Prefectural-level life cycle inventory dataset of vegetable and fruits production in Japan

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Background

- Inventory databases of agricultural products have been developed with country-level data.
- Despite these data will be useful and suitable for background data of life cycle assessment, it is insufficient to use inventory data as benchmarks for consumer product choice.

For example, conventional agriculture is very varied by production area, when considering its detail of practices. Seasonal variation of inventory data would be high if target products are grown in greenhouse with heating.

Benchmarks of consumer product choice are required to contain regional- and seasonal-level inventory data to compare with other type of practice in same area and season.

Develop LCI data of vegetables and fruits produced by prefectural level in Japan, considering standard practice of each area.

Methodology

Development of LCI databases

- Target crops: 41 crops produced in 10 prefectures in Japan
- Functional unit and inventory: 1 kg of product, greenhouse gases (GHG)
- System boundary: Including consumptive materials for crop production (energy, fertilizer, agrochemicals)
- Durable goods and facilities are excluded
- Data collection: Standard practice and production cost data published by each prefecture. Technology level are usually set as „a top runner“

DEA (data envelopment analysis)

have been implemented to analyze technology level toward low carbon production and potential of GHG reduction

- Input & output data
  - Input: labor input (hour) and GHG (kg-CO₂eq)
  - Output: agricultural income (JPY) and amount of product (kg)

  Linear planning

\[
\begin{align*}
\min \ c &= \sum x_2 \\
\text{s.t.} & \sum j \lambda r_j \leq x_i \ (i=1,2) \ y_j \leq y_i \ (i=1,2) \\
\sum j \lambda r_j & < y_i \ (r=1,2) \\
\sum j \lambda^2 & = 1, \lambda > 0, x_i > 0, y_j > 0
\end{align*}
\]

- Indicator of “environmental efficiency” was used for analyzing result,

\[ EE = \frac{c_i}{x_{2i}} \]

Results and Discussion

(1) Preliminary result of LCI and its geographical deviation (crops which >2 samples collected)

- Result (1):
  - Seasonal deference is not small especially practice using greenhouse heating
  - Variation of LC-GHG by prefecture is large in energy-consuming practice
  - -> Average of coefficient of variation (CV) is 0.15

Result (2):

- Price and LC-GHG has midium relationship (correlation coefficient:0.43)

Result (3):

- Not ronly big-producing regions be on the frontier (EE=1)
- High price commodities (practice) is not far from frontier, lower potential (percentage) to reduce GHG

(3) Result of DEA

(Size of bubbles: share of production in Japan)

Conclusions

- Developing regional-level of LCI in 40 vegetables and fruits to consider seasonal/regional difference of practices
- Variation of LC-GHG is high in energy-consuming practice like that including greenhouse heating
- There is no relationship share of production and EE, but high-price commodities seems be close to frontier