

The El Niño –La Niña cycle and recent trends in supply and demand of net primary productivity in African drylands

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The human-environment connection in the mostly rural drylands of sub-Saharan Africa forms a complex, interlinked system that provides ecosystem services. This system is susceptible to climatic variability that impacts the supply of its products, and high population growth, which impacts the demand for these products. When plants remove carbon dioxide from the atmosphere through the process of photosynthesis, they use some of this carbon to maintain plant cellular structure. The rest is stored as plant tissue and forms plant biomass. The annual accumulation of this plant biomass is called net primary production (NPP). On an annual basis, NPP supplies the provision of crops, animal feed and pasture. The societal implications of reduced NPP can be severe, possibly leading to crop failure and eventual food insecurity. The trends in NPP supply trends over sub-Saharan Africa 2000 –2013 are significant in 32% of the area (4.7 million km²). However, these trends are concentrated in three distinct areas: the western Sahel (2 g C m⁻² yr⁻¹), central Africa (30 g C m⁻² yr⁻¹) and parts of Zambia, Malawi and Mozambique (-25 g C m⁻² yr⁻¹). In contrast, the mean overall trend in NPP demand is 3.5 g C m⁻² yr⁻¹, though in urban areas it averages approximately 50 g C m⁻² yr⁻¹. The tradeoffs between NPP supply and demand trends (i.e. change in one quantity relative to another) are locally constrained and linked to the prevailing climate, population growth and net migration. The demand-supply balance of NPP is influenced by climate, such as the variability caused by El Niño –Southern Oscillation. The greatest sensitivity to El Niño occurs in Southern Africa. Here, a +1°C shift in the Niño 3.4 index (as a measure of El Niño) causes a mean change in the NPP supply of -6.6 g C m⁻² yr⁻¹. Despite the fact that there were more La Niña events than El Niño events during the period of this study, the negative impact of El Niño on Southern Africa is strong enough to tip the balance toward the negative.

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