

## ***Interactive comment on “FORUM paper: The significance of soils and soil science towards realization of the UN sustainable development goals (SDGs)” by S. D. Keesstra et al.***

**S. D. Keesstra et al.**

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Referee D. Arrouays I like this paper. I think it is timely and well suited to a FORUM paper. Answer: :)İAŁ

I have a couple of remarks and suggestions. Essay 1 (page 5) Most of the references concentrate on soil degradation and negative aspects. I think it would be helpful to add more references under bullets i) to iv) to illustrate some success stories and show that there are effective solutions for managing soils for food security Answer: bullet points i) to iv) were not intended to describe a gloom picture but rather to point out challenges ahead of soil science as well as possible pathways. We are of course aware of success stories where soil scientists liaised with multiple stakeholders to contribute to restore

degraded land; but the reviewer will surely agree that the spatial extent of such success stories is rather limited in the tropics and that many of them are associated with externally supported, hence often short-lived initiatives. We added references describing successfully implemented strategies to mitigate soil degradation and improve soil quality throughout the referred bullet points. Thanks you for the useful suggestion.

Essay 2 page 6. "Soil eutrophication appears to create favourable conditions for pathogens survival" So, what? What do you propose? Answer: we added a sentence to explain why this is needed.

Essay 3: page 6, line 3 of the Essay 3. I do not agree with the sentence "Soils cover almost all of the ice free terrestrial land surface". Especially within the framework of SDGs. On the contrary I would insist on the fact that soils are a limited resource in terms of area, and in terms of the area we can act on. Answer: We removed this part of the sentence.

End of page 6 (Box essay 3): "it is are also likely" .remove "are" . Answer: done

Page 6. Section on irrigation. It is said that 800 to 1100 km<sup>3</sup>/y are used for irrigation. in comparison, the additional 30km<sup>3</sup>/y proposed seems nearly negligible. So I think the example should be re-written to make it more convincing. Answer: we agree with the reviewer that this does not sound very convincing, so we rephrased the sentence to remove the numbers from the sentence.

Essay 4, page 8. last section. there is an i missing at equivalent Answer: done

Essay 5, page 8 line 5. I had in mind much larger numbers of 'species' by square meter than these figures of 5,000 to 10,000. Please check and include references. End of the section "still largely unknown" there are some recent paper about earthworms abundance and diversity in Europe, and on soil microbial diversity in France, you may cite them to show recent advances Answer: We have checked this and, indeed, the numbers are much larger. We have adapted the text along these lines

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Essay 6 page 9 line 10 of the box, there is a (ref) missing Last sentence. Answer: we are not sure what the reviewer means with this comment.

I'm not a native English speaker, is "possibility of chose products" correct? Answer: Indeed the English was not correct and we adapted the text.

Lines 348-360. Is there a "policy behaviour scientist" in the list of authors? I would be very careful in writing this. Answer: In the author team there are at least two people (Bouma, Montanarella and Fresco) with a long record of scientific papers on this topic and also with ample experience in the policy arena. So we feel that there is enough experience to justify the statements made.

Line 389-390. Do you have a reference for the widespread indiscriminate us of ptf? You should admit too that often there is no other choice than using them. Answer: we have added two references for the ptf.

Lines 413-414. This is mainly true for cultivated soils and grasslands, on the other hand, in many forested parts of the world, organic carbon accumulates because there is no biological activity and increases acidity. The carbon pool we need for biodiversity is a "living" carbon pool, not accumulation of acid O layers. Answer: We have added a sentence to explain that we only mean soils with active living carbon pools. Good point. . Lines 419-421. I think you are very optimistic about monitoring changes in SOC with sensors. Given the error of measurement they have by now, and given the rate of change in SOC, it will take nearly 50 or 100 y to prove a change. Moreover SOC are not so relatively easy to measure and to monitor given their high short-scale spatial variability. Answer: We agree with the reviewer that measuring SOC is a complex issue in terms of measurement and of spatial heterogeneity. Although we are fully aware of this, we would like to keep the statements as made as it provides a guiding point for the future making organic matter a rough proxy for soil quality. Recent papers on sensing, as cited, indicate good possibilities for measuring SOC so we feel that this, in time, may help to obtain a sufficient number of observations.

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Same for lines 368-370, for remote sensors it is even worse because of atmospheric effects, vegetation cover, etc. Answer: Yes we fully agree, but see answer above. Use of proximal sensors may have more potential.

Same again for lines 430-431. "Preferably by remote sensing" this is a very dangerous assumption. First it is not yet operational at all, second, if I am a funding agency, I will never give you again one cent for real measurements but tell you, okay, just look at the satellites images, some of them are free ! Answer: Yes, we agree with this pragmatic point of the reviewer and we have removed this statement from the text.

Recommendation. I'm surprised not to find anything about data collection and data sharing. Answer: We added a sentence about this in the recommendations. Thank you. Good point.

Throughout the text, I'm also surprised that there is not ref to the recent reports delivered by the ITPS, and even not to paper by Montanarella et al on this and in this journal. Answer: we have added some sentences about the recent paper in SOIL ( which covers ITPS) and the new Nature communication paper, both by by Luca Montanarella et al. .

Refs The paper by Montanarella in Nature is published, please add issue and lines numbers. Answer: we have updated the reference Overall a nice paper for the FORUM. Answer: Thanks!

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