Tropentag, September 16-18, 2026, hybrid conference

"Towards multi-functional agro-ecosystems
promoting climate resilient futures"

Regenerative integrated aerohydroculture within a circular agricultural bioeconomy for flood- and climate-resilient, low-emission paddy systems

Diyah Sri Utami[1], Asroni[2], Apip Hermawan[2], Kustiwa Sudrajat Adinata[2], Silke Stöber[3], Astari Widya Dharma[3], Mieke Setiawati[1], Tualar Simarmata[1]

[1] *University of Padjadjaran, Department of Soil Science and Land Resources, Faculty of Agriculture, Indonesia*

[2] *Indonesia Peasant Community Organization (JAMTANI), Indonesia*

[3] *Humboldt-Universität zu Berlin, Centre for Rural Development (SLE), Germany*

Abstract

Regenerative agriculture within a circular bioeconomy is increasingly recognised as a strategic pathway to achieve low-emission and climate-resilient rice systems, particularly in flood prone environments. The systems optimise biological resources, enhance nutrient cycling and strengthen ecosystem resilience to sustain long-term productivity. This study aims to evaluate the effectiveness of Regenerative Integrated Circular Aerohydroculture (RICA) in improving soil health, nutrient-use efficiency, carbon sequestration and productivity in flood prone and climate resilient paddy systems. The study was conducted from November 2025 to February 2026 in Pangandaran using a farmer-led participatory approach, with farmers actively involved in experimental design, monitoring and documentation. RICA integrates crop production, livestock and green bioinputs, including *Azolla,* biochar-based organic bioameliorant briquettes (BOB) and green liquid *Azolla* biofertiliser (GLAB), utilising locally available biomass such as rice straw, banana stems, maize stalks and livestock waste to enhance nutrient cycling and soil organic matter. Treatments included *Azolla* (500 g $m^{-}2$), BOB (1 t ha^{-1}), and GLAB (40 L ha^{-1}, foliar application), combined with the integration of 500 Nile tilapia fingerlings and 100 Mojosari ducks to support nutrient cycling and natural fertilisation. Result showed significant increases in soil microbial biodiversity, with total bacteria reaching 3.5×10^8 CFU g^{-1}, fungi 4×10^4 CFU g^{-1}, nitrogen-fixing bacteria 5×10^6 CFU g^{-1}, and phosphate-solubilising bacteria 5.8×10^8 CFU g^{-1}. *Azolla* contributed 45.73 kg N ha^{-1}, while carbon sequestration reached 712.12 kg C ha^{-1} (2.61 t CO_2-eq ha^{-1} per cycle). Agronomic performance improved, including higher 1000-grain weight, productive tillers, filled grain percentage and rice yields of 6–7 t ha^{-1}. The system also produced 87 kg of Nile tilapia per cycle, indicating enhanced productivity and income diversification. RICA strengthens circular agricultural bioeconomy practices by improving biodiversity, nutrient circularity, carbon sequestration and system resilience, offering a scalable strategy for low-emission, flood and climate resilient rice farming systems.

Keywords: Carbon stock, economy circular, farmer led-research, integrated rice–fish–duck farming

Contact Address: Diyah Sri Utami, University of Padjadjaran, Department of Soil Science and Land Resources, Faculty of Agriculture, Jalan raya bandung sumedang km 21 jatinangor, 45363 Sumedang, Indonesia, e-mail: diyahsriutami81@gmail.com