

# APPLICATION OF PRECISION AGRICULTURE IN CARBON FARMING PRACTICES USING THE REAL-TIME SOIL SENSOR

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## ABSTRACT

Agricultural soil presents a significant potential for mitigating climate change as atmospheric carbon dioxide can be sequestered by improving the farming manners, which nowadays refer to an emerging concept named “Carbon Farming”. This paper presented a Carbon Farming case study in Aguri co. Ltd in Japan based on the technology of precision agriculture. The fields were investigated using the real-time soil spectrophotometer and the data collected from 9 fields from 2004 and 2008 were selected for a more detailed analysis. A significant temporal variability of TC was observed in each field from 2004 and 2008, which indicated the capacity of agricultural activities for sequestering carbon over times. However, the rates of sequestration are dynamic since the spatial variability of TC is also significant. The vertical distribution patterns of soil C and N in the top soil of 30 cm were also investigated and a sampling depth of 15-20cm by RTSS for carbon farming is recommended.

**Keywords:** the RTSS, total carbon, total nitrogen, soil maps, sampling depth

## INTRODUCTION

Agricultural soils are increasingly recognized as an effective means for mitigating climate change since carbon dioxide (CO<sub>2</sub>) can be significantly sequestered by improving farming practices. The additional carbon captured in soils present potential carbon credits for farmers. Japan has committed to reduce CO<sub>2</sub> emissions by 25% below 1990 levels by 2020. To achieve this ambitious target, it is meaningful to explore the potential of Japanese paddy fields for carbon sequestration as they account for 55% of all agricultural filed. This study hence aims to investigate the feasibility of carbon farming in paddy fields through a case study of Precision Agriculture (PA) pioneer in Japan.

## **MATERIALS AND METHODS**

The study was conducted in Matsuyama city in Japan, where a number of paddy fields of small size are managed by an agricultural company - Aguri co. Ltd, following the PA principle.

The fundamental instrument to quantify and map within/between-field variability of soil characteristics is the real-time soil sensor (RTSS) (SAS1000, made by Shibuya Machinery Co. Ltd), which measures the reflectance of soil at wavelengths of 400nm to 2,400nm at the speed of 1.1km/h. In line with the Duke gold standard, 9 fields of 65 Aguri fields were chosen and soil information has been collected by RTSS after harvest annually for 5 years since 2004.

In order to find out whether the changes in TC and TN are statistically significant, one-way analysis of variance (ANOVA) was performed using statistical package for the social sciences (SPSS). To investigate the vertical distribution of TC and TN, soil samples were also taken from different depth and were measured by dry combustion method using a Sumigraph NC-80 analyze in laboratory.

## **RESULT**

The value of TC and TN measured by the RTSS in 9 fields from 2004 to 2008 were measured and a great dynamic of changes in TC and TN was observed not only over time, but also across the fields. Although holistically the trends of TC are fluctuate, some evident increase in TC and TN still can be observed in majority numbers of fields.

Based on the results of the ANOVA, changes in TC and TN in the 9 fields have occurred significantly over time and across the fields. This significant temporal and spatial variability in TC and TN in the 9 fields from 2004 to 2008 can also be observed through TC and TN map of each field of each year.

Distribution of TC concentrations in the soil profiles were demonstrated by soil depth maps. The distribution of TC is strongly stratified with depth of soil. The highest C concentration was observed in top 5cm, and as the depth deeper, the TC concentration became lower. TN distribution in depth followed the same pattern with TC. Finally, the factors that may attribute to the effectiveness of carbon farming are identified as field type and soil type, climatic factors, and organic fertilization based on other literatures.

## **CONCLUSION**

Based on the soil information collected by the RTSS from 2004 to 2008, soil TC and TN in 9 fields managed by Aguri Co. Ltd were analyzed. According to the results, there is a feasibility of carbon farming for the Japanese Paddy fields, however, the effective carbon farming practices rely on how farmers would like to utilize the information and co-operate various factors.