Contents

Responses to reviewer 1 comments

The manuscript 'Positive tipping points for accelerating adoption of regenerative practices in African smallholder farming systems: What sustains adoption?' assesses the potential for successful adoption of Regenerative Agriculture in Sub-Saharan Africa. It introduces the concept of positive social tipping processes using existing frameworks and applies them to the example of the International Small Group and Tree planting programme (TIST) in East Africa.

While RA adoption and the TIST programme is a very interesting examples of a positive social tipping point and the manuscript has the potential to become an interesting publication, the manuscript in its current form lacks clear structure, clear definitions, and coherent use of terminology. It requires fundamental reworking before publication.

RESPONSE 1:

Thank you for reading our manuscript and providing such useful feedback. We acknowledge the need for substantial changes in the overall manuscript structure, clear definition and coherent use of terminology and concepts, clear referencing, and appropriate signposting of illustrations. We appreciate your suggestions to improve the quality of the manuscript (particularly around the clear structure, definitions, and terminology). To shall take the following steps to address the various observed issues.

1. Introduced a section on conceptual framing (just after introduction). In this section, we discuss the relationship between the positive tipping points framework proposed by Lenton et al. (2022) and Moore et al.'s concept of scaling. We then propose an integration between these two frameworks which forms a basis for the rest of our analysis throughout the manuscript and have ensured that consistent terminology is used accordingly.
2. Replace the original Figure 1 (from the FOLU report) with an adapted version informed by our conceptual synthesis.
3. section 2.0 on enabling conditions will be merged with 3.0 on feedback. Under each of the subheadings in this combined section, we discuss enabling conditions, the amplifying feedback they interact with, and the possible scaling effect. The elements under control variables for enabling condition (in Lenton et al. (2022) positive tipping points framework) have been merged into the following four categories (Cost, performance and capability, desirability and symbolism, Accessibility/Convenience, Information/social networks) reflect their interdependencies in regenerative agriculture systems.
4. The section on scaling of TIST (presently section 5, 6) and feedback processes driving adoption of TIST (section 8) have been merged with the section on enabling conditions driving adoption of TIST (section 7). The section will then cover enabling conditions and amplifying feedback processes in the TIST case study and their impact on scaling. Except for Figure 4 which has been integrated under the section on Cost, performance, and capability, the other figures have been omitted.

We shall now provide more specific responses to each of the comments that follow.

The structure of the manuscript is not clear. Why do the authors start with the social tipping point framework by FOLU, then use Fesenfeld et al. (2022) and finally move to Moore et al.'s (2015) concept of scaling? What is the connection between Moore et al and STPs and why is it useful to use them both?

RESPONSE 2:

Thank you very much for this observation. It is helpful to learn that we needed to do more to ensure that we more clearly communicate our conceptualisation and justification of the choice of concepts and their combination in the manuscript. We explain why these concepts and this combination further:

1. The Tipping Points framework suggested by Lenton et al. (2022) and illustrated in the FOLU defines tipping elements and how the interactions between these elements could affect system states. Our choice of this illustration was for two main reasons, (1) to introduce the idea of enabling conditions and feedback loops as essential elements in triggering tipping points, (2) to give the reader an insight into what constitutes these enabling conditions and feedback processes.
2. We think that figure. 1 in Fesenfield et al. (2022) does a good job of showing the system-level effects of the interaction of various enabling conditions and reinforcing feedback processes in time, leading to system-level transition between states. However, to improve the coherence and structural consistency of the manuscript, we replace it with our own illustration of the interaction between Lenton et al.'s positive tipping points framework and Moore et al.'s dimensions of scaling.
3. Moore et al.'s concept of scaling introduces three levels of scaling; scaling deep (impacting social norms), scaling out (impacting greater numbers), and scaling up (Impacting laws and policy). Changing societal norms and policy plays a crucial role in creating enabling conditions for mass adoption and positive social transformation (Global Tipping Points Report, 2023).

In the revised manuscript version, we introduce a section on conceptual framing (just after introduction). In this section we synthesise the relationship between these concepts and use this to set the tone for the rest of the manuscript.

The manuscript is not very well written and requires correction of typos and other language and grammar mistakes before publication. In addition, the manuscript's style (repetition of words, mistakes in referencing) needs to be improved.

RESPONSE 3:

The authors thank the referee for this critical observation. We shall review the document to identify and correct typos, language, and grammar mistakes that we could have missed during the earlier reviews.

Section 1:

Fig 1 which is directly copied from the FOLU report is not necessarily suitable to describe a positive social tipping process. Column 3 (conditions for systemic tipping points) is labelled as 'enabling environment' in the FOLU report (non peer-reviewed grey literature) but usually, positive tipping frameworks start with enabling conditions before reinforcing and dampening feedbacks lead to a tipping point. I would recommend using Fig 3 in Lenton et al (2022) or Fig 4.2.3 in the Global Tipping Point Report as a framework instead.

RESPONSE 4:

Thank you referee for this fundamental observation. Figure. 1 was intended to introduce the tipping point elements to the reader. However, as the referee observes, its labelling does not show the sequence of actions triggering the tipping points. To address this, we shall

1. introduce a section on conceptual framing to explain the relationship between the two main frameworks used in the manuscript, the positive tipping point framework illustrated in figure 1 and Moore et al. (2015) conceptualisation of scaling.
2. Replace the present figure 1 with a figure illustrating the relationship between these two concepts.

Section 2:

I wouldn't define economic competitiveness as an enabling condition. I would rather define it as a social tipping element following Otto et al (2020). An intervention to create an enabling condition to reach economic competitiveness could be investments in R&D or extension services in the RA field. The examples of control variables for enabling conditions provided in the Lenton et al (2022) figure seem more suitable to me.

The categories of economic competitiveness, accessibility, capability, and cultural appropriateness are neither clearly defined nor coherently applied throughout section 2. For example, access to affordable credit is listed under 'capability'. Extension services are discussed in the competitiveness section. Each category needs to be clearly defined.

The role of information is not clear. Is it an additional category or does it run through the four other categories?

RESPONSE 5:

Thank you very much for this critical observation. This further highlights the lack of clarity and the inconsistency in the definition and application of terminology that the referee has observed elsewhere. For coherence and consistency across the entire document, we shall adopt the naming in Lenton et al. (2022) in the appropriate places within the document. We also substantially revised the text in these sections to improve the clarity and consistency of definitions. The elements under control variables for enabling conditions (in the positive tipping points framework) will be merged into the following four categories (cost, capability and performance, Desirability and symbolism, Accessibility/Convenience, Information, and social networks) to reflect their interdependencies in regenerative agriculture systems.

Section 3:

Fig 2: Apparently this figure is adapted from Fesenfeld et al. (2022) but the reference is missing in the bibliography and thus, I cannot evaluate it. Also, the four categories (economic competitiveness, accessibility, etc) are, according to the text, interacting in Fig 2, but they are not even referenced in Fig 2.

RESPONSE 6:

Thank you for this critical observation which further highlights the need to review the manuscript and address referencing gaps in the entire document. However, to improve the consistency and coherence across the entire manuscript, we shall not be using this figure any more and substituting it with one that aligns better with our revised structure. Despite these changes, we shall make the appropriate referencing and address any gaps that we could have missed in the earlier review processes.

The section is titled ‘reinforcing feedback processes’ but they are not discussed in detail in the section. Fig 2 is not well described in the text. It is not clear how Moore’s (2015) definition of scaling is linked to the Fesenfeld et al. transition diagram.

RESPONSE 7:

Thank you very much for this observation. To address this, we shall

1. introduce a section on conceptual framing to explain the relationship between the two main frameworks used in the manuscript, the positive tipping point framework illustrated in figure 1 and Moore et al. (2015) conceptualisation of scaling.
2. Replace the present figure 1 with a figure with a more appropriate illustration of the interaction between these two concepts.

Section 8:

Why is a causal loop diagram used to describe the positive feedback loops? Who developed it and on what basis? Was it developed together with TIST farmers? Or based on a literature review? This is all very unclear.

RESPONSE 8:

Feedback loops emerge from a cause-effect relationship. The purpose of this illustration is to easily present these relationships to our potential readers. The causal loop diagram (fig. 4) was developed by the authors based on literature (peer-reviewed and grey) on TIST.

Figure 5 is labeled ‘reinforcing feedback loops’ but shows dampening feedback loops as well. The negative link between ‘decreased soil productivity’ and ‘decreased crop yield’ is incorrect. More decreased soil productivity leads to more decreased crop yield. Further, the rapid growth of trees leads to a decrease in soil productivity. The link needs to be positive or the label needs to change to ‘soil productivity’. The entire figure needs to be reworked.

RESPONSE 9:

Thank you so much for this critical observation. To stay focused on the main message and maintain structural alignment, we have had to omit certain elements from the manuscript and merge certain sections. Figure 5 is one of these aspects that will be omitted from the revised manuscript however essential aspects of contents will be integrated into the text.

Again, how is Fig 6 linked to the positive social tipping framework? Who has developed the figure, based on what information? Why is the layout different to Figs 5 and 4?

RESPONSE 10:

Fig 6 was developed by the authors based on literature (peer-reviewed and grey) on TIST. The layout is different because the focus of this figure is to show transitions across scales rather than highlighting the internal dynamics that affect these processes which is the focus of figure 4 and 5. However, in the revised version, only figure 4 is retained but repositioned.

Responses to reviewer 2 comments

The presented manuscript "Positive tipping points for accelerating adoption of regenerative practices in African smallholder farm systems: What sustains adoption?" examines the potential of an accelerated and sustained adoption of regenerative agriculture in Sub-Saharan Africa. It analyses the conditions and feedback processes as concepts of social tipping processes using the example of the International Small Group and Tree Planting Programme, supplemented by a literature review.

The idea of analysing the adoption of RA using a concrete example is interesting and promising, but the approach used is unclear and needs more explanation. For example, it is not clear to me, how the framework for operationalising positive tipping points was used throughout the process and how it was linked to other approaches such as the three forms of scaling by Moore.

RESPONSE 11:

Thank you so much for this critical observation. To explain the relationship between the frameworks, we have introduced a section on conceptual framing (just after the introduction). In this section, we synthesise the relationship between the positive tipping points framework proposed by Lenton et al. (2022) and Moore et al.'s concept of scaling. We then go ahead to propose an integrated framework embracing the relationship between these two frameworks which then forms a basis for the rest of our analysis throughout the manuscript.

Furthermore, the manuscript lacks definitions and a standardised use of terminology. For instance, a clear definition of regenerative agriculture practices is missing. In Section 1, conservation agriculture, climate-smart agriculture, and agroforestry are presented as RA practices. In my understanding, conservation agriculture, climate-smart agriculture and regenerative agriculture are all alternative approaches to conventional agriculture that fall under the umbrella of sustainable agriculture, while RA practices tend to include specific agricultural practices such as reducing tillage or growing cover crops (I would include agroforestry here as well) (e.g. Newton et al., 2020). To avoid confusion, I would suggest giving a clear definition of what is meant by RA practices.

RESPONSE 12:

Thank you for this critical observation and a further call for clarity on definitions. Newton et al. (2020) provides a critical review of the various definitions of regenerative agriculture. Based on their work, they identify two possible definition pathways; process-focused definitions (e.g. reduce tillage, crop rotation, cover cropping) or outcome-focused definitions (e.g. increase carbon sequestration, improve ecosystem health). In this piece, we opted for the outcome-based definition for the following reasons;

1. The description of any system as regenerative is based on its outcomes rather than its components.
2. Different combinations of processes could lead to different outcomes depending on the social-ecological context. Thus, rather than defining the processes (which are rather prescriptive), a focus on the outcomes would permit practitioners to identify the most appropriate processes for their unique contexts.

Therefore, in lines 47-50 we write, "*RA here refers to farming practices that improve soil, water and overall ecosystem health, increase carbon sequestration, increase biodiversity, maintain or improve farm productivity and improve social and economic wellbeing (see Newton et al., 2020)*".

RA being such an important concept in this manuscript, in the revised version, we dedicate paragraph 2 in the introductory section to discuss the definition and practical application of the concept.

Also, it is not clear to me whether the Tree Planting Programme is considered as a practice or a programme that facilitates RA practices; again, a more precise definition would be helpful.

RESPONSE 13:

In Line 280, we describe TIST as "an agroforestry, payment for ecosystem services (PES) programme".

In the revised manuscript, we provide more details if the program operations "*The programme also promotes reforestation, conservation farming and entrepreneurship and operates in small groups of 6-12 farmers (Reid & Swiderska, 2008)*" in the introductory paragraph of the TIST case study.

More detailed comments for the respective sections:

Section 2:

- For me, it is not clear to me where the key factors come from and how they are linked to the framework presented in Section 1. Rogers (2003) is cited for the list of conditions and not the framework for operationalising positive tipping points.
- The structure of the respective paragraphs is not clear to me as well. What should be presented and explained? Description of the conditions (e.g. economic competitiveness) in the context of RA in Africa and measures to create these conditions (e.g. information exchange)? If this is the case, it should be made more explicit.
- In the paragraph about "Cultural and social appropriateness", every citation is double. In addition, the description of the competition to the green revolution in Africa in the second paragraph is not clear to me. What is the green revolution? How does this relate to the condition described?
- In the paragraph about "Accessibility", is it not clear what the different forms of accessibility are? The first sentence is incomprehensible to me in this regard. What is meant by intervention? What is meant by process (the examples given were considered practices in section?)? What is meant by product? In the third part of this paragraph, the references seem to be missing.

RESPONSE 14:

1. Thank you so much for your comments which point out the inconsistency in structure (Both overall manuscript structure and paragraph structure in the section on enabling conditions and amplifying feedbacks). To provide more structural alignment across the entire manuscript, we have introduced a conceptual framing section where we synthesise the relationship between the positive tipping points framework proposed by Lenton et al. (2022) and Moore et al. (2015)'s conceptualisation of scaling.
2. The enabling conditions section (previously section 2.0) has now been merged with the former reinforcing feedback loops section. The structure of paragraphs in this section has then been modified to illustrate the interaction between the enabling conditions, amplifying feedback, and the dimensions of scaling.
3. The 'green revolution' in this context is related to the promotion of external inputs like fertilisers and pesticides with the aim of yield maximisation. It was brought up here to explain the trade-off the farmers have to make and how RA could be given an edge. However, to improve clarity, the use of the word green revolution has been dropped entirely in the re-write.

Section 3:

- The chapter is called “Reinforcing Feedback Processes in adoption in RA”, but feedback processes are not mentioned or explained in the text. What do the feedback processes mean for the adoption of RA?
- In Fig. 2, it's not clear how the different conditions from Section 2 are reflected.
- In line 268, a distinction is made between the individual level and the household level. What does this distinction mean with regard to regenerative agriculture? Individual farmers, farming households? Section 8 makes a similar distinction between the household and the community level? I would suggest clearly defining these levels and indicating which levels are of interest or being looked at.

RESPONSE 15:

Thank you for these observations. To set the stage for our discussion, we introduced a conceptual framing section which synthesises the interaction between enabling conditions, feedback processes, and scaling. Recognising the disconnect in our previous presentation of feedback processes, we have merged the discussion of feedbacks with enabling conditions and scaling, and have grounded these interactions with examples from the literature on RA. In this discussion, we also address the various scales and levels of presentation.

Section 5 and 6:

- The table is its own chapter.
- It is not clear to me why the example of TIST is analysed using the three forms of scaling from Moore et al. What is the relationship between the conditions and feedback loops and the three forms of scaling?

RESPONSE 16:

Under the section of Scaling TIST, we present a TIST-focused adaptation of the conceptual framework introduced in the section on conceptual framing. We then follow through with explanation of the enabling conditions and amplifying feedback potentially contributing to the observed scaling pattern of TIST. For consistency and structural coherence, we maintain the terminology and structure in the presentation of this TIST case.

Section 8:

- Figure 4 and 5: It is not clear to me how to read this figure. "Social contagion and network effects" seems to be a category of feedback processes. Do the social, ecological, economic and agronomic processes indicated lead to social contagion? Or does a contagious feedback process result from the interaction of these processes? I would suggest explicitly representing the important feedbacks using causal loop diagrams and labelling indicating the respective feedback processes.
- Small note: In Figure 4 it is feedback processes, in Figure 5 it is feedback loops. I would standardise the descriptions.
- Figure 6: Same comment as for Figure 4 and 5. The figure is difficult to read, a clear indication of the feedback processes would be helpful. To be consistent here, I would suggest also adding the polarities (+/-) as in the other two figures.

RESPONSE 17:

Reflecting on the ineffectiveness of some of these figures in delivering the intended message, we have hence omitted figures 5 and 6 from the revised manuscript and repositioned figure 4. ii

A summary of changes and modifications in the manuscript revision

Revision codes

Red	Sections absent in revised version. • Section 8. in submission one has been merged into section 9. in submission two. • Section 12. in submission one has been merged into section 12. in submission two. • Section 13. in submission one has been integrated in section 14. in submission two.
Green	Added sections to the revised version.

Version returned for revision	**Revised version**
1. Title 2. Authors 3. Author affiliation 4. Corresponding author contacts 5. Abstract 6. Introduction 7. Enabling conditions for successful adoption of RA in Africa 8. Reinforcing feedback processes in adoption of RA 9. A case study of The International Small Group and Tree planting programme (TIST) in East Africa 10. Scaling of TIST 11. How is TIST meeting the enabling conditions for enrolment in its sites? 12. Reinforcing feedback processes driving adoption of TIST 13. What does the TIST Scaling pattern tell us about accelerating RA adoption? 14. Conclusion	1. Title 2. Authors 3. Author affiliation 4. Corresponding author contacts 5. Author ORCID 6. Abstract 7. Introduction 8. Conceptual framing 9. Enabling conditions and feedback processes for successful adoption of RA in Africa 10. A case study of the International Small Group and Tree Planting Programme (TIST) in East Africa 11. Scaling of TIST 12. Enabling conditions and amplifying feedback processes in the scaling of TIST 13. Conclusion

Details on corrections in revised version by section.

Section	**Detailed corrections**
Title	added ‘drives and’
Authors	No changes
Author affiliation	No changes
Corresponding author contacts	No changes
Author ORCID	Added
Abstract	Re-written
Introduction	Re-written to align with a new structure
Conceptual framing	Added – introduced a conceptual framework on which the rest of the manuscript is based.
Enabling conditions and feedback processes for successful adoption of RA in Africa	• Reviewed the labeling of enabling conditions. • Integrated the discussion of amplifying feedback loops with discussions on enabling conditions
A case study of the International Small Group and Tree Planting Programme (TIST) in East Africa	Re-written the introductory paragraph adding more updated information.

Scaling of TIST	Presented a conceptual framework customised to TIST (Figure 3)
Enabling conditions and amplifying feedback processes in the scaling of TIST	Discussed enabling conditions and amplifying feedbacks in TIST, applying the conceptual framework
Conclusion	Drew some key insights and possible future direction.