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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Spatial and temporal runoff processes in the degraded Ethiopian Highlands: the Anjeni Watershed" *by* H. K. Bayabil et al.

Anonymous Referee #1

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General comments

The authors analyzed the differences between typical barley cropping, barley cropping with addition of charcoal and typical lupine cropping on runoff amounts for the Anjeni Watershed in the years 2012 and 2013 in a comprehensive study. Additionally, they compare three transects, which differ in degradation severity, and three slope positions. Cropping treatments with barley or lupine did not only differ due to plant morphology but also due to tillage and fertilization. The slope position had no influence on the results, but cropping and degradation severity has.

To my point of view there are many shortcomings which should be addressed. From the fact that runoff was higher for the lupine crops in 2013, the authors conclude that root morphology, root depths and tillage practice affect runoff. Although this is seem likely, the results do not allow this conclusion since the effects of the plant morphology and tillage practice as well as fertilization cannot be distinguished. Thus, I suggest to conclude only that under the commonly applied lupine cropping practice runoff is higher than under the commonly applied barley cropping practice.

The effect of charcoal was analyzed and had no effect. This result should also be stated in the conclusions and the abstract.

In the last section, the only statistically significant result (runoff on lupine plots is greater than runoff on the other plots) is relativized by speculating that in the long term lupine may have the potential to reduce runoff by improving infiltration rates through the creation of biopores. Thus, the reader is asking himself what message can be "taken home" from the study.

Specific comments

Titel: I am not sure but I wonder what a "spatial process" is. It might be better to write about "patterns" instead of "processes". Moreover, the titel is misleading since the effect of different crops on runoff is analyzed.

Page 4388

Lines 2-7: I would omit most of the first lines of the abstract since the effect cropping and charcoal on runoff is analyzed and not runoff mechanisms themselves.

Page 4389

Lines 6-7: "There is no agreement. . ." I expected some examples for disagreement in the following sentences but did not find any.

Page 4389

Lines 17-20: This is not a sentence. Just omit the word “which”: “Another solution, improving soil acidity and organic carbon pool through the addition of biochar or charcoal, is known to improve soil physical and hydraulic properties (Abel et al., 2013; Asai et al., 2009; Bayabil et al., 2015; Glaser et al., 2002; Kameyama et al., 2010; Karhu et al., 2011; Laird et al., 2010; Spokas, 2010).”

Pages 4391 and 4392

It would be interesting to have more specific information about the soils in the plots: texture, organic matter content in topsoil and bulk density. It might also be helpful for the reader to have the information about soil properties, slopes and degradation for the plots in one table.

Page 4392

The lupine treatments served as indicator for the effect of deep rooting on runoff. Is it possible that lupine and barley roots have also different effects on the soil hydraulic properties at the upper soil layers? If so, it should be stated.

Page 4393

The difference between the treatment types 1 and 3 is not only the crop but also fertilization and tillage, which is fine because the treatments resemble common practice. However, as not only the crop but also fertilization and tillage might have an effect on runoff, this should be stated more clearly here but also in the discussion.

Page 4395

Line 5: Although it is quite simple, please write the exact mathematical formulation for the runoff coefficient (Rcoef = XX/YY [-]).

Lines 11-12: I cannot find any black arrow in B1-B3.

Page 4396

Lins 4 -9: In other sections (page 4395, lines 18-19; page 4397, lines 12ff) the authors argue that rainfall is spatial highly variable and therefore Rcoef can be > 1. Since variability in rainfall might be assumed to be a random error, I do not understand why the authors do not allow Rcoef to be greater than 1 for statistical analysis. If I am not wrong, cutting Rcoef to 1 will produce a bias in the data analysis.

Table D1: Please clarify how total and average 3 day runoff and precipitation are related. I guess all data represent the time spans from 29 June to 4 October 2012 and 25 June to 8 October 2013. However, in 2012 I calculated 98 days. Total rainfall was 1036 mm and 3 days average was 29 mm. If I simply divide 1036 by 29 I come to roughly 36 three-day intervals, which yields 108 days and not 98 days. I hope my thoughts are not too confusing here.

It would be very interesting to have the cumulative runoff for all plots. Thus, I suggest to move table D1 into the paper.

Figure 4: Rcoef > 1 is mainly given for low rainfall intensities in the long term measurements (left). In the measurement campaign 2012 to 2013 Rcoef > 1 is mainly given for high rainfall intensities. This is interesting as I would have expected the latter to be general since high rainfall intensities are often accompanied by storms, which may lead to greater variability.

Page 4397

Lines 21-22: This is only hardly visible in Fig 5. Is this statistically significant?

Page 4398

Lines 6-8: “In general, during the start of the monsoon season (ca. 500mm cumulative rainfall in Fig. 6), plotscale runoff response generally exceeded watershed-scale discharge response.” I gues authors mean until 500mm cumulative rainfall.

Lines 11ff: Is it possible that this difference can be explained by the plant growth and thus enhanced root water uptake at the later stage or by increased macro porosity due

to root growth?

Line 18ff: Unfortunately, I am not an expert but is it really surprising that tillage increases infiltration capacity? I guess there should be literature about that topic. If not, I apologize.

Figure 6: Please use the same colors for treatments as in other figures.

Page 4399

Lines 2-4: Please give the SCS-CN equation in the materials and methods section and explain it a bit since not all readers might be familiar with this equation. If I understand it right, the equation was fitted to the data, thus I would not write about prediction in this case.

Figure 7: Please omit the word prediction as the model is simply fitted to the data. I wonder why the model allows runoff for the charcoal treatment in 2013 even when rainfall is 0. Please explain or better revise the model. I wonder whether this figure and the part with the SCS-CN equation can be omitted. I do not see any benefit here.

Lines 6-7: I did not find the statistical analysis which underlines the statement that transect 3 (more degraded) produced significantly more runoff than the other two transects. Please clarify.

Lines 8ff: I find this discussion very important. To my point of view, the results suggest that typical barley cropping does produce less runoff than typical lupine cropping. The differences between these two systems are root depth and root morphology but also tillage and fertilization.

Page 4400

Lines 4-9: Again, I am not an expert in this field but I wonder whether these implications (tillage practice and root morphology affect water storage capacity, which in turn affects runoff responses) are really new.

Line 7-9: That tillage practice affects storage is already given in the sentence above. I did not find any hint in the paper that root morphology does significantly affect water storage.

Lines 10ff: At this point I was a bit disappointed. Here, the only significant results (runoff on lupine plots is greater than runoff on the other plots; Fig 5) are relativized by a mere speculation, which is far beyond the results presented here.

Technical corrections

All figures: Please increase font size of legends, axis labels and axis tick labels

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 4387, 2015.