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Ecosystem management can mitigate vegetation shifts induced by climate change in African savannas

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The welfare of people in the tropics and sub-tropics strongly depends on goods and services that ecosystems supply. Flows of these ecosystem services are strongly influenced by interactions between climate change and land use. A prominent example are savannas, covering approximately 20% of the Earth's land surface. Key ecosystem services in these areas are fuel wood for cooking and heating, food production and livestock. Changes in the structure and dynamics of savanna vegetation may strongly influence local people's living conditions, as well as the climate system and biogeochemical cycles. We used a dynamic vegetation model to explore interactive effects of climate and land use on the vegetation structure, distribution and carbon cycling of African savannas under current and future conditions. More specifically, we simulate long term impacts of fire management, grazing and fuel wood harvesting. The model projects that under future climate without human land use impacts, large savanna areas would shift towards more wood dominated vegetation due to CO_2 fertilization effects and changes in water use efficiency. However, land use activities can mitigate climate change impacts on vegetation to maintain desired ecosystem states that ensure fluxes of important ecosystem services. We then use optimization algorithms to identify sustainable land use strategies that maximize the utility of people managing savannas while preserving a stable vegetation state. Our results highlight that the development of land use policy for tropical and sub-tropical areas needs to account for climate change impacts on vegetation.