

## Developing a Roadmap by Integrating of Environmental Indicators with the Nitrogen Footprint in an Agriculture Region, Hualien, Taiwan

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**Abstract :** The major component of the atmosphere is nitrogen, yet atmospheric nitrogen has limited availability for biological use. Human activities have produced different types of nitrogen related compounds such as nitrogen oxides from combustion, nitrogen fertilizers from farming, and the nitrogen compounds from waste and wastewater, all of which have impacted the environment. Many studies have indicated the N-footprint is dominated by food, followed by housing, transportation, and goods and services sectors. To solve the impact issues from agricultural land, nitrogen cycle research is one of the key solutions. The study site is located in Hualien County, Taiwan, a major rice and food production area of Taiwan. Importantly, environmentally friendly farming has been promoted for years, and an environmental indicator system has been established by previous authors based on the concept of resilience capacity index (RCI) and environmental performance index (EPI). Nitrogen management is required for food production, as excess N causes environmental pollution. Therefore it is very important to develop a roadmap of the nitrogen footprint, and to integrate it with environmental indicators. The key focus of the study thus addresses (1) understanding the environmental impact caused by the nitrogen cycle of food products and (2) uncovering the trend of the N-footprint of agricultural products in Hualien, Taiwan. The N-footprint model was applied, which included both crops and energy consumption in the area. All data were adapted from government statistics databases and crosschecked for consistency before modeling. The actions involved with agricultural production were evaluated and analyzed for nitrogen loss to the environment, as well as measuring the impacts to humans and the environment. The results showed that rice makes up the largest share of agricultural production by weight, at 80%. The dominant meat production is pork (52%) and poultry (40%); fish and seafood were at similar levels to pork production. The average per capita food consumption in Taiwan is 2643.38 kcal capita<sup>-1</sup> d<sup>-1</sup>, primarily from rice (430.58 kcal), meats (184.93 kcal) and wheat (ca. 356.44 kcal). The average protein uptake is 87.34 g capita<sup>-1</sup> d<sup>-1</sup>, and 51% is mainly from meat, milk, and eggs. The preliminary results showed that the nitrogen footprint of food production is 34 kg N per capita per year, congruent with the results of Shibata et al. (2014) for Japan. These results provide a better understanding of the nitrogen demand and loss in the environment, and the roadmap can furthermore support the establishment of nitrogen policy and strategy. Additionally, the results serve to develop a roadmap of the nitrogen cycle of an environmentally friendly farming area, thus illuminating the nitrogen demand and loss of such areas.

**Keywords :** agriculture productions, energy consumption, environmental indicator, nitrogen footprint

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