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Alternative Landscapes to Face Land and Energy Scarcity: Case Study in Sudanian Savannah of Ghana

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Abstract

Despite steady economic growth, sub-Saharan Africa faces major challenges to develop its bio-economies due to stagnating or even decreasing efficiency in the conversion of environmental resources into socio-economic goods. Many regions of the continent experienced no improvement in terms of nutrition security and hunger alleviation over the last 20 years. There is potential to raise yields significantly but the commercial balance of most African countries hardly allows to undertake the required measures. Therefore, we hypothesise that the path of development followed in the biomass production sector has been so far unsustainable. We propose to concentrate efforts on changes in landscape configuration to maximise the benefits obtained from the potential of nature to sustain biomass provision. We simulated data for each of the main agricultural and woody land use types of the interior savannahs of West Africa under different management techniques, on their capacity to provide biomass products and maintaining ecosystem functions, complemented by a holistic energy balance assessment that includes human and animal labour inputs, as a key measure of sustainability. The results have been stored in the database of a land use change model used to create different landscape scenarios over a fine-resolution land use map. The potential of the current land use pattern to satisfy present human calorie intake requirements is sufficient, but some micro-nutrient shortages are found, particularly acute in the case of vitamins. Future demands of calorie intake will most likely be attained by further agricultural expansion, which will imply a reduction of vegetation cover, including clearing of woodlands to satisfy fuel demands. No alternative land use pattern will provide nutritious enough food unless significant improvements in the irrigation systems are achieved. The potential of promising crops, such as maize, to enhance food and nutrition security is limited, unless mineral fertiliser application increases 5- up to 10-fold beyond current levels, due to their poor performance on the available (low) fertile lands. Furthermore, a trade-off exists between increasing rainfed agriculture yields to desirable levels and water available for irrigation. We provide recommendations regarding cropping systems that enhance the sustainable production of food and fuel.

Keywords: Data envelopement analysis, emergy, trade off analysis

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