33% in comparison to the reference year.

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