

德基水庫集水區農業非點源污染削減效益評估： 以友善農法為例

Evaluation of Agricultural Non-Point Source Pollution Reduction in Techi Reservoir Watershed Exemplified by Rational Fertilization

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摘 要

德基水庫集水區為臺灣中部重要流域及水源，於極端氣候變遷衝擊下，頻繁強降雨與溫度增加，使當地農業活動貢獻氮磷營養鹽因地表逕流輸入集水區之風險增加。當地主要種植作物包括茶葉及水果等，其中以水蜜桃、李子、甜柿、蘋果及梨子為水果之大宗。為減緩集水區非點源污染潛勢，本研究於德基水庫集水區右岸入庫河川周邊，鑑別一處具代表性果園（水蜜桃）進行友善農法試驗，設計四組不同農法策略，包括：慣行農法、不減量施肥搭配溶磷菌、減量 25% 施肥搭配溶磷菌，以及減量 50% 施肥搭配溶磷菌，進行環境樣本蒐集與成效分析，期望提升土壤中磷素利用效率，並確保作物產量與土壤健康。本研究試驗期間針對土壤、地表逕流水、土壤孔隙水、葉片與果實進行定期採樣與成分分析。土壤部分檢測 pH 值、導電度、有機碳、氮、鉀、鈉、鈣、鎂與磷等指標；同時建置施肥管理紀錄制度，記錄肥料種類、施用時機與用量等資料，作為施肥行為與環境變化關聯性之依據。經由環境與作物樣本綜合分析各策略對營養鹽吸收效率與非點源污染削減效益，評估最適合當地條件之施肥管理方案。根據試驗結果顯示，採用友善農法手段有助於提升作物對磷素之吸收效率，並有效降低土壤中磷素累積與地表逕流中之磷濃度，對集水區非點源污染削減具正面效益，未來可將此試驗作為友善農法之推廣依據，共創健康流域管理及氣候韌性農業等綜合效益。

關鍵詞：非點源污染，集水區管理，合理化施肥，友善農法，土壤健康

Abstract

The Techu Reservoir is a crucial watershed and water source in central Taiwan. Under the influence of climate change, increasingly frequent extreme rainfall events have intensified the transport of nitrogen and phosphorus into the reservoir via surface runoff. The surrounding agricultural area is dominated by tea plantations and fruit orchards, with major fruit crops including peach, plum, persimmon, apple, and pear. To mitigate the risk of non-point source pollution (NPSP), this study selected a peach orchard located along the reservoir's right-bank inflow river as a demonstration site to conduct field-based rational fertilization trials. Four fertilization treatments were implemented: (1) conventional farming practices, (2) full-rate fertilization with phosphate-solubilizing bacteria (PSB), (3) 25% fertilizer reduction with PSB, and (4) 50% fertilizer reduction with PSB. Environmental samples were collected and analyzed with the goal of enhancing phosphorus use efficiency in soils while maintaining crop yield and promoting soil health. Regular sampling of soil, surface runoff, soil pore water, leaf tissue, and fruit was carried out to assess nutrient content. Soil samples were analyzed for pH, electrical conductivity, organic carbon, and concentrations of nitrogen, potassium, sodium, calcium, magnesium, and phosphorus to evaluate the presence and dynamics of trace elements. Using integrated data from soil, water body, and plant, the effectiveness of each fertilization strategy on nutrient uptake and nonpoint source pollution mitigation was evaluated to identify the most appropriate fertilization management plan for local conditions. Trial results indicate that eco-friendly farming strategies significantly improve phosphorus uptake efficiency, reduce soil phosphorus accumulation, and lower phosphorus concentrations in surface runoff. These outcomes highlight the potential to mitigate NPSP. These findings underscore the potential of sustainable farming practices to mitigate NPSP. The outcomes of this study offer a solid foundation for promoting eco-friendly farming in mountainous watersheds, reducing dependence on chemical fertilizers, and ultimately contributing to improved water quality in the Techu Reservoir. This trial may serve as a model for the future promotion of eco-friendly agriculture, supporting integrated benefits such as healthy watershed management and climate-resilient farming.

Keywords: Non-point source pollution, rational fertilizer, eco-friendly farming, soil health

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