Interactive comments on "Effects of land use changes on the dynamics of selected soil properties in the Northeast Wollega, Ethiopia

By A. Adugna and A. Abegaz

Dear Editor,

We would like to thank the reviewers for their contributions to this manuscript. We must acknowledge that the incorporation of the recommended suggestions improved the quality of the manuscript. We have tried to address all referees' comments as described below and included changes in the revised version of the manuscript (highlighted in red). Supplement: revised manuscript 1.pdf.

Comments by Anonymous Referee #1 and Authors' responses

Comment: In the methods section 2.2 first paragraph the authors base their identification of land use types from surveys from 2012-3 and the elderly households. The authors called these people of age 60 and older as "smart". This is not a clear statement and they assume the term "smart" means more to them than to me. They should explain how and why they used certain local people for information and their methodology in how they collected and evaluated this information. I don't disagree with using the local people's information but in the way it was presented.

Response: The land uses considered in this study were identified based on the surveys carried out in 201-13. In this processes the elderly people were helped us to identify how land use changes and from which land use the current land uses have evolved. We selected the elderly farmers whose age is above 60 and we called them smart because they are knowledgeable and eye witness on how the processes of land use change evolved and they have ample local knowledge. Hence, based on the comment of the referee the word "smart" is replaced by knowledgeable about the local land use types.

Comment: Methods section 2.5 Statistical analyses, Needs to include the number of samples taken and used in their ANOVA to validate the test.

Response: The number of samples collected from each land use is presented in the revised version and written as: One-way ANOVA was used to analyze the differences in soil texture, pH,

available P, SOM, N-Kjeldahl, CEC and exchangeable cations of the three land use types by collecting 15 composite soil samples (five each from each land use) at the 0.05 level." Please note that, we applied ANOVA to assess differences, but not for validation purpose.

Comment: The Results section 3.1 the authors make an unsupported statement about the clay fraction in the cultivated lands that is major to their paper. They state that the 15 cm of soil that was sampled in this region had changed from a sand and silt fractions to a clay fractions. If this were to be true then the soil fractions below the cultivation processes should still be sand and silt. This would be easily determined by sampling deeper and if cultivation was the cause of the clay formation then there would be a layer where the soil changed back to the forest or grazing land appearance.

Response: The comment is valid, thus the statement is deleted from the revised manuscript.

Comment: I found no argument with the authors results in other areas and they seem to supply needed information especially concerning pH reduction and aluminum and manganese toxicity.

Response: To make more clear the following statement added in the revised version: "Cultivated land is characterized by acidifying effects of acid forming nitrogen fertilizer, poor nutrient cycling and mining of basic cations through harvested crops, soil erosion and acid rain which contribute for development of soil acidity."

Comments by Anonymous Referee #2and Authors' responses

General comments

This manuscript studies the effects of land use change on the variation of different soil properties (organic matter content, organic N, pH, available P, CEC and exchangeable cations) in the 0-15 cm layer of forest, grassland and cultivated soils from Northeast Wollega (Ethiopia). In my opinion, authors have carried out a well-designed experiment and made huge efforts to obtain a high number of data. But, in my opinion, the text needs a lot of work before it is ready for publication in SOIL.

These are some general comments about formal aspects:

Comment: Abbreviations in the abstract and the main text must be used only after defining. "SOM", "CEC" or "AP" are used in the abstract without previous definition. The use of abbreviations is not rational. There are many examples of this through the text that must be revised. Different expressions are used for the same object even in a short text. In page 1085,

lines 4-7 (only four lines!), soil available phosphorus is named as "P" (element), "soil P", "available P" or "AP" (available P).

Response: We accepted the comment and corrected throughout the paper as highlighted in the text

Comment: Try to avoid 4-5 lines long sentences. Describing and discussing results following the sequence [i] mean data and [ii] difference between mean data, with different tables is repetitive and makes the text too long.

Response: We reduced the length of sentences by deleting repetition that occurred as a result of repeating values indicated in the table. Tables are referred than their values are repeated in the text.

Comment: In some cases, even the order of tables is strange (table 2 describes differences between soil properties and table 3 describes soil properties).

Response: the order of tables are re arranged now based on the above comments to suit to the flow or sequence of ideas presented under the result section. For example, the previous table 2 which show the variation of soil properties in reference to forestland labeled, which are ordered as follows:

Table 1: Description of land uses in the northeastern Wollega

Table 2: Mean variation and standard deviation (SD) of soil fraction, organic matter, total nitrogen, C:N ratio and available phosphorous at 0-15cm depth at different land use types in the northeastern Wollega, Ethiopia

Table 3: Mean variation and standard deviation (SD) of soil acidity (pH), cation exchange capacity (CEC), exchangeable bases (K^+, Ca^{2+} and Mg^{2+}) at 0-15cm depth at different land use types in the northeastern Wollega, Ethiopia

Table 4: Percentage changes in selected soil properties on cultivated and grazing land uses compared to forestland in northeastern Wollega, Ethiopia.

Table 5: The correlation matrix for selected soil properties at 0-15 cm depth in northeastern Wollega, Ethiopia

Comment: In some cases, also, discussion of actual data is avoided in favour of variations between data. I would like to seriously highlight this, because variations on sand, silt and clay contents, for example, are described and discussed (see Table 4), but dispersion of original data are not provided and discussion on them is not carried out. What is the relevant thing? Mean differences and standard deviation of differences or mean values and standard deviation of mean

values? What is more important? ANOVAs of differences between data or ANOVAs of mean data?

Response: Presentation of the result is corrected as follows. First mean values (actual data) are presented. Second, variation or dispersions of soil properties under grazing and cultivated land are presented. Third, discussions about why such variations occurred among the soil properties are given. Lastly, the correlations between different soil properties are discussed. These are currently precisely indicated in the text.

Comment: I suggest deleting tables 2, 4 and 5 and moving relevant information to Table 3.

Response: As commented Tables 4 and 5 are deleted by moving the information to Tables 2 & 3 with modified table captions.

Comment: I have serious concerns about the validity of most references. There are a huge number of references that do not support the statements they are supposed to. Some examples are discussed in the detailed comments below, but I strongly suggest authors to revise if all citations do actually support the statements in the text. Although there are many evidences, I was surprised when even my own work is cited in order to support a statement that is absolutely not suggested by me. Authors must carry out a serious revision of the text.

Response: We apologies for the errors. We used the general idea of the references to validate our discussions in some portions of our discussion. However, as commented by the reviewer, we have made significant improvements and revised the text. The examples are discussed under the detailed comments below.

Detailed comments

Comments on page 1076

Line 4-5: Substitute "adjacent land uses" with "adjacent soil plots under different land uses"

Response: substituted in the paper and highlighted in red color

Comment: line 5-6: Delete "and tested in National Soil Testing Center, Ministry of Agriculture of Ethiopia".

Response: deleted

Comment: line 6-8: Were soil properties from cultivated land and grazing land not compared?

Response: Yes, because in this paper natural forest, comprising trees species such as *Podocarptus falcatus (*Zigba*), Olea europaea (*Woyera*)* and *Rosa abyssinica (*Kega), was

selected as the control field against which different soil properties of cultivated and grazing lands were compared to assess the level of land degradation in the Northeast Wollega, Ethiopia.

Comment: page 1076, line 6: delete "parentage"

Response: deleted

Comment on page 1076, line 7: substitute was with were

Response: substituted in the text and highlighted in red color

Comment: line 8 "ANOVA" is an widely accepted abbreviation, so substitute "Analysis of variance (ANOVA)" with "ANOVA"

Response: substituted

Comment: line 9-10, Substitute "The results indicate that sand, silt, SOM, N, pH, CEC and Ca were the highest in forestlands" with "Sand and silt proportions, SOM content, N content, pH, CEC and Ca content were higher in forestlands".

Response: substituted and indicated in the text in red color

Comment: page 13, Substitute "relationship" with "relation".

Response: substituted

Comment: page 15-16, I am not in agreement with this statement. See detailed comments below on page 1088, lines 26-27.

Response: the relation of soil properties with clay particle may be influenced by the type of clay (parent material) and detailed response is given to comments on page 1088, lines 26-27

Comment line 24, Delete "For example".

Response: Deleted

Comment: line 25, Litter is not added in forest soils. Substitute "hinder addition of litter" with "reduce the input of organic residues". Note: The word "litter" is not mentioned in the cited paper (Ozgoz et al., 2013). In addition, unless litter is transported from external sources, higher litter inputs cannot, in any way, increase the nutrient content in soils. Ozgoz et al. (2013) studied organic matter contents in terms of general soil quality and in relation with physical properties. The only time Ozgoz et al. (2013) relate the concepts of nutrients and organic matter together is: "Too much chemical fertilizers application, especially P, and decreased use of organic fertilizers have induced eutrophication at the surrounding drainage channels". These authors may be cited later in the introduction, when the role of organic matter decline on soil physical degradation is reviewed.

Response: As commented, “hinder addition of litter” is substituted with “reduce the input of organic residues”. In addition Ozgoz et al., 2013 is substituted with Biro et al., 2013 and (Muñoz-Rojas et al., 2015).

Comment on page 1077

Comment line 6; Delete “Bochet, 2015” and “Tejada and Benitez, 2014”. These references do not exactly support the statement, as they refer to influence of overland flow on seed removal and effects of mulch, respectively.

Substitute “Cedar” with “Cerdà”.

Response: As commented references “Bochet, 2015” and “Tejada and Benitez, 2014” are deleted from the text and reference list, and Cedar is substitute by Cerdà, 1998

Comment line 8-11Check: It is not clear what authors mean with “overcultivation”, which is not mentioned in the cited source. Biro et al. (2013). These authors make reference, in some cases, to land use/land cover changes or expansion of cultivated areas.

“Grazing intensity and frequency” or relations between grazing and nutrient status are not mentioned by Biro et al. (2013).

If these statements are confirmed, please, re-write: “Biro et al. (2013) observed that grazing intensity and frequency, and over cultivation can substantially affect soil nutrient content by reducing composition of plant species, net primary productivity, above and belowground allocation in plants, and nutrient cycling.”

Response: As commented, checked and the statement is rewritten as indicated above and included in the text of the revised manuscript.

Comment: Line 21, Delete “human-induced” (all land use changes are human-induced).

Response: We accept the comment of the reviewer and have deleted “human-induced”.

Comment line 22-23, Delete and make the ecosystem more delicate and susceptible to land degradation”.

Response: Deleted

Comment line 24-25 Check: “The country’s inherently fragile soils […] make soil highly vulnerable …” This only means that “vulnerable soils are vulnerable”. Instead, cite the main characteristics that make soils “fragile”.

Re-write: “and inappropriate farming practices”

Response: re-written: “Soil compaction, loss of soil structure, SOM degradation, undulating terrain, highly erosive rainfall and inappropriate farming practices make soil highly vulnerable to soil erosion.

Comment line 26-27 Add references to support these soil erosion rates.

Response: Bewket and Teferi (2009) is added

Comment Line 27 Re-write: “Soil degradation causes …”, revise the full sentence and add a reference. Is economic loss an on-site or an off-site change?

Response: re-written: “Soil degradation causes loss of fertile topsoil and reduces the productive capacity of the land. The country lost an estimated USD 1 billion per year from both on-site and off-site changes (Bewket and Teferi, 2009)”

Comment on page 1078

Comment line 3 Substitute “And this is why is necessary to apply restoration strategies” with “Soil degradation in the area makes necessary to apply…”

Response: substituted “Soil degradation in the area makes necessary to apply restoration strategies (Mekonnen et al.,2015, 2014; Bizoza, 2014; Zhao et al., 2013; Morera et al., 2010).”

Comment line 4-5 Re-write: “Soil protection is…”.

Response: re-written as, “Soil protection is fundamental so as to keep sustainable the services of the soils and avoid land degradation.”

Comment line 15, Delete “on their part”.

Response: deleted

Comment line 25 Delete “have” and “appreciable”.

Response: deleted

Comment 26-27, Re-write: “of natural forest into grazing land”.

Response: re-written as “after natural forest converted into grazing land”. “…. The hypothesis that” is also deleted

Comments on page 1079

Comment line 3; Delete: “at different geographical area”.

Response: deleted

Comment line 3-5 This is true, but try to substitute "the study area" and focus on the degraded soils in this region of Africa (and probably others) to attract a wider audience.

Response: rewritten as "To this end, little work was established on the effects of land use on soil properties which have implications for land degradation and land management strategies in eastern Africa."

Comment line 5 Can you describe briefly the type of forest, dominant species…? Just some words.

Response: "Natural forest, comprising trees species such as *Podocarptus falcatus (*Zigba*), Olea europaea (*Woyera*)* and *Rosa abyssinica (*Kega), was selected as the control field against which different soil properties of cultivated and grazing lands were compared to assess the level of land degradation in the Northeast Wollega, Ethiopia."

Comment line 7 What soil parameters?

Response: In the revised version we included "some soil parameters such as soil texture, soil pH, TN, CEC, exchangeable cations ($Ca^{2+,}$ Mg^{2+}, K^{+} and Na^{+}), AP, and SOC….

Comment line 14-15 I have a suggestion about the use of "woreda". This is a local (Amharic?) term, and I am asking authors to think about substituting it with the most common English form "district". Nevertheless, I suggest using a simpler description, re-writing (please, check if wrong): "The study area is located in Northeast Wollega (Horo-Guduru Wolega zone, Oromia Region, Ethiopia), approximately on the coordinates 9o 45'-10o 00' N and 37o 00'-37o 15' E."

Response: we accepted the statement suggested by the reviewer written as: "The study area is located in Northeast Wollega (Horo-Guduru Wolega zone, Oromia Region, Ethiopia), approximately on the coordinates $9^{o}45'$-$10^{o}00'$ N and $37^{o}00'$-$37^{o}15'$E."

Woreda is replaced by district

Comment: delete geologically

Response : deleted

Comment line 23-24: Soils on steep slopes do not downgrade, they come not from a higher evolutional status. Re-write: "Dominant soils on steep slopes are Regosols and Cambisols".

Response: re-written as "Dominant soils on steep slopes are Leptosols, Regosols and Cambisols".

Comment: Substitute "altitude" with "elevation".

Are these characteristics (elevation, temperature and rainfall) for the study area? If yes, move these lines (page 1079, line 14 to page 1080, line 5) to line 15.

Response: substituted and these characteristics are moved into line 15 of page 1079

Comment page 1080

Comments line 11-13 Re-write: "at least during the last 40 years".

Please, revise. It is not clear to the reader if only forestland was present 40 years ago and only land use in "some portions" has changed or different land uses (forestland, grazing land and cultivated land) were present in most of the study area and only small areas have changed to cultivation or grassland (coming from what land use?)

Response: revised as follows "based on the information obtained from the elders, these sites were under the same land cover at least during the last 40 years. Since then, some portions were converted into cultivated and grazing lands while some portions remained as forestland."

Comments line 15: Some details are missing about sampling: what was the sampling period? How were sites and tiles selected (randomly?), how much distance between sites, tiles and subplots? How much distance between the border of the tile and the subplots? Are subplots squared?

Description of sampling is some different from the cited sources, which can help as a guide:

Vågen et al. (2013): "A cluster sampling design (Thompson, 1991) was used by first dividing each site into 16 tiles (2.5 × 2.5 km in size), then generating one random centroid location per tile, and finally generating 15 random sampling plots, each 1000 m2, within a 564 m radius of each cluster centroid. Five of these plots were used as alternate plots and hence 10 were characterized and sampled in each cluster. Thus, the data for each site consisted of 160 stratified-random sampling plots with an area of 1000 m2 each. Within each individual plot, four sub-plots were established, each with an area of 100 m2, one in the center and three on a radial arm with 120° angles between them."

Vågen and Winowiecki (2013): "In short, within each 10 × 10 km site, 16 cluster centroids were stratified into 2.5 × 2.5 km tiles and their locations within the tiles were randomized, but buffered to avoid overlapping with neighboring tiles. Around each cluster centroid 10 sampling plots, each a 1000 m2 circle, were randomly located to fall within a circular area of 1 km2 using a 564 m radius from the cluster center-point. Each plot consisted of four 100 m2 subplots."

Response: The comment is appropriate; we haven't sufficiently described the sampling design. Now we described is as follow and this description included in the revised version. To make it more clear sampling design (Fig. 2) is added in the revised version.

"The cluster sampling design by Thompson (1991), which later has been applied by Vågen et al. (2013), Vågen and Winowiecki (2013), and Assefa et al. (2016) was modified and used for this study. The studies by Vågen et al. (2013) was on mapping of land degradation prevalence and soil functional properties in Ethiopia, Vågen and Winowiecki (2013) was on Mapping of soil organic carbon stocks for spatially explicit assessments of climate change mitigation potential along the Ethio-Kenya highlands, and Assefa et al. (2016) was on spatial and temporal dynamics of soil organic carbon in landscapes of the upper Blue Nile Basin of the Ethiopian Highlands. In each of these studies three different areas each with 10 km × 10 km and 16 clusters or tiles have been used. Since our study is on a small catchment so as to assess the impact of land use differences on selected soil properties, we modified and applied this sampling design to suit to our study area.

Accordingly, three adjacent sites under different land use types (forestland, cultivated land and grazing land) were selected for this study, with similar slope, elevation and aspect in each land use. We established a 1 km × 1 km cluster (sampling area), and 5 cluster centroids (sampling plots) were stratified into 200 m × 200 m tiles and their locations within the sampling area were placed systematically (Fig. 2). The first tile (sampling plot) established first by fixing its central point at the center of 1 km × 1 km area. Then, the area of this sampling plot was established using 100 m radius from the cluster center (sampling area) point. The centers of the other four sampling plots were established at 300 m distance from the center of this sampling plot (the central plot) to north, east, south, and west. The area of each of these sampling plots was established using 100 m radius from their center point. Thus, a 100 m buffered area exists from the boarder of the sampling area and between the neighboring sampling plots. Within each tile four subplots were randomly established, each with an area of $100 m^2$, one in the center and three on a radial arm with 120^o angles between them (Vågen and Winowiecki, 2013; Vågen et al., 2013; Assefa et al., 2016). This form of sampling allows the assessment of variability of soil properties at different spatial scales (Vågen et al., 2013) (in our case among land uses at site level). For each of the sampling plots, soil samples (0-15 cm depth, the average plough layer in the area) were collected

from the center of each sub-plot and composite samples were prepared by hand mixing. Totally, we prepared 15 composite soils.

Comments line 15-16 Re-write: "Three adjacent sites under different land use types (forestland, cultivated land and grazing land) were selected for this study, with similar slope, elevation and aspect".

Response: re-written as, "Three adjacent sites under different land use types (forestland, cultivated land and grazing land) were selected for this study, with similar slope (20%) and (elevation 2228 m)".

Comment line 18: Re-write: "100 m × 100 m".

Response: re-written as follows "100 m × 100 m"

Comment line 23, Delete "from each of the three land use types".

Response: deleted

Comment line 24, Substitute "For each tile, soil samples were collected from each sub-plot and composite samples were prepared by hand mixing for 0–15 cm soil depth" with "For each tile, soil samples (0-15 cm depth, the average plough layer in the area) were collected from each sub-plot and composite samples were prepared by hand mixing". Where were soil samples collected? At the center of each 100 m2 subplot?

Response: substituted and re-written as "For each tile, soil samples (0-15 cm depth, the average plough layer in the area) were collected from each sub-plot and composite samples were prepared by hand mixing"

Comments on page 1081

Comment line 1-2, Delete "at a depth of 0-15 cm, because the 0–15 cm represents the average plough layer in the area".

Response: deleted

Comment 4-6, Delete the first sentence of the paragraph, it is not relevant for the paper.

Response: deleted

Comment: Substitute "Disturbed soil samples" with "Composite soil samples".

Response: substituted and highlighted in the paper

Comment Line 7-14, Re-write: "Soil analyses included soil texture (determined by the Bouyoucos Hydrometer method; Black et al., 1965), soil pH (determined in a 1:2.5 soil:water ratio), total N content, cation exchange capacity (CEC) and exchangeable cations (Ca2+, Mg2+,

K+ and Na+) by atomic absorption spectrophotometry, P content (Olsen et al., 1954) and organic carbon (OC) content (Walkley and Black, 1934)".

Response: Soil analysis included soil texture (determined by Bouyoucos Hydrometer Method; Black et al.,1965), soil pH (determined in a 1:2.5 soil: water ratio), total N content, cation exchange capacity (CEC) and exchangeable cations ($Ca^{2+,}$ Mg^{2+}, K^{+} and Na^{+}) by atomic absorption spectrophotometery, available P content (Olsen et al., 1954) and organic carbon (OC) content (Walkley and Black, 1934).

Comments line 12-13 Re-write: "Soil organic matter (SOM) content (%) was determined by multiplying OC% by…"

Response: as commented by the reviewer we used the much correct, 2.0 factor. Soil organic matter (SOM) content (%) was determined by multiplying OC% by 2.0 factors.

Comment: The normal distribution of data must be checked before using parametric tests (ie ANOVA) and correlation analyses. Results and statistical analyses are not acceptable unless this is checked (in SPSS, Analyze > Descriptive Statistics > Explore and mark the "normality plots with tests" cell). If data are not normally distributed, non-parametric tests must be used or data transformations are required.

Response: we checked the normal distribution of the data before using parametric tests and re-written in the following response.

Comment line 17-24: Substitute "One-way ANOVA was under taken to test the significance of the effects of land use changes on the variation…" with "When the normal distribution of data was confirmed, one-way ANOVA was used to analyze the differences among groups of samples for soil texture, pH, P, SOM, N-Kjeldahl, CEC and exchangeable cases at the 0.05 level. When significant differences among groups were found, homogeneous groups were analyzed using the LSD post hoc test at the 0.05 level."

Response: re-written as follow; "When the normal distribution of data was confirmed, one-way ANOVA was used to analyze the differences among groups of samples for soil texture, pH, P, SOM, N-Kjeldahl, CEC and exchangeable cases at the 0.05 level. When significant differences among groups were found, homogeneous groups were analyzed using the LSD post hoc test at the 0.05 level."

Comment: Na^{+}? Cmol (+) kg^{-1}?

Response: this means exchangeable Na^+ which is not detected in the soils of the study area. Since it is not detected in the soils, we removed it from the text for discussion.

Comments on page 1082

Comment line 4-5 Re-write: "Where ChCI, GI is the percentage of change in soil properties of … and LuCl, LuGl and LuFl are mean values of…".

Response: Where $Ch_{CI,GI}$ is the percentage changes in soil property of cultivated or grazing lands compared to forestland and Lu_{CI}, Lu_{GI} and Lu_{FI} are mean values of soil property under consideration of cultivated, grazing and forestland respectively. Bivariate correlation analysis was conducted to assess the relationships between the studied soil properties.

Comment line 7, Join this sentence to the previous paragraph.

Response: we joined the sentence as indicated in the above response

Comment line 11-14, This is not part of results or discussion. Move to the proper part of the text or remove.

Response: deleted

Comments line 21-22, If difference is not statistically significant, you cannot state that silt fraction is higher or lower than anything. Please, delete.

Response: deleted in the text

Comments on page 1083

Comment line 2-4; Please, explain how plowing, clearing, "disposing" and leveling can transform sand and silt into clay or enhance weathering.

Response: "Because the clay particles are very small in size, silt and sand fractions could be removed by runoff from the cultivated land. These are deposited on topsoil of forestland and grazing land (Biro et al., 2013). Differences in clay content of soil influence the levels of microbial biomass." These statements are highlighted in the text.

Comment line 9, The reference for "Ozgoz, 2013" is not provided. I have tried to find a similar statement in Ozgoz et al. (2013), but these authors do not mention anything related to clay leaching.

Response: we referred these authors because indirectly and generally they explained about soil fraction which also include clay fraction. However, accepting the critics of the referee, we removed Ozgoz, 2013 and substituted by Eyayu et al., 2009. As well, we removed claying leaching; rather the changes could be happened by the effects of erosion.

Comment lines 10-13, Please, check. I have carefully read the cited fourth edition of FAO's guidelines for soil description and have not found anything similar to this statement.

Response: substituted with Eyayu et al., 2009 and (Kartul et al., 2013)

Comment 15 Most compact soils compared to what? Soil compaction has not been studied in this manuscript. So, add a reference.

Response: references such as Eyayu et al., 2009 and (Kartul et al., 2013) are added in the text.

Comment line 18, Check spelling: "lagging".

Response: removed from the text

Comment line 19, What do you mean with workability?

Response: workability means easy for plowing that enhance productivity.

Comment line 20, Try to avoid abbreviations in section titles.

Response: accepted and written as "**3.2 Soil organic matter, total nitrogen and available phosphorous"**

Comment line 21-22: ANOVA and post-hoc results are necessary to state this.

Response: The content of SOM was the highest in forest lands and the lowest in cultivated land (Table 2), and the differences are statistically significant (Table 3). ANOVA and post-hoc results are indicated in the table.

Comment line 22, Check: "is in between (Table 3)"?

Response: checked and removed from the text because in the text the highest and lowest values are considered for discussion. Therefore, the middle value or in between is unnecessary.

Comment line 26-28 Add a reference for this.

I do not think that the contribution of soil macro and microfauna to soil organic matter content in forest soils is comparable to that by plants. Please, try to re-write this statement.

Why do you think bacteria and fungi, for example are not microbial biomass?

Response: to make this section clearer we have re-written as follows:

"The more rapid decrease of SOM contents in cultivated land may be attributed to accelerated rates of erosion and decomposition, because these processes were most active on cultivated lands than forest and grazing lands (Abegaz et al., 2016). On the other hand, the reduction is lesser on grazing land because grass roots were fibrous near the soil surface and easily decompose and increasing organic matter. Land management such as poorly designed terracing and cut-off

drainage that practiced over cultivated land facilitated the drainage of water and soil from cultivated land and deposited over forestland."

Comments page 1084

Comment line 2-3, Delete the first three lines. Are roots not important in forest soils?

Response: deleted

Comment line 4-5 Substitute "and adding organic matter" with "increasing organic matter inputs". Re-write: "lower SOM contents".

Response: substituted

Comments line 6-8, You have not studied erosion rates or risk, so this is speculation. You can speculate, but state it clearly. Explain why erosion and decomposition rates are higher in croplands.

Response: "Land management such as poorly designed terracing and cut-off drainage that practiced over cultivated land facilitated the drainage of water and soil from cultivated land and deposited over forestland."

Comment line 8: Re-write: "SOM".

Response Re-write: "soil organic matter".

Comment line 8-12, I find the first part of this statement is strange. It is true that organic matter (not only soil organic matter) is composed of C, H, O, N, S and other elements, but this is not why it is considered a good indicator of soil quality.

Response: "Thus, the highest SOM in forestland is potentially the highest reservoir for plant essential nutrients of nitrogen, phosphorus, and sulfur"

Comment line 9, USDA (2014) is not a valid source for citing here. Please, delete. See comments on references below for "Gebreyesus"

Response: deleted

Comment line 12-15, I do not understand this. What are N, P and S other reservoirs in grasslands and croplands?

Response: deleted

Comment line 15-16, Not in soils under grass or crops? You mean that soil water holding capacity and CEC are higher in forest soils than in soils under other land use types because of higher SOM content. At this point, it is necessary to know if statistical differences exist between forest and other studied soils. ANOVA and post-hoc results should be shown in table 3.

Response: ANOVA and post-hoc results should be shown in table 3

Comment line 17-18, Significantly higher? Readers do not know. Two lines below, you write that the different between N contents from forest and grazed soils is not significant. So what?

Response: as the discussion under result and discussion section is modified, this section also modified as follows to make it clearer. "The change in total N is higher in cultivated land than the change in grazing land compared to forestland (Table 5)."

Comment line 22-25, Check: "Wider" C:N ratio?

I am not in agreement with this statement. Even if significant differences exist, do you think that differences in C:N ratio have any practical relevance? The highest and lower mean values are different only in 1.3. Again: what is the practical relevance of this? Do you think that nutritional status is different between soils with 2.1 or 3.7 ppm of P?

Response: "wider is replaced by highest; regarding the relevance of discussing parameters like C:N ration and available P, which has smaller variation with statistically significant differences. In this paper we tried to discuss such differences because it indicates the existing value under different land uses and suggests for future management as well as the amount of inorganic and organic fertilizers applied to the soil to enhance production. A holistic understanding of available P dynamics from soil to plant is necessary for optimizing P management and improving P-use efficiency aiming at reducing consumption of chemical P fertilizer and acquisition of soil P by plants as well as recycling P from manure and waste.

Comment line 26, Check: "it is in between"?

Response: deleted

Comment line 27, Re-write: "soil AP". Hyphen may be used to join two or more adjectives before a noun, not an adjective to a noun.

Response: "soil AP" highlighted in the text of the paper

Comment line 3, I suggest substituting "weathered soil minerals" with "secondary minerals", according to Shen et al (2011, http://dx.doi.org/10.1104/pp.111.175232). Re-write: "organic and inorganic fertilizers".

Response: Secondary minerals, organic and inorganic fertilizer are important pools of soil P (Assefa and van Keulen, 2009).

Comment line 15, I find that higher weathering of minerals in cultivated land than in grazing land should be better explained.

Response: "Thirdly, a higher P release as a result of higher weathering process on cultivated land than on grazing land may provide higher amount of available P to the soil of cultivated land. This is because of repetitive plowing to prepare the plot for cereal crop production."

Comment line 22-25, This text is too general and describes stablished science. It should be strongly reduced. I suggest removing "Dynamics … (Barua and Haque, 2013)".

Response: removed

Comment page 1086

Comment line 1-4, Write shorter. Substitute "The mean differences between forestland and cultivated land, and forest land and grazing land are statistically significant ($P < 0.05$, Table 5), but the mean difference between cultivated and grazing lands is not significant (Table 5)" with "Mean pH from forest soils was statistically different from cultivated and grazing land ($P < 0.05$, Table 5)".

Response: Mean pH from forest soils was statistically different from the cultivated and grazing land ($P<0.05$, Table 4).

Comment line 8-9, "Benítez" is not correctly spelled.

Tejada and Benítez (2014) do not mention this in their paper. Please, remove this reference. I have not access to the paper by Yao et al. (2010) and cannot check it.

Response: removed and replaced by Abate et al., (2013).

Comment line 10-11, Again, Tejada and Benítez (2014) do not mention this in their paper. Probably this is just a copy/past error, but check your references.

Response: removed from the paper

Comment line 11-12, The statement "soils in the cultivated land appeared more acidic than those of the forest and grazing lands" is true only on the basis of mean values (no dispersion or ANOVA results are provided). But differences are small: only 0.4 pH units between forest and grazing soils (pH 5.7-6.1) and 0.7 pH units between forest and cultivated soils (pH 5.4-6.1). This must be clearly stated in the text.

Do small differences between pH from soils below forest (pH = 6.1) and pastures (pH = 5.7) validate the statement "Different nutrients are available at different pH levels" (line 6)?

Response: pH under cultivated land lies in strongly to moderately acidic soil category. However, soil under forestland is not in the range. These differences have different implications for crop production and soil management such as liming, compositing and manuring.

This section re=written as "Compared to the pH of soils of forestland, pH of soils of cultivated and grazing lands were lower (Table 5). Thus, soils in the cultivated land appeared more acidic than those of the forest and grazing lands. This is expected where 13.2% of Ethiopian soils are strongly to moderately acidic (pH<5.5) (Abate et al., 2013). This is because of intensive farming over a number of years with nitrogen fertilizers on cultivated land."

Comment line 14, Substitute "This variation may be happened because" with "This is because".

Response: "This is because of intensive farming over a number of years with nitrogen fertilizers on cultivated land."

Comment line 15-17, delete these statements

Response: deleted

Comment line 17-18, I have carefully read the paper by Parras-Alcántara et al. (2013). They studied the impacts of land use change in soil organic C and N (paying special attention to soil organic C content and vertical distribution, the stratification ratio of soil organic C and total N) in a Mediterranean agricultural area. BUT I have not found any reference to the role of Al and Mn as toxic elements in acid soils (which is true, but not mentioned by them) or the study area.

Response: removed

Comment line 19-21, Why pH 5.5 is suggested as a threshold for Al and Mn toxicity? Any evidence or reference to support this?

Response: evidence or reference (Abate et al., 2013). In addition McKie (2014) is removed as it is not a peer reviewed source

Comment line 23, Re-write: "pH", minuscule even at the beginning of a sentence, or substitute it with "Soil acidity".

Response: Soil acidity and highlighted in the text

Comment line 28, The cited reference (Parras-Alcántara et al., 2013) does not support this statement.

Response: removed

Comment line 29, "Nitrate" or "NO3-", not both.

Re-write: "crops with NO3- as the only source of N may". Consider that these are all crops except leguminosae.

Response: substituted

Comments on Page 1087

Comment line 1-2, The cited reference (Gelaw et al., 2013) does not support this statement.

Response: substituted by Yao et al., (2010) and Abate et al. (2013)

Comment line 5-8, Delete "CEC, which is a good measure of the ability of a soil to retain and supply nutrient to a crop is naturally reliant on soil organic matter, pH, amount and type of clay mineralogy, land management (Tahir et al., 2009; Gol et al., 2010)".

Response: deleted

Comment line 10-12, This statement can be combined with the previous one in order to reduce the length of text.

Response: combined and highlighted in the text

Comment line 12, Re-write: Mean exchangeable Ca2+ content".

Response: "Mean exchangeable Ca^{2+} content was highest on forest land and lowest on cultivated land (Table 2)."

Comment line 20-22, If data are not significantly different, you cannot say they are. Please, revise this statement.

Response: accepted and removed from the text

Comment page 1088

Comment line 2, Delete the first sentence and move a reference to Table 6 to the next one, between parentheses.

Response: deleted and table reference is indicated the parentheses

Comment line 3, Re-write: "exchangeable Ca2+ and Mg2+ and …".

Response: "Each of SOM, TN, CEC, exchangeable Ca^{2+} and Mg^{2+}, and pH are positively and significantly ($P < 0.05$, Table 6) associated with each of soil properties except with available P, silt and clay."

Comment line 8, Re-write: "pH". Delete the "+" sign for r coefficients through the text, it is not necessary.

Response: accepted and indicated throughout the texts.

Comment line 8-9, This is OK, but try to avoid repeating results from tables. Otherwise, if all coeffcients and p-values are in the text, the table should be deleted.

Response: Accepted

Comment line 14-17, Check spelling: "Muñoz-Rojas".

In their paper, Muñoz-Rojas et al. (2015) talk about certain land use changes, but not about specific practices as compost, cover crops, manures, minimum tillage or crop rotation.

Response: substituted with Martins et al., 2009; Mikha et al., 2005

Comment line 18-21, Delete "Nevertheless". Not only the low available P contents, also the limited range of pH is involved.

Response: deleted

Comment line 21, Re-write: "exchangeable Ca^{2+}".

Response: "In contrast, clay fraction is negatively and significantly ($P < 0.05$) associated with OM, total N, CEC, exchangeable Ca^{2+}, pH, and silt. SOM significantly and strongly associated with pH."

Comments line 21-23, Any explanation for this?

Response: "Thus, conversion of forestland into cultivated lands implies degradation of SOM that influences most of soil properties, since SOM is the major natural sources of N in the soil, provides P, increases CEC and provides other micronutrients through an effective soil food web (Braimoh and Vlak, 2014)."

Comment line 26-27, This statement is absurd. Revise.

The only time that Emiru and Gebrekidan (2013) [not "Nega and Heluf", see comments below on references] mention the word "clay" in their paper is very far from your statement: "Additionally, increasing clay percentage with depth also has the tendency to furnish hydrogen ions from clay colloidal surfaces to the soil solution again reducing which finally reduce soil pH.

Response: removed from the text

Comment, page 1089, line 1 Kaolinite has a low CEC, of course. But more explanations are needed. pH can contribute to explain high or low soil OM contents, but pH only cannot explain why OM content decreases when clay content increases.

Response: removed from the text

Comment on References

I have not checked all references, but have found some mistakes and repeated errors (as changing family names for given names). Some of these are commented below, but a deep revision of the reference list is necessary. Some changes in the reference list may imply changes of citations in the main text.

Response: We have checked the references taking in to consideration the concern of the referee. The corrections are highlighted in the text.

Comment: □ Biro et al., 2013: One author is missing.

Response: Biro, K., Pradhan, B., Muchroithner, M., and Makeschin, F.: Land use/land cover change analysis and its impact on soil properties in the northern part of Gadarif region, Sudan, Land Degrad. Devlop., 24, 90–102, 2013.

Comment: Braimoh and Vlak (2014): Check spelling of authors (Vlek) and title (land-cover).

Response: removed

Comment: Food and Agricultural Organization (2006): Change to: FAO: Guidelines for soil descriptions, 4th ed, Food and Agricultural Organization of the United Nations, Rome, 2006.

Comment:

Gebreyesus (2013): Substitute "Gebreyesus, B.T." with "Tesfahunegn, G. B.".

Response: Tesfahunegn, G.B.: Soil quality indicators response to land use and soil management systems in Northern Ethiopia's catchment, Land Degrad. Develop., published online, doi:10.1002/ldr.2245, 2013.

Comment: Gelaw et al. (2013): The paper is now published as Gelaw et al. (2015). Check for date, volume and pages.

Response: removed both from text and reference list

Comment: Gol et al. (2010): Check author names: Göl, C. Çakir, M., Ediş, S., Yilmaz, H. Check spelling in the title: Gökçay. McKie (2014): This is not a peer-reviewed publication. It is only a leaflet in the internet and cannot be used as a reference.

Response: removed

Comment: Mekonnen et al. (2014): The paper has been assigned volume and pages. Please, check: Mekonnen, M., Keesstra, S. D., Stroosnijder, L., Baartman, J. E. M., and Maroulis, J.: Soil Conservation Through Sediment Trapping: A Review. Land Degrad. Develop., 26: 544–556, 2015.

Response: Mekonnen, M., Keesstra, S. D., Stroosnijder, L., Baartman, J. E. M., and Maroulis, J.: Soil conservation through sediment trapping: A review, Land Degrad. Develop., 26:544-556,2015.

Comment: Nega and Heluf (2013): Check author names: Emiru, N., Gebrekidan, H. Use capitals for "Senbat" in the title.

Response: Emiru, N., Gebrekidan, H.: Effect of land use changes and soil depth on soil organic matter, total nitrogen and available phosphorus contents of soils in Senbat watershed, western Ethiopia,J. Agric. Biol. Sci., 8, 206–212, 2013.

Comment: Tadele et al. (2013): Check author names: Amare, T., Terefe, A., Selassie, Y.G., Yitaferu, B., Wolfgramm, B., Hurni, H. Check spelling: "toposequence".

Response: Amare, T., Terefe, A., Silasie, Y. G., Yitaferu, B., Wolfgramm, B., and Hurni, H.: Soil properties and crop yield along the terraces and toposequence of Anjeni watershed, central highlands of Ethiopia, J. Agric. Sci., 5, 134–144, 2013.

Comment: USAD (2014): USDA, not USAD. Nevertheless, this is not a scientific article and should not be cited here.

Response: Removed

Comment: Vågen et al. (2013): Check author names: Vågen, Tor-G., Winowiecki, L.A., Abegaz, A., and Hadgu, K.M.

Response: Vågen, Tor-G., Winowiecki, L. A., Abegaz, A., and Hadgu, K.M.: Landsat-based approaches for mapping of land degradation prevalence and soil functional properties in Ethiopia, Rem.Sens. Environ., 134, 266–275, 2013.

Comment on Tables and figures

Comment: In general, tables and figures must be completely understood by the audience when read separately from the main text. I think ANOVA and post-hoc results are missing in some tables (Table 2?).

Response: all comments given by the referee are accepted and the details are indicated in tables in the paper and response of the authors on page 1.

Comment: Figure 1. I think this figure is not necessary and suggest removing it. It would be more useful if land use types were shown in detail, not political borders of woredas. But if authors want to keep it, some changes are required. Remove "Map of the study area" from the figure. Add "Ethiopia" to the general view. Check if the figure is easily read when printed in the journal. Some patterns (Airo or Sobokumi, for example) are too similar to "Other Woreda Kebeles" (may you provide a color figure?). Is it necessary to differentiate woredas and regions (with a pattern for Oromia) in the detailed and general views instead of land use types? A zero to

sixteen km scale is strange, can you provide a zero to twenty with ten or five km subdivisions? Remove the underscore ("_") from the legend.

Response: removed