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2012 Modularization of Korea's Development Experience:

Policy for Promotion of Agricultural Mechanization and Technology Development

2013

RDA RURAL DEVELOPMENT ADMINISTRATION

Northern Agriculture Research Institute, INC

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Policy for Promotion of Agricultural Mechanization and Technology Development

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Preface

The study of Korea's economic and social transformation offers a unique opportunity to better understand the factors that drive development. Within one generation, Korea has transformed itself from a poor agrarian society to a modern industrial nation, a feat never seen before. What makes Korea's experience so unique is that its rapid economic development was relatively broad-based, meaning that the fruits of Korea's rapid growth were shared by many. The challenge of course is unlocking the secrets behind Korea's rapid and broad-based development, which can offer invaluable insights and lessons and knowledge that can be shared with the rest of the international community.

Recognizing this, the Korean Ministry of Strategy and Finance (MOSF) and the Korea Development Institute (KDI) launched the Knowledge Sharing Program (KSP) in 2004 to share Korea's development experience and to assist its developing country partners. The body of work presented in this volume is part of a greater initiative launched in 2010 to systematically research and document Korea's development experience and to deliver standardized content as case studies. The goal of this undertaking is to offer a deeper and wider understanding of Korea's development experience with the hope that Korea's past can offer lessons for developing countries in search of sustainable and broad-based development. This is a continuation of a multi-year undertaking to study and document Korea's development experience, and it builds on the 40 case studies completed in 2011. Here, we present 41 new studies that explore various development-oriented themes such as industrialization, energy, human resource development, government administration, Information and Communication Technology (ICT), agricultural development, land development, and environment.

In presenting these new studies, I would like to take this opportunity to express my gratitude to all those involved in this great undertaking. It was through their hard work and commitment that made this possible. Foremost, I would like to thank the Ministry of Strategy and Finance for their encouragement and full support of this project. I especially would like to thank the KSP Executive Committee, composed of related ministries/departments, and the various Korean research institutes, for their involvement and the invaluable role they played in bringing this project together. I would also like to thank all the former public officials and senior practitioners for lending their time, keen insights and expertise in preparation of the case studies.

Indeed, the successful completion of the case studies was made possible by the dedication of the researchers from the public sector and academia involved in conducting the studies, which I believe will go a long way in advancing knowledge on not only Korea's own development but also development in general. Lastly, I would like to express my gratitude to Professor Joon-Kyung Kim and Professor Dong-Young Kim for his stewardship of this enterprise, and to the Development Research Team for their hard work and dedication in successfully managing and completing this project.

As always, the views and opinions expressed by the authors in the body of work presented here do not necessary represent those of the KDI School of Public Policy and Management.

May 2013

Joohoon Kim

Acting President

KDI School of Public Policy and Management

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Summary

Until the 1950s, farming in Korea was carried out by using manual and animal-drawn implements such as shovel, plow, and sickle. These agricultural implements were mainly manufactured by blacksmith workshops or by small-scale factories. The quality of agricultural implements or machinery was mediocre and uneven. Moreover, the Korean War destroyed agricultural implement production facilities which were meager to start with and technicians for the agricultural implements production were also lost. Under such circumstances, the production of agricultural implements was difficult and there was a shortage of raw materials which made the quality of agricultural implements poorer than ever.

Against this backdrop, the government had to concentrate on disaster prevention measures including drought and disease control, which had significantly damaged the rice production, leading to dangers of risking stable food production. The agricultural implements and small machinery such as water pump and disease controller began being supplied.

In the early 1960s, the government placed all efforts towards economic development to realize a self-independent economy, for a nation suffering absolute poverty due to an economy that has collapsed, with around USD 80 per capita income. With successful drive of the First and the Second Five-Year Economy Development Plan, the secondary industry was developed and urbanization enhanced which increased the manpower demand in these sectors. Good, quality manpower from rural area flowed into the cities. This migration caused the labor force shortages in rural areas, with the result that even with higher wages laborers could not be secured during the peak farming seasons. Therefore, increased food production plan that was the topmost priority of the government to ensure food self-sufficiency could not be met. Agricultural mechanization was therefore strongly on the rise.

The beginning of agricultural mechanization in Korea can be said to be the early1960s when a power tiller was introduced for the first time in Korea. However, hardly 8,000 units

of power tiller were supplied until the end of 1960s. Also, those power tillers were mainly being used for the transportation of construction materials rather than being used in farm work. Farm work still relied upon manual and animal power.

Agricultural mechanization in Korea really took off when the Five-Year Agricultural Mechanization Plan was established by Presidential order during the 1970s.

In the Five-Year Agricultural Mechanization Plan, first of all, mechanization was set to be driven by small-scale agricultural machinery focusing on the power tiller intended to be used for rice cultivation considering the condition of the rural areas with small farming households. The machinery supply plan was set up according to the Five-Year Agricultural Mechanization Plan,. Principally, the agricultural machinery was to be supplied by using domestic-produced agricultural machinery as much as possible. The agricultural machinery manufacturing factories were then categorized into an assembly factory and a parts-production factory. The production factories were designated depending on the types of machinery produced.

Meanwhile, the inspection for the agricultural machinery was to be strengthened in order to supply good quality, performance, and safe agricultural machinery to the farmers. The training instructors were to be educated to give training for the agricultural machinery to the farmers who did not know the handling of such machinery. The training institute for the agricultural machinery were then established at the Agricultural Technology Extension Center (ATEC) at city·district level and training of agricultural machinery given to the farmers. The agricultural machinery manufactures were to give training to the actual users when farmers purchased agricultural machinery, to equip them with basic qualification for the driving, checking, and maintenance of the agricultural machinery.

Besides, the research and development of agricultural mechanization were to be strengthened to develop and improve agricultural machinery to be suitable to the Korean farming condition and to promote the localization by conducting adaptability test of agricultural machinery and selection suitable for Korean farming situations. At the same time, the research on mechanized working technology was strengthened to seek efficient and safe use of the agricultural machinery.

Machinery manufacturers were to install the sales network of the agricultural machinery all over the country to allow farmers to purchase the agricultural machinery easily. They were to carry out after service such as repair and parts supply, etc. In addition, to supplement the sales network of the agricultural machinery manufactures, National Agricultural Cooperative Federation (NACF) that was set up all over the country were utilized to supply the agricultural machinery to the farmers.

Meanwhile, a joint-use organization was established and intensively supplied with agricultural machinery for efficient use of the agricultural machinery. The purchasing fund for the agricultural machinery was supported and lease of agricultural machinery was started to reduce the purchasing burden of the agricultural machinery by the farmers who had weak purchasing powers and to raise the efficiency of its use. The budget required for agricultural mechanization project like supply of the agricultural machinery was realized by preparing agricultural mechanization promotion fund by introducing loan from international organization or foreign countries to subsidize the purchase fund or give loan to the farmers.

Agricultural Machinery Division was also opened in the Ministry of Agriculture and Forestry (MAF) to drive agricultural mechanization plan efficiently and systematically. This division was to handle all the projects related to agricultural mechanization. In addition, agricultural mechanization promotion law was enacted and enforced to prepare a legislative base to drive agricultural mechanization consistently and permanently under the regulations.

After promoting agricultural mechanization projects by setting up agricultural mechanization plan and smoothly integrating the relevant organizations and other sectors, complete localization of power tillers would be achieved at the end of 1970s. In 1990s, complete mechanization of major farm works in the rice cultivation would be achieved. In year 1971, the labor input hours per ha was 1,700 hours which became 928 hours in 1981 and then 162 hours in 2008. The volume of major agricultural machinery like power tillers, tractors, rice transplanters, and combines possessed by farms was also increased to 1,337,000 units, or 1.1 units per farm household. Agricultural machinery like tractors would also be exported to the USA and European countries.

The reason for the short period required in agricultural mechanization was the socio-economic demand for agricultural mechanization and financial support, as well as the strong will of the government for mechanization. Moreover, the confidence and will of the farmers about mechanized farming also attributed to agricultural mechanization. Therefore, this aims to arrange the policy drive and technology developments that were used by Korea for agricultural mechanization, to utilize it as a basic data for policy consulting and development cooperative project for developing countries. The background and the necessity for agriculture and agricultural mechanization, setting up and implementing agricultural mechanization plan, enactment of the necessary laws and regulations, production and supply, technology development and improvement, efficient and safe use, education and training, inspection and quality control, and after service for the agricultural machinery are described in detail by the different stages.

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Chapter 1

Introduction

Introduction

The success of the Five Year Economic Development Plan which started in the 1960s allowed Korea to achieve high economic growth, which triggered a rapid industrialization and urbanization. As a result, the labor demand in the non-agricultural sectors abruptly increased resulting in an inflow of rural labors into the cities. The outflow of the rural labor forces naturally brought reduction in quality as well as quantity of rural labor forces. Ultimately, wages for rural labors were increased. Therefore, during the busy farming seasons, even with higher wages, manpower for farming was difficult to secure.

As self-sufficiency of foods during the periods of spring poverty was established as a major national development policy, the necessity of agricultural mechanization for the stable increase of the rice production was on the rise. Agricultural mechanization in Korea where farming was done using manual and animal drawn implements started after distributing the power tiller in the early 1960s.

Agricultural mechanization in Korea has grown and developed faster than any other countries in the world during a span of 50 years. Agricultural mechanizationIt became a foundation stone not only for the rural areas but for the economic development in Korea. With agricultural mechanization, scientific farming could be established and this mechanization filled the gap caused by labor shortage in the rural areas due to the industrialization and urbanization quite capably. Thus, even if labor forces in rural areas reduced rapidly, agricultural mechanization would fill up the shortage of rural labor forces and farming was possible by increasing the productivity and self-sufficiency of rice which is staple food in Korea.

Agricultural mechanization in Korea was driven intensively centering on the rice cultivation, with considerations to the structural characteristics of the Korean agriculture which was mainly composed of small farms. After that, as agricultural mechanization

progressed, it was spread from rice to the up-land crops. Agricultural mechanization was upgraded from small machinery to the large and high performance machinery such as tractors, riding-type rice transplanters, and combine harvesters.

A complete mechanization for rice cultivation in Korea was achieved in 1990s. The labor input per ha in paddy rice cultivation was 1,700 hours in 1971 which was reduced to 928 hours in 1981, and 162 hours in 2008. The number of major agricultural machinery possessed by farmers including power tillers, tractors, rice transplanters and, combine harvesters also reached 1,337,000 units, an average of 1.1 units per farm household. As agricultural mechanization was successfully developed, Korea was able to export agricultural machinery like tractors to the USA and European countries.

The reason for the short period required in agricultural mechanization was due to the social demand for agricultural mechanization and the strong policy drive and financial support by the government. In addition a, the will and the desire for mechanized farming by the farmers was also a major driving force for the mechanization agricultural mechanization agricultural mechanization.

It is intended to utilize this review in the policy drive, technology development, and the contents for agricultural mechanization of Korea by systematically arranging it as a reference and basic data for the policy set up in developing countries and for development cooperation projects.

This review is constructed in five chapters. Chapter 1 is the introduction and in Chapter 2, the background and necessity of agricultural mechanization are looked into at socio-economic aspects such as changes in rural labor forces and wage increases. In Chapter 3, agricultural mechanization policy such as enactment and enforcement of Agricultural Mechanization Promotion Law is handled. In Chapter 4, agricultural mechanization projects which were driven so far by the Korean government are described by categorizing them into distribution, efficient use, education and training, testing and inspection, production and distribution and after service of agricultural machinery. In Chapter 5, the achievement and spreading effect on socio-economic aspects by agricultural machinery are described.

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Chapter 2

Background of Agricultural Mechanization

1. Socio-economic Conditions before Agricultural Mechanization
2. Reduction of Rural Labor Forces and Wage Increase

Background of Agricultural Mechanization

1. Socio-economic Conditions before Agricultural Mechanization

In 1945, Korea became independent from 36 years of Japanese colonial rule. Of total population, 80% were engaged in agriculture, and agriculture was the country's main industry at that time. After gaining independence, Korea was separated into South and North. Although a democratic government was established in the south, the government was suffering from serious social disruptions and economic difficulties. Agricultural productions were not enough to feed the country. Land was infertile. Farmers were suffering from a shortage of fertilizers and also animal-powers which were traditionally utilized in Korean farming.

To modernize agriculture and increase food production, the government conducted the land reform in May 1950, changing the production based on landowners and peasants to that by farmers on their own lands. Before the land reform, 85.5% of total number of farm households was classified as tenant farmers and the tenancy area reached to 63.3% of the total arable land. In 1964, 14 years later, it was estimated that the tenant farmers were reduced to 28.4% and the tenancy area to 15%. The land reform is seen to have contributed greatly to agricultural modernization in Korea.

Before the consequences of the government's land reform and food production policy actually appeared, the Korean War broke out in June 1950 and lasted for one month and three years. The Korean War devastated the entire Korean peninsula and caused economic and social dark ages resulting from millions of dead and wounded, and destructions of 80% of the industrial, public, and transportation facilities in the country.

Social disruptions and economic crash followed by the independence and the Korean War had made Korea one of the poorest countries in the world. There was no way but to rely on foreign aids for the recovery of national finance and disaster. In 1950s the average agricultural population was 60% of the total population, resulting in 6.1 persons and 0.9ha of arable land per farm household. According to the government's estimation, the average rice yield was 230.8kg/ha in the 1950-1954 time period. Agricultural production was done mainly by human-power and the country was afflicted with food shortage. The economic difficulty and food shortage continued in the 1960s. Although the rice yield increased to 280.3kg/ha, it was due to the land reform. Agricultural production still depended upon traditional practice using human-power and hand tools with low level of farming technology in small patches of lands. In 1950s, per capita income was estimated to be less than $100, and aroud $200 at the end of 1960s.

Agricultural machinery manufacturers in 1950s that were founded by acquisition of plants run by the Japanese before the independence produced mostly manual machines. However, many of them were destroyed during the Korean War and degraded in terms of their functions compared to before the independence. Under such circumstances, the government tried to disseminate good farming tools by conducting performance test for the tools from 1958. However, it was not very successful due to the farming industry's poor economy, feudal ideology, resistance to new practice, and low level of technology.

By the end of 1960s, socio-economic circumstances in Korea were not much different from those of other poor countries back then. The situation was not suitable to pursue agricultural mechanization. However, a military government established by the military revolution in May 1961 calmed the social turmoil and launched a series of economic development plans based on industrial developments. After the military government was transferred to the civilian government, the economic development plans were successfully succeeded and implemented. The government policies for economic development at that time laid a foundation for Korea's current economic growth. Agricultural mechanization was conducted along with successfully executed economic development, and it contributed greatly to the success of economic developments and vice versa.

Korea has demonstrated empirically that agricultural mechanization can be promoted even in the poorest countries and achieved successfully with commitment and momentum of a country's leader to national economic development.

2. Reduction of Rural Labor Forces and Wage Increase

Before 1962 when a series of 5-Year Economic Development Plans (EDPS) was first launched, Korea was one of the poorest agricultural countries in the world. In 1960, agricultural population was 14.56 million, constituting 58.3% of the total population and the number of farm households was 2.35 million, constituting 53.7% of the total households. Arable lands per farm household and per farmer were 0.87 and 0.14ha respectively. Until the early 1960s, Korean agriculture was small-scaled, labor intensive, and performed using human and animal power, thus suffering from problems such as low productivity, overpopulation and potential future unemployment. It was the successful execution of the 5-year EDPS that brought fundamental changes to this structure of agricultural productions.

The 5-year EDPS was an economic development plan executed for 35 years from 1962 to 1996 for the purpose of developing industry, increasing export, and ensuring a self-reliant economy, which resulted in achieving rapid industrialization and economic growth and changing the industrial structure of the country from a primary industry based on agricultural to an export industry based on heavy machinery and chemicals.

As this EDPS was executed successfully, people began leaving farms in rural areas from the end of 1960s. Many people wanted to move and get jobs that were newly created in the developed industrial sectors. Annual out-flow of rural people increased from 200,000 in the beginning of 1960s to 400,000 at the end of 1960s. Particularly, young people were accounted to take a large portion of those leaving farms and moving to the cities. Decreasing rural population naturally caused a shortage of labor forces and wage rise in the rural areas. Reduction of young people also caused a deterioration of labor quality. Farm wage was 106 Won per day for males in 1961. It increased to 530 Won in 1970, an increase of 5 times in 9 years while the price of rice increased by 3.4 times. However, the rice production index increased only by 10% during the same period. In other words, farm wages increased drastically when compared with other prices as shown in [Figure 2-1].

Regarding labor quality, the number of people aged more than 50 increased while thosae younger than 30 decreased. The number of woman engaged in agriculture also increased gradually with decrease in the number of man. These indicate that the rural population started aging with the number of women increasing, which led to a deterioration in quality of rural labor forces.

Leaving farms, and the out-flow of rural labor forces that started in the early 1960s caused labor shortage and quality deterioration followed by a rapid increase in farm wage. The labor shortage and quality deterioration continued even after the 1960s. Agricultural population increased to its peak of 16 million, 54.6% of the total population, in 1967 and continued to decline afterwards to 3 million, 6.4% of the total population, in 2010 as shown in [Figure

2-2]. The agricultural population decreased by 13 million over 43 years. In addition, the percentage of people older than 60 increased from 4.9% of the total agricultural population in 1965 to 42.1% in 2010 while that of female increased significantly from 38.3 to 52.5% during the same period.

Figure 2-1 | Increase in Farm Wages in 1960s

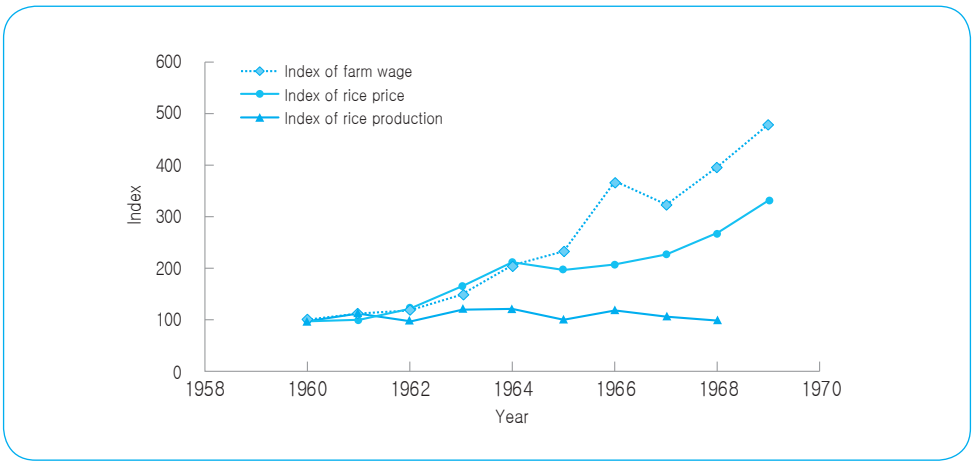
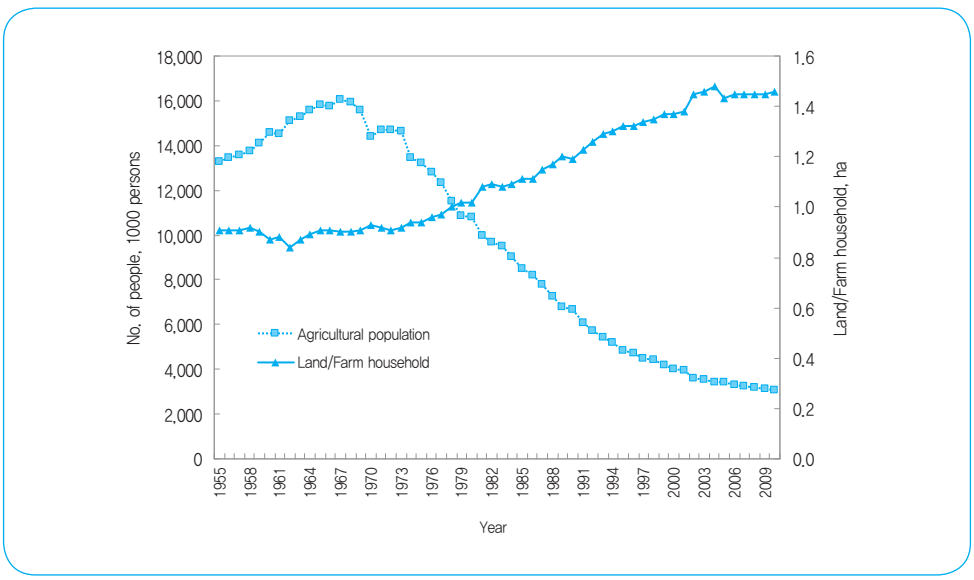


Figure 2-2 | Changes in Agricultural Population and Land Holding per Farm Household



Agricultural mechanization should be economically feasible, which could be made by labor shortage and consequent increase in farm wages as demonstrated in the case of Korea. Korea has accomplished rapid industrial development and economic growth by executing a series of 5-year EDPs successfully, creating more job opportunities in non-agricultural sectors and consequent out-migration of large labor forces from agriculture to new industries. In other words, the labor shortage and increase in farm wages has worked as a driving power for agricultural mechanization in Korea. Such rural socio-economic changes Korea made may be necessary conditions for a successful agricultural mechanization.

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Chapter 3

Establishment of Agricultural Mechanization Policy

1. Stages of Agricultural Mechanization During Different Periods
2. Agricultural Mechanization Promotion Plans

Establishment of Agricultural Mechanization Policy

1. Stages of Agricultural Mechanization During Different Periods

Before 1960s, most of the farm work was performed using manual and animal power agricultural implements. Manual agricultural implements like hoes, rake, sickles, and treadle thresher and animal power agricultural equipments like cattle-drawn plow and harrow etc., were mainly used. Though agricultural machinery like water pump and power sprayer were used to prevent yearly, repeated droughts and diseases in an extremely limited segment, it is difficult to say that agricultural mechanization by power had been started.

The actual agricultural mechanization can be regarded as having started at the beginning of 1960s when tillage operation, the primary and labor intensive work among farm works, was mechanized after distributing power tillers for the first time in Korea.

In 1960s, increase of food production was adopted as the highest priority in agricultural policy. Accordingly, disaster measurepreventation projects to reduce drought damages, diseases, pest injury, etc., that damaged grain production considerably was driven intensively. Agricultural mechanization was also intensively driven focusing on drought measure and pest and diseases control to increase food product, matching it with government's agricultural policy. The development and distribution of agricultural machinery for disaster measureprevetation such as water pump and power sprayer etc., were distributed through governmental support. Meanwhile, various kinds of tillers and tillage machines which were used in foreign countries that plow the soil deeper than the traditional cattle-drawn plow were introduced to increase the productivity of paddy rice by deep plowing and heavy dressing. These power tillers were tested for adaptability and selected according to the size and type (petroleum and six Ps) which were suitable to the Korean farming pattern.

After making the technical tie-up with Mitsubishi, a Japanese agricultural machinery manufacturer, around 30% of power tillers were domestically produced and then supplied to rural areas from 1963.

Power tillers were mainly used for transportation rather than in field operations in the initial stages of distribution. However, it would replace animal-power by being actively used, following gradual usage in farming works such as plowing, harrowing etc., With active government support, power tillers became the center of agricultural mechanization in Korea. The model and the power range of power tillers also became diversified.

Thanks to the successful drive of The Five Years Plan for Economic Development, labor flow from rural areas to the urban areas deepened, and base conditions for agricultural mechanization were met owing to rural wage increases, especially in relation to labor shortage during busy farming season. In 1971, the then-President ordered to establish agricultural mechanization driving measures to achieve domestic production of agricultural machinery as soon as possible by systemizing and actively supporting the agricultural machinery manufactory as agricultural mechanization could not be effectively supported with a marginal agricultural manufactory. By Presidential order, from 1972, the Five Years Plan for agricultural mechanization was set up and agricultural mechanization project was moved forward as a major policy in agricultural administration. Among the plans in the First Five Years Plan for agricultural mechanization, agricultural machinery distribution was planned to supply a total of 196,000 units of agricultural machinery including 38,740 units of power tillers within five years. But in 1974, with an additional KRW 30 billion loan from the National Investment Fund, 100,000 units of power tillers were additionally supplied in three years. Consequently, from 1974, power tillers and their attachments were additionally supplied to intensify agricultural mechanization effort to substitute animal power. As a result, the number of power tillers that were supplied, which were just 11,000 units in 1970, was increased to 235,000 units at the end of 1979, or by around 20 times the original amount. Additionally, power tillers waswere completely localized in 1978.

With the expanded supply of power tillers, the mechanization of plowing, harrowing, and transportation which had previously relied on animal power, was achieved and animal power substitution with agricultural mechanization was successfully implemented. Meanwhile, to ensure systematic and continuous promotion of agricultural mechanization, Agricultural Mechanization Promotion Law was enacted and promulgated at the end of 1978. Also, loan was drawn from kreditanstalt fuer wiederaufbau (*Reconstruction Credit Institute*, Germany) and Asian Development Bank to arrange the fund support for the purchasing of agricultural machinery.

In addition, as rural labor was reduced and rural wages continued to increase during 1970s, it was not possible to procure sufficient laborers even though high wage was

paid during the labor peak seasons which are rice transplanting and harvesting time. The mechanization of rice transplanting and harvest was in dire needs. Thus, adaptability test was introduced and carried out for rice transplanters and harvesting machines to select rice transplanting and harvesting machinery suitable for the Korean farming situation. Then 2 and 4-row rice transplanter and binder and combine harvester with 2 and 3-row were selected. In case of the rice transplanter, there was many difficulties with objections refusing the introduction of such machines, against new farming methods, and reduction in productivity among others. With devoted guidance and efforts made by agricultural extension officers through continuous development and distribution of mechanical rice transplanting and nursery technique and demonstration projects, rice transplanters were well settled in the rice cultivation industry which went on to become the foundation to make major farming operation in paddy rice cultivation mechanized.

With advancement of urbanization and industrialization during 1980s, the labor force leakage from rural areas to the cities became far more aggravated. The labor shortage in labor peak seasons such as rice transplanting and harvesting season became an evident problem and the demand for mechanization of rice transplanting and harvesting was increased. Ultimately, the government decided to promote the distribution of rice transplanters and harvesting machines to mechanize the rice transplanting and harvesting operation. The 2-row type and 4-row type rice transplanter, binders, and combine harvester were extensively supplied. Therefore, at the end of year 1989, around 110,000 units of rice transplanters, 50,000 units of binders, and 32,000 units of combine harvesters were supplied. Thus, the mechanization rate of both rice transplanting and harvesting became over 60%, showing consistent mechanization system in paddy cultivation from tillage to harvesting was established.

In 1990s, with the acceptance of the drying of paddy rice, mechanization rate of farm work in rice cultivation reached over 90%, achieving complete mechanization stage, although it was mainly achieved in small scale machinery. With progress of mechanization and as rural labor force become aged and women-oriented, agricultural machinery also gradually changed to high efficiency, large-scale, and riding-type machines. Meanwhile, the demand for mechanization was also increased for the upland crops which largely lacked mechanization as compared to that of paddy cultivation. Therefore, the distribution of large-scale and high efficiency agricultural machinery was promoted to move forward large scale paddy cultivation and consistent mechanization. Joint utilization groups for agricultural machinery were encouraged and after service were strengthened to achieve complete mechanization in paddy rice cultivation. Also, agricultural machinery for upland crops including cultivators, seeding machines, and vinyl mulching machines, etc., were developed and supplied in order to drive mechanization of upland crops such as upland

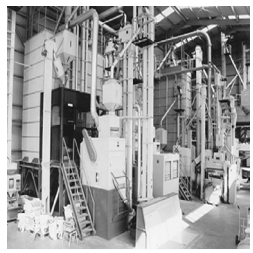
cropping, horticulture and animal husbandry etc., as full time farming scale in major production districts. Also, mechanization for controlled horticulture and post-harvest management work were promoted actively.

During 2000s, along with state of the art agricultural machinery technology like eco-friendly precision farming machinery and automation and robotization of farm work, mechanization technology development for quality differentiation and safety improvement are actively under way. Mechanization in upland crops like controlled horticulture and animal husbandry and low-cost mechanization for the paddy cultivation are being moved forward. Follow-up steps such as efficient and safety utilization of agriculture is also being strengthened.

Figure 3-1 | Agricultural Mechanization by Development Stage in Korea

	Manual, animal power	Small, medium machine	Large machine
Plow			
Leveling			
Trans planting			

	Manual, animal power	Small, medium machine	Large machine
Pumping			
Pest control			
Harvesting			
Threshing			
Drying			

	Manual, animal power	Small, medium machine	Large machine
Milling			

2. Agricultural Mechanization Promotion Plans

2.1. Basic Plan for Agricultural Mechanization

Before 1960s, most of the farm work was performed using traditional agricultural implements like manual and animal power equipments. Agricultural mechanization was also almost non-existent.

At the beginning of 1960s, the government actively implemented disaster prevention measures to reduce damage from drought, pest and diseases injury which had been big hurdles for the increase of food production. Marched with government policy, agricultural mechanization project also started driving the mechanization of drought measure and pest and disease control etc. The agricultural machinery such as water pump and power sprayer were supplied with governmental support to promote the distribution of the agricultural machinery for the disaster management. Government was active in the introduction of agricultural machinery to promote the distribution of high quality agricultural machinery and started inspecting those agricultural machinery and equipments. Also, the research and development like effective utilization and the training for agricultural machinery were conducted by setting up the NAMRI and NAMTC. However, comprehensive and systematic agricultural mechanization plan was neither prepared nor driven by then.

As the First Five Years Economic Development Plan which started from the year 1962 was successfully completed, the industrialization and urbanization were rapidly progressed. The migration of rural labor force to cities led a shortage in the labor force in the rural areas. Consequently, the demand for agricultural mechanization to resolve the shortage of labor also became sharply increased.

In the year 1971, the President said that the agricultural machinery is a product of science and technology and is the best method to develop the rural areas by expelling the superstition which was deeply rooted in the rural society and by improving the labor productivity. Thus there was no way in efficiently driving agricultural mechanization project with marginal agricultural machinery factories like present. The President then instructed that agricultural mechanization drive plan should be established by systemization of agricultural machinery factory to achieve the localization of agricultural machinery at the earlier stage. According to the instruction from the President, The first agricultural mechanization plan was set up to drive agricultural mechanization from the year 1972 to the year 1976. After that, agricultural mechanization was made to be planned and driven for every five years.

Since agricultural mechanization is not a project which can be achieved in a short period, during agricultural mechanization plan set up, a professional implementation unit was organized. First, investigation and analysis were performed for the cultivation area and production by crops, labor input per farm household, and status of agricultural machinery supply and working areas etc., and the mid-to long-term basic direction were prepared to decide which crops and which farm works should be mechanized, whether required agricultural machinery should be locally made products or not, and how to supply the agricultural machinery. According to the basic plan, the demand for agricultural machinery was estimated with considerations to the subjected area, required agricultural machinery, and arable land area under burden per machine. After that, yearly supply plan for agricultural machinery was made by reviewing and analyzing the budget which could be invested to supply the agricultural machinery.

The basic plan of the First Five Year Plan of Agricultural Mechanization was to promote agricultural mechanization focusing on paddy rice cultivation centering around power tillers. The project was driven by focusing on small-scale power tillers and power sprayer for marginal farmers in the sand loam areas, while medium to large-power tillers were supplied for the heavy clay soil area. The direction of the basic plan for agricultural mechanization was a very reasonable decision suiting the agricultural infrastructure in Korea which has small marginal farming structure centering around rice cultivation. Besides, though there were opinions for systemization of agricultural machinery manufacturers and some foreign agricultural machinery to be imported, principally domestic agricultural machinery and its attachments were supplied to promote the domestic agricultural machinery industries. Also, long-term low interest loans were granted to the manufacturers and farmers who were the actual customers to promote the supply of agricultural machinery. The budget required for driving agricultural mechanization plan was arranged from the government budget, loan from international organization and foreign countries by establishing agricultural mechanization promotion fund.

Meanwhile, the agricultural machinery manufacturing factories were categorized into assembly manufactories and parts production manufactories for the production of high quality agricultural machinery. The assembly manufactories were again categorized into an engines assembly manufactory and a main body assembly manufactory and then those manufactories were intensively developed. The expertise production manufactory was assigned as per the kinds of agricultural machinery produced but the number was limited to two companies considering the production capacity and the number of agricultural machinery produced. Meanwhile parts production manufactories and specialized manufacturers were assigned and systemized without categorizing them by kinds of machinery. Development and production of parts were supported by funding the mechanical industries development fund. Assigning the specialized production manufactory prevented unlicensed production manufactories and excessive competition, which contributed to the stable management of agricultural machinery manufacturers and quality improvement of the agricultural machinery and parts by promoting the production volume increases in agricultural machinery. However, it made market entry for other agricultural machinery manufactories difficult; therefore competitiveness, especially external competitiveness, could not be secured.

Meanwhile, the inspection of the parts to certify their quality was executed by the Research Institute for Industry under the Ministry of Commerce, whereas the inspection of the produced agricultural machinery was carried out by NAMII, the MAF.

The detailed agricultural mechanization plan included mechanization of land preparation for 450,000ha at the end of 1976 by supplying 38,000 units of power tillers, 13,000 units of power sprayers, 84,000 units of power mist & dusters to shorten the one time pest control within five days, 23,000 units of water pumps renewed for drought measurepreventation, and 26,000 sets of automatic threshing machines supplied to achieve 20% mechanization for the threshing operation. Also, as attachments for power tillers, 1,940 units of seeding machines, rice straw cutters, and lime spreader, respectively, were included. Also, 3,900 sets of cultivating and weeding machinery were supplied to raise the availability of the power tillers and to promote the mechanization of the cultivation and management works.

The purchasing fund for the agricultural machinery was supported as loan amounting to 70% of the machine's price with five-year equal installment repayment for power tillers, power sprayers, and water pumps. For other agricultural machinery, 50% of the machine's price was supported by loan with two to three-year equal installment repayment. The interest rate of the loans for the agricultural machinery was set as nine percent per annum.

For the First Five Years Plan of Agricultural Mechanization, it was planned to drive agricultural mechanization focusing on the medium to large scale power tillers (8-10pc) and small size power tillers (6ps). However, although the price of small power tillers were

low, traction power was small compared to that of medium to large sized power tillers and working efficiency was inferior, and even consumers of small size power tiller preferred the medium to large size power tillers. Therefore, the supply plan was changed to supply medium to large sized power tillers. During the initial stages of agricultural mechanization, attachments for power tiller were not actively used, thus the demand for seeding machines, rice straw cutters, and lime spreader, all attachments of a power tiller, was poor.

Meanwhile, it was decided to organize an Agricultural Mechanization Driving Committee at county level to supply agricultural machinery efficiently. Also, in order to increase the utilization rate of agricultural machinery, agricultural machinery were supplied to the NACF, farming associations, local autonomous bodies, and commercial farmers on a priority basis for actual users. The machinery were primarily distributed in the order of the project areas which were supported by joint use area and mechanization demonstration area, major cultivation district for paddy rice, agricultural modernization promotion and agricultural income increases project areas, and project area support by local governmental body and normal farms.

However, in the year 1973, by supporting the national invest fund amount, KRW 30 billion was added to the project and 100,000 units of power tiller were additionally supplied for three years from 1974. Also, mechanization of plowing, harrowing, and threshing in the rice cultivation was enhanced. Besides, the basic agricultural mechanization plan was supplemented as tractors were supplied to large-scale rice cultivation areas and animal husbandry areas, the supply of agricultural machinery was made through the National Agricultural Cooperative Federation, and production support was made to the agricultural machinery manufacturers.

As the agricultural mechanization drive plan waswas prepared, agricultural machinery division was newly established in the MAF to drive agricultural mechanization project effectively and the new agricultural machinery division took all the related projects with agricultural mechanization, thus agricultural mechanization project could secure the driving force and could maintain the consistency.

The acceleration of the leakage of labor force from the rural areas created labor shortages during rice transplanting and harvesting seasons. The mechanization in the rice transplanting and harvesting operation became on the rise as the most urgent task.

Therefore, government prepared the Second Five Years Plan of Agricultural Mechanization from the year 1977. The basic direction of the Second Agricultural Mechanization Plan was ① to resolve the labor peak by supplying rice transplanters and harvesting machinery and establish a consistent mechanization rice cultivation system, ② to promote mechanization by supplying various kinds of agricultural machinery focusing on the power tillers in large

quantities, ③ to enhance the distribution of the agricultural machinery with a planned support system by securing stable agricultural machinery supplying fund, ④ to prepare the systematic device for the quality control, development of new agricultural machinery and after service system like safety measure etc., by enacting agricultural mechanization promotion law, ⑤ to research and develop the agricultural machinery which is suitable to farming condition system by establishing agricultural mechanization research institute, and convert the production of agricultural machinery into free competition, ⑥ to raise the availability of agricultural machinery by strengthening the after service and education and training for agricultural machinery, ⑦ to promote the joint use of agricultural machinery by establishing the demonstration farm for agricultural mechanization.

According to this basic plan, the Agricultural Mechanization Promotion Law with primary direction of setting up the agricultural mechanization plan, arrangement of fund for agricultural mechanization promotion, enhancement of systemization of agricultural machinery inspection and joint use, establishment of after service system, and systemization of safety management was enacted. At the end of 1979, the IAEU under the RDA was reorganized as the NAMRI in order to carry out devoted research and development for agricultural mechanization. The reorganization of IAEU to NAMRI was helpful in driving agricultural mechanization. However, the fact that either some of the research function as agricultural engineering, rural energy, and utilization of agricultural products including water management which were the original functions of IAEU were abolished or became nominal could not be regarded as a good measure. The existing research functions should have been maintained and developed through which the functions of agricultural mechanization research could have been expanded. Therefore, it is quite regretful that those functions are only now being magnified these days.

Also, demonstration farm district for rice transplanting and harvesting mechanization was built in order to promote the rice transplanting and harvesting. In the year 1977, the basic plan for agricultural production industries development was set up and executed.

With agricultural machinery diversified and the supply volume increased, there were concerns about benefits enjoyed by the two machinery manufacturers which were originally granted to produce one machinery. Under this development, farm engines, power tillers, rice transplanters, binders, and combine harvesters were categorized as large industry type agricultural machinery, and power sprayers, water pumps, threshing machines, and dryers were categorized as small industry type agricultural machinery. The manufacturers of large industry type machinery were the ones who had engine production capabilities and were designated only after producing more than one type of large industry type agricultural machinery, equipped with facilities, manpower, and after service system of more than specified level and passed the quality and performance inspection standard. On

the other hand, a small and medium industry type agricultural machinery manufacturers were designated only when they produced small and medium type agricultural machinery with a ratio of more than 50% in their company, equipped with facilities, manpower, and after service system higher than specified level, and pass the quality and performance inspection standard. This system managed to calm the concerns to some extent. At the same time, it protected the agricultural machinery industry and restricted excessive invest on the facilities. However, some of problems were also raised that free competition became difficult as the agricultural machinery produced by the designated manufacturers were supplied on a priority basis and had benefit of production fund support etc. Besides, the new entry into market by new agricultural manufacturer became difficult. Also, the production and supply of the agricultural machinery focusing the domestic market made international competitiveness of these machinery weakened.

Meanwhile, the agricultural machinery which used to be supplied by the national agricultural cooperative federations in county level were allowed to be supplied by the local agricultural cooperative federations at eup·myeon unit too which made purchasing of agricultural machinery easier. In particular, the repair centers at county level for the agricultural machinery like rice transplanters and combine harvesters which were used in short periods were expanded to myeon unit (subdivision of county) to make the repair process smooth. The fund for driving agricultural mechanization plan like agricultural machines purchasing fund etc., were met by drawing the loan from *Reconstruction Credit Institute* (Kreditanstalt fuer Wierderaufbau; KFW) and ADB, etc.

With successful drive of the First and Second Agricultural Mechanization Plan, the effect of agricultural mechanization like relaxation of labor peak during rice transplanting and harvesting season became visible. However, due to abrupt decreases in the rural population, agricultural mechanization was made to be driven continuously as a major agricultural policy.

The Third Agricultural Mechanization Plan was established in 1982 with the objectives of full mechanization in the plain paddy fields until the year 1987 and 50% of mechanization in the hilly/mountainous area. Complete mechanization in the rice cultivation was subjected to land preparation, rice transplanting, harvesting and drying work. Land preparations like plowing were planned to be mechanized as 72% of subjected area with power tiller and 28% of subjected area by farm tractor while harvesting was planned to be mechanized as 80% of subjected area with binders, the rest would be mechanized with combine harvester. By considering the small scale and marginal farming system in Korea, mechanization of harvesting was also driven by focusing on the binder. However, it was quickly converted into trends of preferring combine harvester because of the working performance and problem of string for binding. Besides, the supply system of agricultural machinery was

from two channels as National Agricultural Cooperative Federation and private sector. The tax for petroleum used in the agricultural machinery was exempted to reduce the burden on the utilization of agricultural machinery from the year 1986.

In the Fourth Agricultural Mechanization Plan, new policies like mechanization of upland crops, autonomy of agricultural machinery price and distribution, and promotion of secondhand agricultural machinery distribution were planned. First of all, in order to raise the mechanization rate of rice cultivation which was just 50%, over 690,000 units of agricultural machinery including 300,000 units of power tillers, 30,000 units of farm tractors, 98,000 units of rice transplanters, 54,000 unit of binders, 30,000 units of combine harvesters, and 16,000 units of grain dryers were to be supplied. The number of mechanized farming groups was to be expanded to 40,000 places with more than one place in a village to promote the joint use of agricultural machinery. Also the 8,000 units of cultivators were planned to be supplied with 20% of government subsidy to promote the mechanization of the upland crops whose mechanization was poor.

Meanwhile, the value added tax of 10% on machine price was exempted for agricultural machinery to reduce the burden on the purchasing of agricultural machinery by farmer. The price of agricultural machinery which was regulated by the government was made to be self-regulated by the market principle. At the same time, the factors that restricted the competition for the inspection, after service, and supply system was sorted out in order to increase the competition of the agricultural machinery industry. The restriction in the import of the agricultural machinery was also relaxed to expand the competition system.

After the year 1990, with unavoidable domestic market opening for the agricultural products to the international market, re-structuring of the agricultural structure became an urgent task in order to increase the international competitive power. Agricultural mechanization and the modernization of facilities in the agriculture and fisheries were decided to drive as a part of the efforts to re-structuring the agricultural and fisheries structural improvement. Therefore, an agricultural mechanization plan was made in 1992. The basic direction of the plan included large-scale integrated mechanization by increasing the scale in rice cultivation so that 100% of mechanization until the end of 1996 could be driven, the mechanization of vegetables, fruits, and animal husbandry, the modernization of the facilities of full-time farming scale which can be managed as family unit, the promotion of mechanization of post-harvest management to improve the product qualification of agricultural products, the efficient supply of the agricultural machinery, and improvement of utilization and after service function. The detailed plan for each crop is as follows.

The mechanization of rice cultivation was planned with objectives of mechanization of one million ha among the rice cultivation areas. For that land preparation like plowing, rice transplanting, pest control, and harvesting were planned to be 100% mechanized.

Integrated mechanization and labor saving system by medium and large scale agricultural machinery were to be established by categorizing the machine utilization group into the full-time farming, mechanized farming group, and entrust farming firms, and post-harvest management system for drying, washing, grading, storage, and packaging operation were made to be established.

For fruit cultivation, integrated mechanization was driven focusing on the full-time farmers with 1~1.5ha scale which can be managed by family labor. The mechanization was planned for 30,000ha of fruit cultivation area. The open-field vegetable and industrial crop would be driven by making the group centered around major production districts. Integrated mechanization was planned from sowing to harvesting and post-harvesting process planned by deciding the scale as 5~10ha. Joint nursery station was installed for labor saving mechanization for nursery and transplanting of upland crop like vegetable. Furthermore, controlled agriculture was planned to foster capital-intensive agriculture for the items which were suitable for the controlled agriculture like vegetables, fruits, flowers, and mushroom. The scale was decided which can be managed by family labor (0.3~1.0ha for vegetables, fruits, and flowers, 33~66m^2 for mushroom). The facilities structures were categorized into glass, pet, and vinyl house. The modernization and automation of controlled facility was driven. Meanwhile, animal husbandry was driven with dairy farms having number of cows 30~40, cattle for fattening up 50 in number, pig farm of 500~1,000 pigs, and poultry with 20,000~30,000 chickens. And 10~20 farm households were to be grouped to mechanize and automate. The mechanized roughage production complexes of scale 50ha were also constructed.

2.2. Enactment of Agricultural Mechanization Promotion Law

With remarkable success of agricultural mechanization which waswas driven to resolve the labor shortage following the outflow of the rural population to the cities that was generated by success of five years plan for the economic development that started from 1960s, the necessity of sustained, stable, and systematic agricultural mechanization was raised to counteract the labor shortage in the rural area and to improve the agricultural productivity. Therefore, the Agricultural Mechanization Promotion Law was enacted to prepare systematic device based on the law for the production and distribution of high quality agricultural machinery, efficient use of supplied agricultural machinery, set up and execution of agricultural mechanization basic plan, arrangement of agricultural mechanization fund, and quality control of the agricultural machinery. The Agricultural Mechanization Promotion Law was enacted after organizing the enactment teams of experts from various sectors. After reviewing the rules and regulations that were exercised in Japan

and Italy, the Agricultural Mechanization Promotion Law suitable for our farming situation was prepared. This Law was enacted and promulgated as legislation no. 3120 in December, 1978.

2.2.1. Basic Direction of the Agricultural Mechanization Promotion Law

The Agricultural Mechanization Promotion Law specifies the definition of agricultural machinery, fund support, setting up agricultural mechanization plan, arrangement of the fund, notification of distributing, supply and price adjustment, joint use, inspection, after service, and safety management of the agricultural machinery. The Agricultural Mechanization Promotion Law is constructed with 24 clauses and annexures. The main contents of Agricultural Mechanization Promotion Law are as follows.

First, the government should set up the basic plan for agricultural mechanization to disseminate agricultural mechanization policy to the farmers in detail and should notify of the plan. Second, the government should notify the high quality agricultural machinery suitable for the drive agricultural mechanization as supply machinery, and should enable farmers to purchase desired machines with adequate price by supply and price adjustment. Third, the government should arrange the fund for promotion of agricultural mechanization and support the purchasing and production fund for agricultural machinery to farmers and manufacturer respectively. Fourth, supplied agricultural machinery should get the performance test and quality inspection by government inspection institute before supply and if manufacturer or sales agencies supply the agricultural machinery without inspection, penalty is imposed so that farmer should not suffer damages by purchasing defective agricultural machinery. Fifth, the government should install and operate the agricultural machinery demonstration farm or joint use organizations to raise the utilization rate of agricultural machinery. Sixth, the agricultural machinery manufacturer or sales agencies who manufacture or distribute the agricultural machinery should be equipped with mandatory after sales facilities to make the after sales service operated smooth. Apart from this, it was instructed to the agricultural machinery manufacturers to fix the safety device. The persons who wish to drive the agricultural machinery which are designated by President's order should get the license from the Minister of the MAFF and the machinery should be registered by city or county governors. However, the enforcement condition of driving license and registration system of agricultural machinery was not mature and with public opinion that in case of the agricultural machinery, the chance of accident was less and regulation aspect was strong, the driving license and registration were ultimately not enforced.

In December, 1979, the president order of Agricultural Mechanization Promotion Law (President Order no. 9662) and in February, 1980, the Enforcement Rules (the Ministry of Agriculture and Forestry Ordinance no. 784) were enacted and promulgated. In the enforcement ordinance, the operation of agricultural mechanization fund was regulated. In this enforcement rule, the item about accounting process of the fund, inspection of the agricultural machinery, and after service system is specified. Though the enforcement base for driving and registration of agricultural machinery were regulated in the law, the detail was not specified in the enforcement rule, thus, these two regulations were not practically exercised.

2.2.2. Summary of Agricultural Mechanization Promotion Law

o Clause 1 (Purpose)

It has the objective of improving the agricultural productivity and attributing the modernization of rural area by promoting the agricultural machinery distribution and by seeking the efficient utilization of the agricultural machinery.

o Clause 2 (Definition of agricultural machinery)

Agricultural machinery refer to the machines, equipment, and its attachment required for the efficient execution of the plowing, harrowing, sowing, transplanting, irrigation, fertilization and management, pest control, harvesting, processing, feeding and management of livestock, and other farming works. Agricultural mechanization project is the project which seeks the improvement of agricultural structure by sophistication of agricultural production technique through the production, distribution, utilization, education, training, after service, safety control, research and development of the agricultural machinery.

o Clause 3 (Duties of agricultural mechanization promotion)

The Government and local autonomous body should promote agricultural mechanization by providing the policies necessary for the distribution of agricultural machinery, joint utilization, research and development, after service, training, and technical guide.

o Clause 4 (Fund support))

The Government should support either whole or part of the purchasing and production expenses for the persons who wish to purchase the agricultural machinery, install the related facility, and who wish to manufacture the agricultural machinery which were notified as supply machinery.

o Clause 5 (Basic plan for agricultural mechanization))

The Minister of Ministry of Agriculture, Forestry, and Fisheries (MAFF) should notify the basic agricultural mechanization plan and should specify the items required for agricultural

mechanization promotion such as supply of the agricultural machinery, promotion of utilization, training, after service, research & development, inspection, safety management, and fund support for the promotion of agricultural mechanization.

o Clause 6 (Enforcement plan)

The Minister of MAFF should prepare the enforcement plan on a yearly basis for the execution of agricultural mechanization basic plan.

o Clause 7 (Notification of the supply machinery)

The Minister of MAFF should notify the agricultural machinery required for agricultural mechanization promotion as the supply machines.

o Clause 8 (Fund)

Government should facilitate the promotion fund for agricultural mechanization to secure the necessary resources for agricultural mechanization.

o Clause 9 (Arrangement of the fund)

Promotion fund for agricultural mechanization should be arranged by government contribution, loan from the foreign countries, contributions from the individual and units, and profit generated by operating the fund.

o Clause 10 (Operation and management of fund)

The promotion fund for agricultural mechanization should be used in the purchasing and production, research & development and survey, training and after service of the agricultural machinery, and the projects which are acknowledged as necessary by the minister of the MAFF. The fund shall be managed by the minister of MAFF.

o Clause 11 (Supply adjustment)

The minister of MAFF should instruct the necessary items in case the supply adjustment of the agricultural machinery is required due to urgent situation such as disaster prevent measures etc., about production plan per agricultural machinery, supply volume per different area, sales agents per different kinds of machinery, and disaster measure drive to the manufacturers or sales agents.

o Clause 12 (Price adjustment)

The minister of MAFF should adjust the maximum price of the agricultural machinery as per the Clause 2, Price stabilization and Fair Trade Law whenever necessary for the smooth supply the agricultural machinery.

o Clause 13 (Joint use)

Government should support the fund required for the purchasing, installation of the accessory facility and management of the agricultural machinery to the project executor of the joint project when the joint utilization and availability improvement of the agricultural machinery are required.

o Clause 14 (Inspection of the agricultural machinery)

The manufacturer and importer of the existing agricultural machinery should necessarily get the inspection for the supply agricultural machinery manufactured or imported and the items about the kinds of the inspection, inspection method and standard, and keeping and handling the inspection samples should be decided by the order from the minister of MAFF.

o Clause 15 (After service)

The person who manufacture and sell the supply agricultural machinery should be equipped with after service system as specified by the order, the MAFF. The persons engaged in the after service of the agricultural machinery shall be equipped with the qualification and facilities specified by the order, the MAFF.

o Clause 16 (Safety management)

The minister of MAFF could instruct to the manufacturers to fix the safety device on the agricultural machinery whenever required for the safety management for the agricultural machinery.

o Clause 17 (License)

The person who desires to drive the agricultural machinery specified by the order, the President shall get the required license.

o Clause 18(Registration of the agricultural machinery)

The person possesses the agricultural machinery specified in the category 17 of this Law should register the said machinery to the head of local autonomous body.

o Clause 19 (Entrust of agricultural mechanization project)

The minister of MAFF can entrust the part of agricultural mechanization project to the agricultural cooperative federation and corporations or entities that were established to promote agricultural mechanization.

o Clause 20 (Empowerment)

The minister of MAFF can empower the part of authority to the governors of province, Administrator of RDA director and director of NAMII.

o Clause 21 (Punishment)

The manufacturer and importer who supply the agricultural machinery without inspection should be imprisoned for less than one year or penalty of less than KRW one million.

o Clause 22 (Penalty)

The person who operates the respective agricultural machinery without license by clause 17 of this Law and the person who did not register the respective machinery by clause 18 of this Law shall be imposed penalty.

o Clause 23 (Penalty against employer and employee)

If the representative of corporate, attorney of individual, users, and other employee are punished as per the Clause 21 or Clause 22 of this Law, the corporate or individual also can be punished other than the punishment for that act.

o Clause 24 (Enforcement ordinance)

The items which are required for the exercise of agricultural mechanization Promotion Law shall be specified by the President Order.

2.2.3. The Major Contents of Enforcement Rule of Agricultural Mechanization Promotion Law

o Clause 1 (Purpose)

The purpose is to specify the items required to be regulated in the Agricultural mechanization Promotion Law and Enforcement Ordinance.

o Clause 2 (Accounting of the fund)

The promotion fund for agricultural mechanization should be processed separately from other accounts unless specifically required. The accounting of the revenue and expenditure of the fund should be handled as a business accounting type.

o Clause 3 (Collection of fund)

When the fund is collected, notice for the payment should be issued to the payer.

o Clause 4 (Kind, standard, and method of the inspection)

The inspection of the agricultural machinery is categorized as model inspection, pre inspection, and post inspection. The model inspection refers to the inspection of structure, performance and easiness of operation. The pre inspection is to check before supplying if structure and performance are the same as the result of model inspection for the agricultural machinery which have been passed the model inspection. And the post inspection is the

inspection to test the machinery if the performance of the manufactured and shipped machinery which have been passed model inspection is in conformity with the type inspection standard. The inspection standard and method should be specified and notified by the Director of NAMII.

o Clause 5 (Application for the inspection)

The person who wishes to get model inspection for his agricultural machinery should submit the agricultural machinery sample for testing along with the model inspection application to the director of NAMII. Also, drawing and materials specifications of the key parts domestically produced, good's purchase confirmation (in case the machinery was assembled by using foreign parts), characteristics review sheet, and test result for performance etc., have to be attached. The person who wishes to get the pre inspection for his agricultural machinery should submit the application.

o Clause 6 (Submission of the data)

Director of the NAMII may require submission of sample, testing materials, testing machine & equipment for the inspection, testing report from the accredited testing institute and provision of the testing field and inspection venue to the applicant for the inspection of his agricultural machinery.

o Clause 7 (Processing of the inspection results)

When model inspection is executed, its pass or reject should be judged and the inspection reports should be issued to the applicant. The validity period of the model inspection result is for three years. For agricultural machinery which passed the pre inspection, inspection completion certificate should be attached on the machinery. When post inspection is executed, the result should be notified to the manufacturer or importer of the respective agricultural machinery within 30 days of the inspection execution date.

o Clause 8 (Application for the objection)

The person who has objections about the inspection result can raise objection within 15 days of inspection result declaration. The inspection objection should be processed within 30 days of receiving the said application.

o Clause 9 (Exemption of the inspection)

The inspection can be exempted for the imported agricultural machinery for the items passed from the inspection by governmental institute or inspection from the accredited institute. The person who wishes to be exempted the model inspection for the imported agricultural machinery shall submit the copies of the inspection result report.

o Clause 10 (Inspection for the changes)

In case a part of the machine's shape is changed or modified for the improvement of performance etc., for an agricultural machinery that has passed the model inspection, the model inspection for the changed part can be executed.

o Clause 11 (self inspection)

In case the agricultural manufacturer or importer carries out the self pre inspection for the manufactured or imported agricultural machinery which have passed the model inspection as per the standard and method notified by the director of the NAMII, the self pre inspection can be substituted with the pre inspection. When self pre inspection is desired, the self pre inspection plan should be submitted to the director of NAMII before five days of inspection execution. After self pre inspection, the results of self inspection should be submitted to the director of NAMII before seventh day of succeeding month.

o Clause 12 (Inspection certificate)

During the outgoing of the agricultural machinery which has been passed the model inspection, model inspection certificate should be attached only on the agricultural machinery which have passed pre inspection or self inspection.

o Clause 13 (Declaration of model name change)

If the model name of the agricultural machinery which passed the model inspection is disired to change, the proof should be submitted to the director of NAMII to declare the changes in the said machinery.

o Clause 14 (Cancellation of the inspection pass result)

In case agricultural machinery passed the inspection through illegal means, rejected model during the post inspection, and supplied without pre inspection or self inspection, the director of NAMII can prohibit the supplying of the respective agricultural machinery and he can give instruction to supplement or cancel the pass judgment of the agricultural machinery.

o Clause 15 (Keeping and handling the sample)

The agricultural machinery sample which has passed the model inspection should be kept for the period of one year from the issue date of inspection. The sample which was rejected from the model inspection should be kept for 20 days from the date of the result declaration. The kept sample may be displayed and shall be returned to the applicant within 15 days of the expiry of the keeping duration.

o Clause 16 (Identification card of inspector)

The form of the identification card of agricultural machinery inspector was specified.

o Clause 17 (After service system)

The manufacturer or sales agency of the supply agricultural machinery should install the repair centers and agencies which are engaged in the sales arrangement and repair of agricultural machinery and the parts in the county level as specified by the minister of MAFF. Whereas, at myeon level, the repair center which is engaged in the arrangement and repair the agricultural machinery and the parts thereof should be established.

o Clause 18 (Qualification and standard of after service technician)

The person who is engaged in the after service of the agricultural machinery shall have below qualification or the agricultural machinery should be repaired by a person having the qualification as below.

- The agency of agricultural machinery should be run by a person who has obtained the qualification of assistant craftsman or higher than the equivalent in the machinery field or by a person having more than five years of experience in the agricultural machinery repair and maintenance field.
- The agency of agricultural machinery should be run by a person who has obtained the qualification of assistant craftsman or higher or the equivalent in the machines field or by a person having more than three years of experience in the agricultural maintenance and repair fields.

Table 3-1 | Facility Standard for Agricultural Machinery Repair Service Provider

<table>
<tr><th rowspan="2"></th><th colspan="2">Agricultural machinery agency</th><th rowspan="2">Farming machinery repair center</th></tr>
<tr><th>Category A</th><th>Category B</th></tr>
<tr><td>1. Workshop</td><td></td><td></td><td rowspan="4">More than 25m^2</td></tr>
<tr><td>A. Indoor</td><td>More than 30m^2</td><td>More than 150m^2</td></tr>
<tr><td>B. Outdoor</td><td>More than 60m^2</td><td>More than 30m^2</td></tr>
<tr><td>C. Indoor and outdoor</td><td></td><td></td></tr>
<tr><td>2. Mobile equipments</td><td rowspan="4">More than one number</td><td rowspan="4">More than one number</td><td rowspan="4">More than one number</td></tr>
<tr><td>A. Car</td></tr>
<tr><td>B. Motorcycle</td></tr>
<tr><td>C. Bicycle or motorcycle</td></tr>
</table>

	Agricultural machinery agency		Farming machinery repair center
	Category A	Category B	
3. Repair equipments			
A. Essential equipment	All essential equipment should be equipped	All essential equipment should be equipped	All the essential equipments should be equipped
A. General equipments	General equipments more than 15 types should be equipped	General equipments more than 10 types should be equipped	General equipments of more than 5 types should be equipped
A .Parts possession	More than KRW 5,000,000	More than KRW 3,000,000	More than KRW 500,000

※ o Essential tools (22 types)

compass, vernier calipers, monkey spanners, double ended spanners, L-type wrench, socket wrench, Pulley puller, + and – screw drivers, shock drivers, Pliers, plastic hammer, files, tap dies sets, hacksaws, electric soldering irons, tin scissors, grease guns, extractor, ripper, parts rack, tool boxes, vise, cramp

o General tools (19 types)

compression gauge, vacuum gauge, Nozzle tester, valve seat cutters, valve seat grinder, piston ring assembly machine, cylinder gauge, cylinder liner dismantle tools, injection pump tester, dial gauge, volts & ampere meter, ignition plug tester, tachometer, torque wrench, micrometer, chain block, drill, grinder, welding machine

Source: Korean Society for Agricultural Machinery, "Agricultural Machinery Yearbook"

2.3. Establishment of Agricultural Mechanization Drive Organization

Basic plan for agricultural mechanization was set up to achieve self-sufficiency of staple food crops by counteracting the shortage of labor force and wages hike in the rural area. To promote this mechanization plan efficiently, Agricultural Machinery Division in the MAFF was established in the year 1973. This division handled all the work related with agricultural mechanization to drive agricultural mechanization projects consistently. Besides, to supply high quality agricultural machinery, the inspection function of the NAMII that was been established in 1966 was changed from agricultural implements to agricultural machinery. The expert inspection manpower and equipment were then secured to improve the testing and evaluation capability. Agricultural Machinery Training Stations at city and district were expanded and re-organized in the year 1972. The Agricultural Machinery Training Center were established under the RDA. By conducting intensive training about the operation, handling, and checking and maintenance of the agricultural machinery, this Agricultural Machinery Training Centers greatly attributed in the promotion and efficient use of

agricultural machinery by linking with agricultural machinery training organizations at central and provincial level.

Meanwhile, the Institute of Agricultural Engineering and Utilization, a RDA was re-organized as the NAMRI to make it as a devoted research and development organization. The agricultural machinery was developed and improved to support agricultural mechanization policies of the government. Agricultural Machinery Division was also installed in universities and agricultural high schools to foster senior agricultural machinery expert at the end of 1970s.

Agricultural mechanization in Korea could be achieved in a short period by establishing the organization to drive the basic plan of agricultural mechanization efficiently and by making those organizations carry out the duty and the function with responsibility by organically linking each other.

2012 Modularization of Korea's Development Experience
Policy for Promotion of Agricultural Mechanization
and Technology Development

Chapter 4

Promotion of Agricultural Mechanization by Areas

Promotion of Agricultural Mechanization by Areas

1. Support System for the Distribution of the Agricultural Machinery

The distribution of the agricultural machinery is affected by the socio-economic condition, policy of the government and the will of the farmers for agricultural mechanization. The shortage of labor force in rural area and wage hike of rural labors eventually raised the necessity of agricultural mechanization and calls for the supply of agricultural machinery. However, for the farmers who actually purchased the agricultural machinery would have economic surplus enough to purchase the agricultural machinery, economic feasibility by purchasing and utilization of agricultural machinery, and the capability and the will to handle the agricultural machinery. Especially, if purchasing power of the agricultural machinery is weak due to a lack in the economic condition with small farm structure, the finance support by government policy becomes an important factor in the supply of the agricultural machinery.

With success of the Five-Year Economic Development Plan, the secondary and tertiary industries flourished and the demand of manpower for these sectors increased, surplus manpower from the rural area started inflow into the cities. The good quality labor force from the rural area continuously flew into the secondary and tertiary industries which paid the higher wages and had good labor productivity. As a result, it caused the labor shortages in rural areas. During the busy farming seasons, even with higher wages labor force could not be easily secured, and in the rice transplanting and harvesting time, support from the army, students, and government employees became essential. As these socio-economic conditions changed, the necessity of agricultural mechanization was raised in the rural areas where farming was executed by manual and animal drawn equipments. As power tillers were

distributed in the beginning of 1960s, agricultural mechanization was started. Since then, agricultural mechanization was rapidly progressed to achieve a complete mechanization for the major farming works in rice cultivation in 1990s.

The reason why agricultural mechanization became progressed so rapidly under the condition where farmers cannot purchase the agricultural machinery, like in Korea with the small-scale farm households was due to the strong will of the government for agricultural mechanization and continuous financial support by government funding. Overall investments and efforts were continued for the research and development, education and training, production and supply, inspection and quality control, and after service of the agricultural machinery to promote agricultural mechanization. Especially, distribution of the agricultural machinery could be enhanced through the government supporting the farmers that were lacking in the purchasing power for the agricultural machinery through the government assistance, finance with low interest and various tax benefits like exemption of the value added tax for the purchasing of the agricultural machinery. The supporting fund for the purchasing of agricultural machinery was covered by setting up agricultural mechanization promotion funds by introducing government budget, loans from the foreign countries and international finance organizations.

1.1. Support Planning for the Distribution of Agricultural Machinery

Until the year 1950 when the Korean Civil War broke out, farming was executed by using manual implements like shovel, rake, sickle etc., and using animal drawn implements like plow and harrows. Most agricultural implements were made in the blacksmith's workshop and some of them were made from small scale factories. However, the quality of the agricultural implements was not uniform and the quality concept for the agricultural implements too was not properly set up. The Korean Civil War destroyed the agricultural implements production facilities which were few to begin with and the technicians for the agricultural implements production were also lost. Thus, production of agricultural implements was difficult and raw materials were lacked. Under this situation, the quality of agricultural implements deteriorated.

Under the pathetic situation, the government decided to supply good quality agricultural implements for the stable production of food crops. In the year 1958, the Korean government prepared an agricultural implements supply plan and the agricultural bank was set up the plan to support the purchase of agricultural equipments. However, the budget for purchasing of agricultural implements was not arranged consistently and the supply of the agricultural implements and machinery were meager which ultimately could not achieve the effect of policy. During 1960s, the government started support of supplying the agricultural

machinery like water pumps and pest control machines to prevent the disasters like drought and diseases for the stable production and increases in the production of staple food rice.

During this period, with 60% government support and 40% self-funding, 1,400 units of power tillers, 7,100 units of mist and dust blowers and 20,000 units of water pumps were supplied. However, actual supply of the power agricultural machinery was meager due to lacking in the self-financing of farmers, etc. From the year 1967 until 1971, agricultural machinery like water pumps for stable production of rice and power tillers for deep plowing the soil were intensively supplied. Subsidy by the government was added to reduce the burden of agricultural machinery purchase by farmers. It enabled farmers purchase the agricultural machinery with subsidy from the central government at 38%, subsidy from local government at 2%, loan support at 25~40% and self-funding at 20~35%. During this period, the supply of agricultural machinery increased due to shortage of labor force in the rural area, thus 16,000 units of power tiller, 18,000 units of power sprayer, and 22,000 units of water pumps were distributed. However, until 1960s, supply plan of the agricultural machinery could be set up only when the central government or local government supported funds, neither supply quantity nor the support rate were not constant, therefore continuous and systematic supply plan could not be prepared.

In the year 1972, the Five-Year Agricultural Mechanization Plan centering the rice cultivation and power tiller was established. Along with agricultural mechanization plan, the machinery supply plan was also prepared. The Five-Year Agricultural Mechanization Plan was drafted to supply 38,740 units of power tillers, 57,000 units of water pumps, 13,500 units of power sprayers, 84,300 sets of mist and dust blowers, and 26,800 units of power threshers to mechanize 20% of paddy rice-threshing work for rice cultivation areas amounting to 450,000ha until 1976. The fund support for the purchasing of agricultural machinery was made to subsidize the part of the power sprayer. For other machinery, support plan was made to lend the loan to cover 50~70% of purchasing price for agricultural machinery and it has to be repaid over three to six years of installments according to the kinds of the agricultural machinery. The loan for the purchasing of agricultural machinery was covered by establishing a fund from government budget, loan of international organization or foreign countries and the revolving fund of these loans. Eventually, the loan amount USD 6million from AID in 1971 and Mark 12.5 million from KFW were introduced. In the year 1974, by supporting KRW 30 billion from the National Investment Fund by the special order of the President, the plan was changed to supply additional 100,000 units of power tillers for the three years period till 1976. By this arrangement, 109,000 units of power tillers, 114,000 units of power sprayers, and 26,000 units of water pumps were supplied. The supply of powered agricultural machinery centering around the power tillers was therefore significantly increased.

During the execution period of 2nd Five-Year Agricultural Mechanization Plan, the plan was made to intensively supply rice transplanters and harvesting machinery like binders and combines to resolve the labor shortage in the rural area during the peak farming season for mechanization of transplanting and harvesting work. For the rice transplanters and harvesting machinery, first of all, establishing the Mechanized Farming Center was encouraged centering on the agricultural corporation like the NACF and the Farmland Improvement Corporation (FIC) and group cultivation villages, and then whole amount for the purchase of agricultural machinery was supported by 40% of government subsidy and 60% of loan. Mechanized Farming Centers were installed in all over the country at total 510 places until the year 1981. These Mechanized Farming Centers greatly attributed the distribution of rice transplanters and harvesting machinery like binders and combines.

Along with this, Mechanization Model Complex of 300ha scale centering the NACF and FIC was built to drive fully the mechanization of rice cultivation. This arrangement significantly attributed to the supply of large-scale agricultural machinery. From 1977 to the year 1981, 286,000 units of power tillers, 3,000 units of tractors, 15,000 units of rice transplanters, 18,000 units of binders, 2,000 units of combines and 900 units of grain dryers were supplied. Hence, in the year 1981, the distributed number of agricultural machinery became for power tillers 350,000 units (one unit per 5.8 farm household), and 365,000 units of power sprayers were secured which ultimately shortened the pest control capability to 1.7 days per one instance of pest and disease control.

The purchasing fund for the agricultural machinery were covered by getting a loan of USD 2.12 millions from ADB in the year 1976 and JPY 42 millions from OECD, Japan in addition to the government budget. During this period, government subsidy was supported for the Joint Use Organization of the agricultural machinery. For the agricultural machinery which was supplied to the general farms, the fund was arranged by utilizing loans at a 60% rate, with government subsidy at 1%, and 39% by self-financing.

In the Third Round Five-Year Agricultural Mechanization Plan which waswas executed from 1982 till 1986, agricultural machinery supply plan was set under the motto of complete mechanization for the rice cultivation in the plain region and 50% of mechanization for the medium and mountainous area. After that, Mechanized Farming Group of scale 10ha at several farms or village unit was built and the agricultural machinery within 5 kinds were selected among tractors, rice transplanters, combines, threshing machines, pest control machines, and grain dryers. The expenses for the procurement of these machinery were covered by 40% of government subsidy and 60% of loan. Therefore, 5,885 number of mechanized farming group were set up in the country so that large-scale machinery and other machinery like rice transplanters and harvesting machines etc., could be supplied. During this period, 377,000 units of power tillers, 13,000 units of tractors, 48,000 units of binders,

and 15,000 units of combines were additionally supplied. Especially, large-scale agricultural machinery like tractors and combines were increased. The subsidy for the purchasing of agricultural machinery was arranged by utilizing the agricultural mechanization promotion fund, the National Invest Fund, loan, and the NACF Fund etc.

In 1987, basic plan for agricultural mechanization with major contents of mechanization up to 90% in the rice cultivation, and promotion of the mechanization for the up land crops like horticulture and animal husbandry was set up and the agricultural machinery supply plan was prepared according to this plan.

The Mechanized Farming Group was categorized into large-scale mechanized farming group of cultivated land area larger than 10ha and small-scale mechanized farming group with cultivated land larger than 5ha. During the five years of the plan, 7,770 units of large-scale mechanized farming groups and 13,309 units of small farming groups were established. While the large-scale farming groups were supported by large-scale machinery centering on the plain area, small-scale machinery like walking type rice transplanters and binders were supplied to the small-scale mechanized farming groups to drive agricultural mechanization in the medium-mountainous areas.

During this period, 222,000 units of power tillers, 54,000 units of tractors, 143,000 units of rice transplanters, and 53,000 units of combines were supplied along with 98,000 units of cultivators for the mechanization of the upland crops were supplied through government support. As a result, total possession of the agricultural machinery by farmers in 1991 were 768,000 units of power tillers which comes to one unit per 2.2 farm households, 53,000 units of tractors which is one set per 32 farm households, 16,000 units of rice transplanters which is one unit per 10.2 farms, and 54,000 units of combines, for one unit per 32 farm household.

Along with this machinery possession rate, mechanization rate for the rice cultivation was greatly improved as 87% of plowing and soil preparation, 85% of the rice transplanting, 80% for the harvesting, and 93% for the pest and disease control. Meanwhile, the government support as subsidy 50%, loan 40%, and self-funding at 10% were given for the purchase of the agricultural machinery during the same period. For the cultivators, the machinery for the up land crops, 20% of purchasing price of agricultural machinery was supported by the Mechanical Farming Group, whereas 60~90% of purchasing price was supported in the form of loans for the general farm household. Though Mechanical Farming Group has greatly attributed in the supply of agricultural machinery, there was also complaint from the farmers which were not designated as the member of Mechanical Farming Group.

The sixth round of the Five-Year Agricultural Mechanization Plan was framed in the year 1992 with the objective of full-fledged mechanization for the up land crop while carrying

on the mechanization for the rice cultivation at 100% level. During this period, agricultural machinery were supplied at half price over five years from the year 1993 to fulfill the presidential election pledges. In the half price supply plan for the agricultural machinery, if the machinery price was within KRW 2 million, 50% of purchasing price was supported, while if the machinery price was over KRW 2 million, KRW 1 million was supported. Also, 50% of machinery purchasing price was supported by government subsidy for the agricultural machinery joint use group and full time farm household for rice cultivation.

The policy of half price of agricultural machinery, though it helped to reduce the purchase burden of agricultural machinery by farmers and the management stabilization of the agricultural machinery manufacturer, manipulated an increase in the supply of small-scale agricultural machinery like power tiller which were already in the decreasing trends was resulted in the against trends of the agricultural structural improvement. The yearly supply quantity of power tillers was decreased from the peak supply of around 90,000 units in the year 1983 and reduced to 30,000 units in 1992. However, due to the supply of the power tillers at half price, the volume of the power tiller's supply became sharply increased up to 81,000 units in the year 1994. In the year 1998 when the half price supply policy was ended, the supply of power tiller was abruptly decreased to around 10,000 sets. Until 1996, 342,000 units of power tillers, 82,000 units of tractor, 167,000 units of rice transplanters, 46,000 unit of combine, and 238,000 units of small cultivators were supplied for over five years period. The mechanization rate of rice cultivation was thus plowing for 98%, rice transplanting for 97%, and harvesting for 96% that accomplished the mechanization of rice cultivation almost completely.

Table 4-1 | Supply Quantity and Possession Rate of Agricultural Machinery (1992~1996)

Farm machinery	Supply quantity during 1992~1996 (units)	No. of farm machinery at the end of 1996 (units)	Distribution rate (units/100 farms)
Power tiller	342,262	910,404	61.5
Tractor	82,193	113,287	7.7
Cultivator	237,570	272,770	18.4
Rice transplanter	167,202	271,051	18.3
Binder	21,843	67,914	4.6
Combine	45,528	73,831	5.0
Grain dryer	24,171	38,089	2.6

From the year 1998, agricultural machinery purchasing support was switched over as the only loan without government subsidy. The loan amount for the purchase of the agricultural machinery was set at 70% of the purchasing price for agricultural machinery with interest 4% lower than the prevailing interest rate with unredeemed period of a year and installations for 6~7 years. Especially for the rice direct seeders, 80% of machine price was supported. In the year 2004, the 80% loan for machine price support was given to the eco-friendly machinery.

And for the up land crops and animal husbandry, the support was 90% loan of machine price to promote the mechanization of up land and livestock. The loan rate for the power tiller and its attachment was reduced to 50% of the machine price, while 70% of loan was granted for the purchase price of other agricultural machinery as earlier. Also, as supply of agricultural machinery became increased, when second-hand machinery was to be purchased, 90% of the machine price was supported to activate the distribution of the second-hand agricultural machinery. In the year 2009 as of now, 70% of purchasing price for agricultural machinery was supported in the form of loan to the general farm households. Whereas, 90% loan of machine price was given to the full time rice cultivation farm households and agricultural machinery joint use group. Also, the loan amount of 90% was given for the purchase of agricultural machinery for the up land crops and for the eco-friendly agricultural machinery. The interest of loan was 3%, and repayment was to be made with unredeemed period for a year as four to seven years installments.

With the trends in the large-scale agricultural machinery after the year 2000, the supply volume of the agricultural machinery, as a whole, is being decreased. Especially, the supply quantity of small-scale machinery is sharply decreasing. The yearly supply quantity of power tiller is not even 2,000 units. The supply of binder was stopped from the year 2006.

Table 4-2 | Supply and Possession of Agricultural Machinery During 2000s

Farm machinery	Supply quantity during 2000~2009 (units)		No. of farm machine in 2009 (units)	Distribution rate (units/100 farms)
	No. of total supply	No. of annual supply		
Power tiller	18,852	1,885	714,537	59.8
Tractor	122,141	12,214	258,662	21.6
Cultivator	35,539	3,554	406,055	34.0
Rice transplanter	85,582	8,558	282,854	23.6
Binder	1,250	125	-	-
Combine	47,785	4,779	79,561	6.7
Grain dryer	17,661	1,766	75,944	6.4

1.2. Price Adjustment of Agricultural Machinery

While purchasing power of farm households for the agricultural machinery was weak, government started supporting the purchasing fund for agricultural machinery to promote agricultural mechanization. Thus actual demand of the agricultural machinery was decided by the government fund. By doing so, the government could influence the price of agricultural machinery.

The price of agricultural machinery was adjusted through review by agricultural mechanization review committee after reviewing and assessing the prime cost accounting reports which were submitted by the agricultural machinery manufacturers considering the economic situation of the rural areas by the MAFF. From the year 1974 till 1976, the specialized cost investigation organization that was designated by the NACF carried out the investigation of the production cost of agricultural machinery. The investigated price was reviewed and assessed by the MAFF and then the price of agricultural machinery was decided after discussing it with the Ministry of Economy Planning. Evan after that, production cost of the agricultural machinery would be considered, but the price waswas adjusted by government administrative department by considering the economic condition of the farm households.

However, with this practice, the price of agricultural machinery could not be decided by market principles. Farmers used to complain that the price of agricultural machinery was expensive, while the manufactures used to appeal that they had difficulties in the management even when the materials cost was increased, it could not be sufficiently reflected on the price of the agricultural machinery. The problem of the price control by the government while the price of the agricultural machinery could not be formed autonomously by market principles was raised. The countermeasure was therefore prepared to not place too much burden on the farms after collecting the opinions from each sector by discussing with related experts like professor. The price of the agricultural machinery became self-regulated from Oct. 1988.

While exercising the price autonomy of the agricultural machinery, the following systems were introduced to reduce the burden of price hike or purchase the agricultural machinery by farmers.

- Exemption of the value added tax which is imposed at 10% of the price of the agricultural machinery.
- Increases in the government subsidy to the Mechanized Farming Group for the purchase of the agricultural machinery from 40% to 50% to reduce the burden of farmers and to promote the agricultural machinery joint use.

- By boldly improving the restricting factors in the development or competition of agricultural machinery such as agricultural machinery inspection rules, after service, and supply system etc., competition circumstances were strengthened and did not allow for unfair trade like price-fixing etc., by the agricultural machinery manufacturers.
- By supporting the production fund to the manufacturers of the agricultural machinery, part of the burden of manufacturing cost was to be reduced and to make stable production and supply of the agricultural machinery.

Though principally the price of the agricultural machinery should be autonomously adjusted by manufacturers according to the market principle, agricultural machinery are actually sold at similar prices by kinds and specifications of machinery due to sales competition, the price differentiation is not being generated by quality and performance of the agricultural machinery.

2. Efficient Use of the Agricultural Machinery

2.1. Joint Use of Agricultural Machinery

2.1.1. Development of Joint Use Organizations for Agricultural Machinery

One of the important objectives of agricultural mechanization is improvement of the agricultural productivity. To improve the agricultural productivity, it is needed to reduce the expenses by using agricultural machinery efficiently. To reduce the operating cost of agricultural machinery, they should be used as close as possible to arable land area under burden to reduce the fixed cost of the agricultural machinery per area. For that, first of all, the scale of farming should be expanded.

The farm structure of our country was marginal, small-scale with cultivation land per farm household 0.93ha in the year 1970 as the ratio of the farm household with cultivation area less than 1ha was almost 64%. Therefore, economic condition of farm household was so poor and not able to purchase agricultural machinery. Besides, even if every farm household possessed agricultural machinery, it is difficult to expect efficient use of them since the farming scale is too small and duration of utilization was also extremely short. Also, the production cost would be increased due to increases in machine operating cost, thus it is not possible to achieve agricultural mechanization. Besides, it was practically impossible to expand the farming scale where the farmers would strongly claim the possession of the farm land. Naturally, the joint use of the agricultural machinery became on the rise. The various projects to reduce the burden of the purchasing of the agricultural machinery by activating the joint use of machinery were driven with the support by government policy.

As the distribution of the agricultural machinery gradually increased during the beginning of the year 1970, the utilization system of agricultural machinery to reduce the purchasing burden and to raise the utility of agricultural machinery was actively discussed. As a result, in the year 1971, the development plan for comprehensive agricultural machinery utilization organization was prepared by setting up the agricultural machinery utilization plan.

First of all, the agricultural machinery utilization system was categorized into joint use organization and individual use system. The joint use organization was again divided into the joint use organization by farmers, by agricultural confederations, and by setting up the demonstration farming district by agricultural organizations.

The joint use organization of farmers as core executer was organized as farmer as the driving entity. It was organized as a rice group cultivation area or as a naturally organized village unit and planned to operate the cultivation area jointly with management scale 10~15ha per one unit. The types of agricultural machinery for joint use were decided as power tiller (including attachment), power thresher, and power sprayer two units each. And the number of lime spreader, seeding machine, cultivating and weeding device, and straw cutter were decided as one unit each. First of all, required agricultural machinery were converted into the possession by joint use group according to preference of farmer which possesses that machine. The machinery which were in shortage were purchased with loan from government or purchased by sharing the cost jointly. The operational items regarding the management and operation cost was set by self regulations. The joint agricultural use organization by farmers was first operated as "Machinery gye (*private fund*)" as a model case whose organization was later transformed into "Mechanized farming group".

The joint use organization by agricultural confederation was installed and organized as agricultural machinery business unit with local NACF and FIA as the operation core organizations so that farming by lease agricultural machinery and contract farming was possible to replenish the village labor force which was in shortage. The mechanization system was established for the joint use group of agricultural machinery by FIA focusing the farm tractor, while the joint use organization by Local Agricultural Cooperative Federation (LACF) was established focusing the power tiller. The agricultural machinery required use the machinery which possessed firstly and the shortage was purchased with loan from government (LACF) and by self-funding (Agricultural Land Development Association). The operation and management were carried out by agricultural association self. These joint use organizations for the agricultural machinery were later materialized as "Farming mechanization bank" and "Farming Mechanization Center".

The basic purpose of installing demonstration farming district with agricultural organization as core organization was aimed to widely publicize the effect of agricultural mechanization. The model complex was built per different area and scale by Rural Development Administration (RDA), Agricultural Cooperatives, and Agricultural Development Corporation (ADC) as core organizations. The objective of the model complex was to carry out the role of leading agricultural mechanization by performing the consistently mechanized farming works.

The demonstration complex which was organized as RDA as a core body was planned as the subjected area 10~15ha in the rice cultivation area. The operation and management were carried out by farmer's selves and the agricultural extension office under RDA supported technically. Required agricultural machinery were planned as power tiller (including attachments), power sprayer, and power threshing machine two units each. And seeding machines, cultivating and weeding machines, and manual rice transplanters were planned one each. The required machinery were to be purchased and used by budget from RDA and self-funding.

The demonstrational complexes by NACF were established one to two each at county centering the animal husbandry and horticultural complex. The operation and management were carried out by LACF or commercial agriculture by itself. Further, the mechanization demonstration area was made to be operated centering tractor and its attachment.

The demonstration district was established by the ADC as 200ha scale in the rice cultivation region. It was established as one to two units in all over the country and was operated by the ADC. The required agricultural machinery were four units of tractors of capacity 30~50hp, rice transplanters and combine harvesters ten units each, and power tillers and power threshing machines five each. Those machinery were purchased by the ADC.

The demonstration district with agricultural organization as core group was first realized as "Cheorwon Integrated Mechanization" in the year 1977 which, afterwards developed into "integrated agricultural mechanization demonstration complex".

The agricultural machinery joint use bodies were planned and designed during the early stage of 1970 have been gradually driven and operated as one or two districts according to the historical requirement or closed due to several problems.

2.1.2. Development of Agricultural Machinery Joint Use Organization

a. Machinery Gye

The agricultural machinery joint use organization which was operated for the first time by materializing the agricultural machinery use plan was the machinery gye. Machinery gye was not developed as an agricultural machinery joint use organization from the beginning, but it is the transformed form of the existing farmer's organization like Heungnong gye (farmer's proliferation fund) which was organized and operated as a part of 'Saemaeul Movement'. According to Installation guide for agricultural machinery joint use organization (agricultural machinery gye) which was an internal regulation of the Ministry of Agriculture and Forestry in the year 1971, the machinery gye was installed with the purpose of reducing the purchasing burden and rational use of agricultural machinery. The machinery gye was selected in the area of cultivated land arrangement done as rice group cultivation area (including "Tongil" rice cultivation area) or naturally separated village with consolidated paddy land and rural road opened.

The scale of the machinery gye was set as 10~15ha, agricultural machinery were jointly possessed and jointly used. Farmers enacted the farm machinery operation and management bylaws by themselves. Administrative organizations and rural extension office rendered the technical support to the machinery gye. The required machinery per one machinery gye was set as power tiller and power sprayer, and threshing machine two sets each, and seeding machine, weeding machine, lime spreader, and straw cutter one set each. The agricultural machinery which were already possessed by farmers were recommended to be used jointly according to the willingness of the owner. The shortage in machinery was bought by the loan from government (64%) and self-funding by machinery gye members.

In the year 1972, 1,000 machinery gyes were planned to be organized, but 1,012 places were actually organized and they possessed 8.3 units of farm machinery including 1.5 units of power tillers, 2.5 units of threshing machines per one machinery gye. However, the machinery gye which was enthusiastically driven by government was stopped after one year.

The reason of failure is as below. First, voluntary participation of farmers and support by related organization were meager due to lack of awareness for agricultural mechanization and joint use of agricultural machinery, which led the characteristic of machinery gye changed from joint use to individual possession. Second, the purchasing capability of agricultural machinery by farmers was low so that there was problem in securing the agricultural machinery. Third, excessive burden was felt in the administrative work like work log preparation and account settlement etc., and systematic education and training related agricultural machinery were not carried out. Fifth, if machinery gye was organized

by merging more than two villages because the subjected area was small, the operation of machinery gye was difficult with weak humane bonds between villages.

Table 4-3 | Machinery Gye Organization and Agricultural Machinery Possession Status (1972)

Number of Machinery gye	Scale (ha)	Number of member (person)	Agricultural machinery possession status (unit/gye)				
			Power tiller	Power sprayer	Mist and dust blower	Power threshing machine	Total
1,012	20~30	30	1.5	1.7	2.6	2.5	5.2

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

b. Farm Machinery Bank

The farm machinery bank was a part of the cooperative unit creation for agricultural production started in Chuncheongnam-do (province). It was a joint use organization of agricultural machinery made by imitating the farm machinery bank in Germany and Japan. According to the "Formation of high efficiency mechanized cooperative (Installation of farm machinery bank)" guideline, the farm machinery bank was set up to make the field more than 500ha as a cooperative complex to increase farmer's income by increasing land use and labor productivity. The core body of the establishment of farm machinery bank was the governor of the province. The venues were decided as ten numbers of farm land development cooperatives which were located in the province. The operation and management of farm machinery bank were carried out by the Agricultural Land Development Cooperative.

The major duties of the farm machinery bank were mainly to carry out contract farming work using the agricultural machinery possessed by the farm machinery bank, to lease the agricultural machinery to the farm which can operate the agricultural machinery, and to entrust operation for the agricultural machinery of private possession. For the efficient management of the farm machinery bank, administrative institutions has to handle the support like funding, publication, and technology, but operation and management were to be carried out as self-financing system under the responsibility of director of FIC at corresponding area.

The five years plan for farm machinery bank was set up to secure 32% of tractors, 69% of combines, and 90% of dryers among the machinery required in cooperative complex with targets of 35 units of tractors, 175 units of combines, and 136 units of grain dryers in the target year by purchasing 7 units of tractors, 35 units of combines, and 26 units of dryers in every year. Required fund was arranged as 20% each from province and district and rest of

60% was arranged by self-funding of FIC. However, the agricultural machinery practically secured by ten places of farm machinery bank were far less than the target. New invest for the farm machinery bank was stopped in three years of operation in the year 1977. The plan of establishing the farm machinery bank one each at province throughout the country was also not realized.

The biggest reason why farm machinery bank failed without getting the expected effect was that it was difficult to get the active invest and management with FIC in deficit. Also, it was difficult to get skilled agricultural machinery operators during busy farming seasons. Besides, the after service system was lacking as it was limited in raising the availability of agricultural machinery. Further, getting the work order was not easy due to lacking in public awareness about custom work. Even custom work could be secured, land was scattered and there were many places where working with farm machinery was difficult which made agricultural machinery use inefficient. Therefore, farm machinery banks did not achieve the effect other than public relations concerning agricultural mechanization and was eventually stopped.

Table 4-4 | Agricultural Machinery Possession Status by Farm Machinery Bank (1977)

Category	Tractor	Combine	Grain dryer	Total
Plan (unit)	35	175	130	340
Actual (unit)	23 (65.7%)	3 (1.7%)	13 (10.0%)	39 (11.5%)

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

c. Farm Mechanization Center

The parent form of the farm mechanization center was rice transplanting mechanization model complex which was organized as a part of the Saemaeul Income Comprehensive Development Project in the year 1977. Among the model complex of rice transplanting mechanization, the model complex equipped with joint use and integrated service function like management and repair was also separately called as farm mechanization center. With reinforcement of harvesters in the rice transplanting mechanization model complex in the year 1978, it was changed to rice transplanting and harvesting mechanization model complex. And in the year 1980, with its name changes to farm mechanization center, all the model complexes under the FIC, the LACF, and farmer's organizations were integrated.

As can be found out from its name, farm mechanization center had strong model project characteristics at its beginning, but with increases in participation by farms after 1979, the purpose was also changed to resolution of labor force in the rural area and to reduce of production cost by the establishment of the joint use system for the agricultural machinery.

Farm mechanization center has the same characteristics with farm mechanization bank as it is an agricultural machinery use organization by the farmer's cooperative, but was more detailed and organized with active intervention by the administrative organization. The governor of the province guided and supervised the overall operation and administration by establishing the organic cooperation system with the NACF, the FIC, and the Agricultural Technology Extension Center (ATEC). Meanwhile, the city mayors and the heads of districts conducted direct management and had responsibilities for the farm mechanization center. RDA took charge of technical guide such as operation or repair of agricultural machinery. The NACF performed the supply the necessary agricultural machinery in time while taking the responsibility of development and operation of farm mechanization center. The core operation organizations were the Agricultural Cooperative, the FIC, and farmer's organization.

From the year 1977, a total of 513 farm mechanization centers were established in five years. Among those farm mechanization centers, 75% of farm mechanization centers, 384 of them, were operated by the NACF followed by rural village unit 70 in number and 59 units by the FIC. The agricultural machinery possessed by farm mechanization center was in a good number by the farmers since this organizationstarted as rice transplanting and harvesting mechanization model complex from the beginning. Therefore, rice transplanters possessed by one center was 2.1 units which was the largest, combines and binders together was 1.9 units in number, but number of tractors was just 0.5 unit.

The fund for the establishment of farm mechanization center was covered by subsidy of central and local government, loan, and self-financing. The source of fund and support rate was variously changed year to year. In the initial stage, the farm mechanization center was established by governmental subsidy and loan. But in the last year, the cost of establishment was provided by central and local government fund, loan, and self financing. The occupancy of establishment of farm mechanization center was mostly from loan as 45% while 39% was from government subsidy.

The problems in the farm mechanization center which waswas stopped after 1981 was not different from the problems experienced by agricultural machinery joint use organizations which were operated by agricultural organizations or administrative organizations. That is, revenue was greatly worsened by the excessive expenditure of operation and management, excessive spending the repair cost due to lacking the concept of possessing the agricultural machinery, and reduction in the durable life of machinery. Also, it was difficult to secure the skilled manpower for driving and maintenance. Even after arranging such skilled manpower, labor charges were high. Therefore, in spite of support by the government, continuous operation and management became difficult. In the end, the agricultural machinery possessed by the farm mechanization centers was sold to the farmers in the year 1981 and this project was terminated.

Table 4-5 | Number of Farm Mechanization Center and Machinery Possession Status (1977~1981)

Category		No. of installation (place)	Number of possessed agricultural machinery (unit)						
			Tractor	Rice transplanter	Combine	Harvesting machine	Binder	Others	Total
Operation core body	LACF	384	206	814	368	155	359	-	1,902
	ALDC	59	38	128	26	22	71	-	285
	Villages	70	36	126	52	25	91	23	353
Total		513	280	1,068	446	202	521	23	2,540
Number of possession per center (unit/center)			0,5	2.1	0.9	0.4	1.0	0.1	5.0

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

d. Integrated Model Complex for Agricultural Mechanization

The first integrated model complex for agricultural mechanization could be the integrated mechanization project at Cheorwon district among the integrated agricultural mechanization model complexes. The integrated mechanization project at Cheorwon district was established in the paddy field located at the north of the Civilian Passage Restriction line (Mintong seon) to improve agricultural productivity and agricultural technology and to display effect against North Korea.

According to the formation plan of agricultural mechanization model complex by the Ministry of MAFF, the operation and management was made to be taken care by the administrative organization from the setting up stage of the plan. Therefore, Ministry of MAFF took the charge exclusively for the guidance, supervision, and administrative support. Project was pursued with organic cooperation between administrative organizations supervised by the governor of Gangwon province. The integrated model complex for agricultural mechanization at Cheorwon district was planned to settle through mechanization system by input the large-scale agricultural machinery of total seven kinds with 320 units including tractors etc., with three years plan subjected to the farm area 1,000ha. All fund which was spent for the purchase of agricultural machinery was supported by governmental fund (80%) and local administrative fund (20%). At the beginning of this project, FIC managed the project, but Cheorwon district took the charge from the year 1978. The Cheorwon Agricultural Mechanization Office (staff 38 in number) was separately established to handle the project.

For the Integrated Mechanization Project at Cheorwon district, all the required expenses were covered by government subsidy as can be seen from the <Table 4-6>. With systematic

and active support by the government, the operation condition was good as compared with the machinery gye or farm machinery bank. However, as agricultural mechanization progressed, the work volume for the integrated model complex for agricultural mechanization decreased as agricultural machinery possessed by farmer increased. The efficiency of possessed agricultural machinery decreased in the project region while repair and administrative expenses became increased which generated deficit from 1979 that made the project operation difficult. Besides, Cheorwon Agricultural Mechanization Office which was handling the project was closed down in 1982, thus continuous drive of this project became even more difficult. Therefore, by disposing of the agricultural machinery and facilities possessed by the integrated model complex for agricultural mechanization in the year 1982, this project was in practice terminated.

Table 4-6 | Status of Integrated Model Complex for Agricultural Mechanization at Cheorwon District

	Plan				Results			
	1977	1978	1979	Total	1977	1978	1979	Total
Area (ha)	300	450	250	1,000	300	450	300	1,000
Number of supplied agricultural machinery (unit)	100	122	78	300	92	31	26	149
- Tractor	10	13	7	30	10	10	2	22
- Power tiller	10	13	7	30	13	-	-	13
- Rice transplanter	15	10	15	40	3	8	15	26
- Power sprayer	30	30	20	80	30	-	-	30
- Combine	15	30	15	60	6	6	9	21
- Power thresher	10	13	7	30	13	-	-	13
- Grain dryer	10	13	7	30	7	7	-	14
- Mist & dust blower	-	-	-	-	10	-	-	10
Nursing facility (Unit)	2	2	2	6	1	-	-	1 (165)
Agricultural machinery warehouses (Unit)	2	1	1	4	2	-	2	4 (1,320)
Agricultural machinery repair center (Unit)	1	1	1	3	-	1	-	1 (231)
Drying station (Unit)	-	-	-	-	-	1	1	1 (429)

※ ( ) : indicates area (m^2)

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea",

On the model of Cheorwon integrated mechanization project, seven integrated mechanization model complexes were created from 1978 for three years period. In the integrated mechanization model complex, fully mechanization system by big machinery for the rice cultivation was established with the purposes of public relations of agricultural mechanization effects. The project was handled by the MAFF and the RDA took the charge of technical guide.

The subjected area for agricultural mechanization model complex was large scale plain fields of rice cultivation area with good land consolidation and irrigation system as well as drainage facilities. The areas which have shortage of labor force, high effect by model project and easiness of technical guidance was selected. The scale per the model complex was set as 300ha and established one at each province. The new integrated model complex has the similar characteristics with Cheorwon Integrated Mechanization Project, but the practical operation core body was not administrative organization but the FIC or the LACF. Among these, four model complexes were run by the FIC while three were operated by the FIC.

The agricultural machinery possessed by the model complex were mostly medium-and large-scale. The number of possessed agricultural machinery was 9.3 units of tractors, 16.6 units of rice transplanters, and 13.1 units of combines. As subsidiary facilities, agricultural machinery warehouse was built on area 760m^2, nursery station on the area 360m^2, and drying station on the area 430m^2. The integrated model complex for agricultural mechanization was materialized the fully mechanization in the large-scale paddy area so that it has achieved the model effect like motivating of the mechanized farming by farmers. However, operation core body was not active and with stiff operation and management, it could not actively counteract against the changes in the agricultural condition which caused the utility reduction of agricultural machinery. Excessive spending on labor charges, operational cost, and subsidiary facilities also lead deficit which ultimately resulted in closing down the integrated mechanization model complexes.

Table 4-7 | Status of Integrated Agricultural Mechanization Model Complex

	Operation body	Agricultural machinery possession status (units/complex)							Subsidiary facility (m^2)	Project duration
		Tractor	Rice transplanter	Combine	Grain dryer	Binder	Others	Total		
Pyeongtaek, Gyeonggi-province	ALDC	10	16	11	11	5	5	58	1,515	1978~1979
Jincheon, Chungbuk	District	5	19	16	6	-	1	47	1,558	1980~1981

	Operation body	Agricultural machinery possession status (units/complex)							Subsidiary facility (m^2)	Project duration
		Tractor	Rice transplanter	Combine	Grain dryer	Binder	Others	Total		
Buyeo, Chungnam	LACF	10	14	10	11	-	1	46	1,950	1979~1980
Gimje, Jeonbuk	ALDC	8	19	16	15	1	1	60	2,195	1978~1979
Naju, Jeonnam	LACF	10	15	13	8	1	-	47	1,848	1979~1980
Dalseong, Gyeongbuk	ALDC	12	18	10	9	10	13	72	1,234	1978~1979
Goseong, Gyeongnam	LACF	10	15	16	8	1	-	50	2,261	1979~1980
Total		65	116	92	68	18	21	380	12,561	
Average per complex		9.3	16.6	13.1	9.7	2.6	3.0	54.3	1,794	

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

e. Mechanized Farming Group

The mechanized farming group was a group which was established from 1981 to counteract the labor shortage in the rural area and to reduce the burden of the agricultural machinery purchase by developing the joint use organization of agricultural machinery suiting to our farming condition. It was also once called as "saemaul agricultural machinery joint use organization" or "saemaul mechanized farming group" at the initial stage.

The mechanized farming group was organized at several farms, Saemaul youth association, and village unit and made to be operated by farmers themselves. The administrative organization handled the supply of agricultural machinery and fund support under the responsibility of local autonomous bodies. The first batch of mechanized farming group of 612 was formed in the year 1981. After that, around 1,000 units of mechanized farming group were organized in every year until year 1986. However, while categorizing the mechanized farming groups as large-scale mechanized farming groups (area larger than 10ha, farms more than 10 house households, plain field, and large-scale agricultural machinery) and small-scale mechanized farming groups (area larger than 5ha, farms more than five farm households, hilly/mountainous area, medium- to small scale agricultural machinery) from the year 1987, the number of mechanized farming groups was also greately expanded to 3,000~6,000 in every year. Until the year 1994, a total of 44,964 mechanized farming groups were formed.

The fund required for the establishing the mechanized farming group was covered by government subsidy, loan, and self-finance. Until the year 1987, the fund ratio was 40% by government subsidy, 50% by loan, and 10% by self- funding. However, the initial burden on the farmers for the purchasing of agricultural machinery was reduced by adjusting the funding structure as 50% by government subsidy and 50% by loan afterwards. The rice transplanters, harvesting machinery, and grain dryers which were used less in a year and have high manpower substitution effect so the machines farmers preferred were intensively supplied to the mechanized farming group. These farm machinery largely contributed to the fully mechanization of paddy rice cultivation, expansion of the agricultural machinery and reduction of agricultural production cost. The ratio of supplied agricultural machinery throughout the mechanized farming group during this period indicates that combine was 37%, dryer 35%, tractor 21% and rice transplanter 16% of total number of farm machinery disseminated. And farm machinery at the mechanized farming group occupied considerable portion as can be seen in <Table 4-8>.

For the mechanized farming group, agricultural machinery were supposed to be possessed and used by 5~10 farms jointly. However, considerable part of the farm machinery were possessed by individual and used by individual farms. Therefore, the primary objective of joint use was not achieved. Moreover, the dissatisfaction of farmers which were excluded and were not selected in the mechanized farming group was on the rise, which weakened the justification of the government support. Even in the case of joint use, negligence of maintenance and excessive use generated excessive repair expenditure etc., which led worsening the financial performance. Besides, manpower that could operate the machinery after young villager's leakage to the cities was lacking therefore new creation of mechanized farming group became difficult. Thus, the mechanized farming group was eventually terminated in 1994.

Table 4-8 | Establishment and Operation Status of Mechanized Farming Group (1996)

Number of created mechanized farming group	Number of closed mechanized farming group	Running mechanized farming group	Ratio of closed mechanized farming group
44,960 units	28,043 units	16,917 units	62.4%

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

Table 4-9 | Agricultural Machinery Supply Status to the Mechanized Farming Group (1981~1994)

Category	Tractor	Rice transplanter	Combine	Grain dryer	Total
Total supply (units)	113,520	290,683	98,601	24,672	527,476
Supply to the mechanized farming group (units)	23,815	46,083	36,077	8,734	114,709
Supply ratio by MFG	21.0	15.9	36.6	35.4	21.7

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

f. Agricultural Corporation

The trusted farming company was established in the year 1991 for the improvement of agricultural productivity while counteracting the rural labor shortage and aging and resolving the difficulties of farmers who cannot be directly involved in farming. The concept of the trusted farming company was raised in the "comprehensive measures for development of rural area and fishing village" in 1989 for the first time. The next year, the legal base for the trusted farming company was prepared through "Special measurse law for development of rural area and fishing village". According to the comprehensive measures for development of rural area and fishing village, the trusted farming company is a specialized farming agent organization in the form of company which was established to carry out farming instead of farmers which either did not have labor force for the farming or practically farming was difficult due to nonfarm work etc., and to improve the agricultural competitiveness by expanding the farming scale. The trusted farming companies were made to perform the consignment farming work, lease and repair of agricultural machinery, entrust management of small-scale irrigation facilities, and reduction in the farming cost and to seek the convenience in the routine life of farms. In the trusted farming companies, various entrust farming such as consignment of part or entire farming work and management entrust, and hiring management were performed.

The name of trusted farming company was changed to agricultural corporation as special measures law for development of rural area and fishing village was revised in 1995. The scope of business also expanded till the subsidiary businesses like production and supply the agricultural materials, seed production and starter culture, reservation of agricultural and fisheries product, and lease, repair, and keeping of agricultural machinery as well as other equipment, and entrust management of small-scale irrigation facilities other than the distribution, processing, sales of the agricultural products and custom work. The commercial farming by agricultural corporation was possible due to the possessing of farm land was allowed, thus the characteristics of agricultural corporation was much changed from the contract farming company which mainly carried out the entrust farming.

Agricultural corporations should register itself to the city or district after registration of corporation establishment to be an agricultural corporation. It would get the financial benefits only when it secures the farming scale of more than 50ha with farming manpower of more than five persons (more than two agricultural machinery operators) for crop which uses land. Besides, it needs have more than ten units of agricultural machinery of five types to carry out consistent mechanized working, agricultural machinery warehouse of larger than 198m^2 and simple repair facilities. The total invest of agricultural corporation should be more than KRW 0.1 billion but the invest amount by one member should not exceed 25% of total invest. In case the main purpose of agricultural corporation was agricultural production, invest of more than 50% can be made in the form of payment in kind and more than two third of members should have farming experience longer than three years.

The support for the agricultural corporation was by government subsidy 25%, by local government 25%, loan 40%, and self-funding 10% within KRW 0.1 billion for purchasing the agricultural machinery. The facilities building cost like agricultural machinery warehouse and operational cost was supported with low interest rate. It was planned to support and develop the agricultural corporation as total 2,000 units more than one per city, Eup, myeon unit. However, at the end of 1999 as of now, a total of 1,465 units have been established. From year 2000, the subsidy for purchasing of the agricultural machinery was abolished, thus for the purchasing of agricultural machinery for agricultural corporation also converted as loan support.

Table 4-10 | Established Units of Agricultural Corporation

Total	'91	'92	'93	'94	'95	'96	'97	'98	'99
1,465	16	121	272	309	349	206	124	53	15

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

2.2. Lease of Agricultural Machinery

2.2.1. Agricultural Machinery Bank

The agricultural machineries bank which was organized and operated from 1992 was one type of joint use of agricultural machinery made with agricultural machinery bank in Germany as a model. After establishing it in the Galmal area, Cheorwon, Gangwon-province as a cooperative project by Hanns-Seidel Foundation, Germany to counteract labor shortage in the rural area and to raise the competitiveness through reducing the production cost by efficient use of agricultural machinery, it was expanded to the national

level. In the agricultural machinery bank, those businesses namely, the mediation of farming consignment that arrange and mediates between the agricultural machinery owners and the farmers who wanted custom work by agricultural machinery, farming agency which directly carries out the consignment using the agricultural machinery possessed by bank, and renting the agricultural machinery to the farming society, crop cultivating group, and individual farms with or without charges are being carried out.

The agricultural machinery bank was operated by local agricultural cooperative federation at the end of 2002 and as of now, the number of participating farm household is 16,000, working area is 10,499ha, and the average working area is around 0.6ha per farm household. The agricultural machinery possessed by 108 LACF which operate the agricultural machinery bank are total 501 units, thus average 4.6 units of agricultural machinery are possessed per bank. The largest number is occupied by fertilizer spreader followed by combine, rice transplanter and tractor. Among the working area, consignment of farming work is the largest as around 45%, next comes the mediation of entrust as 37%, and the rest is lease of agricultural machinery.

At the beginning of the agricultural machinery bank operation, the mediation of farming consignment was actively carried out. However, the farming contract became active recently. Since custom work or mediation commission was charged low by agricultural cooperative federation at the restoration business aspect and most of them are under deficit due to work load by devoted management manpower and increases in the labor charges, the operation is not being largely activated and actual operation status is also exactly not known.

Table 4-11 | Operation Status of Agricultural Machinery Bank

Category	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Number of bank (unit)	4	13	20	30	38	46	53	70	90	108
Number of participating farms	290	710	1,042	2,648	3,372	4,280	11,764	9,606	14,074	16,413
Working area (ha)	421	824	1,307	1,800	4,357	5,355	9,526	7,870	10,210	10,499

Table 4-12 | Working Area by Farm Work Types

Category	Consignment of farm work	Mediation of entrust	Lease of agricultural machinery	Total
Working area (ha)	4,767 (45.4%)	3,937 (37.5%)	1,795 (17.1%)	10,499

2.2.2. Agricultural Machinery Lease Business by Local Autonomous Body

For farm households, farm work by using agricultural machinery can be carried out by directly purchasing the agricultural machinery, requesting others by paying custom working charges, or agricultural machinery can be borrowed from others. It may be appropriate to buy the agricultural machinery and use it, but the purchasing burden of agricultural machinery is too big for the small-scale farms. Besides, the working hours of agricultural machinery is short which is not economical with increases in the operating cost such as fixed cost etc., and the joint utilization of agricultural machinery also causes poor management that is not easy. Especially, in case of the up land crops, the kinds of crop and farm works are various, so many kinds of agricultural machinery are required which make the purchasing burden for agricultural machinery larger.

Therefore, lease of agricultural machinery was started for the farmers to rent the agricultural machinery whenever required. Lease project of agricultural machinery was executed sporadically by some of the local autonomous bodies at the end of 1990. However, in the year 2002, lease project of agricultural machinery was decided as one of the national policy projects for the efficient use of agricultural machinery through agricultural mechanization basic plan. The lease project of agricultural machinery was started in practice by executing it at the government level. The purpose of the lease project of agricultural machinery was to reduce the purchasing burden of agricultural machinery focusing the farm households that have difficulties in purchasing the agricultural machinery, to raise the availability of the agricultural machinery, to resolve the labor shortage in the rural areas. The execution body was decided as the NACF in the year 2003. However, there existed the LACF which abandoned the agricultural machinery lease project due to the burden in the management etc. Otherwise, as there was no new business application for the project, the supervision of the project was assigned to the Agricultural Technology Extension Center (ATEC) at city and district which has responsibility for agricultural extension work and equipped with technical manpower for the agricultural machinery.

The agricultural machinery lease project was focused on the small-scale machinery for the up land crops and the accessory working implements for the rice cultivation whose mechanization were lacked. However, considering the condition of the respective areas,

the agricultural machinery suitable to the area was selected. The leasing type was mainly a short duration lease for one to three days. The detail items such as leasing method, renting fee, and selection of the farm machinery for lease was enacted as the by law. The purchasing of agricultural machinery and operation cost for the lease project were covered by central and local government subsidy. For two years until the year 2004, the support was made as 30% by government and 70% by local government. From the year 2005, the support ratio of government subsidy was increased to 50% and rest 50% was borne by local governments. At the time of starting the lease project, KRW 0.25 billion per unit lease project was subsidized. But the demand was increased after this project was activated, thus the kinds of agricultural machinery and volume have been increased. The subsidy by government was therefore, increased to KRW 0.5 billion in 2007 and KRW 1 billion each per unit in 2010.

The lease project center for the agricultural machinery was started with five units in 2003. The number of lease project was increased in every year. In the year 2010, the number of lease project center was increased to 61 places and it reached 195 by end of 2010. It is planned to be increased to a total 350 by installing two to three per city and district by 2015. The agricultural machinery for lease are mainly seeding machines, bean threshing machines, cultivators, and balers which are small-scale agricultural machinery. In the year 2010 a total of 155 kinds and 23,000 units of agricultural machinery were disseminated to the leasing center throughout this leasing project, and around 118 machinery are being operated per one leasing center including some of the working machines for the rice cultivation like ridge making machines etc. The numbers of farmer which use the rented agricultural machinery are also being increased yearly. The farmers which use the rented agricultural machinery were 412 farmers in the year 2006 which increased to 1,181 in a large scale in 2010.

The lease project of agricultural machinery has attributed in the promotion of mechanization for the up land crops like the bean, potato, garlic and ginseng and bulky forage which were not much mechanized. It also greatly attributed in reducing operating cost of agricultural machinery. Though lease project of agricultural machinery has helped greatly in the mechanization up land crops and farmers, similar problems as in the joint use organization also could be surfaced.

The problems with the lease project were first low utility of leasing agricultural machinery due to the selection of not much demand in agricultural machinery and excessive possession by local autonomous body, financial burden of the local autonomous bodies which were getting the low rental fee of sort of kindness, fund arrangement was difficult in re purchasing the machinery when durable life of the machinery was over, manpower for management of lease project and operating and repair of agricultural machinery were in short, and excessive repair cost and durable life became short due to increases in the breakdown after used by several farmers though the farmer who rent the lease machinery should receive the training

for safety use of agricultural machinery. Though local autonomous bodies which execute the lease project go through difficulties by deficit from the management and arranging the in charge for the project etc., but it was effective in the mechanization of upland crops which lacked mechanization and it was also highly preferred by farmers and very helpful to the small farmers. Therefore, the problems during the operation of leasing project will be considered to improve it as much as possible.

Table 4-13 | Status of Lease Project for Agricultural Machinery

	2003	2004	2005	2006	2007	2008	2009	2010	Total
Core body of the project	NACF	City and county	City and county	City and county	City and county	City and county	City and county	City and county	
No. of leasing place (unit)	5	8	8	12	20	39	42	61	195
Invest on the project (KRW million/unit)	250			300	500			1,000	
Fund support	Government subsidy 30, local government subsidy 70%	Government subsidy 50, local government subsidy 50%							

2.3. Safety Use of Agricultural Machinery

Agricultural machinery are means of improving the quality of farmer's life by substituting the short labor force and by carrying out the hard farming work in place of farmers. At the same time, these agricultural machinery can cause the loss of bodies of farmers or properties due to safety accident. With rapid progress in agricultural mechanization, especially with increases in the large-scale agricultural machinery, safety accidents by agricultural machinery is being increased as well as the damages, the prevention and countermeasure of safety accident by agricultural machinery are being demanded.

Therefore, accidentsby major agricultural machinery was investigated by support from agricultural mechanization promotion fund in 1982 for the first time. By the results of this study, the safety device of agricultural machinery was to be supplemented in the after comparing them with foreign agricultural machinery. Especially the safety cover for V-belt and flywheel of power tiller which brings about the many safety accidents and parking brakes of trailer were to be attached or supplemented. Also to prevent the accident

caused by illegal changes of engine pulley in the power tillers to increase the driving speed which was specified till maximum 15km/h and by excessive loading by reinforcing the body and attaching the driving shaft of the trailer whose loading capacity is 500kg, the government prohibit the change of engine pulley and trailer in power tiller and safety device of agricultural machinery must be controls in thoroughly crack down. Also, the rear lamp whose recognition distance is 100m at night should be attached in trailer of power tiller to prevent traffic accident in the night.

The safety accident status investigation for agricultural machinery was carried out by the NAMRI from the year 1982 at five years intervals. From the year 1992, the traffic accidents occurred during driving the agricultural machinery on the road were added to investigate and analyze. As the social interest for the safe use of the agricultural machinery became increased, the safety accident status investigation was carried out for every three years interval from year 2002. The status of safety accident by the agricultural machinery was surveyed and analyzed about the accident frequency, accident type, cause, damages and countermeasure of the safety accident, and the status of safety device etc. The frequency of farm work accident and traffic accident by agricultural machinery is in decreasing trend through strengthening the safety use training for the agricultural machinery year by year.

Safety accidents occurred 0.82 times in the power tillers, 0.31 times in the tractors, and 0.37 times in the combine per 100 units of agricultural machinery in a year. Traffic accidents related to the agricultural machinery was occurred around 400 cases in a year which occupies 0.2% of total traffic accidents. The frequency of the traffic accident related to agricultural machinery was 0.28 times and 0.26 times per 100 units of agricultural machinery in a year. Farm work accidents by agricultural machinery are mainly occurred during farming peak seasons of springs and autumns, between two to three o'clock during a day when the concentration power of the machine operator becomes reduced by fatigue. Accidents were mainly occurred during transportation and moving works in the power tillers and tractors, while it occurred during harvesting and movement in the combine.

The major causes of the safety accident of agricultural machinery were mainly due to the carelessness of the driver. The wounded case per one accident was 0.49 people, among these serious wound occupied 53% and minor wound occupied 47%. Meanwhile the traffic accidents mainly occurred during six to nine o'clock in the afternoon when the driver was returning home after completing the farm work. Around 80% of accidents were caused by fault of the drivers. The accident type was largest in the hit accident by cars from back due to not seeing the agricultural machinery running at front in the straight road. As traffic accidents by agricultural machinery driver's fault, the largest case was the collision with cars when agricultural machinery turn at the entrance of the village or during crossing the road. The cause of the traffic accident related to agricultural machinery was in the order of

not following the safe drive obligation like default in seeing the front, illegal pass ahead, and passage violation at the crossing in the cases where cars were assailants. Whereas, in the cases of agricultural machinery as assailants, the causes of traffic accident were in the order of passing violation at the crossing, default in the seeing the front, and violation of crossing the centerline. With traffic accident related to the agricultural machinery, the casualties were 0.86 persons per one traffic accident. Among the casualties, death was 0.06 persons and wound was 0.8 persons among which more than half was seriously wounded.

Based on the accident investigation result by agricultural machinery, safety accident prevention measures were sought. Therefore, safety cover for V-belt in the power tillers, luminous painting on the rear door of the trailers, and attaching the luminous reflectors of trailer were attached as mandatory. Also, to prevent safety accidents in the agricultural machinery, research and development about lighting device for the night work in the power tiller, setting up the safety management standard of agricultural machinery, development of falling and collision warning device of agricultural machinery, and case studies of safety accident of agricultural machinery were performed and the results were reflected in the policy. Meanwhile, the research result about safety accident status investigation and safety device, structure of safety device, specification and systems of safety management in the domestic as well as foreign agricultural machinery were investigated and the results were reflected in the inspection standard and method of agricultural machinery to supplement the safety device and related rules in the agricultural machinery.

Also, publications for the safe use of the agricultural machinery through broadcasting media like TV and radio are being expanded. During busy farming seasons, the announcement for the safe use of the agricultural machinery was carried out through broadcasting media in all the villages to raise the awareness for the safety accident. In addition, training of safe use is being executed by preparing the course about the checking and maintenance for the safety device related part in the machinery as well as the technique for safety use of agricultural machinery. The publication booklets and pamphlets about safe use and safety accident for the agricultural machinery were made in the form of comics for easy understanding and distributed to the farmers through each agricultural extension office etc. These publication materials are also made to be used through internet. Especially, to prevent safety accident for the farmers in October when accident by agricultural machinery was prevalent, safety training and preventive activities of agricultural machinery is intensively driven by agricultural mechanization promotion law.

The agricultural machinery comprehensive mutual aid system was operated to compensate the loss during the safety accident occurring by the Agricultural Cooperative Federation. The agricultural machinery comprehensive mutual aid system is a kind of insurance which comprehensively compensates for the direct loss in the agricultural machinery and for the

accident occurred during the farm work operation of the agricultural machinery. The person who is more than 18 year old age can subscribe this system and the subjected agricultural machinery are nine kinds including power tillers, tractor, combine, and speed sprayer etc. Government supports the insurance premium as subsidy for 50% of subscription fees. Total numbers of subscription in the agricultural machinery comprehensive mutual aid system is 27,000. Among these, subscription rate of power tillers was 0.1%, tractors 15.5%, and combine 5.4% which is meager subscription rate. The agricultural machinery insurance system by property insurance is also being operated, but the subscription charges are high, thus the subscription rate is very low. Therefore, the insurance system which can protect the body and property of farmers from the safety accident and can be easily used by farmer is required.

Table 4-14 | Safety Accident Frequency During Farm Work by Agricultural Machinery

(case/100 units)

Agricultural machinery	2002	2005	2008	Remark
Power tiller	1.07	0.84	0.82	▽2.4%
Tractor	1.64	1.17	0.31	▽73.5%
Combine	0.73	1.18	0.37	▽68.6%

Source: National Agricultural Mechanization Research Institute, "Agricultural Mechanization Research Report"

2.4. Standardization of Agricultural Machinery Parts

The standardization of agricultural machinery has merits of easy service like repair and maintenance possible by increasing the compatibility of agricultural machinery parts, making the use of attachments convenient, and reduction in the production cost by mass production of sharing parts, and improving the industrial competitiveness by improving the production efficiency. Contrary to these merits, it can act as limiting factors in the technology development and the characteristics of manufacturer can be lost.

The industrial standardization project has started in full fledge at national level by enacting and promulgating the "Industrial Standardization Law" as a primary work in the Economy Development Plan in September, 1961. Afterwards, from the year 1961 to 1970 can be regarded as the introductory period of industrial standardization. During this time, basic frame for the industrial standardization was formulated and the Industrial Standardization Law was revised as the Law for Industrial Standardization. In the Law for Industrial Standardization, Korean Industrial Standard (KS), command of unity and simplification, and collective standard are specified. The industrial standardization works are handled by Korean Agency for Technology and Standards under the Ministry of Knowledge Economy.

2.4.1. Korean Industrial Standard (KS)

The standardization project in relation with agricultural machinery can be categorized into the specification control such as enactment, revision, confirmation, abolition of standard specifications and national standardization project like KS mark certification system, and international standardization project like ISO etc. The KATS has constituted the standardization review committee comprising the experts for the standardization of agricultural machinery to review and decide the necessary items like enactment and revision of the standards. The Korean Industrial Standard is enacted by notification from the KATS. Also, for the ISO international standardization activities, NAMRI was assigned as a convener organization for ISO/TC 23 (agricultural machinery and tractor technology committee) to participate in the enactment and revision activities for the international standards.

The standard specifications of agricultural machinery belong to the mechanical part (KSB) in the Korean Industrial Standard. It was started by enacting the KS for shovels and scoops (KS B 7351) and Methods of performance test for small-size land internal combustion engines (KS B 7361) for the first time. During the year 1960s, KS standard for manual agricultural implements was mainly enacted. During 1970s, with start of enacting the KS standard for power tiller, the enactment of KS standard was in fullfledged scale for the power agricultural machinery like hitch of attachments for power tiller. Afterwards, necessary standards were enacted and revised for every year. As a result, 67 standards were used in 1979 and 146 standards were used in 1989. However, as per the policy in the year 1990 that only necessary standards have to be controlled at national level and simple standards would be converted to the standards of related association or organization, 59 KS standards have been transferred as organization standard by the Korea Agricultural Machinery Industry Cooperative (KAMICO). Therefore, the number of KS standard related to agricultural machinery was reduced to 87. The standards which have been transferred were the standards for the small farm implements like hoe, and pickax etc., and simple parts like levers, connecting pin, cock, and oil discharge plug of the power tiller, power thresher and binder. Those standards have been the base of the organizational standard until now. Also, 19 standards including standard of simple parts like sickle, straight tube of mist & dust, and nursery box of rice transplanter were abolished, thus Korean Industrial Standard was reduced till 74 in numbers.

However, after 1999, standardization work was taken over by the Testing and Evaluation Division, NAMRI which handles the testing and inspection of the agricultural machinery, the research about standardization for increasing compatibility of agricultural machinery parts was performed systematically. The results were enacted as industrial standards. From the year 2001, ISO standard was translated into the Korean language and reviewed

as a part of international standardization policy of the Korean Industrial Standard, KS standard (marked as KSB ISO 0000 types) was enacted. In the year 2010, total 228 Korean Industrial Standard (142 for product standard, 66 for method standard, and 20 for passing standard) are being used. The standard is being enacted by Korean Agency for Technology and Standard. However, most of the standardization was performed by reviewing the investigations or researches and development results by the NAMRI and by the Korean Society for Agricultural Machinery.

The MAFF has requested trusted project of standardization for the major agricultural machinery to the Korean Society for Agricultural machinery. Therefore, command of unity and simplification standard for the 28 parts from seven kinds of machinery such as power tiller have been developed. NAMRI started performing the standardization research for the parts specification of agricultural machinery from the year 1981 and around 160 standards for 17 kinds of machinery such as rotary connecting shaft and starting handle for power tiller, oil filter for tractor and planting fingers for rice transplanter and testing standards were standardized and enacted.

Table 4-15 | Industrial Standardization Status of Agricultural Machinery

Category	Passing standard (unit)	Method standard (unit)	Product standard (unit)	Total (unit)
Tractor	10	32	50	92
Attachment for tractor	1	-	8	9
Power tiller	-	-	15	15
Cultivator	-	-	3	3
Rice transplanter	-	-	4	4
Combine	1	1	1	3
Seeding machine	3	-	1	4
Machinery for forestry	3	10	7	20
Others	2	23	53	78
Total	20	66	142	228

2.4.2. Command of Unity and Simplification

The command of unity and simplification system which decides the parts of Korean Industrial Standard such as shape and dimension of the products mandatorily comply to increase the compatibility of agricultural products within the scope of not hampering the creativity of the manufacturer and quality of product was introduced with the purpose of production cost reduction and protection of customer. Command of unity and simplification is mainly implemented on the agricultural machinery parts. It is a mandatory regulation, which if violated imprisonment for less than two years or penalty less than ten million KRW are imposed. The items designated as command of unity simplification are the 4 parts such as plowing depth adjusting wheels and screw, side clutch lever, and hitch of power tiller. 3 parts of farm engine like head light, water drain cock, injection port and cap for cooling water were also designated as command of unity simplification. After that, the part assignment was expanded to seek the compatibility and convenience in the repair of agricultural machinery parts. At the same time, the parts whose necessities were decreased were deleted.

In 1987, the Industrial Advancement Administration requested the research to the Korean Society of Agricultural Machinery to investigate the manufacturer, repair agency, and farmers who are using the agricultural machinery to find out the parts which needs unity and simplification. According to this results, 33 items were designated as the items of command of unity and simplification, thus total 95 parts were designated as the item for command of unity and simplification in 1987. In the year 1989, according to the policy that only necessary standards have to be controlled at national level and simple standards would be converted to the standards of related association or organization, thus 77 standards were eliminated and 18 standards were maintained as the item of command of unity and simplification. Most of the standards eliminated were converted into the corporation group standard of the KAMICO. After that, the the NAMRI proposed that the specifications such as hydraulic port of tractor designated as command of unity and simplification to the KATS. And these specifications were designated as the command of unity and simplification. While the standards whose necessities were not up to the mark were removed, therefore as of now year 2010, 47 parts of 8 machinery like power tiller and tractor are designated as command of unity and simplification items.

2.4.3. Corporation Group Standard

Corporation group standards are based in the Clause 28, Law for Industrial Standardization. The corporation group standards were enacted with purpose that the manufacturer of same business type wishes to protect the customers by seeking the productivity improvement, cost reduction, quality improvement, and compatibility improvement.

The corporation group standards for the agricultural machinery was to be enacted and operated by KAMICO. Since six standards including hitch pin of tractor and agricultural products dryer have been enacted for the first time, corporation group standard was either enacted or abolished as per necessity. In the year 2010, corporation group standards of 113 numbers are retained and operated.

Table 4-16 | Status of Command of Unity and Simplification and Corporation Group Standard

Machinery	Command of unity and simplification	Corporation group standard	Total
Power tiller	11	20	31
Tractor	16	4	20
Rice transplanter	4	6	10
Binder	-	7	7
Combine	4	4	8
Cultivator	5	8	13
Farm engine	1	7	8
Power sprayer	1	11	12
Power mist and duster	-	5	5
Automatic thresher	-	10	10
Agricultural water pump	-	1	1
Power cutting machine	-	2	2
Power mowers	-	1	1
Open and shut device	-	1	1
Hot air heater	-	1	1
Exhausting fan	-	1	1
Environment measures and control devices	-	10	10
Trailer forpower tiller	1	-	1
Rotavators	4	-	4
Others	-	14	14
Total	47	113	160

Source: Ministry of Agriculture, Forestry and Fisheries "Manual of agricultural mechanization affairs"

2.5. Supply of Tax-exempt Fuels and Application of Zero Value Added Tax for Agricultural Machinery

To reduce the farming cost for the farmers during agricultural machinery use, the fuels are supplied with exemption of various taxes imposed on fuels, namely value added tax, special consumption tax, traffic tax, education tax, and automobile tax as per the Special Tax Treatment Control Law. The agricultural machinery entitled to get supply of tax-exempt fuel are 37 kinds of machinery such as power tiller, tractor, rice transplanter and combine. Tax-exempt fuels are supplied based on the number of agricultural machinery and the yearly supply limit was set by the MAFF. The supply limit for one unit of agricultural machinery is calculated considering the fuel consumption per hour and then fuel is supplied by adjusting within yearly limit. In case received fuel amount is short, supply amount of fuel can be increased by submitting the proof documents like working areas etc.

The supply of tax-exempt fuel is handled by the NACF. The farmer who possesses the agricultural machinery must declare the kinds and model of agricultural machinery to the NACF. The NACF then issue the tax-exempt fuel purchasing card to the applicant as per the declared detail. Farmers have to purchase the tax-exempt fuel from the fuel station run by the NACF with tax-exempt fuel purchasing card. As per the prevailing fuel price of year 2010, the tax imposed oil price was KRW 1,497 but the duty free price was KRW 883 which gives around 48% of tax exemption benefit. The supply volume of tax-exempt fuel in a year is 1,898,000kl and the exempted tax amount is almost KRW 1,121 billion which greatly reduce the farming cost.

Table 4-17 | Supply of Tax-exempt Fuel and Benefited Agricultural Machinery [2010]

	Gasoline	Kerosene	Diesel	Heavy oil	Lubricating oil	LPG (ton)	total
Supply amount (1,000kl)	81.9	216.7	1,523.6	73.6	0.7	1.7	1,898,1
Tax exempted amount (KRW million)	73,600	41,800	998,900	6,100	20	20	1,120,800

Meanwhile, to reduce the purchasing burden for the agricultural machinery, value added tax which is imposed on all the goods 10% each is exempted for the agricultural machinery, equipments, and materials for animal husbandry and forestry based on the Special Tax Treatment Control Law from the year 1989. The agricultural machinery on which zero value added tax is applied are 32 kinds of agricultural machinery including tractor and its attachment, 39 items for equipments and tools for animal husbandry including automatic

feeder and 15 items for forestry including power saw for forestry. Though 32 kinds of agricultural machinery are exempted from taxation, since attachments of power tiller, tractor and cultivator are included, it can be said that all the agricultural machinery are entitled to get the exemption of the value added tax.

2.6. Preparation of the Base for Agricultural Mechanization

Agricultural mechanization and the farm land consolidation are closely associated. If the shape of cultivated land plot is irregular or the size of the plot especially the long side of the land is short, the turning time of the agricultural machinery become large which makes work efficiency reduced and drive becomes difficult thereby agricultural machinery cannot exhibit its capability properly.

Until the beginning of the year 1960, land consolidation was not actively performed, thus plot shape was not square but irregular. Also, the area where land consolidation was done was arranged for only irrigation purposes, either the size of the plot was small with no farm road or narrow farm road, the use of agricultural machinery could not but restricted. In the early 1960s, on the farm land whose productivity was low with less size, small and irregular ridge, and no farm road and irrigation and drainage canal, land consolidation projects were executed. However, this project was not driven by the government and land consolidation projects were executed by self-plan of some provinces. The project budget for materials was covered by the province and rest of the expenses was borne by labor allocation on the farmers in the beneficiary area.

At the initial stage of land consolidation, there was severe objection from farmers who had affection for their farmland, worries of reduction in the cultivated land and reduction of yield etc. However, after consolidation, it was possible to achieve convenient farming in the compartmentalized cultivated land equipped with irrigation and drainage canal. Besides, not only one-crop farming but also cropping after rice harvest was possible which made increases in the farm income for which farmer's response became favorable. Therefore, this land consolidation was driven as a government project from 1965. With progress of agricultural mechanization, supply of the agricultural machinery was also increased. Thus the land consolidation was rapidly driven centering the paddy field. When the Agricultural Modernization Promotion Law was enacted and promulgated in 1970, land consolidation project was executed with government subsidy at 50%, local budget at 30%, and self-funding at 20%. From the year 1983, land consolidation project was recognized as an essential project in the maintaining and retaining the agricultural base, the support by government was increased with 60% of government subsidy, 30% of local government finance, and 10% from the beneficiary self.

The required expenses were also covered by getting the loan from foreign financing sources like the International Bank for Reconstruction and Development (IBRD) the and Asian Development Bank (ADB). The criteria for the land consolidation project during 1970s was set as 20~30a scale considering pest control work, smallness of farming scale, and convenience of the land substitution. The width of main farm road was set as 5~6m for branch road 3.3~5m and 1.5~3.3m for cultivation road. During 1980s, as high efficiency large-scale agricultural machinery like tractor and combine were distributed, criteria of land consolidation were revised. In the revised land consolidation project, the size of the plot was set 30~40a. The width of the farm road was also increased to 7m for main road, 5~6m for branch road and 3.5~4m for cultivation road. At the crossing, ear notching was done for the agricultural machinery turning easy. Also, entrance and exit road was prepared at each plot.

During the year 1990, as the large-scale agricultural machinery like tractor and combines became common and farming pattern were also changed, the scale of the plot was expanded more than 1ha so that utilization of the agricultural machinery was increased. The width of the farm road also increased to around seven meter so that agricultural machinery like tractor can cross each other on the same road to shorten the movement time. Especially, the project was executed by including the subjected plots for the re-consolidation where either farm road was narrow or irrigation and drainage road were not equipped as among the plots that have been consolidated during 1960s~1970s. From the year 1992, the whole of the required expenses were met by government at 50% and local administrative bodies at 50% after excluding self-funding. The achievement of land consolidation was hardly 144,000ha until end of 1970, but land consolidation around 430,000ha was executed for the 20 year period from 1970 till 1990 which became one of the promotion factors of agricultural mechanization.

Table 4-18 | Cultivated Land Consolidation by Year

Before 1964	1965~1970	1971~1980	1981~1990	1991~2004	Total
42,743ha	101,703ha	224,248ha	208,483ha	143,919ha	721,096ha

3. Research and Development of the Agricultural Machinery

3.1. Research and Development Organizations for Agricultural Mechanization

The start of the research and development for the agricultural machinery may be the inspection and development and improvement of the agricultural machinery at the division of farm management technology, the Agricultural Experimental Station, Institute of Agriculture which was inaugurated in June, 1957. However, in the division of farm management technology, manpower was short at that time and it has both the research and development as well as inspection functions. It had to take the basic inspection and individual inspection for the agricultural implement like sickle, shovel, and plow, and agricultural machinery like threshers and power pumps etc. In addition, it would take the inspection for agricultural materials like the planting cord for rice transplanting as well as the adaptability test for the imported agricultural machinery like power tiller. Therefore substantial research and development for the agricultural machinery could not be properly performed.

After four years, in October, 1961, as the Experimental Station and Research Institute under Institute of Agriculture was re-organized as the departments under Experiment Bureau, the research and development for the agricultural machinery was stated to perform in agricultural machinery section, the Agricultural Engineering Division, Department of Agricultural Engineering and Utilization. During that time, agricultural management division and agricultural product utilization division were available along with agricultural engineering division in the Department of Agricultural Engineering and Utilization. Thus, the research and development for the agricultural management and agricultural product utilization were also carried out.

As the Rural Development Administration (RDA, former name Office of Rural Development, ORD) was opened in the month of March, 1962, the Department of Agricultural Engineering and Utilization were re-organized as the Institute of Agricultural Engineering and Utilization (IAEU). The research and development for the agricultural machinery were performed by agricultural machinery section, the Agricultural Engineering Division same as the time when the Department of Agricultural Engineering and Utilization was operated. The situation was not much improved for the research and development about agricultural mechanization. Amongst the agricultural research and development conditions, the inspection for the power tillers was started from 1963.

As a necessity for the agricultural engineering research to technically back up the agricultural development project like development of irrigation water source along with

agricultural mechanization by driving the Five Years' Economic Development Plan that started from April, 1965, the Agricultural Engineering Division under the IAEU was separated and re-organized into the Agricultural Engineering Division and Agricultural Machinery Davison, substantial agricultural research and development function at division level was equipped for the first time in our country. However, the number of researchers was just ten which was not enough to carry out even the performance tests for the agricultural machinery.

In July, 1966, the NAMII was inaugurated as a subsidiary organization under the MAFF and the inspection function of the agricultural machinery was transferred to the NAMII, from which the IAEU could be settled as a pure research and development institute for the agricultural machinery. The IAEU was again transformed into the research and development along with Agricultural Management Research Institute under the MAFF to drive the policy of efficient rural development and agricultural mechanization in Apr. 1970, but the IAEU again returned under the RDA through which it settled well as a pure research and development institute.

After four years, in 1974, the agricultural machinery division was separated and the agricultural machinery division and the farm work technology division was to be equipped with more efficient research and development system to promote the mechanization working system and operation technology, but the researcher were not reinforced regretfully.

As the necessity of promoting agricultural mechanization was brought up due to the deepening shortage of rural labor force year after year, increases in the aging and women populations in the rural area, the wage in the rural area was going up, and even with higher wages labor could not be easily arranged during springs and autumns of labor peak seasons, agricultural mechanization Promotion Law was enacted in 1978. The IAEU was re-organized to National Agricultural Mechanization Research Institute (NAMRI). The NAMRI was also designated for research and development for the investigation of agricultural machinery utilization and management, development and improvement of agricultural machinery and mechanization technology by establishing the integrate research division, first research division and the second research division. At this time, number of researcher was also increased to 25.

In the process of re-organization and posting the manpower, the research and development function of agricultural engineering which was under IAEU was transferred to the Institute of Agricultural Technology and Agricultural Development Corporation (ADC). However, these research and development function was not been activated and went on reduced or abolished which left regrets for the development of balanced agricultural technology through the development of technology in this fields. Afterwards, in November, 1981, the farm work technology division was re-organized as harvesting machinery division in order to promote

the post-harvest mechanization technology development as per the organization policy by government. Therefore NAMRI set up with utilization investigation division, cultivation machinery division and harvesting machinery division. In November, 1991, the research manpower was increased from 28 to 68 which could make a good base to drive the research and development about laborsaving mechanization research not only for the rice cultivation but also for the horticulture and animal husbandry which research was lacked due to shortage of researchers. However, it was regretful that the excellent researcher was not fully recruited in the process of expansion of researchers of more than double during a short period.

As the government organization was re-framed mainly integration and closed down the organizations having the similar functions during December, 1994, the NAMRI had the agricultural machinery quality division newly opened by absorbing the inspection function and manpower of agricultural machinery from the NAMII. Therefore, after 27 years of separation of research and inspection of agricultural machinery, it was again equipped with both the research and inspection functions for the agricultural machinery to settle as a true to the name research and inspection expertise institute for agricultural machinery. Also, utilization investigation division was re-organized as agricultural facility machinery division to promote mechanization of controlled agriculture which is technology and capital intensive industry so that the organization was established with cultivation machinery division, processing machinery division, agricultural facility machinery division, and agricultural machinery quality division. In the year 1995, the NAMRI was designated as testing and evaluation institute for the agriculture and forestry tractor for the OECD that improved the testing and evaluation function for the agricultural machinery at international level. Also, the NAMRI was designated as a performance-based organization by open recruitment of its general director as contract base. The NAMRI, as of year 2002, is formed of five divisions, Administration Division, Basic Technology and Machinery Division, Bio-Production Machinery Division, Agricultural Product Processing Machinery Division and Testing and Evaluation Division along with 17 research laboratories. Total number of researcher is 114, among which two are on a contract basis, 75 are in the research and inspection post, seven for the administration work, and 30 technicians.

In the year 2004, the NAMRI was re-organized as the National Institute of Agricultural Engineering (NIAE) to which agricultural engineering functions like irrigation and drainage, agricultural facility and agricultural energy were added. The NIAE was incorporated with the Agricultural Engineering Department of National Academy of Agricultural Science, the RDA (Rural Development Administration). The function of inspection for agricultural machinery was transferred to the Foundation of Agri. Tech. Commercialization and Transfer (FACT) following the government re-organization in 2009. As of 2010, the National Institute of Agricultural Engineering is constituted with four divisions, namely agricultural disaster

prevention division, energy environment engineering division, production automation machinery division, and post-harvest quality division.

Table 4-19 | Change of Research Organization for Agricultural Mechanization

Year	Name of organization	Name of division
Oct. 1961	Department of Agricultural Engineering, Bureau of Research, Institute of Agriculture	Agricultural Machinery Section, Agricultural Engineering Division
Mar. 1962	IAEU, RDA	Agricultural Machinery Section, Agricultural Engineering Division
Apr. 1965	IAEU, RDA	Agricultural Machinery Division
Apr. 1970	IAEU, MAFF	Agricultural Machinery Division
July 1973	IAEU, RDA	Agricultural Machinery Division
Dec. 1974	IAEU, RDA	Agricultural Machinery Division Farm work Technology Division
Dec. 1979	NAMRI, RDA	General Research Division, First Research Division, Second Research Division
Nov. 1981	NAMRI, RDA	Utilization Investigation Division, Cultivation Machinery Division, Harvesting Machinery Division
Dec. 1994	NAMRI, RDA	Cultivation Machinery Division, Processing Machinery Division, Facility Machinery Division, Agricultural Machinery Quality Division
Aug. 1998	NAMRI, RDA	Basic Technology Machinery Division, Bio-Production Machinery Division, Agricultural Product Processing Machinery Division, Testing Evaluation Division
Jan. 2004	NIAE, RDA	Production Foundation Machinery Division, Production Machinery Division, Post-harvest Handling Machinery Division, Utilization Technology Division
Oct. 2008	Agricultural Engineering Department of National Academy of Agricultural Science, RDA	Primary Technology Engineering Division, Facility Resources Engineering Division, Production Machinery Division, Post-harvest Management Engineering Division, Utilization Technology Engineering Division
June 2009	Agricultural Engineering Department of National Academy of Agricultural Science in RDA	Agricultural Disaster Prevention Division, Energy Environment Engineering Division, Production Automation Machinery Division, Post-harvest quality Division

3.2. Research and Development System for Agricultural Mechanization

Agricultural mechanization research and development is comprised of research which can back up the agricultural and agricultural mechanization policy of a country, technology development that can solve the problems and difficulties occurring at rural area, and agricultural mechanization technology development to lead the future.

Agricultural mechanization research and development is performed by government budget for almost all the research. Extremely small portion of the researches are being performed as a contract project from external sources. The budget for research and development for agricultural mechanization is processed as required budget is asked with research target and major research tasks per different field in each year, then it is confirmed as the research budget by the review of budget department in the RDA and government. Research and development budget for agricultural mechanization is comprised with budget for research equipment, facility and ordinary research budget that is consist of budget for the materials, tour of duty, and daily laborer's wages. The budget is organized and executed at one year unit.

Agricultural mechanization research project is selected among projects mainly from the projects which are demanded by agriculture or agricultural mechanization policy executing department such as the MAFF, the projects proposed to solve the problems at rural site such as agricultural extension organization, farmers, and agricultural machinery manufacturers. The research plan is then prepared and then confirmed through review by self and research project designing review committee comprising related experts from agricultural machinery policy executing departments, universities, agricultural extension offices, and agricultural manufacturers and farmers.

Research project is comprised of the project that is being executed only with the research manpower from the institute and the joint research project which is being executed jointly with universities, related organizations like agricultural experiment station, and manufacturer. The number of the joint project is gradually being increased.

The evaluation of the research project is comprised of the interim evaluation and the comprehensive evaluation which was executed at the end of the year. In the comprehensive evaluation, the actual utility, distribution possibility, and spreading effect for the completing project are reviewed. The utilization plan of the research result like proposal for the government policy and reflection in the agricultural extension project is reviewed and decided. For the incomplete projects, the necessity of continuation, the items to be supplemented and direction are discussed based on the research result till then. Comprehensive evaluation is also comprised of self-review meeting and agricultural research evaluation committee

meeting comprising the experts from related fields same as designing review meeting. According to the decided contents from the comprehensive evaluation meeting, the research results are arranged and proposed to the policy executing department in the government. Also, it is requested to be reflected as agricultural extension project. Then, each department reviews the project and either adopt it as a policy or reflect it as an agricultural extension project so that the technology is distributed to the farms.

The agricultural machinery newly developed for the mechanization of farm work whose mechanization is lacking is technically transferred to the agricultural machinery manufacturer. Prototype manufactured machinery can be prepared and then the actual utility test is carried out at the farm household field throughout one to two years period. The problems surfacing from the field trial test are modified and supplemented, the effect, actual utility, and distribution possibility are reviewed, and then these would be distributed after producing from the factory with discussion with manufacturers. The transfer of the developed technology to the industry is carried out after the farm trial test at field of farm household, technical transfer is carried out to one to two manufacturers considering the distribution aspect. The technology so transferred is to make obtain industrial property right like patent etc., to protect intellectual property right. The research result is publicized in the form of report annually.

The research results are being utilized via publication of theses in the academic journals, proposed as policy, reflected in the extension project, and application for the industrial property right etc. The capability of the researcher is evaluated based on the research output.

3.3. Research Trends for Agricultural Mechanization

In the year 1965, the substantial agricultural mechanization research was started in our country. At that time, the Agricultural Machinery Division was newly opened in the IAEU, RDA. During that time, researches about water pumps and pest control machinery which can prevent drought and diseases which created large problems in stable rice production along with development and improvement research for the animal drawn and manual agricultural machinery and equipments. Also, the adaptability test for power tillers which was distributed after going through the adaptability test etc., was carried out at the beginning of 1960s.

During 1970s, research was concentrated on the development of attachment to expand the use of power tiller which was distributed as a technology replaced the animal power. Great achievements were made in the research and development to improve the adaptability of rice transplanter and harvesting machinery like binders and combines to resolve the labor peak that is yearly occurring during rice transplanting and harvesting time. During 1980s,

the research and development for the technology to establish fully mechanization of paddy rice cultivation and post-harvest technology development such as drying and sorting etc., were the main subjects.

During 1990s, mechanization and automation technology development for the controlled agriculture like horticultural crops and animal husbandry whose laborsaving mechanization demand was increased and were the major subjects along with mechanization technology development with large scale in the rice cultivation. Meanwhile, the future-oriented agricultural machinery development was also set forth such as agricultural robot, precision farming and for environment preservation. During year 2000s, mechanization technology development for the evaluation and differentiation of quality and stability improvement, and high-tech agricultural machinery technology such as high efficiency eco-friendly precision farming machinery technology, agricultural robot, and plant factory, non-destructive quality judgment of the agricultural product etc., were mainly carried out.

During 1960s, mechanization technology development was mainly performed for the countermeasure against manual and cattle drawn agricultural equipment and disaster measures. At that time, modification researches to improve the performance and handling properties of the agricultural implement which were used by manpower or animal power. As a research outcome, "Jaegeon" plow, "long hand hoe" "Buheung" seeding machines were developed and distributed. Along with these, distribution of power tillers was promoted by establishing working technology and system through adaptability test for the power tillers. During 1970s, as improvement of utility of power tillers whose distribution to farms became increased, research was concentrated on attachments to mechanize the food crops like rice and barley. As the research outcome, rotary type seeding machine for barley and drill seeder have been developed and distributed.

Also, for the mechanization of rice transplanting and harvesting which have labor competition, various types of rice transplanter and harvester were introduced and adaptability tests were carried out. After that, either the agricultural machinery which was suitable for our situation were selected or localization was carried out which greatly attributed in promotion of agricultural mechanization during rice transplanting and harvesting. Furthermore, development of sun-drying technology for paddy rice which can reduce broken rice and grain storage bin of ambient temperature and ventilation type which can store at farm level were developed and distributed.

During 1980s, researches for not only the development of new agricultural machinery but also mechanization of post-harvest management of agricultural product as well as raising the utilization of agricultural machinery were comprehensively carried out. For the rice cultivation technology was carried out to mechanize from plowing and soil

preparation to harvest. Agricultural machinery like lime spreader, ridge nozzle with which pesticide spraying is possible without entering into the paddy field, reapers, straw cutter were developed and distributed. To improve the utilization of power tiller, multi-purpose small power tillers which can be used in a variety of purposes like rice transplanting and harvesting due to its light weight for easy handling was developed. This multi-purpose small power tiller was developed into the cultivator that is widely being used for the uo land crops. The development of agricultural machinery for the labor-saving for field crops whose mechanization was lacked was fully activated. Various kinds of agricultural machinery like drum seeders for attaching to tractor by which 12 crops can be planted like barley and beans, various kinds of vinyl mulching machine which is by manual or can be attached on the power tiller, fruit grader by weight which sorts the fruits like apples, pears, and peaches according to its weight, and shape sorter. The cocoon harvesters which collects cocoons and even cleans the cocooning frame also reduced the work of farmers. Besides, as the utilization investigation division was installed in 1981, the research on the utilization of agricultural machinery like utilization status survey, safety use, standardization of the part specification and efficient repair measures for the agricultural machinery were broadly carried out to improve the utilization of agricultural machinery.

The NAMRI, during 1990s, concentrated on the mechanization technology development which can improve the productivity. The mechanization in the rice cultivation was directed largely towards three directions, i.e., mechanization of direct seeding to reduce the production cost, mechanization technology for large-scale rice farming, and mechanization technology for rice processing complex. The mechanized working system by rice cultivation method like rice transplanting and direct seeding, and adequate mechanization model per farming scale was developed and reflected on the national policy. Besides, the mechanization technologies of comprehensive rice processing such as automatic evaluating machine for rice quality and milling recovery, cooling device of paddy rice and rice polisher that remove the rice bran on the rice surface were developed and distributed.

For the mechanization of the horticultural crops, cropping pattern was standardized suiting the mechanization for major crops like cabbages and garlic. The mechanization model per different farming scale was developed and the research for the mechanization of the crops for which mechanization was lacked was actively progressed. Along with the mechanization technology development for the cultivation and management such as riding type small tiller and cultivators, mechanization technology development in seedling operation was achieved such as vacuum seeding machine. Besides, mechanized models for the major farming operation in which intensive labor force is input such as harvester for the underground crops like potato, radish, cabbage, and leek were developed. Meanwhile, the research on high quality drying technology like far infrared dryer to dry with high quality

of the special crops like mushroom, washing mechanization for the horticultural crops like radish, carrot, and pepper, cold chain technology like air pre cooling system by differential pressure, development of technology to maintain high humidity and automatic environment control system in low temperature storage house were carried out and the results were distributed to farm households. Especially, the machinery which can fully mechanizes all the process from planting to harvesting, sorting, and separation was developed and distributed for the competitiveness of garlic.

Besides, research for the mechanization technology for the controlled horticulture which has been abruptly increased since end of 1980 was carried out. The assembly materials for plastic houses, light-weight steel houses and glass houses such as frame, roof ridge, and rafters were developed and disseminated. Also, mechanization technology of farm work inside controlled horticultural crops like irrigation and pest control etc., was developed. Further, research on heating energy reduction and alternative energy development and utilization for controlled horticultural have been started.

During the 2000s, research and development about automation of farm work, agricultural robots, unmanned driving technology, precision farming machinery technology, and non-destructive quality judgment technology for the agricultural products were started. For rice cultivation, large-scale mechanization technology with eco-friendly low cost was focused. As an outcome, side dressing type rice transplanter and paper mulching type rice transplanter that can make eco-friendly rice cultivation without pesticide application were developed and distributed. For up land crops and horticultural crops, research and development were concentrated on the mechanization in the planting and harvesting where labor force is largely required. Therefore, automatic vegetable transplanter using plug seedling was developed. This vegetable transplanter can plant peppers, cabbages, Chinese cabbages, beans and corns. Also, semi-automatic onion planter, ginseng planter etc., were developed and distributed in rural area. Beans cutter and beans combine, onion harvester which can carry work from digging, collection till putting into bag after cutting the stem, ginseng harvesting machine for tractor were developed which prepared mechanization base of the most important planting and harvesting work.

In addition, for the mechanization for rape cultivation which is driven by government for the production of bio-energy raw materials, rape seeding machine and conventional type combine harvester were modified to make rape combine which can harvest rape. Also, mechanization technology for processing on site and cold chain system of horticultural crops, hot water washing mechanization technology for paprika, washing and sterilization of grape, strawberry, and leafy vegetable. Cold chain system and highly durable corrugated fiberboard boxes for cold chain system were also developed and distributed.

Meanwhile, with increases in demand for the high quality agricultural products, non-destructive quality judgment technology was developed by which appearance quality like color of the agricultural products and internal quality like sugar contents and acidity can be measured by non-destructive way. Image processing sorting system was also developed which can sort the fruit according to shape and color. In year 2000, basic technology which can judge the sugar contents and acidity can be judged using near infrared rays was developed. With this system, without damaging the agricultural products, 10,800 numbers of apples, pears, peaches and persimmons could be sorted in real-time with error within 1% of Brix. Also, non-destructive sorting machine through near infrared rays for grape and strawberries were developed. This system was distributed to the processing station at production site enabled to realize the distribution of the agricultural product according to the internal quality. Apart from this, rice composition analyzer which can judge the protein contents and fatty acid by which freshness can be figured out using near infrared rays, hot taste jugging device for chili powder etc., were developed. Water melon sorter which judges internal quality using sound wave which is generated when agricultural product is lightly knocked and the technology to sort the eggs with minute crack (cracked egg) were also developed and distributed.

Also, harmful substances judging device that can detect *Salmonella enteritidis*, residual pesticide and heavy metals in the agricultural product real-time were also being developed. Mechatronics research and development in which electronics and agricultural machinery are combined for the technology development in the 21st century are being driven. By this effort, unmanned farm tractor which can drive and carry out farm work without driver using GPS and automatic navigating system, unmanned rice transplanter, unmanned farming helicopter which can perform direct seeding and pest control were also developed. Vegetable grafting robot that can automatically cut the scion and rootstock, grafting, and fix them together with clip was developed for the automation of vegetable grafting work. This grafting machine was once exported to abroad. The technology which can measure and collect the agricultural data like yield of paddy rice, soil property etc.

Real-time precision farming and mechanization technology which carry out automatically the farm work such as fertilizing and spraying of pesticide based on the soil and yield information. During 2000s, in the controlled horticultural fields, the research and development related with energy reduction for saving heating cost inside the controlled horticultural facility following oil price hike. Heat insulation covering materials to reduce the heating energy loss inside the plastic house, automatic rewinding type thermal tunnel which can insulate only the minimum space where crop is cultivated, and automatic ventilation device were developed and distributed.

Research and development which greatly contributed towards saving the energy in heating and cooling in the controlled horticultural farms by developing the exhaust heat recovery device from hot air heater using heat pipe, heat recovery ventilator by collecting the thermal energy during ventilation and return to the greenhouse, heat-pump type heating and cooling system for green house that can warm up and cool the greenhouse using heat pump, and dehumidifier were also developed and distributed. Also, by developing and distributing the horizontal and vertical type terrestrial heat pump system that can save 75% of heating cost of greenhouse using terrestrial heat, greatly attributed in energy saving in green house in winter season. In addition, the system which can warm up the green house using the waste energy from thermoelectric power plant was also developed.

Besides, 36 models of disaster-resistant plastic houses and disaster-resistant type livestock barn were developed by considering the amount of snowfall and wind speed in each area to minimize the damages by natural disaster. These disaster-resistant models were supplied by notification of the Ministry of Agriculture, Forestry, and Fisheries. Horizontal type plant factory from which fresh and clean agricultural products can be automatically produced in a planned manner in industrial factory was developed. Along with plant factory, automatic control device for spacing between plants, automatic environment control system of greenhouse such as nutrient solution, and automation cultivation system for crop transplanting and harvesting were developed. Recently, the research for the vertical type plant factory is also being progressed.

Meanwhile, the researches and development to reduce safety accidents during farm work is being carried out. In order to reduce the safety accident and increase the availability of agricultural machinery, the investigation study about safety accident of agricultural machinery carry out every three years. The results of investigation study were used in training and guidance materials to reduce the safety accidents of agricultural machinery. To drive agricultural machinery lease project efficiently and continuously, lease business execution guideline is prepared through the research of technology development for the standardization of lease industry. And this guideline distributed to the agricultural extension office and is attributed the safe and efficient use of agricultural machinery. If the research projects which have been carried out from.

Looking at the 1960s to 1990s by crop, farming work, and research kinds, we can observe that the research about agricultural mechanization was also kept changing according to agricultural policy and technology development. In 1960s, as the research and development by different crops, almost all the research and development carried out for the stable food crops as the item related with rice cultivation occupied 73%, the items related with up land crops occupied 24%. During 1970s, the weight of research about up land crops like barley and sweet potatoes was somewhat reduced and the research about horticulture and

animal husbandry were increased. However, those researches for the mechanization of rice cultivation still occupied more than 70% of total research outputs. From the later stage of 1970s, with supply of rice transplanter and harvesting machine and the frame for fully mechanization in the rice cultivation was prepared, the research and development about agricultural mechanization in the rice cultivation was gradually decreased. The research and development about mechanization of the rice cultivation were reduced to 43% of total in 1980s. Instead, the research about mechanization of upland crop and horticultural crop like beans etc., were rapidly progressed to occupy the volume 48% of total research project.

During 1990s, research projects related with mechanization in the rice cultivation was in continuous decreasing trends so that the weight was reduced to around one fourth. The research for upland crops also abruptly decreased at around 4% of total researches conducted. On the other hand, the mechanization for the horticultural crops was sharply increased to occupy around 60% of research project because of the UR agreement in the early 1990s and agricultural market was opened thereby production cost reduction and technology development for high quality products were in dire needs for the improvement of international competitiveness along with improvement in life standard which led increases in demand for the high quality fresh vegetables, fruits and flowers. Though the mechanization research and development for the animal husbandry was in continuously increasing trends, the weight was not even 10% level, thus considering the importance of animal husbandry, reinforcement and technology opening for this field has to be more strengthened.

On the other hand the largest research projects were performed on the mechanization of seeding and transplanting, harvesting, and threshing operation by the kinds of farm work. The reason being, these works are highly labor intensive farm work with much effort, the demand for the mechanization was high and the laborsaving effect was large. There have been many research and development as measures to continuing disaster and diseases control during the year 1960s, thereby the mechanization research and development related to the pest control and water management project occupied more than one thirds of total research project but these research project was decreased gradually to 10% level in the year 1990s.

The research on mechanization for the post-harvest management like processing of agricultural products to improve the added value on the harvested agricultural products remained at 17~18% level during 1970s~1980s, but with increases in the demand for high quality agricultural products and for the promotion of mechanization in the post-harvest management from 1990s, the Processing Machinery Division was established in the year 1994. Therefore, the weight of research in this field occupied around 45% of total research projects. Lastly, the researches project for agricultural mechanization by the characteristics,

the research for the development and improvement of the agricultural machinery was the largest with weight of 53% followed by the researches about mechanized work and working system at 27%, and efficient use of agricultural machinery such as breakdown, repair, utilization status investigation, and parts standardization at 20%.

This trend might have been attributed by focusing the application research for the resolution of difficulties occurred in the rural area in the course of rapid drive of agricultural mechanization rather than the basic researches activities. After the year 1980 when NAMRI was established, 237 projects was reflected in the government policy and 106 projects in the agricultural extension project. It has applied industrial property right of total 217 cases. Though the application cases for the Industrial property were just 17 cases in the 1980s, the number of application was increased to 200 cases. Before 1990s, the subjects for industrial property were mostly field machinery, but after 1990s, the contents of the industrial property was diversified and made sophisticated such as automation equipment for farm work, agricultural robots, unmanned machinery, machinery for the controlled horticulture, post harvesting machinery, and non-destructive quality evaluation technology of the agricultural products.

Figure 4-1 | Agricultural Machinery Developed by NAMRI

Lime spreader

Vinyl mulching machine

Weeding machine

Ridgeseeder

Drill seeder

Flooded paddy seeder

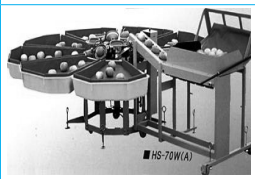
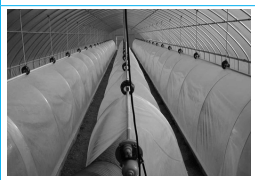
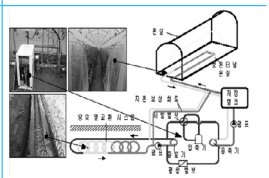
		
Paper mulching rice transplanter	Vegetable Grafting robot	Vegetable transplanter
		
Bean harvester	Onion harvester	Leek harvester
		
Red peper washing machine	Fruit weight grader	nondestructive sorter
		
Unmanned tractor	Automatic tunnel opener	Earth heat heating system

Table 4-20 | Weight of Agricultural Mechanization Research by Crops

(unit: no of project, %)

Category	Rice	Up land crop	Horticulture	Animal husbandry	sericulture ·mushroom	Total
1960	24 (72.7)	8 (24.2)	-	1 (3.1)	-	33
1970	50 (70.4)	10 (14.1)	6 (8.5)	4 (5.6)	1 (1.4)	71
1980	63 (42.9)	33 (22.4)	37 (25.2)	9 (6.1)	5 (3.4)	147
1990	43 (23.7)	8 (4.4)	106 (58.2)	15 (8.2)	10 (5.5)	182
Total	180 (41.6%)	59 (13.6%)	149 (34.4%)	29 (6.7%)	16 (3.7%)	433 (100%)

Source: National Agricultural Mechanization Research Institute, "The 40 years of research and development for agricultural mechanization"

Table 4-21 | Weight of Agricultural Mechanization Research by Farm Work

(unit: no. of project, %)

Category	Tillage	transplanting ·sowing	Fertilization	Pest control	harvest ·threshing	Processing	drying ·storage	sorting · ackage	Total
1960	2 (6.9)	8 (27.6)	6 (20.7)	4 (13.8)	5 (17.2)	1 (3.4)	3 (10.3)	-	29
1970	10 (16.1)	12 (19.4)	9 (14.5)	3 (4.8)	17 (27.4)	3 (4.8)	8 (12.9)	-	62
1980	11 (8.2)	33 (24.6)	18 (13.4)	9 (6.7)	39 (29.1)	7 (5.2)	10 (7.5)	7 (5.2)	134
1990	7 (7.1)	17 (17.3)	10 (10.2)	6 (6.1)	14 (14.3)	14 (14.3)	11 (11.2)	19 (19.4)	98
Total	30 (9.3%)	70 (21.7%)	43 (13.3%)	22 (6.8%)	75 (23.2%)	25 (7.7%)	32 (9.9%)	26 (8.0%)	323

Source: National Agricultural Mechanization Research Institute, "The 40 years of research and development for agricultural mechanization"

Table 4-22 | Weight of Agricultural Mechanization Research by Subjects

(unit: no. of project, %)

Category	Development ·improvement	Work skill ·method	Utilization of agricultural machinery	Total
1960	18 (51.4)	16 (46.7)	1 (2.9)	35
1970	39 (45.3)	41 (47.7)	6 (7.0)	86
1980	88 (49.2)	45 (25.1)	56 (31.2)	189
1990	131 (62.1)	39 (18.5)	41 (19.4)	211
Total	276 (53.0%)	141 (27.0%)	104 (20.0%)	521 (100%)

Source: National Agricultural Mechanization Research Institute, "The 40 years of research and development for agricultural mechanization"

Table 4-23 | Utilization Status of Agricultural Mechanization Research Results (after 1970)

	Utilization of result								Total			
	Policy				Extension project							
	'70	'80	'90	Total	'70	'80	'90	Total	'70	'80	'90	Total
Development Improvement	17	64	101	182	-	3	53	56	17	67	154	238
Utilization	5	25	25	55	3	15	32	50	8	40	87	135
Total	22	89	126	237	3	18	85	106	25	107	241	373

Source: National Agricultural Mechanization Research Institute, "The 40 years of research and development for agricultural mechanization"

Table 4-24 | Status of Industrial Property Application by NAMRI

Category	Total	Duration			
		'71-'80	'81-'90	'91-2000	2001-2002
Prime movers and tillage machinery	3	1	1	1	-
Transplanting and seeding machinery	30	3	5	10	12
Pest control machinery	2	-	1	1	-
Dressing machinery	3	-	1	1	1
Harvesting machinery	14	1	2	6	5
Processing machinery	23	-	1	16	6
Drying·storage machinery	15	-	-	8	7
Sorting·packaging·distribution machinery	28	-	-	11	17
Machinery for animal husbandry	11	-	-	6	5
Machinery for controlled horticulture	42	-	-	42	-
Machinery for mushroom cultivation	7	-	-	3	4
Automatic control	19	-	-	10	9
Agricultural energy	12	-	-	6	6
Others	8	1	-	4	3
Total	217	6	11	125	75

Source: National Agricultural Mechanization Research Institute, "The 40 years of research and development for agricultural mechanization"

4. Education and Training of Agricultural Machinery

It is more important than anything to carry out education and training to the farmers who don't know about the agricultural machinery to make them use agricultural machinery properly by teaching the basic theory, checking and maintenance, and operation skill of agricultural machinery to efficiently promote agricultural mechanization. For the education and training of agricultural machinery, first of all, the instructor who have the knowledge and capability to execute the education and training, positive-minded farmers and the training media such as facilities, equipment, and texts are required.

Before the year 1969, though some of the training about agricultural engineering such as carpentry and earth work was executed, but education and training about agricultural machinery almost has not been carried out. It can be the first training of agricultural engineering in Korea that the carpentry and earth work training for the 4-H members over two weeks of period after receiving the donation of one set of carpentry tools from the American-Korean Foundation in the year 1960. After achieving the remarkable effects in the repairing the houses or cattle sheds in the actual fields by 4-H members trained this course, 4-H Agricultural Engineering Training Centers were established in 13 areas at each province from the year 1962. In the 4-H Agricultural Engineering Training Center, training of carpentry, earth work, and iron work was executed for 181 numbers of 4-H until the year 1969. From 1960s, with increased in the distribution of the power agricultural machinery for disaster measure like water pumps and power sprayer including power tillers, the necessity of technical training about agricultural machinery has started on the rise. Accordingly, the government conducted education and training to foster expertise in technical manpower for the agricultural machinery by establishing the Farmers Training Center in the year 1969. At local level, the Farmers Training Institutes were set up in each province and the Agricultural Machinery Training Stations were installed at county level to execute the systematic training of operation and mechanized farm work techniques for the power tiller, water pump, prime mover, power sprayer etc., to the farmers.

Meanwhile, with expansion of agricultural machinery distribution, the demand for professional manpower was increased throughout the agricultural machinery industry suchg as strategy for agricultural mechanization, research and development, training and extension, production and distribution, and after service etc. Ultimately, the necessity of education for the agricultural machines is also increased. Therefore, from the end of 1960s, department of agricultural machinery was opened in the agricultural high school to foster the senior technological manpower. Also, major courses in agricultural machines were installed in the department of agricultural engineering in the agricultural university and started educating high level technical manpower. These major courses about agricultural machinery were expanded and developed to an agricultural engineering department to supply the technological manpower required in the fields of research about agricultural machines, extension, production, distribution, and after service etc., which actively supported agricultural mechanization policy of the government. Therefore, these efforts became the basis to achieve the mechanized agriculture in a short duration.

4.1. Training of Agricultural Machinery

4.1.1. Training Institution of Agricultural Machinery

From the 1960s, as agricultural machinery for disaster measure such as water pump, power sprayer, and power tiller were distributed for the self-sufficiency and stable production of rice which is staple food grain, the necessity of technical training for the proper handling and operation method of agricultural machinery have been on the rise.. Therefore, the RDA Directives No. 69 was enacted. Accordingly, the National Agricultural Machinery Training Center (NAMTC) under the RDA was established. As a part of training to foster the expertise technical manpower, the education and training of agricultural machinery such as water pump, power sprayer and power tiller which started to widely disseminated, was begun for the agricultural extension officers and agricultural machinery instructors. Also, over two years during 1969 to 1970, 4-H agricultural engineering training station where carpentry and earth work were intensively executed were re-organized and enlarged. As a result, farmers training center and 4-H member's training farms under farmers training center as sub-organization of Agricultural Research and Extension Office at provincial level have been established. Agricultural machinery training to the elite 4-H members was executed about the handling and operation method of agricultural machinery like power tiller, prime mover, water pump, and power sprayer for over the period of six to eight weeks during each training session.

Besides, with full-fledge dissemination of agricultural machinery by the Five Year Plan for agricultural mechanization framed in the year 1972, the demand for the training of agricultural machinery was sharply increased. At that time, it was difficult to achieve the actual effect with the little training which was carried out for the handling method to the actual users who purchased agricultural machines by agricultural machinery manufacturers. Therefore, the training about the handling techniques of small and medium scale agricultural machinery including the power tiller has started by supervising the RDA. Accordingly, agricultural engineering training stations where training focusing on the carpentry and earth works for the youth in rural area that had been carried out at county level was expanded and re-organized. For that, 100 engineering training centers were set up to carry out the training of handling and operation for the disaster measures machinery such as power tiller, power sprayer, and water pump. The agricultural engineering training centers were established, one center each at 144 cities and counties all over the country until the year 1974.

Table 4-25 | Number of Agricultural Engineering Training Center in Province (year 1974)

Total	Gyeonggi	Gangwon	Chungbuk	Chungnam	Jeonbuk	Jeonnam	Gyeongbuk	Gyeongnam	Jeju	Metropolitan cities
144	16	15	10	15	13	21	23	20	2	9

Source: National Agricultural Mechanization Research Institute, "The 40 years of research and development for agricultural mechanization"

The technical training for the operation and management of farm tractors, large sized agricultural machinery, was decided to be separately carried out by the Agricultural Development Corporation (ADC) which possessed and used several heavy machinery and equipments for construction. Some of the training for tractors was executed by ADC using governmental subsidy in 1972. However, the supply of tractor was limited, demand for the training was less and ADC was not a training and extension organization. This training was temporarily executed at the initial stage, but soon stopped which did not have big impact. Therefore from the year 1975, the technical training for tractors also became supervised by RDA which is national research and extension organ so consequently a comprehensive and systematical training for the agricultural machinery could be carried out.

Also, an agreement was made for the agricultural machinery technology cooperation project with the government of United Kingdom in the year 1972 to modernize the facilities and equipments for the training of agricultural machinery and to foster the professional manpower equipped with high level techniques. Over the next five years, 26 units of tractors and 109 units of 5 kinds of its attachment, 4 units of small tillers, 30 units of power sprayers, 13 units of patrol wagons for repair, and over 3,500 sets of maintenance and repair equipments were supported from the United Kingdom. These agricultural machinery and equipment for training were distributed in central and county level training center of each province, and it was reinforced the training ability of agricultural machinery in Korea. At the NNMTC, professional manpower for agricultural machinery was trained by training course for one~two years with technical support by British expert of agricultural machinery. The trained manpower could be utilized as training instructors and expert technicians for repair of agricultural machinery. Also the base frame could be prepared for the training of large-size agricultural machinery such as farm tractor etc.

Also, in the year 1981, 30 agricultural extension offices (currently the Agricultural Technology Center) at county level where transportation were convenient and which were centers in the region were designated to strengthen the training for the agricultural machinery. And large-scale agricultural machinery such as farm tractor and combine harvester and training equipments which led modernization of facilities and equipments for

the agricultural machinery training were supported at these extension offices. Even now, more than 300 agricultural machinery and equipments focusing the high-tech agricultural machinery which are newly distributed are supported as government subsidy projects. Apart from this, agricultural machinery workshop (practical lab) of scale 165m^2 was newly built at the Agricultural Technology Center (ATC) at cities and county level by government support to strengthen the education and training of agricultural machinery from year 1992. The basic frame of modernization in the facilities and equipments for the training was therefore prepared.

Table 4-26 | Equipment Possession Status of Education and Training for Agricultural Machinery (2011)

	Tractor	Power tiller	Rice-transplanter	Power sprayer	Harvesting machine	Cultivator	Cutting models	Others	Total
Center	14	9	8	16	12	10	32	80	181
Province	80	43	63	48	76	52	38	251	651
city·county	390	148	264	301	328	310	322	2,777	4,840
Total	484	200	335	365	416	372	392	3,108	5,672

Source: Ministry of Agriculture, Forestry and Fisheries "Manual of agricultural mechanization affairs"

Table 4-27 | Status of Education and Training Facilities for Agricultural Machinery (2011)

	Lecture room (m^2)	Practical lab. (m^2)	Garages (m^2)	Practical field (m^2)	Hostel (m^2)
Center	320	2,315	2,010	9,900	1,630
Province (9 places)	8,045	2,191	6,354	49,132	7,819
city·county (160 places)	13,343	20,124	39,285	57,572	4,376
Total	21,708	24,630	47,649	116,604	13,825

Source: Ministry of Agriculture, Forestry and Fisheries "Manual of agricultural mechanization affairs"

4.1.2. Education and Training System for Agricultural Machinery

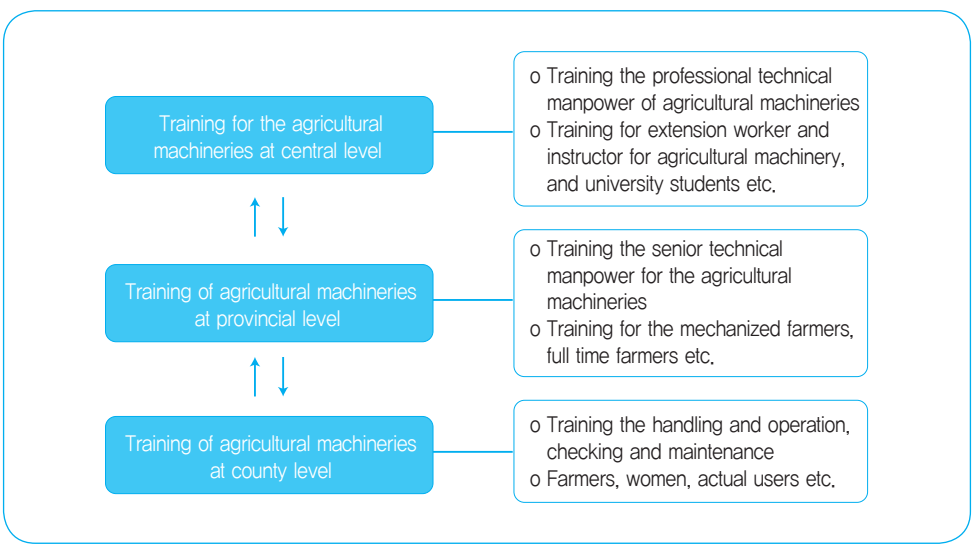
The education and training of agricultural machinery in Korea was driven largely in three stages. At the center, professional technology training for higher than 2nd grade

licensed technicians in agricultural machinery maintenance was carried out by the farmers training division under the RDA intended for the technical menpower who were engaged in agricultural machinery field such as agricultural machinery training instructors, and agricultural machinery extension workers to take charge of agricultural machinery training at province and county level.

Measnwhile, the technical training of handling and operation for newest agricultural machinery and training for higher than licensed assistant technician of agricultural machinery was carried out by provincial agricultural research and extension offices for the leading farmers such as mechanized farmers, members of mechanized farmers groups, and agricultural extension workers. Lastly, in the agricultural extension offices at city and county level, training of handling, checking & maintenance, and safety use of the agricultural machinery were intensively carried out intended for the general farming populace and women. Also, the opportunity to receive training about agricultural machinery was expanded by letting the agricultural extension offices carry out technical training for the operation and maintenance of agricultural machinery while performing the patrol repair service for the remote villages.

Also, by enforcing the mandatory basic operation and maintenance training from the agricultural machinery manufacturers before purchasing the machinery, safe and efficient use of agricultural machinery by the farmers became possible by improving the handling and operation capability of farmers through comprehensive and systematical training.

Figure 4-2 | Training System of Agricultural Machinery



a. Education and Training of Agricultural Machinery at Central Level

With gradual expansion of mechanized farming, the agricultural machinery training division was established in the Agricultural Technology Distribution Bureau, RDA in 1969. In the Agricultural machinery training division, agricultural machinery for the practical training like prime mover, power tiller and tractor were equipped. Also tools and equipments for checking and maintenance training of agricultural machinery were prepared along with the training field. As far as training of agricultural machinery at central level at the initial stage, training was intensively executed over the period of one to two years to train the agricultural machinery training instructor who can teach the agricultural machinery to the farmers as a part of Korea and England Technical Cooperation Project. After that, with a base of such training results, the handling and operation, working techniques, checking and maintenance, breakdown diagnosis, and repair technique have been intensively trained to nourish the agricultural machinery training instructors who could take charge of training the effective utilization and handling skills of agricultural machinery for the farmers. Those agricultural machinery training instructors took part of training the agricultural machinery at the agricultural machinery training department at each extension office of city and county. The elite training focusing the agricultural extension workers were also executed. Besides, it greatly attributed in the fostering young technicians for agricultural machinery by way of professional technical training to the elite 4-H members over six to eight weeks period.

Since then, education and training for the agricultural machinery at central level have been developed with different training subjects and contents with changes in agricultural policy and progress of agricultural mechanization.

As the distribution of tractors, a large agricultural machinery, were increased, the training for the actual users who purchased tractors over the period of 15 years from 1973 was jointly executed with the agricultural machinery manufacturers. The agricultural machinery training instructors were dispatched to the training site at manufacturers to conduct training focusing the practical technics and exercise which generated many beneficial effects. At the end of 1970, as the rice transplanters and combines were distributed for the first time, training of these machinery used to be carried out to the actual users at a central training center. From the year 1978, the technical training sessions were held for the teachers who were teaching the practical course in the agricultural high school during summer vacation to bring up the students of agricultural high school as pillars of agricultural mechanization. Therefore, the practical skills which may be lacking in the school curriculum were being supplemented.

As the trust farming companies were established following the special law for development of the rural areas in the year 1991 and the agricultural machinery were disseminated for the

entrust farming by the governmental support, the education and training for the efficient utilization, handling and management, and mechanized work skill etc., were conducted for the representatives and in charges of agricultural machinery of the farming entrustments.

Handling, repair, and maintenance training was also executed focusing on the skill and practical exercise over two to three weeks for all the students from the Korea National Agricultural College which was established in the year 1997 with the aim of fostering the farming successors, thus the graduate students have been greatly helping in the management of their own farms

Apart from this, practical training of agricultural machinery for the students of agricultural college and students majored in agricultural machinery, agricultural machinery maintenance training for the return to farm and ordinary farmers, agricultural machinery training for the activation of agricultural machinery lease project, and agricultural machinery training for the foreigners to support agricultural technology in abroad are being conducted.

b. Education and Training of Agricultural Machinery at Provincial Level

Provincial level agricultural machinery training was performed mainly for nourishing the licensed assistant technician of agricultural machinery operation and the actual users of large-scale agricultural machinery for the fostering the senior technical manpower for the agricultural machinery.

During the initial stage of provincial training center, technical training required for agricultural mechanization such as handling skill, maintenance and repair, and safety utilization of agricultural machinery was conducted to the youths from rural areas throughout two to eight weeks to train the elite manpower of agricultural mechanization. From the year 1977, training focusing the practical exercise such as handling, operation and working methods etc., before purchasing the agricultural machinery for the actual users of large machinery such as combines and dryers was carried out which ultimately attributed in improving the safety and effective use of agricultural machinery.

Especially, with establishment of mechanized farming groups with the purpose of joint use of agricultural machinery based on the agricultural mechanization policy established by the government in 1981, training for the handling and safety utilization of agricultural machinery was conducted to drivers of agricultural machinery in mechanized farming group. And this training has greatly attributed in the organization and effective management of the mechanized farming group.

Also, by conducting training for the fostering the mechanized farming farmers with two to four weeks course from the year 1993 and made them to obtain the mechanized farming farmer's certificate at the same time of course completion, it concentrates on the fostering

the leading manpower for agricultural mechanization of the respective areas. With increases in returning farmers, the operation and basic technical training was being carried out for the new farmers who start farming for the first time.

c. Education and Training of Agricultural Machinery at County Level

The training of agricultural machinery at county level was carried out mainly for the actual users of agricultural machinery, focusing on the driving, handling, working method, checking and maintenance, and safety use, etc. As manpower in rural areas became aged and women became prevalent, training of medium and small size agricultural machinery like cultivator, rice transplanter, and power sprayer etc., are also being executed. Meanwhile, with the extension of agricultural mechanization it became an urgent task in the agricultural extension project in rural areas, and technical education and training of agricultural machinery was performed in order to strengthen the capability of the agricultural extension workers for three years from the year 1992. In addition, refresher training for traffic safety was also carried out from 1983. This refresher training contributed to the safety and efficient use of agricultural machinery.

4.1.3. Achievement of Education and Training for Agricultural Machinery

Ever since the full-fledged education and training for the agricultural machinery was started in the year 1969, by giving the education and training about agricultural machinery to a total four million and four hundred thousand people including farmers who are actual users of the agricultural machinery as well as instructors of agricultural machinery training, teachers in agricultural high schools, farming successors like students of the Korea National Agricultural College, and repair and maintenance technicians, it became a driving force to quickly mechanize the farming work which was dependent on the man and animal power.

The education and training about agricultural machinery in Korea can be regarded as having been achieved mainly by fostering the technical manpower that can carry out education and training, manpower for repair and maintenance and farmers who practically use agricultural machinery. During the initial stages of distributing agricultural machinery, firstly the education and training of agricultural machinery was carried out intensively to foster the agricultural machinery instructors at central training centers. Operation and handling capability of farmers could be raised in a short period by the training of these instructors at city and county level agricultural machinery training centers.

Operation and handling capability of farmers could be raised in a short period by intensively fostering the agricultural machinery instructors who can teach the agricultural machinery at a center level and allowing them to take charge of the education and training for the actual machine users at each city·district level. During this period, by training 3,259

numbers of agricultural machinery instructors, education and training could be executed for one million and seven hundred thousand farmers. The education and training on agricultural machinery was carried out for 29,000 youths in rural areas and students of agricultural college to produce the pillars of agricultural mechanization.

Also, education and training of agricultural machinery was carried out to the 1,200 teachers of agricultural high school. By training these teachers, it enabled the improvement of practical capabilities of students in agricultural high schools who were equipped with theory as well as practical knowledge of agricultural machinery.

Meanwhile, with increases of agricultural machinery dissemination, the demand for the repair and maintenance of agricultural machinery were abruptly increased. Central farmers training center trained over 5,000 technicians for repair and maintenance of agricultural machinery to counteract the increasing agricultural machinery repair demands. At central and county level training center, key manpower who have received professional training of agricultural machinery were made to obtain the technical license for agricultural machinery certified by the government so that they could be engaged in agricultural mechanization policy with pride as a professional technician. Till now, 37,000 persons have obtained the national technical qualification such as agricultural machinery maintenance technician and operation technician etc.

Besides, the training materials for agricultural machinery were made into booklets, leaflets, slide, and VTR to make farmers understand easily. Those training materials were distributed to each city and county level extension office for training of agricultural machinery. From the year 1982, 69 kinds of agricultural machinery texts, 52 kinds of leaflets, 13 kinds of pamphlets, 3 types of hanging pictures, and 24 kinds of audio and video texts like slides, VTR, and movies have been prepared and utilized.

Figure 4-3 | Agricultural Machinery Training

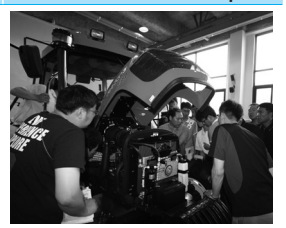
Training for farmers	Training on the spot	Training for maintenance and repair
		

Table 4-28 | Achievement of Education and Training for the Agricultural Machinery with Different Courses

(unit : person)

Course		1969~2005	2006	2007	2008	2009	2010	Total
Center	Instructors	3,259						3,259
	Agricultural high school teachers	1,223						1,223
	New machinery training	2,617	184	188	185	213		3,387
	1st grade maintenance technician	394						394
	Youth member	1,056						1,056
	Repair agent in Agricultural Cooperative	865						865
Center	Agricultural college student	561	34	67	42	46		750
	Actual user	15,782						15,782
	Foreigners	366			37	25		428
	Training industrial technician	113	46	34	30	29		252
	Fostering repair technician	3,543	72	90	89	82		3,876
	Maintenance repair practical	137						137
	Comprehensive practical training	147	67	57	56	92		419
	Repair center agent	122						122
	Agricultural corporation	2,741						2,741
	Koran National Agricultural College students	3,490	483	480	430	540		5,423
	Key training by machinery	2,014	314	380	375	329		3,412
	Remote controlled sprayer			30	43	38		120
	Others	2,337	485	567	751	787		4,962
	Sub-total	40,767	1,685	1,902	2,038	2,216		48,608

Course		1969~2005	2006	2007	2008	2009	2010	Total
Province	Rural youth	14,203			626	696		14,203
	Fosterage of assistance technicians	14,847						14,847
	Agricultural extension workers	1,648						1,648
	Agricultural high school teachers	236						236
	Combine, dryer	16,037						16,037
	Beginner farmer	1,782	159	169				2,110
	Rice transplanter users	1,938						1,938
	Rural women	2,336						2,336
Province	Mechanized farming group	32,602						32,602
	Mechanized farming farmers	12,094	702	671	626			14,789
	Sub-total	97,723	861	840	626	696		100,746
City and county	Actual users	1,349,538	19,739	22,461	21,773	24,700		1,438,211
	Rural women	161,914						161,914
	Safety driving	2,060,552	177,572	269,057	162,761	149,674		2,819,616
	Rural youth	8,280						8,280
	Sub-total	3,580,284	197,311	291,518	184,534	174,374		4,428,021
	Total	3,718,774	199,857	294,260	187,198	177,286		4,577,375

4.2. Education of Agricultural Machinery

Until the beginning of 1960s when the power tiller which can be regarded as the first power agricultural machinery was started being distributed, the education of agricultural machinery in high schools and universities was literally non-existent. In some agricultural high schools, department of agricultural engineering was installed but department of agricultural machinery was not opened at that time and there was no curriculum for the agricultural machinery.

Though department of agricultural engineering existed in universities, courses of studies were generally about agricultural engineering and curriculum for agricultural machinery were limited to courses like internal combustion engines and water pumps. However, with

the progress in industrialization, the labor force in the rural area became reduced since the rural population started migrating to the cities. With the increases in the necessity of agricultural mechanization and dissemination of agricultural machinery, the necessity of education about agricultural machinery was also on the rise. Therefore, majors in agricultural machinery was opened at a graduate school level at the Seoul National University in 1965, but since there was no agricultural machinery department in the bachelor's degree program, due to lack of educational facilities and faculties, normal education for agricultural machinery could not be performed. Instead, the education was mainly carried out through guidance and advice on theses.

After that, an agricultural machinery course was installed in the agricultural engineering department in the Gyeongsang National University in the year 1967 to carry out education of agricultural machinery to university students. In 1970, an agricultural machinery course was installed in the agricultural engineering department in the Seoul National University and student's admission in the department was separately conducted to provide a professional education for the agricultural machinery. In the second half of 1970s, agricultural machinery departments started offering two year diploma courses in agricultural technology colleges. By 1980s, department of agricultural machinery was separated from the agricultural engineering department in most of the national universities.

In the year 1997, though agricultural machinery departments were installed in 17 universities and technological colleges, with the progress of industrial development, the weight of agriculture was reduced and the number of student majoring in agricultural machinery was also reduced. Therefore, the agricultural machinery departments in technological colleges were re-organized as industrial machinery department etc., which resulted in reducing trends of agricultural machinery departments in universities. In the year 2011 till now, around 60 professors are teaching agricultural machinery in agricultural machinery departments in 12 universities around the country. From these universities, more than 300 students graduate in a year.

The curriculum content in the department of agricultural machinery was limited to the traditional agricultural machinery like farm power, farm working machinery, and post-harvest machinery etc. However, from the year 1990, with advance in the automation in the farming works and eco-friendly agriculture drew an importance, the education about preventative measure and automatic control, facilities and environment for agriculture and animal products, and energy along with the traditional curriculum are being strengthened.

Meanwhile, until the beginning of year 1960, agricultural engineering departments were installed in agricultural high schools. However, agricultural machinery departments were not installed, therefore, the education about the agricultural machinery was not executed at all.

Nevertheless, with increased agricultural machinery dissemination, the training of senior technical manpower became necessary. From the later stage of 1960s, agricultural machinery departments were opened in the agricultural high schools in all over the country to teach the theories of farm power, farm working machinery, and agricultural machine tool, and agriculture machinery repair and maintenance etc. These senior technicians who graduated the agricultural high school were inserted in the front lines of industry and greatly contributed to agricultural mechanization and development of agricultural machinery industries. Agricultural mechanization became far more important with abrupt decreases in the rural labor forces from 1980. The education of agricultural machinery became mandatory in all agricultural high schools. Therefore, students in agricultural high schools were trained to obtain skills to handle around 20 kinds of agricultural machinery like tractors, rice transplanter and combines before graduation through a special training for two to three weeks along with the regular curriculum.

However, from the year 1990, the weight of agricultural industry became lesser and the demand for the technical manpower of agricultural machinery was also reduced, thus most of the agricultural machinery departments in high school were re-organized as industrial engineering department. The agricultural machinery course was carried out in parallel with education of heavy machinery like excavators, forklifters and cars repair and maintenance to produce the manpower required in the machinery field in the second industry.

So far the professional manpower majored in the agricultural machinery in the universities and agricultural high schools were produced to be equipped with theory as well as practical knowledge. The professional manpower greatly contributed to the research and development, education and training, production and distribution, and follow- up to achieve the complete mechanization in the paddy cultivation. Moreover, this manpower encouraged the development of agricultural machinery industry, which could be a base to nourish export industries.

Table 4-29 | Installation Status of Agricultural Machinery Department in the Major Universities

Year	University	Year	University
1965	Agricultural machinery, Graduate school, Seoul National University	1978	Agricultural College, Sunchon National University
1967	Department of Agricultural machinery, Agricultural College, Gyeongsang National University	1980	Agricultural Engineering, Sangju Agricultural college
1970	Major course of Agricultural machinery, College of Agriculture, Seoul National University	1984	Department of Agricultural machinery, Agricultural college, Jeonnam National University
1974	Department of Agricultural machinery, Agricultural College, Chungnam National University	1988	Department of Agricultural machinery, Agricultural College, Jeonbuk National University
1976	Department of Agricultural machinery, Jinju Agricultural college		Department of Agricultural machinery, College of Agriculture, Gyeongbuk National University
	Department of Agricultural machinery, Yesan Agricultural college	1990	Department of Agricultural machinery, Miryang Agricultural college
1977	Department of Agricultural machinery, College of Agriculture, Chungbuk National University	1991	Division of Agricultural Engineering, Agricultural Cooperative College
1978	Department of Agricultural machinery, Agricultural College, SungKyunKwan University	1992	Department of Agricultural machinery, College of Agriculture, Gangwon National University
	Department of Agricultural Engineering, College of Natural Science, Konkuk University		

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

Table 4-30 | Curriculum of Agricultural Machinery Department in the University

Field	Courses	Field	Courses
Farm power	Farm power Tractor Engineering Internal combustion engine	Agricultural product processing machinery	Agricultural processing machinery science
			Agricultural processing engineering
			Agricultural product storage engineering
Field achinery	Agricultural field machinery Agricultural machinery Packaging machinery Bio-production system engineering Agricultural machinery designing Agricultural machinery analysis Agricultural machinery management Agricultural mechanization theory Soil-Machine system Tillage engineering Wheels engineering		Agricultural product texture
			Agricultural processing machinery designing
			Agricultural processing machinery system
			Agricultural product packaging and transportation engineering
			Agricultural product drying and storage science
		Agricultural electric, electronics	Agricultural electricity
			Agricultural electronics
			Applied measuremeasures
			Bio-sensor engineering
			Bio-image processing
			Agricultural robot
			Micro-process application
			Agricultural machinery automatic control
			Bio-production control
Computer application engineering	Agricultural expert system Artificial intelligence	Agricultural facility and environment	Agricultural facilities engineering
			Agricultural facilities environment
			Facility automation
Agricultural energy	Agricultural thermal resources engineering		Facility control engineering
			Bio-production environment
			Bio-environment measure

Source: Korean Society for Agricultural Machinery, 1998, "Farm Mechanization in Korea"

5. Inspection of Agricultural Machinery

5.1. Inspection Organization for Agricultural Machinery

Before 1950s in Korea, farm work was carried out with man and animal powered equipments. Most of the agricultural tools were made mainly in the blacksmith's workshop and the quality was not uniform. Besides, there was no concept about the quality control. Therefore, the inspection for the agricultural tools and equipments was not carried out at all and inspection equipment was also not available.

After that, with the agricultural implements were widely distributed and production from factory became increased, the inspection of the agricultural implements was started when the ECA (Economic Cooperation Administration) an economic cooperative organization, requested quality evaluation of the man and animal drawn agricultural implements such as spade, sickle, and plow etc., to the National Agricultural Research and Extension Office (NAREO) which was the prototype for the Rural Development Administration (RDA) in Mar., 1949 to select and disseminate the high quality agricultural implements. The testing and evaluation of the agricultural implements which started for the first time by request from the ECA and were continued until the Korean Civil War in 1950.

The Korean Civil War which broke out in 1950 destroyed the agricultural production base and created manpower losses and shortage in farming materials. After the war, the severe bad crop accounted for hardly 60~80% level of the normal production over three years from 1950 till 1952 and led to a food shortage which did not give any option to the government but to push a policy promoting food production. As part of the effort made by the government, production and distribution of good agricultural implements were hurriedly carried out. However, the small amount of factories which used to produce agricultural implements were reduced to ashes during war and the craftsmen to make the agricultural implements were also scattered. Sufficient production of agricultural implements could not be met. Under this pathetic situation, the quality of agricultural implements deteriorated. Therefore, in order to promote the dissemination of good agricultural implements, the testing and evaluation of the agricultural implements which was previously carried out by the request of agricultural implements manufacturer was switched over to carry out in the National Agricultural Research and Extension Office (NAREO) for all of the agricultural implements distributed with subsidy by government the administrative act by the Ministry of Agriculture and Forestry in the month of Sept., 1952. And this inspection became the first inspection carried out for the agricultural l implements.

The inspection of agricultural implements during the initial stage was conducted by the Division of Farm management Technology, NAREO, a national research institute.

After that, with re-organization of the government in 1962, the RDA which took charge of agricultural researches and extension function was established and the IAEU was set up as an research and development institute under the RDA. And inspection of the agricultural implements was carried out along with research activities for the agricultural implements by the Agricultural Engineering Division, IAEU. In Apr. 1965, the Agricultural Engineering Division of IAEU was re-organized as agricultural engineering division and agricultural machinery division. Accordingly, the inspection of agricultural equipment was taken care by the Agricultural Machinery Division, NAREO along with the research activities for the agricultural machinery.

With development of agricultural technology, farming materials like agricultural implements, pesticide, and fertilizers became diversified and the volume was also prominently increased. Accordingly, the distribution of low quality farming materials also increased. Therefore the demand for the quality control for the distribution of high quality farming materials was in increasing trends. However, since the inspection for the farming materials was taken by the research institutes under the RDA for different farming materials, inspection was inefficient and lacked professionalism since agricultural research and inspection works were simultaneously carried out. Moreover, there was difficult to control the quality and to crack down the defective farming materials. Therefore, the NAMII which was the expertise agricultural materials testing institute was established under the MAFF to promote the dissemination of high quality and safe agricultural materials by establishment law of national agricultural materials inspection institute (Regulation no.1777) in April, 1966 and notified the organization of the above institute by the president order no. 2587 in June, in the same year.

Accordingly, the inspection for the agricultural implements which was executed by the IAEU, the RDA was transferred to the Division of Agricultural Implements Inspection in the NAMII from year 1967. The duties of the division of agricultural implements inspection included data investigation of agricultural machinery and equipments, basic inspection for the performance, quality of materials, and structure, setting up the inspection standard for agricultural machinery and equipment, handling of complaint and accident for the agricultural machinery and equipment inspection, data investigation for the agricultural machinery and equipment manufacturers, and general certification for the agricultural machinery and equipment, etc.

Though the establishment of the NAMII was significant for the integration of the agricultural materials inspection functions, since the fields of different characters like fertilizers, pesticides, and agricultural machinery were altogether integrated, organic relation between the works for different materials was lacked. Moreover, the administration, research and development, education and training, and inspection were separated respectively, so there was lacking points in cooperation between same field and development.

In November 1981, while dissemination of agricultural machinery was increased, the demand of the agricultural implements was decreased. Therefore, the Division of Agricultural Equipments Inspection was re-organized as the Division of Agricultural Machinery Inspection. Among the duties of he Division of Agricultural Equipment Inspection, the duties for the agricultural equipments have been changed to agricultural machinery. Basic inspection was changed into model inspection, pre inspection, and post inspection.

In December, 1994, the organizations having similar functions in the government were integrated. The NAMII was closed as a result of government re-organization after considering the system and linking of testing and research fields to strengthen the competitiveness. The agricultural machinery inspection which was compulsory inspection was converted into inspection by application of manufacturer. At the same time, the inspection function and manpower of agricultural machinery were transferred to the NAMRI to open the Division of Agricultural Machinery Quality.

The Division of Agricultural Machinery Quality was responsible for data collection and analysis of agricultural machinery testing and evaluation, international standard validation of agricultural machinery, research for the quality and safety improvement of agricultural machinery, testing and inspection of agricultural machinery, and setting the inspection·testing method and standard for the agricultural machinery. Therefore, the NAMRI under the RDA could possess the function of research & development, testing and evaluation, and inspection of agricultural machinery. Since then, it was firmly settled as an institute for agricultural machinery research and inspection.

In the year 2009, as the government was re-organized, the testing and evaluation of agricultural machinery which was carried out in the Department of Agricultural Engineering, the National Academy of Agricultural Science in the RDA was made to be performed in the Foundation of Agri. Tech. Commercialization and Transfer (FACT) which was a private organization according to Clause 14, the Agricultural Promotion Law in September, 2009. Therefore, the agricultural machinery inspection function which was performed by government was transferred to the private organization.

Table 4-31 | Transition History of Inspection Institute for the Agricultural Machinery

Organization	Duration	Remarks
Division of Farm management Technology, NAREO	Jan. 1949~ June 1957	- Entrust inspection (before 1952) - By administrative action of the Ministry of Agriculture and Forestry
Division of Farm management Technology, Agricultural Experimental Station, Institute of Agriculture	June 1957~ Oct. 1961	- Basic inspection for agricultural machinery and equipments by subsidy from government (mandatory) - Parallel execution of research and inspection - Performance test and inspection method of high quality agricultural implements,
Division of Farm management Technology, Department of Agricultural Engineering, Bureau, Institute of Agriculture	Oct. 1961~ Mar. 1962	
Agricultural engineering division of Institute of Agricultural Engineering and Utilization, RDA	Mar. 1962~ Apr. 1965	
Agricultural machinery division, Institute of Agricultural Engineering and Utilization, RDA	Apr. 1965~ July 1966	
Division of Agricultural inspection, National Agricultural materials Inspection Institute , the Ministry of Agriculture and Forestry	July 1966~ Dec. 1979	- Basic inspection and individual inspection - Dedicated testing and inspection - Inspection by entrust rules of National Agricultural materials Inspection Institute
Davison of Agricultural machinery inspection, National Agricultural materials Inspection Institute, the Ministry of Agriculture and Forestry	Dec.1979~ Dec. 1994	- Model inspection (mandatory) by agricultural mechanization promotion law - Basic inspection (random inspection): by the Inspection entrust rules of National Agricultural Materials Inspection Institute
Division of testing and evaluation, National Agricultural Mechanization Research Institute, RDA	Dec. 1994~ Sept. 2009	- Inspection by manufacturer`s request (random inspection): - Parallel execution of research and inspection - Model inspection (random inspection): Agricultural Mechanization Promotion Law - Appraise by testing and analysis request rules, RDA
Foundation of Agri. Tech. Commercialization and Transfer (FACT)	Sept. 2009~	- Integration of random inspection and agricultural materials inspection. - Appraise by Agricultural Mechanization Promotion Law

5.2. Enactment of Regulations Related with Agricultural Machinery Inspection

Until the establishment of NAMII, the inspection of the agricultural machinery was carried out based on the internal rules of the MAFF without any legal basis. By the administrative act in 1952, the inspection was made to be mandatory for agricultural machinery supplied by funding from the government. However, systematic inspection was not performed because the inspection method and standard were not systemized and inspectors and inspection facilities were lacked. Under these conditions, generally the inspection results used to be decided by the inspector's judgment. Besides, inspection was performed only on the provided machine for testing not for all the machinery, the defective machinery having inferior quality and performance were found abundant unlike the tested machinery which was passed the inspection which sometimes raised the reliability on the validity of the inspection.

Therefore, in September, 1958, the MAFF has enacted internal rules to carry out the basic inspection by standardizing the inspection methods. The lot inspection was thus performed during the supply time after executing the basic inspection to check if the quality and performance of the machinery were same as the passed sample. But the inspection standards and methods have not been prepared until then. After that, the notification No. 116 "high quality agricultural implements supply and inspection method" by the MAFF was announced to seek foods production increases by way of supplying high quality agricultural implements and the said rule was enforced from 1963. The main contents are as follow.

First, inspections of agricultural implements were categorized into basic inspection and individual inspection. The passing status was inspected for the structure, performance, durability, and easiness of the operation as per the standard separately decided by the Minister of the MAFF while individual inspection was about checking whether the structure and performance of the agricultural implements actually supplied were matching with those of the passed samples from the basic inspection. These inspection processes were carried out by the provincial office and the National Agricultural Cooperative Federation.

Also, the basic inspection was to perform three times in a year. The Minister of the MAFF would notify the inspection date in the government gazette one month prior to the actual execution. The validity of the basic inspection result was granted for two years. The implements which passed inspection were displayed in the Institute of Agricultural Engineering and Utilization of RDA and the NACF for one year period so that the peoples interested can see the implements. Also, the inspection standards and the methods have been set for the first time to enforce the inspection method wherein mainly KS standards were utilized. The inspection standards which were not available in the KS Standards were separately prepared.

The order No. 127 from the Ministry of Agriculture and Forestry about the testing entrust rule to RDA was enacted and enforced in April, 1963. The main context of the order was the preparation of the base to get the supply of required testing materials and manpower for the testing and inspection. Therefore, the inspection of the agricultural implements was legally systemized. The supply and inspection method of high quality agricultural implements and testing entrust rule of the RDA were used until the agricultural implements inspection work was transferred to the NAMII in the year 1967.

The establishment law for the NAMII (Regulation No. 1777) was enacted and enforced in April, 1966 to promote the supply of the high quality agricultural materials by the quality certification of fertilizers, pesticides, and agricultural machinery. In the month of June, same year, the organization of NAMII was promulgated by the President Order no. 2587. The NAMII was established as an expertise testing and inspection institute for the agricultural implements, fertilizers, and pesticides. The inspection of the agricultural implements formerly executed by the IAEU, the RDA was transferred to the Agricultural Materials Inspection Institute from January, 1967.

Accordingly, the basic item required for the inspection of the agricultural materials was enacted in the form of inspection entrust rules of the NAMII (Order no. 237, the Ministry of Agriculture and Forestry). The main contents of the rule are as follow:

- o The agricultural implements subjected to the inspections are the materials and equipments which are required for the efficient execution of tillage, pulverization, nursery, pest and disease control of the harmful animal and plants, harvesting, prime mover, and other overall works (including incidental works).
- o The inspection methods and standards are to be decided and notified by the Director of the NAMII excepting the items specified in the related rules and regulations of the Agriculture. The inspection place shall be set principally at the National Agricultural Materials Inspection Institute.
- o The inspection result shall be marked either Passed or Rejected. ”Passed” should again be categorized into “excellent” and “good”. The validity of the inspection result is for three years for “excellent” and two years for “good”.
- o In case there are objections to the inspection results, the re-inspection request can be applied only once. The passed sample shall be kept by the director of the NAMII during the period of inspection result is valid.
- o The post inspection can be performed for the passed agricultural machinery and equipments during the validity period. If the results of post inspection for product cannot meet the standard of inspection, the pass result can be cancelled.

o Other items like inspection application procedure, re-inspection, the quantity and keeping method of the testing sample, and inspection fee etc., shall be separately decided.

The inspection fees, inspection subjected item, inspection standard and methods for agricultural machinery and equipment have been enacted and publicized as a notification by the NAMII for the exercise of the said rules.

Though the item for which the individual inspection could not been executed, the basic inspection was carried out until 1968, but not on the actually distributed machinery in market. Only passed products were allowed to be supplied after conducting individual inspection at the mediatory organization where agricultural machinery and equipments were purchased and introduced like national agricultural cooperative association and each city and counties from 1969. However, considering the increases in the kind and models of the agricultural machinery and shortage of the inspection manpower, the individual inspection was converted from all number inspection to random sampling inspection.

The individual inspection subject were decided as the agricultural machinery and equipments which were supplied by agricultural mechanization plan, the passed agricultural machinery and equipment from basic inspection, and those introduced and purchased in the related organization with agriculture like government, city·county, agricultural cooperative association, and the ADC. The inspection was carried out by random sampling of specified number (engine starting was inspected for all the quantity) from each production lot submitted by the agricultural machinery and equipment manufactures. The structure, performance, and materials were inspected same method as the basic inspection. If the result became higher than equivalent level of the basic inspection, it was judged as passed and the pass certificate was made to be fixed on each machine.

Meanwhile, the agricultural machinery and equipments that were not included in the agricultural machinery supplied by government support, entrust inspection was carried out by consigning it according to the inspection entrust rules of National Agricultural Materials Inspection Institute.

On 5th December, 1978, the Agricultural Mechanization Promotion Law was enacted and enforced to promote and continuously drive agricultural mechanization through the distribution of agricultural machinery and efficient use of agricultural machinery. In Clause 7 of the Act, the Minister of the MAFF should notify the supplied machinery models by government support for the production and distribution of the agricultural machinery. Also, in Clause 14 of the same law, the manufacturer or importer of agricultural machinery should get the inspection for the manufactured or imported agricultural machinery by the Minister of the MAFF. In Clause 21, it was clarified that in case the agricultural machinery which

did not receive inspection were sold, one year of imprisonment or specified amount of penalty shall be imposed. This law was the basis for practical mandatory inspection for the agricultural machinery. Following this, in December, 1979, the enforcement ordinance of the same law and in February, 1979, enactment of the enforcement rules was followed for the systematic inspection for the agricultural machinery.

In the enforcement ordinance and rules of the Agricultural Mechanization Promoting Law, details of the inspection organization, kind of inspection, inspection standard and method, application of the inspection, documents submission, processing the inspection results, validity period of the inspection results, certifications of inspection, and cancellation of the pass result were prepared.

The inspection of the agricultural machinery was regulated to be carried out in the NAMII. The kind of inspection was categorized into the model inspection, pre inspection, and post inspection. Here, model inspection refers to the inspection about the structure, performance, and operational easiness of the agricultural machinery which was a model certification inspection contrary to the previous basic inspection. The pre inspection was to check before supplying if structure and performance are the same as the result of model inspection for the agricultural machinery which have been passed the model inspection. While, post inspection was regulated as a checking the manufactured and supplied agricultural machinery are in conformity with the model inspection standard.

The application of the model inspection was to submit the model inspection application and the attached design drawing of the respective agricultural machinery, materials specification of the key parts, characteristics explanation, and performance etc., to the NAMII. And the application of the pre inspection before distributing was made to submit to the NAMII.

The Director of the NAMII could require the submission of testing machines and equipment, testing materials and special equipment for the inspection as well as the inspection results from the accredited testing institutes and provision of the testing fields and place. After the model inspection, the pass and reject result was judged according to the inspection results and the certification of inspection was to be issued to the applicant. The validity of the model inspection result was set for three years.

On the agricultural machinery which passed pre-inspection, inspection certificate was fixed. When post inspection was executed, the inspection result was to be notified to the manufacturer or importer of the respective agricultural machinery within 30 days of inspection.

With increases in the agricultural machinery distribution, the demand of the pre inspection before supplying the machine faced difficulties in the government budget and

manpower support. While some of the manufacturers became equipped with good testing facilities and equipments as well as quality control capability. Therefore, the standards of facility, equipment and manpower required for the pre inspection were set up and for the manufacturer of the agricultural machinery that were in conformity with the standard were allowed to perform the pre inspection before distributing by themselves and self-inspection certificates could be fixed on their products. And manufacturer should submit the results of self inspection to the NAMII on a monthly basis. From February, 1989, pre inspection system was abolished and manufacturer of agricultural machinery were allowed to control the quality of agricultural machinery autonomously.

Meanwhile, as for the imported agricultural machinery, if the machinery passed the inspection of the governmental institute or accredited testing institute by the country of manufacture, inspection was exempted. The sample machinery used for the inspection was kept at the Inspection Institute for a specified period (one year for passed machinery, 20 days for rejected machinery).

In case a passed agricultural machinery was judged to have done so through illegal means, rejected during the post inspection, or it was disseminated without pre inspection or self-inspection, the inspection pass was cancelled. Also, if there were objections against the inspection result, the objection could be applied within 15 days of receiving the inspection result and the director of the NAMII would deal with the result within 30 days of receiving the application of objection.

The inspection related rules specified in the Agricultural Mechanization Promotion Law have been changed several times according to the development of agricultural industry afterwards. The key contents are as follows.

In Feb. 1984, the regulation authority for the distribution of the agricultural machinery which were not inspected was designated to be the mayors and governors of each province. In the year 1985, the validity of the model inspection for the simple agricultural machinery was extended from three years to five years and the application period for the model inspection was also extended. In Feb. 1989, by revising the entire text of the enactment rules of the Agricultural Mechanization Promotion Law, structure inspection was deleted among the model inspection contents. Also, the validity period of the model inspection was abolished and the judgment of necessity of the post inspection was empowered to the Minister of the MAFF. To simplify the documents which have to be submitted at that time of application for model inspection, the submission of inspection result of key parts like specification of materials, purchasing confirmation of machine parts, characteristics explanation, and performance inspection results were exempted. The clause about objection application was abolished too. The keeping period of sample machinery was reduced to

within 15 days of inspection result notification to reduce the burden for the sample keeping and management.

In the year 1992, the attachments of the power tillers and tractor were separately inspected from main body to promote development of high quality attachments quality improvement. Accordingly, the manufacturer of attachments could directly apply for the model inspection.

In Nov. 1994, the Agricultural Mechanization Promotion Law went through an overall revision, centering on the relaxation of administrative regulation aspect. Also, the inspection of agricultural machinery was changed from compulsory inspection to random inspection which ultimately brought a big change in the inspection system of agricultural machinery.

The previous dual-inspection system with model inspection mandated by the Agricultural Mechanization Promotion Law and the entrusted inspection by the Inspecting Entrust Rule of the NAMII was unified as a model inspection (random inspection) through the Agricultural Mechanization Promotion Law. Also, the safety devices for seven kinds of agricultural machinery including tractors were to be fixed as a mandatory obligation to prevent safety accidents. The authority for the checking of safety device was to be the director of the NAMII. Also the notification system and inspection application period for agricultural machinery distributed through governmental support were abolished to expand the inspection subject to all the agricultural machinery and inspection application could be made during anytime of the year. In addition, the inspection for the modified machinery after model inspection was changed into the modification declaration. However, the declaration system of modification also was abolished in the year 1999 at the relaxation of the administrative regulation aspect.

Meanwhile, the appraisal system which carried out tests using mutually discussed methods and evaluated the test result of agricultural machinery centering on the test result without a judgment of pass or not was implemented. The appraisal of the agricultural machinery was conducted by classifying it into comprehensive appraisal, technology guidance appraisal, and international standard appraisal. The comprehensive appraisal was the appraisal which comprehensively tests and evaluates the structure, performance, easiness of the operation, and safety to provide necessary technical information for the customer to choose the agricultural machinery. The technological guidance appraisal was the test which is conducted for the specific item requested by the manufacturer with the purpose of development and improvement of the agricultural machinery. The international standard appraisal is the appraisal test which is conducted according to the OECD test code for farm tractor and the ISO standards etc., to support export of agricultural machinery.

Also, with necessity of appraisal for the safety of agricultural machinery followed by the reduction of the inspection subjected to agricultural machinery of model inspection and the

comprehensive appraisal test was on the rise, safety appraisal standard and method for the 30 kinds of agricultural machinery including farm tractor were set up. The safety inspection was carried out either in parallel with model appraisal or executed separately. The standard of judgment for different models or a same model was set up for six large-sized agricultural machinery to restrict frequent model changes to exercise the model name control system for the agricultural machinery. Also, the model inspection for the safety cap and safety frame of farm tractors was executed in the year 2000. This practice was greatly strengthened the safety by mandatory fixing the safety cap and frame on the tractors domestically supplied.

5.3. Inspection Method and Standard of Agricultural Machinery

5.3.1. Inspection Subjected Agricultural Machinery

Before year 1960, the inspection was mainly conducted for the small-sized traditional agricultural implements like plow, spade, sickle and the disaster measure implements such as water pump, power sprayer etc. From the year 1961 to year 1966, the inspection for the power sprayer, threshing machine, and farm engine as well as the small farming implement was mainly carried out.

In May, 1967, with notification by NAMII, the total 45 kinds of the agricultural machinery and equipments like farm engine, power tiller, and man and animal power implement like plow, improved hoe, and rake etc., were notified as the inspection subjects for the first time. In November same year, 18 kinds of implement including pickax and straw cutter were added, thus total 65 kinds of agricultural machinery and implements were notified. However, with increases in the power machinery distribution, in April, 1970 most of the animal power implements were excluded from the list of inspection subject. Thus inspection subject was adjusted to 25 kinds of equipments.

Farm tractors were included as an inspection subject in the year 1972, while as mechanization for the rice transplanting and harvesting started, the rice transplanters, binders, and combine harvesters were announced as subjects for the inspection.

In the year 1980, by the notification of enforcement rule of the Agricultural Mechanization Promotion Law, a total of eleven machinery including power tillers, farm tractors, and combine harvesters were announced as agricultural machinery for distribution through government support and included in the compulsory inspection machinery. The 13 kinds of machinery like cultivator and sowing machine were decided as entrusted inspection subjected machinery. After that, existing agricultural machinery and newly developed or introduced agricultural machinery were newly designated as the agricultural machinery for distribution or excluded.

In the year 1981, the attachment for power tillers and farm tractors such as plow, rotary, and trailer which used to be inspected by included in the power tiller and farm tractor were separated for inspection, and the speed sprayer was added as a agricultural machinery for distribution. In the year 1987, simple and small agricultural machinery such as attachments of power tiller and farm tractor were excluded from the agricultural machinery for distribution, but reaper for multi-purpose cultivator was added to designate and total 16 kinds of agricultural machinery were inspected compulsorily. However, with revision to the Agricultural Mechanization Promotion Law in May, 1995, compulsory inspection system was abolished. The system of designation for agricultural machinery for distribution by government support was also abolished. Therefore, the agricultural machinery whose testing methods were enacted could be tested by the application of agricultural machinery manufacturers or importers whenever required.

Table 4-32 | History of Testing and Inspection Contents of Agricultural Machinery and Equipments

Duration of execution	Base rules and regulations	Major changes detail
Mar. 1949	ECA entrusted evaluation	o Evaluation for the selection and distribution of the high quality agricultural implement. o Evaluation of the man and animal power agricultural implement like plow and sickles
Sept. 1952	Administrative act, MAFF	o Inspection of agricultural implement distributed by government support o Starting the agricultural machinery inspection
Sept. 1958	Administrative act, MAFF	o Introduction of individual inspection system (pre inspection)
Dec. 1962	Order of MAFF	o Categorized inspection as basic inspection and individual inspection o Setting up the inspection frequency (three times a year), validity period of inspection result (for two years)
Apr. 1963	Order of MAFF	o Enactment of testing entrust rules of RDA - Preparation of the base for getting the testing materials and manpower from applicants o Inspection of the agricultural implement was systemized by the law

Duration of execution	Base rules and regulations	Major changes detail
Jan. 1967	Order, MAFF	o Inspection entrust rules of the NAMII - Defined the agricultural implement of inspection subject - Enacted the inspection standard and methods - Set up the validity period of inspection result and introduction of the post inspection
May, 1972	Order, Ministry of Agriculture and Forestry	o Notification by NAMII - Individual inspection system: changed to sampling inspection
Dec. 1978	Agricultural Mechanization Promotion Law	o Compulsory inspection for the agricultural machinery for distribution by government support - Kind of inspection : model inspection, pre inspection, and post inspection - Validity period of model inspection (for three years) - Introduction of inspection objection system, modification inspection system, and cancellation system of passed inspection - Introduction of self-inspection system (same as pre inspection) - Preparation of keeping and handling rules of the testing machinery.
Feb. 1989	Agricultural Mechanization Promotion Law	o Revision of enforcement rules of Agricultural Mechanization Promotion Law - Abolished the structure inspection in model inspection - Abolished pre inspection - Simplified the documents for inspection application like specifications of key parts and attachment - Abolished validity period of type inspection result
Dec. 1995	Agricultural Mechanization Promotion Law	o Abolished compulsory inspection of agricultural machinery for distribution by government - Model inspection was converted to random inspections - Abolished notification of the inspection subjected machinery and period of application - Deleted self-inspection item o Introduced compulsory safety device installation in the agricultural machinery o Enacted entrust rule of testing and analysis of RDA (Order no. 1108, the MAF) - Comprehensive appraisal, technical guidance appraisal, International standard appraisal executed

Duration of execution	Base rules and regulations	Major changes detail
2002.	Agricultural Mechanization Promotion Law	o Introduction of safety appraisal system for the agricultural machinery o Introduction of model name management system - Set up the judgment standard of same model and different model
Apr. 2009	Agricultural Mechanization Promotion Law	o Unification of inspection and appraisal system as agricultural machinery appraisal - Categorized into comprehensive appraisal, safety appraisal, international standard appraisal, technical guidance appraisal

5.3.1. Inspection Method of Agricultural Machinery

The items necessary for the inspection of agricultural machinery such as inspection standards and methods were executed by notification of detailed execution methods which was empowered to the director of the NAMII by the Agricultural Mechanization Promotion Law in the year 1980. In the execution method, the inspection standard and method per each agricultural machinery, part list which requires materials test result from the nominated testing institute, specification of agricultural machinery, facilities, equipment, manpower and inspection method of the manufacturer which can carry out self- pre inspection and about the post inspection were regulated.

The inspection standard and method of agricultural machinery have been continuously supplemented and revised since 45 kinds of agricultural machinery including power tillers were designated by notification of no. 4 of the NAMII in the year 1967. The inspection standard and methods were continuously added as new agricultural machinery distribution or the rules for stopped model have been abolished.

In the year 1982, the testing method for the attachment of power and farm tractor like plow, rotary, and trailer etc., were separately test and evaluated. At the time of integration of model inspection and entrust inspection of agricultural machinery for distribution by revision of the Agricultural Mechanization Promotion Law, inspection methods for a total of 111 machinery were prepared. In the year 2002, inspection standard for a total of 175 kinds of machinery were set and notified.

Inspection standards and methods for the agricultural machinery were prepared by categorizing the items into materials test, structural inspection, performance test, operational easiness test, and dismantle test in 1960s of initial stage of inspection. The materials standard per agricultural machinery focusing the materials used in the parts was set and test for the materials strength and hardness were tested. However, from the year 1989, materials

inspection was abolished since the quality of materials used in the agricultural machinery became improved.

The structural inspection is the investigation about structure of key part like transmission, processing and welding condition, safety device fixing status, size of key portion like thickness of rotary cover (1.6mm). From the year 1972, test for the coating condition which investigates the rust formation after treating the steel plate with salt water was added, but it was changed to plating test afterwards. In 1990, due to the improvement of coating technology, the necessity of this test was reduced thus, this test was eventually abolished.

The structural investigation was executed until 1999, but there were complaints that there were many restrictions for the technology development, thus the structure examination was abolished from the model inspection from the year 1999.

Performance test was constituted with engine performance test that evaluates the output of engine and fuel consumption etc., working performance test that evaluates the working efficiency and accuracy of field machinery, traction and lifting test for tractor. These testing methods and the standards have been changed according to the technology development and government policy. Especially, the performance test of tractors were revised to be matched with OECD tractor testing code.

5.4. Appraisal of International Standard

The OECD has prepared the testing code which can be commonly applied in between the countries. And the testing institutes which were equipped with testing facilities and capability of accepting the OECD testing code were designated as OECD -accredited testing institute. The testing results were made to be acknowledged mutually to activate trading among countries. The government modernized the testing facilities and equipment for the testing and inspection of NAMRI for improvement of performance and quality of tractor and the activation of export by strengthening the international competitiveness. The NAMRI was designated as the accredited testing institute of the tractor for agriculture and forestry of the OECD to make it as a base to grow as an international level agricultural machinery testing institute. At the time of joining the OECD, only tractor performance testing code 1 and 2 were acquired. However, it was equipped with testing equipment for the protective structure of tractor (ROPS) in 1998, and was certified as a testing institute which could carry out all the eight testing codes of the OECD. Besides, the appraisal by international standards like the ISO, the ASABE, and the SAE was also carried out. Until the year 2009, 135 cases of international standard appraisal including the OECD test were carried out.

Meanwhile, in December, 2009, the NAMRI was made to meet the certification requirement of ISO/TEC 17025 which was required by International Laboratory Accreditation Cooperation (ILAC). Ultimately the NAMRI was designated as ILAC/KOLAS international accredited testing institute to carry out international accredited testing. The test report of internally accredited testing institute was certified by 47 countries including the USA and the United Kingdom that are participating in the ILAC accreditation system and is expected to help export of agricultural machinery.

5.5. Modernization of Inspection Facility and Equipment

The inspection equipment during 1950s were carried out by using primary measurement equipments such as hardness testers, tachometers, moisture content testers, watt-hour meters, balance and scales, etc. However, with Korea's property claim against Japan, testing equipments like universal testing machines, impact testers, hardness testers, and standard block gage etc., were introduced to modernize inspections.

In 1970s, following the designation of large-scale high performance agricultural machinery like farm tractors, rice transplanters, combine harvesters, and grain dryers, the electric dynamometers, tachometers, torque and pressure transducers, strain gauge systems, electronic temperature recorders, and ultrasonic inspection equipments etc., were introduced, thus basic inspection facilities and equipment were equipped.

During 1980s, electric dynamometers were equipped in small capacity (5PS) to large capacity (100PS). Besides, traction type dynamometer cars, vibration acceleration testers, universal hardness testers, spring testers, digital auto height gauges, ultrasonic inspection meters, and roughness testers were equipped to achieve modernization of testing and evaluation facilities and equipments.

In 1990s, to designate the accredited testing institute for the OECD, forming purpose tractors, PTO performance testers, hydraulic pressure and lifting testing facilities, and drive testing equipments were supplemented and designated by the NAMRI as an OECD accredited testing institute. Afterwards, facilities like ROPS safety lab, falling testing lab, high and low temperature performance testing lab, rear axle output performance testing lab, exhausting gas performance testing lab, vibration testing road, and traction and driving test road were established. Required testing facilities and equipment of 3-D measurement machine, engine testing performance device, exhaust gas analyzer, noise and vibration tester, center position measuring machine, falling angle measurement machine, pulling performance testing facility were therefore equipped so that the NAMRI could be settled as a modernized testing and evaluation institute.

5.6. Achievement of Agricultural Machinery Inspection

The evaluation for the agricultural implement requested by the ECA from the year 1949 till the Korean Civil War was executed for a total 78 case for 15 kinds of implement like animal drawn plow, foot pedal type water pumps and thresher, and sickles. Among these, 35 implements passed; a low passing rate of 44.9%. Therefore, the necessity of inspection for the agricultural implements was increased greatly.

The inspection by the National Agricultural Research and Extension Office with government support started from 1952 was mainly on agricultural implements like plow, spade, and sickle. From year 1955, inspection for the food pedal type thresher, water pump, and farm engine was mainly carried out. During this period, inspection for ten kinds of implements totaling 500,000 items was executed and the passing rate sharply increased to 96%.

From the year 1962 till the establishment of the NAMII, by the performance testing method for the agricultural implement and distribution of high quality agricultural machinery and testing method, total 1,143 machinery of 14 fields were executed. The passing rate of inspection was around 64%.

From the establishment of the NAMII until the year 1994, total 4,835 cases of basic inspection and total 2,010 cases of model inspections were carried out.

For the power tillers, basic inspection for six models was performed in 1961, but all were rejected. After two years, in 1963, two models could be passed from inspection and started to be distributed in rural area. The inspection for the farm tractor was carried out in 1970 for the first time, while inspection of rice transplanter and binder was executed in 1977 for the first time for the basic inspection. Meanwhile, first inspection of combine harvester was performed in 1974, but the result of inspection was rejected. It was only in the year 1982 when the combine harvester was passed in the model inspection for the first time.

The pre inspection of total 5,580,000 units was carried out. Among this, self-inspection was 4,446 thousand unit which occupied around 80% of total inspection cases. Though post inspection was executed for 600~800 units a year from 1980 until 1988, since the quality of agricultural machinery were greatly improved and the post inspection itself was regulatory in nature, by considering the autonomous quality control by manufacturer was required, the execution authority for the post inspection was changed from the director NAMII to the minister, the MAFF in 1989, thus the post inspection were abruptly decreased.

Table 4-33 | Inspection Result by Kinds of Inspection for Agricultural Machinery

(Unit: stand)

	Basic inspection	model inspection	Pre inspection		Post inspection	Appraisal			
			Inspection station	Self-inspection		Comprehensive	Technical guide	International norms	Safety verification
Before 1970	431	-	87,783	-	-	-	-	-	-
`71~80	1,005	98	1,022,567	-	660	-	-	-	-
`81~94	3,379	1,912	23,377	4,446,319	6,332	30	-	-	-
`95~2009	-	2,723	-	-	68	2,106	210	185	640
Total	10,815	4,733	1,133,727	4,446,319	7,060	2,136	210	185	640

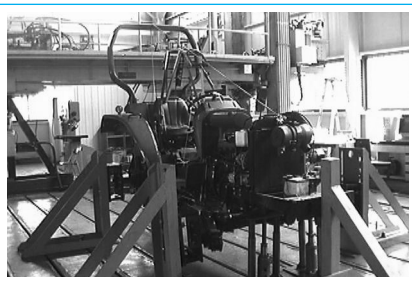
Table 4-34 | Number of the Model Inspection Cases and Pass Rate of Major Agricultural Machinery

	Inspection (units)	Passed (units)	Passing rate(%)	Inspection period
Power tiller	189	151	79.9	1967~1994
Farm tractors	279	196	70.3	1970~1994
Rice transransplaner	94	83	88.3	1977~1994
Combine harvester	81	74	91.4	1974~1994
Grain dryer	96	54	56.3	1968~1994
Power sprayer	331	228	68.9	1968~1989
thr Automatic esher	166	127	76.5	1967~1987
Water pump	327	164	50.2	1968~1989
Hot air heater	542	317	58.5	1992~1994
Farm engines	157	108	68.8	1967~1994

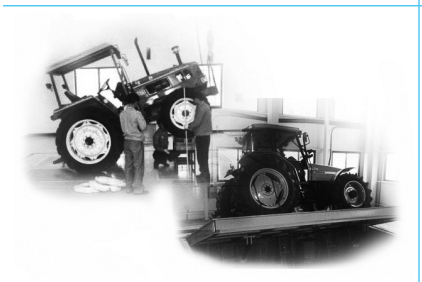
Source: National Agricultural Mechanization Research Institute, "The 40 years of research and development for agricultural mechanization"

Figure 4-4 | Agricultural Machinery Testing and Inspection Facility

PTO performance test of tractor



Test for ROPS of tractor



Test for over turning

Test for lifting performance

6. Production and Supply of Agricultural Machinery

6.1. Supports for Agricultural Machinery Manufacturers

To execute agricultural mechanization smoothly, the agricultural machines necessary for it must be manufactured and supplied. From an agricultural point of view, mechanization is to release the shortage of rural labor forces, to liberate farmers from drudgery, and to increase labor and land productivities by utilizing machines for agricultural productions. However, from a national economic standpoint, there should be tasks to be done for fostering manufacturers of agricultural machines and their marketing systems. As mechanization proceeds, the demand for agricultural machinery naturally increases. Consequently, the government must have manufacturers produce machines as demanded and dealer networks supply them with proper after-sales services.

Until the early 1960s, when Korea became independent from Japanese colonial rule in 1945, agricultural machinery manufacturers were small-scaled and mainly producing

manually-operated or animal-drawn machines. Many of them, like other machinery manufacturers, started their business by taking over the firms operated by the Japanese people during the colonial period. They were mostly small private firms based on the local markets due to a shortage of capital and technology, and the small size of domestic agricultural machinery market as well. Many such firms went bankrupt or suffered from the financial difficulties in the socio-economic chaos caused by destructions and extreme social disorder after the Independence and the Korean war. It was agricultural machinery manufacturers in the early 1960s that had overcome such social disruption and financial difficulties successfully. However, it was still difficult to escape from the small scale of their business in size.

According to the statistics at the end of 1968, the total number of agricultural machinery manufacturers was estimated to be 236. 77 of those were members of the Korean Agricultural Machinery Industry Cooperative (KAMICO). Employment for 68% of them was 50 persons or less and only 13% had more than 100 persons. The capitals for 52% of 77 manufacturers were less than 5 million Won and 23.3% had more than 10 million Won. The number of companies established as a corporation were 22, constituting 30%, and the remains were as a private company, constituting 70%. The produced machines were mainly plows, manually-operated sprayers and threshers. As for engine-powered machines, only water pumps and powered-threshers were produced. Current status of agricultural machinery manufacturers in most developing countries may be not be much different from that of Korea in 1960s. In other words, until agricultural mechanization started, agriculture in Korea was performed by manually-operated or animal-drawn machines like in most of the developing countries. Agricultural machinery manufacturers were small-sized and financially vulnerable, and their products were limited to those kinds of machines as well. From a manufacturing standpoint, the period from the Independence to the early 1960s may be regarded as a preparation period for the production of powered machines afterwards.

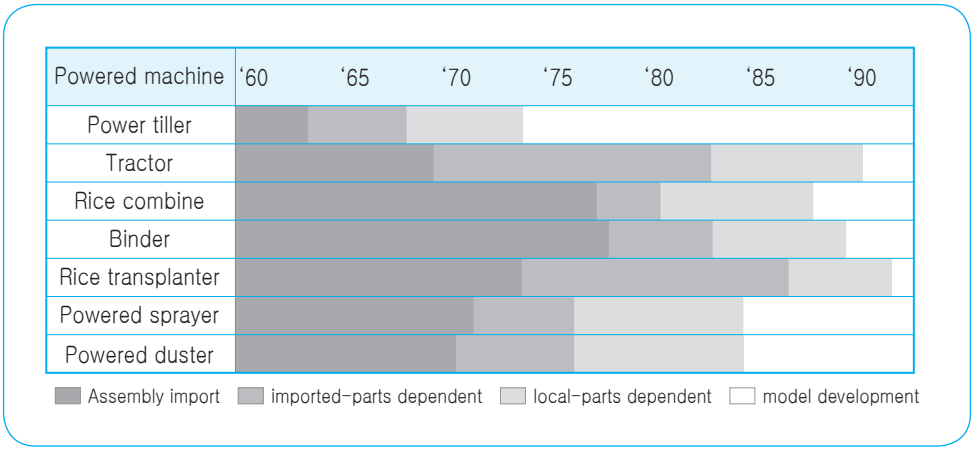
As mentioned above, a successful execution of the 5-year EDPs had created a large demand for labor forces in newly developed industrial sectors and caused many people, particularly young people, to move to those industrial sectors and cities. Naturally, a new means to replace the out-flow of rural labor forces was needed for agricultural productions. The government recognized the needs for fostering of agricultural machinery industry and localization of import machines to resolve the workforce shortages in rural area and supply the manpower required in the newly developed industrial sectors. It conduced to the development of government policies for fostering agricultural machinery manufacturers and localization of imported machines.

Until the early 1960s, most of the powered machines such as power tillers, power threshers and power sprayers supplied by the government were imported. As the demand for such

machines increased the government had initiated and promoted the localization policies. Since the production facilities and technologies of the agricultural machinery manufacturers at that time were not enough to produce independently the powered machines, those to supplement for the lack must be imported from the developed countries. The government approved preferentially the agricultural machinery manufacturers' imports of the necessary foreign capitals, facilities and technologies from the developed countries as a form of technical joint-venture. The first technical joint-venture was made between the Daedong Corporation in Korea and the Mitsubishi in Japan to produce power tillers. Through this joint-venture Daedong produced and supplied 305 units of power tillers first time in 1963. Since then, productions of power tillers, power sprayers, and misters were followed by other manufacturers with a technical joint-venture with Japanese companies. Daedong also started production of tractors since 1969 with a technical joint-venture with Ford in UK. Production of tractors was followed by other manufacturers with technical joint-venture with tractor manufacturers in Japan, Italy and Germany. By the localization policy, the parts in the powered machines produced with technical joint-venture should be replaced by the localized parts to reach the target ratio set by the government year by year. The government has driven this policy of localization strongly upon approval of foreign capitals. Production of agricultural machines by the technical joint-venture was extended to rice combines and rice transplanters. It continued until the mid of 1980s by extending the venture period or new contracting. The joint-venture contributed great to modernizing production facilities and enhancing the level of technology of Korean agricultural machinery manufacturers. The policy of localization driven together with the technical joint-venture also made it possible to localize many powered machines in a short period of time.

Development process of the powered agricultural machines through the technical joint-venture and localization may be divided into 4 stages: periods for assembly import, imported-parts dependent, local-parts dependent and model development respectively as shown in [Figure 4-5].

Figure 4-5 | Development Stages of Powered Agricultural Machines in Korea



In a period of assembly import, the entire machines are imported. However, in a period of local-parts dependent, more than 50% of the parts of the developed machines are produced locally while in a period of imported-parts dependent, they have more than 50% of the parts imported. Manufacturers develop and produce their own models of machines in a period of model development. Through these development stages, agricultural machinery manufacturers in Korea were able to localize all the powered machines since mid-1980s and develop their own models since 1990s. The stages of technology developments for various machines varied depending on the approval of foreign capitals for the joint ventures and the annual localization goals.

Technology provided by the developed countries through joint-venture was costly, as the expenses included technical fees for drawings, royalties for patent use, costs for purchasing facilities and fees for technical consulting. It was also accompanied by a kind of backside contract containing various limitations such as an export ban on the machines produced under the joint-venture and a development ban on particular components of the machine. Even after termination of joint-venture, there occurred frequent patent disputes with the technology providers. Since the imported technology was mainly concerned with productions, it contributed significantly to enhance the production technology and skills of Korean manufacturers. However, there was little effort for the development of design, test, and evaluation technologies to secure the product reliability. It was impossible to import those technologies and they should be developed by manufacturers themselves by investing a lot of time and money because even the developed countries refused to sell such technologies. The government has supplied farmers with the agricultural machines produced under the joint-venture and the localization programs. Therefore, to maintain their

manufacturing business, agricultural machinery manufacturers must be selected as a supplier of the machines that the government planned to disseminate for agricultural mechanization. It caused a severe competition among the manufacturers. However, relatively large-scaled manufacturers were selected as a supplier of such machines and their business became too much government-dependent so that they had a high risk of bankruptcy when the government's plans for the supply were changed or cancelled. In addition, the government plans without taking into account the manufacturer's production capacity have induced manufacturers' over-investments and excessive competitions. This excessive competition led to price dumping and resulted in low profitability which have made it difficult for manufacturers to invest for technology developments.

In 1971, the government introduced a policy in which agricultural machinery manufacturers were classified into two categories by their roles: one as Specialized Manufacturer (SM) and another as In-line Part Manufacturer (IPM). This policy was designed to avoid the excessive competition among the manufacturers, to accelerate the localization of imported machines and to increase quality of the localized machines. It was also considered that agricultural machinery manufactures were still vulnerable and the domestic market for agricultural machines was small-sized yet. The government designated two manufacturers as the SM for power tiller, tractor, combine and rice transplanter respectively. Thus, each of these machines was produced by only two manufacturers. The manufacturers designated as the IPMs produced only parts regardless of the machine types. As the demands for tractors, combines, and rice transplanters increased from the mid-1970s, the government, however, abolished the classification policy. Instead, the government introduced a new policy of production license to strengthen the agricultural machinery industry from 1977 by promulgating the "Plan for Strengthening Agricultural Machinery Manufacturers". Under this policy, manufacturers must obtain one of two different types of production licenses to produce agricultural machines: Integrated Farm Machinery Manufacturer (IFMM) and Specialized Small to Medium-sized Machinery Manufacturer (SSMM). This policy was intended to protect and foster the agricultural machinery industry. Production facilities and personnel qualification were standardized for manufacturers depending upon the machines to produce. Only those manufacturers that met such standards were allowed to produce the agricultural machines. Under this policy, five manufacturers were designated as the IFMM and licensed to produce relatively big-sized machines like power tillers, tractors, rice combines, rice transplanters and farm engines. Eight manufacturers were designated as the SSMM and licensed to produce relatively small-sized machines such as power sprayers, power threshers, water pumps, grain dryers and milling machines.

The manufacturers licensed as IFMM and SSMM had received following benefits and had to satisfy the standard requirements within a certain period of time.

① Products of the IFMMs and SSMMs were supplied preferentially by the government to implement agricultural mechanization plans.

② Foreign capitals for the production of agricultural machines were allocated preferentially to the IFMMs and SSMMs.

③ Long-term and low-interest loans were allocated preferentially to the IFMMs and SSMMs.

④ The IFMMs and SSMMs should produce and supply the machines that the government decided to supply.

⑤ The IFMMs and SSMMs should establish the after-sales service network as required by the government.

⑥ The IFMMs should produce more than 2 kinds of machines except farm engines within two years after designated as the IFMM.

⑦ The IFMMs and SSMMs should accelerate localization of less-developed and undeveloped machines to meet the target ratio of localization.

In addition, the government also conducted a policy to promote parts productions in which the government specified the parts in line with the manufacturers as a series. This policy was designed to avoid the parts disorder and to increase the quality of parts. As of June 1982, 258 manufacturers were specified for the production of 166 parts. This policy for the specialization of parts in series continued until a new policy based on a complete free competition was introduced in 1988. Although the 'Plan for Strengthening Agricultural Machinery Manufacturers' was intended to prevent manufacturers from overinvesting in production facilities and to strengthen the agricultural machinery industry, it did not worked out as it was originally intended. Since various government support and procurement benefits were given only to a few manufacturers designated as the IFMMs and the SSMMs, it limited the free competition in the production of agricultural machines and made it practically impossible for new manufacturers to enter the agricultural machinery market. Moreover, the IFMMs and SSMMs paid their attentions mainly to the product sales in the domestic market rather than the competitiveness in price and quality of their products, resulting in a lukewarm technology development and poor competitiveness in oversea market. Many manufacturers which were not designated as the IFMM or the SSMM were turned into part suppliers to them. The IFMMs and the SSMMs had dominated exclusively the domestic agricultural machinery market from the late 1970s to the mid-1980s.

This policy of the production license for strengthening exclusively agricultural machinery industry became rather a cause of weakening the competitiveness of Korean agricultural machinery in today's international market. It was abolished after all in 1988

and the agricultural machinery industry changed to a fully free and competitive industry. However, it was not easy for new manufacturers to enter the small domestic market which were already dominated by a few manufacturers.

As mentioned above, agricultural machinery industry in Korea has grown up by the government policy supports and now comprised of 4 IFMMs producing power tillers, tractors, rice combines and rice transplanters, and about 400 manufacturers producing sprayers, dryers, cultivators as well as various implements such as plows, rotovators, balers, loaders and facilities for horticulture and livestock productions.

6.2. Production and Supply of Agricultural Machinery

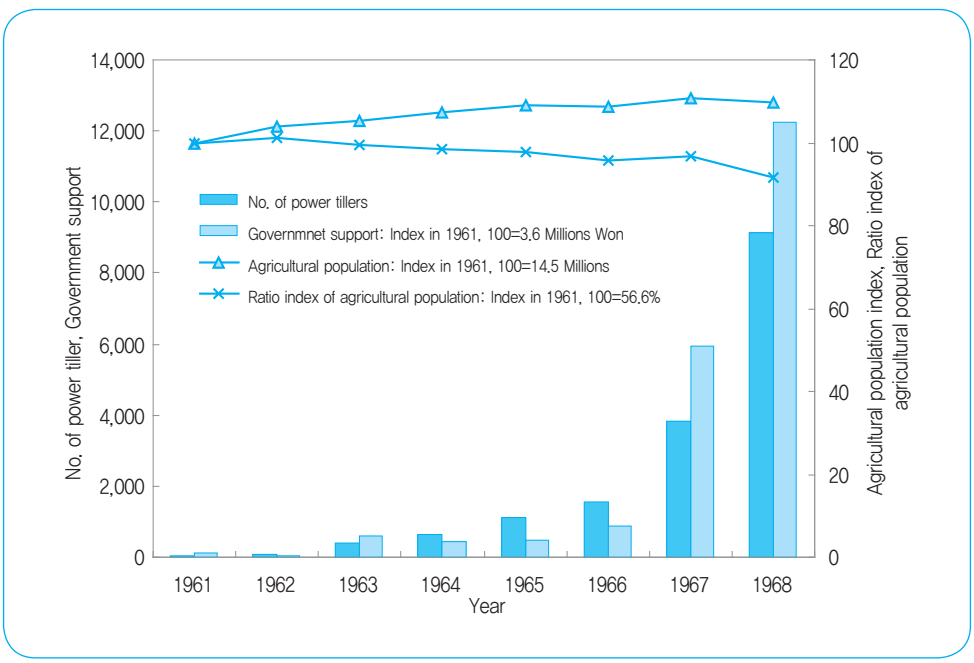
In 1950s and the early 1960s before power tiller was introduced, powered agricultural machines produced in Korea included stationary engines of 5-10 horse powers, water pumps, powered sprayers and misters, and powered thresher. However, most farm machines were human or animal powered machines such as plow, human-powered thresher and human-powered sprayer. According to 1963 statistics, productions of agricultural machinery were 5,083 units of stationary engines, 2,251 units of water pumps, 560 units of powered sprayers and dusters, 738 units of powered threshers, 86,400 units of plows, 38,366 units of human-powered sprayers, 30,103 units of human-powered threshers, resulting in more productions for human or animal powered machines than for engine-powered machines. Although this pattern of production is a typical trend that can be easily seen in most developing countries in which abundant farm labor is available, it caused no problems in promoting agricultural mechanization as experienced in Korea.

It was since the production of power tillers that powered machines were produced substantially in Korea. They were produced at first using the imported facilities and technologies from Japan, Germany, the United Kingdom and Italy through technical joint-ventures. The production was also possible because the government permitted the import of foreign capitals to produce such machines with a high priority and supplied the powered machines by the policy support. In other words, manufacturers was able to produce the powered machines with an aid of foreign capitals and technologies because it was surely guaranteed to sell them, when they were produced, through subsidies and loans that the government provided farmers for machinery purchase.

Government policies to aid farmers to purchase agricultural machinery was one of the most important factors affecting significantly its production and supply. The production and supply were determined by the magnitude of the government support. In other words, they varied with an amount of the government budget allocated for the support. If the government budget was not ensured enough, the production and supply of agricultural

machines were not ensured either. These government-dependent production and supply of agricultural machines were inevitable at the beginning stage of agricultural mechanization because farmers were not able to afford agricultural machines due to their low income and the revenue that farmers could make by utilizing the machines was difficult to ensure. However, the demand for agricultural mechanization increased as the number of rural people leaving the farm continued to increase. This also increased the demand for powered machines. Consequently, the government support for farmers would have to be increased continuously with the increased demands for both agricultural mechanization and powered machines. [Figure 4-6] shows a trend in the number of power tillers influenced by the changes in agricultural population and government support for agricultural machinery purchases at the beginning of agricultural mechanization. Power tiller was a typical machine that the government supplied at first for agricultural mechanization. As shown in [Figure 4-6], increasing number of power tillers in the beginning of agricultural mechanization was affected most significantly by the government subsidy for purchasing agricultural machines, which amounted to 40-60% of the purchase price in 1960s.

Figure 4-6 | Increasing Trend in the Number of Power Tillers and the Changes in the Government Support and Agricultural Population at the Beginning of Agricultural Mechanization



Since government policies to aid farmers to purchase their machines affects drastically the production and supply of agricultural machines at the beginning, the government must allocate properly the machines to supply in their kinds and numbers depending upon the capacities of the manufacturers step by step as agricultural mechanization proceeds. If the policy induces manufacturer's overinvestment for the production facilities or maintains inconsistency in the amount of the purchase aids, the consequences will be shifted to agricultural machinery manufacturers and farmers. The manufacturers will suffer from reduced utilization of their capacities leading to a price increase or, in the worst case, to a bankruptcy. Farmers also will suffer from the increased prices of machines and difficulties in securing the required labor forces. Korea has experienced manufacturer's overinvestment caused by the inconsistent government policies for the purchase aid program during the agricultural mechanization process.

Agricultural mechanization in Korea began for the all-out mechanization of rice production, and continued for the mechanization and automation of upland crops, horticulture and livestock productions. The all-out mechanization of rice production was promoted step by step for plain, mid-mountainous and mountainous areas respectively. Agricultural machines required for the mechanization process were produced and supplied accordingly. Agricultural machines produced in the early 1960s were disaster-prevention machines such as water pumps, power sprayers, power misters and dusters. They were supplied to release the water shortage due to a drought and to control disease and insect. These machines replaced the human-operated machines such as manual sprayers and water-buckets, also having farmers be freed from drudgery. Although power tillers were supplied at first for use in various farm operations, they were widely used as a means of cargo transport in cities and their suburban areas rather than as a machine for agricultural purposes. It was simply because proper means for small cargo transport was unavailable at that time. It was since mid-1970s that power tillers were actually used for agricultural works such as plowing and transporting. From the mid-1970s, rice transplanters, binders, and rice combines were produced and supplied to mechanize transplanting and harvesting operations. More details follow on the production of major agricultural machines for agricultural mechanization.

6.2.1. Power Tiller

As mentioned previously, Daedong Co. started production of power tillers with a technical joint-venture with Mitsubishi in 1963. Kukje, Tongyangmoolsan, and Asia Co. followed Daedong Co. so that four manufacturers in Korea came to produce power tillers. They all produced 5, 6, 8, and 10 ps kerosene and diesel power tillers at first. As the demand for high power increased, productions of 5, 6, and 8 ps kerosene and diesel power tillers were gradually discontinued. Daedong Co. is currently producing about 300 units of 10

ps diesel power tillers per year. Power tiller was used as the key machine for agricultural mechanization in Korea. Its population increased steadily until the end of 1990 and reached to a peak of 960,000 units in 1998 as shown in [Figure 4-7]. Since then, it declined gradually to about 667,000 units in 2011. The declining trend of power tiller is expected to continue and its demand is expected to be replaced by tractor.

6.2.2. Tractor

The first tractor in Korea was a 46 ps water-cooled diesel tractor produced by Daedong Co. in 1969 with the technical joint-venture with Ford in UK. Daedong also produced water-cooled 22 ps diesel tractors from 1976 with the technical joint-venture with Kubota in Japan. Production of tractors followed by other companies since then. Tongyandmoosan produced water-cooled 46 ps diesel tractors in 1975 with the technical joint-venture with KHD in Germany and water-cooled 28 ps diesel tractors in 1980 with the technical joint-venture with Iseki in Japan. Hankuk Heavy Industry produced water-cooled 28 ps and 50 ps diesel tractors in 1979 with the technical joint-venture with Fiat in Italy. Kukje produced water-cooled 30 ps diesel tractors in 1978 with the technical joint-venture with Yammar in Japan. As mentioned above, tractor production started as the assembly-production since early 1970s with the technical joint-venture with companies in UK, Japan, Germany, and Italy. The imported tractors have been localized gradually as planned by the government policy.

Tractor population increased sharply from the mid-1980s to the mid-2000s, resulting in average increase by 21,550 units per year. Since then, it increased steadily to about 268,000 units in 2011. At Tractor power ranged mainly less than 50 ps at first and increased gradually to higher range up to 60 and 80 ps. Now it goes even up to 100 and 150 ps. However, the localization of high powered tractors are relatively low.

6.2.3. Rice Transplanter

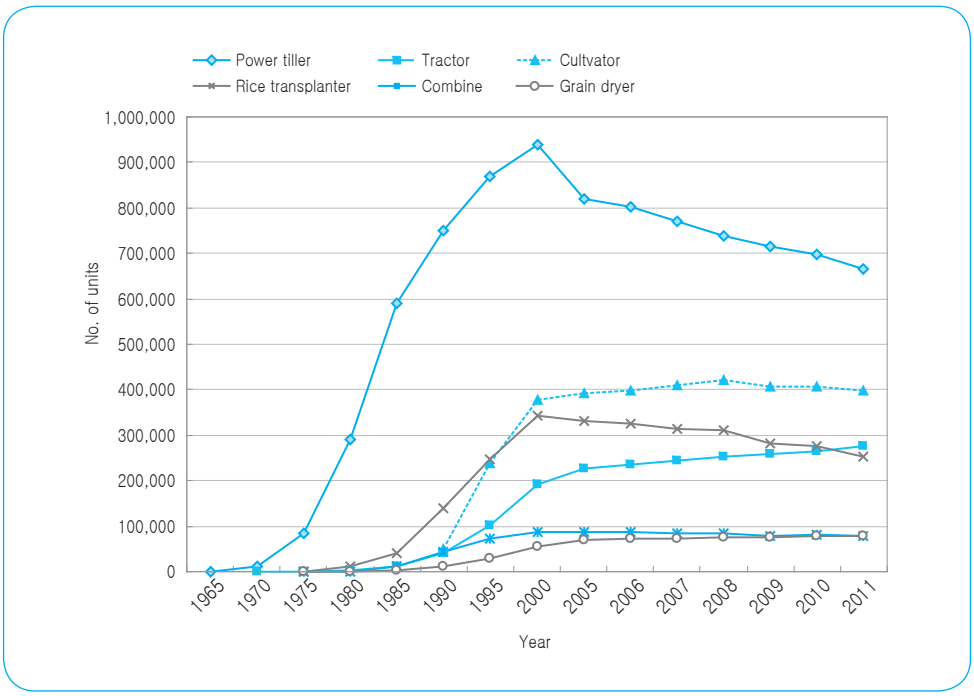
Rice transplanter was first introduced to Korea in 1973. At first, rice transplanters were imported from Japan and supplied to farmers. However, the localized components of transplanter increased gradually by the localization project. Most of rice transplanters were at first walking type of two-row. Their working capacity also increased to three-row and four-row. In 1990s, transplanter of riding type was introduced for high speed operation and driver's convenience. Transplanters of six-row riding type are currently widely used.

6.2.4. Combine

Supply of combines started from 1973. Like rice transplanters, combines imported from Japan were supplied at first and localized year by year. Two-row combines were improved

to large combines of three and four-row types, and later to high speed combines of five and six-row types. Most of first combines were sack-type and dumped the harvested rice into the sacks. However, combines of bulk-type, dumping the harvested rice directly into cargo trucks, are widely used in these days

Figure 4-7 | Population of Major Agricultural Machines for Rice Production



6.3. Distribution System of Agricultural Machinery

Before agricultural mechanization started, agricultural machines were sold and distributed on a free-competition basis by the private dealers. Most of the agricultural machines at that time were small-sized and human-powered. Manufacturer's dealer networks were not well established either. Distribution of small-sized and human-powered machines were still made through the private dealers even in the early 1960s when agricultural mechanization started. However, powered machines were distributed through the different networks.

Since the early 1960s, powered machines such as power tillers, power sprayers, and water pumps were supplied by the government policy support. These powered machines were all distributed through the farmer's organizations such as the Farmland Improvement Cooperative (FIC) and the NACF, but mainly through the NACF. If the government

determined the basic directions for kinds of machines, number of units and period to supply, the NACF purchased and distributed the machines accordingly through the general competitive bidding. Distribution of powered machines through the NACF was designed to prevent the private dealers from making a monopoly of machine prices. In addition, it was simply because manufacturers' dealer networks were not yet established throughout the country. On the other hand, the NACF had already completed its networks throughout the country and was regarded as an organization convenient to farmers because it handled the subsidy and loan affairs for the agricultural machinery purchases. However, in the government-driven supply of agricultural machines through the NACF, machines were selected at the lowest bid prices so that farmers could not choose the machines suitable to their local farming conditions taking the machine performance into consideration. Although manufacturers were competing sharply with each other to sell more, they neglected the quality improvement and after-sales services for their products. To overcome the shortcomings of such a batch type of government-driven procurement, the NACF contracted only the supply prices of machines with manufacturers since 1967 and let farmers buy the machines suitable to their farming conditions at the contracted prices. This way of suppling expanded the range of machines that farmers could choose and induced the competition in quality, price, and after-sales service among the manufacturers.

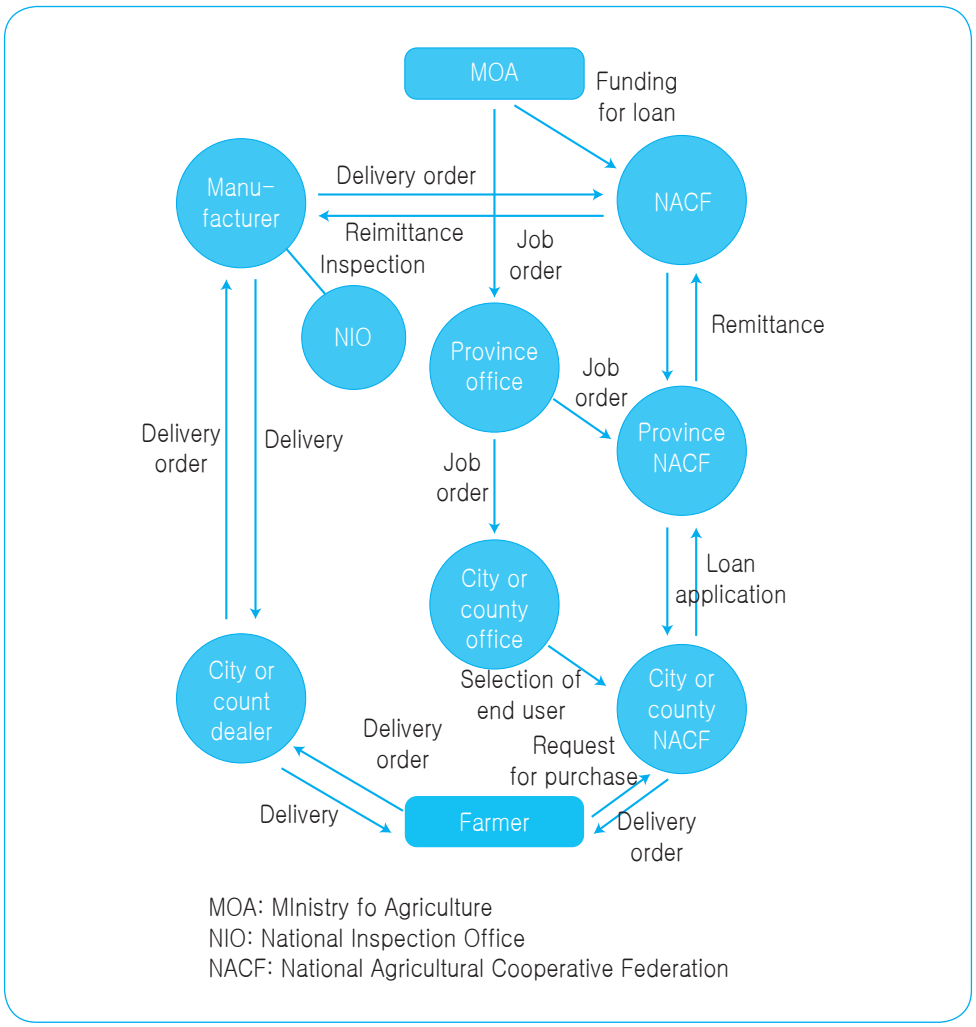
Under the condition that manufacturer's dealer network is still insufficient, free competition among the private dealers in sales of powered agricultural machines may generate a high risk of side effects such as price monopolization by one or two suppliers and production of low quality machines due to price dumping. There is also a high possibility for the dealers to have poor after-sales services. To distribute the government-support machines quickly and efficiently, single supply channel through the nationwide network like the NACF may be more effective. From this point of view, supply of powered machines through the NACF was inevitable at the beginning of agricultural mechanization. It also contributed to increasing the efficiency of the government support for farmers and restraining the price rise in the market. However, manufacturer's after-sales service was poorer than expected and the expansion of the distribution network based on the market principle was insufficient as well during this period of time. Supply of agricultural machines based on the market principle was first attempted in 1972. In other words, the government policy changed to have manufacturers take responsibility for after-sales services for their products, and farmers purchase their machines through the manufacturer's dealer. However, it was difficult to form a free market based on the principle of demand and supply because all machines were supplied unilaterally by the government policy at that time. It was also difficult for the government to ignore the NACF's claim to participation in the supply of agricultural machines because the NACF's claim was based on its foundation purpose of

working for farmers. This supply system through the manufacturers remained two years until 1973 and changed back to the previous distribution system through the NACF in 1974.

In the NACF's exclusive distribution system which was conducted from 1974 to 1976, the NACF made a purchase and delivery contract with manufacturers and placed an order with the manufacturers for the machines that farmers requested through the NACF branch offices. Then, the manufacturers delivered the ordered machines to those branch offices. Through this supply system, the manufacturers were able to receive easily the remittance from the NACF. However, the shortcomings of the government-leading supply system which were experienced at the beginning reappeared. In other words, the manufacturers were interested only in securing a large amount of orders and paid little attention to the quality improvement of products, development of new technologies and quick after-sales services. The Farmer's range of machine selection was limited as well. [Figure 4-8] and [Figure 4-9] show the distribution of agricultural machines conducted in 1970s.

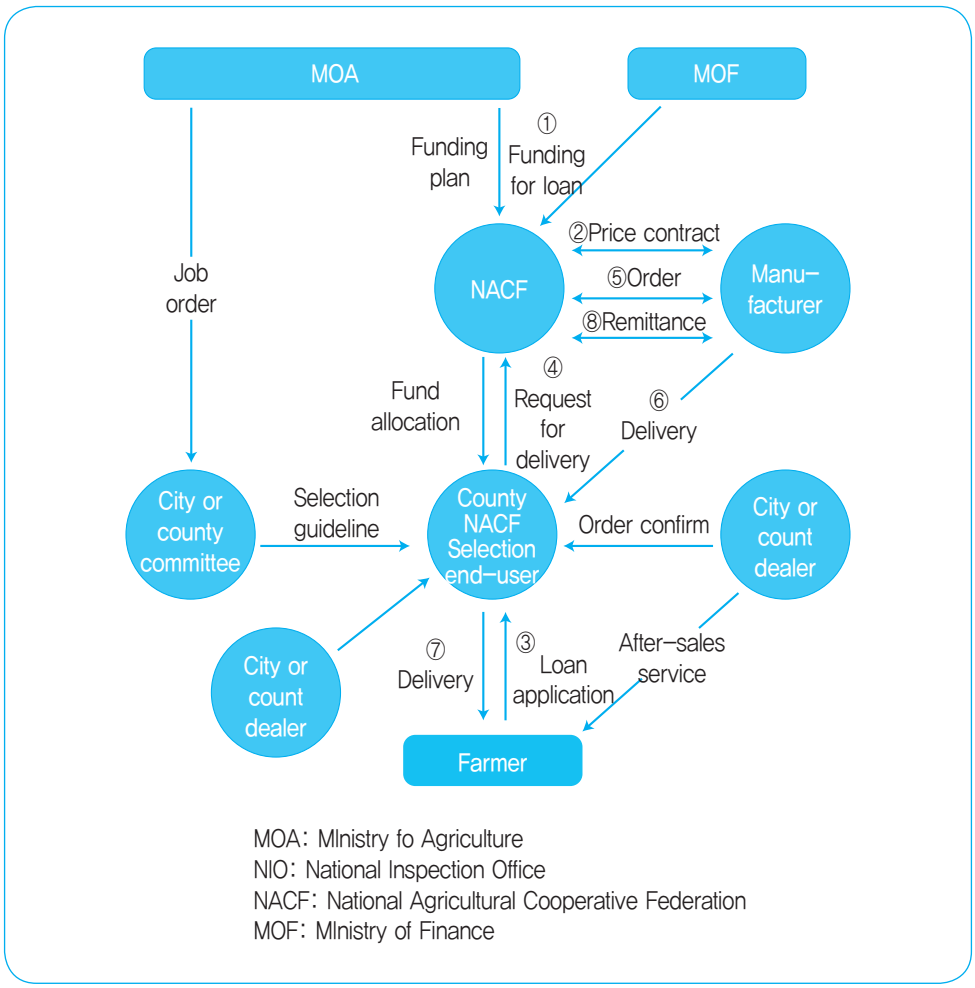
As new powered machines such as rice transplanters, binders, and combines were introduced since mid-1970s, there was a great demand for quick after-sales services and technical assistance which could be provided better by the manufacturers. The manufacturers also needed a large volume of sales to maintain their dealer network expanded throughout the country. In response to such changes, the government divided the NACF's supply system into two channels by the types of machines from 1977, one through the NACF as before and another through the manufacturer's dealer network. In this dual channel system, the dealers supplied the new machines like rice transplanters, binders, and rice combines, and the NACF other machines as before. Thus, the NACF came to handle only the subsidy and loan affairs for the new machines and both the supply, and subsidy and loan for other machines.

Figure 4-8 | Distribution of Agricultural Machines in the Period of 1972-1973



Source: National Agricultural Cooperative Federation, 1983, "Farm mechanization in Korea"

Figure 4-9 | Distribution of Agricultural Machines in 1974



Source: National Agricultural Cooperative Federation, 1983, "Farm mechanization in Korea"

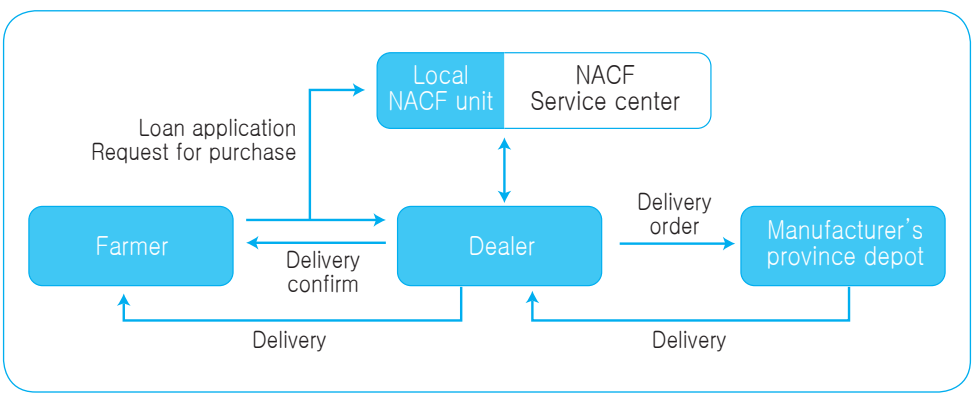
The dual supply system by the types of machines contributed greatly to strengthening the manufacturer's dealer network. However, as the supply of the new machines increased, the NACF again insisted that the NACF should participate in the supply of the new machines to prevent the dealers from the price increase and monopolization. The conflicts occurred between the NACF and the dealers who were against the NACF's claim. The government accommodated the NACF's claim so that the dual supply system by the types of machines was abolished and both the NACF and the dealers were allowed to supply all machines regardless of their types. As the supply system was changed to a dual system, the competition between the NACF and the dealers was inevitable. In addition, the dual

supply system contributed greatly to strengthening the financial structures of the dealers. It also brought a positive effect on expanding the functions of the NACF's service centers to provide better after-sales services.

Letting the NACF supply all kinds of machines was a necessary measure to create a competitive environment in the agricultural machinery market and to reinforce the manufacturer's poor dealer network. However, since complementary functional roles of the NACF and the dealers were not clearly defined, the conflict between them deepened gradually due to imbalance in their supply volumes. As such conflict grew, the government stopped the dual supply system only a year and half later rather than defining their respective roles.

Since July of 1982, the supply system of agricultural machines went back to the single-channel system through, this time, the dealers as shown in [Figure 4-10]. Thus, only the manufacturers were able to supply the agricultural machines through their dealer networks and responsible for after-sales services for the supplied machines. Instead, the NACF was responsible only for handling subsidy and loan matters required for farmers to purchase the machines. This change to manufacturer's exclusive supply system was due to increased demand for quick after-sales services in accordance with rapidly increased number of supplied machines and their kinds. The NACF also acknowledged the limit of its own capacity in performing the after-sales services for all supplied machines. Severe conflict between the NACF and the dealers due to the sales competition was also one of the reasons for the change in the supply system.

Figure 4-10 | Supply System of Agricultural Machines since July, 1982



The single-channel supply system through the dealers was mainly intended to improve the quality of agricultural machines and after-sales services through a fair competition among the manufacturers. However, it didn't work out as intended and it was difficult to

achieve its objectives under the circumstances at that time. Most dealers were small in terms of scale and capital so that they were unable to be equipped well with facilities required for sales, part acquisition, and after-sales services. They were also difficult to secure enough supply volume due to a lack of collateral ability. A complete preclusion of the NACF from the supply system provoked its complaints. Part of the complaints appeared as a delay of time in handling the loan screening and processing for farmers. Naturally, the remittance to the dealers took more time and the dealers often confronted with difficult financial status. In addition, abnormal transactions such as delivery first and loan process later happened due to excessive sales competition among the dealers. Some dealers were also found to use fake parts often due to their low revenues.

As the supply of agricultural machines increased continuously since mid-1980s, the NACF strongly advocated again the participation in the supply of agricultural machines by arguing that the NACF must supply farmers with the machines that they wanted to buy because they were the members of the NACF. According to this claim, the supply system was changed again back to the dual channel system involving both the NACF and the dealers since July, 1984. But this time, NACF's supply was limited to 40% of the total government's supply regardless of the machine types. The NACFs that were allowed to supply the machines were limited only to the NACFs which were operating the service centers. It was based on the principle that the supplier must be responsible for the after-sales services for the machines they supplied. The NACF's supply was not large at first but gradually increased up to 12.2% of the total amount of the sales in the market one time.

As agricultural mechanization was promoted rapidly, the supply of agricultural machines also increased accordingly in the late 1980s. As the machines were diversified in their types and the amount of the government supply was increased, the NACF strongly demanded the removal of the 40% limits on the supply by insisting the NACF's role as a preventer of price hikes. The government again accommodated the NACF's demand and removed the supply limit. Thus, two channel supply system with no limitations on the types of machines and the amount of supply was adopted and remained unchanged until now.

As mentioned previously, although the two channel supply system has positive effects of suppressing the price rise and improving after-sales services through the competition between the NACF and the dealers, a conflict is inevitable between the two because the NACF's strong influence on the loan process in the market, which results from the better financial status and organization than those of the dealers.

Frequent changes in the government policy on the supply system of agricultural machines have been due to a conflict of two justifications claimed by the manufacturers and the NACF respectively. The former has insisted strengthening their dealer networks to conduct

the after-sales services well and the latter has insisted lowering machine prices through the mass procurement, both of which are essential for agricultural mechanization. In the beginning, the NACF was better for supplying agricultural machines more efficiently than the dealers because the NACF had a better nationwide network than the manufacturers did. However, the manufacturer's dealer was better than the bureaucratic NACF for performing quick after-sales services.

Policy directions for the promotion of agricultural mechanization may differ depending upon the socio-economic conditions of the country. However, as seen from the distribution system of agricultural machines in Korea, provisions must be made to coordinates the roles of the parties involved in agricultural mechanization, like the government-affiliated NACF and the private dealers as a machine supplier, to maximize their functions and avoid any conflicts due to the sales competition. In other words, it is recognized that there should have been a clear criteria under which the NACF and dealers work complementarily for the supply of agricultural machines from the beginning of agricultural mechanization. <Table 4-35> shows the changes in the supply system of agricultural machines by the government policy.

Table 4-35 | Changes in Supply System of Agricultural Machines

Period	Supply system	Supplier	Loan handled by	Cause of change
Before 1971	Farmer's organization-based	NACF	NACF	To start mechanization
1972. 1. - 1973. 12.	Manufacturer-based	Dealer	NACF	To strength after-sales service
1974. 1. - 1976. 12.	NACF-based	NACF	NACF	To promote production and supply
1977. 1. - 1980. 12.	Dual channel by machine	NACF, Dealer	NACF	To strengthen after-sales service
1981. 1. - 1982. 6.	Dual channel for all machines	NACF Dealer	NACF	To lay a foundation for free competition sales
1982. 7. - 1984. 6.	Single channel by manufacturer	Dealer	NACF	To strengthen free competition sales, quality improvement and after-sales services
1984. 7. - 1988. 9.	Dual channel for all machines with limits	NACF Dealer	NACF	To provide convenience with purchaser and promote free sales competition
1988. 10. - Present	Dual channel for all machines without limits	NACF Dealer	NACF	To promote free marketing and price competition

Source: Park, W. K. 1998. Farm mechanization in Korea. Korean Society for Agricultural Machinery. Seoul, Korea

6.4. Export and Import of Agricultural Machinery

6.4.1. Export

Even in the early 1960s, Korea was already exporting agricultural hand tools such as spades and hoes to Southeast Asian countries such as Thailand and Malaysia. It was the first export of powered agricultural machines that 5 units of power tillers exported to Vietnam for $4,410 in 1965. The exports of power tillers continued and expanded to include farm engines and sprayers for 1970s. However, major export of agricultural machines for 1970s still remained as hand tools rather than powered machines. The export countries were also limited to Southeast Asian countries. In other words, more than 50% of the export for 1970s was taken by hand tools and Southeast Asian countries.

In 1980s export of agricultural machinery was accelerated by the government's export promotion policy. Daedong Company started exporting small agricultural tractors to the US market for the first time in 1985. Kinds of machines for export were gradually expanded from those based on small agricultural tools to those like farm engines, power tillers, small tractors and parts based on powered-machines. Export countries were also expanded from those in Southeast Asia to US, Australia and to those in Europe, Middle East and Africa. Farm engines and power tillers were exported mainly to Southeast Asian countries, and small tractors and agricultural tools to US, Australia and European countries. KAMICO also made a considerable effort to promote the export of agricultural machines by distributing various kinds of promotional materials to overseas Korean Embassies and dispatching market survey teams to overseas agricultural machinery markets.

In 1990s, sales competition between the domestic and Japanese agricultural machinery began in oversea market. Domestic agricultural machinery was low in terms of quality when compared with Japanese products but dominated in price competitiveness. In addition, many manufacturers struggled in this period of time to expand the export bases by establishing the oversea sales cooperation or joint-venture factories. Export machines and regions were gradually changed to focus on the US market with tractors. As a result of this effort, a total of $134.8 million of agricultural machinery was exported in 2000, exceeding $100 million for the first time. Since 2003, tractor has accounted for over 50% of the total exports in value.

Agricultural machinery export was driven authentically since 2000, as no demands were expected for new tractors, rice transplanters and combines which were major products of the agricultural machinery industry as the mechanization for rice production approached to its final stage. The government also abolished the purchase subsidy when the domestic market was in an extremely shrunk state due to the aftermath of the half-price supply policy.

In other words, the only way for the agricultural machinery industry to overcome the limited domestic market and survive was to export their products. The government also encouraged and supported actively participation of agricultural machinery industry in overseas exhibitions to promote the export of their products. From 1995, the Seoul International Exhibition of Machinery, Science and Technology for Agriculture (SIEMSTA) have been held every two years to increase the brand awareness of Korean agricultural machinery and to provide manufacturers with more opportunities for counseling with oversea buyers. The KAMICO also installed the Korean pavilions in major oversea agricultural machinery exhibitions and supported small and medium-sized enterprises for the promotion of their product exports and public relations.

Agricultural machinery export has increased steadily from the early 1960s as shown in [Figure 4-11], [Figure 4-12]. It exceeded $10 million in value in 1978 and $100 million in 2000. It temporarily decreased due to the global economic recession in 2009, restored to reach the level of $430 million in 2010 and achieved $608 million in 2011, increasing by 40.3% relative to the previous year. As shown in [Figure 4-13] and [Figure 4-14], export machines included tractors less than 50 ps, milling machines, implements, parts, combines and balers. Export countries were mainly US, China, Japan, Australia and Germany.

[Figure 4-15] shows proportions of agricultural machinery export in 2011 by types of machines and countries. In export machines, tractor accounted for 49% of the total export, constituting 31% by the tractors less than 50 ps and 18% by the tractors more than 50 ps, respectively. The followings were 16% for parts, 11% for implements, 7% for milling machines, 2% for combines and 1% for balers. In export countries, the US took 34% which was the largest export market, followed by 6% for China, 5% for Japan, 4% for Australia, 3% for Germany, 2% for India and 2% for Thailand. In summary, tractors less than 50 ps and the US market can be regarded as major machine and market for agricultural machinery export. This structure of export is vulnerable and subject to change depending on the economic situation of the United States. A 5% export decline in 2009 compared to the previous year was primarily due to the US market's woes.

Export of tractors, constituting more than 50% of the total agricultural machinery export in value, amounted to $45 million in 2000 and increased by 7.2 times to $324 million in 2011. During the same period, total export by the agricultural machinery industry increased by 4.5 times from $134.8 million to $680 million. The tractor proportion in the total export also increased from 33.1% to 53.3%.

Figure 4-11 | Export and Import of Agricultural Machines

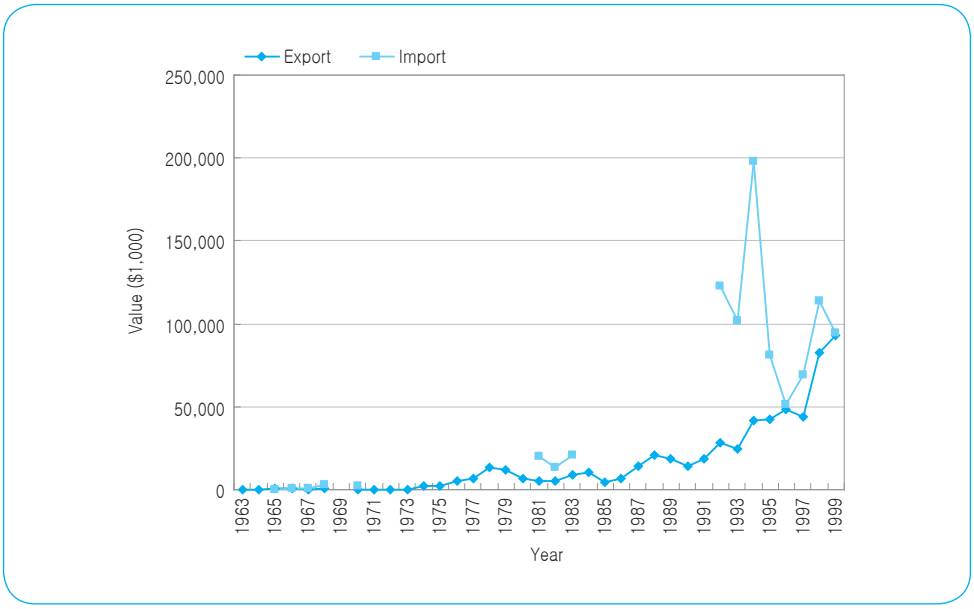


Figure 4-12 | Export and Import of Agricultural Machines in 2000s

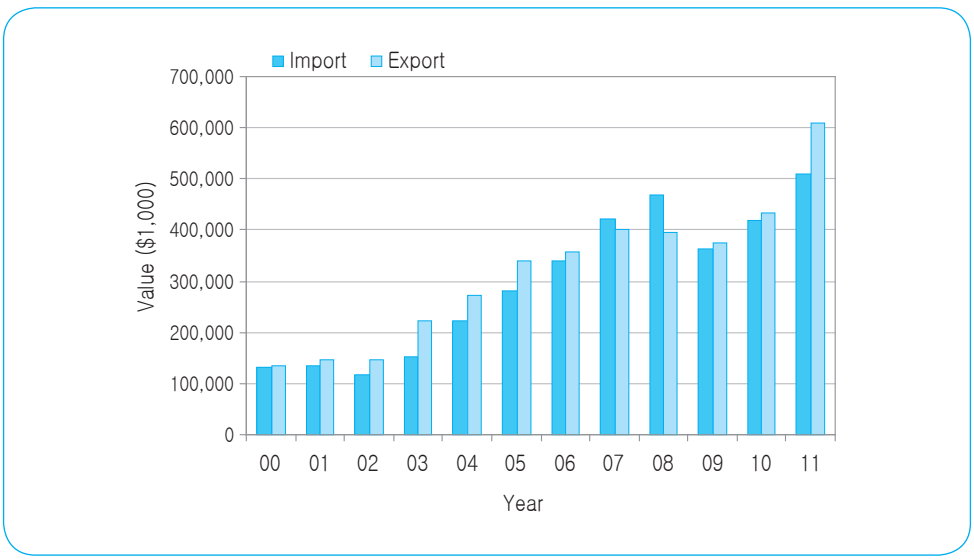


Figure 4-13 | Major Export Machines

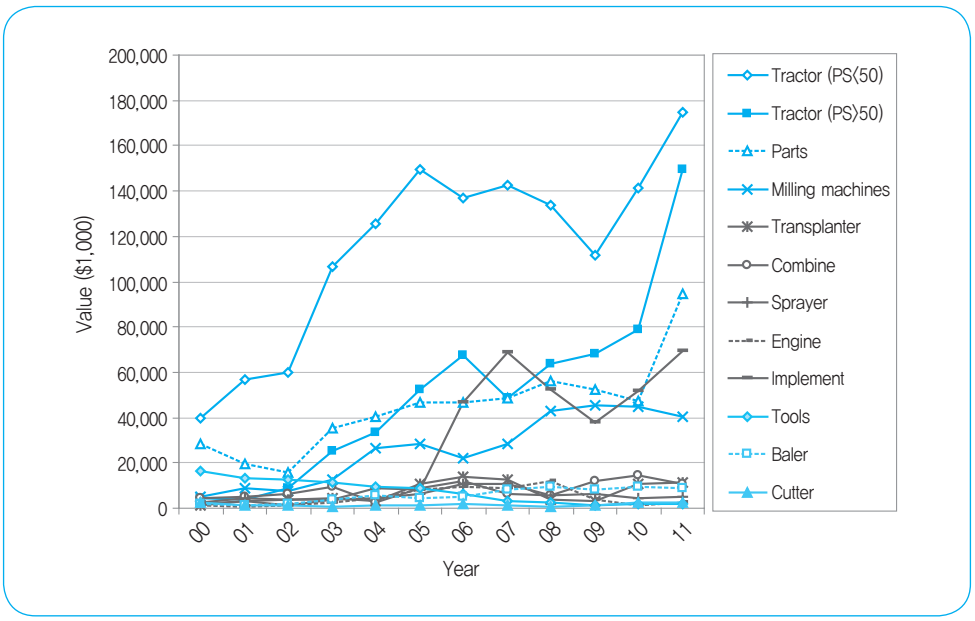


Figure 4-14 | Major Export Countries

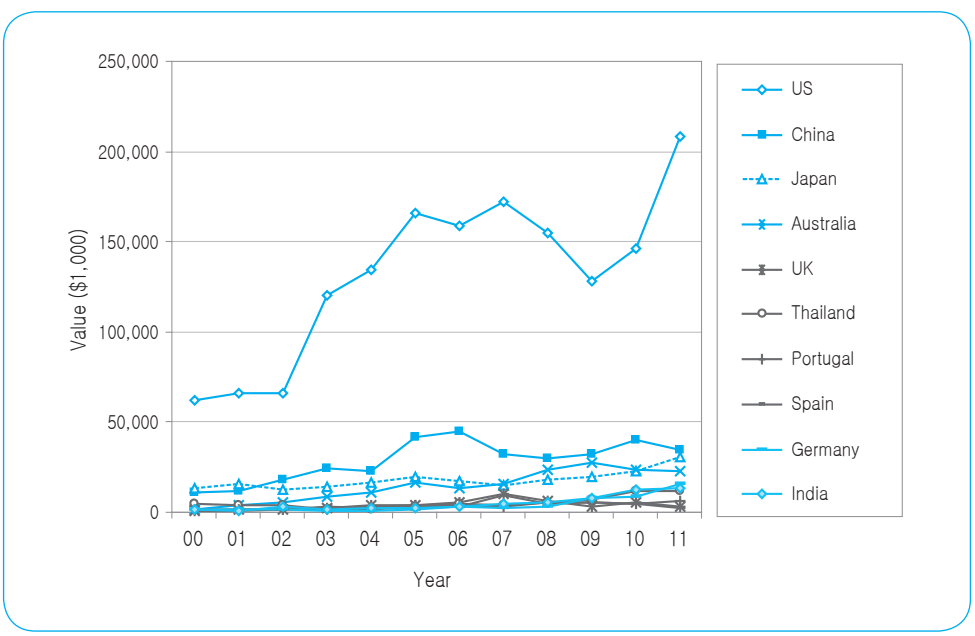
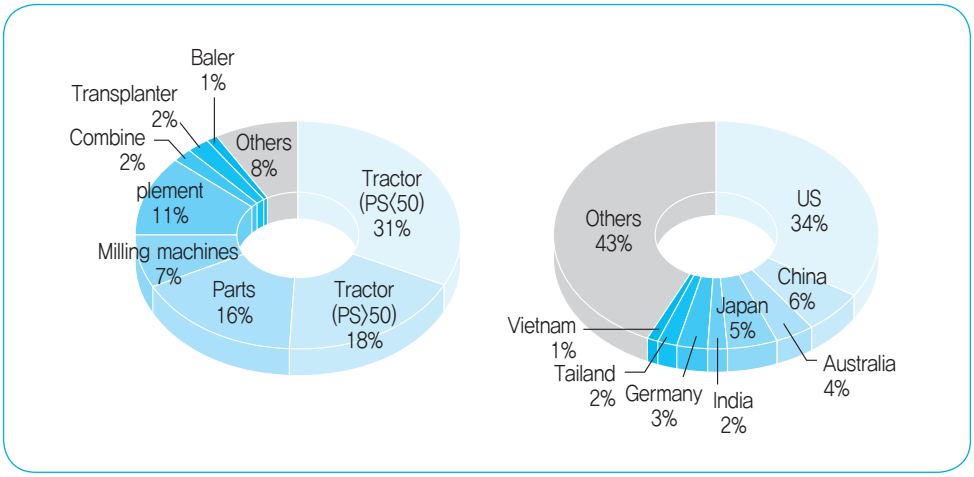


Figure 4-15 | Proportions of Major Export Machines and Countries in 2011



6.4.2. Imports

As already mentioned Korean manufacturers have developed and localized models of various agricultural machines through joint-venture with manufacturers from developed countries such as Japan, Italy, Germany and UK rather than their own models. Therefore, most powered agricultural machines were imported as finished ones at the beginning of agricultural mechanization. As the localization proceeded, the proportion of the finished products was reduced with increasing parts import which was also gradually reduced.

Agricultural machinery was imported mostly from Japan, who has farming conditions similar to Korea, causing a serious trade imbalance with Japan. To improve this imbalance, the government designated import diversification items from 1975 to 2001 and had the KAMICO recommend the items to import since 1976. To enable the KAMICO to directly approve the agricultural machines for import, the government revoked the KAMICO's recommendation procedures and operated through the KAMICO a tariff relief system and a parts-procurement planning committee for agricultural machinery from 1997 The tariff relief system was to reduce the tariff by 65%, instead of charging a basic tariff of 8%, on the imported machines to be used as a part of other agricultural machines such as farm engines, combines, water pumps and others, which were also approved by the parts-procurement planning committee. This system is believed to have contributed significantly to enhancing the localization program for agricultural machines.

As the localization program was carried out successfully for small powered agricultural machines such as power tillers, power sprayers, power dusters, small and medium-sized tractors, walking type rice transplanters and 2-4 row combines, import of these machines

also gradually declined. However, since mid-1990s, a demand for large-sized and high-speed agricultural machines increased with enlarged area for custom operations and promotion of livestock mechanization. In accordance with this demand, import began to rise for tractors of more than 100 ps, 6-row riding type rice transplanters and 5-6 row combines which were not localized yet.

Import of agricultural machinery once amounted to $200 million in the early 1990s due to the large-sized machines. However, it has steadily increased from about $100 million since 2000, reaching $500 million in 2011 as shown in [Figure 4-7]. Imported machines were mainly tractors of more than 50 ps, rice transplanters, combines, parts, farm engines and balers as shown in [Figure 4-16]. The countries to import were mainly Japan, US, Germany and China as shown in [Figure 4-17].

[Figure 4-18] shows the proportions of agricultural machines imported in 2011 by types of machines and countries. Among the imported machines, the parts accounted for 18% of the total import, followed by 14% for tractors of more than 50 ps, 8% for farm engines, 7% for rice transplanters, 7% for combines, 5% for implements, 5% for cutters and 4% for balers. In import countries, Japan accounted for 34% which was the largest, followed by 14% for China, 13% for Germany, 11% for US, 5% for Netherlands, 5% for Italy, and 5% for UK. Major import machine was large-sized tractors more than 50 ps and major import country was Japan.

Figure 4-16 | Major Import Machines

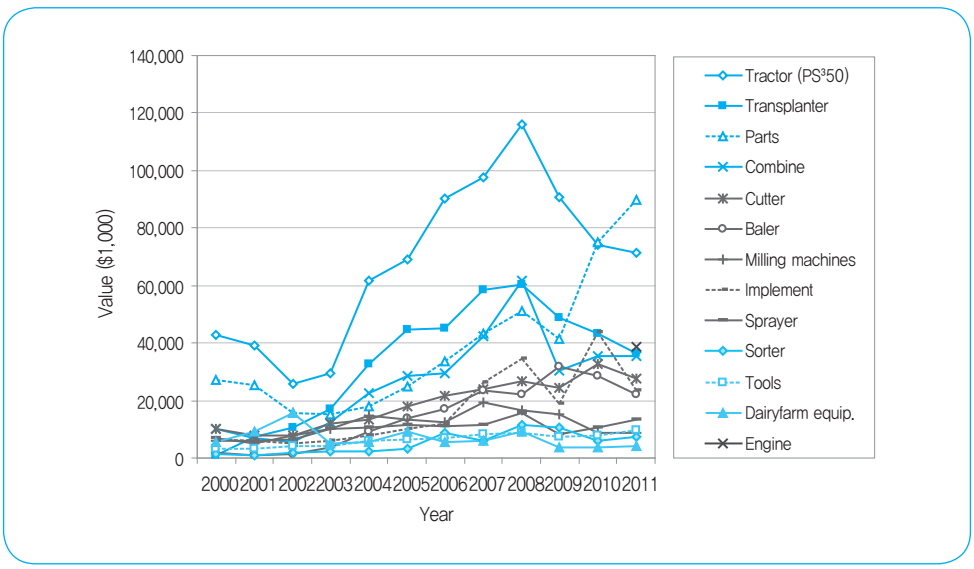


Figure 4-17 | Major Import Countries

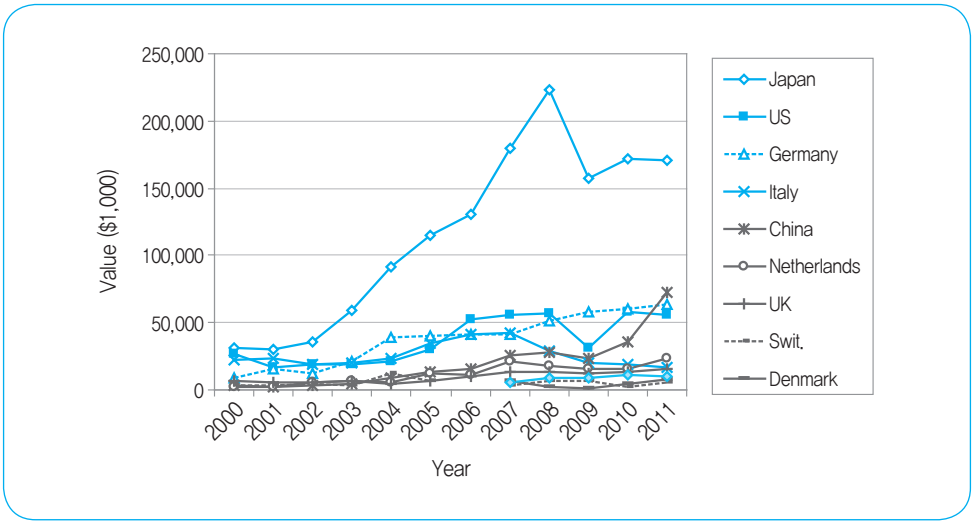
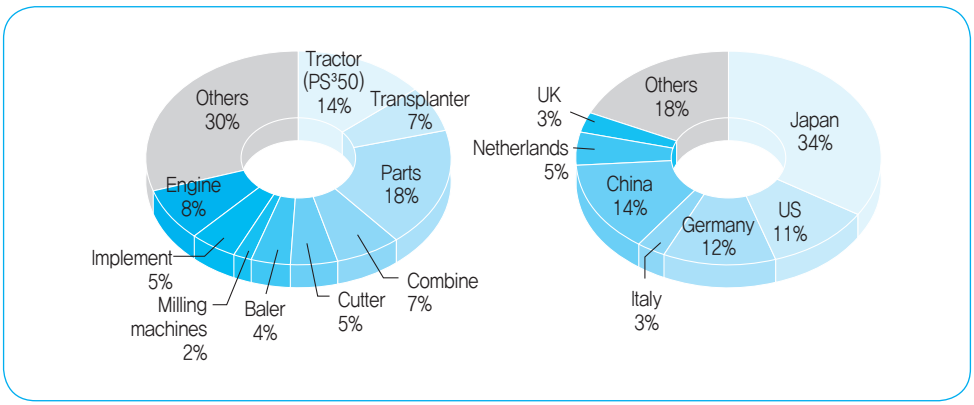


Figure 4-18 | Proportions of Major Import Machines and Countries in 2011



6.5. Used Agricultural Machinery

Trading of used agricultural machinery gradually increased with expansion of agricultural machinery supply. To activate the trading, the government has established and operated 7 dealerships for used agricultural machinery on a pilot basis at the regional NACF units since 2001. In addition, the government calculated reasonable selling prices and developed a trading price benchmark for used agricultural machinery. A certain period of warranty was also made mandatory for used agricultural machinery.

Since 2003, a loan system was conducted to support the purchase of used agricultural machinery so that farmers were able to apply a certain amount of loan within 90% of the benchmark prices specifically set by types of machines, manufacturers, models, and number of years being used. The loan condition was equal repayment within 3 years at an annual interest rate of 4% without a grace period. The loan system was improved in 2007 to apply a certain percentage of the prices depending upon the types of machines and the number of years being used. The ratio of loans was also raised to alleviate the burden of purchasing used agricultural machines. However, no loan support was made available to used agricultural machines which were imported or of which prices were less than 1 million Won.

The financing support for used agricultural machinery was available at first for the machines with the remaining loan payment being 25% or less but it was gradually relaxed to 50% and later to all used machines by succeeding the remaining loan payment to buyers. The annual interest rate for the loan was reduced to 3% since 2008. <Table 4-36> shows the basic ratio of loan support by the kinds of machines and number of years being used and parts supply period for used agricultural machinery.

Table 4-36 | Basic Ratio of Loan Support and Part Supply Period for Used Agricultural Machinery

Year		2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997
No. of years being used		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tractor	Life expectancy (8 years)	→	→	→	→	→	→	→	→							
	Parts supply period (12 years)	→	→	→	→	→	→	→	→	→	→	→	→			
	Basic ratio (%)	57	50	46	42	38	34	30	26	22	19	15	12	8	8	8
Transplanter and combine	Life expectancy (5 years)	→	→	→	→	→										
	Parts supply period (9 years)	→	→	→	→	→	→	→	→	→						
	Basic ratio (%)	55	45	40	35	30	25	20	16	11	8	8	8	8	8	8
Other machines	Life expectancy (5~8 years)	→	→	→	→	→	→	→	→	→	→					
	Parts supply period (9~12 years)	→	→	→	→	→	→	→	→	→	→	→	→			
	Basic ratio (%)	55	47	40	33	27	22	18	15	13	11	10	9	8	8	8

Source: Korean Society for Agricultural Machinery, "Agricultural Machinery Yearbook"

7. After-sales Services for Agricultural Machinery

7.1. Networks for After-sales Services

Agricultural machines work for plant, animal, soil or water. Working time differs depending upon the kinds of works and seasons. Agricultural machines are used under poor working conditions with earth, dust, high or low temperatures, and used also by farmers who have less experience in operating machines. Therefore, agricultural machines are likely to fail frequently during the operations. Unless after-sales service is not quickly provided when a machine has failed, the yield may be reduced due to a loss of timely operation, resulting in economic losses. Although manufacturers and dealers should take the responsibility of performing after-sales services for the machines they sold, their facilities and capabilities were insufficient at the beginning of agricultural mechanization. The government must support not only the supply of agricultural machines but also after-sales services activities for a certain period of time.

In the early 1960s when agricultural mechanization started, a nationwide network for the after-sales service was not yet established. At that time, manufacturers performed the after-sales services on a contract basis like those for general industrial products. Their service load was not heavy either because most agricultural machines were simple and human-powered. It was since 1970 that the government has handled the after-sales services of agricultural machines more systematically as its policy. After-sales service networks were changed according to the supply system of agricultural machines

As manufacturers have been specialized by the types of machines since 1971, they were required to install dealers in cities and counties. The dealers then supplied the machines and conducted after-sales services under the responsibility of the Korea Agricultural Machinery Industry Cooperative (KAMICO). However, as the NACF had taken over the supply right of all agricultural machines since 1974, the dealers were changed to repair-only shops conducting only repair services for all the machines. The NACF, as the sole supplier of agricultural machines, increased the number of its own service centers which started from 1969. On the other hand, the number of dealers declined naturally because they were not allowed to sell the machines. Instead, the manufacturers organized circuit repair-service units and had them perambulate the country four times a year. As the dealers resumed selling transplanters, binders, combines and some other machines from 1977, they also resumed the after-sales services for those machines. The dealers were affiliated to the manufacturers from this time. The NACF also installed service centers in its local unit offices and the parts centers in the provinces.

Since 1980 in accordance with agricultural mechanization promotion law, the manufacturers and vendors of agricultural machinery must install their dealers or repair shops meeting the facility and personnel requirements standardized by the government in the cities and counties in order to produce or sell the machines of the government-supply models. They were also required to install the KAMICO-designated repair shops for repairing only and selling parts in the villages. These government policies were designed to establish at least two dealers in small city or village areas. The NACF installed its service centers in the areas without the dealers. As both the NACF and dealer have been able to supply all agricultural machines regardless of their kinds since 1981, and the dealers only since July 1982, the dealers became more active in their business. However, the NACF's service centers shrank due to the deficit. Since then, the NACF reduced installation of the service centers as much as possible and diversified their operations to autonomic direct-operation, contract-operation or lease-operation that the local NACF's units could choose depending on their local conditions. As the numbers of big-sized machines like tractors combines and rice transplanters increased from the early 1980s, the manufacturers of those machines installed maintenance-factory in the provinces and maintenance-units in the counties for the after-sales services. In addition, the manufacturers installed direct-operated part centers in the provinces and intensified the activities of the nationwide and county-wide circuit repair-service units by expanding their functions. As the NACF resumed the supply of agricultural machines from July 1984, the NACF's service centers became economically viable again. Since then, a competitive relation was made between the NACF's service centers and the dealers in the after-sales service market. However, the NACF's service centers mainly covered small-sized machines and the dealers with large-sized machines. From 1989, the NACF's service centers were classified into two groups depending upon whether or not the local NACF's unit can sell the agricultural machines. The service centers of the selling-machine NACF units must take responsibilities for selling and after-sales services for the machines they supplied, and those of non-selling-machine NACF units work only for repair services.

The after-sales service network for agricultural machinery was a dual network: one through the NACF's service centers and another through the manufacturers' dealers, through which roles and functions were intensified or shrank depending on the changes in the supply system. The NACF has maintained the after-sales service network based on the local unit's service centers and operated the part centers in the provinces. The manufacturers has maintained the after-sales network based on their dealers in the cities and counties, and operated additional repair units in counties, and repair factories and part centers in the provinces. In the town and village levels, the repair services have been performed by the KAMICO-designated repair shops.

Since the number of after-sales service providers were not enough in the period of 1970-1980 when compared with that of the machines supplied, the circuit service units were formed and operated on regular or sometimes non-regular basis. The central repair service unit was formed by the KAMICO to cover the whole country. The regional repair service units were formed jointly by the regional dealers, NACF's service centers, and technical centers to cover the local areas. The manufacturers also operated their own circuit service units as needed. In addition the administration offices in the provinces, cities, counties and towns installed the complaint-reporting centers so the offices can relieve quickly the discomforts and inconvenience faced by farmers when purchasing or repairing their machines. These complementary measures were ended gradually as the number of after-sales service providers and the quality of their services increased.

The dual networks for the after-sales services based on the NACF's service centers and the manufacturer's dealers remained unchanged until the mid-2000s. However, the classification of the after-sales service providers were changed from five levels based on the administration units to three levels of small, medium and large based on the service capacity in order to make the services more systematically. Some of the NACF's service centers were also consolidated to make the service more efficiently. <Table 4-37> shows the after-sales service providers based on the administration units in the dual networks.

Table 4-37 | After-sales Service Providers based on the Administration Units

Administration units	Manufacturer	NACF
Nationwide	Regular circuit service unit Special circuit service unit	
Province	Repair factory Parts center	Part center
City and county	Dealer Repair service unit	City and county NACF service center
Town and village	Repair shop	Local NACF unit's service center

7.2. Strengthening of After-sales Services

In the early 1980s, the policy directions for the after-sales services were to install dealers in cities and counties, the repair shops in towns and villages, and to raise the dealers as family distributors of the manufacturers or vendors, and the repair shops as integrated repair centers. According to this direction, the manufacturers and vendors must install their dealers in every county, on a one dealer one county basis, within three years after they started selling

machines. They were also forced to increase the number of repair shops year by year to meet a target of one repair shop in one town or village. The dealers and repair shops should be equipped with equipment and manpower standardized by the government. The dealers also must be designated as after-sales service provider by the KAMICO after contracting it with manufacturers or vendors, and so did the repair shops by the KAMICO with the recommendation of a KAMICO-designated dealer in the same area. The repair shops, as a forefront after-sales service provider, took the responsibilities of supplying repair parts and performing repairs. The dealers in the counties were responsible for sales, parts supplies and after-sales services for the machines as contracted with the manufacturers.

As the policy direction was expended in 1984, the after-sales service providers included the part centers, repair factories and integrated repair units. The manufacturers producing machines of large-sized and riding types should install more than one parts center and one repair factory in more than two provinces. The KAMICO was also requested to install the integrated repair unit in more than one city or county per province and increase the number of the repair shops to two in every town and village.

The NACF established its service centers in the cities and counties from 1972 and expanded them even to the local NACF units in towns and villages. The service centers of the local NACF units were established in the remote mountainous areas where the private repair shops were not available. These local NACF units' service centers contributed greatly to the after-sales services for agricultural machines at the beginning of agricultural mechanization when the private after-sales service network was poor by performing a nationwide parts supply and repair works. In addition, they played a role of preventing the private repair shops from monopolizing the service charges. The NACF's service centers and the private dealers have competitive relations with each other. Particularly, the local NACF unit's service centers are in conflict with the private dealers due to a severe competition to secure the orders from the limited demand in the region and to scout for qualified repairman. The private dealers regard this competition unfair because the NACF takes advantages of its superior position. The superior position was indicated by the facts that the NACF can exclusively provide farmers with the convenience in loan applications and repairmen with better job stability in scouting them. However, it was difficult for the bureaucratic NACF's service centers to compete with the private repair shops and dealers. Because of that, many of the NACF's service centers, particularly, its local units' service centers have recorded operating deficit.

7.3. Supports for Repair Parts and Facilities

The after-sales service providers must be equipped with the repair parts and facilities necessary to perform their services well. Overstock of the repair parts may make the financial status of the service providers difficult and shortage of repair parts in stock may make quick services difficult. Thus, the government has standardized the repair parts, equipment and manpower for the service providers to be furnished.

Government rules to implement agricultural mechanization promotion law enacted in February 1980 specified the qualifications of the service provider and the standards on equipment as shown in <Table 4-38>. The government classified the dealers into two classes A and B by their business scales and had them install the standard equipment and personnel accordingly. The standard stock of repair parts for the service providers was specified as shown in <Table 4-39>. The repair shops and the NACF's service centers should stock the consumables up to 20%. The dealers should stock all consumables and semi-consumables up to 45%. The parts centers in the province should stock all consumables, all semi-consumables and the durables up to 100%. All repair parts should be delivered in one day.

Table 4-38 | Qualifications of After-sales Service Providers and Standard on Equipment (1980-1988)

Standards		Dealer		Repair shop
		Class A	Class B	
Equipment	1. Work area A. Indoor B. Outdoor C. All	More than 30 m^2 More than 60 m^2	More than 15 m^2 More than 30 m^2	More than 25 m^2
	2. Vehicles A. Truck B. Motor cycle C. Bike or motor cycle	More than 1 unit	More than 1 unit	More than 1 unit
	4. Parts stock	More than 5 million Won	More than 3 million Won	More than 500,000 Won

Standards	Dealer		Repair shop
	Class A	Class B	
Personnel	Person of assistant mechanics or equivalent qualification in mechanical field by the National Technical Qualification Act or person having five-year or more experience in the areas of repair or maintenance of agricultural machines		Person of assistant mechanics or equivalent qualification in mechanical field by the National Technical Qualification Act or person having three-year or more experience in the areas of repair or maintenance of agricultural machines
Essential tools		General tools	
1. Inside-outside calipers 2. Vernier caliper 3. Monkey spanner 4. Open-end spanner 5. L-wrench 6. Socket wrench 7. Pulley puller 8. + - driver 9. Screw driver 10. Plier 11. Plastic hammer 12. Chisel 13. Tap dice set 14. Hacksaw 5. Soldering iron 16. Finner's scissor 17. Grease gun 18. Screw puller 19. Reaper 20. Parts shelf 21. Tool box 22. Vise 23. Clamper		1. Compress gage 2. Vacuum gage 3. Nozzle tester 4. Valve seat cutter 5. Valve seat grinder 6. Cylinder gage 7. Cylinder liner dismantle tool 8. Piston ring assembler 9. Injection pump tester 10. Dial gage 11. Volt ampere meter 12. Plug tester 13. Tachometer 14. Torque wrench 15. Micrometer 16. Chain block 17. Drill 18. Grinder 19. Welder	

Source: Korean Society for Agricultural Machinery, "Agricultural Machinery Yearbook"

Table 4-39 | Standard Stocks of Repair Parts and Delivery Limits

Administration unit	After-sales service provider	Standard stock of repair parts	Delivery limit
Province	Manufacturer's parts center	Up to 100% for consumables, semi-consumables and durables:	1 day
City and county	Dealers	Up to 45 % for consumables and semi-consumables	1 day
Town and village	Repair shops NACF service centers	Up to 20 % for consumables	1 day

Equipment standard for after-sales service providers was reinforced and the dealers were classified into three classes, A, B and C since 1989 as shown in <Table 4-40>. Equipment standard for the NACF's service centers was separated into two categories: one for the NACF's selling-machine and another for the NACF's non-selling. Equipment standard for the class C was applied to the NACF's selling-machine and that for the repair shops to the

NACF's non-selling. The stock standards were also reinforced as shown in <Table 4-41>. Agricultural machinery manufacturers were required to supply the repair parts for two years after the expected life of the machines passed.

Table 4-40 | Equipment and Personnel Standards for After-sales Service Providers (1989-1994)

Standard		Repair factory	Dealer			Repair shop
			Class A	Class B	Class C	
Equipment	1. Work area A. Indoor (m^2) B. Outdoor (m^2) C. Both (m^2)	More than 600 More than 300	More than 200 More than 100	More than 100 More than 100	More than 30 More than 60	More than 50
	2. Vehicles A. Truck B. Motor cycle	More than 3	More than 3	More than 2 More than 1	More than 1 More than 1	More than 1
	3. Tool A. Essential B. General	Keep all Keep more than 60	Keep all Keep more than 40	Keep all Keep more than 20	Keep all Keep more than 10	Keep all Keep more than 5
	4. Parts stock	More than 100 million Won	More than 100 million Won	More than 50 million Won	More than 20 million Won	More than 1 million Won
Personnel		Person of Grade 2 or equivalent or higher qualification in mechanical field by the National Technical Qualification Act	Person of assistant mechanics or equivalent qualification in mechanical field by the National Technical Qualification Act or person having five-year or more experience in the areas of repair or maintenance of agricultural machines			Person of assistant mechanics or equivalent qualification in mechanical field by the National Technical Qualification Act or person having three-year or more experience in the areas of repair or maintenance of agricultural machines

Standard	Repair factory	Dealer			Repair shop
		Class A	Class B	Class C	
1. The standard includes qualification of the after-sales service provider himself. 2. Class C applies to NACF service centers selling agricultural machinery, requiring no truck and stock of repair parts amounting to 5 million Won. Standard for the repair shop applies to NACF service centers not selling agricultural machinery.					
Essential tool		General tool			
1. Allen wrench set 2. Thickness gage 3. Copper hammer 4. Grinder 5. Grease gun 6. Puncher 7. Screw remover 8. Thickness gage 9. +- driver set 10. Long-nose plier 11. Reaper 12. Monkey spanner 13. Vise 14. Vise clip wrench 15. Socket wrench set 16. Hacksaw frame 17. Snap ring plier set 18. Screw clamper 19. Stainless steel rule 20. Arc welder 21. Open-end wrench 22. Open-end spanner set 23. Oiler 24. Oil filter wrench 25. Thermometer 26. Work lamp 27. Electric drill 28. Finner's scissor 29. Chisel set 30. Steel compass 31. Clipper 32. Cutting plier 33. Pipe wrench 34. Combination wrench set 35. Ball pein hammer 36. Pulley puller 37. Plastic hammer 38. Plug wrench 39. Piston ring holder 40. Pitch gage 41. Tachometer		1. Right-angle measuring ruler 2. T-wrench set 3. V-block 4. Gas welder 5. Suspension bench 6. High speed cutter 7. Fixed caliper 8. Crack detector 9. Grease nipple wrench 10. Screw hole reamer 11. Internal micrometer 12. Nozzle tester 13. Dial gage 14. Battery charger 15. Battery tester 16. Valve seat cutter set 17. Valve grinder 18. Bearing plier set 19. Bolt griper 20. Parts cleaning stand 21. Injection pump tester 22. Hydrometer set 23. Chassis oiler 24. Steering wheel puller 25. Steam cleaner 26. Spray gun 27. Spring balance 28. Cylinder gage 29. Pressure gage (for gasoline engine) 30. Pressure gage (for diesel engine) 31. OH hammer 32. Air impact wrench 33. Air checker 34. Air compressor 35. Engine speed tester 36. Engine oil pressure gage 37. Engine cleaner 38. Grinder 39. Oil bucket pump 40. Oil jack 41. External micrometer 42. Universal trolley 43. Universal wheel puller 44. Hydraulic pressor 45. Work area cart 46. Soldering iron 47. Surface plate 48. Adjusting reamer set 49. Mobile crane 50. Vacuum gage 51. Chain block 52. Infrared drying stand 53. Car lazy jack 54. Camber caster gage 55. Timing light 56. Tire lever 57. Tire twisting bar 58. Tire inflation pressure gage 59. Desktop drill 60. Tappet spanner set 61. Tap dice set 62. Torque wrench 63. Toe-in gage 64. Torch lamp 65. Piston ring tension meter 66. Piston feeler gage 67. Pitman arm puller 68. Circuit tester		

Source: Korean Society for Agricultural Machinery, "Agricultural Machinery Yearbook"

Table 4-41 | Standard Stock of Repair Parts for After-sales Service Providers

Manufacturer's repair factory	Dealer	NACF's service center
All repair parts for produced machines	All consumables and semi-consumables for sold machines	All consumables and semi-consumables for sold machines

In 1995, the equipment standard was revamped so that the basic tools were deleted and some general tools were designated as essential tools. <Table 4-42> shows the revised equipment and personnel standards. Since 1999, manufacturers should supply the repair parts for four years after the expected life of the machines passed even though they stopped the production of those machines.

Table 4-42 | Equipment and Personnel Standards for After-sales Service Providers (1995-1998)

Stan-dard		Repair factory	Dealer			Repair shop
			Class	Class B	Class C	
Equip-ment	1. Work area A. Indoor (m^2) B. utdoor (m^2) C. Both (m^2)	More than 600 More than 300	More than 200 more than 100	More than 100 More than 100	More than 30 More than 60	More than 50
	2. Vehicle A. Truck B. Motor cycle	More than 3	More than 3	More than 2 More than 1	More than 1 More than 1	More than 1
	3. Tool A. Essential B. General	Keep all Keep more than 30	Keep all Keep more than 20	Keep all Keep more than 15	Keep all Keep more than 10	Keep all Keep more than 5
	4. Parts stock	More than 100 million Won	More than 100 million Won	More than 60 million Won	More than 30 million Won	More than 2 million Won

Stan-dard		Repair factory	Dealer			Repair shop
			Class	Class B	Class C	
Personnel		Person of Grade 2 or equivalent or higher qualification in mechanical field by the National Technical Qualification Act or more than two persons having five-year or more experience in the areas of repair or maintenance of machines together with more than three assistants.	Person of Grade 2 or equivalent or higher qualification in mechanical field by the National Technical Qualification Act or more than one person having five-year or more in the areas of repair or maintenance of machines together with more than two assistants.	Person of Grade 2 or equivalent or higher qualification in mechanical field by the National Technical Qualification Act or more than two persons having five-year or more experience in the areas of repair or maintenance of machines together with more than two assistants.	Person of Grade 2 or equivalent or higher qualification in mechanical field by the National Technical Qualification Act or more than one person having five-year or more experience in the areas of repair or maintenance of machines together with more than one assistants.	Person of Grade 2 or equivalent or higher qualification in mechanical field by the National Technical Qualification Act or more than one person having five-year or more experience in the areas of repair or maintenance of machines.

1. The standard includes qualification of the after-sales service provider himself.
2. Class C applies to NACF service centers selling agricultural machinery. If the NACF service center covers more than three towns or villages, Class B applies.

Essential tool	General tool
1. Thickness gage 2. Grinder 3. Punch 4. Screw remover 5. Vise 6. Vise clip wrench 7. Socket wrench set 8. Snap ring plier set 9. Screw clamp 10. Arc welder 11. Oil filter wrench 12. Electric drill 13. Scissor 14. Vernier caliper 15. Pipe wrench 16. Pulley puller 17. Plug wrench 18. Piston ring holder 19. Pitch gage 20. Tachometer 21. Nozzle tester 22. Battery tester 23. Tire inflation pressure gage 24. Torque wrench 25. Battery charger 26. Circuit tester	1. T wrench set 2. V-block 3. Gas welder 4. High speed cutter 5. Crack detector 6. Screw hole reamer 7. Internal micrometer 8.Dice gage 9. Valve seat cutter set 10. Valve grinder 11. Bearing plier set 12. Parts cleaner stand 13. Injection pump tester 14. Hydrometer set 15. Steam cleaner 16. Sprayer gun 17. Spring balance 18. Cylinder gage 19. Pressure gage (for gasoline engine) 20. Pressure gage(for diesel engine) 21. Air impact wrench 22. Air compressor 23. Engine cleaner. 24. Grinder 25. Oil jack 26. Hydraulic oil gage 27. Work area cart 28. Soldering iron 29. Surface plate 30. Chain block 31. Mobile crane 32. Car lazy jack 33. Camber caster gage 34. Timing lighter 35. Tire lever 36. Desktop drill 37. Tappet spanner set 38. Tap dice set 39. Toe-in gage 40. Piston ring tension meter 41. Piston feeler gage

Source: Korean Society for Agricultural Machinery, "Agricultural Machinery Yearbook"

In 1998, the equipment and personnel standards were revised again as shown in <Table 4-43>. This revision was designed to encourage the service providers to equip autonomously the required equipment and personnel.

Table 4-43 | Equipment and Personnel Standards for After-sales Service Providers (1999-2003)

Standard		Repair factory	Dealer			Repair shop
			Class A	Class B	Class C	
Equipment	1. Work area A. Indoor (m^2) B. Outdoor (m^2) C. Both (m^2)	More than 600 More than 300	More than 200 More than 100	More than 100 More than 100	More than 30 More than 60	More than 50
	Parts stock	More than 100 million Won	More than 100 million Won	More than 60 million Won	More than 30 million Won	More than 2 million Won
Personnel		More than two persons meeting A or B and more than three assistants for repair works. A: Person of the industrial engineer or higher qualification in mechanical field by the National Technical Qualification Act. B: Persons with five-year or more experience in the areas of repair or maintenance of machines.	More than two persons meeting A or B and more than three assistants for repair works. A: Person of the industrial engineer or higher qualification in mechanical field by the National Technical Qualification Act. B: Person having assistant mechanics or equivalent qualification in mechanical field by the National Technical Qualification Act and three- year or more experience of working at the related fields. C: Persons having five-year or more experience in the areas of repair or maintenance of machines.	More than one person meeting A or C of Class A and more than two assistants for repair works.	More than one person meeting A or C of Class A and more than two assistants for repair works.	More than one person meeting A or C of Class A.

Stan-dard		Repair factory	Dealer			Repair shop
			Class A	Class B	Class C	

1. The standard includes qualification of the after-sales service provider himself.
2. Class C applies to NACF service centers selling agricultural machinery. If the NACF service center covers more than three towns or villages, Class B applies.

Source: Korean Society for Agricultural Machinery, "Agricultural Machinery Yearbook"

Since 2004, classification of the after-sales service providers based on the administration units was changed to the classification based on their capacities so that they were classified as large, medium and small service providers. The equipment and personnel standards for each class are shown in <Table 4-44>. The service providers were also encouraged to equip themselves with a computer system for better parts management.

Table 4-44 | Equipment and Personnel Standards for After-sales Service Providers (since 2004)

Standards		Large	Medium	Small
Equipment	Indoor work area	500 m^2	150 m^2	50 m^2
	Equipment	One of either crane or hoist (more than 2 tons)	One of either hoist, chain block, or lifter (more than 2 tons)	
	Computer system	Required	Required	
Personnel		More than three persons meeting A, B, or C and more than one assistant for repair works. A: Person of the industrial engineer or higher qualification in mechanical field by the National Technical Qualification Act. B: Person having assistant mechanics or equivalent qualification in mechanical field by the National Technical Qualification Act and three-year or more experience of working at mechanical field, or two-year or more experience of working at agricultural machinery areas. C: Person having five-year or more experience of repair and maintenance at mechanical field, or three-year or more experience of repair and maintenance at agricultural machinery fields	More than one person meeting A, B, or C of Large class and more than one assistants.	More than one person meeting A, B, or C of Large class and more than one assistants.

1. Whether or not the personnel standard is met should be judged taking the qualification of the after-sales service provider himself.
2. Indoor work area includes those for repair and maintenance facilities and storage of repair parts.
3. Computer system for management of repair parts should be operated in conjunction with manufacturers and manufacturers' parts centers.

Source: Korean Society for Agricultural Machinery, "Agricultural Machinery Yearbook"

The government support for the after-sales service providers was made in the form of financing them for procurement of equipment and repair parts, and computerization of parts management. About 15-25 billion won were annually utilized for the low-interest financing. The limits of loan support were 1-2 billion won for provincial parts centers, 50-100 million won for county after-sales service providers, 20 million won for after-

sales service providers and the NACF service centers in towns or villages. The integrated after-sales service providers were supported to stock year-around more than 100 million won's worth of repair parts. The after-sales service providers in counties and towns were also supported to stock respectively more than 60 and 20 million won's worth of repair parts. Most after-sales service providers stocked the repair parts for highly disseminated machines. However, no repair parts were guaranteed at local after-sales service providers for the less-spread machines such as imported or newly supplied machines, thus causing after-sales services for those machines difficult particularly during the farming seasons. As agricultural machines were diversified, the number and kinds of repair parts also increased and the parts management became difficult. In severe cases, the unsold repair parts must be disposed of as scrap metal. More systematic part management was required. To solve this problem, the government has provided the after-sales service providers with low-interest financing for computerization of their parts managements since 2000.

7.4. Education for Repair Technician

Repairman for the after-sales service providers are usually graduates of agricultural high schools or professional high schools, who learned agricultural machines and acquired qualification certificate as repair technician for agricultural machines. At the beginning of agricultural mechanization, it was not difficult to recruit the repairmen for agricultural machines. However, as the number of automobiles increased, many agricultural machinery technicians moved to car service centers where they are paid better. This also made it difficult to recruit repair technicians for agricultural machines, particularly in farming seasons.

To ease the shortage of repair technicians, a 3-4 week repair and maintenance education was given to young and machine-experienced farmers to secure 800 machinery farmers per year since 1993. The government provided them with equipment to have them to serve as repair technicians. Agricultural machinery technicians have been exempted from military service from 1994 by registering them as industrial experts. The industrial experts should acquire the qualification certificate as repair technician for agricultural machines and serve three years for the after-sales service providers to be exempted from the military service.

7.5. Mobile Repair Service

Circuit repair service was a mobile after-sales service to repair agricultural machines for a certain period of time in the region where the after-sales service providers are not available and the transportation was inconvenient. It was conducted mainly in 1970s and 1980s when the supply of agricultural machine increased drastically. There were two types of circuit service: one was a nationwide mobile service unit established jointly by the KAMICO and manufacturers and another was a regional mobile service unit formed jointly

by the NACF's service centers, dealers, repair shops, and technical centers in the region. In addition, special mobile service units were also established by the manufacturers and dealers to service tractors, combines and rice transplanters. These mobile services were made for 3-4 months every year, known as months of service.

The purpose of the circuit service was good but its operation was not easy. It was practically impossible to cover the whole country's demand of service with limited equipment and personnel in a given period of time. It was also difficult for the regional mobile service units to satisfy the large regional need of service in short period of a week. Parts and equipment that the service vehicles can carry were limited. It was also difficult for farmers to transport their machines to the mobile service stations. In addition, these circuit services were unavailable in farming seasons because it was conducted usually in off-farming seasons.

2012 Modularization of Korea's Development Experience
Policy for Promotion of Agricultural Mechanization
and Technology Development

Chapter 5

Agricultural Mechanization's Achievement

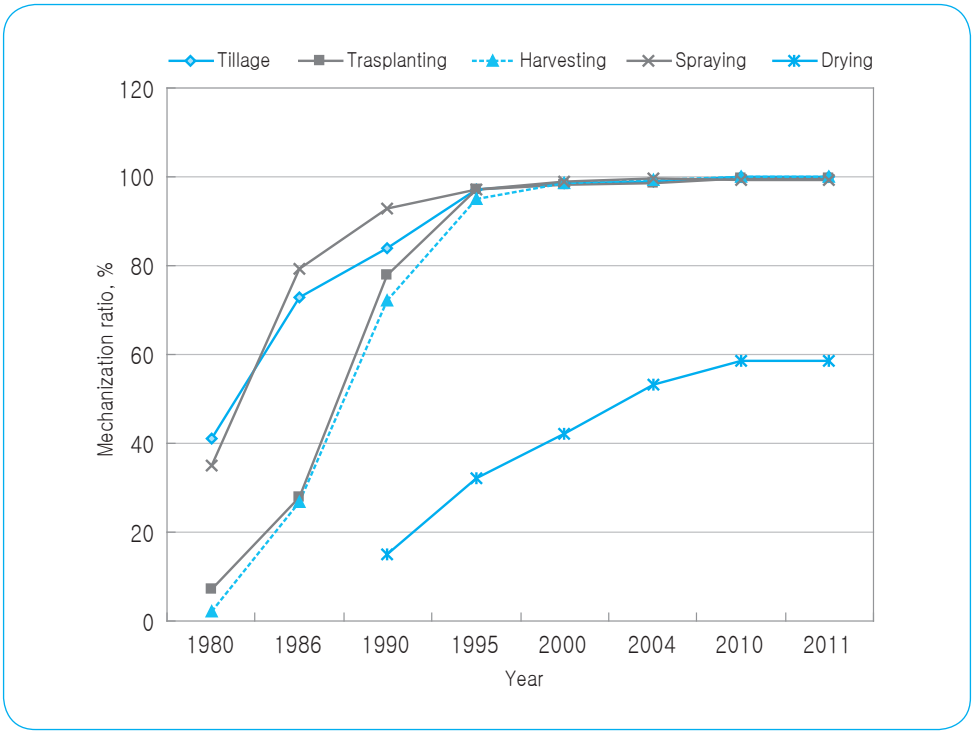
1. Achievement

Agricultural Mechanization's Achievement

1. Achievement

Before 1962, when the series of 5-year Economic Development Plan started, Korea was one of the poorest agricultural country in the world. The Korean agriculture was poor, small-scaled and run by animal and human powers. Agricultural mechanization at the beginning was to overcome the natural disasters due to draught, disease and insects, and to free farmers from drudgery. Therefore, agricultural machines for disaster protection such as water pumps and sprayers were supplied. It was with successful progress of the 5-year EDPs that agricultural mechanization using powered machines proceeded on the right track. In other words, as the 5-year EDP designed for development of heavy machinery and chemical industries was successfully executed, a large workforce demand from the industry increased. This demand absorbed rural labor forces so that wage rise and labor shortage arose in the rural area. Powered agricultural machines such as power tillers, tractors, combines and rice transplanters were supplied as a means of substituting the decreased rural labor forces. These conditions have made an all-out mechanization for rice production successful in a short period of time as shown in [Figure 5-1]. The success of mechanization for rice production has led to the promotion of mechanization for upland crops, horticulture, and livestock productions and worked as a driving engine for agricultural mechanization in Korea. This successful agricultural mechanization in Korea is due to not only the positive socio-economic conditions created by the success of the 5-year EDPs but also the government's policy supports for agricultural mechanization including development of agricultural machinery industry, subsidy and loan programs for machinery purchase, establishment of after-sales service networks, agricultural machinery education and training, and inspections for agricultural machines.

Figure 5-1 | Mechanization Ratio of Rice Farming



Success of agricultural mechanization affected greatly the development of the Korean economy and society in direct and indirect ways. In other words, it is agricultural mechanization that contributed greatly to the development of Korean economy and society. From a micro point of view, agricultural mechanization in Korea has replaced agricultural population of 1.28 million through machines and supplied manpower required by the newly developed industry over the last 45 years. This has laid the foundation of economic growth in Korea and changed agricultural production systems, through which the sustainable food production was possible in spite of continued decrease in agricultural population. Agricultural population decreased by 81.3% from 16 to 3.0 million, which were 53.4% of the total population in 1967 and 6.3% in 2010, respectively. Manpower required for rice production also decreased by 83.9% from 4.1 to 0.66 man/MT while the rice production increased by 52.9% from 3.15 to 4.82 MT/ha over the same period. This is surely the results of increase in labor and land productivities by agricultural mechanization although other factors such as breeding and proper application of fertilizer also contributed to it.

In the early agricultural mechanization for disaster prevention, water pumps and sprayers were mainly supplied and contributed significantly to overcoming the natural disasters due

to draughts, insects and disease. Farmers got gradually free from drudgery by replacing the human-powered and animal-powered machines with engine-powered machines. Introduction of the powered agricultural machines as a civilized means to the conservative and traditional rural society has increased naturally farmer's awareness of culture and machine. It also made farmers gradually away from the stereotype notion that agricultural is hard, difficult and low income job that only less-educated people do. This change in farmers' notion has greatly contributed to modernizing rural life style together with the New Village Movement and had young people actively involve in new agricultural production systems such as mechanized farming units and farming enterprises.

Various kinds of machines are needed for agricultural mechanization. In the early 1960s, not only the agricultural machinery industry but also the mechanical industry itself was yet unformed. Manufacturers producing agricultural machines such as stationary engines, human-powered threshers and human-powered sprayers instead laid a basis for mechanical industry. It was production of power tillers in 1963 that started the agricultural machinery industry in Korea, which also laid a foundation for the mechanical industry. The government policy supports for the development of agricultural machinery industry has made tractors, rice transplanters, and combines localized completely in a short period time of 20 years, and the production technology developed to that level of advanced countries. In addition, the government also has small and medium-sized manufacturers specialized in producing parts for agricultural machines, which promoted the growth of agricultural machinery industry. Many technicians and small and medium-sized manufacturers which produced agricultural machines and their parts moved to automobile and shipbuilding industries in 1970s and contributed to developing those industries. In other words, the successful agricultural mechanization has accelerated the development of agricultural machinery industry. The technicians, production technologies and experiences from the agricultural machinery industry became the foundation for promoting automobile and shipbuilding industries.

Agricultural mechanization in Korea, started in the early 1960s, was regarded as one of the most successful case accomplished in a short period of time than in any other countries. Agricultural mechanization in Korea may be characterized by its promotion in accordance with the national economic development plans but it was also evaluated as the biggest factor that contributed to the success of that economic development plans. Agricultural mechanization has made it possible to supply work forces required for the national industrial development and to produce food for the country's growing population in spite of reduced rural labor forces. In addition, it has liberated farmers from hard labor and promoted the agricultural machinery industry.

As the government policies for agricultural mechanization have been successfully implemented, agricultural operations mainly relied on human and animal powers have

been carried out by various agricultural machines and the ratio of mechanized farming has increased. The mechanized farming has increased labor and land productivities and made it possible to actively respond to natural disasters so that food production could be maintained in spite of reduced rural labor forces. Agricultural mechanization also introduced new technology and culture to conservative rural society, which has contributed greatly to the modernization of the rural society.

These are not the benefits of agricultural mechanization that only the Korean case could generate. The theoretically known benefits of agricultural mechanization have been demonstrated in the Korean case. The lessons and experiences from the Korean case may be a good reference or benchmark for the policy makers in developing countries, particularly in rice growing regions in Asia or newly industrializing countries, who wish to pursue better agricultural mechanization in the future

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