Appendix 1. Additional images of study system showing recent Indigenous innovations. (Photo credits: Moses Ndlovu and Jon Solera)

Images of Indigenous management interventions

Figure 1 from the main paper also demonstrates one possible crop spatial configuration, in which the crops are largely grouped together, with remnant woodland area in the foreground and in the upper half of the image.

Figure A1.1 Maize production near Mudhomori village ("Crops" in our model)

Figure A1.2 A Muonde Trust project meant to enhance crop growth through water harvesting: a "Phiri pit" designed to increase infiltration of runoff into groundwater ("Crop Innovations" in our model)

Figure A1.3 Ploughing crops using livestock for draft power – necessary for planting

Figure A1.4 A hungry cow which may try to eat crops

Figure A1.5 Cutting down woodland biomass in order to make brushwood fences to keep hungry livestock out of crops.

Figure A1.6 A brushwood fence meant to keep hungry livestock out of crops

Figure A1.7 A stone wall which will not need to be replaced, in contrast with a brushwood fence ("Stone Walls" in our model)

Figure A1.8 Some parts of the woodland grow faster than others, referred to as 'key resources' in Scoones (1989) ("Preserve Forest" in our model).

A note on increased rainfall variability in the model and in Mazvihwa

Higher year-to-year rainfall variability in our model results in lower persistence and lower annual harvest, regardless of the number of interventions or the definitions of persistence thresholds. Because the high-variability rainfall scenario had the same mean as the historical rainfall distribution, this result indicates that the management strategies depicted in the model are not enough to average good years across bad. However, there is an important subtlety in the system's ecology that we did not represent: the real system thrives on variable rainfall, with plants germinating in times of abundant water and then persisting through times of drought. That said, the kind of increasing year-to-year variability triggered by climate change could still harm the ecosystem as well as the people, as it does in the model, if droughts become longer than they have been historically. In the real system, too, within-year rainfall variation is likely to be even more important in impacting sustainability success by any measure (this level of complexity was unfortunately beyond the scope of our modeling). Increasing within-year variation in rainfall has already pushed the system towards erosive events followed by dry periods in which nothing can be planted.

Muonde's Indigenous agricultural innovations (which we have implemented in the model simply as increased crop growth regardless of rainfall) include building water harvesting structures designed to retain precipitation on the landscape and improve groundwater infiltration. Vegetated contour ridges interrupt flashy runoff from large storms, reducing erosion and extending the growing season, and "Phiri pits" (named after renowned water harvester Zephaniah Phiri Maseko, Witoshynsky 2002) are deep reservoirs which help to recharge groundwater and potentially retain moisture for longer than a single growing season, a strategy for reducing the impacts of drought years. Muonde's water harvesting projects could therefore become critical for buffering the community against both within-year and between-year variation in rainfall.

LITERATURE CITED

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