

Development of methodology to quantify environmental, economic and social impacts related to agricultural production

Naoki Yoshikawa*¹⁾, Koji Amano¹⁾, Koji Shimada²⁾
¹⁾College of Science and Engineering, Ritsumeikan University
²⁾College of Economics, Ritsumeikan University
 *n-yoshik@fc.ritsumeai.ac.jp

Background

Quantifying social, economic, and environmental impacts is important for making decisions. Farmland and production activities are considered to have multifunctional roles (Table 1).

➡ How can we quantify multifunctional roles in LCA?

Economic assessment of multifunctional roles have been done in some study

➡ Is this consistent with the concept of LCA?

This study discusses methodology to quantify the social, economic, and environmental impact of the multifunctional role of agriculture within the framework of SLCA

Table 1: Multiple functional role of agricultural production

Land category	Definition
Food security	Decreasing risk of food importing country
Positive effect to environment	Promoting water cycle (e.g. flood mitigation)
Social effect	Maintaining agroecosystem
	Inheritance of local culture
	Healing and education

Assessing multifunctional role

How to deal functions (positive effect) of agricultural production?

- (1) Deal as one of the function crops have
- (2) Deal as impact and value inventory analysis

Comparing is economic assessment
Aversive expenditure method assesses expenditure for function alternative to the target good /service provides. this method needs to assume the alternatives for all functions agriculture provides.

CVM estimate willingness to pay for function based on questionnaire. This method assesses total value of the functions but is difficult to separate impact categories (environmental/social/economic) explicitly.

Conjoint analysis can assess value separated to its impact categories, however process to impact is not clear.

➡ Positive function should be assessed by damage assessment methodology as much as possible, combining with economic assessment method to ensure transparency

Table 2: correspondence between economic assessment and SLCA

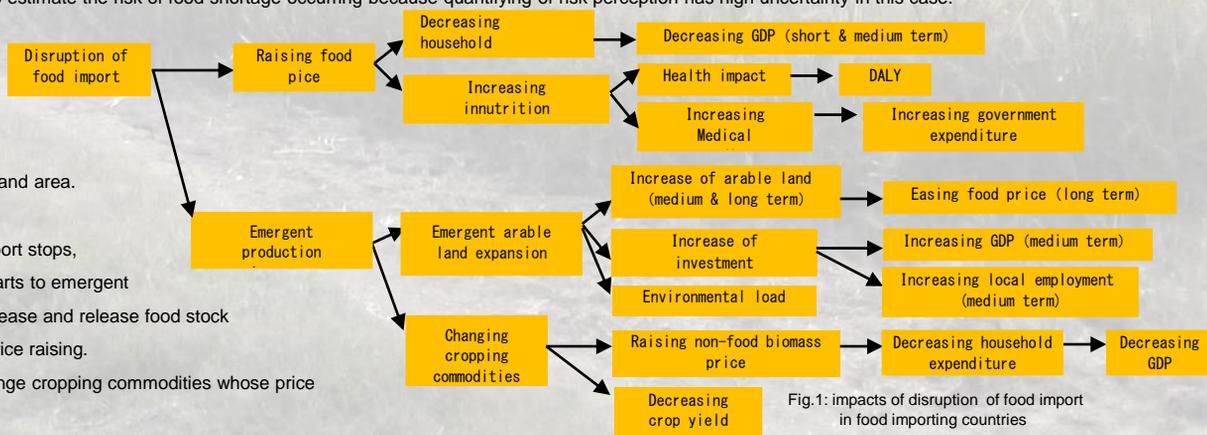
Economic assessment		SLCA	Comments
Aversive Expenditure Method	➡	Regard multifunctional roles as one of function	Need to set alternatives of all functions Difficulty to define functional unit
CVM (Contingent Valuation Method)	➡	Treat multifunctional roles in inventory	Can estimate value that is difficult to quantified Cannot to separate impact categories
Conjoint analysis	➡		Can separate impact categories May not consistent with damage assessment and weighting in ELCA

Case study

Case study on easing food shortage risk in food importing countries. This function is defined as maintaining food production infrastructure in case of food shortage by keeping farmland arable.

The impacts are influenced through behavior of consumers, agricultural producers, markets, and governments. These impacts seem to be quantified by using scenario analysis. Scenario considers government's response against food shortage.

It is difficult to estimate the risk of food shortage occurring because quantifying of risk perception has high uncertainty in this case.



Midpoint: farmland area.
 Assumption:
 When food import stops, government starts to emergent production increase and release food stock to ease food price raising.
 Producers change cropping commodities whose price raises.

Fig.1: impacts of disruption of food import in food importing countries

Conclusions

- Framework that estimate multi-functions of agricultural production in LCA is proposed. Some of function seems to be quantified utilizing methodology of damage assessment in environmental LCA.
- Some of parameters (e.g. risk of rare & critical event) may be hard to quantified and expert judge is needed.