

## Changes of Nitrogen flow in food systems: Lessons from Iwate, Miyagi, and Fukushima

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Nitrogen, a crucial agricultural element, is at the forefront of a critical planetary boundary. Evaluating its flow in the food system is essential. This study employs a hybrid IO-MFA method (NutriIO) [1] to investigate the changes in nitrogen flows in the food system of Japan's three Northeast regions that were heavily impacted by the 2011 Great East Japan Earthquake and Tsunami. The four base years for each prefecture, 2005, 2011, 2013, and 2015, are used to understand the extent of the disaster's impact on the regional food system and its subsequent recoveries.

In all studied years and prefectures, feed and organic fertilizers were primarily used in the livestock industry, likewise as chemical fertilizers for agriculture. The use value of feed and organic fertilizers, specifically in agriculture (63-73%) and agricultural services (46-62%), declined in 2011 for all three regions due to the disaster that destroyed coastal areas and reduced labor (including fatalities and refuge). Nevertheless, Iwate and Miyagi's chemical fertilizer use contrarily showed a linear rising trend.

The use trend in agriculture for both fertilizers in Fukushima is the same. Meanwhile, a dramatic decline in chemical fertilizer use in 2015, with a significant incline for feed and organic fertilizer, suggested a major shift in fertilizer use from the former to the latter in Iwate.

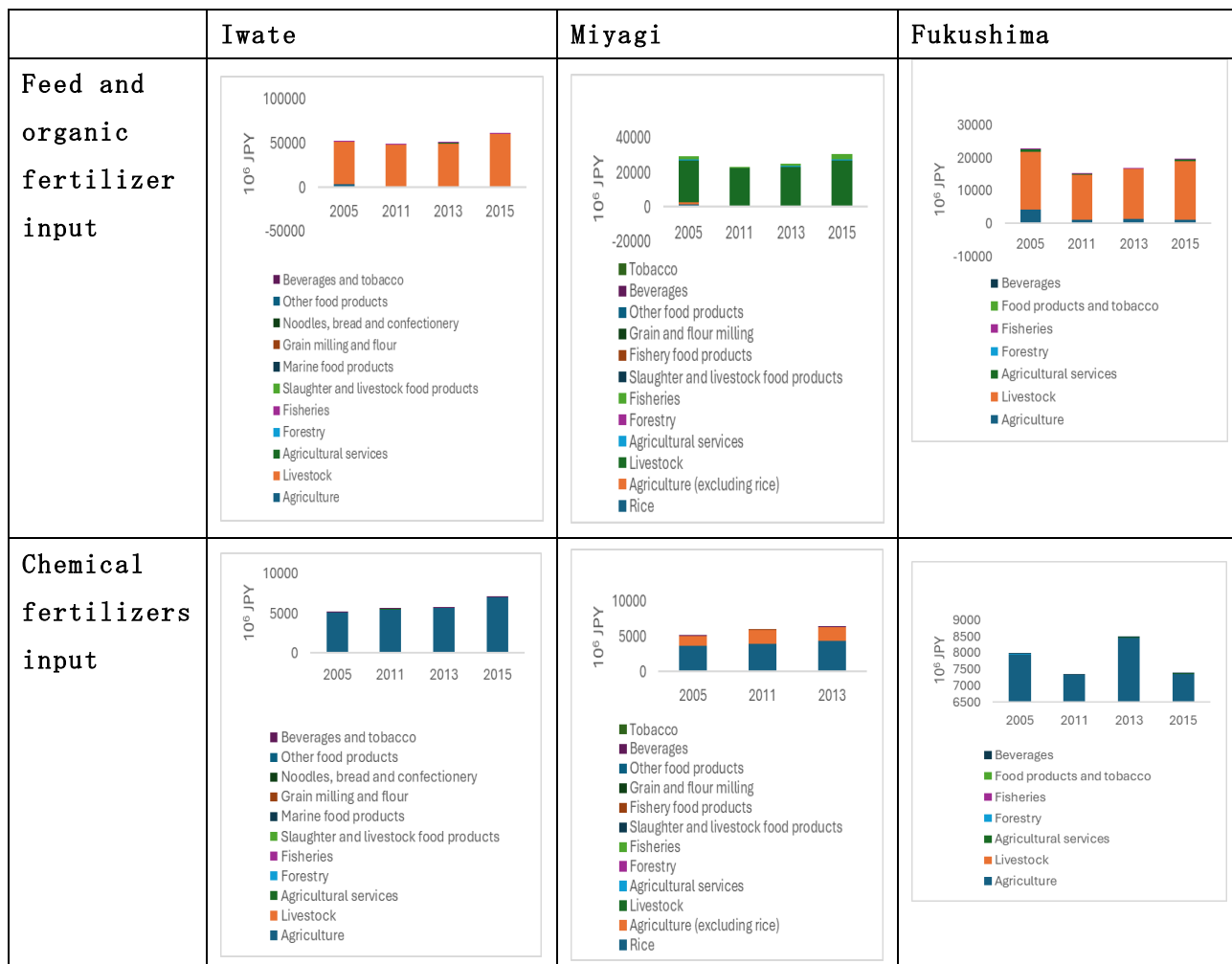
The disaster considerably lowered the use value of feed and organic fertilizers in agriculture. Although the recovery process is underway, the use value in 2015 has yet to return to the situation before the disaster (2005). Meanwhile, agriculture's dependency on chemical fertilizers is relatively linear and higher. Additionally, both fertilizers are used in minor values in the food and beverage manufacturing sectors.

Next, we intend to use the NutriIO model to provide comprehensive details of Nitrogen flow in the regional food system, from farm to table.

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Table 1 Value of feed and organic, and chemical fertilizers input in Iwate, Miyagi, and Fukushima prefectures in 2005–2015



Source: modified from Iwate, Miyagi, Fukushima Prefectural Offices' Input-Output Tables [2], [3], [4]

## References

[1] Oita, A., Katagiri, K., Eguchi, T., Morioka, R., Shindo, J., Hayashi, K., & Matsubae, K. (2021). Nutrient-extended input-output (NutrIO) method for the food nitrogen footprint. *Environmental Research Letters*, 16(11), 115010.

<https://doi.org/10.1088/1748-9326/ac2c35>

[2] <https://www3.pref.iwate.jp/webdb/view/outside/s14Tokei/bnyaBtKekka.html/B03/B0303/I015>

[3] <https://www.pref.miyagi.jp/soshiki/toukei/rennkann.html>

[4] <https://www.pref.fukushima.lg.jp/sec/11045b/17023.html>