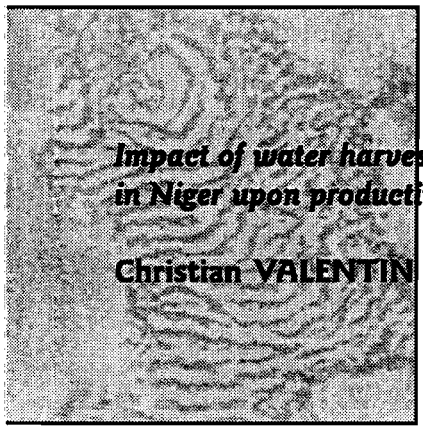

Impact of water harvesting variations along a climatic transect in Niger upon productivity and patterns of tiger bush

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Banded patterns of vegetation have been recognised in many arid and semi-arid regions of the world, notably in West Africa where they are known as "tiger bush". They consist of bands of trees alternating with bands of bare soil. These vegetation stripes run parallel to the contour on virtually flat to gently sloping surfaces, as the most effective intercepting arrangement of dispersed runoff. The sequential pattern of runoff, interception, and run-on zones in this landscape constitutes a natural water harvesting system. This pattern is expected to differ across space and time, as driven by global change forces like climate change and increased human pressure. The objective of this paper are (i) to analyse the variations of the tiger bush patterns as influenced by major factors, e.g. slope gradient and surface features along a climatic transect; (ii) to test a model of vegetation productivity based on surface water redistribution; (iii) to simulate the possible impact of global change in terms of climate and land use.

The transect has been selected on a series of Panchromatic SPOT images covering a 60 km x 200 km band from the vicinity of the W Game Park in southern to the region of Ouallam, near the Mali boarder. The mean annual rainfall ranges from 300 mm in the North to 700 mm in the South. Fifteen typical sites of tiger bush were identified on the satellite images and surveyed in the field. In each site, one to three transects were sampled including three bands and interbands. Major variables were slope gradient, soil surface conditions, e.g. soil crust types, litter, faunal activity, vegetation type, structure and density. The hydrological model used to simulate runoff from the bare bands and infiltration in the vegetation bands was based on the typology of surface features of Casenave and Valentin (1992).

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This study led to the identification of the combined climatic and topographic boundary conditions for tiger bush occurrence. For a given slope angle, dryer conditions result in narrowing of the vegetation band and a consecutive extension of the bare interband. The late stage sees the vegetation reduced to a series of aligned dashes increasingly surrounded by bare surfaces. Conversely, at the wet margin of the zone of occurrence, bare areas tend to be restricted to more or less circular crusted spots, often related to termite mounds. In a given location, patterns range from broad bands on nearly flat land (0.2%) to small "dashes" on steeper slopes (1.5%). Along the climatic transect crust types are also primarily controlled by slope gradient. Satisfactory relations were obtained between simulated infiltration in the vegetation band and assessed biomass, except where human disturbance was too severe. The difference between expected and assessed biomass indicated the importance of human use of the tiger bush. Simulations clearly showed that climatic change would have a minor impact on vegetation productivity compared to increased human pressure. Management strategies are proposed accounting for landscape hydrological processes as influenced by topographic, climatic and crust conditions.