General comments

The paper addresses relevant scientific questions within the scope of BG, here plant-animal-soil interactions between rangelands and cropping areas. Management strategies derived from scientific results are much needed as conflicts between farmers and herders are increasing in many Savannahs. Novel concepts are presented, in this case the coupling of a plot-scale agronomic plant-soil model with a landscape-scale vegetation model. The paper is written fluently and is well structured.

As the model has not been calibrated and validated on site and given that there are few significant differences between modelled scenario outputs, the innovations (coupling, landscape scale, rangelands) and their added value for the model should be emphasized. This information is given, but rather hidden in Supplement B. Grazing rules are the linkage between the two (crop and vegetation) models and should be prominently explained in the Methods section (otherwise this info is missing to understand the feed gap section). Supplement B (walking distances etc) also explains the spatially explicit nature of the model, which is necessary for the landscape aspect highlighted in the title.

As scenarios are hypothetical, they should have been chosen such that differences in model outcomes are clearer. The inclusion of fire events further blurs results, so that effects can be less clearly attributed to certain management.

Specific comments

Title and Abstract:

- Should the Title not indicate more clearly that this is a modelling study?
- The Abstract should highlight some of the findings related to ESF / ESS and landscape level, which are emphasized in the title
- Line 9: Please describe the current management in a few words (crop-livestock); do scenarios (ii) and (iii) include grazing access to crop lands? “Dry-season crop residue grazing substantially reduced feed deficits” – which scenario does this refer to?
- Were “targeted irrigation” and “off-field residue feeding” tested in the scenarios? If not, it might be better to describe the model outcomes in more detail instead.
- How are the impacts on “selected ecosystem services”, implied by the title, represented in the abstract? Are yields and fodder supply seen as ESS? How about soil C, and soil water contents, which are also shown in the results section?

Introduction:

- A number of ecosystem functions and services are mentioned here (as would be expected from the title), but these are not reflected by / discussed in context with the model scenarios. E.g. run-off, soil erosion, evaporation, species diversity.
- How are ESS and ESF defined in this paper? Are agronomic measures (yield, biomass, LAI) also considered ESS / ESF?
- It is explained that APSIM represents the croplands and the DGVM the rangelands, but how are the animals represented? Is livestock represented in a process-based manner, i.e. including feedback between fodder and herd body weight, plant and dung quality etc. as in the cited LIVSIM studies?

Materials and methods

- How did the two models interact, where they dynamically coupled (if so, how?), was a wrapper used or data "manually" transferred between models? At which intervals were data exchanged? What is the time step of each model?
- Does the SQ scenario include manure management, e.g. dung collection or corralling? Section 2.3 explains that grazing management differs between the two surveyed villages. In how far does this affect the scenarios?
- In the SI scenario, which species are used for rotation?
- In Table 1, it would be good to calculate stocking density.
- Line 128: Was feed demand (parameterised as) constant over time?
- Line 144: Figs 1e, 1f and 2 don't show when crops are harvested, but when livestock is present.
- Line 170: Grazing on random days – were these days the same for all model runs or was a probabilistic approach taken? Information from Supplement B should be shown here (grazing rules)
- Line 175: Were fire events the same for all model runs?
- Line 195 ff. not clear
- Line 215: Descriptions in this section are somewhat difficult to follow, would be good to refer to a figure showing the resp. outputs (Fig 6?).

Results

- Has APSIM been calibrated / calidated regarding crop yields? The maize yields for Gabaza appear relatively high (also compared to what has been stated in the methods section.
- Fig. 3a and b: The stacked bars make visual comparison for peanut and cowpea between SQ and SI scenarios relatively difficult. One chart per crop, in parallel to the description in the text, might facilitate interpretation.
- Line 258: The statement "For cowpea and peanut, SI had a stronger positive effect at Gabaza for relative and hectare-specific increases." seems to contradict the numbers presented for peanut (factor 1.22 in Gabaza and 1.28 in Selwana).
- Line 271: "SI reduced SOC-loss to 3.70%, […]" should probably say "by 3.70%".
- Section 3.2.1: The term *biomass* could be changed into *pasture* to avoid confusion with crop residue consumption.
- Table 2a and the respective description in the text are very hard to read; why not showing Fig S3 and S4 instead and moving Table 2a to the supplements (for those who are interested in the exact numbers)? The text could be limited to the main trends and comparisons instead of repeating means and standard deviations from the table.
- Line 300: Why was the number of animals lower in woodlands compared to grasslands?
- Section 3.2.2: The feed deficit at Gabana (Fig 6 b and d) raises the question on grazing decisions: Were these decisions dynamic (taken by the model during the run) and animals moved to another grazing area when pasture became limiting, or were grazing periods per area determined before the model run started? This should be explained in the methods section.
- Secondly, some areas in Gabana were affected more seriously (frequently) by feed gaps (RO A2 and A4, RC A3). Was this because animals stayed there longer or because the areas were smaller or due to the timing of grazing within a season?
- Line 347f. "grazing frequently caused significantly (two-sided t-test with $p<0.05$) higher average biomass-normalized GPP and NPP values relative to control" – was there an optimum grazing frequency for pasture regeneration?

Discussion

- Management-related differences between villages could be discussed in more depth? Effects of SI between sites (expected to be stronger on the more extensive = poorer site)?
- Did more frequent grazing on certain areas affect the regeneration of pasture (positively or negatively)?

- Line 376: “SI-measures could result in yield losses in dry years due to enhanced crop growth and associated increased water demand” – yield loss due to enhanced crop growth sounds paradoxical. It is explained in lines 386 ff and I would suggest to move this sentence there.
- Line 385: Not sure whether N input would increase cowpea growth.
- Line 396: Loosening sandy soils and increasing infiltration to increase plant growth – these measures appear to be more appropriate for heavy soils.
- Lines 408 ff.: Could undergrazing be a problem (grass becoming moribund)? Does the model account for stimulated regrowth by grazing? Is pasture quality considered in the model? This is mentioned later (lines 454ff.), perhaps both paragraphs could be better connected.
- Line 423: Sounds unlikely that vegetation growth reacts with 2-3 months delay to the onset of rains.
- Section 4.3: Surprising that farmers do not store crop residues; this is common practice from Senegal to Ethiopia in densely populated areas. In this context, population density in the research area might be interesting (in the MatMet section).
- Line 444f.: Pasture quantity is only part of the problem, correct, and so is pasture quality (high lignin contents, if moribund biomass or standing litter are fed).
- Lines 451 ff.: Did the decreasing trend in SOC stem from APSIM or from the DGVM (or both)? Should the control treatment not represent (and the models be calibrated to) carbon equilibrium?
- In context with line 258, stronger effect of SI at Gabaza (one would expect higher impact in the poorer environment, i.e. in Selwana) could be discussed.

Conclusions
The section summarizes added value of the coupling well and identifies the next steps (inclusion of an animal and a herder decision model).

- Line 468: Holistic management is a much disputed strategy that should probably not be introduced in the last section without further explanation. What is meant here is probably integrated crop-livestock systems.

Supplements

- Fig S1: As bars are the same and only the y-axis label differs, one of both subfigures could be omitted.
- Fig S2: Differences between solid and hatched signature are not visible
- S3 and S4: Why is biomass demand for CO (no animals) > 0?
- Fig.s 7 and following: What are the red and blue lines at the bottom (should be explained in the captions, so that the figures are self-explaining)? Why are standard deviations for CO sometimes (around 2007 in Gabaza A1 and A3) higher than for the grazed treatments?

Technical corrections

Instead of t (for tons) Mg should be used throughout (SI unit). Scenario names RC and RO have not been introduced when first mentioned in context with Fig 1 and 2.

Line 9: a**n** SI

Line 28: The first sentence of the introduction requires a reference.

Line 67: Space missing in front of “CSM”.

Line 106 repeats line 89, could be omitted.

Line 144: harvest**ed**

Line 149: Better use Mg (SI unit) instead of t

Line 174: Space missing “between2000”

Line 209: results results [replication]

Lines 222f.: Suggestion “determine differences between villages and RO- and RC-scenarios”

Line 255: Please rephrase “was less than half that of of”

Line 271: Space missing after comma “On average,cropland […]”

Line 273 Space missing “).2010”

Line 278: Space missing after “harvest”

Caption Fig 2: the different color hues show how animal presence [**verb missing**] on the four sub-areas

Captions Fig 1 and 2: RO and RC are not explained / spelled out.

Caption Fig 5: Mmonthly

Figure 5: Instead of the “n n n n n n” near the upper x-axes one could state that differences were never significant. The y-axis label for a) and b) should be LAI, not vegetation cover (which cannot be > 1).

Fig. 6: I would suggest to show Gabaza on the left side as in the previous figures.