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Review

# Sustainable rice production in African inland valleys: Seizing regional potentials through local approaches

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ABSTRACT

With an estimated surface area of 190 M ha, inland valleys are common landscapes in Africa. Due to their general high agricultural production potential, based on relatively high and secure water availability and high soil fertility levels compared to the surrounding uplands, these landscapes could play a pivotal role in attaining the regional objectives of food security and poverty alleviation. Besides agricultural production, i.e. mainly rice-based systems including fish-, vegetable- fruit- and livestock production, inland valleys provide local communities with forest, forage, hunting and fishing resources and they are important as water buffer and biodiversity hot spots. Degradation of natural resources in these vulnerable ecosystems, caused by indiscriminate development for the sole purpose of agricultural production, should be avoided. We estimate that, following improved water and weed management, production derived from less than 10% of the total inland valley area could equal the total current demand for rice in Africa. A significant part of the inland valley area in Africa could hence be safeguarded for other purposes.

The objective of this paper is to provide a methodology to facilitate fulfilment of the regional agricultural potential of inland valleys in sub-Saharan Africa (SSA) such that local rural livelihoods are benefited and regional objectives of reducing poverty and increasing food safety are met, while safeguarding other inland-valley ecosystem services of local and regional importance. High-potential inland valleys should be carefully selected and developed and highly productive and resource-efficient crop production methods should be applied. This paper describes a participatory, holistic and localized approach to seize the regional potential of inland valleys to contribute to food security and poverty alleviation in sub-Saharan Africa. We analyzed over a 100 papers, reference works and databases and synthesized this with insights obtained from nearly two decades of research carried out by the Africa Rice Center and partners. We conclude that sustainable rice production in inland valleys requires a step-wise approach including: (1) the selection of '*best-bet*' inland valleys, either new or already used ones, based on spatial modelling and a detailed feasibility study, (2) a stakeholder-participatory land use planning within the inland valley based on multi-criteria decision making (MCDM) methods and using multi-stakeholder platforms (MSP), (3) participatory inland-valley development, and (4) identification of local production constraints combining model simulations and farmer participatory priority exercises to select and adapt appropriate practices and technologies following integrated management principles.



**Contents**



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## 1. Introduction

Inland valleys can be defined as seasonally flooded wetlands comprising valley bottoms (*fluvial*) and hydromorphic fringes (*phreatic*) but excluding river flood plains (Fig. 1; Table 1). With an estimated land area of 190 M ha (FAO, 2003) inland valleys are abundantly available in Africa and serve a multitude of ecosystem functions. Inland valleys, in particular the valley bottoms – *bas-fonds*, *fadamas*, *inland swamps* in West Africa; *mbuga* in East Africa and *vleis*, *dambos*, *mapani*, *matoro*, *inuta* or *amaxhaphozi* in Southern Africa according to Acres et al. (1985) – generally have a high agricultural production potential due to their relative high and secure water availability and soil fertility (Andriesse et al., 1994). The hydromorphic slopes of the inland valleys are often used for dryland rice and cash crops like cotton, while the upper slopes, with lower groundwater levels (Fig. 1), are often grown by high value fruit trees, like mangos and cashew nut, and fodder crops (Balasubramanian et al., 2007), and the crests by maize or sorghum (e.g. Lawrence et al., 1997). The ground cover provided by these trees and crops on higher parts of the slope reduces soil run-off towards the hydromorphic slopes and valley bottom (e.g. de Ridder et al., 1997; Rodenburg et al., 2003). The only major food crop that can be grown under the temporary flooded conditions of these valley bottoms is rice (e.g. Andriesse and Fresco, 1991). Depending on the species (*Oryza sativa* or *Oryza glaberrima*), sub-species (*japonica* or *indica*) and cultivar, this crop can be grown along the upland – lowland continuum (e.g. Saito et al., 2010). The development of inland valleys into rice-based production systems, can be accomplished with relatively small-scale technologies that would require moderate investments (Roberts, 1988). For this reason, inland valleys, comprising such huge and yet largely unexploited area, are strategically important for the development of the African rice sector (e.g. Sakurai, 2006; Balasubramanian et al., 2007).

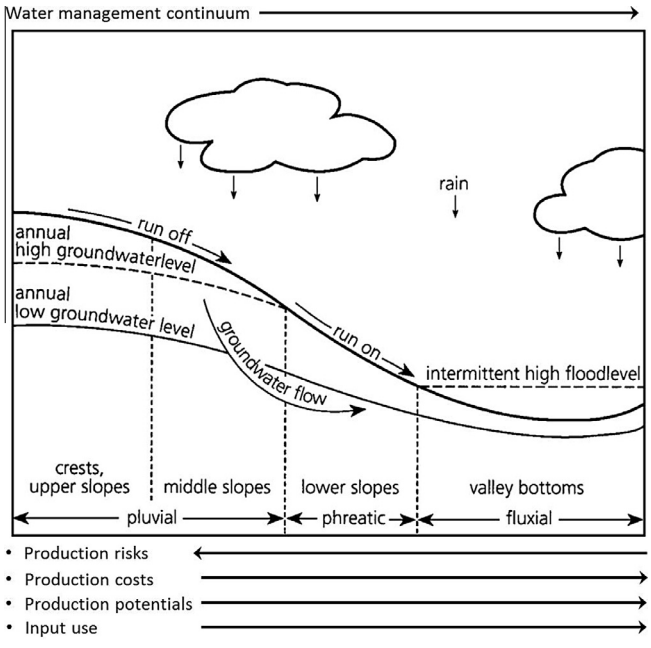


**Fig. 1.** Schematic landscape presentation of rice production environments along the upland – lowland continuum, and their hydrological regimes (Adapted from: Windmeijer and Andriesse, 1993).

Wetlands, such as inland valleys, are particularly important assets for the rural poor as they can fulfil many services (Turner et al., 2000). Apart from agricultural production, these ecosystems supply local communities with a range of goods, including hunting, fishing, forest and forage resources (e.g. Roberts, 1988; Scoones, 1991; Adams, 1993) and they are local hot-spots for biodiversity (Chapman et al., 2001). As different inland-valley ecosystem functions may conflict with agricultural objectives, and because there are large area-specific differences in development suitability and risks, indiscriminate development should be avoided (McCartney and Houghton-Carr, 2009). Ecosystem functions of inland valleys, such as biodiversity and water buffering, are affected when inland valleys are used for agriculture. Where developments are implemented without proper impact assessments, they can negatively affect local livelihoods and environments (e.g. Whitlow, 1983). Indeed, aligning food production with biodiversity conservation is an important future challenge for agronomic and environmental research (Verhoeven and Setter, 2010). Following the above, the central aim of this paper is to develop an approach to fulfil the regional agricultural potential of inland valleys in sub-Saharan Africa (SSA) such that local rural livelihoods are benefited and regional objectives of reducing poverty and increasing food safety are met, while safeguarding other inland-valley ecosystem services of local and regional importance.

A number of useful frameworks have recently been proposed to characterize wetlands for their agricultural and ecological potentials in order to make informed decisions on their use (e.g. McCartney and Houghton-Carr, 2009; Kotze, 2011; Sakané et al., 2011). As a step forward compared to earlier methods specifically targeted to inland valleys, such as the ones proposed by Andriesse and Fresco (1991) and Andriesse et al. (1994) that were primarily based on biophysical and land use characterizations, these approaches combine biophysical with socio-economic characteristics. The next step forward is to integrate these characterizations in a comprehensive methodology, supported by appropriate tools, that runs from selection of the most suitable inland valley for agricultural production to the actual development and eventually to sustainable management practices. Such methodology should also provide guidelines on how to ensure participation of local stakeholders in all these stages. The current paper, focussing specifically on sustainable realization of the inland-valley potential for rice-based production systems, attempts to do just that, as we believe that for the sustainable development of these ecosystems, the site selection, land use planning and design, development and resource