Authors' responses to interactive comment on "Evaluation of soil fertility in the succession of karst rocky desertification using principal component analysis" by L. Xie et al.

To:

Anonymous Referee #1

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Manuscript/Discussion paper: Solid Earth Discuss., 6, 3333-3359, 2014 «Evaluation of soil fertility in the succession of karst rocky desertification using principal component analysis, by Lianwu Xie et al.»

General comments

In this paper the authors investigated the changes in 19 different soil fertility-related variables along a gradient of karst rocky desertification (RD), in five different counties belonging to the central Hunan Province (SW China). By applying PCA analysis to the soil data matrix they obtained a standardized integrate fertility indicator whose averaged scores matched (some of) the four predefined RD grades. Taking into account the correlations between the calculated integrated fertility and the measured variables they concluded that the most useful variables to be used as indicators to evaluate soil integrated fertility were: total soil organic C and P; C, N and P content in the soil microbial biomass; cation exchange capacity and bulk density. In my opinion, the research is relevant and matches the scope of SE. Besides, the authors gathered a valuable set of soil chemical, physical and biological data on different sites/plots affected by differentlevels of RD. The sampling design, sample processing and lab parameter determination seem also to be solid. My main criticism to this work is related to the data analysis and interpretation, and the extent to which the statistical analyses carried out in this paper are suitable and actually support the conclusions of the paper.

At first, we thank the anonymous referee for the constructice suggestions. And we correct the context one by one according to the following specific comments.

Specific comments.

In the following paragraphs I will comment in detail the different sections of the paper:

1) The introduction is clear and focused on the importance of efficiently assessing soil fertility in order to study the changes occurring along the RD process while minimizing the cost of determining unsuitable or redundant soil indicators. The objectives of the work are indicated, although no working hypotheses are stated.

The introduction had been adjusted slightly accoding to the comments from two referees.

2) Methods -Sections from 2.1 to 2.4 are, in general, clear and informative. Nevertheless, regarding the table 1, it is no clear how the grades used to select the plots were defined. Did you mean that all the plots belonging to a given RD grade must simultaneously satisfy the pre-established ranges for each of the three variables (soil depth, vegetation coverage and bedrock exposure) used here for the classification? What happens when the value of one (or two) of these variables is outside the range defined for the same row (Grade) in the remaining variable(s)?

The Table 1 had been corrected accordingly. A given RD grade should simultaneously satify the pre-established ranges for two out of three variables (soil depth, vegetation coverage and bedrock exposure). So we added this sentence in Section 2.2.

-Statistical analysis In section 2.5. Authors said that they used ANOVA "to test homogeneity of variance", while ANOVA is used to test the overall homogeneity of MEANS. However, homogeneity of variances is a pre-requisite to apply parametric ANOVA, and is tested by using different ad-hoc tests (Bartlett, Brown-Forsythe, Levene etc). If the homocedasticity hypothesis is rejected you must either transform variables or use specific approaches (e.g. Welch) or use a non-parametric test (as Kruskal-Wallis, for example). Soil variables are frequently highly skewed and transformations are usually necessary for meeting the assumptions required for the parametric test used by the authors, but no indication related to this problem was found in this section. On the other hand, they used repeated paired t-tests to make post-hoc comparisons between the four RD grades for each of the measured variables. In my opinion, it was not a good idea, unless you apply an additional procedure to avoid the associated inflation of type I error (such as a Bonferroni or Bonferroni-like correction). Alternatively ad hoc test to perform post hoc comparison while controlling Type I error (Tukey, Duncan, etc) could be used.

When revising this manuscript, we used SPSS software to do all statistical analyses (i.e., average of 6 samples in each plot, average within the same desertification level, standard-deviation, correlation coefficient, and principal component analysis). One-way analysis of variance (ANOVA) by Bonferroni method was conducted to test homogeneity of means (Post Hoc test)of 4 RD classes.
Thus, the section 2.5 had been changed to "All statistical analyses (average of 6 samples in each plot, average within the same desertification level, standard-deviation, correlation coefficient, and principal component analysis) were performed using SPSS Statistics (ver. 20, IBM, USA). The mean values were compared using Post Hoc test for paired differences at 5% and 1% level of significance after one-way analysis of variance (ANOVA) by Bonferroni method was conducted to test homogeneity of means of 4 RD classes.".

In the section 2.6, authors proposed an integrated soil fertility index whose value for each sample is calculated by summing the scores of the sample in each of the selected ("meaningful") components, weighted by the fraction of the total variance explained that is associated to each component. However, they do not argue at all why this particular numerical combination of latent variables is an optimal integrated indicator of the overall soil fertility (i.e. the ability of soil to store and supply nutrient for plants / to serve as a suitable substrate for plant growing). A priori, I do not see any advantage of using this particular mix of standarized components, which are also difficult to interpret, instead a standardized set of well-known measured variables whose meaning is broadly known for everybody. I will expand on this issue later.
We tried to find a integrate fertility indicator to reflex the soil fertility status of karst land. It is hard to find appropriate indicators, which will guarantee the accuracy of evaluating results. Generally, evaluating indicators are chosen empirically based on the researching fruits of predecessors. Some physiochemical, microbial biomass, and enzymatic activity properties had been chosen to assess the soil fertiltiy. But the adaptability of soil fertility indicators should be paid close attention to karst area due to its fragile ecosystem. Based on the analyses of literatures and suggestions from experts on the stands investigation, we evaluated soil fertility of karst lands using 19 selected indicators. We stated these in

the section Introduction and Discussion.

3) Results In the section 3.1, authors present the results of the pairwise comparisons between the different RD grades, for the 19 measured indicators (table 2). As I commented above, the significance of the results in table 2 may be flawed and should be revised/clarified taking in account my previous warnings on normality, homocedasticity and methods for correctly performing post hoc multiple comparisons, avoiding type I error inflation and spurious significances. Additionally, note that the high number of tests performed in table 2 produce a large tablewise type I error inflation. To avoid this problem, I suggest to use some Bonferroni or FDR corrections (see Rice 1989 and Garc á 2004). The same can be applied for the multiple significances marked in the correlation matrix in table 3. Some of them cannot be probably considered as significant in such a context of multiplicity. The same applies for correlations in table 5.
The significance of the results in table 2 had been clarified after performing post hoc multiple comparisons. The same applies for the Table 3 and 5.

Section 3.2. Even in the case that the significance of the results shown in Table 2 were not flawed, I could not understand why have been included in the set of variables to be analyzed by PCA up to seven variables that, according to table 2, were not significantly different for any pair RD grades. If one of the main objectives of the paper is to find an integrated indicator to evaluate fertility in lands with different RD grades, eliminating noise and reducing the number of variables to be measured, it could be reasonable to retain into the ulterior PCA analysis only those measured variables that exhibited significant differences between, at least, two RD grades, and exclude those variables with no significant differences between any pair of them. Aditionally, perfectly correlated variables (as BD and TOP in table 3) should not be included simultaneously in the PCA analysis, since it could generate artifacts. On the other hand, I disagree with the interpretation (and the names) given by the authors to the different extracted components in the page 3422 (lines 10-26). I think that they are rather arbitrary and may induce to confusion. For example, PCA1 is interpreted as a synthetic indicator of soil water holding capacity / permeability, because of its high correlation with CMC, FMC and TOP.

However, according to loadings in table 4, this PC also exhibited high correlations with total nutrient contents (TN, TP) and nutrient holding capacity (CEC). Additionally, organic carbon (TOC) had its highest loading in this component. Therefore, one could think that this component summarizes a set of soil physico-chemical properties (bulk density, water and nutrient holding capacity and nutrient content) which may by directly related with soil organic content. PC2 is considered as an "organic matter component", despite that its correlation to TOC is lower than that with PC1. Some indicators (available P, microbial P, microbial C and Microbial C) showed significant positive correlations with this component and with TOC. But a similar number of indicators -having similar loadings in PC2 (0,5-0,7, in absolute value): pH, TK, CAP- were nor correlated with TOC. Looking at these values one could think that PC2 may be interpreted as a combined mixed gradient revealing relationships between soil TOC and MBC, and between soil P availability and MBP, modulated by soil pH. That could be a manifestation of the coupling between soil nutrient content/ availability and the activity of the microbial community. In summary, the main (first few) components are complex mixed gradients which are closely related to variables of different nature and have not an unambiguous meaning. On the other hand, the average integrated soil fertility scores largely fluctuated among sites for all RD grades (fig. 1), and even the mean across-site values for the four defined RD grades (fig. 2) did not show significant differences for most of the paired RD grade comparisons, except for the extreme ones (comparisons of PRD or LRD with IRD). In summary, you cannot adequately estimate neither the mean value of the integrated fertility of an area by knowing its RD grade nor viceversa, but only in the extremes of the RD gradient.

As a matter of fact, we try to find an integrate indicator to evaluate fertility in lands with different RD grades, eliminating noise and reducing the number of variables to be measured. This is the third objective of our work, which had been added in the end of Introduction. The correlation coefficient of BD vs TOP is -1.000 because the TOP was calculated from BD data. And TOC highly correlated to TN with r = 0.936. Thus, we removed TOP and TN from dataset of measurements in following pricipal component analysis. PCA was performed using the data matrix of standardized means of 17 indicators (19 originally). Then the PC1-PC6 also changed correspondingly. So the

following paragraph changed into "The order by which the principal components are interpreted depends on the magnitude of their eigenvalues. The PC1 explained 29.2% of the variance (Table 4). It had highly positive loadings from CAP (0.922), CMC (0.818), FMC (0.800), and TK (0.690). In a rough sense, the PC1 was identified as the "water/air permeability and water-holding capacity component" since it mainly covered features related to water and air permeability water-holding capacity of soil. The PC2 explained 19.2% of the variance with highly positive loadings from CEC (0.864) and BAC (0.772), so we named PC2 "cation exchangable capacity and bactiria component".

The PC3 was defined as the "microbial biomass and organic matter component" because it explained 11.1% of the variance with positive loadings from MBC (0.874), MBN (0.861), TOC (0.674), and MBP (0.549). Explaining 9.5% of the variance, the PC4 was called as "microbial communities component" because it had positive loading from ACT (0.784) and FUN (0.775).

The PC5 explained 8.1% of the variance and was defined as the "phosphorus nutrient component" because it had positive loading from TP (0.662). The PC6 explained 5.7% of the variance and was referred to "potassium nutrient component" since it had positive loading from AK (0.946)."

Discusion In the section 4.1 one expected to find some clear ideas about what happens with the measured soil fertility-related parameters along the succession of RD grades and the implications of these changes. Instead, a confusing discussion including references to some previously named PCA components is found. However the authors produced a nice table of data (table 2) on many interesting parameters averaged for each RD grade. This table, easily understandable, clearly shows that the average values of TOC, TN, AP, MBC and MBN perfectly matched the pre-defined succession of RD grades, and that TP and MBP showed a similar tendency. I think that PCA analysis did no add nothing to these results, but only confusion.

In this section, we deleted discussion to some previously named PCA components. So the sentences "First two components (Table 4) were identified as "water/air permeability and water-holding capacity component" and "organic matter component", so water/air permeability, water-holding capacity, and organic matter content would be affected

strongly by the aggravation of RD." were deleted. Instead, we added the sentence "Table 2 clearly showed that the average values of TOC, TN, AP, MBC and MBN perfectly matched the pre-defined succession of RD grades, and that TP and MBP showed a similar tendency. Thus, soil fertility decrease along with the the aggravation of RD." in the beggining.

The section 4.1 turned into "Table 2 clearly showed that the average values of TOC, TN, AP, MBC and MBN perfectly matched the pre-defined succession of RD grades, and that TP and MBP showed a similar tendency. Thus, soil fertility decrease along with the the aggravation of RD. Soil fertility, as the basis of soil quality, directly affects the productivity of land. In return, land use type and frequency influence the soil quality (Ozgoz et al., 2013). The aggravation of RD is not only caused by anthropogenic factor (land overuse), but also by climate (Li et al., 2009a). Degradation of phytocommunity (tree → tree/shrub → shrub → shrub/grass → grass) results in homogenized community structure, decrease of biomass and litter fall, and reduction of plant nutrition such as soil organic matter, TN. The altered soil ecosystem leads to microorganism population reducing and microbial degradation of litter fall decreasing, so that C, N, and P retentions in soil decrease (Lu et al., 2014). Subsequently, the aggravation of RD leads to soil hardening, bulk density enlarging, water/air permeability worsening, and water-holding ability of surface soil decreasing would happen, then the strong surface runoff causes great loss of N, P, and K nutrients (Peng and Wang, 2012). In one word, multiple affects above eventually lead to integrate soil fertility decreasing with the aggravation of RD.".

In the section 4.2, the fact that the average values of the integrated fertility-PCA based index do not match the RD grades is discussed. The explanation for this lack of concordance is that the reference RD classification system was not probably satisfactory. But this lead to a circular argument: while testing the ability of the calculated integrated fertility to predict the predefined RD levels, the resulting lack of matching led them to question the reference RD system itself, instead to questioning/ rejecting the proposed integrated index. However, looking at table 2 one can conclude that many relevant variables related to soil fertility (see the precedent paragraph) change, on average, as

expected in a gradient of soil degradation. Mixing these key relevant variables with other non-relevant or non-affected ones, by applying PCA and making a confusing integrated index, lead to obscure the relevant relationships that one can directly observe in table 2.
When we conducted PCA not using 19 indicators but 17 indicators, the sequencing of the mean soil fertility scores was PRD > LRD > MRD > IRD. Then this section turned into "Discordance between soil fertility level and RD grade in some sites" beginning with "Althrough the sequencing of the mean soil fertility scores was PRD > LRD > MRD > IRD (Figure 2), soil fertility fluctuated remarkably with different sampling sites and with different RD grades (Figure 1)."

In the section 4.3 authors selected as the best (sensitive) indicators to evaluate RD those that were best correlated to the calculated integrated fertility index. Most of them (TOC, TN, TP, MBC, MBN, MBP) changed individually across the RD succession as expected (table 2), while the two remaining (CEC, BD) did not changed at all across RD grades (table 2), despite the integrated index was significantly different when extreme grades were compared (p. 3343, line 6-10). In summary, there is no reason to think that a significant correlation with the calculated integrated fertility is a good criterion to select a key soil indicator to evaluate RD.
This paragraph changed into "Furthermore, TOC, CEC, MBC, MBN, BD, CMC, and FMC were significantly correlated to the integrate soil fertility ($p < 0.05$) (Table 5). Some of them (TOC, MBC, MBN) changed individually across the RD succession as expected (Table 2), while CEC, BD, CMC, and FMC did not changed at all across RD grades (Table 2). We could put forward that TOC, MBC, and MBN, might be reasonable and sensitive indicators to estimate soil fertility in RD region. They could be included in the minimum dataset of evaluating indicators for RD."

Finally, I would like to remark some points related to possible improvements for future versions: -the authors gathered a valuable set of multivariate soil data from different sites affected by Rocky Desestification.. -by (correctly) comparing statistically the average values of the measured parameters in each of the pre-defined RD-level they can detect the most relevant. -by analyzing redundancies among the relevant set (analizing the

correlation matrix and/or using PCA) they could refine the selection of indicators without applying complex, not useful and unnecessary statistical procedures. -An elegant multivariate alternative which would overcome most of the above-cited problems could be a canonical analysis using the three indicators used to define RD grades (i.e. soil depth, vegetation coverage and bedrock exposure) as dependent set. This will avoid the constraints associated to the RD grades defined in table 1. As an independent set, the non-redundant measured variables could be used. In this way you get the best combination of soil indicators that maximizes the optimal combination of RD indicators. Both manually (by analizing the correlations between canonical axis and the measured variables) or by objective procedures (stepwise or AIC criterion) an optimal soil variable set (i.e. taking into account both explained variance and model parsimony) could be obtained.

The answer is the whole revised manuscript.

In summary, - In my opinion the work is not publishable in the present form and should be completely rewritten on the basis of the valuable data base generated in the work, and resubmitted for reevaluation. -In think that both PCA and the integrated fertility index introduce unnecessary complexity and are useless to reach the objectives of the papers.

The answer is the whole revised manuscript.

Minor comments. - p. 3335, lines 10 -15: information is redundant with that in p.3337, lines 18-20, and partially redundant with Table 1. Please simplify. -An abbreviation (as ISF) is needed to avoid repeating "integrated soil fertility" many times throughout the paper. - The PCA info (p. 3336, lines 17-21) should be moved to the Methods section. - Table 1, PRD row: conversation or conservation ? -Figure 2: Explain in the legend what the bars and whiskers represent (mean ± std.error?). -Figure 2, legend: The pairwise comparisons made here seem not to match those performed in the text (p. 3343, lines 7-10). For example, the comparison PRD-IRD in the legend of fig. 2 seem to have an associated p=0.120 (i.e. a not significant difference), while the same comparison in the text seem to have an associated p=0.008 (i.e. a highly significant difference). Please clarify this.

All of these had been correcited.

Cited References. Rice, W.R. (1989). Analyzing tables of statistical tests. Evolution 43: 223-225. Garc á, L.V. (2004) Escaping the Bonferroni iron claw in ecological studies. Oikos

Had been cited.

To:

P. Pereira (Referee)

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The paper submitted by Xie et al. is is under the scope of Solid Earth. However, the paper has to be strongly rearranged to be published. The importance of the work has to be integrated in a wider context and the authors have to do a better job in the justification of their work and the novelty. Some aspects of the methodology have to be revised and the description of the studied area has to be more detailed. The results section has been rearranged and some aspects in the discussions have to be better explained.

We thank Prof. Pereira for the constructice suggestions. And we correct the context accordingly as following.

Abstract The abstract in the current form it is almost impossible to understand. Please restructure it like this. Drop some lines about the study background, aim of the work, methods used, main results and findings. Line 6: Which stands? Line 6: Grades of what?

The Abstract had been revised according to the suggestions above and rearranged as "Expanding of karst rocky desertification (RD) area in southwestern China is strangling the sustainable development of local agricultural economy. It is important to evaluate the soil fertility at RD regions for the sustainable management of karst lands. The changes in 19 different soil fertility-related variables along a gradient of karst rocky desertification were investigated in five different counties belonging to the central Hunan province, China. We used principal component analysis method to calculate the soil data matrix, and obtained a standardized integrate soil fertility (ISF) indicator to reflect RD grades.

The results showed that the succession of RD had different impacts on soil fertility indicators. The changing trend of total organic carbon (TOC), total nitrogen (TN), available phosphorous (AP), microbial biomass carbon (MBC), and microbial biomass nitrogen (MBN) was: potential RD (PRD) > light RD (LRD) > moderate RD (MRD) > intensive RD (IRD), whereas the changing trend of other indicators was not entirely consistent with the succession of RD. The degradation trend of ISF was basically parallel to the aggravation of RD, and the strength of ISF mean values were in the order of PRD > LRD > MRD > IRD. The TOC, MBC, and MBN could be regarded as the key indicators to evaluate the soil fertility.".

Page 3334 Introduction Line 23: Please give a broad focus to your study. Show some studies from other areas. Line 24-1 (page 3335): Rearrange this sentence. In the current form is not understandable.
It had been corrected.

Page 3335 Line 2: Which anthropogenic driving forces Line 5: Delete "Y.B" Line 10-16: This should be placed in the materials and methods Line 15-16: Which classification methods with minor modifications? Line 17: Delete "and elsewhere" Line 20-25: Provide a reference to this idea. Line 25-26: "the quality".
These had been revised.

Page 3336 Line 7: Delete "have not been achieved at present" Line 8: Delete "eco-" Line 10-11: Please delete "Those indicators that influence plant growth should be included into evaluating system." is redundant Line 14-19: Please provide the references from where you took this information. The authors should be acknowledged for their work.
We Deleted "have not been achieved at present", "eco-", "Those indicators that influence plant growth should be included into evaluating system." The references had been cited in the front of this sentence.

Page 3337 Materials and Methods Line 7: Please provide some information about the soil type and vegetation cover in the studied area. Line 18: Delete "(RD)" Line 21: Delete

“typical” Line 25: Please explain this sentence “evenly distributed by walking on the way like letter “S” over the area”. Were the samples collecting randomly or using a grid design.

Some information about the soil type and vegetation cover in the studied area had been added as “Carbonate rocks and granite cover the majority, non-carbonate rocks account for 11% of the total area. According to the Chinese Soil Taxonomy system, the major soil types are red soil and purple soil. The vegetation in these areas are mostly covered with sparse shrub grass embellished with timber, and non-wood forests, such as Magnoliaceae, Lauraceae, Theaceae, Hamamelidaceae, Eucalyptus spp., Michelia macclurei, Bambusa textilis, and Sinocalamus latiflorus.”.

The sentennce “evenly distributed by walking on the way like letter “S” over the area” means samples collecting using a grid design. Thus, we corrected this sentence.

Page 3338 Line 3: Please describe how many samples you analyse per plot in the laboratory. Why did you use composite samples and then you divide it? Line 19-20: To calculate the CEC, you had to measure the cations. Please show the cations analysed.

Six samples per plot, 4 plots each county were analysied in this work. “(6 samples per plot, 4 plots each county)” added in this sentence. We explained why we divide the composite samples into two parts in the following sentence as “Every composite sample was divided into two parts, a field-moist sample and an air-dried one. The field-moist samples were kept in refrigerator under –20 ℃ until culturing microbe to enumerate bacteria, fungi and actinomycetes, and analyzing microbial biomass carbon (MBC), microbial biomass nitrogen (MBN) and microbial biomass phosphorus (MBP). The air-dried samples were used to determinate chemical and physical parameters.”.

When calculating the CEC, we do not need to know how many cations contained in soil samples according the method. Then we discribe the method in datail as “Cation exchange capacity (CEC) was determined saturating the exchange sites with an index cation (NH4+). This involved initial addition of 1 mol/L NH4OAc at pH 8.2 (Bower et al., 1952), washing the soil free of excess salt, displacing the adsorbed index cation (NH4+) with NaCl, and measuring the amount of index cation displaced using Kjedahl determination method directly (Brookes et al., 1985a).”

Page 3339 Line 5: Provide a table with all variables analysed. It will be easier to the reader. Line 9: “principal component analysis” is not a descriptive analysis method Line 9-10: Have you test the data normality and homogeneity of the variances before use a parametric test? Line 11-12: The ANOVA test do no assess the homogeneity of the variances. Please use the Kolmogorov test to test the data normality and the Levene test to assess homogeneity of the variances. Line 6-14: Please describe with better detail the statistical methods and with a logical order, descriptive statistics, data quality test, data comparison method(s) and Principal Component Analysis analyses. Line 15-17(page 3340): This part should be resumed and described in statistical analysis.
This paragragh had been revised according to the suggestions from two referees as “All statistical analyses (average of 6 samples in each plot, average within the same desertification level, standard-deviation, correlation coefficient, and principal component analysis) were performed using SPSS Statistics (ver. 20, IBM, USA). The mean values were compared using Post Hoc test for paired differences at 5% and 1% level of significance after one-way analysis of variance (ANOVA) by Bonferroni method was conducted to test homogeneity of means (Garc á, 2004; Rice, 1989) of 4 RD classes.”.

Page 3341 Line 6-7: Delete this, Describe directly the results. Line 8: According to the table 2 some post-hoc test was carried out. Please describe it in the statistical analysis section. Line 9: Change “TOC” by “Total organic carbon” Line 20-21: Delete. Describe the results directly. Line 22: Please mention in the statistical analysis the correlation method used. Line 22: Change “MBC” by “Microbial biomass carbon”.
These had been corrected.

Page 3342 Line 13-17: It would be positive to have a graphic were we could see the ploted PC1 and PC2. Line 17-18: This is not true. According to the table 3, the correlation between TOC and AP and MBP is not significant. Please check it.
We checked it and corrected.

Page 3343 Line 12-13: Delete and describe the results directly. Line 15: The correlations

of TOC, TN, TP and MBC are significant, but not strong. Delete “strongly” Line 20: Please describe the major findings of “Effects of succession of RD on soil fertility”, discussed it with other works. The data obtained in the ANOVA analysis should be discussed also, not only th PCA results. Line 23: Delete S.

These had been revised.

Page 3344 Line 1: Specify what do you mean with “so on”? Be precise in the discussion of your results. Line 1: Substitute “total N” by “TN” Line 6: Please explain why the variables of PCA 1 contribute to RD aggravation. Line 8: Change “worsening” by “decrease” Line 16: Change “satisfactory as expected” by not “correct” Line 16-18: Maybe the variables used (despite the large number) were not enough to explain the levels of RD. it would be important to drop some lines about this limitation and propose some potential co-variates that can explain RD. Line 21-23: Maybe climate variables, land use, topography of the studied area and soil type should be used in the PCA bshould also be considered in a future work to explain RD.

We revised this paragragh accordingly.

Line 3345 Line 1-3: Please explain why burning could cause degradation. Line 4-5: This may be correct, thus this variables should be used in the model Line 6: Delete “Y. B.” Line 8-11: On my humble opinion this propose is somehow extreme. Mountain closure for the communities that depend on the resources of the studied area. Perhaps a better management would be the better thing and please show management practices that could decrease the RD. Line 16-1(Line 1 page 3346): Delete this. Describe the major findings and discussed. Use this information to discuss your results.

We reviesd this paragragh accordingly.

Page 3346 Line 1: Change “MBC” by “Microbial biomass carbon” Line 21: What do you mean by “pre-researching” Line 23: TOC, TN, TP, MBC, MBN and MBP, were not strongly correlated. Please rearrange the sentence. Line 26-27: This needs a better explanation.

We reviesd this paragragh accordingly.

Page 3347 Conclusions Line 1: Change “RD affected evaluating” by “RD affected the” Line 3-8: This has to be revised with carefully. Some of these correlations are not strong.
We reviesd this paragragh accordingly as “Soil chemical indicators TOC and CEC, microbial indicators MBCand MBN, and physical indicator BD, CMC and FMC might be the key indicators to evaluate soil fertility in RD regions according to their paired correlations and significant correlation to the integrate soil fertility.”.

Tables Table 1: Change “Utilization” by “land-use”. What do you mean by “forest conversation” Table 2: Please show only the letters if there is significant differences among study areas. Table 5: according to this table CMC has a non significant correlation with a coefficient of 0.449, and for example the correlation of TK with a coefficient of 0.145 is significant. Please check it.
We checked it and reviesd this paragragh accordingly.

Figures Figure 2: Please show the meaning of the hanging bars.
The hanging bars refer to the standard deviation (SD) of the means. It had been added.