

## Combating hunger in North Korea through super-corn development and science-based sustainable farming system

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### Abstract

Malnutrition and food shortage issues in North Korea are the center of the world concern. Flood, hail and drought hit NK during the early and mid-1990s. Economic hardship has triggered the problems. Since 1998, the first author visited NK 27 times (238 days). The International Corn Foundation project on “Super-corn development” that started in 1998 has taken two prolonged tasks: immediate increase of corn (*Zea mays* L.) production and development of new corn cultivars. The outcomes of the project for six years include: sustainable corn production system development with soybean intercropping, considerable increase of the purity of F1 hybrids, and selection of 25 outstanding new hybrids from different ecologies. An average of 0.5 million tons of more grains are additionally produced annually since 2001. In addition, this project has promoted science based agriculture in the country and introduced a new term, “Seed Revolution”. The project has increased not only corn production, but also developed sustainable and ecology specific crop promotion technologies as well as promoting dialogues with South Korea and adopting of an incentive system.

### Media summary

The super-corn development program of ICF and KNU, South Korea has helped North Korea to reduce food shortage, mal-nutrition and to develop sustainable farming system, science based agriculture, and seed revolution and it has also encouraged to dialogue and harmonize between two Koreas.

### Key Words

North Korea, inter-Korea collaboration, food shortage, mal-nutrition, sustainable agriculture, Genetic IPM.

### Introduction

During the last decade, North Korean (NK) populations have suffered much due to food shortage and malnutrition. Four important crops and acreage of NK are corn (700,000ha), rice (600,000ha), potato (200,000ha) and soybean (150,000ha). Natural disasters with historical floods, hail and drought put NK into the worst economic situation that opened dialogues with South Korea (SK) and with the free-world. By studying the NK agriculture thoroughly the super-corn development project of the International Corn Foundation (ICF) in Seoul and Kyungpook National University(KNU) in Daegu identified that there was a lack of sustainable system development in food production (corn in upland and rice in lowland). Both crops were cultivated with over 50% higher density, and only with 25% of fertilizer requirement were applied to the crops (ICF 2000). The most popular motto for food production was “rice is the communist” that over emphasized to increase rice production. Another motto was “corn is the king of the upland crops”. Continuous cropping of corn has reduced soil fertility in the upland. Soybean was grown only on rice bunds. Based on the field observations from many locations in the country and discussions with NK authorities and scientists, an estimation of total annual food production was about 1.5 million tons. The project activities started by reducing population density of cereal crops, increasing purity of F1 hybrid corn, and by developing sustainable cropping systems particularly in the uplands. In addition, the project suggested to open dialogues with SK, and to get economic assistance and cooperation at both private and government levels. The First Fertilizer Talk in Beijing in April, 1998 and the business opening to the

Hyundai were also arranged. This paper summarizes the outcomes of the collaborative super-corn development between South and North Korea, potential impacts and difficulties.

## Methods

### *Immediate increase of corn production*

The increase of corn production was started with Suwon 19 hybrid and a parental inbred (KS6) from SK. Suwon 19 was developed at the Rural Development Administration in Suwon in 1976, and was the first single cross hybrid commercialized in Asia. Suwon 19 has been grown in South Korea since 1977 with about 2.5 t/ha of F1 seed production. It doubled the national corn yield in five years, and tripled the farmers' income (Kim 2003b). Five tons of the hybrid and a parental inbred (200kg) were offered to NK in 1998 for planting in 83 Cooperative Farms (Table 1). Seed production of F1 hybrid was produced locally with one parent each from NK and SK. Each farm consisted of approximately ten villages and five were involved for Suwon 19 cultivation, with a NK's parent becoming as Kang 19. Both commercial and seed productions have been increased considerably in the following years, with start of the cultivation of super-sweet corn in 1999 (ICF 2000; Kim et al. 2001).

### *Breeding new hybrids*

Breeding of new cultivars of corn in NK was started with 3,000 crosses in 1998 at 12 research stations in NK, 2 stations in China and 2 stations in SK (Table 1). Numbers of the experimental crosses were jumped up to 8,000 in 2000, testing at 25 stations in NK and 7 in SK (ICF 2000).

### *Sustainable cropping system development*

Corn cultivation in NK was characterized with transplanting of 3-week old seedlings to shorten the growing period and for easy weed control. Soybean was introduced into corn field as an intercrop in 1999. To promote soybean inter-cropping, a bonus system was introduced, where 10% of the product was given to farmers (ICF 2003).

## Results

### *Increase of corn production*

In 1998 (first year), Suwon 19 hybrid yielded an average of 23% more compared to the top yielding local hybrid from the 83 Cooperative Farms. At least 50,000 tons of more grains of Suwon 19 were produced with the new production system (Table 1). In 1999 (second year), Suwon 19 yielded an average of 20% more from 1,000 farms, with 80% of the farms becoming highly successful. Approximately 150,000 tons of more grains were produced. In 2000, more encouraging results were obtained from 1,500 farms (1/2 of the total farms). The best performing years of crop production were 2001 and 2002, with half million tons of increase in each year (Table 1). In the spring of 2001, though it was very dry in early stage of the crop, the dry soil conditions stimulated corn production with the minimum pest infection (ICF 2003).

**Table 1. Effects of ICF's project to increase food production in North Korea.**

Year	Increase (x1000t)	Coop. Farms* (NO.)	Test locations (crosses tested)	Technologies that have contributed to increase yield
1998	50	83	12	Optimum density (50%), 28/0.0003ha→18~20, hybrid-purity

			(3,000)	75% (main cause, parental mix).
1999	150	1,000	18 (6,000)	Soybean inter-planting, direct sowing (10%), optimum density (80%), hybrid purity 85%, foods first to farmers, introduce science farming
2000	200	1,500	22 (8,000)	Soybean inter-cropping (100,000 ha), hybrid purity 95%, direct sowing (50%), competition among farms for production
2001	550	1,500	25 (7,000)	Soybean inter-cropping 150,000 ha, direct sowing (70%), competition among farms for production
2002	500	1,500	25 (4,000)	Soybean inter-cropping (150,000 ha), optimum density (90%), direct sowing (80%), competition among farms for production
Total	1450	5,583	102 (27,000)	Sustainable farming, introduce competition for food production (2002)

\*The Cooperative Farm in North Korea is equivalent to Myeon of South Korea in administration with about 10 villages.

#### *Breeding new hybrids*

In 1998, 100 crosses were selected with 43% of yield increase. Through extensive testing at many locations

43 outstanding crosses were bred by 2002 with tolerance to drought and *Exserohilum turcicum*. Twenty five outstanding hybrids were selected as the candidate of super-corn in 2003. Genetic information against major production constraints was obtained from different ecological zones in both NK and SK regions. On-farm testing with new hybrids was carried out since 2002 (Kim 2003a).

#### *Sustainable cropping system development*

From 1998, corn cultivation with Suwon 19 was direct sowing instead of traditional transplanting, with significant labor savings. Since 1999, soybean cultivation in corn field has also been very successful. This cereal-legume system increased sustainability of corn production. Soybean products were used to produce soy milk that were fed to children and elders, contributing to improvement of health of the citizens. Purity of F1 hybrid seeds of corn was increased from 75% in 1998 to 98% in 2001, leading to "Seed Revolution". The adoption of the optimum density of crops was employed not only for corn, but also for another staple crop, rice. This project has also demonstrated the adoption of genetic IPM(integrated pest management) system with co-survival tolerance that produces healthy foods, protects health of living organisms and the environments. Importance of high quality seeds in hybrid corn, seed potatoes (micro tube), livestock and fishes has been well promoted that also led "Seed Revolution (Kim 2003b)"

#### *Ecology specific crop deployment*

Recommendations have been made to cultivate ecology specific crops such as the highland with white potatoes, ecology specific hybrid development, and cultivation in drought-prone areas with sorghum and millet, etc (Kim 2000). Though the central government controls the options, all cooperative farms choose their own preferred crops and cultivars.

## Conclusions

This collaborative project has adopted science-based sustainable crop production system, diversified NK's agriculture, and provided hope for food production. Breeding tolerant corn cultivars against biotic and abiotic stresses has put NK's agriculture to be more sustainable and environmentally friendly. The estimate of the mean annual production increase was 0.5 million tons and the outcome of the five years was \$261 million (1,450,000 tons x price/ton, \$180). In addition, the adoption of bonus system in groups and individuals has been gradually employed first for the products from the cooperative farms and later for other areas. This has increased the efficacy of labor inputs in various sectors of the country. Since ICF has made a significant contribution to increase food production in NK and also to improve NK's cropping systems in a sustainable way, new projects were started in Vietnam, East Timor and Mongolia.

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