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A summary of the LINKS-Tetratech Nigerian SRI Pilot Study Report

This is a summary by SRI-2030 of the study: "Report of soil and GHG monitoring for the system of rice intensification (SRI) under rainy season for the LINKS-SRI project in Kano and Jigawa states", by M. Bello, A. Shuaibu, B. Shehu, and B. Lawan. Further information for the project can be found at https://www.links-nigeria.com/climate-smart-agriculture/

Introduction

LINKS engaged the Center for Dryland Agriculture (CDA), Bayero University, Kano, to undertake a study of soil carbon sequestration and of greenhouse gas (GHG - methane, carbon dioxide, and nitrous oxide) emission over 27 representative fields in a rainy season pilot project across Kano and Jigawa States where System of Rice Intensification (SRI) rice-growing methods are being introduced by the LINKS project. Two sets of measurements were taken at each location (one In the SRI fields and another In the control fields) and the CDA followed standard protocols for conducting the studies. The methodology used for the soil carbon sequestration studies included collecting soil samples from individual fields at both baseline (before starting rice cultivation) and endline (after the crop harvest). Baseline and endline sampling were carried out similarly on neighbouring non-SRI control plots for comparison.

Parameters measured included soil pH, electrical conductivity, soil texture, organic carbon, total nitrogen, available phosphorus, exchangeable cations, and available micronutrients. The soil organic carbon data at baseline and endline were used to estimate the real carbon sequestration rate[1] following methods developed by Rodigro (2009). An average period of 110 days was used as the time interval between the baseline and endline survey.

For the GHG emission trials, field measurements were done by collecting gas using the static closed-chamber technique. GHG emissions were monitored at five critical growth and management stages: early rice growing stage (2-3 weeks after transplanting); first fertiliser application stage; second fertiliser application stage; maturity (reproductive) growth stage; and at harvest stage.

Results

Carbon Sequestration

Soils in all locations were sandy, which calls for proper application of organic fertilisers to improve the moisture content of the soils. Overall, fertility parameters showed poor fertility which requires intensive to semi-intensive fertility management. There was a reduction in N, P, K, and Cu levels in the soil after SRI cultivation, which was expected due to the high demand for these nutrients by rice. However, there was an increase in soil organic carbon and soil organic matter seen at the end of the SRI trial.

The implication is that the depleted nutrients will be replenished and increased before the end of the season with proper decomposition of applied organic matter. Overall, the soil organic matter and soil organic carbon gains after SRI are a huge positive for the soil as both its fertility and physical characteristics are improved.

[1] Real carbon sequestration rate = Change in carbon stock in treatment by the time between treatments

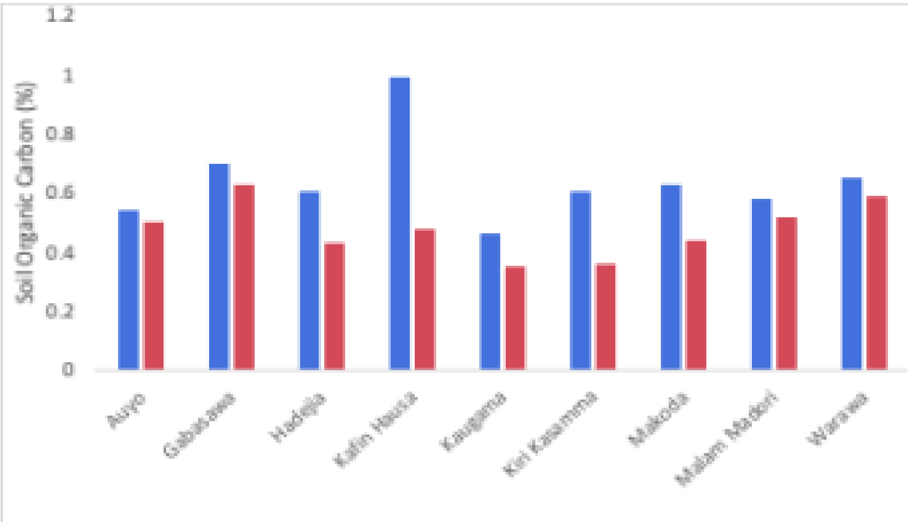

Figure 1. Difference in organic carbon (%) in soil after (blue) and before (red) SRI is applied

Real carbon sequestration rates ranged approximately between 180 and 350 t/ha. Since there were no baseline data for real carbon sequestration rates for the areas under study, it was difficult to have a defined metric to measure the real carbon sequestration. Considering that 21 kg of carbon is sequestered by an average tree per year, it was concluded that the real carbon sequestration resulting from the adoption of SRI in the study sites is enormous. The variation in real carbon sequestration across locations is an indication of the gains that are possible across different ecological biomes.

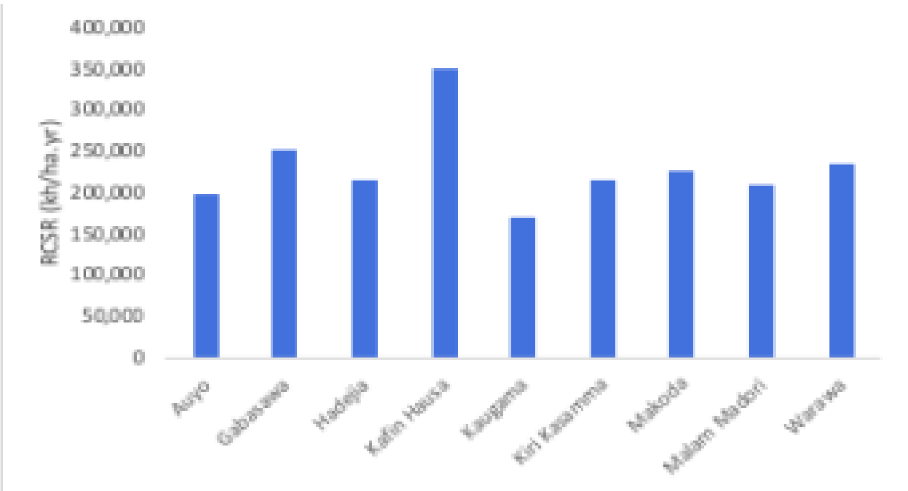

Figure 2. Real Carbon Sequestration Rate (RCSR) (kg/ha/yr) across the study area using SRI practices

Greenhouse gas emissions

This study indicated that the adoption of SRI led to a significant decrease in emissions of methane, carbon dioxide, and nitrous oxide across all locations. In some locations, the control fields emitted up to 41% more methane than the SRI fields, in other locations the difference in emissions was less than

5%. The differences in emissions between SRI and non-SRI fields was less pronounced for carbon dioxide than for methane. Nevertheless, more carbon dioxide was emitted across all non-SRI fields compared with the SRI fields.

Similar findings were observed for the nitrous oxide data. It has been expected that changing from non-SRI to SRI cultivation would increase nitrous oxide because soil management changes from anaerobic to aerobic conditions, but that was not seen in this evaluation. The reduction In N_2O emissions by changing from inorganic to organic fertilisation outweighed the increase from moving from continuously flooded to intermittently flooded rice fields. That the package of SRI practices can reduce nitrous oxide as well as methane and carbon dioxide is important because N_2O is a much more potent greenhouse gas than CH_4.

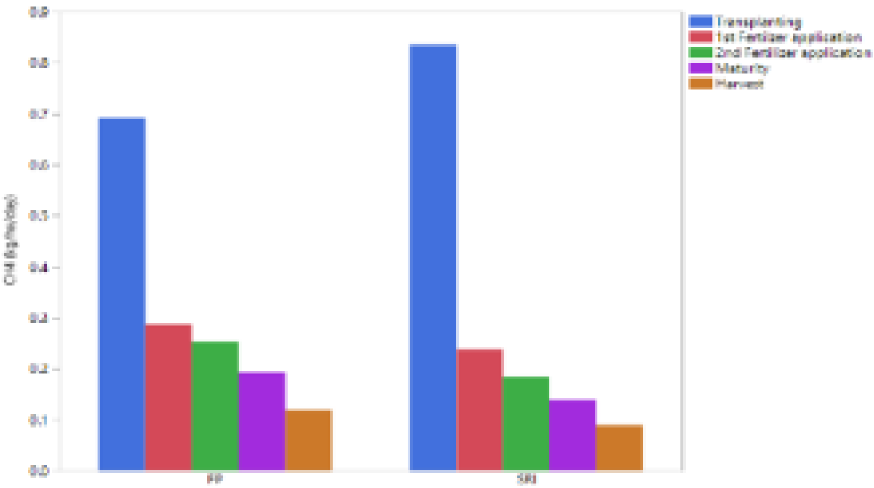

Figure 3. Taken from GHG report, comparing CH_4 fluxes between SRI and FP fields in all locations

Throughout the various measurement periods, more methane was emitted at baseline than at any other time, the methane fluxes kept reducing throughout the season with more emissions in non-SRI fields than SRI fields. This demonstrates the benefits of SRI practices for the reduction of methane emissions. For carbon dioxide, the SRI plots were found to be serving as carbon dioxide sinks rather than sources. Furthermore, the non-SRI fields had more nitrous oxide emissions than the SRI fields because of the use of inorganic nitrogenous fertilisers and the flooding of the fields.

Additional results reported from this study included an increase in average yield across farmer groups. Lead farmers from Kano demonstrated an average yield of 3.41 Mt/Ha from SRI fields, compared with 2.36 Mt/Ha from comparator sites. Yields from SRI fields of lead farmers from Jigawa demonstrated an average yield of 7.35 Mt/Ha compared with 3.47 Mt/Ha from comparator sites.

Conclusion

These initial results found reductions in methane, carbon dioxide, and nitrous oxide emissions, all three major greenhouse gases, as well as increased carbon sequestration in SRI fields compared with the non-SRI control fields. This latter effect, which also helps to abate global warming dynamics, is attributable to the much larger rice root systems that SRI cultivation induces. The larger and deeper systems take $CO_2$from the atmosphere and deposit it in the soil. Larger roots, with larger plant canopies carrying out more photosynthesis, also exude more carbon-based compounds (sugars, organic acids, amino acids) into the soil where they support larger populations of microbes, mesofauna, and earthworms which also increase the amount of carbon in the soil.

These gains were recorded over a limited number of fields and in just one production cycle, and we await more data from the dry season pilot. Nonetheless, these results prove to be promising indicators of the beneficial role of SRI as a climate-smart agricultural practice.