

Development of World Food Supply and Demand Model with Consideration to Environmental and Resources Constraints

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1. Objective

The situation of world food supply and demand has been of great concern, particularly to countries that largely depend on imported food, including Japan. The long-term prospects for the global food supply, however, have been beset with uncertainties, particularly the deterioration of the environment and the declining availability of production resources. Much of the literature has been pessimistic. The arguments are based mostly on the negative impacts of various environmental and resources constraints. Others, on the other hand, chief among them economists, have been espousing optimistic views. They emphasize the fact that the progress of agricultural production technology has solved the food problems of human beings in the past, and they argue that this can also be expected in the future.

The objective of this study is to provide the soundest and most quantitative information possible regarding the long-term prospects of the food market.

2. Approach

The study develops a new type of econometric model that accounts for food-supply constraint factors. Various scenario analyses that utilize the model provide profound knowledge on the future situation of food supply and demand in the world under the environmental and resources constraints.

3. Research Outcomes

(1) By introducing resource constraint factors into supply functions, *The Resource Constraint Pilot Model* is developed. The supply side of the new model is formulated with the assumption of the optimization behavior of multi-output producers with allocatable fixed inputs. Some of the parameters are newly estimated, while the others are cited from existing models and other related proceeding studies. The model is a partial equilibrium type that deals with the international and domestic supply and demand situation of three major grains, i.e., rice, wheat and maize. Two constraint factors, arable area and irrigate farmland area, are included in the model.

(2) Price, utilization and production of rice, wheat and maize in the year 2000 (see Fig. 1) are projected according to three different scenarios regarding the availability of arable and

irrigated area (see Table 1). This scenario analysis indicates that our plausible assumption does not lead to an extreme rise of international grain prices. It is, however, necessary to heed that this somewhat optimistic result simultaneously reveals the fact that the present low level of food consumption in poor countries will continue.

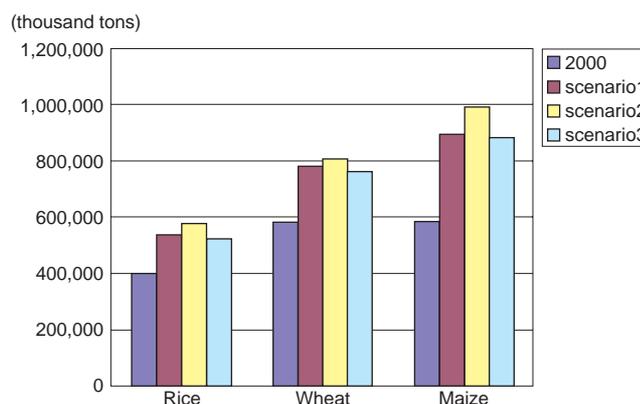


Fig. 1. World Production Projection in 2030

Table 1. Simulation Scenario

	Changes of Total Arable Area (2000~2030)	Changes of Irrigated Area (2000~2030)	Resources Constraint
Scenario1	no change	no change	medium
Scenario2	change rates of total arable land observed in 1990s	change rates of irrigated land observed in 1990s	weak
Scenario3	change rates of total arable land observed in 1990s	change rates of total arable land observed in 1990s	severe

(3) The relations between the population and food market are explored by the application of the model. The United Nations' population estimations of three levels, i.e., low, middle, and high, are utilized for the simulation scenario settings.

(4) The deepening international specialization under the WTO system and active FTA negotiations have been influencing the food supply and demand situation. Our simulation analysis shows the change of the Asian rice market towards the state that is suggested by the Heckscher-Ohlin (Factor Proportions) model. This change leads toward diversified agricultural policy directions in these countries. Food security policy may become more important to food-importing countries in the Asian region, since they are expected to increase their dependency on food imports. On the other hand, countries endowed with relatively plentiful amounts of arable land and water resources, like Thailand, are warned of the overuse of

such resources and the environmental deterioration as the result of their increased food exports.

(5) In order to explore the effects of production substitution between oilseeds and grains, as well as the consumption substitution between direct grain intake and feed use, the FAO's World Food Model is modified by the introduction of arable area as the resource constraint factor.

The simulation finds that a 10% decrease of arable land in the United States and China, the two major food producing countries, can be largely mitigated by more intensified land use, crop diversification, expansion of food trade, and the like. (This part (5) was mainly carried

out by Koji Yanagishima, Economist of FAO, Visiting Research Fellow of PRIMAFF)

4. Publication

Sotaro Inoue, Atsuyuki Uebayashi, Koichiro Akashi and Shunji Oniki "Long-Term Grain Market Projection with Considerations on the Availability of Arable and Irrigation Land: Development and Use of Resource Constraint Pilot Model", *Journal of Agricultural Policy Research*, vol. 4, 2003, p1-25.

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Demand Analysis of Vegetables by Intended Purpose

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While demand for vegetables is increasingly diversified, it is inevitable that the future promotion of domestic vegetable production relies on accurately tracking and responding to trends in vegetable demand determined by the intended purposes of the vegetables, which can be classified in three categories: household consumption, food processing, and food services (catering and ready-to-eat meals industry). The objective of this research is to understand changes in demand for vegetables according to certain types of items and their intended purposes, plus whether they are domestically produced or imported.

The methods used for the research are described below. With reference to the food balance sheet (conversion of perishable items), estimations of vegetable demand for intended purposes for the year 2000 were made according to major items, and whether they are domestically produced or imported. Also, regarding vegetables in general, demand was classified in three categories by intended purpose: household consumption, food processing, and food services.

The estimation of the vegetable demand for household consumption was made mainly with reference to the amounts of fresh vegetables purchased, which were acquired from the "Annual Report on the Family Income and Expenditure Survey." For the estimation of the vegetable demand for food processing and food services, a questionnaire regarding types of items, and domestic products and imported products, was given to those who are involved in vegetable processing and the food services industries, and the findings were applied with

the necessary factors, which were added to the existing statistics in order to enable the estimation.

(1) The proportion of the vegetable demand of major items for household consumption in 1990 and 2000 was calculated in comparison with the overall demand for other purposes (Fig. 1). For many items, the proportion of the vegetable demand for household consumption decreased from 1990 to 2000. Especially, the proportions of carrots and spinach decreased sharply, because the demand for carrots as ingredients in vegetable juices, and for frozen spinaches by the food service industry increased respectively.

Frozen vegetables are indispensable materials for the food service industries, in that the inedible parts are removed beforehand and the prices and product quality are more stable than fresh vegetables.

(2) Fig. 2 shows the proportions of vegetable demand for major items by intended purpose in 2000. In the case of tomatoes, radishes and Chinese cabbage, the proportions for the food processing are relatively high, because tomatoes are used as ingredients in juice and ketchup, and Chinese cabbage and radishes are used as ingredients for pickles. The proportion of onions and welsh onions for food services are relatively high, because of their role as basic foods.

(3) The usage of vegetables in processing and food services is increasing in accordance with the tendency to eat out. Additionally, pre-processed and processed foodstuffs are wide