

# THE AGRICULTURAL SITUATION OF NORTH KOREA

Woon-Keun Kim  
Research Director, Center for North Korea Agriculture,  
Korea Rural Economic Institute  
4-102, Hoigi-Dong, Dongdaemun-Ku, Seoul 130-710,  
Korea

## ABSTRACT

*The recent food shortages in North Korea are the result of climatic disasters, some problems with collective farming, and the economic difficulties which began in the early 1990s. As economic difficulties resulted in a shortage of energy, and of raw materials such as fertilizer and agricultural chemicals, agricultural productivity decreased. The situation was made even worse by the cold weather, floods, and droughts which have occurred frequently since 1993. Thus, the food situation in North Korea is now in a state of difficulty. Recently some policy changes are giving encouraging results.*

## LAND TENURE SYSTEM

In North Korea, most economic decisions are made by the central government, in the form either of economic plans or specific instructions. Agricultural policies have been closely linked with the national goals of a series of economic plans formulated by the government. All decisions concerning production targets, distribution of outputs, allocation of inputs, prices and marketing were made according to these plans.

One of the first acts of the North Korean government after it was established in 1946 was land reform. Under the Land Reform Act, nearly 54% of cultivated land in private ownership was confiscated. All land holdings held under continuous tenancy or in excess of 5 ha (12.3 acres) was also confiscated. By August 1958, all individual peasant farmers had been absorbed into the newly created collectives.

Immediately after the completion of collectivization, a major program was launched to expand the scale of farming. The government considered that the prevailing size of collectives was too small to realize economies of scale, particularly for the use of farm machinery. Farm mechanization was regarded as one of the most powerful ways of transforming traditional farming into a modern system. All collec-

tives, which so far had been based on the traditional village unit, were merged to make a single collective in each Ri (the smallest administrative unit, equivalent to a district). As a result, the number of collectives fell from more than 50,000 to only 4,000, while their average size expanded to around 500 ha, each containing about 300 farm households. Today, the average farm size in North Korea is 466 ha (1,151 acres). Each farm is operated by 80 - 300 farm families.

Cooperative farms account for 90% of cultivated land and agricultural production, and state farms for 10%. State farms are model farms run as industrial enterprises. They are generally larger and more highly mechanized than collectives, and are also managed more efficiently. The management of collective farms is in the hands of management committees made up of agricultural and technical experts. The committee sets production quotas, allocates resources, determines and disburses wages, monitors credit and directs the use of seeds, tractors and fertilizers. The collective farms have also developed the Chongsan-ni method of management, a personalized, on-the-spot guidance method which requires management committees to help farmers to improve production through incentives and other encouragement.

Along with the expansion of farms into

Keywords: collective farms, cropping system, fertilizer, food shortage, irrigation, mechanization, North Korea, pest control.

larger units, non-agricultural institutions such as health clinics, elementary schools, kindergartens, and community dining halls were established on each cooperative farm. Individual farmers were given small private plots to cultivate for themselves. The size of plots is limited to 30-50 pyong (100-170 m<sup>2</sup>), depending on the size of the family. Farmers are allowed to grow vegetables, fruit trees and other cash crops, and to raise poultry, pigs and bees, both for consumption at home and for sale at farmer's markets.

## AGRICULTURAL POLICY

North Korean agricultural policies are directed towards solving the problem of food shortages through the "four improvements" in agricultural technology: irrigation, farm mechanization, rural electrification, and agricultural chemicals. The government has also carried out a number of reclamation projects to increase the area of arable land.

Priority has been given to improving the agricultural infrastructure, especially expanding irrigation facilities, and terracing and draining new arable land. In order to become self-sufficient in fertilizers, North Korea has built new fertilizer plants. Agricultural research and guidance services have been expanded to improve farming technology, particularly the application of fertilizers and pesticides. A program was begun to replace the production of miscellaneous cereals (Italian millet, milo etc.) by corn. The area of arable land planted in corn increased from 10% in 1953 to 35-40% in the 1990s.

Agricultural development strategies in the 1970s and 1980s had the broad objective of balanced development for agriculture and industry. Some features of the Six-Year Plan (1971-76) and the second Seven-Year Plan (1978-84) were:

- Improvement of rural living conditions and rural infrastructure;
- Expansion of foodgrain production to achieve self-sufficiency;
- Development of land and water resources to protect farmers from unfavorable climatic conditions;
- Accelerated farm mechanization so as to free farm workers from heavy manual labor.

Specific targets were:

- Annual production of 10 million mt of grain;
- 100% irrigation of non-rice upland crops;
- Reclamation of 150,000 ha of slopeland

by bench terraces;

- Distribution of tractors to achieve 10 tractors per 100 ha;
- Application of 2 mt/ha fertilizer;
- Production of 900,000 mt of meat per annum;
- Production of 1.5 million mt of fruits.

To boost agricultural production, North Korea developed "specialized production areas" for corn, livestock, fruits and some selected industrial crops. It provided intensive support, both financial and technical, to the State and collective farms located in these designated regions. Research emphasized improved varieties of corn and soybean, as part of an effort to encourage double-cropping.

In spite of all these efforts to increase agricultural production, the actual growth rate was not as high as expected. In order to solve this problem, North Korea has made efforts to increase the area of arable land since the 1980s.

However, the damage from recent natural disasters has been exacerbated by the overuse of land. The floods of 1995 caused widespread landslides in the terraced fields constructed in these nation-wide programs. In that year 300,000 ha was inundated. Even after the floods receded, 100,000 ha were left covered in sand and gravel. This explains why the arable area has sharply decreased in recent years.

Current agricultural policies in North Korea emphasize improvement of the agricultural infrastructure, increased potato production, expansion of the double cropping system, seed improvement and adjustment of land holdings.

Under the new leadership of Kim Jong-Il, there was some expectation of changes in agricultural policy. However, North Korea decided that there would be no changes, but instead a strengthening of the socialist central economic system. It declared that cooperative management would be gradually transformed into a state management system. Extension and administration in rural areas would conform to the principles and methods of the 1964 *Thesis on Agriculture* by Kim Il-Sung.

North Korea is now improving agricultural production by promoting crop diversification, and supplementing agricultural chemicals with organic farming methods. Under Kim Il-Sung, maize became the single most important upland crop throughout North Korea. This policy did not take fully into account the wide variation in soils and climate in mountainous areas, where before 1945 many different crop species and varieties had been cultivated.

In some cases, overzealous agricultural

administrators and specialists attempted to please Kim Il-Sung by recommending extremely high-density planting and heavy applications of chemical fertilizer for a very limited number of varieties and hybrids of the two major crops, rice and maize. The current program of diversification is a major improvement on the uniform maize-based cropping system formerly prevalent throughout most of North Korea.

The current crop diversification program, which began in 1999, aims to increase potato production either by double cropping or by replacing unproductive second crops of maize by potato after crops of small grains (especially spring barley and winter wheat). This emphasis on potato production for increased food security is a significant policy change.

Diversification does not mean that potato has been chosen as the major upland crop. Maize is still the major field crop, along with rice. However, this policy change does reflect the willingness of the leadership to add a third major crop to the already fully implemented small-grain double-cropping system. Additionally, it demonstrates more autonomy for cooperative farms, which now allowed to select which crops they produce.

Another is the transformation of chemical farming into organic farming. North Korea stresses that this is essential to avoid further soil acidification caused by the excessive application of chemical fertilizers.

## THE AGRICULTURAL SITUATION IN NORTH KOREA

### Available Land

The total area of North Korea is 12.0 million ha. Of this, 75% is hilly or mountainous. The remaining 1.96 million ha (16.3%) is arable, with 320 thousand ha being for perennial crops such as mulberry and fruit. The area of arable land per person in 1999 was only 0.091 ha.

Two-thirds of the arable land is found in four western provinces, (North Pyongan, South Pyongan, North Hwanghae and South Hwanghae), while the three provinces fronting the Yellow Sea contain 60% of the nation's paddy fields. (see Fig. 1.). One-fourth of the arable land is contained in the three provinces of the eastern region (North Hamgyong, South Hamgyong, and Kangwon). The interior region (the provinces of Chagang and Ryanggang) is mountainous, dry and cold, but rich in forest resources.

### Farm Population

According to FAO data, the total population of North Korea in 1997 was 22.8 million, of whom 29.6% are involved in agricultural production. This percentage is much lower than in 1965, when 40.8% of the population was agricultural.

Farm labor accounts for about 40% of the total labor force in North Korea, which is higher than the 11% in the South. The rather low labor productivity in the North is because the country uses outside labor such as students and soldiers at planting and harvest. A major problem is that as in South Korea, the average age of full-time farmers is fairly high.

### Irrigation and Drainage

Water conservation is very important, especially in rice-growing regions. North Korea has a slogan: "Irrigation is the lifeblood of agriculture and without irrigation, there is no increase in productivity."

Since North Korea has 70-80% of its total annual precipitation in the two summer months of July and August, water must be stored to minimize water stress in crops during the rest of the year. For this reason, North Korea has emphasized irrigation from its first development plan in 1957-60. The irrigation system extended even into mountainous areas. Reports showed that almost 100% of paddy fields were irrigated and 60% of upland fields. Substantial investments were made into reservoirs, canals and pumping stations.

As part of its irrigation network, North Korea has constructed 80,000 artificial lakes, 1,700 reservoirs, 25,210 pumping stations, 124,000 ground-water facilities and 40,000 km of flumes. Irrigation projects on the western coast for rice-growing areas established a 100-kilometer-long waterway, with tunnels 40 km long and ditches 60 km in length. It is reported that in all but 300,000 ha of irrigated land, water must be pumped up from rivers, often to a considerable height. However, nowadays there is some doubt whether the irrigation system is still fully functional. Many watersheds in mountainous areas have been damaged and some irrigation facilities have been destroyed by floods.

### Fertilizer

In 1947, North Korea was able to produce 300,000 mt of chemical fertilizers. However, some factories were destroyed during the Korean War, after which North Korea had to import fertilizers

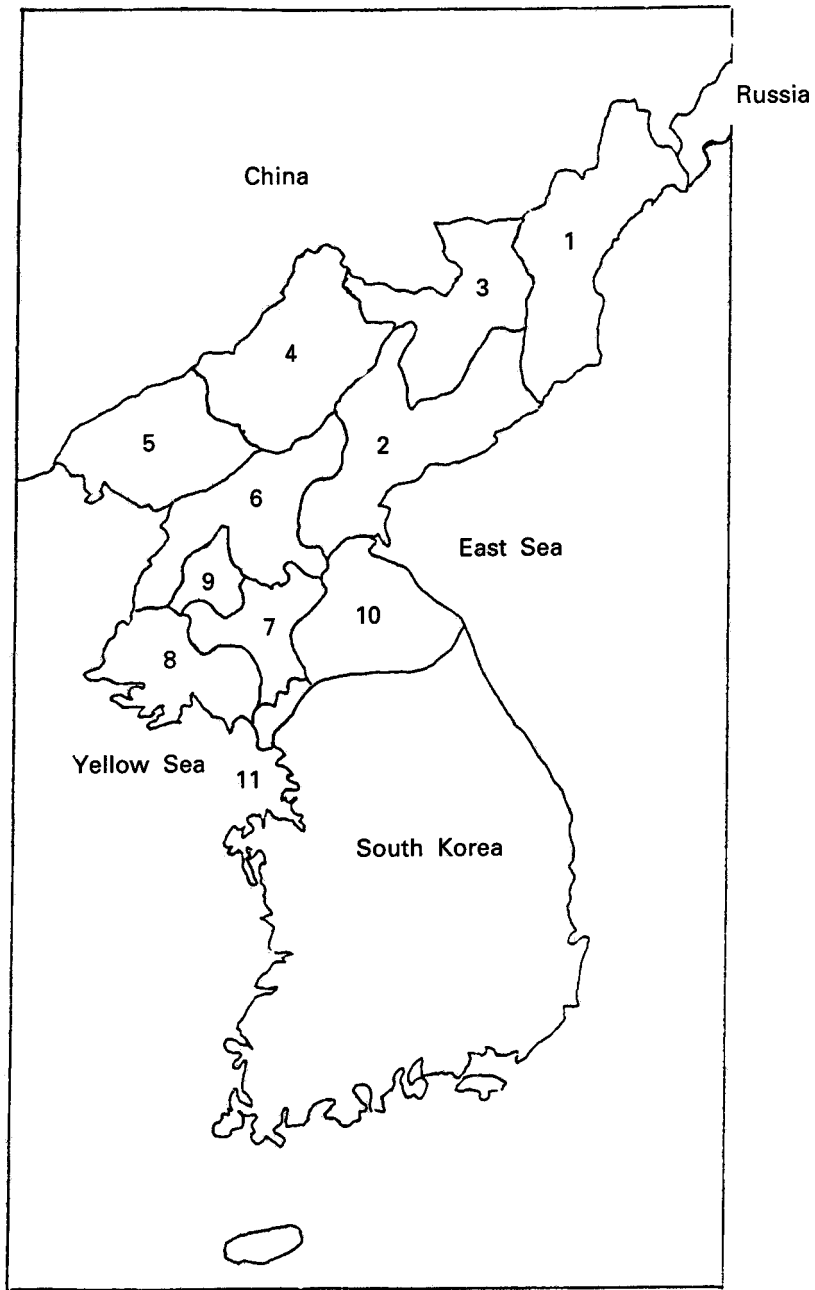


Fig. 1. Map of North Korea

1. North Hamgyong
2. South Hamgyong
3. Ryanggang
4. Chagang
5. North Pyongan
6. South Pyongan
7. North Hwanghae
8. South Hwanghae
9. Pyongyang City
10. Kangwon
11. Kaesong City

from the Soviet Union. A decree of 1961 promoted the production and use of chemical fertilizers. As a result of this decree, domestic production of fertilizers increased.

North Korea produced 300,000 mt in 1970, 460,000 mt in 1975 and 850,000 mt in 1990. It is estimated that North Korea has a production capacity of 3.5 million mt (2 million mt of nitrogenous fertilizer, and 1.5 million mt of phosphate fertilizer). The target of the Third Seven-Year Plan (1985-1992) was to increase the application rate to an average of 2.5 mt/ha. The increase in the use of chemical fertilizers was one of the main reasons for the steady rise in grain yields in North Korea during the 1980s.

However, the recent economic difficulties have led to a decline in both fertilizer use and grain yields. The Ministry of Agriculture of North Korea is asking farmers to produce compost from crop residues and barnyard manure, but according to data from the U.S. Department of Agriculture, the World Bank, and FAO, fertilizer production has fallen since 1990. According to the North Korean Ministry of Agriculture, in 1997 North Korea used 600,000 mt of nitrogenous fertilizers. In the western rice granary areas, average application rates are 300 - 400 kg/ha. In upland fields in mountainous areas, application rates are 200 - 250 kg/ha. These application rates are much lower than those of the 1980s, when 600 - 800 kg/ha of chemical fertilizers were applied.

The most serious problem of the fertilizer industry in North Korea is a lack of balance in applied nutrients. Nitrogen is overused, while much of the phosphate fertilizer used is available only through imports. Urea and ammonium sulphate are produced at a sufficient level to meet demand.

In recent years, efforts have been made to introduce varieties that require little chemical fertilizer but still give a reasonable yield. The use of microbial fertilizers is being expanded, to reduce

dependence on chemical fertilizers, while arable land is being given a soil amendment of rich alluvial deposits from rivers to replenish the topsoil. Sixty specialized production plants have been put into operation to produce soil-fertility-enhancing bacteria, using technology that requires only a low energy input.

## Machinery

North Korea began a program to mechanize farming in 1960. It emphasized the development of multi-purpose machinery, initially for lowlands and later for mountainous areas. Because of the topographical characteristics, large tractors were used in lowland fields and smaller machines in mountainous ones.

We can expect a future increase in the number of tractors, since high opportunity costs are involved in maintaining or expanding the supply of draft animals. Also, machines can be used for a variety of different tasks, while animals are usually used for only one. However, the average field size is too small for 25-35 hp tractors. If tractors of this size are to be used efficiently, the average field size needs to be enlarged to about two-thirds of a hectare.

Farm mechanization has shown much progress since the 1970s. The number of tractors, an indicator of mechanization, increased from 9,000 in 1960 to 75,000 in 1997. Similarly, the number of tractors per 100 ha increased from 11 in 1970 to 37 in 1997. Mechanization has greatly contributed to grain production in North Korea. However, the number of farm machines in operation has declined since 1994, due to a shortage of fuel and spare parts as a result of the economic crisis.

## Seed Supply and Pest Control

Seed production in North Korea is the

Table 1. The availability of chemical fertilizers in North Korea, 1998

Unit: mt

Type	Domestic production (1000 mt)	Imports	Total 1998 (1000 mt)	Total available in 1997	Total available in 1996
N	37	59	96	131	139
P <sub>2</sub> O <sub>5</sub>	10	16	26	60	61
KCl	0	2	2	2	0

responsibility of the Ministry of Agriculture. Research, plant breeding and pure line development are carried out by the Academy of Agricultural Sciences.

The development of high-yielding varieties has been very important in the development of modern food production in North Korea, as it has been elsewhere in the world. Disease-resistant, high-yielding dwarf varieties have been developed and extended to farmers.

The quality of crop seeds in the North is excellent, although this fact is not recognized abroad. However, North Korea has climatic limitations. The frost-free growing period is short, and the climate is very cold for rice production. Thus, North Korean scientists have developed varieties suited to the local climate and altitude. North Korea's climate precludes double-cropping of rice in most areas, so that different methods have had to be devised to increase productivity. One method is to use cold-bed seedlings. Farmers plant rice seedlings in protected dry beds, enabling them to begin growing their rice crop before the normal cropping season.

Plant density per hectare is comparatively high, at 420,000 - 480,000 rice plants/ha and 70,000 - 80,000 maize plants/ha. The seeding rate is also relatively high, ranging from 120 to 150 kg/ha for transplanted rice and 40-50 kg/ha for maize. Given the quality of seed and allowing for losses and spoilage, these rates are fairly typical of most countries in Southeast Asia. The dominant varieties and their yields are shown in Table 2. Which variety farmers plant is determined by the altitude of their farms and the number of frost-free days.

North Korea has recently been concentrating on the production of first-generation hybrid seeds. The government recognizes that plants grown from such seeds have high productivity and are hardy, so they are able to survive bad weather. Hybrid seeds of maize, soybean and pumpkin were produced in 1998. Hybrid maize has twice the yield of conventional seed, and can be planted even at an altitude of 2,000 m. Hybrid soybean crops can be grown twice a year, while hybrid pumpkins often weigh 100 kg.

In rice paddies, the rice water weevil is potentially the most serious pest affecting production. The pest was first identified in 1988, and has periodically damaged rice since then. The most serious damage occurred in 1992, reducing production by 20%. Since then, the levels of damage have been much lower.

North Korea has been relying on imports for the necessary pesticides. It is assumed that a decrease in imported chemicals due to the economic

crisis after 1992 has had some effect on agricultural production.

## Research and Extension

North Korea's system of agricultural research and extension is organized to disseminate modern technology from the top to the bottom. The system is modeled after that found in the former Soviet Union. Agriculture in North Korea is based on the principle of "growing proper crops in proper soil at the proper time," and emphasizes Juche (self-reliance). The Juche method of farming is seen as a scientific farming method designed to best suit the characteristics of North Korea and its collective farming system.

The North Korean government has expanded the use of chemical fertilizers on a very large scale. North Korea has been able to adopt many new varieties, new technology, advanced farm machinery and chemical fertilizers over the last 50 years.

The Academy of Agricultural Sciences (AAS), established in 1952, has three management departments, 36 laboratories and 14 branches. It also has seven research farms, five of which are for special crops, one for livestock, and one for general crops. It is the primary institution for agricultural research in North Korea, and employs 2,900 scientists plus technical staff.

The AAS conducts research, and also works with agricultural cooperatives to carry out field demonstration trials. Agricultural universities and colleges also carry out agricultural research in different parts of North Korea.

## CROPPING SYSTEMS

### Staple Crops

In North Korea, rice is the most important food crop. Maize is second in importance, but ranks almost as high as rice in terms of planted area. Other crops include wheat, barley, potato, soybean, sugarbeet, vegetables, fruits, mulberry, sorghum, millet and buckwheat.

The rice production season lasts from 150 to 180 days. All of the rice grown in the North belongs to the Japonica type, and more than 80% belongs to only three varieties: Pyongyang 15, Pyongyang 18, and Pyongyang 21 (Table 2). Hybrids are still being developed on research stations. The main disease affecting rice is blast, while the main pest is rice water weevil. In well-managed research trials of new, improved cultivars, yields of

up to 8-9 mt/ha have been obtained.

An important innovation is the so-called "mature seedling method," by which 45-day old rice seedlings are transplanted into the field. This cultivation method aims to increase rice production with fewer inputs, and establish a double cropping of barley with rice by shortening the growing period in the main field. Another advantage of this method is that it minimizes the impact of spring floods.

Maize is another important crop, and is used for both animal feed and human consumption. The normal growing period ranges between 110 and 135 days. Most of the maize crops grown in North Korea are hybrids, although some open-pollinated varieties are still sown in mountain areas. The main pests and diseases are armyworm, stem borer, cornborer, and smut. Early maturing varieties (90-100 days) with resistance to cold, lodging, etc. are now being developed. The technology used for breeding and seed propagation is relatively advanced.

Potato is traditionally grown in the northern highlands. Average yields are about 9-10 mt/ha, and tubers are fairly small. Potato is usually cultivated as a second crop after maize, or intercropped with other vegetables.

Potato varieties grown in North Korea have a high starch content. They are mainly used for noodles, fried potato cakes and similar foods. Present research is directed towards breeding varieties with a high starch content that can grow well in the

southern lowlands. In my opinion, approximately 100,000 - 200,000 ha of land in the southern lowlands could be used for potato production.

Virus-free planting materials are very important in potato production. At present, approximately 1,500 kg of seed potatoes are used per hectare. Normally, potato is planted at the beginning of April as an intercrop and harvested at the end of June. If it is the main crop, it is planted at the beginning of June and harvested at the beginning of September.

Soybean is a major source of protein food. Soybeans are normally planted in home gardens, on ridges and embankments around paddy fields, or on any open ground available. Soybean yields range from as low as 0.4 mt/ha to 3 mt/ha, with an average of 1 - 1.2 mt/ha. Soybeans are not treated as a major field crop, but rather as a subsidiary crop grown or intercropped wherever land is available. Even so, I would estimate that a total of more than 100,000 ha of soybean are grown every year.

In view of the importance of soybean for soil fertility (nitrogen fixation) and as a source of protein and vegetable oil, research is being conducted on various methods of cultivation, such as inter-cropping with maize and vegetables. Low-input, pest- and disease- tolerant and salt-resistant varieties are being tested for future release in the field.

Table 2. Predominant crop varieties and their characteristics, North Korea, 1997

Variety	Duration of crop (days)	Optimum yield (mt/ha)	Average yield (mt/ha)	% of total area sown
<b>Rice</b>				
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	-	-	-	
<b>Maize</b>				
Hwasong	110-135	7-8	6.5	55
Unsan	110-135	8	6-6.5	20
Pyongan	150	10	5-6	15
Other	150	-	-	10

## Double Cropping

In the 1950s, the North changed maize production from a rotational cropping system to a single cropping system, in order to maximize grain production. This threatened the production of small grains such as millet, sorghum, red bean, green bean, and Italian millet, all of which had lower yields than maize.

The late president Kim Il-Sung recommended hybrid maize as the second major food crop, to alleviate food shortages. Maize production became a priority even in areas which were not very suitable. The prevailing system, in which a single crop of rice is grown in paddy fields and a single crop of maize in the uplands, is now being revised, and double cropping is recommended. Crop rotation has the advantage of improved fertility for soils depleted by monoculture, as well as higher total yields per unit of land.

North Korea permits farmers to choose for themselves the most suitable crop for double cropping in their area, but a grain crop is usually followed by another grain crop. Spring barley or wheat is often planted from the end of February to the middle of March, followed by rice or maize as the second crop. When a double cropping system is implemented in lowland paddy fields, it is often too late to transplant rice after harvesting the first crop in the first 20 days of June. North Korea is now using 60-day-old mature seedlings for transplanting, to overcome this problem. In some provinces, a potato-rice double cropping system is being encouraged.

In areas where it is difficult to implement grain-plus-grain double cropping, such as the provinces of Ryanggang, Chagang, and North and South Hamgyong, a potato-rice double cropping system is being encouraged, along with rice after spring barley and winter wheat south of Anju in South Pyongan Province, and south of Hamhung in South Hamgyong Province.

The expansion of double cropping in North Korea appears to be closely linked to the Double Cropping Programme of the UNDP/North Korea Joint Program, which has been followed since 1996 to improve grain production. In the first large-scale double cropping program of 1997, 38,000 ha of spring barley was planted. In 1998, this was expanded to 70,000 ha of winter wheat, spring wheat and spring barley. In 1999 the double cropping area was increased to 100,000 ha, and cropping systems diversified to include potato, soybean and vegetables.

## CURRENT FOOD PROBLEMS

### The Grain Supply

Grain production in North Korea was only 1.9 million mt in 1946, but had risen to 10 million mt in 1984 - a five-fold increase in less than 40 years. This must be compared with the fact that during the same period, South Korea's grain production increased only 2.5 times.

The goal of grain production in the Six-Year Economic Plan, which ended in 1976, was 8 million tons. The goal in the Second Seven-Year Plan, ending in 1984, was 10 million tons. North Korean authorities announced that these goals had been met.

In 1995, the North Korean authorities announced that the grain production for that year was only 3.76 million mt. According to the Ministry of Unification in Seoul, North Korea's grain demand in 1998/99 was 6.5 million mt, while production was 3.8 million mt.

North Korea has suffered natural disasters every year throughout the 1990s, and the shortage of grain is estimated to be around 3 million mt each year. North Korea has been importing grain from abroad in order to overcome this problem (see Table 3).

### Causes of the Food Shortage

Agriculture in the North faces a number of problems. First of all, North Korea was heavily dependent on the former Soviet Union, China, and East European countries for economic and technological cooperation. After these countries adopted a market economy, North Korea was no longer able to enjoy socialist-style barter trade with its allies. Because of its lack of foreign exchange, North Korea had to curtail the import, not only of grain, but also of various raw materials it formerly procured through barter trade. Due to a lack of fuel, many factories had to reduce their operational hours. As a result, they have failed to meet the demand for fertilizer, agricultural chemicals and farm machinery.

Second, the cooperative farming system has some problems. North Korea has about 1.48 million ha of cropland out of a total area of 12 million ha. North Korea is reported to have developed good technology for breeding rice and corn, but productivity on cooperative farms has been declining. A North Korean farm family is usually given a small plot of land, about 100 m<sup>2</sup>, for private use. Productivity on private plots is 3-5 times higher than on



cooperative farms. This is because farmers care more for them, and frequently use on their plots fertilizers and pesticides taken from cooperative farms.

Third, North Korean authorities ordered farmers to cut down perennial plants such as pine trees on mountain slopes, and plant corn in their place. This method was successful at first, but corn production required a great deal of fertilizer. The rugged terrain also meant that a large labor input was needed to harvest the corn and transport it to towns. The really damaging result was that as trees were cut, there were landslides which destroyed not only the upland terraces but covered fertile lowlands in sand and rock.

Forest clearance and the construction of terraces were the main cause of the floods in 1995 and 1996. About 70% of North Korea's arable land is in the southwestern coastal area, and has been damaged by flooding. Moreover, North Korea is poorly endowed with agricultural resources compared to e.g. South Korea. About 90% of its land is mountainous, and the average height of the country is 400 m above sea level. Due to low temperatures and a short growing period, crop yields have always been fairly low.

## **PROSPECTS FOR AGRICULTURAL REFORM IN NORTH KOREA**

North Korea has recently carried out reforms to deal with its food production problems. These include extending new technology, encouraging farmers to work in smaller groups, permitting farmers to sell excess produce, and providing incentives for individual farmers.

These reforms are strongly supported by top political leaders in the country, including Kim Jong-Il. New administrative staff for agriculture were appointed between 1995 and 1997.

The new work teams for farmers were also important. The old work teams had 10-25 members. Each member received an allocation of the harvest according to the number of work days he or she had contributed. The new work teams are smaller, with only 7 or 8 members. Production goals are smaller, and members are allowed to share and sell what they produce in excess of their quota. These smaller teams are often made up of family members or close relatives, who know each other well and find it easy to cooperate. It is also easy to mobilize teams if natural disasters occur.

It is generally recognized that this adjustment of work teams and quotas will have a positive effect on farmers' incomes.

Table 3. North Korea's grain supply and demand, 1984-1998

Unit: 1000 mt

Year	Demand (A)	Production			Total (B)	Shortage (A-B)	Self- sufficiency (%)
		Rice	Corn	Other			
1984	5,303	2,214	2,450	936	5,600	-297	105.6
1985	5,402	2,010	2,530	490	5,030	372	93.1
1986	5,431	2,009	2,371	445	4,825	606	88.8
1987	5,515	2,034	2,409	509	4,952	563	89.8
1988	5,629	2,099	2,503	608	5,210	419	92.6
1989	5,762	2,159	2,681	642	5,482	280	95.1
1990	5,757	1,932	2,380	500	4,812	945	83.6
1991	5,762	1,641	2,210	576	4,427	1,335	76.8
1992	5,894	1,043	2,256	599	3,898	1,996	66.1
1993	6,065	704	1,690	529	2,923	3,142	48.2
1994	6,156	913	2,256	599	3,768	2,388	61.2
1995	6,224	761	1,370	475	2,606	3,618	41.9
1996	6,061	1,068	1,046	333	2,447	3,614	40.4
1997	6,188	1,247	1,065	247	2,559	3,629	41.4
1998	6,311	1,327	1,347	464	3,138	3,173	49.7

\* The decrease in estimated demand in 1996 was because the population was thought to have decreased.

## REFERENCES

- Kim, Woon-Keun. 1993. Evaluation of Agricultural Productivity in North Korea. Korea Rural Economic Institute, 1993.
- Kim, Woon-Keun, An Estimation of 1996 Grain Production in North Korea. Korea Rural Economic Institute, 1996.
- Kim, Woon-Keun. 1996. The Food Crisis in North Korea: Background and Prospects. 8,4 *East Asian Review* 1996.
- Kim, Woon-Keun. 1998. Food Situation and Agricultural Reform in North Korea. *Journal of Rural Development*, Korea Rural Economic Institute, 10.
- Kim, Woon-Keun, Hyun Ok Lee, Daniel A. Summer, Assessing the Food Situation in North Korea. *Economic Development and Cultural Change*.
- Eugene, C.I. and B.C. Koh. 1982. *Journey to North Korea*.
- FAO. 1998. DPRK, Agricultural Recovery and Environmental Protection (AREP) Programme, 20 Nov, 1998. (Unpub. mimeo.).
- FAO. WFP 1998. Special Report: FAO/WFP Crop and Food Supply Assessment Mission to the DPRK. (Unpub. mimeo).
- FAO. DPRK, Livestock Development and Vegetable Production GCP/DRK/002/ROK. (Unpub. mimeo.).
- Moon, Pal-Yong. 1992. *Agricultural Economy of North Korea*.
- IFAD. 1997. Investment Framework for the Agricultural Sector, Dec. 1997. (Unpub. mimeo).