

Young Reporters for the International Environment Collaboration
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Izmir Private Çakabey Middle School and the Osnovna šola Železniki
The main theme is **Food and Food Supply Security**
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Title of the submission: Fish Wastewater as an Organic Nutrient Source in Microgreen
Cultivation

The Private Çakabey Middle School of İzmir (Türkiye) and Osnovna šola Železniki (Slovenia) conducted a collaborative study investigating the use of fish wastewater as an organic nutrient source in both hydroponic systems and conventional pot cultivation. This research addresses global challenges such as rapid population growth, decreasing arable land, water scarcity, soil degradation, and excessive use of chemical fertilizers, all of which threaten food security and environmental sustainability (Food and Agriculture Organization [FAO], 2009; Karaman & Gökalp, 2010). Additionally, micronutrient deficiencies, known as hidden hunger, continue to impact human health worldwide (Lowe, 2021).

To respond to these issues, the study explores soilless agriculture (hydroponics), a method that delivers water and nutrients directly to plant roots under controlled conditions. Although still limited in global agricultural production, hydroponics is increasingly recognized as a key technology for sustainable agriculture and future food systems (Pradhan & Deo, 2019).

Both Türkiye and Slovenia have active fisheries and aquaculture sectors. Slovenia maintains traditional inland and marine fishing practices on a relatively small scale (European Commission, 2016), while Türkiye has experienced rapid growth in aquaculture production, particularly in species such as sea bass and sea bream (Turkish Seafood Promotion Group, 2023). Despite this progress, both countries face sustainability challenges related to resource management and environmental protection.

This study evaluates whether fish wastewater, typically considered waste, can be repurposed as a nutrient-rich alternative to chemical fertilizers. By integrating aquaculture by-products into plant production systems, the project supports circular economy principles and contributes to sustainable agriculture.

Hydroponic System: Hydroponic systems, derived from the Latin words “hydro” (water) and “ponos” (work), represent one of the earliest soilless agriculture techniques (Bingöl, 2019). These systems typically use the Hoagland nutrient solution, containing essential macro- and micronutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, copper, iron, manganese, molybdenum, and zinc (Karataş, 2023). Precise control of nutrient dosage is essential in hydroponic cultivation, as it must be adjusted according to plant species and growth stage for healthy development (Van Delden et al., 2020).

This project aims to cultivate dill microgreens using wastewater from fish farming facilities during scale and organ cleaning processes in both conventional agriculture and hydroponic systems. By recycling this wastewater, the project seeks to reduce environmental pollution and provide an alternative to conventional nutrient solutions. Furthermore, the produced microgreens are expected to be nutritionally rich, contributing to the fight against hidden hunger. This innovative approach supports the United Nations Sustainable Development Goal “Zero Hunger” and offers environmentally friendly solutions for agricultural production systems. As students of **Osnovna Šola Železniki** and **İzmir Private Çakabey School**, we collaboratively investigated the potential of fish wastewater as an alternative organic nutrient source for sustainable plant production.



Figure 1. Plant cultivation experiments in pots using fish wastewater conducted by students from Osnovna šola Železniki, Slovenia.

In Slovenia, experiments were conducted with beetroot (*Beta vulgaris*) using fish wastewater for soil-based irrigation. Results showed that plants irrigated with fish wastewater exhibited faster initial growth and appeared stronger compared to those watered with tap water. These findings suggest fish wastewater contains beneficial nutrients that support early plant development. However, environmental factors significantly influenced outcomes. Limited sunlight, high indoor temperatures, prolonged foggy weather, small pot sizes, and irrigation management challenges (rapid soil drying and fungal risk due to excess moisture) affected plant performance. Based on these observations, fish wastewater demonstrated promising potential as a sustainable irrigation source. Microgreens and sprouts were identified as more suitable for indoor cultivation due to their short growth cycles. Future experiments are planned for spring under outdoor conditions, and further applications will be tested in the school vegetable garden to evaluate large-scale feasibility.

In Türkiye, we cultivated garden cress (*Lepidium sativum*) microgreens in a hydroponic (soilless) system. The experimental group was treated with fish farm wastewater, while the control group received a standard nutrient solution. During the 9-day growth period, sprout length (cm) and root length (cm) in both root and shoot tissues were measured and recorded.

The experimental group showed enhanced growth, indicating that the organic biomolecules present in fish wastewater facilitated nutrient uptake and supported plant development.



Figure 2. As middle school students of İzmir Private Çakabey School, we cultivated garden cress (*Lepidium sativum*) microgreens in a hydroponic system using fish farm wastewater in the experimental group and a standard nutrient solution in the control group.

Our findings were evaluated considering existing literature. Alegre (2023) demonstrated that combinations of fish wastewater and fish scales contribute positively to soil fertility, supporting our results.

Due to decreasing agricultural land productivity and excessive water consumption in conventional farming, hydroponic systems are increasingly preferred. By reusing fish wastewater, we aimed to promote circular water use and reduce dependence on chemical fertilizers.

Overall, this study demonstrates that fish wastewater is not merely a recyclable by-product but a valuable natural nutrient source. The research contributes to the development of environmentally friendly agricultural production models and supports the Sustainable Development Goals. The use of wastewater in agriculture strengthens agro-ecosystems and enhances resilience against environmental risks such as drought and climate change. Furthermore, by encouraging the production of nutrient-rich foods, this approach may help combat micronutrient deficiencies (hidden hunger).

In this context, we present an innovative model that integrates waste management with food security and sustainable agriculture practices.



Figure 3. The collaborative work of Osnovna šola Železniki Middle School and İzmir Private Çakabey Middle School.

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