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Land clearance and long-term changes in the water balance in semiarid Niger 1 – Evidence of increased runoff using aerial photographs

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In the rain-fed agricultural belt of the Sahel, for the past decades, a lasting rainfall deficit and one of the world's highest population growths have resulted in a dramatic land cover change. Using a normalised mosaics set of aerial photographs dating back from 1950 over a 500 km^2 area in southwest Niger, land cover and hydrological changes were quantified. For the 1950 – 1992 period, the whole landscape was significantly cleared, first to extend the millet field area and secondly for firewood supply. By 1975 and 1992, land clearance had affected respectively 23% and 87% of the sandy slopes, with similar figures obtained for the other landscape units. These observations indicate an accelerated loss in the woody savannah that could not be recovered on the short term. For the same period, aerial photographs show a 157% increase in the drainage density with the development of larger drainage systems and new ponds. These changes highlight a long-term increase in surface runoff production, and indicate that land clearance had a stronger effect on the water balance than the rainfall deficit. The drainage network density appears to respond quasi immediately to land clearance; however a time-lag of a few decades is observed for the connectivity of the drainage network. As the annual rate of land clearance increased for the past century, its main hydrological effects may not yet be fully perceptible. These results imply a long-term effect of land clearance on several key parameters (e.g., albedo, LAI) known for their possible feedback on the West African monsoon dynamics.