



Analyzing DPRK's Food Supply and Demand Condition with Food Culture

Jangho Choi
Bum Hwan Kim



Founded in 1989, the Korea Institute for International Economic Policy (KIEP) is a government-funded research institute established to conduct studies, research and analyses of global economic issues that impact the Korean economy, and to help guide the nation toward effective international economic policies.

KIEP is responding to recent developments in the global economy, conducting a wide range of research projects that will offer significant implications for the government's New Northern and New Southern policies, a new trade policy regime that aims to support inclusive growth, and international macro-financial initiatives in line with the unfolding 4th Industrial Revolution.

We are committed to introducing policies that can elevate the nation's capacities for innovative growth, and to promote international discourse on issues that impact the global community, as we ensure that KIEP remains an influential global think tank that leads the formulation of international economic policies.

Since its founding, KIEP has conducted insightful studies on newly emerging economies and global regions, and has dedicated itself to the development of trade negotiations and national agendas.

KIEP will continue its policy research on global and regional economies, trade investment and international macro-finance, with the aim of contributing to sustainable growth as a responsible research institute, and establishing itself as a nationally reliable institute through the dedicated efforts of all KIEP members.

Korea Institute for International Economic Policy
370 Sicheong-daero, Sejong-Si 30147, Korea
Tel: 82(44) 414-1251 / Fax: 82(44) 414-1144
URL: <http://www.kiep.go.kr>

 Korea Institute for International
Economic Policy

Price USD 3

Working Paper 22-03

Analyzing DPRK's Food Supply and Demand Condition with Food Culture

Jangho Choi and Bum Hwan Kim

Working Paper 22-03

**Analyzing DPRK's Food Supply and Demand Condition
with Food Culture**

KOREA INSTITUTE FOR
INTERNATIONAL ECONOMIC POLICY (KIEP)
Building C, Sejong National Research Complex, 370,
Sicheong-daero, Sejong-si, Korea
Tel: (822) 82-44-414-1251 Fax: 82-44-414-1144
URL: <http://www.kiep.go.kr>

Heungchong Kim, President

Published December 30, 2022 in Korea by KIEP
ISBN 978-89-322-4302-3 94320
978-89-322-4026-8 (set)
Price USD 3

© 2022 KIEP

Executive Summary

Estimation of food supply and demand in North Korea follows the FAO/WFP calorie standard at least 1,640 kcal per person per day. This method is useful in that it can estimate the minimum amount of food shortage for survival, but has a limitation in that it does not accurately reflect real life in that it ignores the food culture of North Korean residents. In this study, the amount of food supply and demand in North Korea was estimated by considering the food culture. The amount of food shortage was calculated by the difference between food consumption and supply. For food consumption, South Korea's food supply and demand tables (1970 and 1990) and North Korean population were used to consider food culture. The amount of food supply considered North Korean food production, imports, and exports. As a result of the estimation, first, when the food shortage in North Korea in 2014 was estimated by reflecting South Korea's food supply table in 1970, 2,388.4 thousand tons were over-supplied, resulting in a food supply and demand rate of 1.26. Second, assuming that North Korea's food culture changes similarly to that of South Korea in 1990 due to the spread of marketplaces or the unification of South and North Korea, total food consumption increased by 33.3%, and the food supply and demand rate fell from 1.26 to 0.95. The results of this study have two implications. First, it is possible that the cereals shortage estimated by FAO/WFP based on the minimum calorie required for survival was overestimated. Second, North Korea's carbohydrate-oriented food aid does not take North Korea's food culture into account, so it is necessary to increase support for fish, meat, fruits and vegetables.

JEL code: O13, P32, Q13

Keywords: North Korea Food Security

Contributors

Jangho Choi

Jangho Choi is the Head of International Cooperation for Korean Unification Team, Institute for International Economic Policy (KIEP). After joining KIEP in 2014, he studied North Korea's trade, North Korea's international relations, the Greater Tumen Initiative developing a border area where North Korea, China, and Russia meet, and the transition of the North Korean regime. His major research includes 'Analysis of North Korea's Trade with China (every year since 2015); Implications of the Transitional Outcomes of Southeast Asian Countries CLMV for North Korea: Development and Application of Transition Index (2020); Study on North Korea's Trade System: Implications for the CEPA between South and North Korea (2018); Transition Economies' Experience of WTO Accession and its Implications for DPRK (2018); Developing Analysis Model and Analyzing Growth Effects of South and North Korea Economic Integration (2017).

Bum Hwan Kim

Bum Hwan Kim is the senior researcher of International Cooperation for Korean Unification Team, Korea Institute for International Economic Policy. He obtained a Master's degree in Economics from Seoul National University in 2015. He joined the Korea Institute for International Economic Policy in 2016 and have been conducting research on economic cooperation between South and North Korea.

Contents

Executive Summary	3
Contributors	4
1. Introduction	7
2. Method of study	11
3. Data of study	13
4. Results	21
5. Conclusion	32
References	34

Tables

Table 1. Variables and data sources	13
Table 2. Changes of Food Consumption by items in 1970 and 1990	15
Table 3. Availability of production statistics by item	19
Table 4. Number of livestock and meat production in North Korea in 2014	20
Table 5. Total Consumption by Item in North Korea(2010-14)	27
Table 6. Total supply by item in North Korea(2010-14)	28
Table 7. Food supply and demand rate and shortage by item in North Korea(2010-14)	29
Table 8. Supply and demand rate by item in North Korea (2010-14)	30
Table 9. Changes in food supply and demand rate assuming changes in food culture in North Korea (based on food supply in 2014)	31

Analyzing DPRK's Food Supply and Demand Condition with Food Culture

Jangho Choi and Bum Hwan Kim

1. Introduction

A stable supply of food is an essential issue not only for personal safety but also for social stability and sustainable growth. Even if food production plummets or food prices skyrocket due to disasters, epidemics, or sudden social changes, all citizens should be able to survive and maintain dignity as human beings. It is only after we have the ability to stably supply the minimum amount of food that we can expect stable growth of society. This is called food security.¹⁾²⁾

The fact that food security issues are receiving attention on the Korean Peninsula can be considered from various perspectives. The focus of this study is the issue of food security in North Korea. The first reason South Korea needs to ensure food security is that Northeast Asia is an arena of confrontation where the interests of the US, China, Japan and Russia collide as well as the military confrontation between the two Koreas. In addition,

¹⁾ Kim, Kim, and Kim (2008), p. 1.

²⁾ Song (2014), pp. 2~3.

there is a point that global grain price volatility has increased due to climate change such as drought, flood, and abnormal temperature. Next, the ups and downs of the supply of domestic livestock products have increased with the outbreak of large-scale livestock diseases such as AI, Brucella, and foot-and-mouth disease. And internally, it is necessary to protect the socially and economically vulnerable groups caused by the income gap and polarization between classes. Finally, assessing food security in North Korea is important in various aspects, such as easing tensions on the Korean Peninsula, improving inter-Korean relations through economic cooperation, inter-Korean economic integration, and establishing the foundation for ultimate peaceful unification.

It is presumed that North Korea is suffering from a chronic food shortage problem. Since the North Korean government does not officially publish statistics on food production and consumption, South Korean institutions and international organizations such as the World Food Program (WFP) and the Food and Agriculture Organization of the United Nations (FAO) jointly estimate and publish them. From 2011 to 2017, FAO has designated North Korea as a food-shortage country in need of external assistance.³⁾ In the 1990s, the deteriorating food situation in North Korea led to starvation deaths and increased instability in the border area between North Korea and China. In addition, it has led to problems such as an increase in the physique gap between North and South Korean residents, a decrease in life expectancy, and a decrease in economic growth potential.⁴⁾ Even after the 2000s, it is still suffering from food shortage, but it is judged to be gradually improving.

The issue in estimating food production and consumption in North Korea is the methodology. Supply and demand estimation can be divided into supply estimation and consumption estimation, but most institutions only esti-

³⁾ FAO/WFP (Each year).

⁴⁾ Hwang *et al.* (2011), pp. 155~159.

mate North Korea's supply. The Rural Development Administration and National Statistical Office of Korea only estimate food supply and not consumption. FAO/WFP estimates the amount of supply and consumption based on the results of due diligence, and based on this, announces the amount of food supply and demand. As an international organization, FAO/WFP announces the amount of supply and demand in addition to the amount of food supply in North Korea to make comparisons between countries. The target of analysis is not only North Korea, but also all countries around the world, such as Africa, the Middle East, and Southeast Asia.

The focus of this study is the method of estimating food consumption in North Korea. As mentioned above, FAO/WFP estimates food consumption by applying the same method to all countries for cross-country comparison, but distortion occurs in this process. The method used by FAO/WFP to estimate food consumption is to use the minimum daily calorie required for survival (1,670 Kcal). The composition of items was also based on six items (rice, maize, wheat/barley, potatoes, bean, and other grains) used as staple food in most countries for cross-country comparison.⁵⁾⁶⁾ The first distortion that occurs is an overestimation of food shortages. Estimation of consumption was not made in consideration of the unique food culture of the country in question, but as the minimum daily calorie standard was used for international comparison, the fact that the daily minimum calorie content could be met with other items was excluded. Second, as a result, North Korea's unique food culture is ignored in estimating supply, consumption, and food supply. Third, there is a possibility that the supply volume will be underestimated as the supply volume is estimated mainly for 6 items. As a result, FAO/WFP's estimate of food supply and demand in

⁵⁾ FAO/WFP (2013), pp. 35~37.

⁶⁾ When estimating food demand in North Korea, WFP estimates and announces based on the minimum daily requirement rather than normal demand. Since WFP treats North Korea as an emergency food aid country, it estimates food consumption at 1,600 kcal per day instead of the 2,130 kcal per day recommended by the World Health Organization (WHO). Kwon and Nam (2010), p. 8.

North Korea is highly likely to be underestimated, so it can be seen that it is not suitable for reality.

This study supplemented the estimation method of FAO/WFP in three aspects. First, South Korea's food culture, which has a similar food culture to North Korea's, was used as a proxy variable instead of the minimum calorie method to estimate consumption. South Korea's food culture utilized South Korea's food supply and demand tables (1970, 1990), which provide statistics on consumption by item per person per year in South Korea. Second, North Korea's food supply was reconstructed based on the food supply table. Production by item was not newly estimated, and production statistics of items other than the six items introduced in the FAO/WFP report were used. Third, the amount of food supply and demand was estimated in connection with changes in food culture. Changes in North Korean food culture can be caused by an increase in the supply of imported food along with the spread of *jangmadang*(North Korean market), or by the introduction of South Korean food culture into North Korea in the process of inter-Korean integration. Changes in North Korea's food supply and demand due to changes in food culture were estimated by assuming that the food supply and demand table changed from 1970 (carbohydrate-oriented) to 1990 (protein-oriented).

2. Method of study

In this report, the estimation of food supply and demand in North Korea between 2010 and 2014 was made in the following steps. First, food consumption by item in North Korea was estimated using South Korea's Food Balance Sheet (1970). Next, the food supply of the items presented in the food balance sheet was estimated. Food supply and demand was calculated by subtracting supply from the estimated consumption. Lastly, the change in food supply and demand according to the change in food culture was estimated by assuming the change in the base year (1970 → 1990) of the South Korea's Food Balance Sheet.

First, when we look at the food consumption, total consumption by item D_{it} in t period is estimated by multiplying North Korea's population in t period by annual consumption per capita.

$$(1) D_{it} = d_{it} l_t$$

Where d_{it} is the annual consumption per capita for item i in t period, and l_t is the number of North Korean in t period. Next, the total supply by item i (S_{it}) was estimated by adding the quantity of imports and grant aid to the production volume of each item, and excluding the quantity of exports and other uses. etc_{it} is a variable that refers to things used for purposes other than food in the total supply, such as feed, seed, and weight loss.

$$(2) S_{it} = q_{it} + im_{it} + b_{it} - ex_{it} - etc_{it}$$

Where q_{it} is the production of the item i in t period; im_{it} is the imports of the item i in t period; b_{it} is the grant aid of the item i in t period; ex_{it} is the exports of the item i in t period. The food shortage by item L_{it} was derived by subtracting the total supply amount by item i from the total consumption amount by item i .

$$(3) L_{it} = D_{it} - S_{it}$$

D_{it} and S_{it} are the total consumption and supply amount by item i in t period obtained from the above (1) and (2), respectively. If $L_{it} > 0$, it means that item i is short in t period. If $L_{it} < 0$, it means that item i is excessively supplied in t period. The food supply and demand rate by item i (R_{it}) was derived by dividing the total supply of each item by the total consumption of each item in t period.

$$(4) R_{it} = \frac{S_{it}}{D_{it}}$$

The total food supply and demand rate considering all items in t period (R_t) was derived by dividing the sum of total supply amount by item in t period by the sum of total consumption amount by item in t period.

$$(5) R_t = \frac{\sum_i S_{it}}{\sum_i D_{it}}$$

Finally, in order to compensate for some of the limitations of the total food supply and demand rate (R_t) above, the total food supply and demand rate reflecting the difference in calories per item (R_t^c) was additionally calculated and compared with the previous results. R_t^c is calculated by multiplying the calorie weight by item i (C_{it}) by the total food supply and demand rate by item i (R_{it}) and summing. Here, the calorie weight by item i (C_{it}) is derived by dividing the calories per 1 g by item i (c_{it}) by the sum of calories per 1 g per item i ($\sum_i c_{it}$). The data presented in the food balance sheet were also used for the calorie data for each item (c_{it}).

$$(6) R_t^c = \sum_i C_{it} \cdot R_{it} \quad (\text{where, } C_{it} = \frac{c_{it}}{\sum_i c_{it}})$$

3. Data of study

Various variables are needed to estimate food supply and demand in North Korea, and the data sources corresponding to these variables are summarized as follows.

Table 1. Variables and data sources

Type	Variables	Sources
Consumption	Annual Consumption per Capita(d)	KREI(2017)
	North Korea Population(l_t)	Statistics Korea(2016)
Supply	Production by item(q)	FAO/WFP(2012~2015), FAO STAT, ⁷⁾ Statistics Korea(2016) ⁸⁾
	Exports(ex), Imports(im)	UN Comtrade Statistics, Ministry of Unification(2014)
	Grant aid(b)	FAO/WFP(2015)

Source: Written by the author.

The year that is subject to the food supply and demand analysis of North Korea is analyzed from 2010 to 2014, five years in total. Per capita net food supply for each item in the 1970 South Korea's Food Balance Sheet was used as a proxy variable for per capita food consumption by each item in North Korea. The per capita food consumption of North Korea and the North Korean population for each year were used as variables to estimate the amount of food consumption by year.

Next, for the population of North Korea, statistics by the Statistics Korea were used, and the population of North Korea from 2010 to 2014 was 24,187 (thousand people), 24,308 (thousand people), 24,427 (thousand people), 24,545 (thousand people), and 24,662 (thousand people), respectively.⁹⁾

⁷⁾ FAO STAT (Search date: 2022. 8. 15).

⁸⁾ Seafood catch by Kosis National Statistics Portal, https://kosis.kr/bukhan/files/anal/ANL011/ANL011_TNT007.htm (Search data: 2022. 8. 15).

On the other hand, when estimating the food supply and demand assuming changes in food culture of North Korea, the standard year of the Food Balance Sheet, which is assumed to be a proxy variable, was converted from 1970 to 1990.¹⁰⁾¹¹⁾¹²⁾

Comparing the food balance sheet in 1970 and 1990, we can see that the grain-oriented eating habit turns into the meat-based eating habit.<Table 2> As mentioned above, the change of food culture in North Korea takes into consideration the possibility of expanding the supply of processed food due to the spread of the market and the increase of foreign trade, and the possibility of food culture of North Korea converging to that of South Korea by increasing the influx of South Korean food into North Korea in the process of integration. This can be provided as basic data for the agricultural policies (food production and stockpiling) to ensure North Korea's food security in the course of future inter-Korean economic cooperation or economic integration process.

⁹⁾ Statistics Korea (2016), p. 58.

¹⁰⁾ The year 1990 was set arbitrarily for the convenience of the study.

¹¹⁾ For the convenience of the study, the items in the 1970 food supply and demand table of South Korea were classified into five food groups. That is, it was classified into grains and potatoes, fish and meat, fruits and vegetables, milk and dairy products, fats and sugars, and the like.

¹²⁾ We did not differentiate between adults and adolescents when using per capita annual net food supply. This follows the calculation method of the food supply and demand table. This is because the annual net food supply per capita is calculated by dividing the total supply by the population. This is because the same method was used in this study. However, experts pointed out that there is a possibility of underestimation when estimating North Korea's consumption by applying this method. In the 1970s, South Korea's demographic structure had a high share of the youth population. On the other hand, the demographic structure of North Korea in the 2010s has a high proportion of adults. Therefore, if this is not taken into account, there is a possibility of underestimation. It seems like a valid point, but this report was not able to analyze it by considering this part.

Table 2. Changes of Food Consumption by items in 1970 and 1990

(unit: 1,000 ton, %)

	1970	1990	Growth rate
1.Cereals	4,806.7	4,326.4	-10.0
Wheat	618.6	732.7	18.4
Rice	3,217.2	2,978.3	-7.4
Barley	907.6	59.8	-93.4
2.Starchy Roots	1,380.5	272.1	-80.3
Potatoes	363.8	157.6	-56.7
Sweet Potatoes	1,016.7	114.5	-88.7
3.Sweeteners	153.3	378.4	146.8
4.Pulses	182.3	252.9	38.7
Soy beans	151.0	204.2	35.2
Red Beans	2.3	24.7	973.9
5.Tree Nuts	1.5	11.9	693.3
6.Oil Crops	2.3	16.0	595.7
Sesame	2.3	10.6	360.9
7.Vegetables	1,478.2	3,270.8	121.3
8.Fruit	247.9	714.2	188.1
9.Meat	204.4	581.1	184.3
Bovine Meat	38.1	101.8	167.2
Pig Meat	88.5	290.4	228.1
Poultry Meat	34.3	98.8	188.0
10.Eggs	78.6	194.6	147.6
11.Milk	40.4	784.4	1841.6
Milk	17.5	751.2	4192.6
Whole Milk Powder	3.1	6.0	93.5
Skim Milk Powder	n/a	10.5	-
12. Oils and Fats	35.8	352.1	883.5
Vegetable Oils	16.8	291.4	1634.5
Animal Fats	19.9	60.8	205.5
13.Fishes and Shellfishes	361.5	752.1	108.0
Fishes	267.0	517.5	93.8
Shellfishes	94.6	234.6	148.0
14.Seaweeds	64.8	139.9	115.9
15.Alcohol Beverages	1,132.6	1,638.9	44.7
Total	10,170.8	13,685.8	-

Note: The above values are calculated by reflecting the population of North Korea.

Source: KREI, Food Balance Sheet(1970, 1990).

There were various issues raised by the use of South Korea's Food Balance Sheet in order to estimate the food consumption of North Korea, they are summarized in two ways: (1) Can the food consumption in South Korea's Food Balance Sheet represent North Korea's food consumption?, (2) Why did you assume that South Korean food consumption in 1970 shows the current food consumption in North Korea?

In this study, it is for four reasons that the food consumption of South Korea in 1970 is similar to the food consumption of North Korea at present. First, 1970 is the base year in which the availability and reliability of the South Korea's Food Balance Sheet are considered in a comprehensive manner. The year in which the food consumption of the two Koreas is most similar will be shortly after the division of the two Koreas. The oldest Food Balance Sheet currently available was written in 1962. However, this continued to show changes in the classification and estimation methods of items, and it was not until 1970 that it was similar to the current Food Balance Sheet form.

Second, the industrial policy and food consumption patterns of South Korea in the 1970s seem to be similar to the current situation in North Korea. The 1970 of South Korea is the year included in the end of the Second Five-Year Economic Development Plan (1967-1971), a time when self-reliant economy and food self-sufficiency was the central goal to escape poverty and hunger. Currently, North Korea also adopts self-reliant economy and food self-sufficiency as its main policy to escape hunger. In the 1970s, South Korea imported agricultural products, brought in surplus grain from the US for free, and imposed policies to boost food supply to make up for food shortage.¹³⁾

Next, in terms of food consumption pattern, in 1970, South Korea had a consumption structure focused on cereals, especially rice, which showed a similar pattern to the current North Korea. According to the National

¹³⁾ Maeil Business News Korea (1970. 9. 2).

Nutrition Survey conducted by the Ministry of Health and Social Affairs, the ratio of cereals energy (= cereals calories / total calories) was 84.1% in 1969.¹⁴⁾ On the other hand, the relatively high consumption of fishes and shellfishes among the low protein intake was a characteristic of Korean food culture at that time. Fishes and shellfishes were used as protein source instead of meat. The proportion of fishes and shellfishes consumption compared to meat consumption was 2.8 times as of 1969. In terms of caloric intake, calorie intake per capita per capita in 1969 was 2,105 kcal, far less than the 2,900kcal recommended by Korean FAO in 1962.¹⁵⁾

Third, in terms of economy, North Korea seems to be similar to South Korea's economic structure in 1970. According to the comparison of economy and society between South Korea and North Korea from the Hyundai Economic Research Institute (2014), North Korea is similar to South Korea in the early 1970s in the field of agriculture. Annual food production per farm population in North Korea in 2013 is 0.50 tonnes, similar to South Korea's 0.48 tonnes in 1970, and at the same time North Korea's farm population is 36.8% of the total population, not much different from that of South Korea in 1970 (44.7%). The industrial structure of North Korea where the primary industry accounts for 23.4% is also similar to the 1970s in South Korea when the primary industry occupied a high proportion.

Fourth, the income level of North Korea is similar to that of South Korea in 1970. Lee Jong-mi (1990a, 1990b) found that the national income is highly correlated with the food consumption structure, and food consumption patterns change with income level. In 2014, North Korea's gross national income per capita (per capita GNI) is KRW 1.39million.¹⁶⁾ In 1970, GNI per

¹⁴⁾ At that time, the FAO Korea Association proposed a change in food policy so that the grain-based diet could be changed to a fat and protein diet. *The Kynghyang Shinmun* (1970. 9. 12).

¹⁵⁾ Kang (2000), pp. 25~56.

¹⁶⁾ 1.39 million won was calculated based on the price of items in South Korea. *Statistics Korea* (2016), p. 30.

capita in South Korea was \$257 (equivalent to the current value of KRW 1.63million in South Korea)¹⁷⁾, which is almost similar to the current income of North Korea.

Next, for the supply by item, the net food supply by item in North Korea was calculated and used. For North Korea's consumption by item, South Korea's net food supply by item was used as a proxy variable. North Korea's supply by item was directly calculated and used by North Korea's net food supply by item. Previously, the formula for calculating the total supply by item was briefly reviewed through Equation (2). More specifically, the net food supply by item is [food supply = production + import + carry-in - (carryover + export + feed + seed + loss + demand for food manufacturing)]. If waste is subtracted from food supply, it becomes net food supply. In this study, due to the nature of North Korea, the carry-in volume, carryover volume, and demand for food manufacturing were judged to be negligible and were not applied.

Here, the loss refers to a decrease in the amount of edible part of agricultural products(or livestock products, aquatic products) that can be lost during the storage and transportation after harvesting and slaughtering. According to FAO, the average loss rate was 10% for rice, maize and potatoes, 10% for wheat, barley and other cereals, 5% for soybeans, 20% for vegetables and 10% for fruits.¹⁸⁾ The refuse is the proportion of the amount of food that can not be eaten (eg hair, bone) to be discarded. The average refuse rate was 20% for chicken and 40% for fishes and shellfishes. In cereals supply, demand for feed and seed was additionally excluded. In this case, the demand for feed was calculated by multiplying the livestock numbers by feed

¹⁷⁾ If you convert \$257 to South Korean won by applying the exchange rate at the time, \$1 = 310 to 315 won, it is about 80,000 won. Applying the 1970 consumer price index of 5.902 (2015 = 100) to convert this to the present value, it is about 1.63 million won. Source: South Korean GNI and consumer price index in 1970, Statistics Korea (<http://kosis.kr>, Search date: 2022. 8. 5); Exchange rate information is provided by the Bank of Korea's economic statistics system (<https://ecos.bok.or.kr>, Search date: 2022. 8. 5).

¹⁸⁾ The average loss rate was based on FAO and Food Balance Sheet.

requirement.¹⁹⁾²⁰⁾ Demand for seed was estimated by FAO, which is calculated by multiplying the planted area by the quantity of sowed seeds per unit area.²¹⁾

Meanwhile, production statistics used estimates from FAO and the Statistics Korea. Although FAO provides estimates for many items, there are also a significant number of items for which estimates are not provided. (Table 3) Due to limitations in the use of such data, items for which production statistics do not exist were excluded from supply estimation in this study. However, among items for which production statistics do not exist, if export/import statistics for the item do exist in UN Comtrade, they are included in the supply estimate.

Table 3. Availability of production statistics by item

Type	Item	Source
Items for which FAO provides production statistics	Cereals, Starchy Roots, Pulses, Tree Nuts, Vegetables, Fruits, Meat, Eggs, Milk	FAO STAT
	Fishes and Shellfishes	Statistics Korea
Items for which FAO does not provide production statistics	Sweeteners, Pulses, Oil Crops, Milk, Oils and Fats, Seaweeds	

Source: Written by the author.

FAO estimates and provides meat production based on livestock breeding statistics presented by the North Korean Ministry of Agriculture. Table 4 shows the number of livestock and meat production in North Korea using FAO statistics.

¹⁹⁾ FAO applied feed demand differently for different livestock species.

²⁰⁾ Feed demand is 100,000 tons of corn and 20,000 tons of potatoes.

²¹⁾ Demand for seeds is 12,000 tons of wheat, 56,000 tons of rice, 4,000 tons of barley, 62,000 tons of corn and 3,000 tons of others.

Table 4. Number of livestock and meat production in North Korea in 2014

Livestock Type	Number of heads (thousand)	Meat production (tons)
Cattle	575	20,378
Pig	2,100	101,854
Chicken	15,400	33,438
Sheep	168	958
Goat	3,665	15,052
Rabbit	32,500	151,909
Duck	6,000	10,802

Source: FAO STAT (Search data: 2022. 8. 5).

The amount of exports and imports are based on UN Comtrade data(HS code 6 units) and monthly inter-Korean exchange trends data from the Ministry of Unification. The HS Code of UN Comtrade and the KSITC of North and South Korea trade are arranged according to the Food Balance Sheet classification.²²⁾ The grant aid was provided by FAO.

On the other hand, in some cases, there was no production statistics required to compose food supply and demand tables. FAO and Statistics Korea do not provide statistics on the production of some items. In our study, when production statistics are not available, the production statistics section is set to 0 (zero) when calculating the net food supply of the items. Instead of completely excluding the item from the supply estimate, we chose to estimate the inaccurate quantity using some existing statistics. As a result, certain items such as oil crops, shellfishes, and oils without production data are likely to be overestimated, but they are expected to have little impact on the overall results.

²²⁾ Using Food Balance sheets: A handbook (FAO 2001), the HS Code was organized according to the classification method shown in the food supply and demand table. Details are summarized in <Attachment 1>.

4. Results

Based on the above discussion, the total consumption of North Korea by items during 2010 ~ 2014 is shown in Table 5 below. During the analysis period, food consumption is gradually increasing, due to population growth.²³⁾ Conversion of total consumption to calories shows that a lot of energy is obtained through consumption of carbohydrate items such as cereals. The daily total calorie supply per person is 2,370kcal, 1,818kcal is obtained from cereal, which is 76.7% of total calorie supply.²⁴⁾ On the other hand, protein intake, such as beans and meat, is not relatively enough, suggesting that proteins are supplemented through the consumption of fishes and shellfishes.

North Korea's food consumption, estimated based on the 1970 Food Balance Sheet table in South Korea, and North Korea's food consumption, estimated using the FAO/WFP methodology, show a big difference. FAO/WFP assumes that North Koreans consume 1,640Kcal, the minimum calories per person per day, with only five grains (rice, maize, potatoes, soybeans, wheat/barley and other grains). Next, they estimate the food consumption of North Korea by inversely calculating the consumption of five grains that can meet the minimum calorie. According to the FAO/WFP methodology, the amount of food consumed through cereals, potatoes, and pulses in total food consumption from table 5 will be about 70.4% in 2010 ~ 2014. Thus, the FAO/WFP methodology can be interpreted as analyzing whether only 70.4% of total food consumption meets the minimum calorie 1,640 Kcal per person per day.

²³⁾ To derive the total consumption by item in North Korea, the population of North Korea from 2010 to 2014 was 24,187 (thousand people), 24,308 (thousand people), 24,427 (thousand people), 24,545 (thousand people), and 24,662 (thousand people), respectively. Statistics Korea(2016).

²⁴⁾ Previously, in Chapter 3, it was mentioned that the daily calorie intake per capita in 1969 was 2,105 kcal. The 2,370 kcal used here is a calorie calculated based on the net food supply per person per day in the 1970 food supply and demand table, and is closer to the concept of supplied calorie than actual intake.

North Korea's total food supply by item is shown in <Table 6>. Most items remained stable during the analysis period. Cereals, potatoes, fruits, oil and fishery production gradually increased, while the production of beans, vegetables, meat, and milk remained stable without big change. However, in the case of some items, such as oil crops and shellfish, it can be seen that the total supply is negative (-), which is a result of the absence of production data.

Interestingly, as a result of this report, even though the total food supply is not insufficient compared to the total food consumption, the FAO/WFP methodology estimates that the food supply is insufficient for some of the five grains. According to the methodology of FAO/WFP, if we calculate the share of grain, potatoes and pulp feeds supply then, proportion is around 50%, from 49.1% in 2010 to 52.1% in 2014.

<Table 7> shows North Korea's food supply and demand rate(R_{it}) and food shortage(L_{it}) by item. For the convenience of the study, the items in the 1970 South Korea's Food Balance Sheet were classified into five food groups: cereals and starchy roots, fishes and meat (including eggs and beans), fruits and vegetable, milk and dairy products, and fats and sweeteners. The overall food supply and demand rate is gradually improving from 1.18 in 2010 to 1.26 in 2014.²⁵⁾ Grain and potatoes supplies are insufficient, but fruits and vegetables are generously supplied. In 2010, cereals and potatoes were short of 1,291.7 thousand tons, but total foodstuffs were supplied in excess of 1,585 thousand tons. In 2014, cereals and potatoes were short of 563.1 thousand million tons, but total foodstuffs were supplied in excess of 2,380.3 thousand tons.

On the other hand, FAO/WFP(2015) estimated that the total cereals consumption of North Korea in 2014 was 5,370 thousand tons and the total ce-

²⁵⁾ The food supply/demand rate was derived by dividing the total supply by the total consumption, and the shortage was derived by subtracting the total supply from the total consumption.

reals supply amounted to 5,343 thousand tons, which means that about 30 thousand tons of cereals were lacking.²⁶⁾ In this case, the food supply and demand rate is 0.99. For reference, 2014 is the year in which food supply and demand are almost in balance, and the food situation has been the best since the mid-2000s.²⁷⁾

Of course, the estimated North Korea's total consumption by item in this paper is based on South Korea's 1970 Food Balance Sheet table. As mentioned above, two assumptions were made for this estimation. One is that food culture of South Korea in 1970 did not show much change with the food culture before the division of South and North Korea, and the other was that the food culture of North Korea in 2010 did not show much change with the food culture before the division of South and North Korea. In 1970, 17 years after the division of the two Koreas, South Korea also suffered from food shortages. It seems unlikely that the food culture has changed drastically in the 1970s compared to the situation before South Korea's division. In addition, the food culture of North Korea seems to have not changed much considering that the social change of North Korea is static.

Next, in order to compare the methodology of FAO/WFP with the methodology of this study, the food supply and demand rate of this study was re-estimated based on calories. <Table 8> shows the total food supply and demand rate (R_t^c) based on the difference in calorie supply by each food item. R_t^c is calculated by multiplying the calorie weight of each item (C_{it}) by the total food supply and demand rate by item (R_{it}) and summing.

The total food supply and demand rate in the first row is the value obtained in Table 7 above. This figure is presented for comparison with the

²⁶⁾ FAO/WFP (2015), "The Democratic People's Republic of Korea: outlook for Food Supply and Demand in 2014/2015 (November/October)," p. 7.

FAO/WFP (2013), "The Democratic People's Republic of Korea: outlook for Food Supply and Demand in 2012/2013 (November/October)," p. 37.

²⁷⁾ Kwon (2015), "North Korea's Food Supply Outlook and Implications for 2015."

food supply and demand rate, which is based on the difference in calorie supply by food items.

The second row is derived by reflecting the calorie weight without artificially adjusting the supply-demand ratio for each item. The results show irregular values ranging from 1.62 to 0.63, which is attributed to the fact that the supply and demand rate of oil crops and tree nuts is excessively high or too low due to data limitations. Therefore, it seems that the sum of these figures influenced the overall rate of supply and demand. The supply and demand rate of nut seeds was estimated to be negative(-) because the total supply of oil crops was negative(-). The yield of nut seeds was not available, but the amount of export was large and the total supply was negative(-). In the case of tree nuts, it can be seen that it is derived to be excessively large compared to the supply rate of other items. The consumption of tree nuts in the 1970 South Korea's Food Balance Sheet, which we used as proxy variables, is relatively low, but the total supply of tree nuts at present is relatively large.

In the third row, the total supply and demand rate readjusted outliers is shown. Total supply and demand rate(2) is the value obtained by adjusting the supply and demand rate of seed to 0 and then adjusting the maximum rate of supply and demand rate for each item to the supply and demand rate of fruit. In this case, the overall rate of supply and demand rate is between 1.30 and 1.37. The figures show a stable flow within a certain range compared to the results without any artificial adjustment.

The fourth row is the value derived by lowering the maximum rate of supply and demand for each item to 2 rather than the supply and demand rate of fruit. In this case, the rate was lower than overall rate of (2), showing a gradual increase from 2010 to 2014. This shows the same trend as the total demand rate shown in <Table 7>.

The values given in the fifth row are the estimates of the maximum rate of supply and demand for each item to make the total rate equal to one for each year inversely. For example, in 2010, when the numerical value of the items

whose rate exceeds 1.77 is changed to 1.77, the total rate becomes 1. These values are distributed between about 1.5 and 1.7. What this means is that some items, such as cereals, have a rate of one or less, but North Koreans can get the calories they need by consuming other items.

The estimated food shortage differs slightly from the FAO/WFP(annual) deficit because of the difference in the estimation method. Specifically, the first FAO/WFO does not allow substitution of cereals and other food consumption by considering only six cereals.²⁸⁾ Insufficient calories from cereals can be filled with vegetables, fruits and meat. Areas with high access to fishes, such as the Korean Peninsula, should be considered for substitution of calories from fishes. If the food supply and demand rate is calculated by considering only 6 cereals items, ignoring the consumption substitution of food, the food supply rate is likely to be low.

Second, the standard values are different. FAO/WFP assumes 174kg per capita annual grain consumption, which meets the minimum calorific value of 1,640 kcal per person per day. On the other hand, if the 1970 Food Balance Sheet was compiled according to the FAO/WFP standards, the per capita daily supply of nutrients through six grains would be 1,932kcal, resulting in an annual cereals consumption of 217kg per capita. As a result, it shows the difference in the supply and demand rates calculated by different analytical standards.

Finally, it is assumed that the food culture of North Korea, which is supposed to be similar to the food culture of South Korea in 1970, is changed to the food culture of South Korea in 1990 as follows. South Korea experienced a rapid food culture change from a carbohydrate diet in 1970 to a protein-oriented diet in 1990. North Korea's foreign trade openness is at a level of 15 ~ 30%. As the size of the distribution of overseas imported food in the

²⁸⁾ FAO estimates food shortages in developing countries such as Southeast Asia and Africa besides North Korea with grain-oriented items. This seems to be to investigate the food supply and demand situation of each country in a standardized way.

market(jangmadang) increases, the food culture of North Korea will likely change like South Korea. Also, as the economic integration of North and South Korea accelerates due to inter-Korean economic cooperation and unification, the food culture of North Korea is likely to converge to South Korea. In this case, the following two changes are observed in total consumption by item. First, the grain-based diet changes into a protein-based diet such as fishes, meat, milk and dairy products, fruits and vegetable, oils and sweeteners. Second, total food consumption increases. In the case of North Korea having a food culture based on the food balance sheet in 1970, total consumption amounted to 9,038.3 thousand tons, but when the food supply standard of 1990 was based on the food supply standard, total consumption amounted to 12,046.7 thousand tons, which is 33.3%

Table 9 summarizes the changes in food supply rate due to changes in food culture. North Korea's total food supply and demand rate in 2014 drop to 0.95 from 1.26. Some items that have been oversupplied are converted to food shortages as food consumption increases due to changes in food culture. Specifically, it is cereals and starchy roots that are converted into 'supply shortage → oversupply', and fishes, meat, milk and dairy products, fruits and vegetables, oils and fats are converted to 'oversupply → supply shortage'. In other words, if the food culture of North Korea changes, cereals and starchy roots become oversupplied, and fish and dairy products become short supply. If South Korea makes food aid based on changes in food culture in North Korea, it is necessary to change the related items from the aid of grains to the aid of dairy products.

Table 5. Total Consumption by Item in North Korea(2010-14)

(Unit: 1,000 tons)

	Total Consumption				
	2010	2011	2012	2013	2014
1.Cereals	4,714.1	4,737.7	4,760.9	4,783.9	4,806.7
Wheat	606.7	609.7	612.7	615.6	618.6
Rice	3,155.2	3,171.0	3,186.5	3,201.9	3,217.2
Barley	890.2	894.6	899.0	903.3	907.6
Etc	62.1	62.4	62.7	63.0	63.3
2.Starchy Roots	1,353.9	1,360.7	1,367.4	1,374.0	1,380.5
Potatoes	356.8	358.6	360.4	362.1	363.8
Sweet Potatoes	997.1	1,002.1	1,007.0	1,011.9	1,016.7
3.Sweeteners	150.4	151.1	151.8	152.6	153.3
4.Pulses	178.8	179.7	180.6	181.4	182.3
Soy beans	148.1	148.9	149.6	150.3	151.0
Red Beans	30.7	30.8	31.0	31.1	31.2
5.Tree Nuts	1.5	1.5	1.5	1.5	1.5
6.Oil Crops	2.2	2.3	2.3	2.3	2.3
Sesame	2.2	2.3	2.3	2.3	2.3
7.Vegetables	1,449.7	1,456.9	1,464.1	1,471.2	1,478.2
8.Fruit	243.1	244.3	245.5	246.7	247.9
9.Meat	200.5	201.5	202.5	203.4	204.4
Bovine Meat	37.4	37.6	37.8	38.0	38.1
Pig Meat	86.8	87.2	87.6	88.1	88.5
Poultry Meat	33.7	33.8	34.0	34.2	34.3
Etc	42.6	42.8	43.0	43.2	43.5
10.Eggs	77.0	77.4	77.8	78.2	78.6
11.Milk	23.2	23.3	23.4	23.5	23.6
Milk	17.2	17.3	17.4	17.5	17.5
Etc	6.0	6.0	6.0	6.0	6.1
12. Oils and Fats	35.2	35.3	35.5	35.7	35.8
Vegetable Oils	16.5	16.5	16.6	16.7	16.8
Animal Fats	19.5	19.5	19.6	19.8	19.9
13.Fishes and Shellfishes	354.6	356.3	358.1	359.8	361.5
Fishes	261.8	263.1	264.4	265.7	267.0
Shellfishes	92.8	93.2	93.7	94.1	94.6
14.Seaweeds	63.6	63.9	64.2	64.5	64.8
Total	8,864.2	8,908.6	8,952.2	8,995.4	9,038.3

Note: Calculated by considering annual per capita consumption by item in the South Korean Food Supply and Demand Table (1970) and population change.

Source: Written by the author.

Table 6. Total supply by item in North Korea(2010-14)

(Unit: 1,000 tons)

	Total Supply				
	2010	2011	2012	2013	2014
1.Cereals	3,318.6	3,629.5	4,034.1	3,999.0	3,991.4
Wheat	304.2	368.4	296.2	249.7	238.8
Rice	1,355.7	1,434.9	1,393.2	1,599.7	1,641.4
Barley	49.9	61.9	43.8	24.0	24.8
Etc	1,420.5	1,465.5	1,729.3	1,672.6	1,853.3
2.Starchy Roots	144.1	154.9	163.9	163.6	162.9
Potatoes	1,457.8	1,499.4	1,298.3	1,546.7	1,632.7
Sweet Potatoes	1,151.5	1,184.5	1,025.7	1,223.2	1,297.5
3.Sweeteners	306.3	314.9	272.6	323.5	335.1
4.Pulses	117.6	43.0	7.3	13.5	3.4
Soy beans	350.0	350.0	344.7	336.2	322.0
Red Beans	350.0	350.0	344.7	336.2	322.0
5.Tree Nuts	19.8	17.2	19.8	19.5	3.3
6.Oil Crops	-1.2	-4.9	-5.6	-10.3	-9.7
Sesame	1.8	1.9	0.7	0.9	0.2
7.Vegetables	-3.0	-6.7	-6.3	-11.2	-9.9
8.Fruit	2,908.0	2,710.0	2,804.6	2,808.7	2,879.9
9.Meat	1,360.9	1,414.0	1,443.7	1,441.5	1,455.4
Bovine Meat	325.8	343.0	352.1	347.9	345.7
Pig Meat	22.3	22.3	23.0	22.6	21.0
Poultry Meat	111.7	111.6	114.1	115.4	108.6
Etc	25.5	26.7	32.3	27.3	30.8
10.Eggs	160.0	176.1	176.1	176.1	179.0
11.Milk	122.5	122.5	122.5	122.5	122.1
Milk	98.0	97.6	101.0	99.8	100.4
Etc	97.9	97.5	100.9	99.8	100.4
12. Oils and Fats	37.9	44.0	52.7	58.3	80.6
Vegetable Oils	32.5	40.0	47.0	59.5	83.2
Animal Fats	5.4	4.0	5.7	-1.2	-2.6
13.Fishes and Shellfishes	331.8	376.0	413.3	436.5	490.4
Fishes	376.0	423.4	465.9	483.9	543.6
Shellfishes	-44.2	-47.3	-52.6	-47.4	-53.2
14.Seaweeds	1.7	1.7	1.9	1.2	1.0
Total	10,449.2	10,643.1	10,990.4	11,220.9	11,418.6

Note: Derived from 'production amount of FAO by item + import amount - export - loss amount.'

Source: Written by the author.

Table 7. Food supply and demand rate and shortage by item in North Korea(2010-14)

Type	Supply and Demand rate					Shortages(1,000 tons)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
1. Cereals and Starchy Roots	0.79	0.84	0.87	0.90	0.91	1,291.7	969.6	795.9	612.2	563.1
Cereals	0.70	0.77	0.85	0.84	0.83	1,395.6	1,108.2	726.8	784.9	815.3
Starchy Roots	1.08	1.10	0.95	1.13	1.18	-103.8	-138.6	69.1	-172.7	-252.1
2. Fishes and Meat	1.39	1.46	1.51	1.51	1.55	-319.3	-376.6	-413.7	-420.2	-453.3
Meat	1.63	1.70	1.74	1.71	1.69	-125.4	-141.5	-149.6	-144.5	-141.3
Fishes and Shellfishes	0.94	1.06	1.15	1.21	1.36	22.8	-19.7	-55.2	-76.7	-128.8
Eggs	1.59	1.58	1.57	1.57	1.55	-45.5	-45.1	-44.7	-44.3	-43.6
Pulses	1.96	1.95	1.91	1.85	1.77	-171.2	-170.3	-164.2	-154.8	-139.7
3. Milk and Dairy product	2.47	2.45	2.52	2.48	2.48	-58.4	-57.8	-60.9	-59.6	-60.0
4. Fruits and Vegetagle	2.43	2.34	2.40	2.39	2.42	-2,514.2	-2,360.5	-2,476.4	-2,469.0	-2,545.4
Vegetable	2.01	1.86	1.92	1.91	1.95	-1,458.3	-1,253.0	-1,340.5	-1,337.5	-1,401.8
Fruits	5.60	5.79	5.88	5.84	5.87	-1,117.7	-1,169.7	-1,198.2	-1,194.8	-1,207.5
Seaweeds	0.03	0.03	0.03	0.02	0.02	61.9	62.2	62.3	63.3	63.8
5. Fat and Oils, Sweeteners	0.92	0.52	0.39	0.42	0.40	15.2	90.9	116.9	111.1	115.3
Fat and Oils	1.08	1.24	1.49	1.63	2.25	-2.7	-8.6	-17.2	-22.6	-44.8
Sweeteners	0.78	0.28	0.05	0.09	0.02	32.7	108.1	144.5	139.1	150.0
Nut seeds	-0.55	-2.15	-2.48	-4.54	-4.22	3.5	7.1	7.9	12.6	12.0
Tree Nuts	13.23	11.43	13.10	12.83	2.18	-18.3	-15.7	-18.3	-18.0	-1.8
Total	1.18	1.19	1.23	1.25	1.26	-1,585.0	-1,734.5	-2,038.2	-2,225.5	-2,380.3

Note: If the shortfall (1,000 tons) is negative (-), it means that the item is in oversupply, and if it is positive (+), it means that the item is in short supply.

Source: Written by the author.

Table 8. Supply and demand rate by item in North Korea(2010-14)

Supply and Demand rate	2010	2011	2012	2013	2014
Total food supply and demand rate derived from <Table 7>	1.18	1.19	1.23	1.25	1.26
(1) In case there is no adjustment for the maximum supply/demand ratio by item	1.62	1.26	1.33	1.02	0.63
(2) Maximum value of supply/demand rate by item = supply/demand rate of fruits	1.30	1.30	1.34	1.37	1.30
(3) Maximum value of supply/demand ratio by item = 2	1.05	1.04	1.07	1.11	1.17
(4) The highest value of supply/demand ratio by item that makes the overall supply/demand ratio equal to 1	1.77	1.78	1.64	1.55	1.56

Note: In the case of (2) and (3), this is the total supply and demand rate when the maximum value of supply and demand rate by item is modified to either the fruit supply and demand rate or 2, respectively; In the case of (4), the highest value for each item that makes the total supply and demand rate equal to 1 is obtained; Seeds supply and demand rate=0.

Source: Written by the author.

Table 9. Changes in food supply and demand rate assuming changes in food culture in North Korea (based on food supply in 2014)

(Unit: 1,000 tons)

Type	Total Supply	Total consumption1 (1970)	Total consumption2 (1990)	Ratio1	Ratio2
	S_{i2014}	D_{i1970}^{1970}	D_{i1990}^{1990}	$\frac{S_{i2014}}{D_{i1970}^{1970}}$	$\frac{S_{i2014}}{D_{i1990}^{1990}}$
1. Cereals and Starchy Roots	5,615.6	6,187.2	4,598.5	0.91	1.22
Cereals	3,728.4	4,806.7	4,326.4	0.78	0.86
Starchy Roots	1,887.2	1,380.5	272.1	1.37	6.94
2. Fishes and Meat	1,280.6	826.8	1,780.6	1.55	0.72
Meat	339.3	204.4	581.1	1.66	0.58
Fishes and Shellfishes	491.1	361.5	752.1	1.36	0.65
Eggs	122.1	78.6	194.6	1.55	0.63
Pulses	328.1	182.3	252.9	1.80	1.30
3. Milk and Dairy product	100.4	40.4	784.4	2.49	0.13
4. Fruits and Vegetagle	4,331.7	1,790.9	4,124.9	2.42	1.05
Vegetable	2,874.0	1,478.2	3,270.8	1.94	0.88
Fruits	1,455.4	247.9	714.2	5.87	2.04
Seaweeds	2.2	64.8	139.9	0.03	0.02
5. Fat and Oils, Sweeteners	98.4	193.0	758.3	0.51	0.13
Total	11,426.7	9,038.3	12,046.7	1.26	0.95

Note: Total consumption 1 is calculated based on the South Korean food supply and demand table in 1970, and total consumption 2 is the total consumption in North Korea based on the 1990 South Korean food supply and demand table.

Source: Written by the author.

5. Conclusion

In this study, North Korea's food self-sufficiency and food shortage were estimated by referring to North Korea's food culture. As a result of the analysis, it was found that there is a possibility that the food shortage in North Korea estimated by FAO/WFP was overestimated. Comparing North Korea's food supply and demand rate in 2010 with that of South Korea in 1970, it was found that the food supply and demand rate was gradually improving from 1.18 in 2010 to 1.26 in 2014. This is because FAO/WFP assumed that 1,640Kcal of calories per day required for survival was covered only by 6 major grains, and it was considered that it could not be replaced with other foods. On the other hand, people can replace the lack of calories by including fish, meat, vegetables, and fruits in their meals in addition to the six grains. As in this study, if North Korea's food supply and demand rate is re-estimated based on the 1970 food supply and demand table, the food supply in 2014 was rather overproduced.

However, the results of this study do not mean that North Korea is not short of food. Above all, North Korea's total supply by item estimated in this study includes the amount of aid supported by the international community. Second, South Korea in 1970, which is used as a comparison standard in this study, suffered from food shortages and was receiving food aid from the international community. Third, supply of food is important, but distribution is also very important. In regions like North Korea, where logistics infrastructure is not developed and logistics costs between regions are high, there is a possibility that some regions will experience serious food shortages even if the total supply is sufficient.

Second, from the perspective of food culture, South Korea's aid and support policies toward North Korea need to change from grain-oriented to meat, vegetables, and fruits. This also has implications for mid- to long-term food supply and demand policies in preparation for unification. Immediately

after unification, a grain-oriented support policy should be implemented to minimize social confusion, but in the stabilization period after unification, a stable supply of meat, vegetables, and fruits will become more important than grain.

References

[References in Korean]

- FAO/WFP. 2012. “FAO/WFP Special Report on Crop and Food Security Assessment in North Korea in 2011/2012.”
- . 2013. “The Democratic People’s Republic of Korea: outlook for Food Supply and Demand in 2012/2013.” (November/October)
- . 2014. “FAO/WFP Special Report on Crop and Food Security Assessment in North Korea in 2013/2014.”
- . 2015. “The Democratic People’s Republic of Korea: outlook for Food Supply and Demand in 2014/2015.” (November/October)
- Hwang, Nami, Shinwook Kang, Junghoon Shin, and Yonghwan Noh. 2011. “Strategies for the Health and Food Assistance on the Crisis in North Korea.” Korea Institute for Health and Social Affairs.
- Kang, Inhee. 2000. “History of Korean Food and Living.” Samyongsa.
- Kim, Myunghwan, Taegon Kim, and Sooseok Kim. 2008. 『Food Insecurity; Its Factors and Countermeasures in a National Perspective of Korea』. Korea Rural Economic Institute (Korean).
- Korea Rural Economic Institute(KREI). 1971. Food Balance Sheet.
- . 1991. Food Balance Sheet.
- Kwon, Taejin. 2015. 『North Korea’s Food Supply Outlook and Implications for 2015』. GSJ No. 197. p. 4.

- Kwon, Taejin, and Minji Nam. 2010. "North Korea's Food Supply Forecast for 2010." KREI North Korea Agricultural Trends. Volume 11, Issue 4.
- Song Jooho. 2014. 'Food security and the case of the Philippines.' "World Agriculture." Korea Rural Economic Institute (Korean).
- Statistics Korea. 2016. "2016 Major Statistical Indicators of North Korea."

[Internet Materials]

- Exchange rate information by the Bank of Korea's economic statistics system.
<https://ecos.bok.or.kr/> (Search data: 2022. 8. 5).
- FAO STAT. www.fao.org/faostat/en/#data (Search data: 2022. 8. 5).
- FAO. 2001. 『Food BALance Sheets: A handbook』 . <https://www.fao.org/3/X9892E/X9892E00.htm> (Search data: 2022. 8. 5).
- Ministry of Unification. 2014 Monthly North-South Exchange Trends.
<https://www.unikorea.go.kr/content.do?cmsid=3809> (Search data: 2022. 8. 5).
- Seafood catch by Kosis National Statistics Portal. https://kosis.kr/bukhan/files/anal/ANL011/ANL011_TNT007.htm (Search data: 2022. 8. 15).
- South Korean GNI and Consumer Price index in 1970 by Statistics Korea.
https://kosis.kr/statisticsList/statisticsListIndex.do?menuId=M_01_01&vwcd=MT_ZTITLE&parmTabId=M_01_01&outLink=Y&parentId=P2.1;P2_6.2;#content-group (Search data: 2022. 8. 5).
- UN Comtrade. <https://comtrade.un.org> (Search data: 2022. 8. 18).

[Press Materials]

- Maeil Business News Korea. 1970. 9. 2. 'Focus on Increased Production Policy.'
- The Kynghyang Shinmun. 1970. 9. 12. 'Urgency to improve diet.'

국문요약

북한의 식량 부족량에 대한 추정은 FAO/WFP의 열량(1인당 1일 최소 1,640 Kcal) 기준 추정 방식을 따르고 있다. 이 방식은 생존을 위한 최소한의 식량부족량을 추정할 수 있다는 점에서 유용하나, 북한지역 주민이 소비하는 식문화를 무시하였다는 점에서 실생활에 따른 수치를 정확하게 반영하지 못하는 한계를 갖는다. 이에 반해 본 연구에서는 식문화를 고려하여 북한의 식량 수급량 및 부족량을 추정하였다. 식량 부족량은 식량 소비량과 공급량의 차로 산출하였다. 식량 소비량은 식문화를 고려하기 위하여 남한의 식품수급표(1970년, 1990년)와 북한인구를 활용하였다. 식량 공급량은 북한 식량 생산량과 수입량, 수출량을 고려하였다. 추정결과, 첫째 1970년(분단 후 17년) 남한 인구 1명이 1년 동안 먹었던 식단을 기준으로 2014년 북한의 식량 부족량을 추정할 경우, 2,388.4천 톤이 과잉 공급되어 식량 자급률은 1.26를 기록하였다. 둘째, 장마당의 확산이나, 남북한 통일로 북한의 식문화가 남한의 1990년도와 유사하게 변하는 상황을 가정할 경우 식량의 총소비량이 33.3% 증가하면서 식량 자급률이 1.26에서 0.95로 하락하였다. 본 연구 결과는 두 가지 시사점을 갖는다. 첫째, FAO/WFP가 생존에 필요한 최소 열량을 기준으로 추정한 곡물 부족량이 과대 추정되었을 가능성이 있다. 둘째, 탄수화물 위주의 북한 식량원조는 북한의 식문화를 고려하지 못하고 있으므로, 어·육류, 과일 및 채소류에 대한 지원을 늘려갈 필요가 있다. 향후 북한 식문화에 관한 정보에 접근 가능하다면 북한식생활이 남한의 식생활로 수렴할 가능성이 있음을 강건성 검정으로 확인할 필요가 있다.

〈책임〉

최장호

서울대학교 농경제사회학 학사

서울대학교 농업경제학 석사

미국 Oregon State University, Applied Economics 박사

대외경제정책연구원 경제안보전략실 통일국제협력팀장

(現, E-mail: choi.j@kiep.go.kr)

저서 및 논문

『동남아 CLMV 국가의 체제전환 평가와 북한에 대한 함의: 체제전환 지수 개발과 적용』(공저, 2020)

『외국인 기업의 남북경협 참여활성화 방안』(공저, 2021) 외

〈공동〉

김범환

서울대학교 경제학 석사

대외경제정책연구원 경제안보전략실 통일국제협력팀 전문연구원

(現, E-mail: bhkim@kiep.go.kr)

저서 및 논문

『2016년 대북제재 이후 북한경제 변화와 신남북협력 방향』(공저, 2019)

『대북제재의 게임이론적 접근과 북한경제에 미치는 영향』(공저, 2021) 외

KIEP List of Working Papers (2018–2022)

■ 2022	22-01	COVID-19 and the Health of Banking Sector in Japan and South Korea: A Comparative Study Munim Kumar Barai
	22-02	A Study on the Effects of Multinational Production on Global and Domestic Value Chains Following Trade Restructuring and Corresponding International Economic Policies Myoung Shik Choi and Hun Dae Lee
	22-03	Analyzing DPRK's Food Supply and Demand Condition with Food Culture Jangho Choi and Bum Hwan Kim
■ 2021	21-01	Consumer Responses to Price Shocks of Wine Imports in Korea Chul Chung, Min-chirl Chung, and Bonggeun Kim
	21-02	A Theoretical Approach to Evaluating Global Vaccination Plans Youngseok Park and Sangjun Yea
■ 2020	20-01	Trump Tariff and Firm Relief: Winners and Losers from Steel Tariff Exclusion Request Yeo Joon Yoon and Wongi Kim
	20-02	Global Financial Imbalance: Firm-level Evidence from Korea Tae Soo Kang, Kyunghun Kim, and Yuri Kim
	20-03	Defined Contribution Funded Social Security and Labor Supply: Focus on Mexican Social Security Reform in 1997 Sungwoo Hong
	20-04	Bargaining and War: On the Existence of Communication Equilibrium in Conflict Games Youngseok Park and Colin Campbell
	20-05	Determinants of Korean Outward Foreign Direct Investment: How do Korean firms respond to the labor costs of host countries? Hanbyul Ryu and Young Sik Jeong
■ 2019	19-01	Push vs. Pull Factors of Capital Flows Revisited: A Cross-country Analysis Tae Soo Kang and Kyunghun Kim

- 19-02 Deeper Regional Integration and Global Value Chains
Nakgyoon Choi
- 19-03 Repercussions of Negatively Selective Migration for the Behavior of Non-migrants when Preferences are Social
Oded Stark and Wiktor Budzinski
- 19-04 The Effect of Export Insurance and Guarantees on Export Performance: An Empirical Analysis for Korea
Kyunghun Kim and Hyelin Choi
- 19-05 New Delhi's 'Act East' and the India-ASEAN Engagement: What They Mean for India-Korea Relations in the Indo-Pacific
Jagannath P. Panda
- 19-06 Institutional Quality, Trade Costs and Comparative Advantage
Sangkyom KIM and Soon Chan Park
- 19-05 New Delhi's 'Act East' and the India-ASEAN Engagement: What They Mean for India-Korea Relations in the Indo-Pacific
Jagannath P. Panda
- 19-06 Institutional Quality, Trade Costs and Comparative Advantage
Sangkyom KIM and Soon Chan Park
- 19-07 Stakeholders' Interest Relations in Korea's Services Trade Liberalization: A Political Economy Analysis
June Dong Kim
- 19-08 The Effects of Technological Similarity and Diversity on Merger and Innovation
Gu Sang Kang
- 19-09 The Effects of US Sectoral Shocks through the World Input-Output Network
Minsoo Han
- 19-10 How Does Protectionist Trade Policy Interact with FDI?
Jongduk Kim and Moonhee Cho
- 2018
- 18-01 Vietnam's Low National Competitiveness: Causes, Implications and Suggestions for Improvement
LE Quoc Phuong
- 18-02 Financial Market Integration and Income Inequality
Jae Wook Jung and Kyunghun Kim
- 18-03 Exchange Rates and Firm Exports: The Role of Foreign Ownership and Subsidiaries
Hyelin Choi and Hyo Sang Kim
- 18-04 A Quantitative Trade Model with Unemployment
Kyu Yub Lee

- 18-05 A Study on the Dynamics of Foreign Trade and the Issues of Regional Economic Integration in Central Asia
Kodirjon Maxamadaminovich Umarkulov
- 18-06 Sources of Comparative Advantage in Services: Institution vs. Social Capital
Nakgyoon Choi and Soonchan Park
- 18-07 The Rise of China and the Rebound in Korea's Manufacturing Employment
Kyong Hyun Koo and Unjung Whang
- 18-08 The Spillover Effects of Regional Trade Agreements on Trade
Dakshina G. De Silva, Soon-Cheul Lee, Robert P. McComb,
and Maurizio Zanardiy



www.eaerweb.org

Call for Papers for the East Asian Economic Review

With great pleasure, the *East Asian Economic Review* is welcoming submissions.

AIMS and SCOPE

The *East Asian Economic Review* is an economic journal, for the promotion of interdisciplinary research on international economics. Published as a quarterly by the Korea Institute for International Economic Policy, a Korean government-funded economic think-tank, the Journal is global in perspective and covers both theory and empirical research.

The Journal aims to facilitate greater understanding of all issues pertinent to diverse economies of East Asia through publication of rigorous analyses by renowned experts in the field. The EAER connects policy and theory, providing empirical analyses and practical policy suggestions for the economies in the region.

TOPICS COVERED

The *East Asian Economic Review* brings together articles from many different realms of economics at both regional and global levels. Issues relevant to East Asia's diverse economy are the major focuses. Specific areas of interest include, but are not limited to:

- Trade and Investment Issues
- Economic Integration
- APEC
- ASEAN
- ASEM
- International Finance
- Liberalization of Financial Services and Capital
- International Cooperation for Korean Unification.

EAER Abstracting and Indexing Services

The East Asian Economic Review is indexed and abstracted in EconLit, e-JEL, JEL on CD, OCLC WorldCat, ProQuest, Google Scholar, ECONIS, EconBiz, EBSCO, British Library, SSRN, RePEc, Emerging Sources Citation Index (ESCI), Directory of Open Access Scholarly Resource (ROAD), DOAJ and registered to Ulrichsweb, ITS-MARC, CrossRef, ORCID, SHERPA/RoMEO, Korea Citation Index, Think-Asia, Microsoft Academic, Dow Jones Factiva, Dimensions and Lexis Advance.

NOTE FOR AUTHORS

SUBMISSION GUIDELINE:

Refer to our website www.eaerweb.org and Click "Submission" menu at the top of the main page.

SUBMISSION DEADLINE:

The Journal is published every March, June, September and December of each year and submissions are accepted for review on an ongoing basis.

REVIEW PROCESS:

We have introduced a "fast-track" system, which takes four to five weeks on average from submission to the first round review in order to provide quick and authoritative decisions to the authors. In general, the Journal's manuscript decision process includes submission, editorial decision on whether the paper should be reviewed, peer review, decisions after review, revision, acceptance in principle, final submission and acceptance, proofs, advance online publication, and print publication.

For further information regarding submission, Contact EAER Editorial Office:

[30147] 3rd Floor, Building C, Sejong National Research Complex, 370 Sicheong-daero, Sejong-si, Korea.

Tel: 82-44-414-1213 FAX: 82-44-414-1044

Email: eaer@kiep.go.kr

Website: www.eaerweb.org

AWARD FOR EAER

The East Asian Economic Review Award is given annually to articles that have made exemplary contributions to advance the public as well as academic understanding of international economics. Every article published in the Journal is given an honorarium of KRW 2,500,000; and annual nominations for the outstanding and noteworthy articles include KRW 5,000,000 prize and a detailed nomination statement describing how the selected papers have contributed to the knowledge of international economics.



Analyzing DPRK's Food Supply and Demand Condition with Food Culture

Jangho Choi and Bum Hwan Kim

FAO/WFP uses cereals items to estimate food supply and demand in North Korea. However, this methodology has a limitation not considering the food culture of North Korea. In this study, North Korea's food supply and demand was estimated by considering food culture. This study estimated North Korea's food consumption by using South Korea's food balance table. As a result, it was confirmed that the FAO/WFP methodology has a possibility of overestimating the amount of food shortage in North Korea.

