

Journal: Solid Earth

Title: Soil erosion assessment and factors of erosion control in Northeast Wollega, Ethiopia

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MS Type: Research article

General Comments:

Dear Authors,

It was a pleasure for me to review this manuscript. To start with, the issue addressed in this manuscript is researchable and crucial in many developing countries across the globe including Ethiopia. In terms of voluminous, the paper is a very concise. Linking spatial modeling, geospatial and socio-demographic datasets to examine soil erosion status is the other good quality of this manuscript. I understood, however, quite a lot of critical issues that should be solved or explained.

The methodology adopted for the study lacks consistency, not clear and not easily understandable. Specifically, the assumption of multiple linear regression model lacks the necessary details and justifications. This section also lacks in presenting the details of the socioeconomic and demographic background characteristics of the respondents, justifications of statistical model selection and specification criteria, and description of variables and hypothesised relationships. Although several intervening factors shall be considered as a predictor variable, I argue that, considering only 8 variables is not enough to discourse the issue critically. Most of the arguments in the results/discussion section, even in the introduction section, are unfocused as well as lacks coherent from the perspective of the specific problem of soil erosion estimation in Northeast Wollega region.

In general, the purpose of the paper is to estimate the amount of soil loss in different land uses and identify factors controlling soil erosion interventions. However, the paper failed to present the spatial distribution of soil loss hotspot sites across each LULC type in the form of "map". This is one of the critical weaknesses of this manuscript. Besides, the dynamics of soil erosion is a manifestation of the cyclic correlation among the magnitude of erosion status, drivers of soil erosion dynamics, the on-site and off-site impacts of soil erosion. I argue that the manuscript didn't address the implications of long term soil erosion dynamics on environment, livelihood of the local community as well as the regional development of Northeast Wollega region with concrete evidences, and decisively collected, organized, analyzed and interpreted datasets. Thereupon, the paper's contribution is insignificant and does not add new ideas in terms of soil erosion estimation, soil and water resources development intervention mechanisms as well as general scientific methodological advancement point of view.

Thus, I recommend for complete rework of this paper!

Best of luck!!!

Specific Comments:

Abstract Section

L2p3512.....“Soil erosion is the main driver of land degradation in Ethiopia.....” Soil erosion is not the main driver rather it is one components of land degradation. Right?

L5p3512 “... although the purpose of this paper is to identify erosion spot areas”..... I didn't find the major erosion hotspot sites in the form of maps for this specific study site.

L5p3512...“byknowledge” Spacing problem!

Introduction Section

L12-14p3512... “Gessesse et al., 2014” please cite the latest and published version of this article”; <http://onlinelibrary.wiley.com/doi/10.1002/ldr.v26.7/issuetoc>.

L6-7p3513...” This research finding is not based on field assessment of rill and inter-rill measurements rather the researchers estimated using USLE model. Thus, how you concluded like that?

L10-12p3513...” Approximately, 75 % of the total area of the Gerado catchment.....”. This statement needs proper source.

L20-25p3513... The section of “Ethiopia is... (Bewket and Teferi, 2009)” should be moved before the sentence “The soil loss rate by..... (Tamrie, 1995; Tesfaye et al., 2014)” documented in L2-14P3513.

L17-28p3513... This paragraph is narrating the causes of soil erosion as well as the nature of Ethiopian topography. However, from **L25-28P3513**, authors attempted to link research findings from Spain with Ethiopian situations? Being mostly research issues are context dependent, how you decided to relate these two cases in this section of your manuscript perspective point of view?

L17-28p3513 and L24p3525... It is boldly stated that you used the “Revised Universal Soil Loss Equation (RUSLE) “to estimate soil erosion. However, in the other sections of your manuscript (for example, **L25-28p3514 and L5-23p3517**) you described that the Universal Soil Loss Equation (USLE) was used for your case to estimate soil loss. Which model you used? RUSLE or USLE? Do you think that RUSLE and USLE are similar? What are the critical strengths and weaknesses of these two models? Why you decided to use these very old models, being many advanced and informative environmental and spatial processed based models were developed recently to assess soil erosion? Do you think that would your finding acceptable with this kind of methodologically confusion? Strong justification and convincing arguments shall be presented for this?

L14-17p3514... these arguments are based on research findings which were conducted in Rwanda, Kenya, and Tanzania. Do you think that these concepts also reflecting the Ethiopian conditions? Why did you missed to review dozen of research findings which were conducted in Ethiopia from controlling factors of soil and water conservation measures point of view?

L21p3514... you estimated soil erosion considering different “land cover types”. Contrary to this, **L25-27P3514** “.....the purpose of your study was estimating soil loss considering different land use systems”. Do you mean that land covers and land uses are similar? Do you mean your study area is composed of only “land cover” types or “Land use types”? However, your land cover map (Figure 3) shows both land cover and land use types. This needs further elaboration!

L22p3514... What does it mean “other erosion prone areas” in Northeast Wollega, Ethiopia?

L23-24p3514...adopt methodologies that combine research information from “different sources” What are these “different sources”?

Materials and Methods Section

L2p3515..... What does it mean “Northeast Wollega”? Besides, your study area location map (**p3538**) is not clear and understandable from spatial science as well as cartographic

map compilation point of view so that critical revision of this map is a must. What is the total size of your study area? Did you use political or physical boundary for your analysis? This is because your soil erosion estimation modeling approach requires precisely delineated physical boundary like basin, sub-basin, watershed, macro watershed or micro watershed! Thus, your study area boundary delineation procedures and the quality of your data sources used to delineate it shall be clearly justified in this section.

L2p3515 “..... dissected terrain with steep angle slope (>20 %)”. Do you mean that there is no slope angle < 20% in your study area? On the other hand, in your analysis section i) **Table 3 on P3534** clearly revealed that your study area slope angle ranges from 0 to 13%, and ii) Figure 2 on p3539 the slope class ranges of your study area is from 0 to 140 % and +. Being slope angle and slope length are two major factors for soil erosion modeling, why these kinds of conflicting ideas reported in this manuscript? I strongly suggest that revisiting your DEM source data and slope analysis is critically mandatory!

L2p3515 “..... the ...is humid... rainfall is 1875 mmTemperature is 24 °C.” How do you know these? Did you conduct long term hydro-climatic analysis? If so, how many years climate data used for this and which metrological station(s) was (were) considered as source for your analysis? “....about 90% of the livelihood of the local community in the study area”. You should acknowledge source for this also.

L24-25p3515 “.....is currently exposed to land degradation and imminent food insecurity?” How do you know whether the community in your specific study area is food insecure or not? Did you conduct statistical analysis regarding the food security status to come up with these kinds of conclusive argument? Nothing is reported in the analysis section of your manuscript about the food insecurity status based on concrete evidences. Please provide sufficiently discoursed justification for this.

L1-20p3516..... what were the major criteria employed to apply purposive sampling to select the sample “Kebles” as well as to use systematic random sampling techniques to identify representative household heads? Detailed explanation is a must for this section.

L1-20p3516..... This section of your manuscript needs complete rework and revision. I completely agree that Earth Observation products have been tremendously serving researchers as an input for different applications at these days. However, to use these datasets for different purposes, knowing and understanding of the data acquisition, processing as well as applications techniques is very crucial. However, in this manuscript, I found that very misleading and conflicting ideas. As a result I have the following serious concerns:

i. Did you conduct visual image interpretation? If so, what visual image interpretation parameters were considered to interpret your image visually?

ii. Did you carry out on screen digitalization to derive your land use land cover (LULC) map? If so, is it possible to apply on screen digitalization to generate LULC classes from low (30m) spatial resolution satellite image for the whole study site? Technically, why you refused to employ remote sensing software to analyze your data digitally and derive LULC map instead of using Arc-GIS Software which is highly compatible for vector datasets analysis? On the other hand, **L13-15p3519** you reported that you used supervised digital image classification to derive the LULC map of your study area. If you employed on screen digitalization to extract the LULC map of your specific study area, why you used supervised digital image classification approach?

iii. You used the 2005 Landsat image to derive LULC map? Did you have special reason to use these dataset? Otherwise, this dataset is very old (as compared to the latest freely available Landsat 8 Image which is obtainable since 2014) to capture the current environmental dynamics of your study area. It is also fact, Landsat images acquired by ETM+7 since 2000 are severely affected by “stripping” or “banding” problem due to sensor malfunction and calibration defect. How did you challenge this problem and derive your LULC map, and later use this map as one factor map for erosion modeling?

iv. In this manuscript, I didn't find any explanation (analysis) regarding the quality control strategy of your LULC map derived from Landsat image of 2005. Did you conduct LULC map accuracy assessment and map quality control work? If your answer is no, your LULC map is not acceptable without checking its quality. In this regard, unless and otherwise, ...

a LULC classification (map) is not complete until its accuracy is assessed (Congalton, 1991; Lillesand et al., 2008; Congalton and Green, 2009). If your answer is yes, please kindly allow me to forward some critical issues concerning the design of your LULC map accuracy assessment analysis and how the reference (ground truthing) data were collected: What were the map classes you considered for accuracy assessment analysis and how are they distributed across the North East Wollega region? What were the sources of the ground truth (reference) data for your analysis? What was the appropriate sampling unit used to collect ground truthing datasets? How many ground truth samples were taken? How the ground truth samples were selected? When did you collect the reference data? How did you ensure the consistency and objectivity in your ground truth data collection? What type of accuracy assessment approach you used to check the quality of your LULC map? And what types of statistical indices were used to check the agreement (correlation) between your map and ground truthing data for your analysis?

L26-27p3516... “Digital Elevation Model (DEM) was also produced from this image, which is important to generate slope.” I am wandering to know the novel approach you used to generate DEM from Landsat image! Truly speaking, this is technically impossible and methodologically wrong.’ How comes “three dimensional Digital Elevation Model (DEM)” data is derived from a “2D Landsat image? Please kindly convince your remote sensing and geosciences scientific community regarding this case.

L13-p3517 ” ...what is the tolerable soil loss limit of Ethiopian condition in general and your specific study site in particular?

L15-20 p3517... you stated that “one” metrological station data used to compute Erosivity factor of your model. Is it logical, feasible and acceptable to use one metrological station to calculate the “R” factor of your model for the entire study area? What type of approach you used to make this “point based data” into “surface model” for the entire study area to calculate “R” factor?

L4-16 p3518... you described soil erodibility as one factor for your model. What was the soil map data source for this study? Did you use secondary soil map or conduct your own soil survey? In this connection, you only considered two variables such as soil texture and

organic matter content calculate “K” factor for your study. However, on top of texture and organic matter, soil erosion is a function of various soil properties such as soil depth, soil hydrologic group, bulk density, available water capacity, saturated hydraulic conductivity, soil albedo, rock fragments and others. What is your stand regarding the effects of these factors on your soil erosion model running and the final out put quality of your model?

L17-25 p3518 and L1-7P3519...This section requires critical revision.

L19-22 P3519... How other researchers calculate the “C” factor values of cultivated, forest, grassland and shrubland units? Did you simply adopt these values directly to your study area?

L14-21 P3520... you considered 8 independent controlling variables to enhance soil erosion management. What criteria adopted to single out these variables among several independent factors controlling soil erosion management interventions? Do you think that are these the only factors governing soil erosion intervention in the study site? I wonder how the decision has been taken to choose only 8 predictor variables for this study. Of course, these predictor variables are not wrong, but it is possible easily formulate more than 20 or more other variables for your specific case that could have been taken into account. This needs to be explained. Several research findings regarding soil and water conservation themes from Ethiopian context might be helpful for this. On the other hand, why you used multiple liner regression statistical model for this specific analysis? I also missed the multicollinearity analysis section of your manuscript. Do you have any justifiable reason for these?

Results and discussion Section

L2-11 P3521 “... The annual rate of soil erosion is in the range of 4.5–65.9Mgha⁻¹ yr⁻¹. It was.....cropland 65.9 Mgha⁻¹ yr⁻¹.” “As expected, soil lossin cropland is very highly severe (50–80 Mgha⁻¹ yr⁻¹).” How your soil loss estimation value in cultivated land (50–80 Mg ha⁻¹ yr⁻¹) out of the previously mentioned value of cropland 65.9 Mgha⁻¹ yr⁻¹. Did you carry out model sensitivity, calibration and validation analysis to validate the final estimated soil loss value of your model? If not, do you think that your model result is acceptable by the scientific community without validating the result considering

independently measured data? Where is your erosion hotspot map of Northeast Wollega region?

In general, most of the arguments in the results/discussion section are unfocused as well as lacks coherent from the perspective of the specific problem of soil erosion estimation in Northeast Wollega region. Moreover, the discussion section should be supported by literatures which are directly addressing soil and water conservation status in Ethiopia.

Conclusions Sections

L25-26P3525 The sentence needs revision. Did your research findings are considered to be as a “tool” or an “information” that would be helpful to support decision makers to halt soil erosion problem in Northeast Wollega region?

L2-5P3526 On what background you recommend these soil and water conservation technologies? What will happen, for example, if these recommended technologies may not be suitable for your specific study site agro-ecological and topographic settings as well as if the local communities might be refused to accept/adopt them?

References Section

L3-20p3514..... Citations such as Mati and Veihe, 2001; Hurni, 1993; Sonneveld, 2002; Gelaw et al., 2013; Erenstein, 2003; SIDA, 2003; Bolliger et al., 2006 and Giller et al., 2009; L15p3515 DoA, 2013; L7p3517... Hui et al., 2010; L22p3517... Hurni, 1985a; L17 or 213521... Angima et al., 2003; L5-6p3523...Nigonja and Shrestha, 2015; L5 or 10 p3525 Lal, 2015.....are cited in the text. However, they are totally missed in the reference section of this manuscript.

Table Section:

Source should be acknowledged to all your tables.

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