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INPUT FACTORS OF GRAIN PRDUCTION AND GRAIN CONSUMPTION IN NORTH KOREA

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I. Introduction

In the fifty-three years since the Democratic People's Republic of Korea was established, North Korea fell short of meeting the basic needs of food even though the country made a desperate effort to increase the crop production. In particular, the recent shortage of food is likely to develop into massive famine across the country unless drastic measures are taken.

The grain production of this year is also reported to be 2.83 million tons.[1] The amount is far less than the original target set by the North Korean government in January 1998. The total production would be close to 4 million tons, including the grain produced in the private farmlands. However, the target that the government had confidence to hit was 5 million tons. The weather that had been consecutively unfavorable to grain production during the last four years is comparatively good this year except for floods and tidal waves in some areas.

This proves that the recent food problem was not only attributed to the weather condition. The situation suggests that the scant supply of grain will be chronic and has become a structural problem. It is evident that North Korea will also suffer from the shortage of food in the next year. Therefore, it is important to investigate the potentiality of grain production in North Korea.

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[1] Chief of Bureau of North Korean Agricultural Department, Cha In-Suk interviewed with Pyongyang Times, only English Newspaper in Pyongyang, on November 23, 1998.

This paper examines North Korea's food requirement and input factors of grain production. Forecast of food shortage can be done by investigating the food demand and possibility of grain production in the future since grain production totally depends on input factors. In the paper, first, grain consumption is considered. North Korea controls daily grain rations through the Public Distribution Systems (PDS). Therefore, total grain rations for the whole country vary according to harvested grain. Next, the analysis of input factors and systems that are responsible for grain production are considered. Finally, we examine the problems associated with the international community's food aid to North Korea.

II. North Korea's Food Problems

All grain harvested is procured and distributed by government authorities. Prices of production and consumption of goods are fixed by the Price Fixation Committee, which is under the supervision of the People's Central Committee. Prices, however, have a purely accounting role, and do not reflect supply and demand conditions. There are small plots of private farmland that are formally allowed by the government for private cultivation to raise income on the side which is limited to no more than 30 pyong (1,150 square feet) (Lee 1997, 3).

Crops produced from this privately cultivated land can be made available for private use. However, this private use excludes the production of grain. Rice and maize are rationed by the North Korean government according to a basic formula which varies by location and the recipient's age and occupation.

The quantitative rationing system is the tool which permits the government to adjust supply and demand. It may be necessary to understand PDS in order to comprehend the food problems in North Korea. The details are briefly as follows. All households are registered at either an agricultural cooperative, village or town, by family status and composition: newly born, infants, nursery/school age children, adults by work grade, hard/easy, or pensioners. Each person is registered at either an agricultural cooperative or the nearest PDS center by category of entitlement based on the age and the type

of work. All key commodities, foremost rice and maize, and also meat, fish or vegetables, are channeled through these centers and distributed to the non-agricultural population, usually twice a month, according to a ration scale that is determined centrally in keeping with overall availability at a given time.

Earlier observations that the system would break down if the food availability became too low were not realized and the system remained operational even when standard rations were successively reduced to 200 grams per day from 700. Traditionally high rations for hard work, however, were not reduced until a common ration of 200 grams per person was uniformly applied at the peak of the crisis. With the beginning of the harvest in October, rations were raised appreciably to 450-500 grams per day (FAO/WFP Special Report 1996, 2).

Norms have been defined for the basic consumption needs in grams per day, with cereals normally providing 75 percent of daily calorie intake, the remaining 25 percent expected from fish, meat, vegetables, fruit, fats and oil, etc. Seventy percent of the cereal ration is obtained from rice and 30 percent from maize. These norms have been established for various population groups, initially determined according to their work activity. The rice and corn per capita daily rations are as follows:

TABLE 1 Rice and Maize Per Capita Daily Rations, North Korea, 1993

Occupation and Age Group	Per Capita Daily Ration (g)	Ratio of Rice to Maize	
		Pyongyang areas	Other areas
High-ranking govt. officials	700	10 : 0	10 : 0
Regular laborers	600	6 : 4	3 : 7
Heavy labor workers	800	6 : 4	3 : 7
Office workers	600	6 : 4	3 : 7
Special security	800	7 : 3	7 : 3
Military	700	6 : 4	3 : 7
College students	600	6 : 4	3 : 7
High school students	500	6 : 4	3 : 7
Primary school students	400	6 : 4	3 : 7
Kindergarten	300	6 : 4	3 : 7
Children under 3	100-200	6 : 4	3 : 7
Aged and disabled	300	6 : 4	3 : 7

Source: National Unification Board (1997, 357).

However, for some time the government had not been able to provide rations according to the system and, at present, it is operating a 3-level system with the age of the person being a determining factor. Table 2 shows the 3-level system of food distribution in 1997. North Korea set the average daily intake requirement as 2,131 kcal across the population (FAO/WFP 1995, 7). The regime changed from the old ratio of 70 percent rice and 30 percent maize to the new ratio of 60 percent rice and 40 percent maize in all areas except the capital city, Pyongyang, as food shortages have worsened since 1993.

Based on this ratio, the per capita yearly consumption of rice and maize can be calculated to yield 100 kg and 67 kg, respectively, giving a total of 167 kg of cereals. Therefore, we can compute the total grain demand by multiplying the total population classified by occupation and age by the per capita yearly cereal consumption. The seed and feed requirement should be added to the above total grain demand. The seed demand for the 1998 crop year, assuming that the area planted is similar to 1997's, would be equivalent to approximately 75,000 tons of paddy (seed rate of 125 kg/ha) and 29,000 tons of maize using a seed rate of 45 kg (FAO/WFP 1997, 14).

Since 1995, there has been a dramatic reduction in the number of animals. Animals actually depend on the crop by-products such as stalks and dehusked maize cobs. Generally speaking, an average provision of 250-300 kg per animal was made for intensively fed livestock in a normal year. In the present conditions a yearly provision is assumed to be reduced to 150 kg per animal.

TABLE 2 Regulation and Actual Ratio of Food Distribution, North Korea, 1997

Occupation and Age	0-6 Year	7-15 Year	Over 16 Year		
			Labor	Military	Disabled
Regulation (rice : maize)	300 (10 : 0)	500 (93 : 7)	700 (3 : 7)	800 (6 : 4)	300 (3 : 7)
Actual Distribution (rice : maize)	234 (10 : 0)	390 (1 : 9)	546 (1 : 9)	694 (6 : 4)	234 (1 : 9)

Source: North Korea Research Instituet (1997, 350).

It is estimated that the ratio of seed and animal feed use to the total utilization is less than 20 percent. However, the requirements for seed and feed are secondary in these emergency circumstances when the nation's 23 million peoples are living on an average 200 grams of food per day, or 15 spoonfuls, - one-fourth of the intake experts say is needed for a healthful diet. Children and the elderly are dying at an increasing rate, although the exact death toll is not immediately known (CNN report, August 13, 1997).

As showed in the introduction, in North Korea there will be a continuous gap between the production and consumption levels of grain. North Korea will be unavoidably linked to the world food system even though the country has emphasized self-reliance. It seems that the North Korean government has maintained the minimum consumption standards of grain intake in rationing 167 kilograms of grain per year. Therefore, it will be an important task for the future to substantially improve the North Korean level of nutrition.

A former defector from North to South Korea confessed that: "I was surprised to find that South Korea's intake of food is far less than one-half of North Korea. Assuming that an average South Korean eats such high-calorie food as steamed rice, meat, egg, edible oil, cake, sugar and vegetables, North Korean generally eat corn and vegetable soup only; but quantitatively North Koreans eat twice as much as South Koreans (Lee 1997, 8)."

It is difficult to predict a future balance sheet of grain for North Korea. However, it is certain that North Korea's grain deficit will increase and needs of its grain import will increase in the years ahead.

III. Prospects of North Korea's Grain Production

It is necessary to increase both cultivated acreage and yields to achieve faster growth of food production. The intensity of cropping also can be increased which has the impact of making more land available. There is not much potential for adding acreage in many of the most heavily populated areas of the world where grain consumption exceeds grain production.

However, there is some potential for raising yields since

average grain yields in most underdeveloped and developing countries are still far below those in the developed countries. Particularly, North Korea has great potential for raising its yields because the shortages of grain are due to the insufficient supply of input factors and the application of inappropriate agricultural policies. In this context, it is helpful to examine the availability of land in the future and the various major inputs which may enhance yields in North Korea.

1. Land

The total area of North Korea is 12,054,000 ha. Land area is 12,041,000 ha. North Korea is a mountainous country, with 75 percent of its area in hills and mountains, and an average elevation of 480 meters. Agricultural area is just 15 percent (2,050,000 ha), but 2,000,000 ha (16.6 percent) of land area is cropland, arable land area is 1,700,000 ha (14.1 percent of the total land area) while 300,000 ha are used by permanent crops and 50,000 ha are pasture.[2] Arable land area per person in 1994 was 0.085 ha and was much smaller than any other socialist countries including 0.17 ha of Bulgaria, 0.68 ha of Hungary, and 0.63 ha of Poland. The arable area compared to the total area has increased gradually. Paddy areas have continued to increase, while the remaining patch areas were held constant: The sown acreage and the ratio of used land to arable land has decreased since 1969.

These distinguishing features are correlated with the land use policy of North Korea. This illustrates the agricultural policy to enlarge the amount of arable land, which is intended to increase grain production, to expand paddy land favorable for the main staple food and mechanization, and to replace the multi-crop system with a single-crop system. As the single-crop system had been constituted, maize which was a substitute for insufficient rice had become the main crop in a patch without cultivating barley, oats, sorghum, and

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[2] Agricultural area is composed of arable land and land under permanent crops. Permanent crop land is cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee and rubber; this category includes land under flowering shrubs, fruit trees, nut trees and vines, but excludes land under trees grown for wood or timber.

millet, and therefore the sown acreage of corn had sharply increased from 170,000 ha in 1945 to 700,000 ha in the 1970s.

In order to solve the food problem, North Korea has made desperate efforts to increase the arable land area since the 1980s. North Korea adopted the "Policy of the Five Nature Remodeling" in October 1976 and the "Project of the Four Nature Reconstruction" in October 1981. The nation-wide efforts for the discovery of 200,000 ha of new land (1980-84) and the reclamation of a 300,000 ha area (1981-85) were presented as the main tasks.

However, these goals have never been accomplished due to the lack of human and material resources. Further, the damages by the recent natural disasters have been exacerbated by the excessive exploitation. The flood aggravated landslides in the terraced fields constructed by these nation-wide programs. In 1995, 300,000 ha was inundated and 200,000 ha of which were rehabilitated, leaving 100,000 ha covered with sand. This problem explains why the arable area has sharply decreased since 1992.

Even though the vice director of the North Korean agricultural commission maintained that "North Korea had produced 7 to 8 million tons of grain in the 1980s. In order to attain the same goal, we should explore and expand new agricultural fields including 100,000 additional hectares of corn fields." North Korea's frantic efforts are not likely to increase arable land substantially in the near future either (*The People's Korea,* January 15, 1997), because the cultivated area is already close to the total arable land and, hence, uneconomically high costs are involved for further developing arable land through leveling and terracing. Also, economic difficulty prevents the regime from implementing the new projects. This suggests that most gains in terms of production must come from increases in yields in the future.

2. Farm Population

Data regarding the population of a socialist country like North Korea can be used as primary materials for conducting an analysis of its political, economic and social conditions. So far, the problem has been that North Korea has rarely released such statistical data, and even the released have been unreliable.[3]

The North Korea Central Bureau of Statistics used to compile

vital statistics based on reports from local branches which counted the number of local residents in accordance with the "population registration system" maintained by local administrative units. After the census, North Korea announced that it conducted a "correct" census in a "modern way" for the first time, and it published the results in May, 1995.

However, this census showed that North Korea excluded the number of soldiers on active duty (between 755,000 and 1,252,000), political criminals (200,000), college students living in dormitories (500,000) and the crippled (57,883). This exclusion was the main difference between figures that North Korea made public and statistics prepared by South Korea, FAO and IBRD. For the sake of convenience, this study will use population data published by FAO, and the 1993 North Korean census results.

According to the FAO data, the total population of North Korea in 1997 was 22,825,000. The number of males and females were 11,229,900 (49.2 percent) and 11,595,100 (50.8 percent), respectively. The urban population was 14,037,375 (61.5 percent) and the rural population was 8,787,625 (38.5 percent). The agricultural population was 6,756,200 (29.6 percent) and the non-agricultural population was 16,068,800 (70.4 percent) in 1997. Compared to the agricultural population of 40.8 percent in 1965, the ratio of agricultural population to total population has sharply decreased, due to North Korea's first priority policy given to light industry.

It is estimated that the comparative decrease of the agricultural population had a negative effect on the safe production of food. The annual population growth showed a comparatively high rate of 1.7-1.8 percent. Despite its inability to overcome chronic economic difficulties, spotlighted by the present extreme food shortages in particular, North Korea maintained life expectancy at a high level (U.S. CIA, 70.32 years in 1996) and the death rate at a low level (U.S. CIA, 5.45 deaths /1,000 population in 1996). U.S. CIA also reports that persons over 65 years of age constitute about 4 percent of the

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[3] North Korea reported data on population with some agricultural indicators to the FAO in 1977, and submitted the social indices to the United Nations Funds for Population Activities (UNFPA) in order to obtain technical assistance. During January 3-15, 1994, North Korea, with the help of UNFPA, conducted a general census for the first time since 1945.

total population, similar to the South Korean level. Therefore, in light of population trends, North Korea is claiming to stand on a par with developed countries.

As of 1993, the number of the working population in North Korea, comprising those over 16 years of age (soldiers are excluded), was 14,476,000, or about 70.5 percent of the total population. Among them, about 11 million people, or 76 percent of the potential working population, participated in economic activities, and in particular, female workers registered a high rate of participation (68.9 percent). The participation ratio of female workers was comparatively higher than that in South Korea (61.1 percent: male 76 percent, female 47.2 percent). In North Korea, a working female is rationed with 700 grams of food, but one who stays at home is given only half.

North Korea's labor force is composed of laborers (63.1 percent), farmers (23.5 percent) and office workers (13.4 percent), according to the North Korean classifications. It is estimated that North Koreans belonging to the "nonproductive" sectors, though the North Korean authorities do not maintain a specific classification for them, comprise soldiers, students, housewives and the disabled.

Literacy is an important factor affecting the quality of the agricultural labor force. Particularly, a low rate of literacy is a big problem hindering the increase in the yield of grain in under developed countries which have a market economy. The problem prevents farmers from farming using a method of high technology. This was the case in countries like Latin America, India and China. However, it seems that North Korea has not experienced this dilemma because literacy in the country is 99 percent and the people aged 15 and over could read and write Korean in 1996. The country has implemented an obligatory education for the total population. Also, under collective farming the creativity of individual farmers does not play a great role in increasing grain yields. Thus, the situation in North Korea is slightly different from the countries mentioned above.

The job classifications indicate that 1) the number of factory workers is 2.7 times as the number of farmers, and therefore, North Korea can be regarded as an industrial country, 2) female workers occupy 49.5 percent of the total working population, and 3) the number of female workers is higher in agriculture and other manual labor professions than in clerical work. This indicates that North

Korea's labor policies, at least officially, aim to apply the same standards to both male and female.[4]

North Korea is an industrial country, but it is experiencing severe economic difficulties because the operating rate of its factories has been at an extremely low level. North Korea has nearly 31 percent of its population on farms but is suffering from chronic grain shortages. This means that a marginal value product of labor forces is very low in its agriculture production. In fact, North Korea has had no choice but to rely on labor-intensive methods to run farms due to shortages of farm machinery and technology.

One of the big problems of the agricultural labor force is that the labor force is composed of mainly old people. This is due to the fact that the North Korean military consists of 6,844,035 males ranging from 15 to 49 years old, and 4,143,713 of them are conceived as drafted from civilian status. Approximately 194,922 males at the age of 18 start their military obligation annually (U.S. CIA, *The World Fact Book page on North Korea*). They usually serve the military for 5 to 7 years.

Even as North Korea has been mobilizing military personnel and students to support farmers during fall and spring seasons, this provides nothing but temporary help. The regime has developed a campaign of labor mobilization during the harvest season under the slogan "do not waste even a single grain when you harvest in threshing crops." Each agricultural unit has established a transportation system which involves soldiers, local workers and clerks. They regard it as an iron rule that they carry the harvested maize to a threshing floor on harvesting day, because if the grain is damaged, it results in reduced output.

These efforts do not increase the yield but keep it constant. The interim measures do not solve the basic labor force problem. An increase in labor does not significantly contribute to increased grain production in the current situation. Thus, it can be suggested that a young and energetic generation be infused into the farms by reducing the period of military service. The most important thing is that incentives will be given to individual farmers by resolving the state

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[4] The share of the labor force in industries shows that 37.4 percent are engaged in manufacturing, followed by farming and the education - culture sectors.

farm system, and then the marginal value product of labor in agriculture is likely to be increased as already seen in China after the reform of 1978.

3. Irrigation and Drainage

Water conservation is very important especially in rice growing regions to raise productivity and yields. The North Korean slogan: "irrigation is the lifeblood of agriculture and without irrigation, there is no increase in productivity" tells their recognition of the importance of water.

Since North Korea has 70-80 percent of the total annual precipitation in July and August, they have to control the water resources in order to decrease crop damages during dry seasons. Therefore, North Korea had put an emphasis on irrigation since the first development stage in 1957-60.

Kim Il-Sung made a speech on "the Theses on the Socialist Agrarian Question in Our Country" on February 25, 1964. In it he considered 1) the basic problem of agriculture as the backwardness of agriculture, 2) the wide economic difference between urban and rural areas and 3) emphasized three principles to solve this problem. They were: 1) accomplish drastic revisions in technique, culture and ideology reform, 2) strengthen the national support for the labor class in rural areas, and 3) improve the agricultural guidance and management system, transforming it from cooperative ownership to total population ownership.

After the speech, North Korea set irrigation, mechanization, electrification and chemicalization as the four tasks of the agricultural technique reform. North Korea announced the completion of irrigation in paddy and patch lands and electrification of collective farms in 1974.

North Korea also announced that they constructed 80,000 artificial lakes, 1,700 reservoirs and 25,210 water pumping places, 124,000 underground water facilities and 40,000 km of flumes. North Korea has improved substantially the traditional farming conditions of production depending on the timely supply of water. According to the data of the U.S. Department of Agriculture, World Bank and FAO, the ratio of irrigated area to the total agricultural area was 73 percent in

1997.

Compared to other input factors, irrigation has not been the problem in North Korea's agricultural history. It seems that North Korean agriculture has no problem with irrigation. Considering the situation of grain production and the supply of other input factors, a 73 percent of irrigation rate is not low compared to the world standard. Of course, the irrigation and drainage facilities have helped the productivity of land rise significantly by protecting crops from drought and floods. But the cost of irrigating the remaining non-irrigated areas increases rapidly as irrigated areas are expanded since incremental water supply comes from deep wells, rather than shallow wells and rivers. This requires more industrial inputs such as steel and cement. Thus, it should be more cost efficient if the regime invests more resources for the improvement of other input factors than for irrigation and drainage in the future.

North Korea has taken a wide range of steps to reverse the trend of continued flooding. The first important measure was dredging out the rivers in the granary region and making them at least one meter deeper, as well as reinforcing and raising embankments and dikes one meter higher to withstand repeated floods.

4. Fertilizer

Chemical fertilizers receive much government attention and investment because of their importance. North Korea produced 300,000 tons of chemical fertilizers in 1947 by making use of sufficient raw materials and hydraulic power in the Hengnam fertilizer factory constructed in the Japanese colonial era. But since some of the factories were destroyed during the Korean War (1950-1953), they had to import the needed fertilizers from the Soviet Union. North Korea promulgated the decree of chemicalization encouragement in 1961 to increase the production of fertilizers. Due to this policy, production had been increasing since the 1970s.

North Korea produced 300,000 tons in 1970, 460,000 tons in 1975 and 850,000 tons in 1990. It is estimated that North Korea has 3,510,000 (Nitrogenous fertilizer: 2 million, Phosphate fertilizer: 1.5 million) tons of production capacity. The target of the third seven-year plan is to increase the rate to 2.5 tons per hectare. The increase in the

use of chemical fertilizers has been one of the main reasons for the steady rise in grain crop yields in North Korea.

However, the recent economic difficulty led to a production decline. The North Korean agricultural commission has asked farmers to produce compost and barnyard manure. According to the data of U.S. Department of Agriculture, World Bank, and FAO, that production has decreased since 1990. Vice Director Choe Hyun-Su of the agricultural production bureau of the North Korean agricultural commission disclosed in September, 1997 that "we have spent 600,000 tons of nitrogenous fertilizers this year; 300 to 400 kg per hectare in granary farmland of North and South Hwanghae provinces, and 200 to 250 kg per hectare in fields of the mountainous areas. This is a radical decrease in comparison to figures in the 1980s in which about 600-800 kg of chemical fertilizers were spreaded per hectare."

"Furthermore, we added some substitutes this year. They are green grass and combined microbic fertilizers. Green grass contains nitrogen and insecticidal elements. Combined microbic fertilizers have been provided to all agricultural parts of the country by 60 factories built with the financial support of North Korea Chongryun (the general association of Korean residents supporting North Korea in Japan)" (*The People's Korea,* September 15, 1997). This suggests that even if North Korea has overused fertilizers until the 1980s, the country has suffered from insufficient supply of fertilizers since the 1990s. Thus, the supply of insufficient fertilizers should be increased in order to increase yields.

The one serious problem of the fertilizer industry is the unbalanced production of fertilizers: nitrogen has been overused; a large portion of phosphate fertilizer used were available only through imports; and urea and ammonium sulphate were produced at a level that was required.

Another problem is the effectiveness of fertilizers. An increased use of fertilizers will be necessary to meet increased grain consumption in the future. However, the marginal productivity (the number of kilograms of increased grain output from each added kilogram of fertilizers-diminishes as additional quantities of fertilizer are applied. There has been a decline in North Korea's yield response rate since 1990. In a 1991 "advisory note" addressing the North Korean economy for the years 1992-96, the United Nations

Development Programme (UNDP), one of the international agencies resident in Pyongyang, warned that the practice of intensive chemicalization has led to land degradation-that is, declining soil fertility, falling organic matter content, erosion and soil acidification, and water pollution, with resulting environmental damage (Chung 1994, 137).

Nonetheless, the increased use of fertilizers will be one of the best and fastest ways to achieve high yields in the near future. The effectiveness of fertilizers can be raised with a better mix of new seeds, compost and barnyard manure, effective pesticides and scientific methods of cultivation to prevent oxidization of paddies, and enriching the paddies by "spending" [5] without cultivating during some periods. Efforts are underway to introduce high yielding, low fertilizer use varieties, expanding the usage of microbial fertilizers to reduce dependence on chemical fertilizers and covering arable land with rich deposits from river basins to replenish topsoil. Sixty specialized plants were put into operation across the country to produce soil fertility-enhancing bacteria with little electricity consumption. It is reported that 120 liters of the specially produced bacteria were applied per hectare. The results of application were highly evaluated.

5. Machinery

North Korea announced the ordinance of mechanization enforcement in agriculture in September, 1960 to reduce the burden of collective farms and increase grain production. The project of mechanization had emphasis on the development of multi-purposes rather than single-purpose machines. It started with field areas[6] and then extended to the mountainous areas. Because of the topographical characteristics, large size tractors were used on field areas and small-medium size machines were used on mountainous areas.

The future direction seems to be toward the tractorization since

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[5] The period that no crop is planted in soil is required in order to keep it fertile. The crops absorb the necessary nutrients during the time. Also, different crop is required to be planted in the same field each year. The techniques prevent the soil from declining productivity.

high opportunity costs are involved in maintaining or expanding the draft animal stock. Also, machines can be used for a variety of different tasks while animals are usually used only for a single job. However, the average field size is too small to use 25-35 horsepower tractors. In order to use that tractor efficiently, the field size needs to be enlarged to about two-thirds hectare per plot.

The number of tractors, an indicator of mechanization, increased from 9,000 in 1960 to 75,000 in 1997. The number of tractors per 1,000 hectare rapidly increased from 11 in 1970 to 37 in 1997. However, many tractors are engaged in road transport while animals plow the fields. This indicates that transportation is a more serious production bottleneck than the mechanization of production. Notwithstanding the problems, mechanization has greatly contributed to grain production in North Korea.

However, the percentage of machinery in operation has sharply declined since 1994 due to the shortage of spare parts and accessories, petroleum, and gas, caused by the economic plight. Farm machinery has become obsolete due to the lack of fuel and spare parts. Also, the provision of electricity for various farm operations has deteriorated due to a significant fall in generating capacity.

Vice Minister Ju Tong-Il of the North Korean ministry of power industry revealed on January 15, 1997 that as is clear from the drought which did harm to agriculture last summer, the poor record of precipitation last year significantly reduced the hydraulic power generation to 700,000 kW at the plants which are capable of producing 3.2 million kW. A combination of these factors has significantly reduced productivity and agriculture has become increasingly dependent on hand labor and animal draft power. Mechanization is closely related to the condition of the general economy. Therefore, grain production depends also on the recovery of the economy. Mechanization seems to solve North Korea's urgent problem of rapidly increasing the productivity by increasing yields per hectare and increasing total output to feed its starved population.

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[6] North Korea is mountainous country. In the northern part of the country with average elevation of 480 m, the use of machinery was less convenient than field area. The field area is located in the western part near Pyongyang. Rice is primary crop in the field area. Mechanization was mainly accomplished in the field.

6. Seeds and Pest Control

The development of high-yielding seeds has been a very important component of the modernization of food production in North Korea as it has been elsewhere in the world. The potential for a "green revolution" is great. Short-stock, disease-resistant, high-yielding seed varieties have been developed to raise yields.

Unlike low international evaluation of North Korean agricultural seeds, the quality of agricultural crop seeds of the regime is excellent. In fact, the country has climatic limitations such as short frost-free periods and extremely cold weather to produce rice. Thus, they have invented specific seeds pertinent to climate and altitude since the 1960s. North Korea's climate precludes double-cropping of rice in most areas, and different methods had to be devised to increase productivity. One method is to use cold-bed seeding, a process that enables farmers to begin rice growing before the regular season by planting seedlings in protected dry beds. The results were estimated to be noticeable. The former researcher Lee Min-Pok noted that, "experimental cultivation at the Agricultural Science Institute in North Korea of "Tongil" rice seeds developed in South Korea to raise rice yield showed that its quality is not much better than that of North Korean rice and its yield was less than that of North Korean rice" (Lee 1997, 5).

Plant densities per hectare are comparatively high, ranging from 420,000 to 480,000 plants in rice and from 70,000 to 80,000 in maize. The seeding rate is also relatively high, ranging from 120 to 150 kg per hectare for transplanted rice and 40 to 50 kg per hectare for maize. Given the quality of seed and allowing for losses and spoilage, these rates are fairly representative of most other countries in southeast Asia. The dominant seed types available with percentage coverage and characteristics, under favorable conditions, are shown in Table 3. The use of the different seed types is determined by altitude and duration in relation to the number of frost-free days in different localities (FAO/WFP 1997, 5).

North Korea recently concentrated effort on the production of first-generation hybridizing seeds. They recognized that the seeds have high productivity and strong ability to survive in bad weather and topographic conditions. Plans have been made to develop hybrid

seeds of maize, soybean and pumpkin by 1998. The crossbreed seed of maize have twice the yields of conventional seeds and can be planted even in 2,000 meters high mountainous areas. The soybeans can be planted twice a year and the pumpkins usually weigh 100 kilograms.

In paddies, the rice water weevil is potentially the most serious pest affecting production. The pest was first identified in 1988 and has periodically damaged the rice. The most serious damage occurred in 1992, reducing the production by 20 percent. The North Korean prime minister who was visiting Seoul in May, 1992 to discuss the political issues between North and South Koreas even presented a proposal that North and South Korea jointly deal with the pest.

North Korea could not produce the necessary pesticide and had to import it from Japan. North Korea imported 1,099 tons in 1991, 920 tons in 1992, and 148 tons in 1994. It is assumed that the decrease in imports came from the facts that the incidence of infestation became less and they could not import the pesticide because of the shortage of foreign currency. North Korea has to

TABLE 3 Predominant Seed Types and Main Characteristics, North Korea, 1997

Seed Type	Duration crop	Optimum yield tons/ha[1)]	Average yields tons/ha[2)]	% of total area sown
RICE				
Pyongyang	180	10	7	70-80
Hamzu	150-160	5-6	4-5	
Yomzu	135	4-5	3-4	20-30
Pyongbuk	160-170	6-7	4-5	
Other	-	-	-	
MAIZE				
Hwansong	110-135	7-8	6.5	55
Unsan	110-135	8	6-6.5	20
Pyongan	150	10	5-6	15
Other	150	-	-	10

1) Optimum yields possible under ideal climate and input conditions.
2) Average yields possible under ideal climate and input conditions.
Source: FAO/WFP (1997, 6).

overcome this problem in order to secure steady yields of grain in the future.

7. Research and Extension

North Korea's system of agricultural research and extension is organized to disseminate modern techniques from the top to rather than the other way around. The system is modeled after the one in the Soviet Union and is partly transformed into a specific organization so that research and extension have organic relations with factory, university and the department of agriculture, with consideration of conditions in North Korea. North Korean agricultural management, based on the "principle of growing proper crops in proper soil and at a proper time," is focused on "Juche agriculture" (self-reliance). It has been defined that "Juche" method of farming is a scientific farming method designed to best suit the biological characteristics of farm crops as well as characteristics of the North Korean climate under its collective farming system.

The North Korean government has expanded the use of chemical fertilizers on a very wide scale, but little attention has been paid to detailed soil analyses to help obtain optimal fertilizer allocation and cropping patterns. That kind of top down system has both strengths and weaknesses. North Korea has been able to adopt many new seeds, new technology, advanced farm machines and chemical fertilizers during the last 50 years. However, the top-sided, unsophisticated science system hinders further progress and sometimes creates a potential danger to production as North Korea's agricultural systems become more and more complicated and the characteristics of local areas become more and more important.

In March, 1952, the Agricultural Science Institute was established by uniting the agricultural department's central agricultural committee and the Science Academy's agricultural laboratory. In August 1963, the institute was expanded to a large organization with 3 management departments, 36 laboratories and 14 branches, 1 aggregate research farm and 5 special research farms and 1 livestock breeding farm (NKRI 1997, 456). Another organization is the Science Academy that carries out joint research with other fields such as science and technology. The Science Academy sent the researchers to

farms to solve the problems of two crops per year and livestock breeding improvements in 1997. The Academy also developed compost microbe fertilizer that increased yields in 1997. The fertilizer has an immediate effect that at most takes 10 days. The Academy was awarded a prize by Kim Jong-Il.

The Academy concentrated on developing new seeds and other modern inputs. A number of researches on fertilizers and seeds were initiated and the research system was strengthened. However, there are many problems in the research and extension system in North Korea. The system mainly focuses on the implementation of "Juche farming method." Some part of them have not been verified by experiments and do not totally reflect feedback from production in farm fields. They are likely to be blamed for no other reason than that they are short of "revolutionary spirit," if researchers do not follow the method. This system also tends to ignore sustained effort in basic research in favor of intensely practical and production oriented work.

Furthermore, North Korean laboratories are poorly equipped in academies and institutes of agricultural science and there is lack of communication with other developed countries whose research should be helpful to North Korea's agricultural development because they have emphasized self-reliant farming. North Korea needs more consistent long-term commitments of resources to raise crop yields. In the long run, North Korea must carry sound basic agricultural research.

8. Incentives

The loss of ownership following the 1946 land reform and 1958 collectivization weakened family-based traditional motivations to work hard since the income of an individual no longer depends on the individual's work but on the performance of a group. The collective farming system could not provide strong motivation to work hard since the farms guaranteed at least the minimum level of living. Therefore, the farmers have interest in raising the yield from the small private farmland (1,150 square feet) formally allowed by the government. This private lot has greatly contributed to supplement insufficient production of collective farm.

The North Korean government has tried to provide incentives to

the individuals to enhance their productivity. The work squad management system for farms originated in an instruction given by Kim Il Sung when he visited Pochon Cooperative farm in 1965. Under the system established the next year, the 150-man work team was broken down to squads with 25 members each to enhance the farmers' collective responsibility and increase their productivity. But the system has not paid off because of excessive output assignments and little incentives given to the squads. In an effort to make the work squad system more effective, North Korea in 1996 began to allow the squad to keep or dispose of the portion of their products produced in excess of assignments to them, the number of members of a squad was reduced to seven or eight and their output assignments were realigned, according to an article in Choson Shinbo, organ of the pro-Pyongyang General Association of Korean Resident in Japan, on October 24 that year.

Another incentive is farmer's market. The farmer's market is the place administered and allowed by the government to have commercial dealings with products in their backyards, which is one of rare instances of capitalism in North Korea. It gives North Korean farmers the pleasure of private ownership, by owning vegetables which they grew in a patch of fenced-in land adjacent to living quarters. Even after the establishment of the collectivist economic system, North Korea was unable to eliminate this capitalistic market system although it tried to abolish it in 1958.

Now they can be found not only in rural areas but also in urban ones, even near Pyongyang. In these markets, food products and consumer goods that are outlawed are sold secretly at prices much higher than official ones. This is due to chronic shortages of commodities and food, and moreover, the agricultural products raised by farmers on their backyards are far better in quality than those sold in government-run stores. Now these markets have grown into black markets where even contraband goods are sold.

But these are temporary measures to overcome the shortages. The results are not noticeable because the patch-up compromises keep the limits of the collective farming system. North Korea also recognizes the weakness of the collective farm policy. However, the regime is concerned that the growing and spontaneous "privatization" movement is bound to pressure the North Korean regime of Kim

Jong-Il into reform, irrespective of its will. North Korea has recently been reluctant to change the policy by accepting the recommendation from FAO and the U.S. Department of Agriculture. They are trying to make a gesture that will change the policy since the food shortage has worsened recently.

North Korea permitted for the first time the International Fund of Agriculture Development's loans in the amount of 31 million dollars for the farmers in October 1997. The IFAD's project is one of the comprehensive programs of the United Nations Organizations such as United Nations Development Programme, FAO and WFP to help the grain production of North Korea. Some amount of the fund will also be distributed to even farmers who raise livestock through collective farms. The farmers will repay the fund by benefits that they earn through breeding the livestock under their responsibility, not collective farms.

The representative of North Korea declared the four important measures of agriculture reform in the international seminar held at Hanoi, capital of Vietnam on November 24, 1997. The four reforms are as follows: 1) liberalization of the agricultural product price, 2) activation of small-size agriculture markets, 3) adoption of an incentive system for the work squad on a farm, and 4) execution of scientific farming. They also announced that the price of grains except the basic cereals such as rice, maize and wheat, will depend on the supply and demand in the market, and distributed the small part of collective farm land to farmers who are permitted to dispose of the products freely in the farmers market. North Korea also submitted the radical reform plan of agriculture to the UNDP in April, 1998. The essence of the reform is reportedly to give up the collective farming system and follow the agricultural reform of China which adopted the individual farming system in 1978. With the help of the United Nations, North Korea made the plan of economic recovery and requested financial aid of $ 2 billion to U.N. and $ 0.3 billion of that amount will be invested in the modernization of fertilizer factories, social infrastructure construction and surveys of land area. These reforms have deep meanings in the sense that North Korea admitted the limits of socialistic economic system and partly accepted the principles of a market economy.

IV. International Community's Food Aid to North Korea

Vice Minister of the Public Health Ministry of North Korea in December 1997 frankly admitted that of 2,089,000 children under five years old in the country, currently, 30 percent of them, that is, about 600,000 children are suffering from malnutrition and people need 2,600 calories on average daily, but it is not available.

The Vice Minister noted that in 1996, major grain output in the country was 2,500,000 tons, but wheat, barley and corn which were harvested in July and August have been consumed by the end of October. The food remaining was only 1,500,000 tons. Since North Korea has a population of 22.8 million, about 10,000 tons of foods are needed to feed the population per day. Therefore the country has a substantial lack of food. To cope with these difficulties the Vice Minister said, the government would take urgent measures in cooperation with UNICEF and the World Health Organization. In order to improve agricultural methods, the regime is strengthening long-term cooperation with WFP and International Agricultural Development Fund (*The People's Korea*, January 1998).

The overall objective of WFP assistance is to prevent the present food shortage from developing into a famine situation. More specifically, the intention is to maintain and improve the health and nutritional status of children, expectant women, nursing mothers, handicapped people and hospital patients, and support agricultural rehabilitation and reconstruction through food-for-work activities.

In early July 1997, Catherine Bertini, executive director of the World Food Programme said that her organization estimated 50 to 80 percent of the children it had seen in nurseries were underweight and markedly smaller than they should be for their age. She said food distribution rations have been radically reduced, and in many areas the daily rations were only 100 grams (350 calories), roughly equivalent to one-half a bowl of rice.

For the period January-November 1997, WFP has recorded the arrival of about 820, 000 tons of food aid. Of this amount 40 percent is WFP food with the remaining 60 percent provided on a bilateral basis, including also contributions from Non Governmental Organizations. An FAO/WFP survey team of crop and food supply assessment team which visited North Korea in November, 1997

estimated the import needs for 1997/1998 at 1.95 million tons. Commercial imports, including cross-border trade with China, mostly on barter terms, were provisionally estimated at 700,000 tons, resulting in a need for some 1,25 million tons as an emergency food aid by international organizations. The WFP plan to implement the emergency operation for 7.47 million people was estimated to cost US$ 378,208,543. The quantities of WFP assistance amounted to 658,000 tons, 360,000 tons of which was effected to be contributed by the Non-Governmental Organizations.

V. Concluding Remarks

The study tried to find out the food requirement and input factors in North Korea. The conclusions to be drawn from this research may be outlined as follows: The main structural problem is the collective farming system that does not give incentives to farmers. Collective farming does, in part, contribute to increasing production in the initial stage of socialist agriculture, but it hampers the continued and sustained increases in production. The collective farming should be modified since it eliminates the willingness of farmers to work.

North Korea's future grain production depends on both cultivated acreage and yields. Arable land is not likely to increase substantially because cultivated area is already close to the total arable land. Yields can be increased by adopting a market economic system and individual incentive farming instead of a collective farming system. An increase of fertilizer use, efficient irrigation system for serious drought, mechanization, and research and extension of high technology will be significantly contributed to faster growth of productivity. But these factors have their own bottlenecks in North Korea. As the supplies of inputs like fertilizer and machinery are closely related with economic conditions, it is important that the economy recovers.

Closing the gap between grain production and consumption in the future in North Korea will be difficult because present trends indicating the problem is becoming worse rather than better. Thus, North Korea will have to import a large quantity of grain from international markets through foreign aid or via commercial trade. If

the country is unable to import a large quantity due to poor economic conditions and humanitarian aid is not available, it is likely that a massive famine will occur because the gap between grain production and consumption is becoming wider in recent year. The political stability of the government may become questionable.

Even though North Korea has declared reforms such as liberalization of agricultural product prices and acceptance of the 1978 agricultural reforms of China that gave up the traditional collective farming system, it is uncertain whether it will implement these policy changes. The regime may just be making a gesture in this direction to receive sufficient food aid and financial support from the international community.

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