

# The Sustainable Symphony of Rice-Duck Farming

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## ABSTRACT

Rice-duck farming represents an innovative and sustainable agricultural system that synergizes rice cultivation with duck rearing, offering significant environmental and economic benefits. This integrated approach minimizes the dependency on chemical pesticides and herbicides by employing ducks as natural agents for pest and weed control. The ducks' activities, including foraging and trampling, naturally enhance soil health by increasing nutrient levels and improving soil aeration, thereby contributing to higher rice yields. Additionally, rice-duck farming has been shown to reduce methane emissions from rice paddies, aligning with global efforts to mitigate climate change. While this farming method holds considerable promise, challenges such as the initial capital investment and the complexities of managing duck populations must be addressed to facilitate its wider adoption in sustainable agriculture.

## INTRODUCTION

Human life is intrinsically linked to agricultural production, with agriculture serving as one of the most prevalent forms of employment globally. Among the various crops cultivated, rice stands out as one of the most significant agricultural commodities worldwide. The current rice production system heavily relies on the use of agro-chemicals, including fertilizers and pesticides, often applied in large quantities. These chemicals, especially pesticides, pose significant environmental risks as they can contaminate water sources and accumulate in the tissues of animals and humans at toxic levels. In recent years, the need to address health concerns related to pesticide residues and chemical substances in agricultural products, along with their impacts on human health and the environment, has prompted the consideration of alternative methods. In this regard, organic farming has emerged as a widely accepted, environmentally friendly alternative that avoids the use of synthetic chemicals. Among the organic farming, one of the most popular systems is Integrated Rice Duck Farming. In the rice-duck cultivation system, rice serves as the primary crop, while ducks play a crucial role as a key component of the ecosystem (Noorsuhaila *et. al.*, 2020). Ducks are recognized as a natural biological control agent within the rice fields, effectively managing pests and weeds. This integrated approach promotes sustainable agricultural practices and enhances environmental protection.

### What is Rice Duck Farming?

Rice-duck farming system, as a mode of free-range rearing system, in which raises ducks in fenced paddy fields within the rice growing season according to a principle of ecological food chain. During the day, ducks roam among the rice seedlings, feeding on pests and

consuming or trampling weeds. Their movement across the fields also helps to mix the surface water with the soil, which in turn stimulates rice tillering. This practice is prevalent in several Asian countries, including Japan, China, Vietnam, and the Philippines, where rice is a staple crop. In Japan, this method is popularly known as 'Aigamo- rice cultivation'. Integrating rice cultivation with crossbred duck farming, a practice known as mixed farming, allows small-scale farmers to harvest both rice and additional products such as duck meat and eggs from the same land simultaneously. Moreover, the ducks' droppings naturally enrich the soil by supplying essential nutrients to the rice crops.

In Rice Duck Farming, Ten days after transplanting, 20-day-old ducklings are introduced into the plots at a density of 350–400 birds per hectare. Initially, the ducklings are allowed to stay in the plots for 2–4 hours daily for the first three to five days. Subsequently, they are left in the plots from morning until evening. Protective measures are implemented to safeguard the ducklings from predators and to restrict their movement within the designated areas. By the time the rice reached the flowering stage, the ducklings, which are now four months old, removed from the fields. These ducks are then either sold or continued to be raised in the usual manner (Mofidian and Sadeghi, 2015).

The rice-duck system proves to be more economically beneficial and environmentally friendly compared to the traditional method of growing rice alone.

### How does it work?

The relationship between the rice plants and ducks is mutually beneficial. The beneficial effects of the system are discussed below:

### Effect on Yield of Rice:

The rice-duck system significantly improves the key characteristics that contribute to higher rice yields. This includes an increase in the number of tillers per hill, a greater number of grains per panicle, and an enhancement in the average grain weight. These combined factors lead to a substantial boost in overall rice productivity. Duck causes a ten-percent-increase in grain yield in comparison with a treatment by duck's absence (Hossain *et. al.*, 2005). The length and width of flag leaf which has a main role in filling of grains at the end of growth season, is more in rice duck farming system.

### **Effect on Pest Population:**

The populations of the green leafhopper, brown plant hopper, zigzag leaf hopper, rice bug, short-horned grasshopper, and long-horned grasshopper are significantly lower in rice-duck plots compared to farmers' plots without ducks. In rice-duck plots, ducklings play a crucial role in pest management by efficiently catching and consuming insects. This natural method of pest control leads to a substantial decrease in the insect population, contributing to healthier rice plants and reducing the need for chemical pesticides. The integration of ducklings into rice cultivation not only enhances ecological balance but also supports sustainable farming practices. Raising ducks in paddy fields effectively reduces the risk of damage to rice plants from invasive species, such as the golden apple snail (*Pomacea canaliculata*).

### **Effect on Weed Population:**

Weeds have a significant impact on rice yield. The density of weed plants per square meter is notably lower in the rice-duck plots compared to the traditional sole-rice plots managed by farmers. *Echinochloa crusgalli*, *Scirpus mucronatus*, *Monochoria vaginalis* and *Fimbristylis miliaceae* are the predominant weed species generally observed in the rice

field. Ducks are found to eat young weed plants and weed seeds for which weeds are controlled without the use of herbicides. Moreover, their trampling activity also kept the weeds under control by as much as 90%. Furthermore, duck activity effectively inhibits not only common weeds but also certain weeds that are difficult to control with herbicides, such as *Paspalum distichum* L., *Eclipta prostrata* L., *Marsilea quadrifolia* L., and *Monochoria vaginalis* which indicating the rice-duck farming being environmentally friendly.

### **Effect on Soil Health:**

Soil analysis demonstrates that the concentrations of essential nutrients such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and sulfur (S) in the rice-duck plots increase significantly after cultivation compared to their levels before planting. This enrichment is likely due to the ducks' grazing behavior, which naturally fertilizes the soil through their excreta. The presence of ducks also plays a crucial role in improving soil conditions by enhancing aeration. As they move through the rice fields, they help to loosen the soil, allowing more oxygen to reach the roots and preventing the accumulation of harmful gases in the rhizosphere. This improved soil environment not only boosts nutrient availability but also promotes healthier root systems, which may be a key factor in the vigorous growth observed in rice plants cultivated under the rice-duck system. The activities of soil enzymes also gently increased in this system.

### **Effect on Meat Quality:**

The rice-duck system provides ducks with an environment closely resembling their natural habitat, enabling them to display their innate behaviors. In this system the rice field provides the ducks with feeds, such as plants, insects, and planktons for which ducks have

significantly higher intramuscular fat content. The level of intramuscular fat plays an important role in the quality of poultry meat also increase the egg yield and weight gain (Huo *et. al.*, 2021).

### Effect on CH<sub>4</sub> Emission:

Rice fields are a significant source of methane (CH<sub>4</sub>), contributing approximately 6% to the total global methane emissions. According to various studies, Rice Duck farming decreases cumulative CH<sub>4</sub> emission. Through paddling, trampling, and foraging, the ducks can increase dissolved oxygen concentration in water and soil, for which it is considered as a main reason for decrease CH<sub>4</sub> emission (Wang *et. al.*, 2020).

### Challenges and Considerations

Despite the numerous advantages of rice-duck farming, it also poses certain challenges. Farmers must carefully manage the timing and density of ducks to prevent potential damage to rice plants, particularly during critical growth stages. Furthermore, the initial investment required for ducklings and infrastructure, such as fencing to contain the ducks, can be a significant obstacle for some farmers.

Proper training and support are essential to help farmers transition to this method. Extension services and farmer cooperatives play a crucial role in disseminating knowledge and providing resources to ensure the successful adoption of rice-duck farming.

### CONCLUSION:

Rice-duck farming exemplifies a sustainable agricultural practice that harmonizes crop production with livestock rearing. By leveraging the natural behaviors of ducks, farmers can enhance rice yields, reduce

chemical inputs, and promote environmental health. As global agriculture faces the dual challenges of feeding a growing population and mitigating environmental impact, integrated systems like rice-duck farming offer a promising path forward. Embracing such innovations can lead to a more sustainable and resilient future for agriculture.

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