

GENERAL COMMENTS

This manuscript deals with land use change effects on soil organic carbon and nitrogen in a semi-arid Mediterranean agricultural area in Southern Spain, between 1965 and 2011 (46 years). Results show that land use change affected negatively to soil organic carbon and nitrogen contents. In contrast, soil quality (measured as the stratification ratio) was significantly increased. This research is interesting for the scientific community and falls into the scope of SE.

However, some revision is necessary before the manuscript is ready for final publication.

First of all, the title does not inform adequately of the research carried out and the important questions in the manuscript. I suggest changing the title to: "Impacts of land use change in soil carbon and nitrogen in a Mediterranean agricultural area (Southern Spain)". In my opinion, results here are widely interesting. So, discussion of results should not stick to a particular area, although the experiments were carried out at farm scale. Results must be put in a more general context.

The use of the stratification ratio as a quality index should be discussed by authors, as some conclusions are shocking: it is difficult to understand that soil carbon and nitrogen decrease when soil quality increases. But research is OK, so authors must insert some discussion about the limitations or controversy of this methodology.

The following are detailed comments that can be helpful for authors.

DETAILED COMMENTS

Page 2

- Line 21 and following The initial statement should include not only the effect of soils in the atmosphere. A broader view is necessary.
I suggest re-writing: "Soils play a key role in the C geochemical cycle because...".
- Lines 21-22 Re-write: "Agriculture and forestry can contribute to C sequestration through photosynthesis and the incorporation of C into...".
- Lines 23-25 I think this statement is derived from Johnson et al. (2007), who wrote:
"C sequestration by vegetation into soil organic matter (SOM) is a key sequestration pathway in agriculture. [...] For C to be sequestered in the soil it needs to be protected from microbial degradation...".
So, I suggest changing the sentence: "Crops capture CO₂ from the atmosphere during photosynthesis into soil organic matter (SOM). Degradation of SOM by microbial processes may be limited by aggregate stability, adsorption by clays or the formation of organo-mineral complexes (Johnson et al., 2007; Lal, 1997)".
If considered by authors, add this reference to the references list:
[http://dx.doi.org/10.1016/S0167-1987\(97\)00036-6](http://dx.doi.org/10.1016/S0167-1987(97)00036-6).

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- Lines 3-4 Re-write: "to improve soil quality and favor C sequestration into soils".
- Lines 5-7 Powlson et al. (2011) wrote:
"[...] any increase in the C content of soil resulting from a change in land management might be referred to as sequestration, in that additional C is held on to in the soil and is separated from other parts of the ecosystem. However, it has become common for the term sequestration to imply a contribution to climate change mitigation. This is only correct if the change in land management practice causes a net additional transfer of C from atmospheric CO₂ to the terrestrial biosphere (soil or vegetation), thus slowing or even reversing the increase in atmospheric concentration of CO₂".

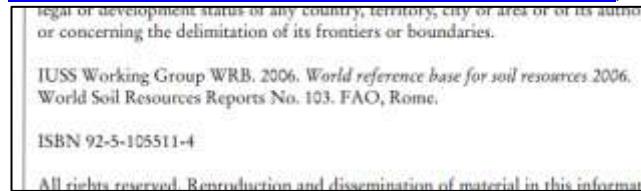
- So, to avoid confusion, I suggest re-writing: “Carbon sequestration is defined as a net additional transfer of C from atmospheric CO₂ to soils after a change in land management (Powlson et al., 2011). So, C sequestration into soils is one of the most important ecosystem services because of its role in climate regulation (IPCC, 2007)”.
- Lines 7-9 According to definition by Powlson et al. (2011), intensive and conventional tillage does not cause soil organic carbon losses (just a movement of C from one pool to another), but transformation to intensive and conventional tillage does. So, it is better to write “Intensification of agriculture or transformation or application of conventional tillage (CT) practices may cause...”.
- Line 10 Join both paragraphs.
- Lines 15-16 Abbreviation for soil organic carbon has been used in line 9, so substitute “soil organic carbon (SOC)” with “SOC”.
- Lines 25-27 Remove or re-write “which is a weak and degradable structure”. Also, I have not found a reliable link between the statement “In Spanish soils ... a low SOM content” and the cited reference (Acosta-Martínez et al., 2003). Let me suggest some references supporting this statement: <http://dx.doi.org/10.5194/se-3-375-2012>. <http://dx.doi.org/10.1002/lqr.2194>. <http://dx.doi.org/10.1007/s003740000289>. <http://dx.doi.org/10.1016/j.catena.2011.06.004>.

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- Line 3 Côte et al. (2000) is not an adequate reference for the effect of agricultural management practices on the C:N ratio, as this article deals with boreal mixed forests (*Populus*, *Betula*, *Abies* and *Picea* sp.). I suggest removing this reference. Some more adequate references on the effect of management practices on soil C:N ratio are: <http://dx.doi.org/10.1016/j.proenv.2011.10.015>, <http://dx.doi.org/10.1016/j.still.2009.06.007> and [http://dx.doi.org/10.1016/0167-8809\(94\)90048-5](http://dx.doi.org/10.1016/0167-8809(94)90048-5). Or even a more general works, as: [http://dx.doi.org/10.1016/S0065-2113\(08\)60570-2](http://dx.doi.org/10.1016/S0065-2113(08)60570-2) or <http://dx.doi.org/10.1016/B978-008045405-4.00263-9>. The first of these two book chapters discusses carbon and nitrogen processes in soils in relation with agronomic efficiency, while the second one describes decomposition and mineralization processes in relation to the cycles of carbon and other nutrients.
- Line 13 Substitute “Sombrero and Benito” with “Sombrero and de Benito”.
- Line 14 I think something is lacking in this sentence. Probably, “This is essential in studies about the effects of LUC on SOC, because”.
- Line 20 Re-write: “a significant number of arable crops (AC) have been transformed into olive grove cultivations...”.
- Line 21 For a more general point of view, substitute “in Montilla-Moriles Denomination of Origin (DO)” with “in vineyards from the Montilla-Moriles Denomination of Origin (DO) in Córdoba (S Spain).
- Lines 21-22 Substitute “This LUC” with “LUCs in this area”.
- Line 23 Substitute “Very few reports have compared the effect of LUC from AC to OG and V on SOC” with “Very few reports have compared the effect of transformations from AC to OG and V on SOC”.
- Lines 25-26 Substitute “to study its vertical distribution of SOC (entire soil profile by horizons, non-section control);” with “to study SOC vertical distribution;”.
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- Line 3 You have previously used abbreviation “DO”, not “D.O.”. Check it for homogeneity.
- Line 6 “Triassic gypsumiferous marls”.
- Lines 8.-9 Re-write: “According to IUSS Working Group WRB (2006), the most abundant soils are Luvisols (LV) and Cambisols (CM), locally known as “alberos” and “albarizas”, respectively. Fluvisols (FL), Regosols (RG) and Vertisols (VR) are also present”.

Here and through the text: use "IUSS Working Group WRB (2006)" instead of "FAO (2006)" (also check in the references list), as citation must fit the suggested citation in the original document. Check it at:

<ftp://ftp.fao.org/docrep/fao/009/a0510e/a0510e00.pdf>, third page:



- Line 10 What do correspond to the Pliocene, soils or substrates?
- Line 13 What do you mean with "soft soils"? I do not understand the following statement: "These are soft soils owing to the presence of limestone, which combines permeability with high water retention. This latter feature is essential for lands with frequent dry spells". Can you re-write it?
- Line 16 What are provided temperature values? Extreme measured temperatures or mean monthly temperatures? Although obvious to authors, you must clearly enounce it. Also, use the same number of decimal places in both values.
- Line 18 Use "elevation" instead of "altitude".
- Line 19 Just a suggestion: remove "of AC".
- Line 19 I am confused at this point. Section 2.1 begins with "The study area comprises...". But here, authors state that "An unirrigated farm [...] was selected for study". I think that the first lines of section 2.1 describe the general area, but study area correspond to the farm described here.
- Line 26 "Summarizes".

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- Line 2 Remove initial "The".
What do you mean with "soil samples were ground"?
- Line 3 "Gutián".
- Line 6 I suppose soil particles > 2 mm were discarded and not included in analyses.
- Line 7 Substitute "(2004)" with "(USDA, 2004)", as in line 10.
- Line 8 "Hartge"
- Line 10 Substitute "system" with "method".
Substitute "(1934)" with "(Walkley and Black, 1934)", as in line 10.
- Line 13 Substitute "dividing the SOC concentration by the TN concentration" with "dividing SOC% by TN%".
- Line 23 Add a citation for the used software: SPSS Inc. (2004).
And add the following to the reference list:
SPSS Inc. (2004). SPSS for Windows, Version 13.0. Chicago, SPSS Inc.
- Line 15 Re-write: "using the Anderson-Darling test".
- Line 26 Re-write: "Differences with $p < 0.05$ ".

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- Line 3 Re-write: "The studied soil is classified as a LV cc/cr". Remove the following "was characterized by exhibited differences in some physical and chemical parameters with depth", as it is redundant and not necessary.
- Line 5 I suggest re-writing: "a high clay content in the Bt horizon due to migration of clay particles".
- Line 7 Re-write: "of typically Mediterranean uses".
- Lines 9-18 I have some concerns about this.
Soil thickness determination was not explained in the methods section. However, no changes in the thickness of a Luvisol are expected in 46 years, except after severe erosion processes involving the removal of the topsoil. If authors want to maintain this statement,

they must justify it in the objectives and the methods section. However, in my opinion, such intense erosion is difficult to determine just with soil thickness determinations after a 46-years period, especially in deeply developed soils as Luvisols. Investigation on the degradation of surface horizons (organic matter loss, degradation of structure, or even B horizon outcropping) might be more useful here, although I am afraid this is not the objective of this research.

I have not found coincidences in cited research by McKenzie and Austin (1993). However, the spatial and time scales at McKenzie and Austin (1993) are different.

In contrast, cited Bakker et al. (2005) studies soil depth variations after a 110-years period using WATEM/SEDEM model and a soil depth map from 1996. Methodology by Bakker et al. (2005) has some problems under my point of view, but I think that results are not comparable with those in this manuscript.

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- Line 5 Re-write: “semiarid regions, soils present a low OC content due to the”.
- Lines 7-8 Albretch and Kandji (2003) studies tropical forest soils. In my opinion, it is much better to use a reference concerning Mediterranean ecosystems, like:
<http://dx.doi.org/10.5194/se-3-375-2012>,
Or more general works:
[http://dx.doi.org/10.1016/S0065-2113\(10\)08005-3](http://dx.doi.org/10.1016/S0065-2113(10)08005-3) and
[http://dx.doi.org/10.1016/S1469-3062\(02\)00025-6](http://dx.doi.org/10.1016/S1469-3062(02)00025-6).
- Line 23 “In contrast”.
- Line 25 Substitute “the lower” with “deeper”.

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- Line 4 Add a reference for the cited map:
FAO. 1970. Suelos de España Peninsular, clasificados de acuerdo con el sistema FAO (Julio 1969). Map (1:2500000). Food and Agriculture Organization of the UN. Rome.
- Line 9 Re-write: “This is in agreement with our results, which show that SOC stock is affected by LUC. The highest...”.
- Lines 13-14 Just a brief comment: Muñoz Rojas et al. (2012b) did not use soil horizons, but control sections at 0-25, 25-50 and 50-75 cm. This included full depth for shallow soils (eg, Leptosols) or soils limited by rock above 75 cm, but did not take into account soil profiles deeper than 75 cm.
In contrast, Rodríguez-Murillo (2001) used descriptions of soil profiles deeper than 1 m in his research.
- Line 24 Substitute “our soils” with “soils included in this research”.
- Lines 25 and following More than cited factors are involved, and the discussion should be extended here.
Some references that can help are:
Mtambanengwe F, Mapfumo P, Kirchmann H (2004). Decomposition of organic matter in soil as influenced by texture and pore size distribution. In: Bationo A (eds). Managing nutrient cycles to sustain soil fertility in sub-Saharan Africa p. 608. Available at: http://ciat-library.ciat.cgiar.org/Articulos_ciat/AfNetCh19.pdf.
Krull, E.S., Baldock, J.A., and Skjemstad, J.O., 2001, Soil texture effects on decomposition and soil carbon storage, in Kirschbaum, M.U.F. and Mueller, R., eds., Net Ecosystem Exchange, Cooperative Centre for Greenhouse Accounting, Canberra, 103-110., available at: <ftp://ftp.biosfera.dea.ufv.br/users/francisca/Net%20Ecosystem%20Exchange.pdf> (pages 101-110).
Also, the following reference might help:
<http://dx.doi.org/10.1016/j.still.2006.08.006>.

Page 10

- Lines 3-5 Re-write: “On the other hand, Muños-Rojas et al. (2012a) found an increase of SOC for LV (14%) after conversion from arable land to permanent crops in Andalusia (southern Spain)

- between 1956 and 2007".
- Line 13 Substitute "elevated" with "relatively high".
- Lines 19-20 According to the paper by McLauchlan (2006), clay concentration correlated positively with aggregate size and the rate of aggregate accumulation.
Substitute "clay amounts" with "clay content" or "clay concentration".
Substitute "aggregate amounts" with "aggregate size and the rate of aggregate accumulation", as in the original paper.
- Line 22 Substitute "A fundamental issue has been to analyze the LUC influence" with "A fundamental issue has been to analyze the influence of LUC on SOC stock, TN and C:N ratio".
- Line 27 Substitute "caused by tillage" with "influenced by management".

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- Lines 5-8 I do not understand this sentence: "can be explained by ...unsuitable chemical properties".
- Lines 8-10 Beneficial effects of increased OM inputs in SOC content, and soil erosion risk have been also discussed in <http://dx.doi.org/10.1016/j.catena.2010.01.007> and <http://dx.doi.org/10.1016/j.still.2013.02.004>.
- Line 17 Substitute "We confirmed this because" with "Our results are in agreement with this".

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- Line 25. Re-write: "The higher soil quality observed at OG and V".