

## ***Interactive comment on “Impacts of conservation tillage on the hydrological and agronomic performance of *fanya juus* in the upper Blue Nile (Abbay) river basin” by M. Temesgen et al.***

### **Anonymous Referee #2**

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The manuscript presents the results of a field investigation to document the impact on hydrological and agronomic performance of new proposed conservation tillage (CT) to address practical and environmental problems associated to the use of soil conservation structures (SCS) and traditional tillage. The study site presents intrinsic novelty in relation to the use SCS and CT in “high rainfall areas” of Ethiopia and the use of a new CT practice, knowledge that certainly is needed to improve and benefit farming practices toward mitigating environmental impact. Despite the authors’ efforts on putting together information for such a complex topic, the manuscript in its current form presents issues in relation to lack of data and analysis, failure to proper communica-

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tion of the results and discussion, and provision of results and evidences to support the conclusion arrived. The results and conclusions are based on data corresponding to “one site” over “five farms” selected for performance comparison between CT and TT. Is this right? Why is that? Do the authors have the data for the other sites? More questions arise from the fact the instrumentation is not well presented. Do the CT and TT results presented here come from the same farm under the same soil types???? This question is critical. If the CT is in a different property than the TT trial, then topography, soils, and other factors will impact on the results. If other sites are available, certainly the conclusions about the advantages of CT over TT need to be supported by data from the other instrumented sites. The analysis of the field data is not rigorous and the result section barely describes them. For example, hydrological processes resulting from the implementation of CT in relation to infiltration are based on the comparison of soil moisture dynamics at two different depths for CT and TT. A difference of approximately 3% in water content is used to conclude on the positive impact of CT in reducing surface runoff and crop yield improvement (statistical analysis based on daily average values for this is not presented). It is well known that soil moisture measurements present large errors associated to the technology that can jeopardize the conclusion. The authors neither present nor discuss/mention this issue in the manuscript. What is more, water-logging as hydrological consequence of excess in surface runoff has been only related to crop improvement and two photographs on the physiological response for plants are presented as evidence of its occurrence. Would it be possible to present pictures of water-logging areas upstream/upslope of the SCS??? Did the soil moisture sensors at 10 cm reflect/capture the occurrence of water-logging??? The above mentioned information will be a more convincing evidence of the occurrence of water-logging in relation to hydrological processes. Although cumulative surface runoff clearly indicates the significant differences across practices (CT and TT) and crops (wheat and tef), it is clear from the Figure that individual rainfall events have substantially contributed to such differences while small events seem to respond in similar ways (as given by the parallelism in the cumulative curves). Since

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the novelty of the work is given by the fact that the study is on high rainfall areas, the detailed analysis and results from a few large and small rainfall events will highlight and strengthen the conclusions arrived by the authors in relation to improvement on hydrological processes by CT. This reviewer believes that the authors have the necessary data to conduct this analysis. The statistical analysis in the method and result sections is not well presented, and more details on the null hypothesis, parameters selection, criteria and discussion are needed. Statistical analysis for significance in the results should be applied to hydrological (daily soil moisture and runoff?), sediment, and crop yield results in order to conclude about the advantages of CT over TT. The analysis should include the data from the four farms (If this is applicable). It is clear that crop yields cannot be only associated to hydrological processes or soil moisture conditions as soil fertility and the time lag between harvesting for CT and TT have contributed to lack of significance. This supports this reviewer point in that physiological response by the plant (greenness) presented in the photographs cannot be associated to the occurrence of water-logging behind the SCS structures alone. The manuscript needs major changes to improve readability for both text and figures. Much of the space is needed to include information and description on soil of the region (association between clay and compaction data?, soil horizons at the site), new figures and results (hydrological response for CT and TT during events), and method descriptions. The much needed space can be achieved by reducing the excessive number of references (currently about 50!) and re-grouping/removing some of the current figures. The above issues and the specific comments that follow are required to improve the manuscript. Specific comments Page 1086 Line 10. CT and TT comparison on 5 farmers' field. . .Is this correct?? Page 1087 Line 16. Which ones are the biological measures? Please clarify for completeness. Page 1088 Line 5. Wrong citation to Figure 1. Please check all Figures' numbers throughout the manuscript. Line 16. What does CA stand for?? Page 1089 Lines 12-15. The results and conclusions are mainly based on the comparison between CT and TT. Consequently, it should also be stated in the specific aims. Page 1090 Line 5. Too many references for the geology of the area. Please cut down

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the number to one or two. Line 10-12. The manuscript needs more details in relation to soil data in order to interpret soil moisture results and discussion. Please include description, depth and type of different soil horizons, etc. Line 24. Please introduce (or include reference) for the RCBD's method. Lines 25-28. Here the authors stated that 2 field segments were selected from EACH of the four farmers (for CT and TT comparison). Why do the authors only present moisture and surface runoff data from only one farm???? Please clarify. Page 1091 Lines 4-6. Depth description for iron sheet is in contradiction to Figure 2's caption. Please clarify. Line 12. Did the farmers document the occurrence and degree of water-logging areas behind SCS after rainfall events? This information is important for the manuscript. Lines 20-25. Please use past tense to describe methods. This reviewer suggests that Figures describing Maresha and agronomical practices (pictures) should be merged into one Figure (several panels). Page 1092 General. Soil methods (Testing compaction and soil profile) should be presented under one title. Similarly for Meteorological and Hydrological data (soil moisture, surface runoff, and sediments). Agronomic data described as it is. Page 1093. Line 1. Soil moisture method requires more details such as type of sensor, units for reported data, logging time interval, errors and accuracy, etc. Also it is important to clarify if these sensors were installed at four different farms (For example (2 x CT+2 x TT) x 4 farms). Please also mention if the sensors were installed for both treatments: wheat and tef. Lines 7-10. Wrong figure number. The paragraph stated that only 4 surface runoff structures were installed (in one property?). Is this right??? This is confusing as it is not possible to get a clear picture of the "real number" of sites instrumented by the authors for comparison. Please clarify. Line 15. Add 10yr return period for readers no familiar with the concept. Lines 18-24. What was the frequency for sediment data collection? Please include this information in the manuscript. Page 1094. Data analysis. This section is poorly explained and more details are needed. Please rewrite it. Line 15. There is not discussion in this section. The results on soil penetration should be discussed also to the light of soil profile data (with depth) and how do soil physical parameters (for example porosity) change with depth as they influence infiltration

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processes. Page 1095. Line 18-24. Are these average values representing daily or monthly averages? How significant is the difference of 3% in soil moisture content between CT and TT in relation to the data errors?? Please clarify. Association between soil moisture and surface runoff in here seems to be wrong. The comparison between rainfall intensity and infiltration capacity of the soil is what determines how much surface runoff will be produced if water-logging areas are not present. A difference of 3% in soil moisture content alone cannot result in a 48% increase in surface runoff reported. Please clarify. Also, could the authors clarify why is no soil moisture data for other sites reported? Since no information on soil porosity is provided it is difficult to assess soil moisture level to reach saturation of the soil (and thus water-logging) behind the SCS, information certainly needed in the manuscript to support conclusions. Page 1096. Lines 8-11. Move this paragraph to section 3.8. 3.4 Surface runoff section. How these results relate to soil moisture data?? Do they correspond to the same field site???? Please clarify. Also, here an analysis based on individual rainfall events is needed to compare performance of CT and TT practices, particularly for large and high intensity rainfall events. From the Figure it seems that not all events will produce such a significant reduction in surface runoff. This data will strengthen the conclusions regarding comparative advantages of CT over TT. Page 1097 Lines 8-12. No evidences for water-logging have been presented. The suggestion of its occurrence is based on generation and quantity of surface runoff. Would the soil moisture data at 10 cm indicate soil saturation at those points??? If not data or evidences are presented then this section should be removed. Lines 15-20. Times series of sediment concentration data need to be presented and properly discussed in this section. It is unclear in the manuscript the frequency of the sampling, temporal variation and other aspects needed to support the conclusions. Page 1099. Conclusion section presents a summary of the work and the claim that CT lowered water-logging period resulting in an increment of productivity. This conclusion is not supported by either data or analysis presented in the manuscript. This issue need to be addressed. Page 1100 References. Too many! The number should be cut down to 35 or 40. Table and Figures:

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Note that all figures have wrongly been referenced throughout the manuscript. Please change figures numbers accordingly. Page 1107. Figure 1. Experimental plots map, symbols, and fonts need to be increased to improve readability. Page 1108. Figure 2. Please check figure caption, as there is a disagreement with stated values for iron sheet height in the method's sections. Page 1109 Figure 3. Panels a) and b) should be part of Figure 2, and a new Figure 3 should be created with panel a (figure 2) and panel c). Additional schematic/pictures regarding instrumentation should be included here. Page 1112 Figure 6. Please enlarge and expand the figure. Remove reference box from second plot as they are the same in both figures. Page 1113 Figure 7. Nice figure. The manuscript needs new plots that zoom into single high intensity rainfall events to demonstrate the clear differences between CT and TT. This plot will strengthen the manuscript in relation to the differences in surface runoff generation. Page 1114 Figure 8. This figure serves as illustration purpose but it does not provide conclusive evidence for water-logging effect. Pictures after rainfall events will be desirable.

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