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Hydrological Gradients in a Tanzanian Floodplain: The Potential Use of Indicator Plants for Bio-Monitoring

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Abstract

While flooding periods curtail cultivation, extended soil moisture availability during dry seasons makes flood plains and riparian environments suitable for seasonal cropping and other agricultural uses. Unsustainable cultivation practices coupled with the establishment of drainage structures can however result in degradation of soil physical properties and hence overall soil water availability. This can consequently result in productivity decrease of agro-ecosystems. Also from the ecological point of view, altering hydrological regimes of floodplains can lead to disruption of habitat integrity for living organisms. Thus, implementation of bio-indication using vascular plants may provide a practical tool for quick assessment of degradation status of wetlands in large areas. In order to evaluate the potential capacity of vascular plant species for bio-monitoring, we assessed the shallow groundwater regime of a hydrological gradient in the floodplain of the Kilombero River around Ifakara (Tanzania). The area is mainly characterised by rice cultivation. Four hydrological indices were calculated from shallow groundwater monitoring time series data (March 2015 to June 2016) from 10 piezometers located along the hydrological gradient in the floodplain. These indices describe the overall shallow groundwater availability, their variability, flooding intensity and duration. Vegetation samples were collected in the proximity of piezometers and linked to the respective hydrological variables. The prevalence (optimum growth conditions) of the recorded species along hydrological gradients was estimated by weighted averaging. While dynamics of shallow groundwater table is complex and difficult to reduce to one variable without losing information, flooding regimes showed a clear positive linear relation between duration and intensity. Flooding duration is therefore a good proxy of flooding regimes, especially in sites without installed flooding monitoring devices. Though most of the species had an optimum around intermediate hydrologic conditions, some species may indicate different combinations of levels such as general low water table regimes with strong fluctuations (e.g. *Panicum fluviicola* and *Heliotropium indicum*) or high, more stable regimes (*Acmella uliginosa* and *Ammannia baccifera*). Similarly there is a continuous sequence of species indicating low flooding intensity and short flooding periods (*Eragrostis ciliaris* and *Indigofera hirsuta*) to higher flooding intensity for longer periods (*Ethulia paucifructa* and *Persicaria senegalensis*).

Keywords: Croplands, ecological modelling, land use, plant ecology

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