Replies to the specific comments and suggestions that reviewer made on the manuscript

Thank you so much for your kind and useful comments

S.No	Comments & Justification
1.	**Comment**: Some statements are maybe valid for Andhra Pradesh, but not globally. **Justification**: Thank you for your comment; I do agree that some statements are very well valid for Andhra Pradesh due to its climatic situations and soil conditions.
2.	**Comment**: Line 48: "In the open land use system, the bulk density is higher because of soil compaction." - why, which effects compact the soil? Maybe, it is the heat in summer time. **Justification**: In open land use systems, soil compaction contributes to higher bulk density. This is primarily due to the loss of natural soil structure, which includes aggregates and pore spaces. Compaction disrupts these structures, causing aggregates to break down under pressure from soil particles, thus reducing pore spaces and increasing bulk density. Additionally, mechanical compaction from activities like foot traffic or animal movement further reduces pore size, leading to increased bulk density. Moreover, high temperatures can exacerbate compaction by drying out surface soils, making them more prone to compaction.
3	**Comment**: Line 71: "Soil cropping practices enhance soil carbon, nitrogen and phosphorus contents" - this is a nonsense, and much more complicated. Soil carbon gets enhanced from CO2 aerial uptake resulting in the formation of fine roots, if the roots largely remain in the soil after cropping; this is not the case for e.g. onions, potatoes. Soil nitrogen gets enhanced only from the aerial uptake by leguminous crops. There is, however, almost no P-input from the atmosphere (in Europe about 0,3 mg/ha) with rain and dust. But microbes may change the solubility of phosphates in the soil by weathering P-minerals. **Justification**: Thank you for your valuable comment the study conducted by Bastida et al. (2017), which clearly states that soil cropping practices enhance soil carbon, nitrogen, and phosphorus content, potentially increasing the diversity of soil microbes. It is indeed valid to consider that atmospheric CO_2 serves as a source of enhancing soil carbon, while the retention of crop residue and organic amendments further increases soil carbon by adding organic matter. Additionally, as you rightly mentioned, leguminous crops have the ability to fix atmospheric nitrogen, thereby increasing soil nitrogen content. Furthermore, crop rotation and the use of organic amendments can improve soil phosphorus content. Through the addition of fertilizers and organic amendments in conjunction with different crops and their rotation, there is a substantial increase in soil carbon, nitrogen, and phosphorus.

	Comment - Soil carbon gets enhanced from CO2 aerial uptake resulting in the formation of fine roots, if the roots largely remain in the soil after cropping; this is not the case for e.g. onions, potatoes **Justification**: The enhancement of soil carbon through CO_2 aerial uptake occurs via photosynthesis, where plants absorb atmospheric carbon dioxide and convert it into organic carbon compounds. This process supports the growth of plant roots, including fine roots, which contribute organic matter to the soil upon decomposition, thus enhancing soil carbon content. However, in the case of certain crops like onions and potatoes, the roots are typically harvested along with the crop and are not left in the soil after cropping. Consequently, the contribution of these crops to soil carbon enhancement through root retention is limited compared to crops where a significant portion of roots remain in the soil after harvesting. Therefore, the contribution of these crops to soil carbon enhancement through root retention is limited compared to crops with a higher proportion of roots remaining in the soil after harvesting. **Comment**: Soil nitrogen gets enhanced only from the aerial uptake by leguminous crops. There is, however, almost no P-input from the atmosphere (in Europe about 0,3 mg/ha) with rain and dust. But microbes may change the solubility of phosphates in the soil by weathering P-minerals **Justification:** The comment that soil nitrogen gets enhanced solely through aerial uptake by leguminous crops is inaccurate. Leguminous crops indeed make a substantial contribution to soil nitrogen levels through biological nitrogen fixation, but atmospheric nitrogen deposition, which occurs through various mechanisms such as precipitation and dust settling, also contributes to soil nitrogen; apart from that, nitrogen also enters the soil through organic matter decomposition, fertilizer application, biological processes like mineralization. In the case of phosphorus, direct atmospheric input in the form of phosphorus is indeed minimal. However, soil microbes play a crucial role in modulating the phosphorus dynamics within the soil. These microbes are involved in the weathering of phosphorus minerals, liberating bound phosphorus, and increasing its solubility. Subsequently, the availability of phosphorus for plant uptake is facilitated by microbial action, further increasing the phosphorus levels in soils.
4.	**Comment**: Line 112: Though exchangeable potassium is rather similar, no matter which extract is used, the extractant solution mentioned in Pratt 1965 should be given, because this book might be hardly available to a broad audience. **Justification**: Thank you for your suggestion, Patt's (1965) procedure involves the extraction of potassium through ammonium acetate as an extracting solution. This procedure provides a standardized method for assessing the exchangeable potassium content in soil, which is important for understanding soil fertility and nutrient management.
5.	**Comment**: Line 134: "..increase in the pH clearly states the enhanced use of synthetic fertilizers" - This is not generally true. K-salts are neutral (KCl, K2SO4); the natural phosphates are usually acidified to yield superphosphate with sulfuric acid, or hyperphosphate with phosphoric acid. If you deliver nitrogen as ammonium, you acidify the root surface, and if you deliver nitrogen as nitrate, you alkalize the root

	surface. If in Andhra Pradesh a pH-increase from fertilization was noted (see also line 174), the wrong products were selected. Unfortunately, the authors did not deliver a market study, which fertilizers had been sold in the region. **Justification**: The statement that an increase in soil pH necessarily indicates enhanced use of synthetic fertilizers may not be universally acceptable, as various factors influencing soil pH dynamics include the type of fertilizers applied and their specific chemical properties. It has been agreeable that potassium chloride and potassium sulphate are in nature neutral, which might not affect soil pH on the application; these provide without altering the soil's acidity or alkalinity. By the addition of sulphuric acid or phosphoric acid, natural phosphorus is often processed as superphosphate or hyperphosphate, which leads to acidification. However, the degree of acidification depends on the type and amount of phosphate fertilizer used. Similarly, different nitrogen sources can influence soil pH differently; ammonium tends to acidify the root surface upon nitrification as it releases hydrogen ions into the soil, and if it is nitrate-based, then it leads to an increase in pH due to the release of hydroxide ions during nitrification. Now in the current study in Andhra Pradesh, if a pH increase has been noticed resulting from fertilization, which suggested that the selection of fertilizer may not have been suitable for the soil conditions and crop requirement, this could be due to factors such as the availability of fertilizers in the market, farmer preferences or lack of awareness about soil pH management, which was identified.
6.	**Comment**: Line 155: "...accumulation of organic carbon in perennial crops ..." which perennial crops were considered (table 1)?, was the straw taken away, or left on-site? This is too much simplified! **Justification**: In the study, the microbial biomass carbon, microbial biomass nitrogen, and microbial biomass phosphorus concentrations vary significantly across all cropping systems, with perennial crops exhibiting higher concentrations compared to others. However, the question arises whether the observed differences in MBC, N_{mic}, and P_{mic} can be attributed solely to the presence of perennial crops or other factors also play, there might be such as the fate of crop residues such as straw which influence soil microbial biomass and nutrient dynamics if the straw is removed it can lead to decrease in soil organic carbon and nutrient availability impacting microbial biomass if the straw is left, it can provide carbon and nutrient source for soil microbes, enhancing microbial biomass. Secondly, perennial crops often have a deep root system and more root biomass compared to annual crops, which might increase carbon inputs through root exudation, promoting microbial biomass accumulation, thirdly seasonal variation, and soil management practices improve soil organic matter. Moreover, soil properties also influence microbial biomass and nutrient availability.
7.	**Comment**: Line 193-195: more sand in LWA-land might be explained by the fact that weathering is favoured by microbial activity. The result of weathering of primary silicates are either clay minerals, or pedogenic oxides, which are mainly found in the clay-size fraction. Addition of sand seems obscure - the authors should explain why they had this idea.

	Justification: Microbes have a significant role in mineral weathering processes by secreting organic acids and enzymes that break down mineral particles, including sand. While microbial weathering typically affects mineral composition rather than soil texture directly, it can indirectly influence soil texture dynamics. The idea of sand addition in LWA land leading to higher sand proportions compared to silt and clay in other lands with different crops may seem hypothetical; it is grounded in the understanding of soil erosion processes (water erosion, wind erosion that can selectively remove finer soil particles, leaving behind coarser particles like sand) land management practices (where tillage, cultivation, and irrigation can disturb soil structure and promote soil erosion, that can lead to the displacement and redistribution of soil particles, with finer particles like silt and clay being more susceptible to erosion than sand), and soil texture dynamics.
8.	**Comment**: Line 198: " ... the PCM lands have higher water retention ..." - this is logical. Fine roots remain in the soil after removal of the crops, which degrade or are fed by worms, and the resulting channels can be filled with water. **Justification**: The higher water retention capacity observed in PCM lands compared to other lands can be attributed to a combination of factors, including organic matter accumulation, root development (extensive root systems create channels for water infiltration and extraction from deeper soil layers increases water retention capacity), soil structure and aggregation (continuous cropping increase stability of soil aggregates which creates macropores and micropores that hold water and allow for better water movement), crop rotation (different crops have varying root architecture and water uptake patterns which can complement each other), reduction of soil erosion, and microbial activity (enhancing soil aggregation and cycling nutrients).
9.	**Comment:** Line 204: ".. continuous cultivation results in the compaction of the soil layers .." --> too heavy agricultural equipment? Increased water consumption by crops? Formation of roots should have the opposite effect! **Justification**: True, continuous cultivation results in the compaction of soil layers, loss of soil structure (mechanical action compacts the soil, reducing pore spaces and increasing bulk density), reduction in organic matter (decline in soil organic matter can contribute to soil compaction and higher bulk density), decreased microporosity (reduction in microporosity limits water infiltration and air exchange further enhances bulk density), and loss of soil aggregation (extensive cultivation can break soil aggregates which reduces the stability of soil structure).
10	**Comment**: Lines 229/230: for me, this is no correlation! **Justification**: A coefficient close to zero implies a weak or negligible linear relationship between soil electrical conductivity (EC) and nutrient concentrations. While these correlations may not be practically significant, they still provide valuable perceptions of potential associations between variables. Although the correlation coefficients for nitrogen and phosphorus are small, they indicate a slightly positive relationship between soil EC and the concentrations of these nutrients. This indicates that as soil EC increases, there may also be a slight tendency for nitrogen and phosphorus concentrations to increase. While the correlation is weak, it may still reflect fundamental processes such as nutrient cycling, soil fertility, or management practices that influence both soil EC and nutrient availability. Similarly, the negative

	correlation coefficient for potassium suggests a weak negative relationship between soil EC and potassium concentrations. This means that as soil EC increases, there may be a slight tendency for potassium concentrations to decrease. Again, while the correlation is weak, it may reflect factors such as soil mineralogy, nutrient uptake by plants, or fertilizer applications that influence both soil EC and potassium availability.
11.	**Comment**: Line 254: "..oversaturation of microbes.." what should that be? If there are too many nutrients plus water, there is danger of anoxia, sulfate reduction, ammonia formation and the like! **Justification**: Yes, nutrient limitation can constrain microbial biomass and activity in soils, while nutrient excesses, combined with waterlogging, can lead to the over-saturation of microbial populations and the potential for detrimental processes such as anoxia, sulfate reduction, and ammonia formation
12	**Comment**: Line 290: when you consider the P/P-mic ratio, do not forget that the P is from the Olsen extract, which has been invented as exchangeable versus bicarbonate; this is not the total or the CAL-P! **Justification:** By comparing the P/Pmic ratios obtained using the Olsen-extract method with either total phosphorus or CAL-P, one can assess the relationship between phosphorus availability and microbial biomass phosphorus using different phosphorus extraction methods. This comparison provides comprehension of the dynamics of phosphorus cycling in the soil and its availability to microbial communities.