

SOIL Discuss., author comment AC2  
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## Reply on RC2

Guoyu Lan et al.

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Author comment on "Network complexity of rubber plantations is lower than tropical forests for soil bacteria but not for fungi" by Guoyu Lan et al., SOIL Discuss.,  
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**Manuscript number:** Soil-2021-98

**Title:** Network complexity of rubber plantations is lower than tropical forests for soil bacteria but not fungi.

**Journal title:** SOIL

On behalf of my co-authors, we appreciate reviewer 2 very much for his positive and constructive comments and suggestions on our manuscript entitled "Network complexity of rubber plantations is lower than tropical forests for soil bacteria but not fungi" submitted to SOIL. We have studied the reviewer' comments carefully and made the revision according the comments of the reviewers. The following are major changes (in blue) in the revised MS and responses to the comments.

### Main comments:

This study did a comprehensive investigation on soil bacterial and fungal networks in response to tropical forest conversion, by comparing the network degree within microbial community and between microbiomes and environments under protected rainforests with those under rubber plantations. The author demonstrated a simpler bacterial network while a more complex fungal network in the rubber plantations, mainly through comparing the network degrees. The idea is novel, the method is reasonable, and the main results can advance the understanding of soil microbial shifts caused by forest conversion in tropical areas and help with the management strategies in terms of soil system. Nevertheless, I have some minor issues on the manuscript organization that should the author concern before accepted by SOIL.

1) Too much description of tropical biodiversity (both above and below ground communities) in the introduction make it difficult to concentrate on the hypotheses.

Response: Thanks for the comments. We have rewritten most of the introduction.

2) Some definitions and expressions in methods need further clarification, such as sampling interval, shared edges, keystone taxa, etc.

Response: Thanks for the comments.

Soil sampling was performed twice in 2018, once in January (dry season) and once in July (rainy season).

The number of shared edge and unique edge as well as keystone OTU were calculated to evaluate whether the network structure has changed. Shared network edge is the link (edge) between species A and species B not only exists in rubber plantation network, but also in rainforest network. Unique edge is the link only existing in rubber plantation or rainforest. Keystone OTU are known to be important for ecosystem structure and function and were selected on the basis of high network degree, high closeness centrality, and low betweenness centrality as defined by Berry and Widder (2014). The bacterial-fungal community network analysis were performed to investigate soil microbial network complexity.

Moreover, the bacterial-fungal interkingdom network analysis is proposed to investigate soil microbial network complexity.

Response: We have performed the bacterial-fungal community network analysis in the revised manuscript and the results were as follows:

The bacterial-fungal community network were more complex in rubber plantation (4284 edges in dry season, 7257 edges in rainy season) than in rainforest (3650 edges in dry season, 6507 edges in rainy season), and more complex in rainy season than in dry season. The results further revealed that rubber plantations (844 edges in dry season, 1744 edges in rainy season) have more negative links than rainforest (149 edges in dry season, 489 edges in rainy season) indicating network of rubber plantation was more stable than rainforest.

3) As the author investigates the connections of microbial communities with soil nutrients content and functional groups, further explorations about the potential effects on ecosystem functioning caused soil microbial network shifts might be important.

Response: Thanks for the comments. We have discussed the potential effects of network shifts on ecosystem functions.

Most species of Proteobacteria was positively correlated with metabolic function (Figure 7). Therefore, the reduced complexity of soil bacterial network structure in rubber plantation was mainly due to the reduction of the proportion of Proteobacteria. Due to metabolic function of a specific species usually affected by environmental conditions (Louca et al., 2018), some species are not correlated with any function in the dry season, but correlated with metabolic function in the rainy season, indicating there is a lot of functional redundancy in microbial community in dry season, especially for the rubber plantations.

4) English Grammars and some word expressions need to be improved.

Response: Thanks for the comments. We have read the manuscript carefully and eliminated many small errors.

#### **Detailed comments/technical corrections:**

L21: rainforest should be rainforests.

Response: Done.

L22-23: we used the data from Illumina sequencing and metagenome shotgun sequencing....

Response: Done.

L25: please clarify the "shared network edges".

Response: Here we defined shared network edge is that the link (edge) between species A and species B not only exists in rubber plantation network, but also in rainforest network.

L32: in rubber plantations...; please remove "higher" before links.

Response: Done.

L33: forest conversion increased fungal network complexity.

Response: Done

L34-35: maybe it is more clear as "The keystone taxa in bacterial networks shifted from Acidobacteria in rainforests to Actinobacteria in rubber plantations".

Response: thanks for the comments. We have rewritten abstract.

L37-39: it is not clear for the relationships between soil properties and microbial network structure, Please rewritten the conclusion sentence.

Response: Thanks for the comments. We have rewritten abstract.

Further analysis shows soil pH, potassium (AK), total nitrogen (TN) had more links with species of some phyla. Inclusion, forest conversion results in an increase in soil pH, and a decrease in AK and TN, and these changes as well as seasonal variations had a great impact on soil microbial composition, network structure and function.

Please add some values when describe the changes in networks.

Response: Done

L93-94: remove "[3]", did you investigate soil microbial activity?

Response: Sorry for the errors. We did not investigate soil microbial activity.

L98: Drivers and mechanisms: do you mean the soil properties or relating soil processes? Please clarify.

Response: By testing these hypotheses, we want to clarify the drivers and mechanisms of microbial community assembly that link forest conversion to differences in soil microbial network structure.

L112: Please move the sentence "Rainfall is abundant, ranging from 1000 mm to 2600 mm yearly, with an average annual precipitation of 1639 mm." to L109.

Response: Thanks for the comments. Done.

L115: When the rubber plantations have been established and what are the total areas?

Need general information of the forest conversion.

Response: Thanks for the comments. We have added some information in method part.

There are about 530, 000 hectares of rubber plantations in Hainan Island. We selected 25-30 years old rubber trees (i.e., mature rubber plantations) as our study objectives.

L118-120: What are the criteria when selecting these sampling sites?

The tropical rainforests in Hainan are mainly distributed in Bangwangling, Diaoloshan, Wuzhishan, Yinggeling and Jianfengling. Therefore, we selected a tropical rainforests in each of these sites as our study objectives. Five rubber plantations were selected in Wanning, Ledong, Danzhou, Haikou, Qiongzong, and these five rubber plantation locate in the east, south, west, north and middle of Hainan, respectively.

L122: Which soil layer?

Response: After the removal of the litter layer, by using a 5-cm diameter steel drill, top soil (0 to 20 cm) was collected, then homogenized and passed through a 2-mm mesh sieve.

L123: What means sampling interval?

Response: Sorry for the errors. Deleted "per sampling interval"

L127: Soil water content; please specify the sample store conditions;

Response: Thanks.

The other was stored in ultra-low temperature (- 80 °C) refrigerator for later DNA extraction.

L138: archaeal community was not included in the following analysis;

Response: Sorry for the errors. Deleted "archaeal".

L139: The sequence data should be deposited in an online dataset, such as NCBI;

Response: Thanks for the comment.

The raw reads were deposited into the NCBI Sequence Read Archive (SRA) database (Accession Number: SRP108394, SRP278296, SRP278319). In the revised manuscript, we put this sentence in the method part.

L183, L196-199: The connectors, module hubs and network hubs have been commonly identified as keystone taxa in network in many studies, what are the differences between these network groups and the keystone taxa that you identified in 183?

Response: Thanks for the comments. We agree that module hubs and network hubs have been commonly identified as keystone taxa in network. However, in our study, there were no module hubs and network hubs (please see figure S3 and figure S4). We adopted another standard, that is high degree, high closeness centrality and low betweenness centrality.

L228: What means "more correlations"? Please clarify.

Response: deleted "more".

237-239: Maybe the statistical comparisons of network parameters should be applied to obtain this result.

Response: Thanks for the comments.

The whole results section is wordy, to simplify by concentrating on the main results, we have deleted this sentence.

L284-288: Need statistical values or network parameters when comparing the network complexity.

Response: Thanks for the comments. The results showed that soil microbial network structure in at rainforests sites (460 edges in dry season, 1750 in rainy season) was more complex than rubber plantations (223 in dry season, 451 in rainy season) indicating that more links between microbes and function were observed in soils of rainforest..

The whole results section is wordy, Please simplify by concentrating on the main results.

Response: This part has been simplified.

L392-394: Did the rubber plantation received any fertilizer?

Response: Yes. We added this information in method. Management practices, such as latex harvest and the application of fertilizers, are used in rubber plantations. Usually, compound fertilizer (1-1.5 kg per tree) and organic fertilizers (20-25 kg per tree) were applied once or twice a year.

L420: impact on

Response: Done.

L421: What kind of implications for ecosystem functions? Could you please be more specifically?

Response: Our study demonstrates the impact of forest conversion for soil network structure, which has important implications for ecosystem functions, such as metabolic function, of soil ecosystems in tropical regions.

Figure 8: Maybe it is better to use different symbol to display environmental variables.

Response: We have redone Figure 8.