

# **Modelling the supply chain impacts of local specialty products on sustainability in islands: a case of the Goto Islands, Japan**

Topic: Input-Output Analysis: Regional policies (1)

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## **Background**

Remote islands are characterized by acute vulnerabilities, including demographic decline, severe resource constraints, and highly undiversified economies reliant on external imports. Ensuring socioeconomic and environmental sustainability in these regions is a critical global challenge. In the Goto Islands of Nagasaki Prefecture, Japan, recent public policies have promoted smart island initiatives, introducing technologies like floating offshore wind power and drone logistics. However, unbalanced reliance on external technological investments often fails to resolve structural profitability issues faced by local primary industries, such as agriculture and fisheries, predominantly managed by small-scale operators. To pursue sustainability, it is imperative to foster endogenous development by transforming local resources into high-value specialty products and expanding their markets. Doing so requires a comprehensive understanding of supply chains within and outside the island. Existing research rarely provides a structural evaluation of how branding local specialties impacts the broader economy, employment, and environmental footprint across different geographical tiers.

## **The Research Question**

The central question driving this study is: To what extent do endogenous development and market expansion of local specialty industries mitigate remote islands' external dependency? Specifically, how do these shifts alter economic ripple effects, employment generation, and greenhouse gas emissions across local, domestic, and global supply chains? By addressing this, the study determines whether strengthening local supply chains can simultaneously achieve economic resilience, social stability, and environmental sustainability (the Triple Bottom Line).

## **The Method Used**

We employ an input-output model combined with scenario analysis. The primary method is a nested multi-regional input-output (MRIO) model. We systematically link three economic data levels: city, prefectural, and global. To integrate these scales without double counting, we isolate the target island's economic structures and calculate residual regional matrices for the rest of the prefecture and the world. The system is then balanced using the Generalized RAS (GRAS) algorithm ensuring mathematical consistency. A crucial methodological step is the sectoral disaggregation of the input-output framework. Standard sector classifications obscure the unique industrial fabric of the island. Therefore, we expand generic agricultural and food sectors into specific categories representing the island's key specialties: Goto beef, seafood, and camellia oil. Using this resolved model, we establish a baseline of current production, employment, and emission footprints. We then introduce import substitution scenarios, simulating the economic and environmental impacts if intermediate goods required for these specialties were produced locally rather than imported. Additionally, to capture critical micro-level environmental initiatives uncapturable by the IO model, we conduct life cycle assessment (LCA). This independent evaluation quantifies greenhouse gas reduction benefits of specific local actions, such as transitioning from expanded polystyrene to alternative packaging in fisheries.

## **The Data Used**

Our nested model integrates the 2020 Goto City Input-Output Table with the Nagasaki Prefecture Input-Output Table and global MRIO (EXIOBASE v3.9). To achieve accurate sectoral

disaggregation, we utilize primary empirical data to overcome generic secondary data limitations. This data, encompassing detailed upstream inputs and downstream sales distributions, was collected through field interviews with local producers, cooperatives, and municipal authorities. We corroborate these primary findings with regional secondary statistics, including agricultural output estimations and fishery distribution reports. The independent LCA utilizes the Japanese IDEA v3.5 database, applied to primary material consumption data gathered from local enterprises.

#### The Novelty of the Research

This research contributes three novel elements to the field of input-output analysis. First, it establishes the first nested MRIO model tailored to a Japanese remote island, bridging micro-regional economic activities with global supply chains. Second, it demonstrates a rigorous methodology for disaggregating generic IO sectors using primary interview data, allowing precise modeling of niche local specialty markets that typically vanish in aggregate statistics. Third, it provides a unique analytical framework assessing macro-structural impacts of import substitution while acknowledging micro-level environmental stewardship, offering a holistic tool for policymakers building resilient and sustainable island economies.