SupplementaryMaterials: Article

The Impact of Climate Change on Crop Production in Uganda—An Integrated Systems Assessment with Water and Energy Implications

Vignesh Sridharan, Eunice Pereira Ramos, Eduardo Zepeda, Brent Boehlert, Abhishek Shivakumar, Constantinos Taliotis and Mark Howells

1. Demand representation

In this study, we took into consideration the catchment specific water consumption in households and by livestock. The NWRA provided projected water use rates for urban and rural population until 2030 [1]. In this analysis, it is assumed that water use rates will reach 100 and 50 litres/head/day in urban and rural areas respectively, by 2050 (Table S1). Our assumption follows the NWRA's conservative projections. To identify the rural and urban population splits, the 100m resolution population density map of Uganda from WORLPOP was used [2]. A threshold of 1500 people/km^2 was used to differentiate the urban and rural areas. Population statistics from the Uganda-Bureau of Statistics (UBOS) was used to calculate the total catchment specific urban and rural population. The United Nation's urbanisation prospects [3] were used to project the urban and rural population shares until 2050, as illustrated in Figure S1. The model also takes into consideration the water consumed by livestock. The share of livestock by region (Table S2) obtained from UBOS (2015)[4] was used to calculate area-specific water demand. Water consumed by livestock varies by breed, whether they are lactating or not, average air temperature amongst other contributing factors. For this study, a water consumption relevant to the type of livestock found in Uganda and suitable air temperature was chosen [5].

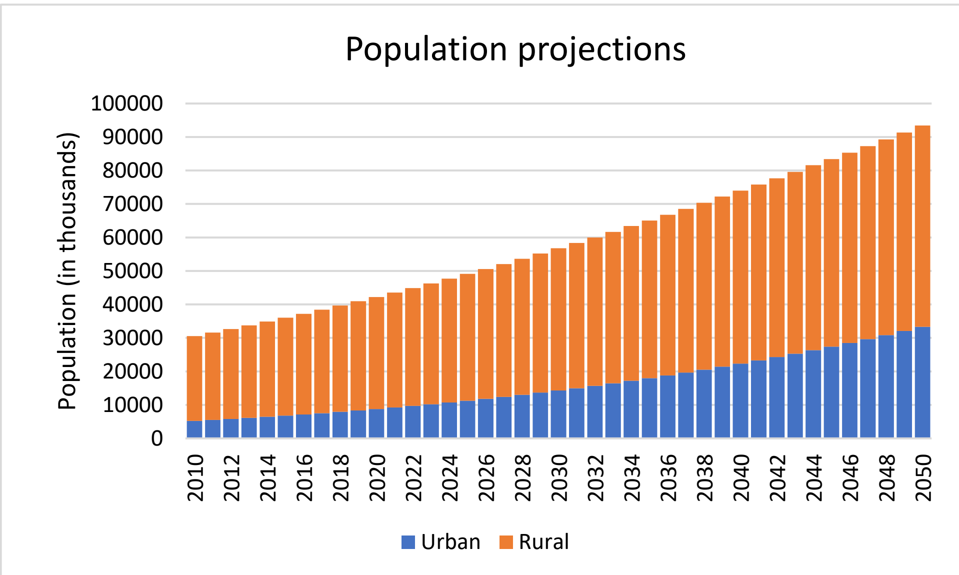

Figure S1. Population projections used in the WEAP model.

Table S1. Water consumption rates (litres/person/day).

Category	2010	2030	2050
Urban	46.8	50	100
Rural	21	22	50

Table S2. Livestock shares per region.

Region	Cattle	Pigs	Goats and sheep	Poultry
Central	21.65%	41.06%	12.35%	27.63%
Eastern	21.76%	21.97%	18.53%	28.79%
Northern	34.30%	12.52%	43.61%	24.38%
Western	22.29%	24.44%	25.51%	19.19%

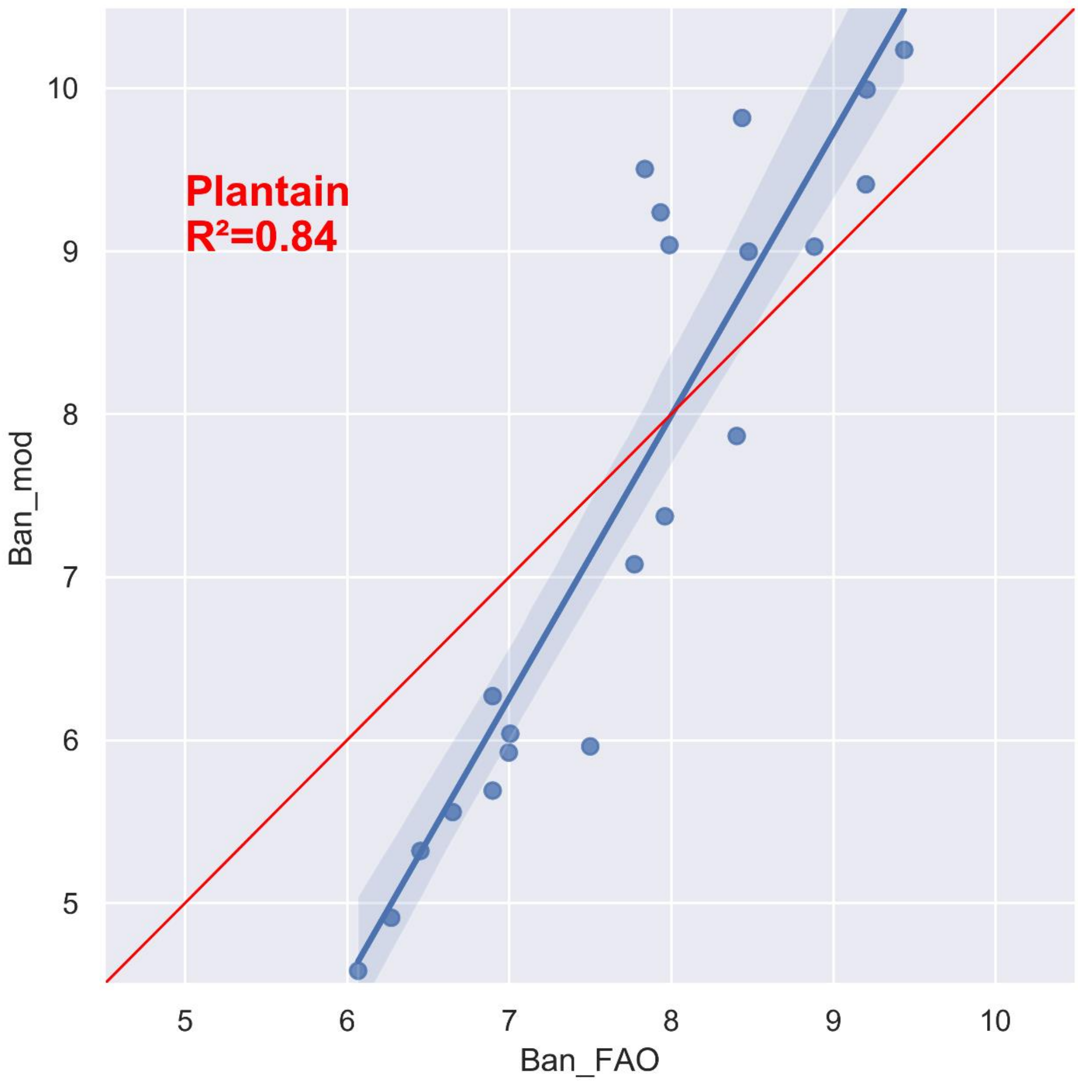

Figure S2. Calibrated model outputs vs FAO statistics for Plantains (Matooke Bananas)-in million tonnes.

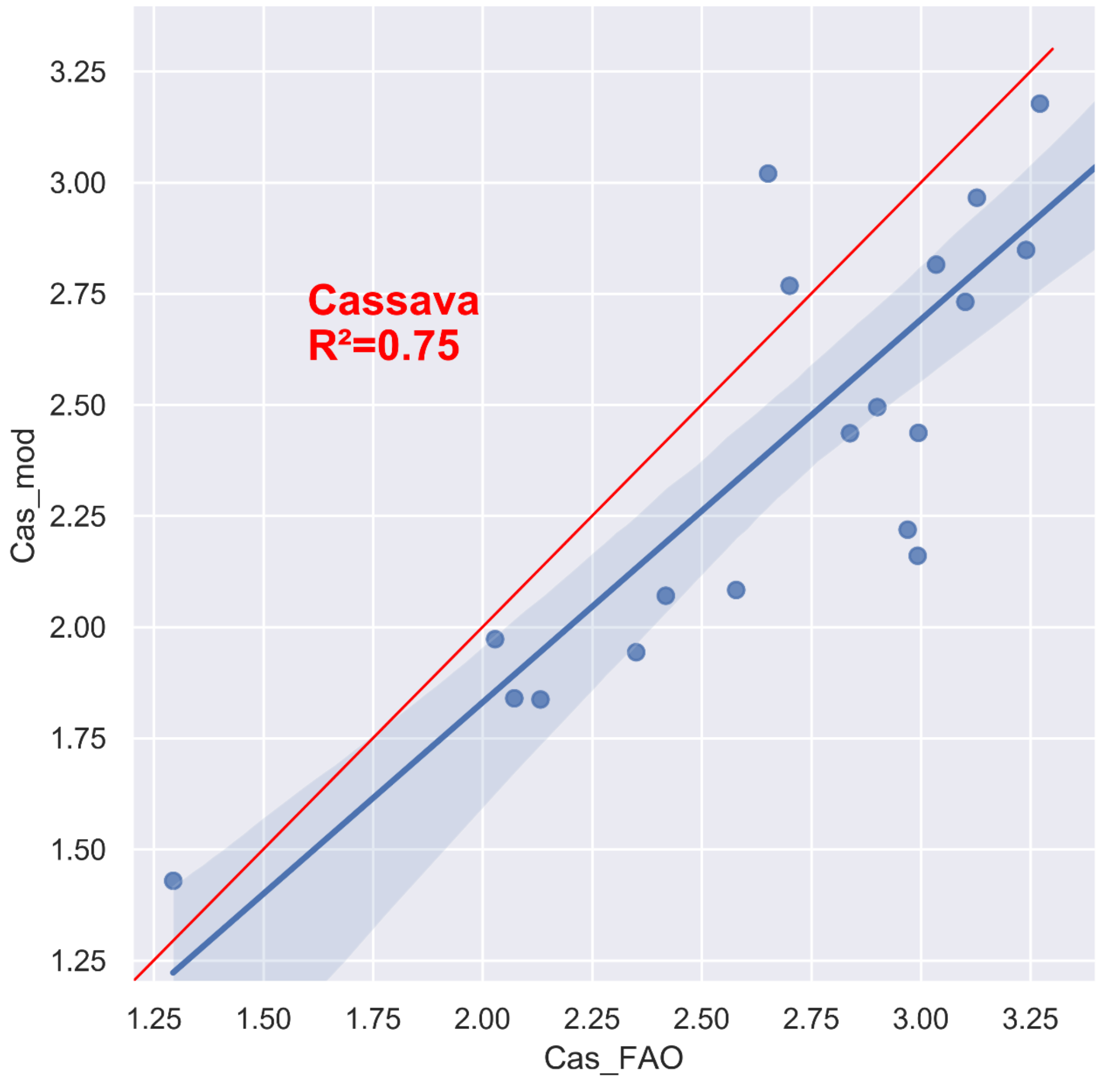

Figure S3. calibrated model outputs vs FAO statistics for Cassava in million tonnes.

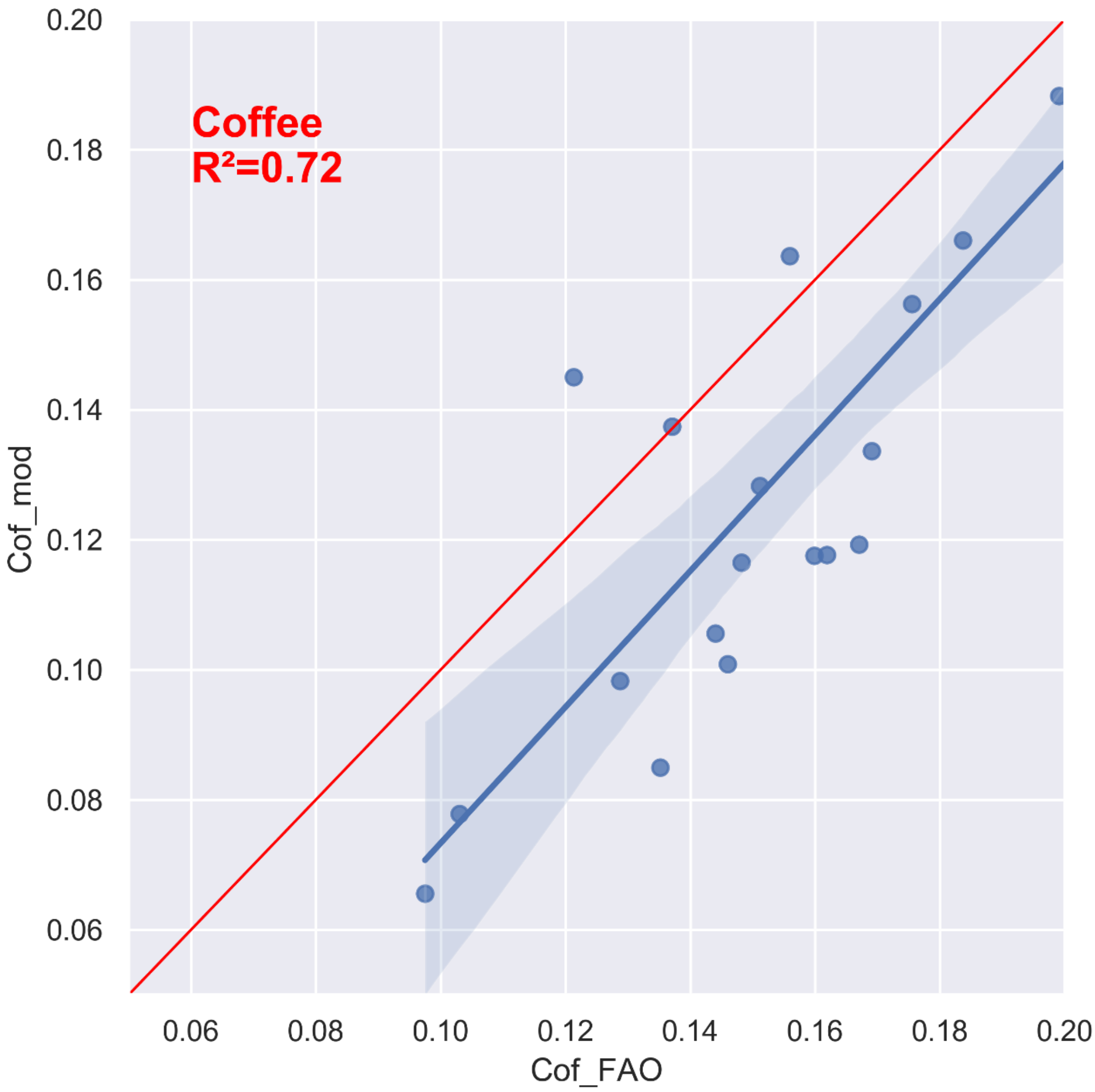

Figure S4. Calibrated model outputs vs FAO statistics for Coffee in million tonnes

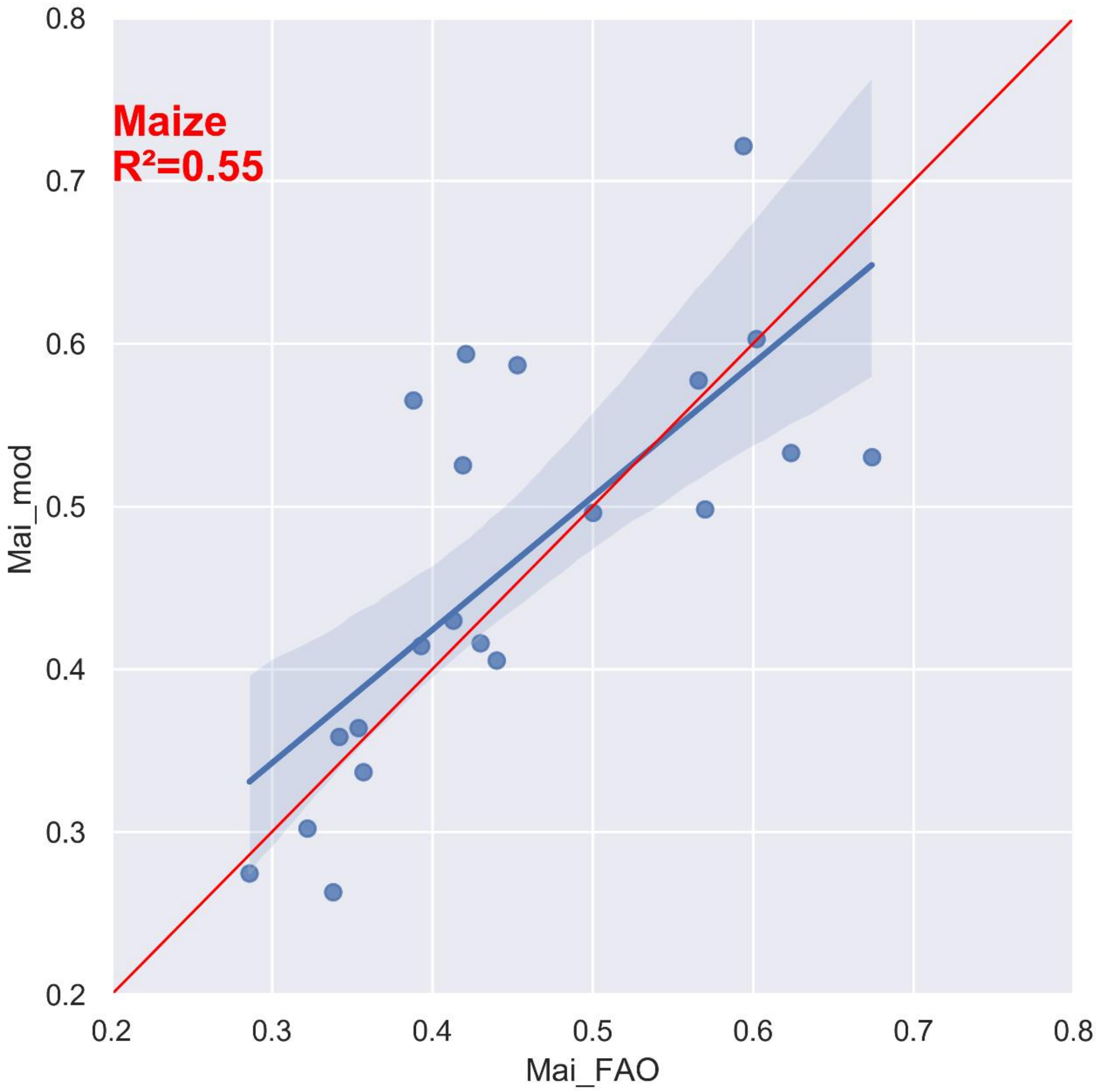

Figure S5. Calibrated model outputs vs FAO statistics for Maize in million tonnes.

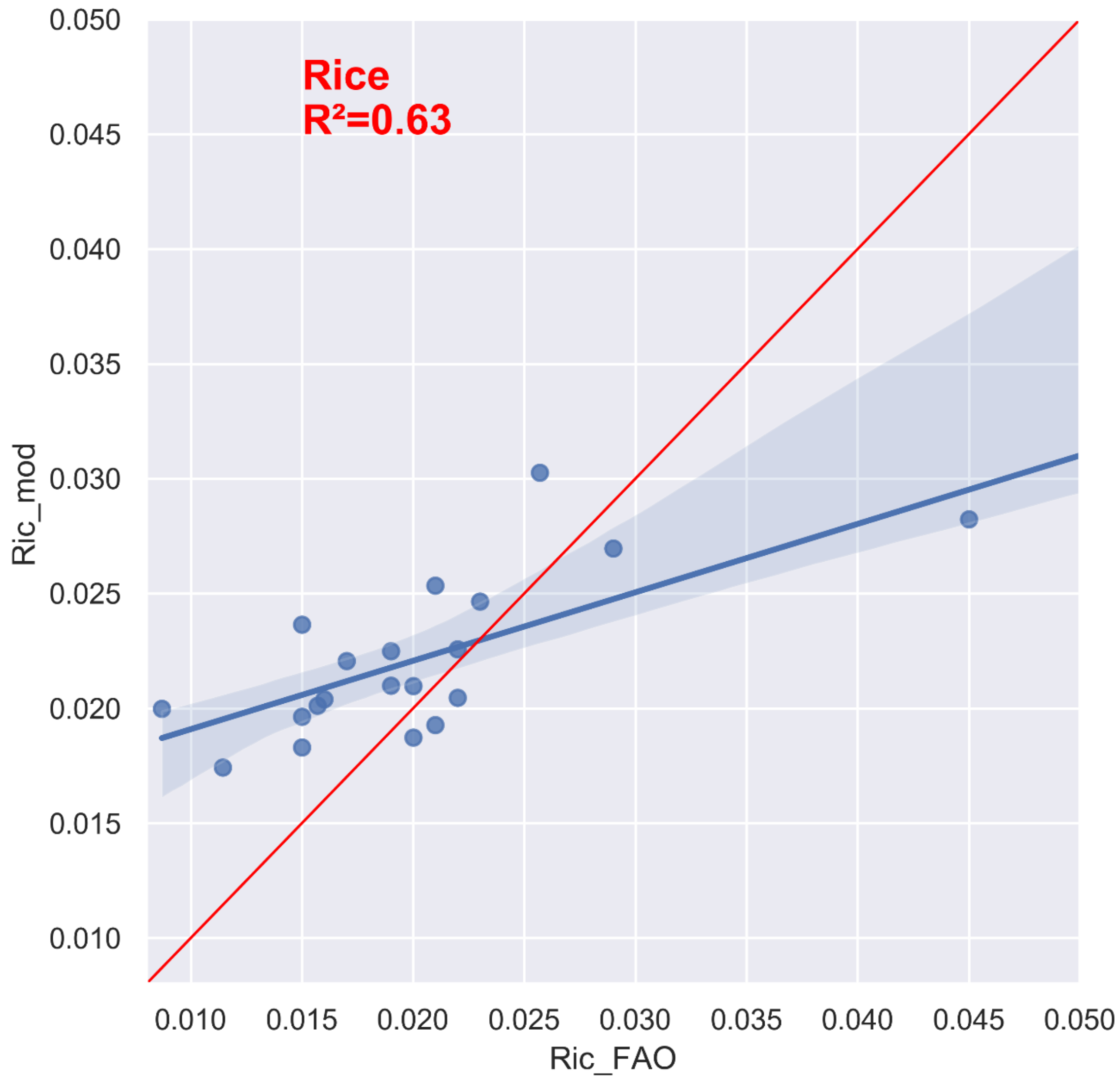

Figure S6. Calibrated model outputs vs FAO statistics for Rice in million tonnes.

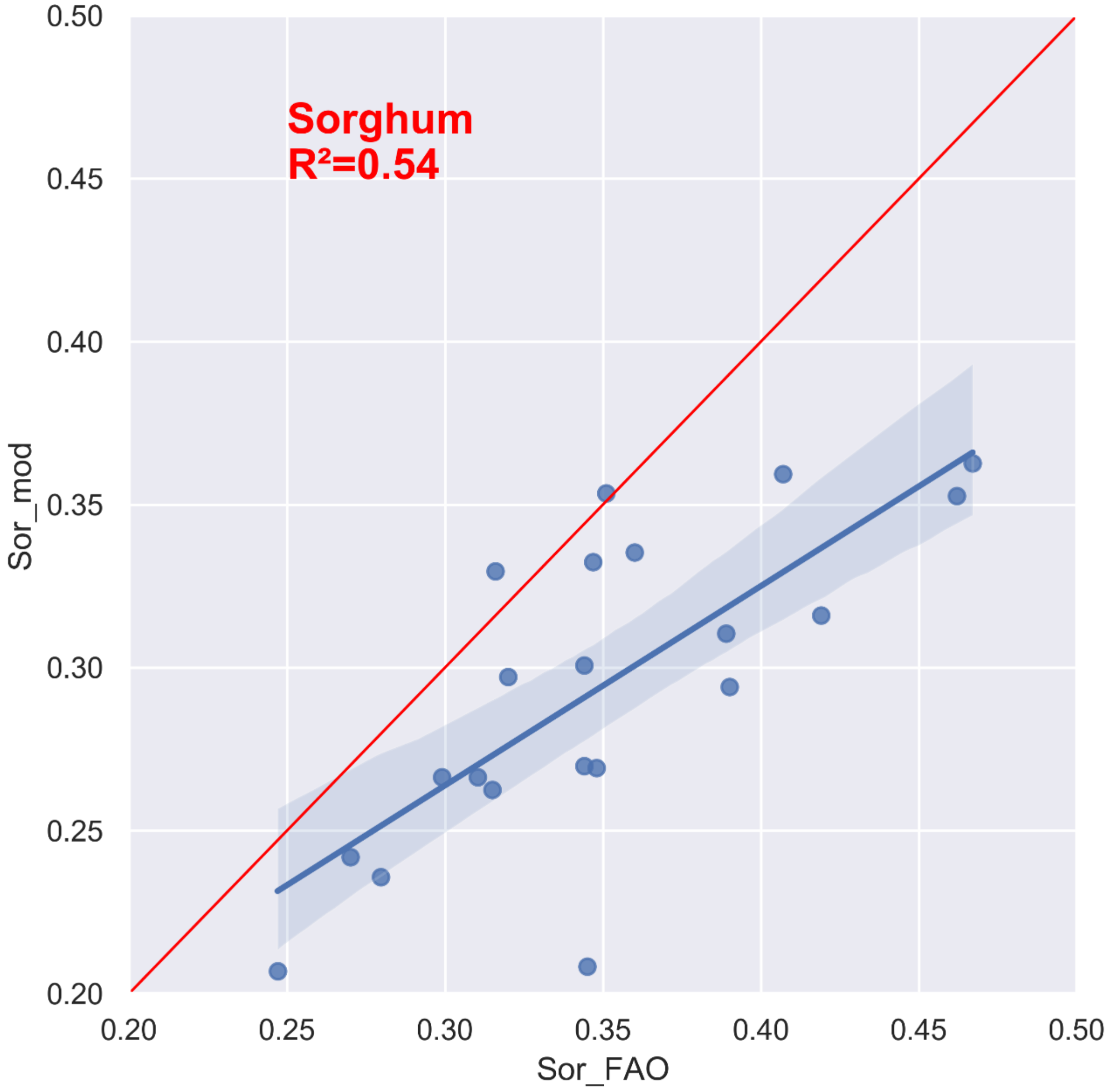

Figure S7. Calibrated model outputs vs FAO statistics for Sorghum in million tonnes.

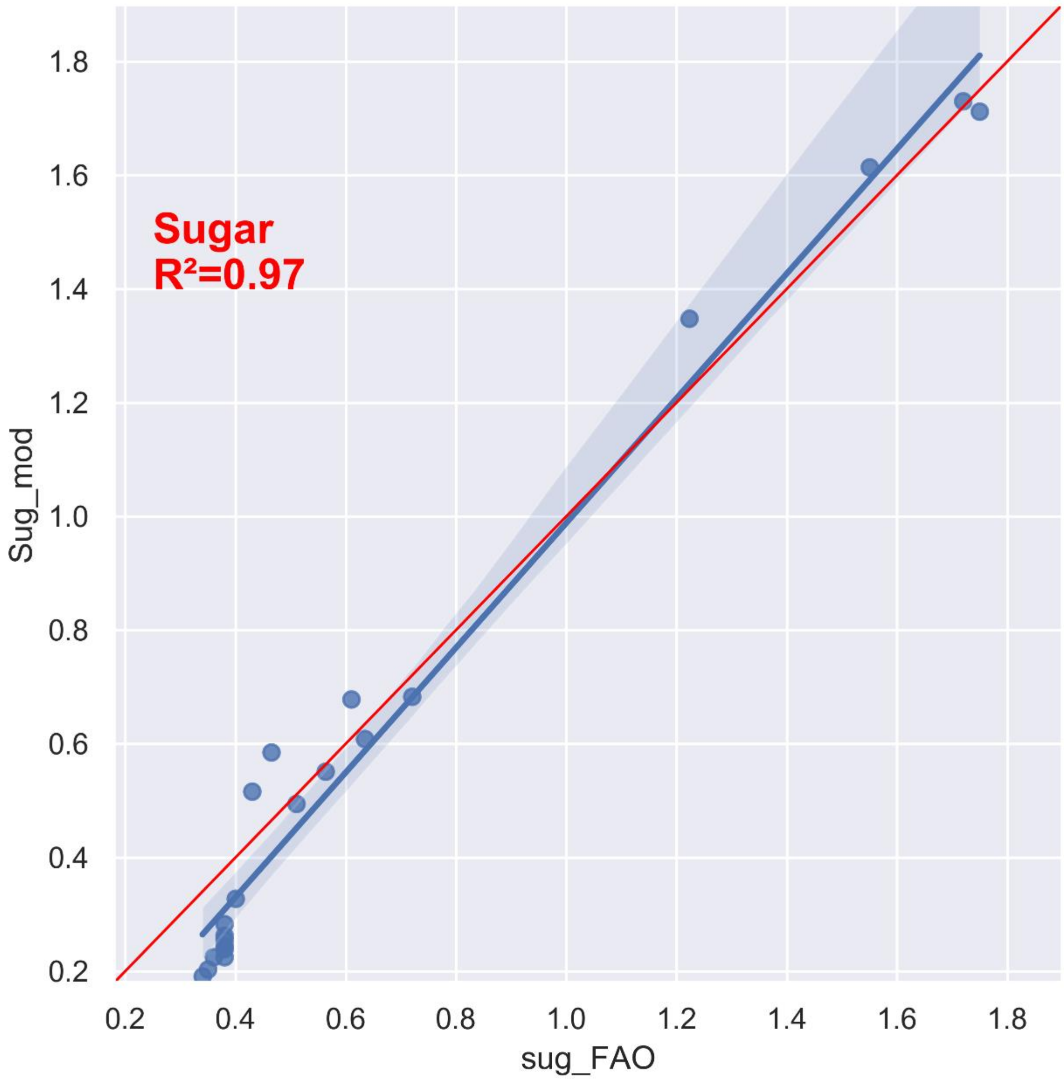

Figure S8. Calibrated model outputs vs FAO statistics for Sugarcane in million tonnes.

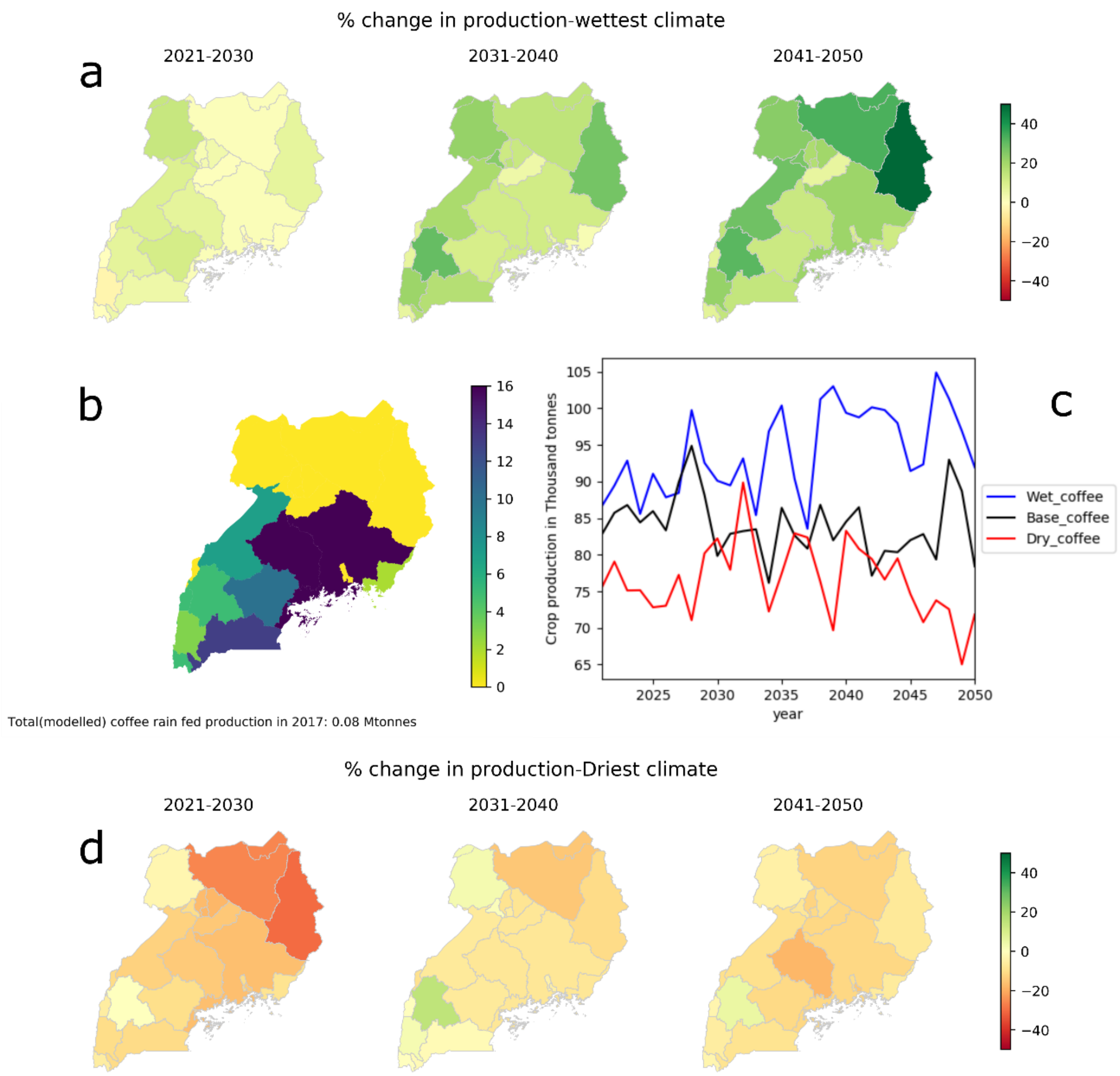

Figure 9. Climatic impact on Coffee production. Catchment specific differences in crop production in the (**a**) wettest and (**d**) driest climate futures and the reference scenario is presented. Total modelled (catchment specific) Coffee production (**b**) in 2017 is provided to differentiate high production zones from the rest. Parts **a** & **d** should always be interpreted in relation with part **b**. The line graph (**c**) provides the annual variation in Coffee production between the analysed climate futures on a national level. .

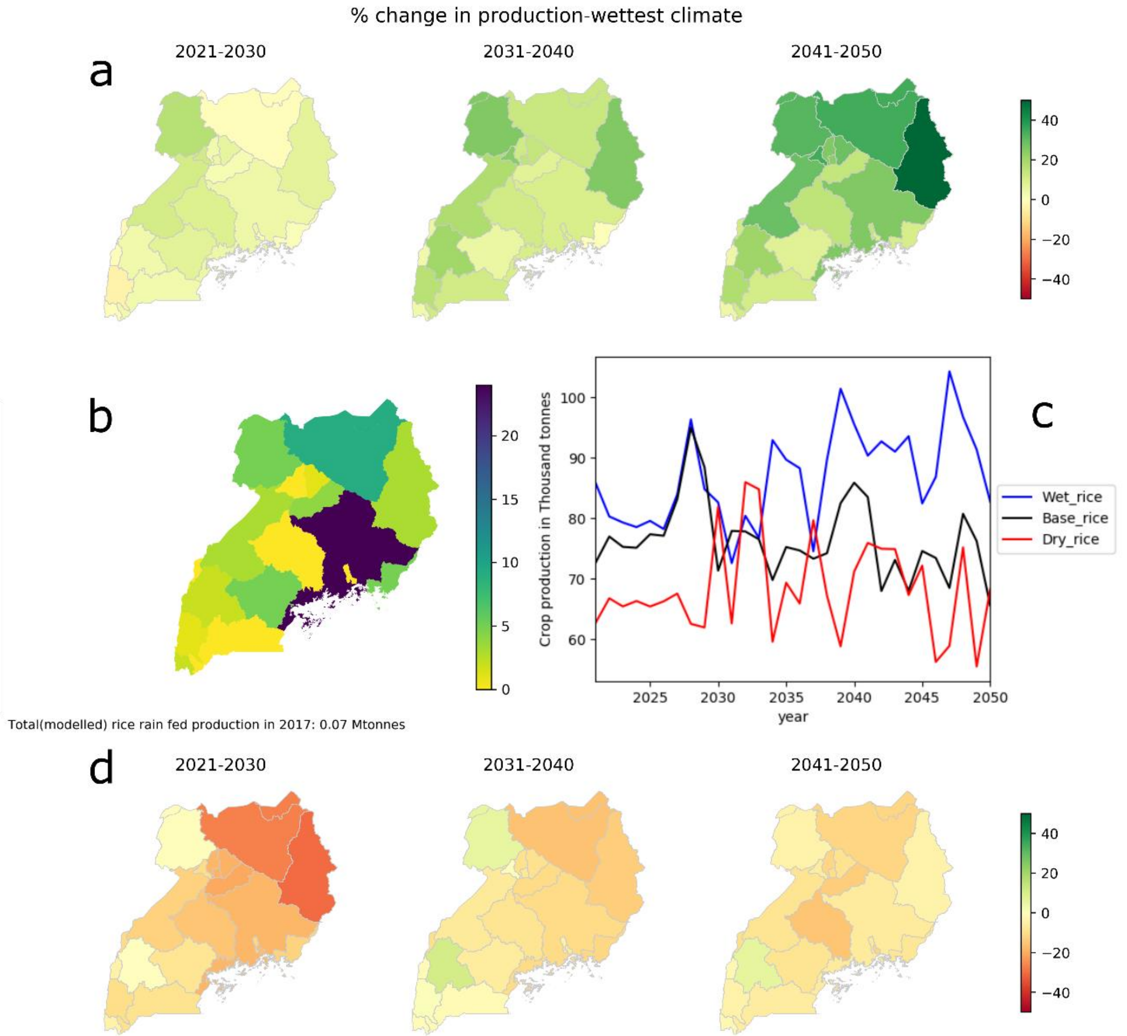

Figure S10. impact on Rice production. Catchment specific differences in crop production in the (**a**) wettest and (**d**) driest climate futures and the reference scenario is presented. Total modelled (catchment specific) Rice production (**b**) in 2017 is provided to differentiate high production zones from the rest. Parts **a** & **d** should always be interpreted in relation with part **b**. The line graph (**c**) provides the annual variation in Rice production between the analysed climate futures on a national level.

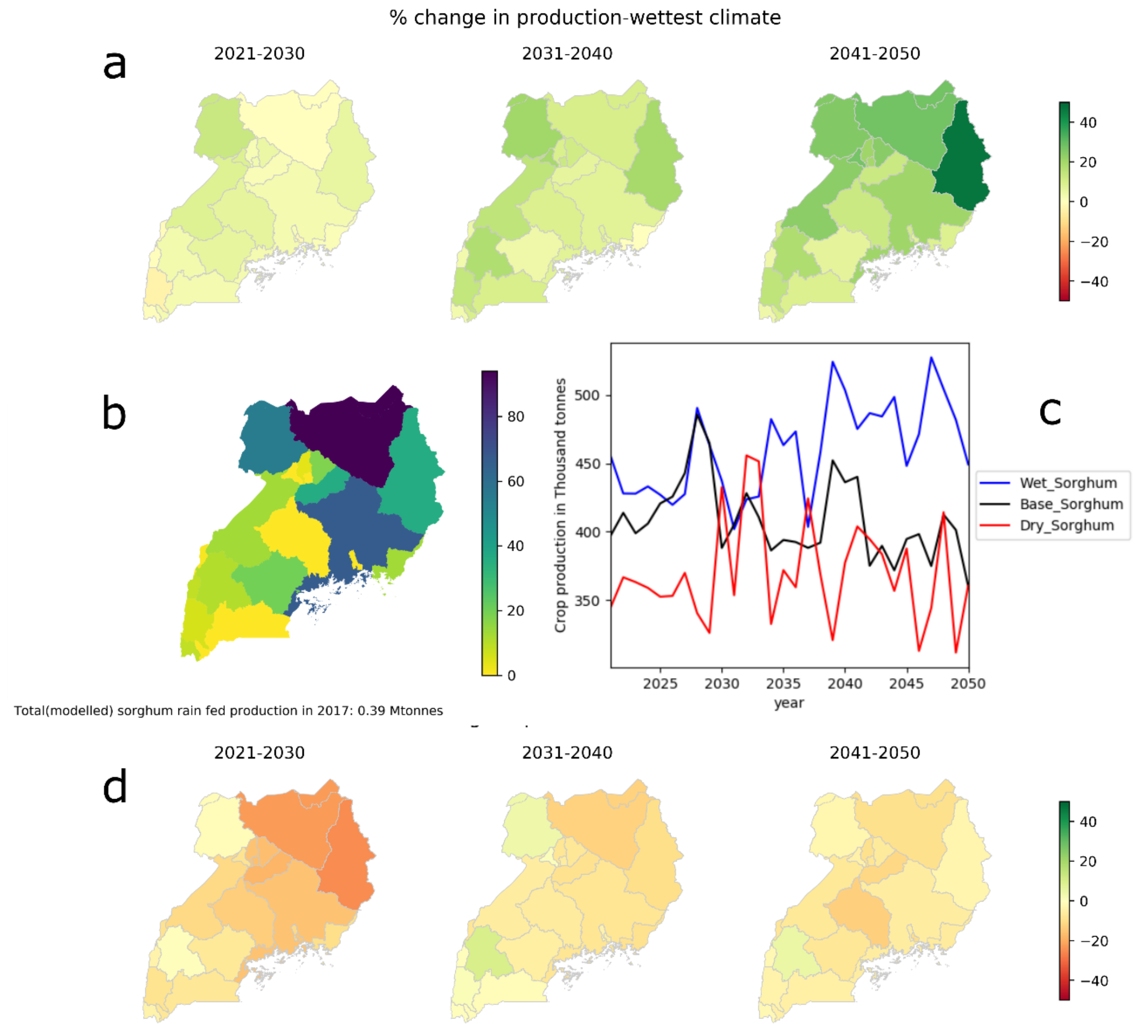

Figure S11. impact on Sorghum production. Catchment specific differences in crop production in the (**a**) wettest and (**d**) driest climate futures and the reference scenario is presented. Total modelled (catchment specific) Sorghum production (**b**) in 2017 is provided to differentiate high production zones from the rest. Parts **a** & **d** should always be interpreted in relation with part **b**. The line graph (**c**) provides the annual variation in Sorghum production between the analysed climate futures on a national level.

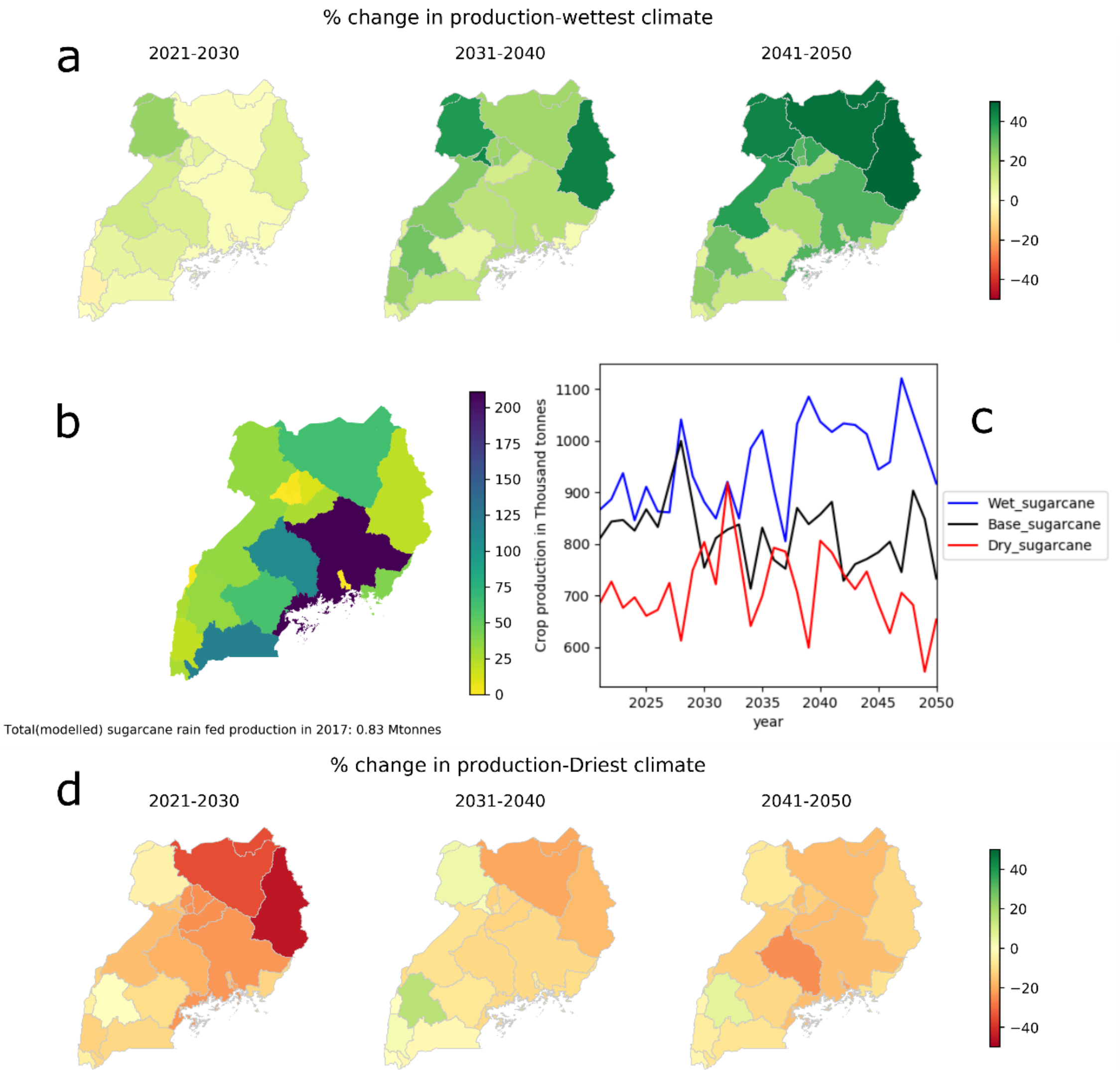

Figure S12: impact on Sugarcane production. Catchment specific differences in crop production in the (**a**) wettest and (**d**) driest climate futures and the reference scenario is presented. Total modelled (catchment specific) Sugarcane production (**b**) in 2017 is provided to differentiate high production zones from the rest. Parts **a** & **d** should always be interpreted in relation with part **b**. The line graph (**c**) provides the annual variation in Sugarcane production between the analysed climate futures on a national level.

Bibliography

1. MWE, "Uganda National Water Resources Assessment. Ministry of Water and Environment (MWE)," Kampala, Uganda, 2013.
2. Worldpop, "Uganda 100m Population." University of Southampton, 2013.
3. UNDESA- United Nations- Department of Economic and Social Affairs, "World Urbanization Prospects - Population Division-United Nations," 2017. [Online]. Available: https://esa.un.org/unpd/wup/CD-ROM/. (Accessed on 23 February 2017).
4. Uganda Bureau of Statistics (UBOS), "Statistical Abstract 2015," Uganda Bureau of Statistics, statistical Abstract, October. 2015.
5. H. Steinfeld, P. Gerber, T. Wassenaar, V. Castel, M. Rosales, and C. de Haan, "Livestock's long shadow," 2006.