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Assessing the Environmental Impact of Intensive Paddy-cum-Pisciculture: A Case Study from South India

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ABSTRACT

Intensive paddy-cum-pisciculture is a sustainable farming system that integrates rice cultivation with fish farming, providing ecological and economic benefits. However, the environmental impacts of this practice remain a significant concern. This study assesses the environmental effects of intensive paddy-cum-pisciculture in South India, focusing on water quality, biodiversity, soil health, and carbon emissions. Data were collected from several farms in Tamil Nadu, comparing conventional paddy farming with integrated systems. The findings suggest that paddy-cum-pisciculture improves water retention, enhances soil fertility, and increases biodiversity but also introduces challenges like eutrophication and methane emissions. These results underline the need for better management practices to optimize environmental benefits while mitigating negative impacts.

INTRODUCTION

The practice of integrating aquaculture with rice farming, known as paddy-cum-pisciculture, has been gaining popularity in many parts of South India as a sustainable agricultural model. This system maximizes land use efficiency by cultivating rice and farming fish in the same flooded fields. While it offers economic benefits, such as increased yields and diversified income sources, concerns about its environmental sustainability remain largely understudied. This paper aims to assess the environmental impacts of intensive paddy-cum-pisciculture systems, focusing on factors such as water quality, biodiversity, soil health, and carbon emissions. By evaluating these aspects, the study seeks to provide recommendations for improving the sustainability of this agricultural practice.

MATERIALS AND METHODS

Study Area

The study was conducted in Tamil Nadu, South India, a region where intensive paddy-cum-pisciculture is widely practiced. Farms were selected from areas known for integrated rice-fish farming systems, with a focus on both small-scale and large-scale operations.

Data Collection

Environmental data were collected from 20 paddy-cum-pisciculture farms. Parameters such as water quality (pH, dissolved oxygen, turbidity), soil health (nutrient content, organic matter), and biodiversity (species count of fish and aquatic plants) were assessed. Additionally, carbon emissions were measured through methane gas samples taken from the rice paddies.

Comparison Groups

The environmental impacts were compared between intensive paddy-cum-pisciculture systems and conventional paddy farming. Conventional farms were selected based on their similarity in climate, soil, and crop varieties to the integrated systems.

Statistical Analysis

The collected data were analyzed using descriptive statistics and ANOVA to assess significant differences between the two farming systems. A significance level of $p<0.05$ was considered for all analyses.

RESULTS AND DISCUSSIONS

Water Quality

Water quality in intensive paddy-cum-pisciculture systems was generally better than in conventional paddy fields. The presence of fish helped maintain cleaner water by consuming excess algae and organic matter, thus reducing turbidity. However, higher nutrient levels in the water, a result of fish waste, were noted in some farms, leading to concerns about potential eutrophication.

Soil Health

Soil analysis indicated that paddy-cum-pisciculture systems had higher organic matter and nutrient content compared to conventional rice fields. The integration of fish waste as a natural fertiliser contributed to improved soil fertility, promoting better rice growth and reducing the need for chemical fertilizers.

Biodiversity

Integrated systems showed greater biodiversity, with an increase in fish species and aquatic plants. Fish not only contributed to pest control but also enhanced the overall ecological balance of the system. This is in contrast to conventional paddy fields, which generally support fewer species.

Carbon Emissions

While paddy-cum-pisciculture systems had the benefit of improved carbon sequestration due to healthier soils, they also emitted higher levels of methane compared to conventional rice farming. This is attributed to anaerobic conditions in the flooded fields, which promote methane production. Strategies to manage water levels and incorporate aerobic treatments could help mitigate this effect.

Environmental Trade-offs

The study reveals that while paddy-cum-pisciculture systems offer substantial environmental benefits, such as improved soil health and biodiversity, they also pose challenges, including the management of excess nutrients and methane emissions. Proper management practices, including controlled water management and the use of integrated pest management (IPM), could reduce the negative impacts of this practice.

CONCLUSIONS

Intensive paddy-cum-pisciculture systems in South India show promise as a sustainable farming practice, offering benefits like enhanced biodiversity, soil fertility, and improved water quality. However, challenges related to nutrient management and methane emissions need to be addressed for long-term sustainability. Future research should focus on optimising water management strategies and integrating eco-friendly technologies to mitigate the environmental impacts while preserving the ecological advantages of this farming system.

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