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ESTABLISHMENT AND OPERATION OF SOUTH-NORTH COOPERATIVE DEMONSTRATION FARMS

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Key words: South-North cooperative demonstration farm, Ecological and Environmental Demonstration Farm, Variety Demonstration Farm, Crop Diversification Farm

ABSTRACT

This study provides a detailed program concerning the establishment and operation of South-North cooperative demonstration farms which solves short-term food problems and achieves long-term advancement. Existing cooperation projects have been failed. Therefore, new ways of cooperation are needed. Possible types of demonstration farms can be taken into account the Ecological and Environmental Demonstration Farm, the Variety Demonstration Farm, and the Crop Diversification Farm.

I. Introduction

The severe food shortage problem in North Korea since the mid-1990s has been affected by artificial factors rather than natural disasters. The North Korean government completed its

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agricultural collectivization in 1958. Agricultural production activities have occurred mainly in collective farms. These include 3,000 cooperative farms, 1,000 nationally-operated farms, and a few comprehensive demonstration farms. These collective farms have a lower efficiency level due to the lack of incentives for the increase of production. In addition, North Korean agriculture has material and technical problems. Agricultural inputs, such as fertilizers, pesticides, and agricultural machinery, are extremely low. The chloridation of arable land is high and agricultural technology is not advanced. In particular, the Juche Farming Method that is aimed at maximizing the quantity of production through overcoming less favored natural farming conditions and the limited size of arable land, and to achieve self-sufficiency in foods, has established a farming system based on corn and rice. The Juche Farming Method risked agricultural operations by focusing on the improvement of land productivity.

These North Korean agricultural problems cannot be solved by merely through its own efforts, but it will be possible through cooperation with South and North Korea. The most desirable method is to establish demonstration farms run by two Korean participants and to provide opportunities to experience advanced South Korean technology through operating demonstration farms.

Although several civilian-based joint farm projects have been carried out until recently, most of them have not succeeded. The main reason for this failure is the lack of trust that has resulted from the ambiguity of project goals and detailed plans. Because the project driving format is the South's unilateral support, there is a lack of participation in the North. Hence, the cooperation projects were unable to continue. In particular, among South-North cooperation projects, cooperation projects related to farm operation are not fit for civilian investments aiming at profits. At this point in time, neither profit-seeking projects nor unilateral material supports in civilian bases are facile. It is desirable for South and North Korea to participate positively and exchange personnel to activate the project.

Demonstration farm projects have been carried out for general economic interchanges in the beginning stages among nations. Their achievements have been successful. Similarly, the South-North demonstration farm projects will be successful in their efficacy because these vitalize the interchanges of personnel and materials. In order for the South and North to be effective, practicable detailed plans and investment plans should be established.

The purpose of this study is to provide a detailed program concerning the establishment and operation of South-North cooperative demonstration farms which solves short-term food problems in North Korea and in the long run achieves balanced development in the agricultural sector in the Korean Peninsula.

II. Current Situations and Problems in South-North Cooperative Farm Projects

1. Cases of Farm Projects

Doore Village Cooperative Project

The Doore Village Cooperative Project was designed to establish a cooperative project in about 30 hectares of farmland, seek seeds, and conduct farming experiments and contract farming in 3,000 hectares. The South participant invests agricultural inputs, facilities, and operational funds and the North provides land and labor force. The ratio of investment of both sides is about 50 to 50[1]. The farm was designed to cultivate mainly potatoes and food grains. Farm management methods were based on the decisions of the committee. The South was responsible for selling products and profits were divided evenly.

[1] This project is run by Doore Village Farming Association of the South and Rasun Economic Cooperative Firm of the North according to an agreement on cooperation.

Baeksan Company's Cooperation Project

The Baeksan Company signed a contract agreeing to establish and run a cooperative farm in the Najin-Sunbong region. The Baeksan Company was supposed to provide mushroom-producing soil and mushrooms at the farm, but was blocked before starting farming.

Hyundai Asan Agricultural Cooperative Project[2]

The Hyundai Asan is carrying out contract farming with the Chosun Geumgang Mount Tourist Coperation under the contract at Onjeong-ri of North Goseong County. The cooperative project is in the form of greenhouse farming and traditional farming. This project consists of four hectares with 96 greenhouse buildings made of plastic film, and six hectares for traditional farming producing fruits and vegetables under contract. The South invests 880,000 dollars for facilities, agricultural inputs, seeds, and farming technology. The North is responsible for the entire process of production and repaying to Hyundai Asan the investment within three years with these products. In return, the Hyundai Asan must sell these products to the Geumgangsan company of the Hyundai Asan as well as on the cruise ships.

2. Progress of South-North Agricultural Cooperation

Cooperation projects such as Doore Village and the Baeksan Company have failed shortly after the initial contract due to the North's unilateral shut down of the Najin-Sunbong region, the lack of understanding in running commercial businesses, and insufficient preparation of contract cultivation. On the other hand, the Hyundai Asan is currently carrying out cooperative projects which shows much promise for success. Therefore, the case of Hyundai Asan project is a worthy model for agricultural cooperation.

There were several factors in the cooperative farming

[2] The Hyundai Asan was supposed to carry out a cooperative project with Ilshin Chemical Company that produces vinyl plastic hothouses.

project of the Hyundai Asan. First, the Hyundai Asan has accumulated vast know-how such as educating experts, research, operation methods, and trust building methods enabling the implementation of agricultural cooperative projects. Second, South-North agricultural cooperative projects need huge investments. Civilians or small- and medium firms, lacking investment funds, cannot initiate projects with commercial characteristics. On the other hand, the Hyundai Asan has the capacity to sustain a stream of investments until it will finally generate profits. Third, there was no conflict in the process of operation because of the simple contents of the project and contract cultivation. Because contract cultivation did not make growers consider the quantity of production, cultivating methods asked by the contractor can be easily adopted.

This cooperation not only functions as a demonstration field and a seed gathering field through growing the seeds of the South and North but also makes the exchange of agricultural technology. These points give an important clue for running the farms between the South and the South.

3. Problems of South-North Cooperation

There are several problems in the South-North cooperation projects. First, people from both sides could not understand the commercialized cooperation seeking mutual economic benefits. Second, sufficient funds could not be invested to meet preparation costs and operation costs. Small and medium size companies from the South could not meet the continuous investments needed. Third, there were some problems in selling products and distributing profits. The cooperation partners of the South were responsible for selling products. However, they could not establish international and domestic market networks. And Fourthly, recklessly competitive participation in cooperation projects caused problems. Because the participating partners of the South began the cooperation projects without preparing perfect agreements and the schedule of investments under competition, they followed the North partner's intention and

finally stopped at last.

One alternative for solving these problems is a government-based demonstration farm project. It is desirable that government develops a cooperative project and expand this kind of project to civilian-based cooperation projects. Also government should give institutional support by implementing policies to make them succeeded.

There may be several institutional obstacles in establishing the farm. First of all, the operation of the farm by states with different political systems has some obstacles in policy-making, land ownership, and supporting system. Accordingly, adjustment and agreement is not an easy task.

Ⅲ. Types and Development Plans of Demonstration Farms

1. Definition and Objectives

A demonstration farm is a field in the extension center to demonstrate advanced farming technology, cropping patterns, and farm operation techniques, as well as a center of the farming development in the extension district. It is a test field for the available packages of agronomic practices to sustain high yields and high cropping intensity in the area. The results will be disseminated to surrounding farmers through demonstration programs, and training/practice program.

The purposes of a demonstration farm operation are to show a model of advanced farming technology, proper on-farm water management and cropping patterns.[3]

[3] There are many cases which cannot disseminate technology to the farmers after technology was developed. The possible subjects would be ones that give farmers economic benefits including the increase of income and the reduction of production costs as well as non-economic benefits including the reduction of labor.

2. Necessity and Effect of Demonstration Farm Operation

In order to solve the food problem in North Korea, food supply is the fastest and most direct way. However, it is not a fundamental solution. It is needed to maximize effects through adopting diverse supporting devices. Among these, demonstration farm projects will be one of the best alternatives because it does not need lots of investment, because it will have long-term effects, and because it is very effective in building mutual trust. The Korea-China Demonstration Farm Project and Korea-Thailand Demonstration Farm Project served good examples for agricultural cooperation.

The North can accept this demonstration farm project because the South has capital and technology. This project will have high possibility of success. The reason is that the North is carrying out a similar project provided by international organizations.

Because North Korea has sufficient land and labor force among production factors and South Korea has capital and technology, it is very rational to combine these factors in order to maximize the effect of cooperation. However, the current economic situation in North Korea is very serious and it prefers support to cooperation in the short term. Cooperation projects are thought of as mid- and long-term tasks. Therefore, we can carry out a demonstration farm project as a typical method of cooperation, as it has substantially supporting characteristics and formally cooperative characteristics.

3. Basic Plan and Objectives of Demonstration Farm by Types

Selection of Types of Demonstration Farm

Agricultural development in North Korea and an increase in exchanges are important factors to be considered in selecting the types of demonstration farm. Although the maximization of food production is very important in order to solve difficulty of food supply, environmentally friendly agriculture that protects

degradation of soil and the provision of safe foods is also important to maintain agricultural sustainability. Ecological and environmentally friendly agriculture will encourage exchanges between the two Koreas and boost ecological tourism.

It is important to establish a demonstration farm for comparing various seeds and selecting the most suitable seeds that the two Koreas have. Also, considering cropping patterns of the North focused on corn and rice, we can facilitate crop diversity through a demonstration farm.

Basic Plans of the Different Types of Demonstration Farms

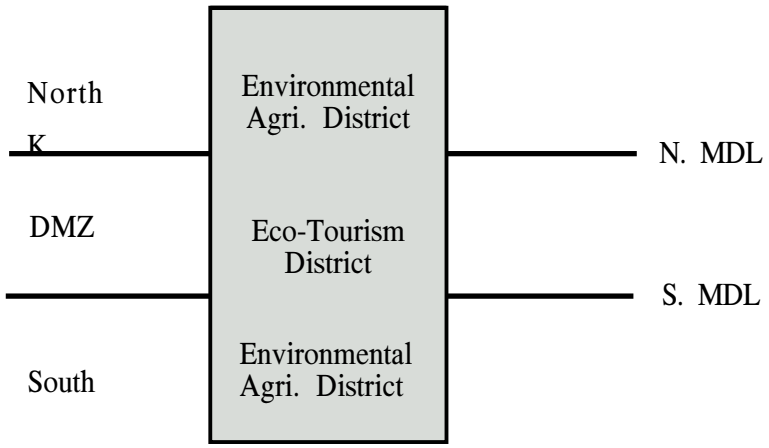
A. Ecological and Environmental Demonstration Farm

Objectives: The ultimate goal of this type of farm is to develop future-oriented farming to conserve environment and harmonize farming with natural ecology. However, it needs certain steps before achieving ecological and environment-friendly agriculture. The first step is to exchange technology for preserving the environment. The second step is to facilitate ecology conserved farms located on lands on both sides, and the third step is to practice environmentally friendly agriculture on the ecologically preserved farm. This farm will create solid foundation for combining green tourism with environment-friendly agriculture, locating it in the demilitarized zone (DMZ).

Location: the DMZ and its vicinity are proper locations for ecological and environment-friendly agriculture. the DMZ is internationally recognized as an ecologically valued place. the DMZ is a place where the South and North recognize its value and show and disseminate sustainable agriculture. Also, the DMZ and its vicinity are politically accessible without any difficulties(Figure 1) Scale and Method of Farm:[4] each farm has 50 hectares and 400 hectares in the DMZ located in-between South Military Demarcation Line (S. MDL) and North military

[4] The DMZ region is divided into the Northern part of the farm and the Southern part of the farm in geographical characteristics and functions as a channel to link the two farms and an ecological tourism center as well.

FIGURE 1. Conceptual Framework of Ecological and Environmental Demonstration Farm



demarcation zone (N. MDL) zone is established as an ecological tourism area. The DMZ is designed to allow public access and the rest of the areas are undeveloped as ecological conservation area. Demonstration farms are established in both territories outside the DMZ.

Operation: The DMZ and farm area are designated as a special zone. In this special zone, the South and North cultivate crops together according to agreement about crops, kinds of crops, inputs and sell products to visitors. Profits are used to cover operation costs.

Crop Cultivation: Considering the food problem in the North, rice is the best crop because rice growing is the easiest farming in the introduction of environmentally friendly farming methods. It is possible that a demonstration farm can achieve its goal through successful operation. However, until farmers gain knowledge and technology for adopting environmentally friendly farming methods, low input farming needs to be applied as a learning process. After that, organic farming should be applied.

Expected Effects: Operation of a demonstration farm will contribute to the identification of national homogeneity and the

reduction of tension between the South and the North. Also, environment-friendly agriculture will be expanded in accordance with international trends.

B. Variety Demonstration Farm

Goal: The comprehensive goal is to exchange kinds of crops and organic resources for developing new varieties between the South and the North and to gain superior seeds. There are three step goals in this demonstration farm. The first step is to establish an exhibition field for comparing crops based on food grains. The second step is to expand the exhibition field to all crops. The third step is to develop the farm as exchange center of genetic resources and for selecting better seeds.

Crop cultivation: It is desirable to grow many possible crops. However, considering that North Korea has set up its own agricultural direction to solve its food problem, the cultivation of food grains is the way to maximize the effects of cooperation. Accordingly, rice, corn, and barley are major crops and in part vegetables can also be grown.

Location: It is desirable that the demonstration farm should be located in many sites in order to spread it effects. In this context, three farms in South Pyungan(S. Pyungan), South Hwanghae(S. Hwanghae), and Yangang-do are being considered. It is planned that rice and barley will be cultivated in S. Hwanghae, corn and vegetables in S. Pyungan, and potato in Yanggang, respectively.

Farm Size: Although this kind of farm does not need to be large scale, it should be of a certain scale in order to achieve the purpose of comparing crops and searching for good seeds. About 10 hectares of farmland in nationally-run farms is appropriate.

Operation: Crops that the South and the North recommend will be exhibited. Various cultivating methods will be adopted and the results compared. Approved crops and methods will be disseminated.

Expectated Effect: This farm will contribute to recognizing seed quality, having the opportunity to increase productivity and to

develop new crops, and ultimately solve food difficulty in North Korea.

C. Crop Diversification Farm

Goal: Its comprehensive goal is to support agricultural inputs and technology for mitigating North Korea's food problem. The first step of this project is to provide fertilizers, pesticides, seeds, and other agricultural inputs needed for the production of food grains such as barley and potato. The second step is to expand its operation to vegetables and special crops, and the third step is to provide a model of agriculture and livestock raising.

Crop Cultivation: We should consider the North's food problem in the Crop Diversity Demonstration Farm and should rather grow rice, barley, corn, potato, vegetable.

Location: The farms are located in all areas. But we should consider the characteristics of crops to be cultivated. We designed two farms in selected provinces: rice and barley in S. Hwanghae; corn and vegetable in S. Pyongan, potato in Yanggang.[5]

Farm Size: The scale of each farm would be 50 hectares. The working unit in North Korea is formed by a small working unit (Buncho). Each working group cultivates 10 hectares and each cooperative farm consists of five small working units.

Operation: The South provides agricultural machinery and parts, oil, agricultural inputs such as fertilizer, pesticide, and vinyl and the North provides farmland and labor force. Crops are selected by agreement. Various farming methods are adopted in order to select the most suitable one which is fit for the region.

Expectation: This farm project will contribute to solving food problem and exchange of agricultural technology between the South and the North.

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[5] Experts stress that it is effective to locate the farm on existing cooperative farms in every province.

Ⅳ. Basic Plan for Demonstration Farm

1. Land Utilization Plan

Table 4-1 shows the land utilization plan of demonstration farms. Cropping patterns of demonstration farms are as follows: One type of farm is a paddy field. Here rice is set up as a major crop in the first growing season, and barley is in the second season. The second type is the farm that grows corn and vegetables. And the third type is the farm that grows potato in the high mountain areas.

Three hectare pipe vinyl houses are equipped at the variety demonstration farm and crop diversification farm forgrowing corn and vegetables. Also, in order to support

TABLE 1. Land Utilization Plan by Farm Type

Unit: ha

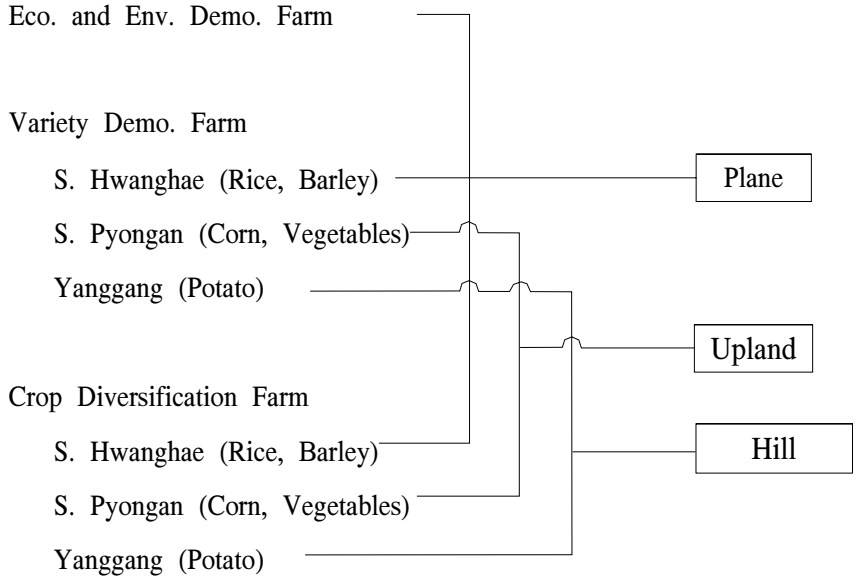
Farm type	Acerage	Crop rotation	Common work place	Green house
Eco. and Env. Demonstration Farm				
South	52	Rice - Rye	2	-
North	52	Rice - Potato, Barley	2	-
Variety Demo. Farm				
S. Hwanghae	10	Rice - Barley	-	3
S. Pyongan	10	Beans · Maize - Potato · Vagetables	-	3
Yanggang	10	Potatoes	-	3
Crop Diversification Farm				
S. Hwanghae	52×2	Rice - Barley · Wheat · Potato	2×2	-
S. Pyongan	52×2	Corn - Potato	2×2	-
Yanggang	52×2	Potato · Beans - Vegetables · Potato	2×2	-

production, the rice processing center, machinery depository, common working place, processing facilities are established on two hectares of land, which connects the farm with the living home. Land utilization plan according to the types of farms and regions are different from the cropping patterns of farms.

2. Basic Types of Farms

Three types of demonstration farms are established as follows: two farms are located in the vicinity of the cease-fire line and three farms in S. Hwanghae, S. Pyongan, Yanggang, respectively. Rice in the phase term of the growing season and rye, potato, and barley in the second term of season are planned to be grown in the Ecological and Environmental farm in the vicinity of the cease-fire line and the crop diversification farm in S. Hwanghae. The variety demonstration farm and crop diversification farm located in S. Pyongan and Yanggang are set up to grow potato, legume, corn, and vegetables.

FIGURE2. Classification of Farm Types



Ecological and environmental demonstration farm located in the vicinity of cease-fire line and variety demonstration farm to be located in S. Hwanghae, S. Pyongan, Yanggang are classified as flat field types of farm based on paddy fields. The variety demonstration farm to be located in S. Pyongan is classified as hilly type of farm.

Variety demonstration farm and crop diversification farm to be located in Yanggang are classified as a sloping high mountain type of farm that mainly cultivates potato.

3. Detailed Operation Plan of Demonstration Farm

Organization and Management

Ecological and environmental farms must have two organizations and management systems because this farm is separated into two areas over the DMZ and a committee to manage the farm. For operating a variety demonstration farm and crop diversification farm, experts of the South must stay in the farm area because they are located in the North.

Considering that the size of farms are 10 hectares or 50 hectares, one expert per farm is enough. Accordingly, two persons consisted of one of the North and one of the South are needed in the ecological and environmental demonstration farm, three persons for three variety demonstration farms, and six experts for six crop diversification farms, respectively. However, the variety demonstration farm located in S. Pyongan needs one additional greenhouse expert. Also, one chief administrator and one administrator are needed. This number of experts are minimal. In addition, more personnel may be needed to meet specific purposes such as touring experts with crop knowledge and experts in the fields of soil, fertilizer, pesticide, and water management.[6]

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[6] One expert for each crop such as crop, rye and barley, potato and sweet potato, corn, vegetable, and one expert each one field such as soil and fertilizer, pesticide, repair and water management.

Crop and Farming Management

The dissemination of farming technology must be based on the North's traditional farming methods, because we have to understand the North's methods and to harmonize its methods with the South's ones.

Crop Patterns by Farm Types

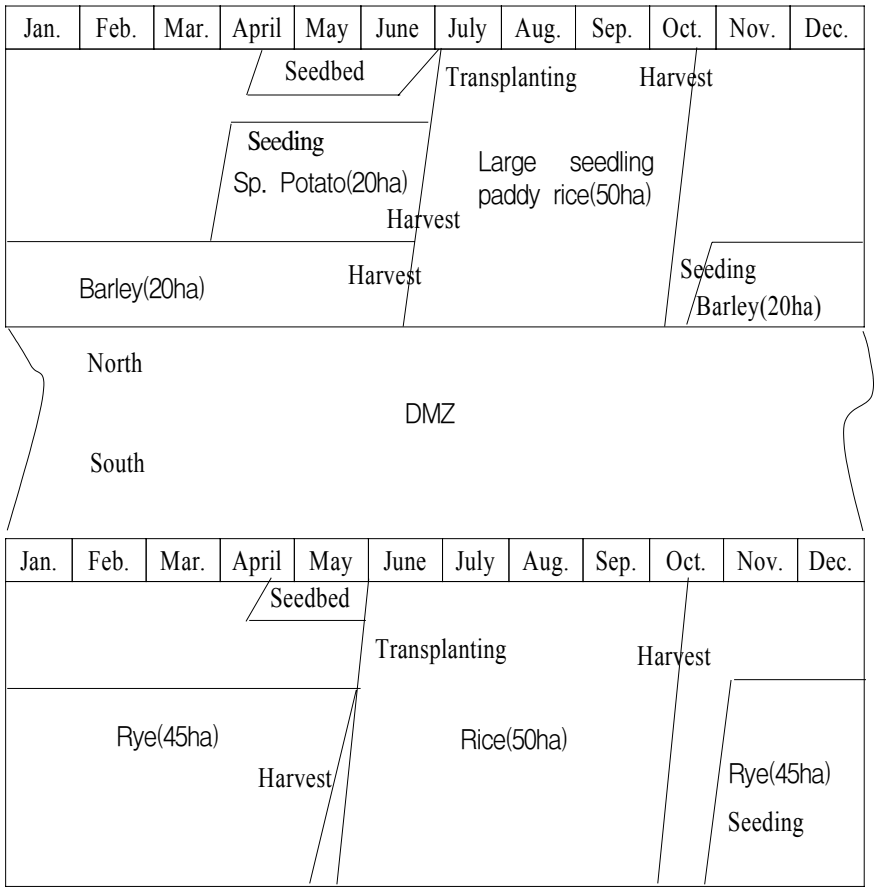
A. Ecological and Environmental Demonstration Farm

Crop patterns and farm acerage are as follows(Table 2, Figure 3)

TABLE 2. Crop Acerage by Farm Types

Farm type	Region	Crop	Acerage(ha)		
			First crop	Second crop	Total
Eco. and Env. Demo. Farm (1 farm each in the south and the north)	South (50ha)	Rice	50		50
		Rye		45	45
	North (50ha)	Paddy-rice	50		50
		Spring potato		25	25
		Winter barley		20	20
	Subtotal(100ha)		100	90	190
Variety Demo. Farm (1 farm each province)	S. Hwanghae (10ha)	Paddy-rice	10		10
		Winter barley		9	9
	S. Pyongan (10ha)	Beans	2		2
		Corn	1	4	5
		Spring potato	4		4
		Vegetables		3	3
		Greenhouse		3	3
	Yanggang (10ha)	Potato	10		10
	Subtotal(30ha)		30	16	46
Crop Diversification Farm (2 farms each province)	S. Hwanghae (100ha)	Paddy-rice	100		100
		Winter barley		20	20
		Winter wheat		20	20
		Spring potato		55	55
	S. Pyongan (100ha)	Corn	100		100
		Winter barley		100	100
	Yanggang (100ha)	Spring potato	50		50
		Vegetables		50	50
		Beans	50		50
		Potato		50	50
	Subtotal(300ha)		300	295	595
Total(490ha)			430	401	831

FIGURE 3. Crop Rotation on Ecological and Environmental Demonstration Farms



(a1) Northern Farm

Seedbed for large paddy rice: raising rice seedling in cold frame from mid-April to early June

Transplanting in Paddy field: June 20-30

Harvest: October 5-20 (50 ha)

Winter Barley: Seeding October 10-25

Harvest: June 15 - July 5 (20ha).

Spring Potato: seeding April 1-10

Transplanting: April 20-30

Harvest: June 20 - July 10 (20 ha)

(a2) Southern Farm

Seedbed for paddy rice: seeding April 10-20 (Vinyl house)

Transplanting: May 20-30

Harvest: September 30 - October 15 (50ha)

Rye for winter green field: seeding October 15-30

Harvest(feed and green fertilizer): May 10- 30 (45ha)

B. Variety Demonstration Farm

TABLE 2 shows the crop patterns and the farm size. One farm in a province is established and the size of the farm is ten hectares. Crop pattern is focused on food grains. Crop patterns recommended are as follows:

- ○ Farm in S. Hwanghae: rice (the first crop), winter barley(the second crop)
- ○ Farm in S. Pyongan: beans, corn, spring potato(the first crop), corn, vegetables, greenhouse(the second crop)
- ○ Farm in Yanggang: potato(the first crop)

FIGURE 4. Crop Rotations in Variety Demonstration Farms(S. Pyongan)

Crop	Acerage (ha)	Month 1	2	3	4	5	6	7	8	9	10	11	12
Greenhouse	3	Tomato →						Cucumber →					
Soybeans-Corn -Vegetables	3					Soybeans →		Vegetables →					
						Corn →							
Corn-Potato	4						Corn →						
						Spring Potato →							

Seedbed for large paddy rice: Raising rice seedling in cold frame from mid-April to early June

Transplanting in Paddy-field: June 20-30

Harvest: October 5 - 15 (10 ha)

Winter Barley: Seeding Oct. 15-20, Harvest June 15-20 (9ha), Seedbed 1ha

Potato: Seeding Mid-May, Harvest Mid-September

FIGURE 5. Crop Rotations in Variety Demonstration Farms(S. Hwanghae and Yanggang)

Region	Crop Rotation	Acerage (ha)	Month 1 2 3 4 5 6 7 8 9 10 11 12
S. Hwanghae	Paddy Rice -Winter Barley	10	Barley → Seedbed Rice → Barley →
Yanggang	Potato Monoculture	10	Monoculture →

When we select seeds of the South, we must choose an early ripening variety or extremely early ripening variety and pass pilot cultivation test. Also, we have to observe the status of those seeds and try to apply the farming method of the South. Seeds to be compared are chosen from seeds that the North recommends, the North's seeds that were passed test in the south, and the South's seeds that can be adjusted in the North climate.

C. Crop Diversification Demonstration Farm

Crop diversification demonstration farms are planned to establish four farms in three provinces of S. Pyongan, S. Hwanghae and Yangang. Two farms will be set up in one province. Two farms in S.Hwanghae will be selected in paddy fields and other four farms in dry fields in S. Pyongan and Yanggang (Table 2).

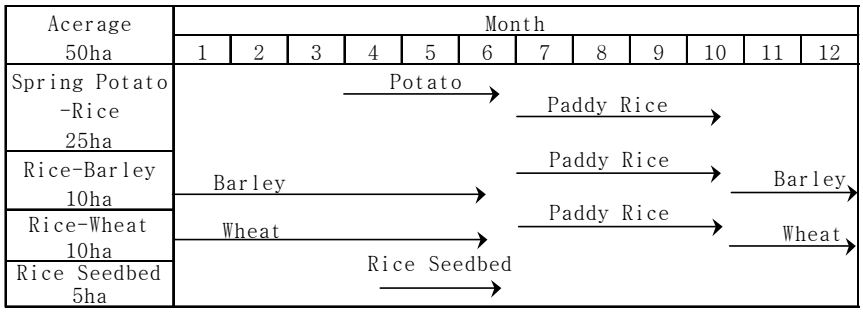
As Figure 6 shows, crop patterns are one crop in the growing season. Crop patterns are as follows:

○ Farm in S. Hwanghae: paddy rice (the first term), winter barley, winter wheat, spring potato (the second crop)
○ Farm in S. Pyongan: corn, winter barley
○ Farm in Yanggang: spring potato and beans (the first term) vegetables and potato (the second term)

And the growing season of crops are as follows:

Barley: seeding October 15-20; harvest June 15-20 (10 ha)
Wheat: seeding October 15-20; harvest June 20-25 (10 ha)

FIGURE 6. Crop Rotations in Crop Diversification Farms (S. Hwanghae)



Spring potato: seeding April 1-5; harvest June 15-20 (25ha)

Seedbed for large paddy rice: raising rice seedling in cold frame from April 20-30; transplanting June 20-30; harvest October 5-15 (50ha)

Provision and Utilization of Agricultural Inputs

Requirement of agricultural inputs are classified into seeds, fertilizers, pesticides, herbicides and others (Table 3).

TABLE 3. Input Requirement per Hectare

Crop	Seed (kg)	N (kg)	P_2O_5 (kg)	K_2O (kg)	Lime (kg)	Herbicide		Insecticide		Fungicide	
						Liquid (cc)	Granule (kg)	Liguid (cc)	Granule (kg)	Liquid (cc)	Wettable Powder (g)
Rice	80	220	90	40	1,000	3,000	30	2,000	40	3,000	300
Large Seedling Rice	60	150	75	75	1,000	3,000	30	2,000	40	3,000	300
Corn	250	150	75	75	1,000	2,000	10	1,000	20	1,000	200
Potato	150	150	60	75	1,000	2,000	10	1,000	20	2,000	200
Wheat/Barley	180	140	60	70	1,000	2,000	10	1,000	20	1,000	200
Soybeans	70	55	65	55	1,000	1,000	10	1,000	20	1,000	200
Vegetables	6.5dl	200	150	180	5,000	2,000	10	3,600	20	3,600	300
Greenhouse Cucumber	6.0dl	340	180	320	1,100	330	-	13,000	20	2,800	26,500
Greenhouse Tomato	0.7dl	230	130	230	1,000	520	-	3,300	20	6,000	10,000

TABLE 4. Requirement of Seeds, Fungicides, Plastic Film by Farm Type

Farm Type	Region	Crop	Acer-age (ha)	Seeds		Fungicides, liquid		Fungicides, Wettable powder		Planstic film	
				kg/ha	M/T	cc/ha	ℓ	g/ha	M/T	m/ha	km
Eco. and Env. Demo. Farm	South (50ha)	Rice	50	80	4.0	3,000	150	200	10		-
		Rye	45	180	8.1	1,000	45	200	9		-
	North (50ha)	Large seedling rice	50	60	3.0	3,000	100	200	10		-
		Spring potato	25	150	3.8	2,000	50	140	3.5	7,000	175
		Winter barley	20	180	3.6	1,000	20	140	2.8		-
	Sub-total(100ha)		190		22.5		365		35.3		175
Variety Demo. Farm	S. Hwang-hae (10ha)	Large seedling rice	10	60	0.6	3,000	30	300	3.0		-
		Winter barley	9	180	1.6	1,000	9	200	1.8		-
	S. Pyongan (10ha)	Soybeans	2	70	0.1	1,000	2	200	0.4		-
		Corn	5	250	1.3	1,000	5	200	1.0		-
		Potato	4	150	0.6	2,000	8	200	0.8	3,000	12
		Vegetables	3	6.5dl	19.5dl	3,600	10	300	0.9	7,000	105
		Greenhouse	3	6.7dl	20.1dl	8,800	26	36,500	110	-	-
	Yanggang (10ha)	Potato	10	150	1.5	2,000	20	200	2.0	7,000	70
	Sub-total(90ha)		46		39.6dl 5.7		110		119.9		187
Crop Diversifica-tion Farm	S. Hwang-hae (100ha)	Large seedling rice	100	60	6.0	3,000	300	300	30		-
		Winter barley	20	180	3.6	1,000	20	200	4		-
		Winter wheat	20	180	3.6	1,000	20	200	4		-
		Spring potato	55	150	8.3	2,000	110	200	11	7,000	385
	S. Pyongan (100ha)	Corn	100	250	25.0	1,000	100	200	20		-
		Potato	100	150	15.0	2,000	200	200	20	3,000	300
	Yanggang (100ha)	Spring Potato	50	150	7.5	2,000	100	200	10	7,000	350
		Vegetables	50	6.5dl	325dl	3,600	180	3,600	180	7,000	350
		Soybeans	50	70	3.5	1,000	50	1,000	50		-
		Potato	50	150	7.5	2,000	100	200	10	3,000	150
	Sub-total(300ha)		595		325dl 80.0		1,180		339		1,535
Total(490ha)			831		364.6dl 108.2		1,605		494.2		1,897

TABLE 5. Requirement of Herbicides and Insecticides by Farm Type

Fary type	Region	Crop	Acer-age (ha)	Herbicides, Liquid		Herbicides, Granule		Insecticides, Liquid		Insecticides, Granule	
				cc/ha	ℓ	kg/ha	M/T	cc/ha	ℓ	kg/ha	M/T
Eco. and Env. Demo. Farm	South (50ha)	Rice	50	3,000	150	30	1.5	2,000	100	40	2.0
		Rye	45	2,000	90	10	0.5	1,000	45	20	0.9
	North (50ha)	Large Seedling Rice	50	3,000	150	30	1.5	2,000	67	27	1.3
		S. Potato	25	2,000	50	10	0.3	1,000	25	14	0.3
		W. Barley	20	2,000	40	10	0.2	1,000	20	14	0.3
	Subtotal(100ha)		190		480		4.0		257		4.8
Variety Demo. Farm	S. Hwanghae (10ha)	Large Seedling Rice	10	3,000	30	30	0.3	2,000	20	40	0.4
		W. Barley	9	2,000	18	10	0.1	1,000	9	20	0.2
	S. Pyongan (10ha)	Soybeans	2	1,000	2	10	-	1,000	2	20	0.1
		Corn	5	2,000	10	10	0.1	1,000	5	20	0.1
		Potato	4	2,000	8	10	0.1	1,000	4	20	0.1
		Vegetables	3	2,000	6	10	0.1	3,600	11	20	0.1
		Greenhouse	3	850	3	-	-	16,300	49	40	0.1
	Yanggang (10ha)	Potato	10	2,000	20	10	0.1	1,000	10	20	0.2
	Subtotal(90ha)		147		97		0.8		110		1.3
Crop Diver. Farm	S. Hwanghae (100ha)	Large Seedling Rice	100	3,000	300	30	3.0	2,000	200	40	4.0
		W. Barley	20	2,000	40	10	0.2	1,000	20	20	0.4
		W. Wheat	20	2,000	40	10	0.2	1,000	20	20	0.4
		S. Potato	55	2,000	110	10	0.6	1,000	55	20	1.1
	S. Pyongan (100ha)	Corn	100	2,000	200	10	1.0	1,000	100	20	2.0
		Potato	100	2,000	200	10	1.0	1,000	100	20	2.0
	Yanggang (100ha)	S. Potato	50	2,000	100	10	0.5	1,000	50	20	1.0
		Vegetables	50	2,000	100	10	0.5	3,600	180	20	1.0
		Soybeans	50	1,000	50	10	0.5	1,000	50	20	1.0
		Potato	50	2,000	100	10	0.5	1,000	50	20	1.0
	Subtotal(300ha)		595		1240		8.0		825		13.9
Total(490ha)			831		1,817		12.8		1,192		20.0

TABLE 6. Fertilizer Requirement by Farm Type

Farm type	Region	Crop	Acer-age (ha)	Fertilizer							
				Ammonium sulfate		Urea		Fused phospate		Potassium chloride	
				kg/ha	M/T	kg/ha	M/T	kg/ha	M/T	kg/ha	M/T
Eco. and Env. Demo. Farm	South	Rice	50	200	10.0	348	19.6	450	22.5	133	3.4
		Rye	45	140	4.2	243	7.3	300	9.0	117	3.5
	North	Large seedling rice	50	150	5.0	260	8.7	375	12.6	125	4.2
		S. potato	25	150	2.5	260	4.4	300	5.0	125	2.1
		W. barley	20	140	1.9	243	3.2	300	4.0	117	1.6
	Sub-total		190		23.6		43.2		53.1		14.8
Variety Demo. Farm	S. Hwang-hae	Large seedling rice	10	150	1.5	260	2.6	375	3.8	125	1.3
		W. barley	9	140	1.3	243	2.1	300	2.7	117	1.1
	S. Pyongan	Soybeans	2	50	0.1	98	0.2	325	0.6	108	0.2
		Corn	5	150	0.8	260	1.3	375	1.9	125	0.6
		Patato	4	150	0.6	260	1.0	300	1.2	125	0.5
		Vegetables	3	200	0.6	348	1.0	750	2.3	300	0.9
		Greenhouse	3	570	1.7	991	2.9	1550	4.7	917	2.7
	Yang-gang	Potato	10	150	1.5	260	2.6	375	3.8	125	1.3
	Sub-total		46		8.1		13.7		21		8.6
Crop Diversifi-cation Farm	S. Hwang-hae	Large seedling rice	100	150	15.0	260	26.0	375	37.5	125	12.5
		W. barley	20	140	2.8	243	4.9	300	6.0	117	2.3
		W. wheat	20	140	2.8	243	4.9	300	6.0	117	2.3
		S. potato	55	150	8.3	260	14.3	300	16.0	125	6.9
	S. Pyongan	Corn	100	150	15.0	260	26.0	375	37.5	125	12.5
		Potato	100	150	15.0	260	26.0	300	30.0	125	12.5
	Yang-gang	S. Potato	50	150	7.5	260	13.0	300	15.0	125	6.3
		Vegetables	50	200	10.0	348	17.4	750	37.5	300	15.0
		Soybeans	50	50	2.5	98	4.9	325	16.3	108	5.4
		Potato	50	150	7.5	260	13.0	300	15.0	125	6.3
	Sub-total		595		86.4		150.4		217.3		82.0
Total			831		118.1		207.3		290.9		105.4

Plastic film and its attached materials are included in other inputs. However, we took into account only plastic film. Requirement per hectare are outlined in table 4. In particular, requirements of herbicides and pesticides were calculated as an average because of the lack of real data, even if there are data about the kinds of weeds and harmful insects. Fertilizer requirements are indicated by three elements of chemical fertilizers per hectare. Requirements per hectare by crops are indicated as Table 6.[7] Table 4 shows the requirement of seeds, fungicides, and plastic film by farm types. Table 5 shows the results of the requirements of herbicides and insecticides by farm types.

Support of Agricultural Machinery

The farm mechanization level of North Korea was once claimed

TABLE 7. Farm Machinery Requirement by Farm Type

Unit: ha

Farm type	Power Tiller	Tractor	Rice Trans-planter	Power sprayer	Rice Combine	Cultivator	Truck
Eco. and Env. Demo. Farm	-	2	3	2	3	-	2
Variety Demo. Farm	3	-	1	3	1	4	3
S. Hwanghae	1	-	1	1	1	-	1
S. Pyongan	1	-	-	1	-	2	1
Yanggang	1	-	-	1	-	2	1
Crop Diver. Farm		12	6	12	6	40	12
S. Hwanghae	-	4	6	4	6	-	4
S. Pyongan	-	4	-	4	-	20	4
Yanggang	-	4	-	4	-	20	4
Total	3	14	10	17	10	44	17

[7] Kwon Tae-Jin. "Situation of Fertilizer and Support Effect in North Korea." *KREI North Agricultural Trend*, Vol. 2, No. 1. Korea Rural Economic Institute. 1999.

to be more advanced than the South's level. However, machinery except for a few tractors, has not been used due to the lack of fuel. The supply of machinery should be supported in order to operate demonstration farms. Machinery such as tractors and attached machines such as power sprayers, rice combines, cultivators, and others are required.

Maintenance and Management of Facility

Maintenance and management concerning the operation of demonstration farms are related to the provision of agricultural water and equipment for water management, the maintenance of support machinery and vehicles, and the way of assuring fairness and accuracy in managing seeds, fertilizers, pesticides, vinyl and fuel. We have to establish a plan to manage the machinery effectively. Using the warehouses of existing national farms and cooperative farms is an ideal way. Machinery repair centers and technicians are an important condition for choosing a demonstration farm because this will lower project costs. Parts for repairing machinery will be initially firstly provided at the beginning of the project and it is planned to make farm management buy additional parts to save project costs. Appointment of technicians for effective management of machinery should be included in the condition of the agreement.

An additional plan for managing greenhouses has to be established. Manuals for managing automatic facilities and covering materials have to be made and special training has to be conducted. Guidelines for managing fertilizers and pesticides should be made and included in the agreement. And these guidelines should be taken into account in choosing national farms or cooperative farms.

Maintenance and management of irrigation and drainage canals should be the responsibility of chosen national or cooperative farms. Sprinkler management for dry field irrigation should be included in the maintenance and management function of the agricultural machinery.

Parts of facilities, fuel, and grease oil will initially be

provided at the beginning of the project and it is planned to make farm management buy additional parts to save project costs.

Dealing with Production and Operation Fund Provision

In order to achieve the goals of cooperative projects and help to maintain demonstration farms, equipment, agricultural machinery, seeds, fertilizers, pesticides, herbicides, and vinyl should be provided in the first year. In the second year, the level of support should be reduced and in the third year, farms can be operated without support through profits gained from selling products.

Foods should be distributed within North Korea. Agreement concerning the quantity and price of products provided to government and farmer's markets should be established. Also, except foods, other products can be sold in South Korea in order to make nest year's operational funds. With these ways, we should give the North legitimacy to transfer the market system from a socialistic to a free market system.

In particular, we have to make farms in S.Pyongan and S.Hwanghae sell their products to the South and adopt the South's cropping pattern and farming methods. And we have to pave a way to sell agricultural inputs and machinery of the South to the North. These contents should be included in the agreement.

Additional Requirements for Demonstration Farm Projects

Because demonstration farm projects should be planned to be a door or gateway for exchange, we should try to achieve this goal in the process of discussion. Current situations of soil, climate condition, cropping pattern and quantity of production, the amount of agricultural machinery, the possibility of existing farms should be taken into account. Without data accumulation, the project cannot be developed in the future. Extension worker should record everything and should report the essential data to supervising organization. Kinds of data and formats should be unified for compilation. Recording factors are farming practices, crop water requirement, crop yield, cropping intensity, cropping

pattern, corp variety.

It is important that the main finding of management and evaluation should be analyzed quickly and be released promptly. Routine monitoring should be designed to point out potential and actual bottlenecks for the projects. Results of monitoring surveys should be used for demonstration farm management to help identify and rectify problems as early as possible. Similarly, evaluation data may indicate that particular recommended practices appear to have little effect on production or income.

Ⅴ. Conclusions

The major causes of the food problem in North Korea are natural disasters, irrationality of the farming structure, the lack of inputs, and the low level of technology. Among these difficulties, causes resulting from materials and technology can be solved through cooperation. In particular, the cropping pattern centered on corn and rice destroyed the cropping rotation system. However, we cannot point out the mistakes in the North's farming methods. We have to make the North recognize its problem through experiencing the South's advanced technology. The best way may be the operation of demonstration farms run under cooperative schemes. We may not be able to gain obvious results in the short-term, but in the long run the impact will be great. Existing cases of cooperation projects with other countries have been successful.

If we take into account the North's circumstances, it is clear that we cannot implement demonstration farm projects with civilian partners. An alternative is that governments initiate demonstration farm projects and expand these to civilian based cooperation projects. Governments should support civilian-based cooperation projects through research and policy.

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