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The environmental sustainability of sugarcane cultivation under scenarios of climate change: case studies for Brazil and Ghana

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Over the next decades increasing oil and carbon prices will lead to a proliferation of energy crop cultivation initiatives. Many of these will be based in developing countries, and hence will affect some of the poorest people in the world. The capacity of such initiatives to alleviate poverty in the long term depends on their environmental sustainability. Specifically, the exploitation of water resources in an unsustainable manner may permanently damage vulnerable ecosystems and ultimately deepen poverty. These issues have motivated a collaborative project - Integrated Carbon, Water and Land Management for Poverty Alleviation (ICWALPA), which asks whether the export of bio-fuel technology from Brazil to Ghana will alleviate poverty. This presentation will describe the initial results from ICWALPA - including the development of an integrated environmental modelling framework and its application to sugarcane cultivation under scenarios of climate change. The environmental model used to represent the biophysical interactions is process-based and implemented in the framework of the Joint UK Land Environment Simulator (JULES). Crop growth is predicted dynamically by accumulating the carbon assimilated during photosynthesis and is then allocated according to well-established allometric principles.

Two contrasting case studies will be presented: the Sao Paulo region of Brazil (where there is an established sugarcane industry) and the Daka River region of Ghana (where commercial sugarcane cultivation is planned). We show that our model is capable of reproducing both the spatial and temporal variability in sugarcane yield for the Sao Paulo province of Brazil – lending credence to the projections for Ghana. For Ghana, we show that, providing there is sufficient irrigation, it is possible to generate approximately 75% of the yield achieved in the Sao Paulo province. In the final part of the study, the behaviour of sugarcane under an idealized climate change scenario is explored. It is shown that the increased drought tolerance that results from higher CO_2 concentrations mitigates the greater water stress associated with higher evaporation.