Topical Editor Decision: Reconsider after major revisions (08 Mar 2021) by <u>Sebastian Doetterl</u>

Comments to the Author:

Dear authors,

Thank you for providing answers to the reviewer comments and thank you as well to the two reviewers for their helpful and extensive feedback. After evaluating both reviews and your response I recommend to go forward with a major revision for this manuscript which involves reworking the manuscript and in parts more analyses to provide further details to methods and the interpretation of your results.

In particular, I think it is important to address the comments of both reviewers considering the presentation and statistical analyses of your data (improving methods description and in parts revising the way the results have been presented); and to provide a substantially revised discussion, referenced with relevant international literature for framing and comparison of your findings to former research in other tropical regions.

While these comments involve extensive revision of the text, I do believe their implementation is straight forward since the reviewers gave very detailed advice. Additionally, I want to point out that the relevance of your work is high and I would much appreciated to see a revision of this manuscript. When providing the revision, please also provide a point-by-point response letter to all reviewer comments and a track-changes version of the manuscript for an easier tracing of the modifications made to the MS.

Non-public comments to the Author:

Dear authors, while I think the comments are easy to implement I have selected "Major Revision" in order to allow for idle time for the revision. Let me know if the timeline of the revision is too tight but I am confident this can be done in the given time with that decision.

Best wishes,
Sebastian Doetterl

I.   *Comments to the Editor:*

Dear editor,

Thank you for the opportunity to revise the paper. As you can see from the track changes we have made major revisions, which we think greatly improved the focus of the paper. We took each of the reviewers' comments into account, and have provided a detailed account of how we addressed them below. In general, we restructured the introduced to include a section on the role of soil and land health indicators for achieving the SGDs as well as climate change and restoration targets. We removed much of the background on Rwanda and moved some of this into the Methods section. We also removed the paragraph on the Regreening Africa project. We look forward to your feedback on the same. In the Methods, we expanded each section including LDSF description, statistical analysis, MIR predictions and soil mapping methodology. We expanded the results on the same. The discussion is completely rewritten.

We hope the reviewers will be satisfied with the complete revision, however we will be happy to address any further comments to finalize the publication.

Thanks again!
Leigh

II. Comments from Reviewer #1

Thank you for these comments.

These were very helpful and have guided to improve the paper. We have gone through each one of your valuable comments and agree that a comprehensive re-write and expansion was needed to improve the paper.

We have addressed each one of your comments below and have taken action on the same in the updated version of the manuscript, kindly see track changes. Yes, we have better integrated the indicators of soil and land health, beyond soil erosion. And we have changed the title, replacing the word biogeochemical with inherent.

R1 C1: "better focus on differences in the extent of soil degradation (including possible reasons for the differences) and potential consequences for restoration measures by using the indicators the authors determined"
This point is well taken. We have expanded the section on drivers of SOC. This includes a better thread from the introduction through to the results and discussion. This includes an assessment of the controls of SOC.
We included a more thorough and detailed analysis on the differences of the extent of soil degradation and consequences for restoration .

Regarding your comments to the specific sections:

R1. Abstract:
Yes, we have now highlighted the major conclusions around drivers of SOC and its connection to restoration activities and specifically for ecosystem function.
Specifically, we highlight the relationship between SOC and sand and KfS and expand on the role of soil carbon on soil health, as well as the opportunity to increase SOC with land management. We also highlight the influence of vegetation structure on soil erosion. And the opportunity to include these data and information in the land restoration agenda.

Yes, we have fixed the format for reporting 13C ratios. - ^{13}C

We agree, and have removed the mention of "low" SOC in the abstract. Done

Introduction:
"Prepare the main objectives of your study to keep the focus as intended by the title"

We have completely restructured the introduction, we added a section on soil health and the link with landscape restoration.
We also included more detail and references on indicators and SOC as suggested.

We have shortened the more general aspects and most of the introduction to Rwanda.

Methods:
We have included a more comprehensive site description, including soil types, etc.
We expanded the explanation of the LDSF sampling design, specifically the randomization, the set-up of the subplots, the soil collection, e.g., soil augering and the soil erosion scoring.

We had included the location of the laboratories, but can perhaps make this more clear.

We also expanded the description of the MIR database, and how many samples were included in the calibration and validation datasets.

We also expanded the soil mapping approach used and the statistical analysis.

Results:
Agreed, we will stick to using just one measure, mean, for example and not use both mean and median.
We further explored the differences between land uses, as suggested. We ran statistical tests on the effects of vegetation structure on SOC: cropland~grassland<shrubland<woodland

The difference in tree densities was due to Eucalyptus plantations, but this was not explicitly mentioned in the text .Yes, we will expand the soil mapping section, both in the methods and results, including

These sections will be greatly expanded.

Discussion: We are completely expanding the discussion section as per your suggestions. With more attention and focus on drivers of SOC and how they are related to restoration. We will also better discuss the differences in the measured indicators and the implications for soil health and restoration. We will also include more international references.
Thanks for the suggestion to combine the data and look at the effects of texture, pHand bases on SOC. We will expand on the interpretation of the hotspot map as well.
We thank you again for the thoughtful and thorough comments.

Reviewer 2:
Thank you for the comments on the manuscript, which are very valuable.

Comment 1:
We have expanded and strengthened the discussion particularly with regards to aligning it with the title of the manuscript.
We will added additional references as suggested. Specifically we expanded the discussion around site-specific effects as suggested as well as the effects of vegetation structure. We also discussed implications for management and how these data compare to other landscapes in SSA.

Comment 2:
We have included additional statistical tests (in the methods and the results) to explore significance of key variables, including SOC. (SOC by site, by sand, and with vegetation structure). We ran anova test and yes SOC was statistically higher in Kayonza compared to Nyagatare (P<0.001) and higher in topsoil vs subsoil. We also used lmerTest library in R to asses differences in SOC by Vegetation Structure and the patterns were the same in the both sites, though the magnitude varied- cropland~grassland<shrubland<woodland.

Comment 3:
We expanded the section on the LDSF in order to reduce the effort required by readers to familiarize themselves with the methodology from other papers/sources. Including a better description of the scoring of erosion and soil sampling.

Comment 4:
Yes, we explored the effect of climate in the discussion.

Comment 5:
We expanded the methods section, providing more details as requested. We included available soil classification systems. Since the vegetation classes were results of the field surveys, we will keep this in the results but perhaps include other references for the vegetation description in the site description within the methods.

Regarding the suggestion to turn Figure 2 into a table. We have gone back and forth on this and have decided to keep it as it demonstrates a desperately low occurrence of indigenous species and a dominance of Eucalyptus across the sites. If the Editor insists we delete it, we will do so. Thanks.

Comment 6:
On MIR predictions and correlations between SOC and ^{13}C. We have explored this for this particular data set. However, it does not seem to be the case that SOC and ^{13}C are strongly correlated, therefore we do think the prediction are detecting isotopic differences.
I include a figure here for you to demonstrate the lack of correlation between ^{13}C and SOC.
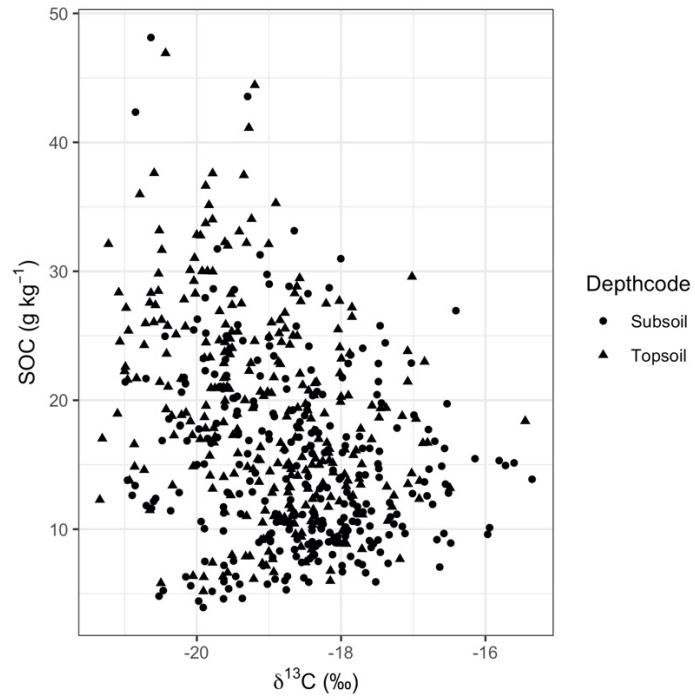
Editorial comments:

Thanks for the many minor comments and suggestions, we have actioned each edit.

Thanks also for noticing some missing cross-references, which we have corrected.