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## The Scale Issues in Assessing Matter Fluxes and Balance In/out Agro-Ecosystems

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### Abstract

Define the boundaries of the agro-ecosystem and that of its components, and precise the time step considered when assessing matter fluxes within, or in-and-out, agro-ecosystems seem common sense. Unfortunately, it is not systematically done, often just because it is felt trivial and remains implicit, or because of complex interactions between intervening processes organised at various spatial and temporal scales.

Recent attempts to assess C, N, P, and sometimes K, fluxes and to calculate their balances in savannah agro-ecosystems of South Saharan Africa have implicated both, the multi-scale pattern of heterogeneity of the natural resource, and the multi-layered pattern of land use and tenure systems. High local diversity is related to geomorphologies inherited from alternant arid and humid periods during the quaternary and their impact on rain and nutrient redistribution in the landscape. Contrasts are enhanced by the strength of single-season tropical rainfalls, and by the selective land-use. Farm-household and village communities constitute the main scales at which natural resource management and agriculture production are organised. However, the geographical attributes of these scales are not straightforward. Indeed, property rights in rural areas largely bear on the traditional usufruct and access rights attached to the different products and not to the land. The rights to crop are generally separated from the rights to manage and use grazing resources, including those of the stubbles, and also separated from gathering rights that may differ with the product gathered. Grazing rights are communal, spatially organized from key resources: water points, livestock path and resting spots. They are not exclusive and are organised through calendar and priority access negotiated between stakeholders.

The challenging overlay of complex and dynamic land use pattern over heterogeneous landscapes is now eased by the development of GIS software. Because of different time scales and many decision makers involved in the management of natural resource GIS are associated with mathematical modelling to assess matter fluxes and balances. The performances and limits of GIS and mathematical models to solve the scale issues in these assessments are discussed and recommendations made for further developments.

**Keywords:** Matter fluxes, agro-ecosystem, land use pattern, GIS