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Post-Soviet changes in irrigated crop production in the Amu Darya Basin

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Water withdrawals for irrigated crop production constitute the largest global consumer of blue water resources. Monitoring the dynamics of irrigated crop cultivation allows to track changes in water consumption of irrigated cropping, which is particularly paramount in water-scarce arid and semi-arid areas. We analyzed changes in irrigated crop cultivation along with occurrence of hydrological droughts for the Amu Darya river basin of Central Asia (534,700 km²), once the largest tributary river to the Aral Sea before large-scale irrigation projects have grossly reduced the amount of water that reaches the river delta. We used annual and seasonal spectral-temporal metrics derived from Landsat time series to quantify the three predominant cropping practices in the region (first season, second season, double cropping) for every year between 1988 and 2020. We further derived unbiased area estimates for the cropping classes at the province level based on a stratified random sample (n=2,779). Our results reveal a small yet steady decrease in irrigated second season cultivation across the basin. Regionally, we observed a gradual move away from cotton monocropping in response to the policy changes that were instigated since the mid-1990s. We compared the observed cropping dynamics to the occurrence of hydrological droughts, i.e., periods with inadequate water resources for irrigation. We find that areas with higher drought risks rely more on irrigation of the second season crops. Overall, our analysis provides the first fine-scale, annual crop type maps for the irrigated areas in the Amu Darya basin. The results shed light on how institutional changes and hydroclimatic factors that affect land-use decision-making, and thus the dynamics of crop type composition, in the vast irrigated areas of Central Asia.