**Tropentag, September 10-12, 2025, hybrid conference**

"Reconcile land system changes
with planetary health"

# Land use changes and anthropogenic impacts due to rice fields in Santa Fe (Argentina)

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## Abstract

The Bajo de los Saladillos, a wetland system in Santa Fe (Argentina), has undergone significant environmental transformations due to the expansion of rice cultivation. These crops use water from the San Javier River for irrigation, and discharge excess water into the Saladillo Dulce stream, along with intensive use of agrochemicals and controlled burning. To analyse land-use changes associated with this activity, we performed land cover classification for two time periods in the region between the San Javier and the Saladillo Dulce (220,000 ha). We created land cover maps using unsupervised k-means classifications on Landsat 4-MSS (summer 1986 and winter 1987) for the past, and Landsat 8-OLI satellite data (from winter 2021 and summer 2022) for the present. Current rice fields were delineated using Sentinel$^{-2}$ and Google Earth imagery. Currently, forests and savannahs are the dominant environments (30.8 %), while rice fields occupy 17.4 % of the area. Notably, 54.9 % of the land converted to rice fields was formerly marshes, indicating the loss of natural wetlands. Secondly, we analysed fire trends using MODIS satellite products (MCD64A1) from 2002 to 2022. Fires have increased in recent years, mainly in rice fields for post-harvest stubble removal. Finally, during the spring and summer of the 22/23 and 23/24 rice seasons, we collected water samples from intake points on the San Javier and drainage points into the Saladillo Dulce from three rice complexes, including sites 1 km upstream and downstream of drains. We analysed physicochemical variables, agrochemicals, and metals. A water quality index (WQI) generally showed lower values at drainage points, where we also found higher concentrations and diversity of agrochemicals (e.g., glyphosate, 2,4-D). Additionally, we evaluated biomarkers of oxidative stress and neurotoxicity in Rhinella arenarum larvae exposed to water samples from intake and drainage points. From these, we calculated an integrated biomarker response index, which negatively correlated with the WQI. We conclude that rice cultivation has significant multiscale impacts on the Bajo de los Saladillos ecosystems, underscoring the need for this diagnosis to inform environmentally sustainable rice production measures.

**Keywords:** Agrochemicals, Argentina, ecotoxicology, land use change, remote sensing, rice fields

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