

# RICE and PEOPLE in KOREA 1975, through 2000

Eun Woong Lee

College of Agriculture, Seoul National University

## 國民食糧의 需給展望 (1975~2000年)

— 米穀을 中心으로 —

서울대학교 農科大學 李 殷 雄

### Contents

1. What are the opinions of people concerning the food problems?
2. Food problems in developed and underdeveloped countries.
3. Nature of food.
4. Characteristics of rice consumption.
5. Population and food problems in Korea.
  - a. Present status of population.
  - b. Present status of food production.
  - c. Recent status of the food demand and supply.
  - d. Perspective of food demand and supply.
6. The problems imposed on agricultural researcher.

Human beings cannot live without food. Food is absolutely required for human beings to maintain their livings and prosperities.

We should take a certain amount of food for our life. If population increases, the more food is needed. Here food problem raises. The food problem is the problem of food supply for increased population.

1. What are the opinions of people concerning the food problem?

There have been two different opinions, optimistic and pessimistic, about the food problems since the

theory of Malthus was reported. The pessimistic opinions of Malthus' theory is that population increases geometrically while food production increases arithmetically. The theory of Malthus based on eighteen century's English economy. But the system of English economy have been changed by the development of capitalism. In other words, Malthus said that the increase of birth rate is the main factor for the population increase. But in fact the birth rate decreases instead of increasing. Also the increase of population due to the low rate of death has begun to decrease since the last part of nineteen century. Even though there are difference of time, all of these facts are true in the United States and other European countries.

In the production of food the law of yield-diminishing became no more effective, because the yield per unit area was increased more than the yield limited by the yield-diminishing law by improved techniques. In some countries under the capitalism food surplus is rather big problem than food shortage problem. But it does not mean that the Malthus theory is no more valid. Still the Malthus theory has been applied through the world. Around 1950 Boyd, president of FAO said that more than two thirds of the world population is suffering from malnutrition. Many people also expressed the problems of food due to the increase of population and decrease of arable land. Certainly the shortage of food is one of the most important problems to solve.

However, it is not impossible to solve food problem as suggested by Malthus. The way of solving world food problem asks for world cooperation. It is certainly believable that the intelligence of human beings will solve the food problem. The reason to study is to contribute toward solution of world food problems. For example, the development of human intelligence will promote the development of agricultural techniques and finally increase the yield per unit land. The reclamation of new land will extend arable land, and the study on the marine plants and animals will also contribute toward increasing food production. If the effort to solve the food problem were made throughout the world cooperation, the food problem would become much easier to solve. At present the world population increases dramatically. For example, the world population was 12 billion in 1850, 16 billion in 1900, 25 billion in 1950, and 32 billion in 1962. The rates of population increase were 0.7 per cent from 1850 to 1900, and 1.0 per cent from 1900 to 1950. At present the rate of population increase is 1.7 per cent. If the present rate of world population increase, 1.7 per cent, continued without decreasing, the world population would be 64 billion in 2005. In some developed countries the birth rate is quite low, even though the national income increase. On the other hand, some countries showed, different pattern of population increase. For example if underdeveloped countries improve their life standards by increasing total income, the rate of population increases also tends to increase rather than decreasing as in other developed countries. Therefore, it may be concluded that the world population is increasing all the time.

Next, let's see the world food production to feed the increasing population. First, the total land area is 13,422 million hectares, of which about 10.6 per cent are under cultivation. Second, the total production of main food crops is about 840 million M/T to 865 million M/T. But total amount of food available for human beings is only about 500 million M/T, which supply 1,550 calories per person per day. 1,550 calories per person per day is lower than the standard calories, 2,500 calories, required by per person per day. Dr. Bennedt, professor of Stanford University,

indicated that the figure for necessary calories recommended by FAO is higher than the actual amount of calories. But it is assumed that the amount of calories needed depends on activities, and other social conditions. For example, even certain amount of calories may be sufficient for certain countries, the same amount of calories may not be sufficient for other countries. Therefore, it is important to consider all situations of society in evaluating food problem.

Even though there was a great increase in food production just after world war II, still a lot of food is required to meet the demand of population increase. According to the report of USDA there was more than 1.5 per cent of increment in the world agricultural products in 1965 than in 1964, and the food production was only 1 per cent of increment. However, the world population increased more than 2 per cent in 1965 than in 1964. In European countries the increasing rate of food production is generally higher than that of population, while in other countries population increases faster than food production. This indicates that still Malthus theory is valid and the way to solve the food problem should be found.

## 2. Food problems in developed and underdeveloped countries.

There are many kinds of food and even one kind of food is different in quality and in usage. The way of food consumption is different due to historical and social background of countries concerned. In the old times when transportation system was not so well improved, the food produced in a area used to be consumed in that area. Under such area the food production was influenced by historical and social conditions. For instance, in the eighteenth century most of the rye, barley, and oat were grown in northern part of Europe, while wheat for bread was grown in the area of the Mediterranean. In European countries including England wheat was the main source for bread. In the United States the wheat was replaced by corn for bread. In Japan the consumption of barley, naked barley and other crops decreased, while the consumption of rice increased. In Korea rice is the main staple crop. Throughout the world rice and wheat are becoming the main crops. The change of crops to wheat and rice brought about also change of food usage.

The consumption of starch is getting decreased. In other words, the proportion of calories obtained from the starch source is decreasing. For example, the proportion of starchy food was 53 per cent of total food materials in 1890. But it was dropped to 27 per cent around 1950, even though there were no changes in total amount of necessary calories. The increased portion is milk, dairy products, vegetables, fruits and egg. Sugar, oil and meat showed no change. But in countries having low national income meat, sugar and butter show remarkable demands.

Table 1. Nutritional Status of the World by Region

| Region                   | Calorie/day/man | Rate of total protein supply | Rate of animal protein |
|--------------------------|-----------------|------------------------------|------------------------|
| Underdeveloped countries | 2,184           | 55                           | 11                     |
| Latin America            | 2,545           | 65                           | 23                     |
| Africa                   | 2,209           | 58                           | 10                     |
| Near East                | 2,194           | 67                           | 15                     |
| Asia Far East            | 2,079           | 50                           | 8                      |
| North America            | 3,090           | 91                           | 64                     |
| E. E. C                  | 2,910           | 87                           | 46                     |

Source ; FAO Agricultural Commodities Projections for 1975, 1985 No. 2 (1966, 8, Rome)

The nutritional status of the world is presented briefly in Table 1. In Asia and eastern countries the calories per day per person are only 2,000, which are about two thirds of calories available in the northern America and European Common Market countries (E. E. C.). The proportion of protein supply has also quite different pattern due to countries, i.e. 50 per cent in Asia and eastern countries, 91 per cent in the northern America, and 87 per cent in E. E. C. The protein source is also different. The percentage of protein from animal is 64 in the northern America, 46 in European countries and 8 in Asia and far eastern countries, respectively. It is evident that the protein from animals is very less than that from plants in Korea. This indicates also that a great difference of protein supply exists between developed and underdeveloped countries. It should be noticed that qualitative improvement of food is a lot more important than quantitative improvement of food,

when quantitative increase of food reached a certain point. In other words, more meat, sugar and dairy products are required than cereal crops. Under such condition there are two kinds of change in food demand: surplus of plant protein and shortage of animal protein. These were almost indispensable process in the most of advanced countries. The change of food source, from plant protein to animal protein, is an important indicator to improve the living standards. Even under same conditions the average consumption rate is different due to social strata or individual's income, especially under capitalism. For instance, in 1936 the average consumption of milk in the United States was 847 quarts per person for the highest income tax payer and 242 quarts per person for the lowest income tax payer. The consumption of oranges and tomatoes was 240 pounds for the highest income tax payer and 31 pounds for the lowest income tax payer. The difference between two tax payers was 605 quarts in milk (2.5 times of the lowest tax payer), and the highest tax payer eats 7.7 times more than the lowest income tax payer in orange. In England the individuals belonging to the upper class consume 8 times more than the individuals of the lower class in fruits, 6 times more in vegetables and 3 times more in egg. In Japan there are 20 per cent of difference in calories and two times of difference in animal protein between upper class and lower class.

It may be summarized that the living standards of underdeveloped countries are inferior to that of the lowest class of developed countries. For example, the total calories available per person per day are: less than 2,000 calories in Ecuador, Dominica and Bolivia, about 2,000 calories in India, Ceylon, Pakistan and Korea, and 3,000 calories in the United States and European countries. If the calories mentioned above were converted to wheat in the aspect of economic value, the amount of wheat to supply calories a year will be 300 to 400 kilograms in underdeveloped countries and 2,500 kilograms in the United States.

The only reason why there is such big difference in taking calories between developed and underdeveloped countries is due to the difference in national income between two groups of countries compared.

In some countries food production is sufficient enough to provide national demand, while in some countries people is starving. In some countries they produce enough food materials for people, but some people starves because of the lack of purchasing ability. The United States and Canada produce more agricultural products than the needed.

### 3. Nature of food

The characteristics of the capitalism is the unbalanced development in all aspects of industry, and production comes from profit, not from necessity. All factors of industry are controlled by profit. The profit depends upon the market price. Production, demands, and supply are all the time changeable and constitute market system. The response of agricultural products to market is not so sensitive as industrial products. It is the characteristics of agricultural products to take long period to produce. If there is a lack of supply, the price of products will increase and will continue until new products produced. Especially food is an essential one for living. The food should have stable yield all the time and at the same time should be good for people. The storage of food is also another problem. Since the food is essential for daily life, under the capitalism the extension of purchasing ability cannot solve the food problem. It needs international cooperation to provide food under emergency situation. But every country should make great effort to be self-sufficient. For example, West Germany where agricultural factors for producing agricultural products are not favorable is trying to be self-sufficient. These are true in Japan, England, and Russia. Even though there are small difference among nations due to geographical and social condition, each nation should have long-term plan to provide nation's food.

In Korea agriculture is a main industry to produce nation's food. But the total yield is not enough to meet the demand of nation. A great part of barley and rice was damaged by severe drought in 1967 and 1968. Our government is planning to import 400,000 tons of rice, and 800,000 tons of wheat and other cereals from other countries this year. If we assume the price of rice per ton is \$160 and the prices of wheat and other cereals are \$80, they are equal to \$124,000,000

which are approximately half of total amount of export, \$300,000,000. The import of food will ruin the international receipt and expenditure, and will be in favor of other countries. Plan for self-sufficient should be made. Even in England and West Germany where natural conditions are unfavorable for crop growing, the import of food materials are only 4.6 per cent and 3.1 per cent of total national products, respectively. In Korea where the first industry is not developed well, producing food materials are important to balance international receipt and expenditure and to make the economy of nation stable.

### 4. Characteristics of rice consumption

Food is the products of photosynthesis of higher plants. Direct food comes from plants and indirect food from animals. Generally food from plants are inferior to the food from animals, because animals use first plants as feed and produce meat etc. for human beings. In other words plant materials for food should be used directly without feeding other animals. This means that, in countries where the absolute amount of food is not enough, study for vegetative food materials should be made. Products of photosynthesis in a plant vary with regions due to the total amount of light energy, etc. For example, in temperate regions the annual total light energy is about 3,600,000 calories per 3.3 square meters. The ability to use the light energy is different according to the kinds of plants. The plant which is going to be used as food should be first adequate for food and should have high capability of using light energy. For instance, rice plant takes about 6 months from the first part of May to the end of October. During this period rice converts light energy to chemical energy. The ability of plant to change light energy to rice may be calculated as follows:

$$(360 \text{ cal.} \times 1000 \text{ g.} \div 100\text{g}) \div (3,600,000 \text{ cal.} \div 2) \times 100 = 0.2 \text{ per cent}$$

360 cal. = total calories in 100g. rice

1,000g. = total rice per 3.3 square meters

3,600,000 cal.  $\div$  2 = total light calories during 6 months

0.2 per cent is the ability of rice to fix light energy into chemical energy.

Table 2. Total Calorie Production of Crops and the Ability Nourishing People of Crops in 1965 in Korea.

| Crops                 | Yield per ha in 1965 (kg) | Eatable rate (%) | Eatable amounts (kg) | Calorie (cal/100g) | Total calorie (K cal) | Total calorie index | People sustaining capacity(a) (man, ha) |
|-----------------------|---------------------------|------------------|----------------------|--------------------|-----------------------|---------------------|---|
| Polished rice (paddy) | 2,866                     | 95               | 2,723                | 360                | 9,802.8               | 10.0                | 13.8                                    |
| Barley                | 1,317                     | 94               | 1,238                | 354                | 4,382.5               | 44.7                | 6.2                                     |
| Naked barley          | 1,908                     | 91               | 1,736                | 354                | 6,145.4               | 62.7                | 8.6                                     |
| Wheat                 | 1,247                     | 90               | 1,122                | 358                | 4,016.8               | 41.0                | 5.6                                     |
| Corn                  | 802                       | 80               | 642                  | 362                | 2,324.0               | 23.7                | 3.4                                     |
| Soybean               | 562                       | 96               | 540                  | 420                | 2,268.0               | 23.1                | 3.2                                     |
| Sweet potato          | 10,921                    | 83               | 9,064                | 111                | 10,061.0              | 102.6               | 15.5                                    |
| Potato                | 7,177                     | 90               | 6,459                | 76                 | 4,908.8               | 50.1                | 7.0                                     |

(a) Assumption : One man absorbs 2,000 calorie per day.

Table 2 presents total calory production of crops and ability nourishing people in 1965. Sweet potato has the highest ability. Next one is the rice. However, sweet potato has some disadvantage as food materials because it has high moisture content and it has storage problem. On the other hand, rice is not only the crop all people like to eat as main food, but also good for general management. Especially rice yields high and is stable in production. Even under nonfertilized plot it yields a lot. All of these facts support the importance of rice crop as nation's main food. The same is true in Japan. The proportion of farmers growing rice is about 76 per cent of total farmers. Growing rice is important in the aspect of total farmer's income. The problem how to modernize the rice production will be the government's great concern in the future.

### 5. Population and food problem in Korea

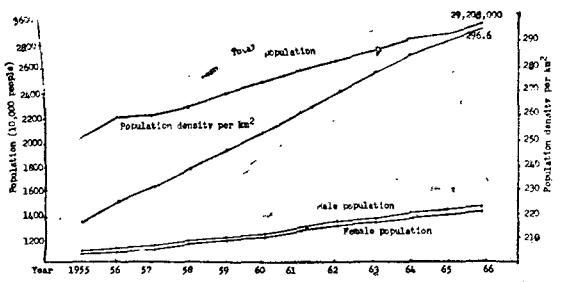


Figure 1. Growth of Population

Source ; Economic Planning Board

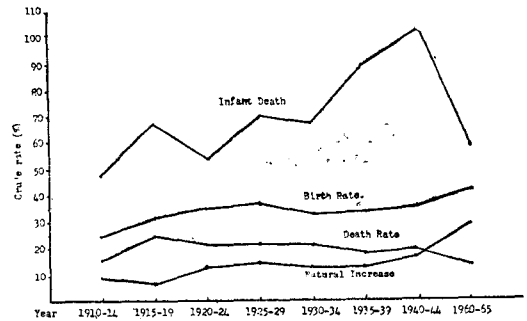


Figure 2. Vital Rates

Source ; Economic Planning Board

#### a. Present status of population

Hoping that the statistics on population reported would be true, Figure 1,2 present on population of Korea. The rate of population increase from 1960 to 1966 was 2.7 per cent. The total number of population in Korea is 29,200,000 as of October, 1966. The total area of Korea is 98,477.5 square kilometers. The density of population is 296.6 per square meter, which is fourth after Netheland, Taiwan, and Belgium. If the present rate of population increase, 2.7%, would continue without decreasing, the total population in November, 1967, would be more than 30 million, becoming 19th country of the world. The reason why number of people increased so many will attribute to the decreased rate of death and increased rate of birth. The birth rates per 1,000 persons in 1961,1964,1965, 1966, and 1967were 42,39,37,35,34, respectively. In

other countries like Canada, the U.S.A., and Sweden, the birth rate per 1,000 persons in 1965 were 21.4, 19.4 and 15.9, respectively.

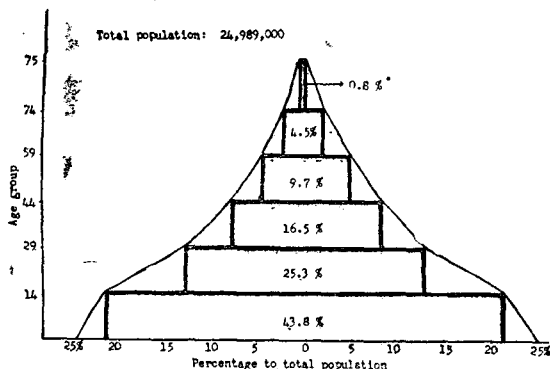


Figure 3. Population Composition by Age Group in 1966. Source ; Economic Planning Board

The distribution of age is presented in Figure 3. The number of people whose age is below fourteen is 12,940,000 constituting about 43.9 per cent. The number of people whose age is more than 60 years old is 1,520,000 (about 5.3 per cent). The number of people who has ability of producing food, 15 to 60 years old, is 14,480,000 constituting about 50.8 per cent of total population. The Philippines and Thailand show the same tendency. The percentage of people whose age is below 14 is 35.5 in the U.S.A., 25.6 in France and 30.0 in Japan. The increase of population will help strengthening the nation, but it needs-

Table 3. Status of Grain Import

| Year | Total amount | Rice    | Barley  | Wheat   | Sorghum & Corn | Soybean | Wheat flour |
|------|--------------|---------|---------|---------|----------------|---------|-------------|
| 1955 | 84,598       | —       | 23,312  | 51,510  | —              | 8,848   | 708         |
| 1956 | 502,214      | 4,050   | 241,028 | 195,872 | —              | 41,694  | 19,570      |
| 1957 | 965,834      | 202,180 | 290,141 | 359,894 | 36,250         | 33,176  | 44,193      |
| 1958 | 968,382      | 23,160  | 322,678 | 429,755 | 24,768         | 64,875  | 50,600      |
| 1959 | 266,664      | 3,759   | 31,644  | 186,812 | 26,689         | 28,772  | 38,988      |
| 1960 | 467,688      | —       | —       | 348,730 | 9,596          | 35,890  | 31,867      |
| 1961 | 603,123      | —       | 189,790 | 329,579 | —              | 21,616  | 18,410      |
| 1962 | 499,207      | —       | 47,119  | 377,064 | 2,440          | 16,161  | 20,748      |
| 1963 | 1,318,095    | 118,408 | 263,461 | 788,757 | 51,591         | 10,118  | 26,562      |
| 1964 | 915,625      | —       | 225,872 | 345,438 | 5,000          | 8,934   | 61,791      |

Source ; Bureau of Food Administration. Min. of Agr. & Forestry.

more food to feed. Here food problem raises.

b. Present status of food production

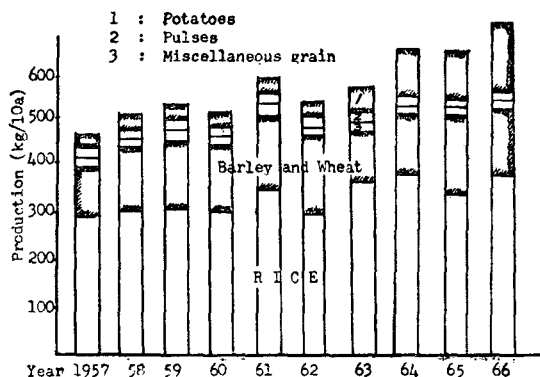


Figure 4. Agricultural Production in Korea

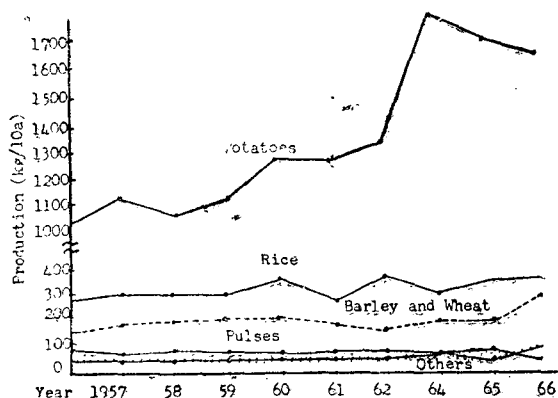


Figure 5. Yield Per Unit Area

year ; rice year unit ; metric ton

The main crops in Korea are rice (lowland and upland rice), barley, wheat, rye, soybean, corn, Italian millets and potatoes. The production of these crops is presented in Figure 4. Total crop production in 1965 is about 66,740,000 M/T. Production of rice is 39,550,000 M/T, more than half of the total crop production. Production per hectare is presented in Figure 5. Rice: 2,866 kg., barley: 1,317 kg., naked barley: 1,908 kg., wheat: 1,247 kg., corn: 802 kg., soybean: 562 kg., sweet potato: 10,921 kg., and white potato: 7,177 kg. The increasing rate of crop production was on the average 3 per cent from 1951 to 1966 according to statistics.

The import of the grains is presented in Table 3. About 3,336,000 M/T were imported from other countries between 1961 and 1964 (835,000 M/T yearly). The imported

crops are mainly wheat, barley, flour, soybean and corn. Because of the severe drought in southern regions this year, it is required to import about 400,000 M/T rice and about 800,000 M/T the other grains.

c. Recent status of the demand and supply of food Table 4, 5 are the governmental plan about the demands and supply of food in 1970, which is based on the natural increase of population.

According to the Table 4 it is assumed that the number of population in 1970 will be 32 million. The difference between supply and demand in 1965 was 669,000 M/T. Government plans to close the gap between supply and demand up to 149,000 M/T in 1970. The way to increase the food production is based on two methods, first, production increase and second, controlling the composition of grain consumption. The

Table 4. Government's Estimate of Population Growth for 1964~1970

| Year     | Item | Estimate for food supply by Gov't |              |      | Under the natural condition |             | Under the family planning |             |            |
|----------|------|-----------------------------------|--------------|------|-----------------------------|-------------|---------------------------|-------------|------------|
|          |      | Population growth rate            |              |      | Total population            | Growth rate | Population                | Growth rate | Population |
|          |      | First plan                        | Plan amended | Ave. |                             |             |                           |             |            |
| 64. 5. 1 |      | 2.82                              | 2.70         | 2.76 | 27,489,453                  | 2.977       | 28,493,748                | 2.815       | 27,654,508 |
| 65. "    |      | 2.78                              | 2.60         | 2.69 | 28,228,924                  | 2.994       | 29,349,308                | 2.730       | 28,437,008 |
| 66. "    |      | 2.74                              | 2.50         | 2.62 | 28,968,522                  | 3.011       | 30,235,547                | 2.576       | 29,201,473 |
| 67. "    |      | 2.57                              |              | 2.57 | 29,713,013                  | 3.033       | 31,753,687                | 2.410       | 29,928,524 |
| 68. "    |      | 2.54                              |              | 2.54 | 30,467,723                  | 3.045       | 32,155,478                | 2.258       | 30,645,301 |
| 69. "    |      | 2.64                              |              | 2.46 | 31,217,229                  | 3.065       | 33,092,770                | 2.106       | 31,321,136 |
| 70. "    |      | 2.38                              |              | 2.38 | 31,960,199                  | 3.085       | 34,115,361                | 1.962       | 31,964,121 |

Table 5. Estimate of Over-all Demand and Supply of Grains for 1970 unit ; 1000 M/T

| Item     | Year                        |       |       |
|----------|-----------------------------|-------|-------|
|          | 1965                        | 1970  |       |
| Demand   | Food use                    | 5,132 | 5,984 |
|          | Gov't use                   | 190   | 190   |
|          | Seeds                       | 164   | 217   |
|          | Processing & industrial use | 1,209 | 1,583 |
|          | Feed use                    | 225   | 261   |
|          | Natural loss                | 243   | 297   |
|          | Export                      | 5     | 50    |
|          | Gov't carry-over            | 166   | 200   |
|          | Private carry-over          | 928   | 1,211 |
|          | Total                       | 8,267 | 9,885 |
| Supply   | Total production            | 6,674 | 8,711 |
|          | Rice "                      | 3,955 | 4,523 |
|          | Barley "                    | 1,856 | 2,422 |
|          | Others "                    | 863   | 1,428 |
|          | Other supply                | 924   | 1,025 |
|          | Total                       | 7,598 | 9,736 |
| Shortage | -669                        | -149  |       |

Table 6. Composition of Unit Food Consumption

| Year                | 1965    |         | 1971    |          | Ratio A/B (%) |
|---------------------|---------|---------|---------|----------|---------------|
|                     | Amounts | Rate(A) | Amounts | Rate (B) |               |
| Rice                | 126.09  | 54.4    | 129.08  | 50.8     | 93.4          |
| Barley and wheat    | 741.40  | 32.0    | 68.86   | 27.1     | 84.7          |
| Pulses              | 8.84    | 3.8     | 11.15   | 4.4      | 115.8         |
| Miscellaneous grain | 5.77    | 2.5     | 4.22    | 1.7      | 68.0          |
| Potatoes            | 16.78   | 7.3     | 40.71   | 16.0     | 219.2         |
| Total               | 231.62  | 100.0   | 254.02  | 100.0    | 109.7         |

Source ; Government's Project for Food Increase.

increasing rate of each crop is presented in Table 6. Total crop production will increase about 10 per

cent more in 1971 than in 1965. The decrement of crops in 1971 compared with the production in 1965 will be 7 per cent in rice, 15 per cent in barley, and wheat and 32 per cent in other crops.

However, there will be 16 per cent of increase in soybean and 119 per cent of increase in potatoes. It should be added that the level of living standards remains the same in 1971.

Table 7. Government's Project of Grain Production in 1970

| Grain               | 1970        |             |                | Indices based on 1964 |            |              |
|---------------------|-------------|-------------|----------------|-----------------------|------------|--------------|
|                     | Area (ha)   | Yield/ha kg | Production M/T | Area %                | Yield/ha % | Production % |
| Rice                | 1,281,808.9 | 3,628.5     | 4,651,086.2    | 103.5                 | 128        | 152          |
| Barley & wheat      | 1,391,498.6 | 1,697.6     | 2,422,150.2    | 115                   | 110        | 130          |
| Pulses              | 475,211.5   | 706.6       | 335,760.4      | 129                   | 128        | 165          |
| Potatoes            | 279,290.2   | 14,094.5    | 1,137,522.2    | 130                   | 143        | 187          |
| Miscellaneous grain | 197,035.9   | 835.0       | 164,530.1      | 91                    | 149        | 137          |
| Total               | 3,624,844.9 | 2,403.2     | 8,711,049.1    | 111                   | 124        | 139          |

Plan for the crop production by 1970 is presented in Table 7. The total production planned in 1970 is about 8,710,000M/T. The government is going to increase this amount by means of increasing arable land (11 per cent) and increasing yield per unit area (24 per cent). In rice crop the area will extend about 3.5 per cent more and the yield per unit area will increase 28 per cent more. The total increment will be 52 per cent in 1970.

All of these plans will be successful when other conditions like birth control and other natural conditions are going on smoothly. However, we have already difficulties attaining planned targets. For instance, population increases faster than the planned and crop production has not kept with the plan.

#### d. Perspective of food demand and supply

It may not be easy to predict the food situation in 2000. But it is only 32 years after from now on. If the author lives by 2000, he will be 77 years old and see the results.

Table 8. Estimate of Near Future Population

| Year      | Low assumption |            | High assumption |            | Medium Assumption Population |
|-----------|----------------|------------|-----------------|------------|------------------------------|
|           | Growth rate    | Population | Growth rate     | Population |                              |
| 1971~75   | 2.0%           |            | 3.0%            |            |                              |
| 1975.5    |                | 3,640      |                 | 3,820      | 3,730                        |
| 1976~80   | 1.9%           |            | 3.2%            |            |                              |
| 1980.5    |                | 3,990      |                 | 4,480      | 4,235                        |
| 1981~85   | 1.8%           |            | 3.4%            |            |                              |
| 1985.5    |                | 4,370      |                 | 5,280      | 4,825                        |
| 1986~90   | 1.7%           |            | 3.6%            |            |                              |
| 1990.5    |                | 4,750      |                 | 6,280      | 5,515                        |
| 1991~95   | 1.6%           |            | 3.8%            |            |                              |
| 1995.5    |                | 5,125      |                 | 7,550      | 6,337                        |
| 1996~2000 | 1.5%           |            | 4.0%            |            |                              |
| 2000.5    |                | 5,500      |                 | 9,180      | 7,340                        |

※ Based on the estimated population in 1970 (33,000,000)

Table 9. Food and Rice Needs in Near Future

| Year | Under the Population Control Condition (A) |               | Under the Population with natural increasing rate (B) |               | Under the Population Condition of A & B average |               |
|------|--|---------------|---|---------------|---|---------------|
|      | Grains 1000M/T                             | Rice 1,000M/T | Grains 1,000 M/T                                      | Rice 1,000M/T | Grains 1,000M/T                                 | Rice 1,000M/T |
| 1975 | 11,247.6                                   | 5,132.4       | 11,803.8  | 5,386.2       | 11,525.7  | 5,259.3       |
| 1980 | 12,329.1                                   | 5,625.9       | 13,843.2  | 6,316.8       | 13,086.2  | 5,971.4       |
| 1985 | 13,503.3                                   | 6,161.7       | 16,315.2  | 7,444.8       | 14,909.3  | 6,803.3       |
| 1990 | 14,677.5                                   | 6,697.5       | 19,405.2  | 8,854.8       | 17,041.4  | 7,776.2       |
| 1995 | 15,836.3                                   | 7,353.2       | 23,329.5  | 10,645.5      | 19,581.3  | 8,935.2       |
| 2000 | 16,995.0                                   | 7,755.0       | 28,366.2  | 12,943.8      | 22,680.6  | 10,349.4      |

Assumption ; Future needs are calculated under the assumption that consumption rate of food and rice is same as the rate of 1970.



Prediction on population increase in the future is presented in Table 8. If the number of population is controlled artificially from 2.0 per cent of the rate of population increase to 1.5 per cent, the total number of population will be 55 million in 2000. If population increase is not controlled (3.0 to 4.0 per cent of birth rate), the number of population will be about 92 million. The average between these two critical figures will be 73 million.

Table 9 shows the amount of food needed in 1970, when the food consumed by one person does not change in amount. When the population is controlled, about 12,330,000 M/T in 1890, 14,770,000 M/T in 1990 and 16,990,000 M/T in 2000 of food crop will be needed. The amount of rice needed in the same years will be 5,620,000 M/T, 6,690,000 M/T, and 7,750,000 M/T respectively. When the population increase is not controlled, more food will be needed. That is, 13,840,000 M/T in 1980, 19,400,000 M/T in 1990, 28,360,000 M/T in 2000. The rice needed in each year will be 6,310,000 M/T in 1980, 8,850,000 M/T in 1990, 12,940,000 M/T in 2000.

Table 10 presents the crop production expected in the future, when the average production rate from 1957 to 1966 is applied. The area under cultivation in 1970 will be 3,620,000 hectares and will be 4,700,000 hectares in 2000. The yield per hectare in 1970 is 2.4

M/T and will be 4.5 M/T in 2000. The total crop production in 1970 will be 8,710,000 M/T and will be 21,300,000 M/T in 2000. The total area for rice crop in 1970 will be 1,280,000 hectares and will be 1,660,000 hectares in 2000. The yield of rice per hectare in 1970 will be 3.6 M/T and will be 5.0 M/T. The total rice production in 1970 will be 4,650,000 M/T and will be 8,370,000 M/T in 2000.

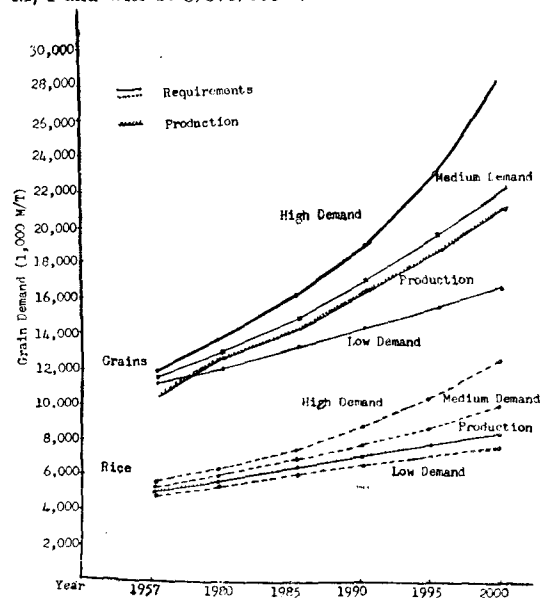


Figure 6. Estimate of Food Requirements and Supply in Near Future

Table 10. Estimate of Food Production in 1975 to 2000

| Year | All Grains    |             |                      | Rice         |             |                     |
|------|---------------|-------------|----------------------|--------------|-------------|---------------------|
|      | Area 1,000 ha | Yield kg/ha | Production 1,000 M/T | Area 1,000ha | Yield kg/ha | Production 1,000M/T |
| 1970 | 3,624.8       | 2,403.2     | 8,711.0              | 1,281.8      | 3,628.5     | 4,651.1             |
| 1975 | 3,804.0       | 2,758.2     | 10,492.2             | 1,345.6      | 3,863.5     | 5,198.7             |
| 1980 | 3,983.2       | 3,113.2     | 12,400.5             | 1,409.4      | 4,098.5     | 5,776.4             |
| 1985 | 4,162.4       | 3,468.2     | 14,436.0             | 1,473.2      | 4,333.5     | 6,384.1             |
| 1990 | 4,341.6       | 3,823.2     | 16,598.8             | 1,537.0      | 4,568.5     | 7,021.8             |
| 1995 | 4,520.8       | 4,178.2     | 18,888.8             | 1,600.8      | 4,803.5     | 7,689.4             |
| 2000 | 4,700.0       | 4,533.2     | 21,306.0             | 1,664.6      | 5,038.5     | 8,387.1             |

Assumption : Agricultural production keeps the previous increasing rate in area and yield per unit area  
: Area for all grains 1,792,000ha ; yield 355 kg/ha ; Area for rice 638,000ha ; Rice yield, 235kg/ha increased during past 5 years.

(a) Estimate on Government's Project.

The summary on the relationship between predicted population growth and food production is presented in

Figure 6 and Table II. From the Table it is estimated that the production of food is all the time not enough

Table 11. Can Food and Rice Needs be Satisfied in Near Future ?

| Year | Low assumption |        | High assumption |          | Medium assumption |          |
|------|----------------|--------|-----------------|----------|-------------------|----------|
|      | Grains         | Rice   | Grains          | Rice     | Grains            | Rice     |
| 1975 | -755.4         | +66.3  | -1,311.6        | -187.5   | -1,033.5          | -60.6    |
| 1980 | +71.4          | +150.5 | -1,442.7        | -540.4   | -685.7            | -195.0   |
| 1985 | +932.7         | +222.4 | -1,879.2        | -1,060.7 | -473.3            | -419.2   |
| 1990 | +1,921.3       | +324.3 | -2,806.4        | 1,833.0  | -442.6            | -754.4   |
| 1995 | +30,525        | +336.2 | -4,440.7        | -2,956.1 | -692.5            | -1,245.8 |
| 2000 | +4,311.0       | +632.1 | -7,060.2        | -4,556.7 | -1,374.6          | -1,962.3 |

to provide the food needed unless the increase of population is artificially controlled. When the increase of population is not controlled, the shortage of food will be 1,440,000 M/T in 1980, 2,800,000 M/T in 1990, and 7,060,000 M/T in 2000.

The amount of rice needed will be 540,000 M/T in 1980, 1,830,000 M/T in 1990, and 4,550,000 M/T in 2000. But if the increase of population is controlled the production of food will meet the demand in the future.

**Assumption:** Under the assumption that rice production area in 1970, 1,231,800ha will not be changed in near future.

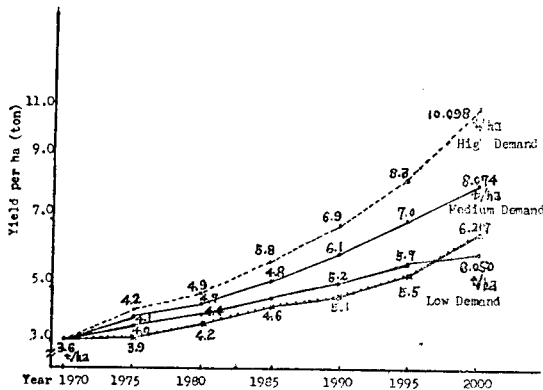


Figure 7. What Level of Rice Production per Hectare will be Required to Meet the Rice Needs in Future ?  
 +++The level of rice yield to be produced to meet the medium demand in the case that rice area increases with the previous rate.

If the yield of rice per unit area is increased and the area under rice production in 1970, 1,231,800 hectares, is fixed, the yield per hectare will be 3.63 M/T in 1970, 3.91 M/T in 1980, and 4.8 M/T in 2000. If the increasing rate of rice area from 1957 to 1966 is continued by 2000, the yield of rice per hectare will be 3.86 M/T in 1975, 4.1 M/T in 1980,

4.57 T/M in 1990 and 5.04 M/T in 2000. It is the problem whether the projects to increase the food production and to control the population growth is worked out or not.

**6. The problems imposed upon agricultural researcher**

As far as many people believe the theory of Malthus on population and food, how to solve the food problem is the problem imposed on agricultural researcher. Whether to import or to produce in nation is the utmost important things to solve. The way to increase the food production is either by increasing arable land or by increasing yield per unit area. Increasing of arable land by reclamation of fallow land or by improvement of drainage system is quite different from the improvement of agricultural techniques. However, the method to increase the yielding ability of crops in the land reclaimed belongs to agricultural techniques. The ways to increase the yield per unit area are either by improving cropping systems or by improving the yielding abilities of crops. All factors influencing production of crops should be studied and should be applied at most to attain the stage of self-sufficient.

The author believes that food problems can be solved. The predicted yield per hectare in 1985 is 4.33 to 4.62 M/T, which is equal to present Japanese record. It is our goal to obtain Japanese record on yield per unit area within 10 years.

I do hope to have an opportunity to discuss about the food problems and other factors influencing crop yield with people interested in increasing crop production. It will be also my great honor to have an opportunity to suggest to governmental officials so that they can make plan for the modernization of rice production in Korea.