Effect of the conversion of paddy fields to uplands on the soil organic matter dynamics in Shonai area, northeastern Japan

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Rice paddy ecosystems are specific because of the long period of soil flooding during the rice growing season. This recurent situation create anoxia and the establishment of reductive conditions in soils, which is a strong determinent for the soil organic matter (SOM) transformation and decomposition. The rice production in Japan reached a level of overproduction several decades ago, leading the authorities to incitate the conversion of rice paddiy fields to upland soils in order to diversify the food production in Japan. For this reason, large agricultural areas were converted and underwent drastic changes in redox conditions. The objective of this research is to determine how the conversion of paddy fields into upland soils modify the stocks of C and N as well as the composition of SOM. The composition of SOM was assedssed throught the fluorescence properties of dissolved organic matter. Our hypothesis was that chemically labile, easily degradable organic compounds were preserved in paddy soils because of the reductive conditions limiting the microbial decomposition of organic matter.

We collected samples in the Shonai area, in Yamagata prefecture, in a location were agricultural surface used rice production was reduced during the last 40 years. Four replicates were sampled in the following fields:Two rice paddies, four upland fields mainly used for buckwheat production, one orchard where chestnuts are planted and one wetland that developped naturally since the abandon of rice cultivation.

We did not observe a clear effect of landuse change on C and N stocks, but a slight decrease in C to N ratio was observed in the soil now used for buckwheat cultivation. We also measured an increase in the C stable isotope enrichment for these soils. These results suggest that the composition of SOM was modified after the landuse conversion, that can be explained by the favorized decomposition of isotopically light organic compounds (lignins and phenols) in upland soils compared to the rice paddy soils. Moreover, we found that less SOM was water-soluble in the soil after landuse conversion and the water-soluble organic matter in these soils is more aromatic, have larger molecular weight and is less biodegrable.

To conclude, we showed that the conversion of rice paddies to upland soil do not lead to a shift in SOM stocks but the composition of SOM is altered by the landuse conversion, which may be mostly controlled by the change in redox conditions for the soil ecosystem.

Keywords: rice paddy fields, landuse change, soil organic matter SOM, C and N stocks, DOM fluorescence

