氣候變遷下台灣農地碳匯潛勢與水資源相關性之研究

A Study on the Relationship between Carbon Sink Potential and Water Resource of Taiwan's Agricultural Lands under Climate Change

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摘　要

再生農業的目的在於將碳儲存於土壤與地上生質量，以減低大氣中的溫室氣體，同時又能增加農作物產量、提昇對不穩定氣候的韌性、以及改善農村社區的健康與活力。其原則包括：不斷地改善農業生態系統（土壤、水、與生物多樣性）、因地制宜與整體性的決策、公正的交互關係、小至個人大至社區都持續成長演進。本文將對改善農業生態系統此一原則加以深入探討。

再生農業的農法包含：減少對土壤物理干擾的保護性耕作、增加田地的生物多樣性、可增加土壤碳並且阻止侵蝕的覆土作物、可促使土壤養分均衡使用的輪作、以及不施用化學肥料與農藥等。

與有機農業類似，再生農業也需要一套檢核標準，而負責制定這套認證標準的是國際組織 Regenerative Organic Certified 簡稱 ROC，規章中有寫到三大不同領域的認證，分別是土壤健康與土地管理、動物福利、農場主與勞工公平性。

至於農業碳權的認證部分，Verra 為市面上佔比最大的一家碳標準（Carbon Standards）機構，2021 年有將近八成的碳信用計劃都是採用 Verra 的標準（名叫 Verified Carbon Standards）並且審核通過的，其中對於農林業的碳標準稱為 AFOLU（Agriculture, Forestry, and Other Land Use Project），AFOLU 又細分為四大類別，分別為「植樹造林，再生林，植被恢復」、「農業土地管理」、「改善森林管理」、「減少森林砍伐與退化造成的碳排」。

本研究之內容，首先探討農業土壤的各個物理參數與其碳匯量的關係，主要包含含水量、孔隙率、地上生物量、微生物量等等。接著，就台灣地區之環境，研究各農區的碳匯量與水資源的相關性，並且推估在氣候變遷的影響下，各農區未來的碳匯潛勢。

關鍵詞：再生農業、農業碳匯、農業水資源、農業土壤、氣候變遷

Abstract

The purpose of regenerative agriculture is to store carbon in soils and aboveground biomass to reduce greenhouse gases in the atmosphere, while increasing crop yields, increasing resilience to unstable climates, and improving the health and vitality of rural communities. Its principles include: continuous improvement of agricultural ecosystems (soil, water, and biodiversity), localized and holistic decision-making, fair interactions, and continuous growth and evolution from individuals to

communities. This article will take a closer look at the principle of improving agricultural ecosystems.

Regenerative farming practices include: conservation tillage that reduces physical disturbance to the soil, increased biodiversity of the field, cover crops that increases soil carbon and prevents erosion, crop rotation that promotes balanced use of soil nutrients, and the absence of chemical fertilizers and pesticides, etc.

Similar to organic agriculture, regenerative agriculture also requires a set of inspection standards, and the international organization Regenerative Organic Certified for short as ROC is responsible for formulating this set of certification standards. There are three different areas of certification written in the regulations, namely soil health and land management, animal welfare, farmer and labor equity.

As for the certification of agricultural carbon credits, Verra is the largest carbon standards organization on the market. In 2021, nearly 80% of carbon credit plans will adopt Verra's standards (Verified Carbon Standards) and have passed the review. Among them, the carbon standards for agriculture and forestry is called AFOLU (Agriculture, Forestry, and Other Land Use Project). AFOLU is subdivided into four categories, namely "Afforestation, Reforestation and Revegetation (ARR) ", "Agricultural Land Management (ALM) " , "Improved Forest Management (IFM) ", "Reducing Emissions from Deforestation and Degradation (REDD) ".

The content of this study discusses the relationship between various physical parameters of agricultural soil and its carbon sink, mainly including water content, porosity, aboveground biomass, microbial biomass and so on. Next, regarding the environment in Taiwan, the correlation between carbon sinks and water resources in each agricultural area is studied, and the future carbon sink potential of each agricultural area is estimated under the influence of climate change.

Keywords: Regenerative Agriculture, Carbon Farming, Agricultural Water Resource, Agricultural Soil, Climate Change.