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KOREAN AGRICULTURAL SECTOR STUDY

Special Report 3

AN ANALYSIS OF NEW LAND DEVELOPMENT IN KOREA

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FOREWORD

This publication is one of a series of Korean Agricultural Sector Study Special Reports. Through the cooperation of the Republic of Korea, Michigan State University and USAID, an agricultural sector study, entitled Korean Agricultural Sector Analysis and Recommended Development Strategies, 1971-1985 was completed between September 1971 and July 1972. Concurrent with and contributing to the sector study the rudimentary components of a computerized simulation model were developed. This work continues with the objective of developing and institutionalizing a fully operational agriculture sector simulation model as a tool for use by Korean decision makers in policy formulation and program development.

The KASS special reports are the result of the work of a number of joint Korean and American task forces established to collect and analyze data and develop working papers on a variety of specific topics for background and input and follow up to the sector analysis efforts. The reports are joint publications of the Agricultural Economics Research Institute, Ministry of Agriculture and Forestry, Republic of Korea and the Department of Agricultural Economics, Michigan State University, East Lansing, Michigan.

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Introduction

This report considers some of the institutional and noninstitutional factors affecting the use of agricultural land in the Republic of Korea (ROK). Attention will be given to the distribution of land among competing uses and how that distribution is affected by various economic changes. To investigate analytically how land and water resources are used, effects from both the anticipated demand for and the potential supply must be considered. Primary emphasis here will be given land rather than water use because it is felt that the ROK is aware of the importance of water management and is taking measures which will deal with the potential problems before they become critical.

The report is organized into four parts. In the first section dealing with the general setting of the problem, consideration will be given to objectives in land tenure and the accomplishments of Korea's land reform. The second and third sections will contain the empirical analysis with a fourth section summarizing the results. The empirical analysis offers two approaches: first, a single equation regression model, and secondly, a linear programming model which will look more carefully at upland development cost and utilization.

The regression model will be a reduced form equation from the supply and demand for land which depends on the agricultural prices, nonagricultural prices, government investment in agriculture land development, and demographic characteristics of Korea, such as population and the rapid urbanization which has continued over the last several years. In the regression model the dependent variable whose variation we seek to explain will be total land in agricultural use over time.

An alternative model will be presented which takes a different approach to explaining land utilization. The linear programming model presented here

takes the total land potentially usable in agriculture less what was in use in 1969 and attempts to discover how much of this land would be used and for what purpose under alternative sets of assumptions about output and input prices. Attention is paid to the intensive margin in which several crops can be grown and farmers must decide which crop to grow, as well as the extensive margin in which new land can be brought into production given the rent combination of output and input prices.

Between these two approaches the reader should get a reasonable view of the possibilities of expanding the land base of Korea and how the allocation of land among crops will vary with price changes.

Problem Setting

Some of Korea's major land and water resource problems center in the question of, does the nation have sufficient resources to care for the type of future it envisages for itself? Realistic planning for the future calls for careful analysis of the present situation with respect to supply and demand relationships, the changes in this situation that can be anticipated in the foreseeable future, and the nation's ability and willingness to marshall its resources for attainment of the ends it has in view.

Emerging Demands for Land

Korea's demand for land resources and for the products of land reflects its status as a rapidly developing nation. The population is growing and the nation is becoming more urbanized. Literacy levels are rising and students are securing more education than in earlier years. Individual and national productivity are rising. Average real income and levels of living are improving. All of these factors signal an upward surge in the overall demand for land and the products of land.

Official census findings show that the population of the Republic of

Korea increased from 16.2 million in 1944 to 20.2 million in 1949, 25.0 million in 1960, and 31.8 million in mid-1970. The size of the population almost doubled in the 26 years following 1944. This doubling, which in part reflects the immigration of people from North Korea, represents a very rapid rate of population growth. It means that the land resources of South Korea have been called upon to feed, clothe, and house twice the resident population it supplied at the end of World War II.

This development by itself has created tremendous problems for the ROK. Its implications for the future are further complicated by the imminent prospect of further population growth. David Scott of the Population Council projects a total population of 40.9 million in 1985 with the assumption of a low fertility variant, 41.8 million with a moderate fertility variant, and 46.3 million with a high fertility variant. If population increases at the moderate level, the nation will have to plan to feed, clothe, and house approximately one additional person for every three people in the population in 1970.

The above quoted statistics indicate only part of the picture concerning the emerging demand for land resources. Analysis of the population growth situation in the ROK provides a strong basis for hope that the rate of population increase will indeed continue to decline and approach a stability level.[1] South Korea has shifted from its classification among the "high population growth" nations to the "transitional growth" category. Progress

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[1]Significant differences of opinion have been advanced concerning the prospects for additional population growth. Some writers, who can often best be described as alarmists, predict that the population of developing nations such as South Korea will more than double in the next three decades and that these nations are doomed to a hand-to-mouth type of continued existence. Informed demographers such as Dr. Donald Bogue of the University of Chicago, in turn, see hopeful signs that suggest a leveling off of the rates of population growth in these nations by the end of the century.

made in reducing both mortality and birth rates in recent years suggests that the ROK may soon be classed among the "incipient population decline" group of nations, and that it can then move on to a "cultural balance" classification that will signify population balance with low levels of birth and mortality rates. A number of factors are operating to implement this shift towards population stability. These include the changes in attitudes that come with the medical-sanitary advances that permit increasing average life expectancies, with urbanization of higher proportions of the population with higher real incomes, improved levels of living, and higher levels of education, and with programs for encouraging family planning and the control of unwanted births.

While the prospect forpopulation stability will have a beneficial effect in helping to ease the demand for land and the products of land, certain other emerging developments will have a contrary effect in further complicating the demand situation. Important among these are the increasingly urban nature of the population, the changing age structure of the population, the increase in household numbers, and the effects of higher real income and rising levels of educational attainment.

Seventy-four percent of the people of South Korea were classified as farmers in 1939. This proportion dropped to 58.3 percent in 1960 and 49.6 percent in 1969. In the short 15 years between 1955 and 1970, the proportion classed as urban-living in myons with 20,000 or more people increased from around 13 million in 1949 to a peak of 16.1 million in 1967, since which time the total farm population, which had been increasing at less than national average rates, has shown a net decline. Farm people are now moving to the cities faster than the rural population reproduces itself.

Urbanization is expected to continue as a prominent feature of the changing population picture. Economic Planning Board projections indicate

that more than two-thirds of the population will be urban by 1981. Some 5.8 million people or 23 percent of the population lived in nine cities with more than 100,000 people in 1960. By 1969, this total had increased to 11.3 million or 35 percent of the population, living in 18 cities with over 100,000 people. By 1986, it is expected that 22.6 million people, or 53 percent of the population of South Korea, will live in 29 cities of more than 100,000 persons.[2]

With increasing urbanization, changes can be expected in the nature of the nation's demand for land resources. Thousands of hectares will be needed for urban expansion and growth. Land will be needed for new housing, industrial, and commercial sites, for streets, parks, reservoirs, and urban service areas. Steps will be taken to secure adequate urban water supplies. Increased urbanization will call for the production of more products for industrial fabrication and manufacturing. The nation's policies will give greater emphasis to caring for the problems of the cities. Changes in attitudes towards farming and the tilling of the earth may also be expected as smaller and smaller proportions of the population find themselves intimately associated with the problems of planting and harvesting crops.

Reduced infant mortality and the provision of improved medical facilities have brought an extention of the life expectancy of the average Korean. Average life expectancies are expected to rise from 55 years in 1960-65 to 63.2 years in 1975-80. This trend in combination with the decline in the birth rate is contributing to a more rational balance between the various age groups in the population. A higher proportion of the population, both now and in the future, will be in their productive working years. This means that a more than proportionate increase in the number of job opportunities

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[2]Cf. Mark Fortune, Mobilizing for Urbanization. Consultant report. Seoul: September 1971.

will be needed to care for this work force. A more than proportionate increase in the number of households also can be anticipated. Both of these trends suggest higher household and wage earner demands for land its products than one would anticipate from calculations based simply on the average expected rate of population increase.

The average Korean is ambitious, energetic, and very much interested in securing education. He and the government of the ROK are also interested in increasing labor productivity and in the provision of higher real incomes. Higher levels of educational attainment and higher real incomes will have a distinct effect on the overall demand for land and its products. Educated people are normally more mobile and more market-oriented in their thinking. They know more and they want more. Higher real incomes give them the wherewithall to satisfy their demands, and the combination of these two factors can and does generate an endless chain of demands. Higher real incomes and increased purchasing power allow people to convert their wants into effective demands.

As the human capital stock of Korea grows it can be expected that industrialization will continue and, in fact, increase. Given the apparent mobility of capital across international borders, it is clear that the only impediment to an even faster rate of industrialization in Korea is the lack of a skilled labor force. And this impediment is declining much more rapidly in Korea than in most developing countries. Given the attitude of Korea and Koreans toward education, it is a safe prediction that within the next ten to fifteen years Korea's stock of human capital will be sufficient to support a much more industrialized society than it is at present.

Many of the items demanded by an educated prosperous population have important implications for public land and water policies. The demands for food and clothing, and housing dictate the use of substantial areas for these

purposes and frequently call for shifts in existing land use patterns to provide more land for such purposes as urban housing and beef production. Prosperous families desire opportunities for outdoor recreation. This will call for the reservation, development, and protection of park and recreation sites.

The population characteristic trends listed above indicate that South Korea faces the prospect of a rapidly increasing demand for the products of land. The fulfillment of these demands constitutes a major problem for national land and water resource development policy. Much of the success Korea will enjoy in taking its place among the more developed nations will depend upon the progress it realizes as it marshalls its resources to meet and fulfill these emerging demands.

Supply of Land for Agricultural Use

According to the official statistics for 1969, South Korea has a total land area of 9,847,750 hectares of which 2,330,419 hectares or 25.7 percent were classified as farmed cropland. (See Table 1, Appendix 1.) The nation has 1,293,709 hectares of paddy--646,855 hectares of double cropped paddy and 646,854 hectares of single cropped paddy. The remaining 1,036,710 hectares of cropland are cultivated uplands. Korea is a mountainous country and, except for 688,600 hectares of industrial and urban lands, nearly all of the nonfarmed area is classified as "forest land."

Approximately 27.1 percentof the "forest land" is owned by public agencies. Most of these lands are best described as uncultivated wild uplands. They involve the steeper uplands usually found adjacent to the farmed parcels. Many of these lands have some potential for use for orchard crops, mulberry, forage crops, and for growing trees for fuel and timber. Intensive use is made of the grass and litter from these areas for fuel and compost purposes. Many of these wild uplands are underutilized in terms of the production potential

they could realize with careful management.

The problem that the Republic of Korea faces in trying to produce enough food to supply its expected demands is essentially the same as that faced in all land-short nations. Korea starts with a physically limited supply of land, only about one-fourth of which is well-adapted to agricultural use. In its effort to secure a better balance between its man and land resources, it can follow three alternatives. First, it can take steps to increase its land supply either by developing new lands or be extending its sources of materials to other areas. Second, it can intensify the use it makes of the lands it now utilizes. Finally, it can act to reduce the pressure of people on the land by such actions as rationing the use of the land products, discouraging births, or encouraging citizens to migrate to other areas.

The great majority of the additional food that must be produced in South Korea will come from more intensive use of the land area now used for crop-land. It is logical, however, that emphasis be given to the potential for developing additional cropland.[3] This subject will be dealt with in more detail in the next section. But it should be recognized that the potential for bringing in additional land areas is limited. When consideration is given to past trends in cropland area, to current plans for new upland development, and to the impact of the increasing demand for urban and industrial lands, highways, reservoirs, and possible park areas, it appears that the nation may be hard pressed to retain its present area of farmland.

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[3] Consideration also should be given to an alternative not stressed by the Third Five-Year Plan--the prospect of importing needed food supplies from other countries while stressing the development of an industrial export economy that will provide the funds to pay for the importation of needed resources. Great Britain, Belgium, Holland, and Japan have used this approach to advantage in the past. Whether or not the ROK can follow their example will be influenced in large measure by international trade, foreign policy, and national defense considerations.

Dr. Sung Hwan Ban's study of the long run productivity of South Korea's agriculture shows the total area cultivated for crops dropped below the 2,107,619 hectare base area for 1918 in all the years between 1943 and 1963 and has only recently risen to an index level 10 percent above 1918.[4] (See Table 2, Appendix 1) The index of paddy area (1918 = 100) was below 100 in only two years between 1918 and 1969. The index of upland area dropped to a low of 82 in the 1952-54 period and did not rise above 101 until 1965. This index was up to 107 in 1968 and 1969. Dr. Ban's index of crop area (1918 = 100) rose to index levels of between 111 and 116 in 12 years between 1930 and 1943, and then dropped to a low of 91 in 1951 and did not rise again to levels of over 110 until 1963,. Since then it has risen to levels of more than 120 in four separate years. Meanwhile, the multiple cropping index (1918 = 137) rose to levels above 150 in 12 years, between 1930 and 1943 and has agair reached this level in 13 of the 16 years since 1954.

Dr. Ban's analysis shows that while the government's program for encouraging upland reclamations after 1963 succeeded in adding 170,000 hectares to the total additions brought an increase in the crop area index, but the multiple cropping index dropped slightly below the levels that existed in the early 1960's and throughout the 1930's and early 1940's.

Two general indications of the extent of the shifts in farm land area that may be expected are provided by recent government reports. Background data prepared by the Ministry of Agriculture and Forestry in 1970 for the Third Five-Year Plan projects the development of 160,000 hectares of new upland (32,000 hectares annually) in the 1971-76 period. During this same period, a total of 57,839 hectares—41,500 hectares for the industrial plant, urban housing, and new highway sites; 3,839 hectares for new reservoir areas;

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[4]Sung Hwan Ban, The Long-Run Productivity Growth in Korean Agricultural Development: 1910-1968, Doctoral dissertation, University of Minnesota, 1971.

and 12,500 hectares for the provision of new or wider roads in paddy rearrangement projects—will be lost to agriculture.

Preliminary projections now indicate that 27.7 thousand hectares of new paddy will be developed through tide land reclamation by 1981. Projections published by the Ministry of Construction show 72.4 thousand hectares of paddy will be lost to agriculture by 1981. Similar figures for upland show agriculture with a net gain of 131.7 thousand hectares so that on net, agriculture will gain only 87 thousand hectares of land, all of which will be upland. (See Table 4, Appendix 1.)

It may be well to point out at this time that little attention has been paid to the public works nature of much of the upland development. The labor used for such projects would be either totally unemployed or underemployed and as a result, there is an income transfer which tends to stimulate aggregate demand with concomitant multiplied effects which are particularly helpful when unemployment is excessive.

The Korean Land Base

According to the official statistics for 1969, South Korea has a total land area of 9,847,750 hectares of which over 2.3 million hectares or 25.7 percent are in farmed cropland. The nation has about 1.3 million hectares of paddy, or about 650 thousand hectares each of double cropped and single cropped paddy. The remaining one million plus hectares of cropland are cultivated uplands.

For the nearly three decades prior to the Korean War, the arable land base of the present Republic remained relatively constant. However in the decade immediately after the Korean war there was a decline of 8 percent from the former stable level of arable land. During the 1960s there was a direct effort to reverse this trend and, indeed, to increase the total land base

for agricultural production to the pre-war level. Public assistance, both technical and financial, was provided for new upland development and for tideland reclamations. The following areas of new lands have been developed.

Year	Uplands	Tidelands
1962	12,972 ha.	
1963	15,517	
1964	22,482	7,536
1965	37,317	
1966	22,339	
1967	16,785	
1968	13,500	758
1969	7,690	1,287
1970	2,953	1,135
1971		3,787
Total (1962-70)	151,555	

Reports concerning the areas reclaimed indicate that much of the upland developed has not been particularly productive, at least in the first years following development.[5] Soil acidity and shortages of top soil and soil humus have been common problems on the newly developed uplands. Reports are heard of owners who apparently have not taken adequate precautions to control and prevent soil erosion. Development costs have often been high, and it is still too early to say whether the benefits realized by many operators through new upland development will exceed the total costs impended including public subsidies. Similar problems exist with the tideland reclamation projects. Several of these projects undertaken during the middle 1960's had benefit-cost ratios of around 0.5. Large-scale tideland development projects were undertaken at costs exceeding one million Won per hectare, or more than twice the selling

[5] Dr. Jin Hwan Park, An Economic Analysis of Land Development Activities in Korea (Seoul National University, 1969), p. 121, reports that the average crop yields for the 10 principal crops on the newly developed uplands ranged from 46.9 to 69.7 percent as high in the first 5 years of cultivation as on the existing uplands.

price for paddy land during this same period. The results to date have not been sufficiently encouraging to attract large sums of new investment capital required for any appreciable change in land area through tide land reclamation However, additional uplands and tideland areas can and will be brought into use These reclamation activities will produce some high quality lands, but more often than not will involve the addition of lands that, for some time, will be near the extensive margin for economic use. Unfortunately, the nation must look to reclamation of low quality land to offset the loss of the often quite productive lands that will shift out of agriculture to industrial, urban housing, highway, and reservoir uses.

Various ministries of government have been given extensive responsibiliti for natural resource development. The Ministry of Agriculture and Forestry (MAF) has planned about one-third of its total investment outlays in the 1972-76 (Third Five-Year Plan) for development of the agricultural production base. Of a total of 496,952 million Won, (including 23,005 to be administered by the Ministry of Communication and Public Health), 173,534 million are planned for the agricultural base in million Won as follows: 18,246 for water resource development, 45,394 for land consolidation, 4,800 for tide water development, 53,334 for the four Big River Basin multi-purpose projects and the remaining of 51,780 million Won for such other activities as bench terracing, afforestation and the control of soil erosion. Other parts of the MAF planned investments have direct implications for a changed pattern of land use (limestone application 4,866 million Won, development to new cash crops 12,696, pasture development 7,806, new plantings to mulberry 2,800, rural road construction 16,241, etc.).

Figures published by the Ministry of Construction project the reclamation and development of approximately 265,200 hectares of new farmland by 1981 and the loss of around 178,200 hectares. This will provide the nation

an initial increase of 87,000 hectares of farmland. However, it will have 44,700 fewer hectares of paddy and much of the land sacrificed to other uses has production potential far superior to that of the newly developed lands.

It is logical that emphasis be given to the potential for developing cropland,[6] but it should be recognized that the potential for bringing in additional land areas is limited. Because of past trends in cropland area, current plans for new upland development, and the impact of the increasing demand for urban and industrial lands, highways, reservoirs, and possible park areas, the nation may be hard pressed to retain its present area of farmland.

Technical opportunities for new farmland developments in Korea are great, but economic opportunities are far more limited. About two-thirds of the total land area is classified as forest. Much of this area is suitable only for threes, while some of it is bare rock, and virtually all of it is mountainous or hilly upland. Nearly all of the area suitable for development as paddy or as terraced uplands has been developed already. Korea has followed the normal historical process of first developing those lands that are most fertile, and easiest and least costly to develop.

Of the 9.8 million hectares of land area, nearly 6.7 million hectares or 67.8 percent have been classified as forest land including 321 thousand hectares of convertible forests which are the sparsely forested mountain areas with slopes not greater than 24 degrees. Approximately 36,000 hectares of protective forest is contained within the 321,000 hectare are defined as convertible forest, and exclusion of the protective forest reduces the

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[6]Sung Hwan Ban, The Long-Run Productivity Growth in Korean Agricultural Development: 1910-1968, Doctoral dissertation, University of Minnesota, 1971.

potential land area witha lessthan 24 degree slope to 285,739 hectares. What proportion of this approximately 286,000 hectares would in fact be available for agricultural production? Taking into accounta number of factors, including inaccessibility and the amount of land to alternative uses, an estimated 70 percent of the total potential land would be available for agricultural production, leaving about one-half of the approximately 300,000 hectares in the double cropping region. Of the 200,000 hectares of upland developable, approximately 41,000 hectares have been classified as suitable for upLandcrop production, 45,000 suitable for orchards (apples, pears, grapes), 74,000 hectares with thin soil depth potentially usable for pasture, and 40,000 with steep slopes potentially usable mainly for mulberry and grass.

When people need land badly enough this need is reflected in higher product prices and they are willing to undertake high cost developments. Thus one might argue that a critical need for additional farm land in Korea is reflected in higher agricultural crop prices. This would lead to higher economic returns to land as a productive factor and to higher farm land values. These developments in turn would provide private owners and the government with a stronger economic incentive to bring more land into production. Higher product prices and land values would give the stamp of economic feasibility to many development projects that under present conditions have benefit-cost ratios of less than unity.

The government can anticipate this situation and use public assistance and subsidies to encourage development activities that would not otherwise take place. Public subsidies may very well be needed for this purpose if the government is to push the policy goal of attaining self-sufficiency in food production. In adopting this policy, the government might justify its subsidy outlays on

the ground that the benefits to be derived from achieving self-sufficiency outweigh the additional costs of land development.

Dr. Park's excellent study of the economics of upland development indicates an economic potential for new developments for the production of traditional crops. He feels, however, that much of the upland that has a potential for development should be used for mulberry, orchard crops, or for livestock and forage enterprises. The greatest potential for increasing the production of Korea's traditional crops can come through more intensive use of the existing farmlands.

Some of the intensification practices that can be used involve land and water developments. Programs are underway to complete the paddy rearrangements of 75 percent of the nation's remaining potential of 600,000 hectares by the end of the Third Five-Year Plan in 1976. A total of 158,000 hectares had been rearranged by 1970 and 267,000 additional hectares are scheduled for rearrangement in the 1972-76 period.[7]

The area of irrigated paddies had been expanded from around 700,000 hectares in 1966 to over a million hectares by 1970 and agricultural water resource developments were planned to bring irrigation water to an additional 176,000 hectares by 1976. As a part of the comprehensive development projects envisaged for the Han, Kum, Nakdong, and Yongsan river basins, plans were projected for the construction of 12 new multipurpose dams in the 1971-81 decade that would provide new and supplemental water resources for the irrigation of 123,200 hectares.[8] The four projects will provide erosion control for 41,300 hectares.

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[7]Government of the Republic of Korea, The Third Five-Year Economic Development Plan, 1972-76, p. 37.

[8]Ibid., p. 39.

Margin Between Farm and Forest Land Use

An important policy issue in Korea centers around the margin between farm and forest land use. This issue has been generally ignored in the past but can easily pose problems in the future. Up until the present time, the classification of "farmland" has been limited to the areas of cultivated paddy and uplands. All other lands, except those used for cities and a few specialized uses, have been described as forest lands. The classification of "forest" has included potential upland development areas, scenic areas, bare mountain sides, and lands with a potential for commercial forest use.

Emphasis has been given in the nation's forestry programs to the afforestation of denuded areas and to the development of commercial stands of timber. The Third Five Year Plan calls for the afforestation of 275,000 hectares. Most of the emphasis in the forestry programs has been placed on lands classified as forest reserves. A classification program of this order is desirable and is needed to prevent unwarranted dissipation of the funds allocated for forestry investments. Unfortunately, however, some of the areas legally designed as forest reserves also have a potential for upland development.[9]

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[9]Cf. Park, op. cit., pp. 54-55. One third of the new upland farm developments in the 1962-67 period involved forest reserves. Dr. Park indicates that the decision to designate an area as a forest reserve has been made by local forest administrators on the basis of criterion such as presence of forest cover, need for erosion control, defense purposes, and need to preserve landscapes. The Forestry Law of 1961 prohibits land reclamation, open grazing, tree cutting, and the removal of sand, stone, turf, branches, or roots of trees, grass roots, fallen leaves, or resin from the forest reserves without permission of the Minister of Agriculture and Forestry. Burning is prohibited. Private owners of forest reserve lands must formulate management plans for government approval. Government afforestation plans may be substituted, and private lands can be turned over to mutual associations for management.

Serious consideration should be given to the development of a more detailed classification scheme that will obviate the possible need for cutting down partially developed forest stands to make room for new upland farm developments. At the minimum this classification should distinguish between (1) the wild uplands that have a potential for farmland development and those that are needed as support areas for farms, and (2) the areas that will find their optimum long-term use in forestry, as scenery, as park or recreation areas, or are needed for military purposes.

A more detailed classification scheme could recognize the following sub-classes:

1. Urban and industrial areas.
2. Highway and public service areas.
3. Farm lands.
   a. Paddy
   b. Uplands
4. Agricultural reserve areas.
   a. Wildlands needed for support of farms and rural villages.
   b. Potential reclamation areas.
5. Uplands available for tombs.
6. Scenic, park, and recreation areas.
7. Forest management areas.
8. Mining areas.
9. Lands needed for defense and other national purposes.
10. Water and reservoir flowage areas.

The rationale for most of the classifications suggested are self-explanatory. Additional comments are needed, however, concerning classification items

5 and 6. Dr. Pak et al. report that 305,909 cheongbo or 4.55 percent of the forest land was registered as tomb lands in 1964.[10] The area registered for this purpose is apparently increasing and in many cases is infringing on lands that could be developed for agricultural use. Separate classification of the areas available for tombs offers one means for minimizing possible future conflicts between the use of land for this purpose and for farming.

A separate classfication of lands for scenic, park, and recreation uses can be justified on the ground that these lands ought to receive a different type of administration than the forest management areas. Korea can anticipate an increasing demand for the public use of park and outdoor recreation facilities. Plans should be made now for the reservation and administration of appropriate sites for these uses.

Objectives in Land Tenure Programs

Korea's land tenure programs have been generally heralded as successful.[11] Public programs for modifying and improving land tenure arrangements are normally planned with some specific goal or collection of goals in mind. Five general goals are now emphasized in programs for land tenure improvements. These goals

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[10]Cf. Ki Hyak Pak, Woong Bin Han, Ki Hong Lee, Jin Hwan Park, and Kee Chun Han, A Study of Land Tenure in Korea (Seoul: Korea Land Economics Research Center, 1966), p. 425.

[11]Four significant reports on the farm land tenure situation in Korea have been published during the past six years. These are Ki Hyak Pak, Woong Bin Han, Ki Hong Lee, Jin Hwan Park, and Kee Chun Han, A Study of Land Tenure in Korea, USOM/K consultant report, September 1965, Ki Hyak Pak, "Economic Effects of Farmland Reform in the Republic of South Korea" in James R. Brown and Sein Lin (ed) Land Reform in Developing Countries, 1967; and Robert B. Morrow and Kenneth H. Sherper, Land Reform in South Korea, USAID Spring Review, 1970.

include:

1. Widespread distribution of the rights of land ownership and occupancy among those citizens who wish to exercise these rights;
2. Land holdings of sufficient size and production potential to permit maximizing of production opportunities;
3. Equitable operating arrangements that encourage efficiency in land resource use;
4. Arrangements that offer considerable security and stability to land operators; and
5. Arrangements that facilitate the development and conservation of land resources.

Korea's land reform program was focused, as time has shown that it should have been, on attainment of the first objective. A widespread distribution of ownership rights was provided for the farmer who lived on the land. The primary purpose of this program was the attainment of social justice for the tillers of the land. Secondary emphasis was placed on giving the new owners security and stability in their rights and keeping the maximum size of holding large enough to permit operators to make efficient use of their land.

Most observers agree that the land reform program of the post-World War II period has succeeded in achieving the purpose for which it was designed. The problem that gave rise to the need for this land reform in South Korea, however, no longer exists. Other problems and concerns have risen to take its place, and the land tenure arrangements found on the nation's farms should now be viewed in terms of the nation's present aspirations and problems. Viewed in this context it may be observed that the land redistribution program of the late 1940's and 1950's was appropriate for a

society in which agriculture is organized along traditional and near-subsistence living lines. Other types of reforms become more meaningful as a nation proceeds along the road to economic development. At this point, however, more emphasis is needed on measures that promote productivity, efficiency in operations, and the development and conservation of land resources.

Attention has been given to this changing situation in Korea. The paddy rearrangement program is designed to increase the efficiency of farm land use and farm management operations through the rationalization of farm boundaries and service facilities. The land reclamation and drainage programs undertaken in recent years also recognize the importance of the new objectives. These examples represent only a few of several programs that could be pushed. When attention is given to other programs for promoting efficiency in land use and production, consideration should be given to the relative efficiencies of the operations on present farms, their economics of scale, and to possible barriers to proposed land development and use operations.

Accomplishments of the Land Reform Program

Several questions may be raised concerning the accomplishments of the land reform undertaken following World War II and of the possible problems it has generated. All authorities agree that the reform accomplished its initial purposes of providing land for the tillers. Observers today, however, are interested in the effects of the reform program on land tenure patterns and on total agricultural productivity. They wonder if the area limitation of farm holdings has provided a barrier to efficient operations and to the commercialization of agriculture. They wonder whether the reform has encouraged the rearrangement of paddies, what effect it has had on farm credit arrangements, and on whether or not maximum area limitations should be applied to reclaimed and wild upland ownership.

The farm land reform program had a very definite impact on farm tenure conditions. As the data reported in Table 1 indicate, the prevailing farm tenure pattern has changed from one in which the majority

Table 1. Farm Tenure Patterns, Korea, 1945 - 1965

Type of Tenure	1938	1945	1965
	%	%	%
Full owners	19.0	13.8	69.5
Part owners	25.3	34.6	23.5
Tenants	55.7	48.9	7.0
Slash and burn farmers		2.7	
	100.0	100.0	100.0
Total Farm Households (000's)	2,831	2,065	2,507

of the operators were tenants to one in which more than nine-tenths of the operators are full or part-owners. The reform has not brought the complete abolition of tenancy. Seven percent of the operators included in a 1965 survey of farms were full tenants while an additional 23.5 percent were part-owners who rented-in some farm land. Some 17.9 percent of the farm land area covered by MAF's 1970 Survey of Farm Households was reported as leased. Some of this leased land was newly developed uplands not affected by the land reform law. Some was rented from clans that are permitted to hold family lands for agricultural purposes. Some also represent cases in which operators, usually relatives, rent fields from village residents or others.

Source: Pak et al., op. cit., pp. 48, 87 and 131.

It appears that this final category represents violations of the land reform law. A young tenant who is renting land from a parent or other relative, however, is not apt to report the violation. Also, while these cases mean that the nation has some tenancy, the situation is not necessarily bad. Some allowance for tenancy is needed in the farm tenancy system to permit flexibility. No effort should be made to outlaw infrequent cases of tenancy as long as the leasing arrangements contribute to the mutual welfare of the land owners and tenants, landlords do not exploit their tenants, and there is no movement towards establishing a landlord class.

The evidence gathered concerning the impact of the land reform program on farm productivity is inconclusive. A straight comparison of average crop yields and total farm production for the years immediately preceeding the land reform with the situation following the reform shows that the crop yields and total productivity increased substantially in the post-reform period. A number of factors contributed to this change. Conditions in agriculture were disrupted during the prereform years, while more stable conditions, wider use of commercial fertilizers, and improved management practices helped to bring about higher yields after 1954. It is assumed that the land reform program has had a favorable impact on agricultural productivity. It certainly provided individual operators with better incentives to increase production. In the absence of some control areas with which comparisons might be made, however, one cannot argue conclusively that the land reform either increased or decreased farm production.

The land reform appears to have had two unforseen and unfortunate effects on farm credit arrangements. Recipients of land parcels under the reform were not able to use their land as security for loans until full payment was made to the government for the land. This situation reduced the amount of credit available to operators and undoubtedly affected the individual operating decisions

of many farmers. This problem no longer remains as virtually all of the debt on the redistributed land has been paid. One other problem remains, however- Because of the rule against the ownership of farmland by nonfarmers, private money lenders are reluctant to lend money on farmland mortgages. A possible solution to this problem could involve legislation that would allow money lenders to foreclose on delinquent farm mortgages that meet specified standards as to duration, interest rates, and conditions of payment. The lenders could then be required to resell the foreclosed land within a given period or sell it to the government for redistribution.

There is some feeling in Korea that the 3-cheongbo limit may represent a barrier to the adoption of efficient economies of scale in farming operations. This may be true with some special types of farming such as dairying. But the evidence available at this time does not indicate a need for increasing the 3-cheongbo limit. Most of the farms in South Korea are small, the average holding per farm household being only 0.915 cheongbo in 1969. Only 5.1 percent of the holdings were between 2 and 3 cheongbo in size at that time, while only 1.1 percent involved more than three cheongbo.

If a considerable number of holdings were found in the 2.5 to 3.0 cheongbo size category, one would suspect that the 3-cheongbo limit represented a barrier to efficient operations. Farm management observations seem to warrant the view, however, that farmers in Korea with the now available and accepted technology find their optimum scale with less than 3 cheongbo. A trend towards farm mechanization and the adoption of more labor-saving technology could call for an upward revision in maximum farm sizes.

Three notable exceptions to the 3-cheongbo limitation should be noted. Farm lands held by schools and welfare organizations were exempt from the maximum acreage limitation at the time of the reform. No area limitation applies to the amount of reclaimed farm land an individual may own, and no limitations apply to

to the amounts of undeveloped forest or wild upland an owner may hold. Farmland is supposedly owned only by actual farmers. Reclaimed uplands and wild uplands, however, can be owned by absentee investors and nonfarmers as well as by actual tillers. These exceptions help to explain much of the farm tenancy now reported in the nation.

The rule that farmland must be owned by actual farmers in holdings of not more than 3 cheongbos has provided a significant barrier to nonfarm investments in land. As such it has probably encouraged the investment of considerable nonfarm capital in other ventures which have contributed to the nation's overall productivity. Other important impacts of the 3-cheongbo limitation involve its effects on farm credit arrangements and on operator decisions relative to economd of scale.

In summary, it would appear that in the near term, there needs to be a relaxation of the tenure laws to allow a land rental system to develop. At the present time a system of land rental, which in no way can be interpreted as a tendency to return to the tenant-landlord system successfully eliminated in Korea by the land reform program is needed to prepare Korean agriculture for the coming technical advances and feed a growing and increasingly urban population.

The fact that land cannot be used as collateral for production loans as the major source of farm credit in Korea is also seen as a major impediment to expanded production in agriculture. Credit restraints will ultimately slow the growth of nonfarm produced capital which is so badly needed. In addition there is need for a credit institution which can finance land development and purchase. Farm population began declining in 1967 and is expected to continue declining. As a result more land will become available for purchase outside the family unit as time passes and there will be a need for credit to be available so these transactions can be completed. The declining population will also

lead, eventually, to larger size farming units. This is not observable in the data yet, so the three cheongbo limitation does not now appear to be restraining substantial numbers of farms from increasing in size.. It is probable that this limitation on size will restrain substantial numbers of farms from increasing in size in the future and the undesirable effects of such restraint far outweigh any benefits which may result. It therefore would be more reasonable to allow the three cheongbo limitation to float upward when it becomes clear this limit is restraining substantial numbers of farms from expanding. In order to insure that attention will be paid to this problem a regular review of the limitation should be instituted. Given the slowness with which farm size will change, either a yearly or biyearly review would be reasonable.

A Regression Model of Land Expansion

Introduction

New land development has had a high priority in the agriculture budget in past years and does in the third five year plan (TFYP). There is, however, a limit to the new land that is feasible to develop. In addition, there are certain economic considerations that determine whether or not a given plot of land will be used in production at all, and if so, for which particular crop. In this section, as well as the next, we will attempt to postulate models in which the expansion or contraction of land in agriculture use is in response to economic incentives. Many of these incentives were discussed in the problem setting section of this paper in a rather loose fashion and some variables discussed there as affecting either demand or supply of land prove rather difficult to measure. However, the explicit model proposed here will be in the spirit of the problem setting section above.

Economically Usable Land

Clearly, the additional amount of potentially usable land is a technical bound and is in no way affected by prevailing prices of agriculture output. The purpose of this section will be to set down an equation in which arable land in use is determined by the prevailing values of certain economic variables.

As pointed out above, the arable land in use will be determined by the intersection of the supply and demand curves for land. The supply curve and the demand curve along with the equilibrium condition that they be equal at any moment in time constitute the structural equations of our model. The structural equations will contain both variables which are determined within the model and those which are determined outside the model. In particular, the price of land is one variable which would be determined within the model but for which no reliable data are available. To get around this problem, we will ultimately estimate a reduced form equation rather than one or both structural equations.

The demand for land in agriculture can be written as,

$$(1) \qquad L_t^d = a_0 + a_1 P_t + a_2 \overline{PF}_t + a_3 \overline{PNF}_t + a_4 \overline{FP}_t + \varepsilon_t$$

where:

P_t is the price of land at time t;

$\overline{PF}_t$ is the price index of food at time t;

$\overline{PNF}_t$ is the price index of nonfood at time t;

$\overline{FP}_t$ is the farmer population at time t;

ε_t is a random error term.

Equation (1) is essentially an aggregated demand for the land input over all farms in Korea. The economics of land use suggest that a_1 and a_2 will be negative with a_3 and a_4 positive. The bars over certain variables indicate that they are determined outside the model.

The supply of land in agriculture can be written as,

$$(2) \qquad L^s_t = b_0 + b_1 P_t + b_2 \overline{PF}_t + b_3 \overline{U}_t + b_4 \overline{GI}_t + n_t$$

where variables in equation (2) which also appear in equation (1) are as defined in equation (1) and:

$\overline{U}_t$ is the ratio of urban population to total population at time t;

$\overline{GI}_t$ is the total spending by the government for land expansion in time t;

n_t is a random error term.

The $\overline{U}_t$ variable is intended to represent the effect of urbanization on the agricultural land base. The economics of supply suggest that b_1, b_2 will be positive and b_3 will be negative. The effect of government land development programs, determined by the sign of b_4, is ambiguous. If food demand is being satisfied at prevailing prices then newly developed land will most likely be more productive than the marginal land in current production. We would expect to observe the more productive newly developed land to substitute for the less productive and most marginal land causing total arable land to decline. Therefore, any government investment which would bring into production more productive land than the most marginal land now in use, will cause total land in use to decline, other things the same. If, on the other hand, there exists excess demand for food at current price levels then newly developed land would not substitute for more marginal land already in use but rather supplement existing production in order to satisfy the existing demand. Therefore, government investment would increase total land cultivated. The implication of all this is that the sign of b_4 may be either positive or negative. That is, government investment in new land development such as tideland reclamation may increase or decrease the total amount of arable land in use.

The third equation is the equilibrium condition that the supply of land be equal to the amount demanded,

(3) $$L_t^d = L_t^s = L_t.$$

With this third equation we can drop the superscripts s and d from L_t in equations (1) and (2) and we are left with two equations in two endogenous variables and five exogenous variables. That is, two variables determined by the supply and demand for land (P_t and L_t) and five variables determined by forces other than the supply and demand but which affect the supply and/or demand for land if they are changed.

As mentioned above, data on the price of land is not available but by solving equations (1) and (2) for the reduced form equation for land, we can obtain an expression which does not depend on the price of land, P_t. We can also determine the expected signs of the coefficients in the reduced form equation from the signs of the coefficients of equations (1) and (2). The reduced form equation which will be used to predict the total quantity of arable land in use in agriculture is,

(4) $$L_t = c_0 + c_1\overline{PF}_t + c_2\overline{PNF}_t + c_3\overline{FP}_t + c_4\overline{U}_t + c_5GI_t + \S_t$$

where,

$$c_1 = -\frac{a_2b_1 + b_2}{a_1 - b_1} \lesseqgtr 0 ;$$

$$c_2 = -\frac{a_3b_1}{a_1 - b_1} > 0 ;$$

$$c_3 = -\frac{a_4b_1}{a_1 - b_1} > 0 ;$$

$$c_4 = -\frac{b_3}{a_1 - b_1} < 0 ;$$

$$c_5 = -\frac{b_4}{a_1 - b_1} \lesseqgtr 0 ;$$

$\S_t$ is a disturbance term.

Even though we cannot determine, for example, the elasticity of demand or supply, we can at least determine if our model is reasonable in a qualitative sense. All signs of the regression coefficients should be as shown in equation (4).

Table 1 shows the coefficients associated with each variable along with the units of measures on each variable.

Table 1. Regression Results[a]

Independent Variables	Regression Coefficients	Units of Measure
Constant	1720.94*	———
Food Prices	n.s.	1965 = 100
Nonfood Prices	4.44*	1965 = 100
Government Investment	n.s.	1000 won
Farm Population	23.14*	100,000 persons
Urbanization	-5.90*	percentage
R^2 = .996	D.W. = 2.47 n.s.	d.f. = 9

[a]The independent variable is in units of 1000 hectares.

*The coefficient is more than two and one half times its standard error.

As can be seen from Table 1, none of the coefficients have an unexpected sign. The coefficients with an asterisk are considered to be statistically different from zero. The n.s. means that coefficient is not statistically different from zero. We find that neither the price of food (PF) nor government investment (GI) significantly affect the amount of arable land in use. The high correlation between food prices and nonfood prices coupled with the insignificance of food prices might lead one to suspect multicollinearity is a problem.[12] The fact that no land expansion can be attributed

[12]Food prices were more highly correlated with nonfood prices than with land.

to government investment is more difficult to explain. As discussed above, one possibility is that excess demand for food is an illusion and in fact there is no tendency for food prices to rise as a result of demand shifting more than supply.

However, one must be somewhat cautious with this interpretation in view of the fact that food prices have been increasing more rapidly than have nonfood. Given that the income elasticity of nonfood products exceeds the income elasticity of food products. We would expect the demand for nonfood to shift more than the demand for food as income grows. Unless there is a very substantial difference in the elasticities of supply of food versus nonfood, this difference in income elasticities would lead to food prices rising slower than nonfood prices. Either nonfood supply is substantially more price elastic than food supply or something like excess demand is forcing food prices up.

One other possible rational for the apparent failing of government investment to significantly affect land use is lack of complimentary investment in roads to transport production from the newly developed land to main arteries of transportation. Newly developed land will probably be somewhat less productive than land already in production, but in addition the costs of production on new land will be higher than on old. This bulk of this increased cost can be attributed to the increased amount of labor spent on a unit of new land as compared with old land. Basically it takes longer to get seed and fertilizer to the new field and to carry the product out when the crop is harvested. This would seem to be an inconsistent line of reasoning in a labor abundant country like Korea until one considers that times in which more valuable during the times of year when new land would be planted or harvested than during the times when it is actually developed. That is, land which has been developed may not be put into production because the

farmer does not have time to plant new land during the peak planting and harvesting periods without sacrificing production in older, possibly more productive land.

The coefficient on nonfood prices is positive as expected. As the price of nonfood goods increase consumers tend to demand less nonfood goods and more food causing the demand for land to increase in an effort to satisfy the increased demand for food. In this context, we are viewing food and nonfood goods as substitutes in consumption. This is, of course, something of a simplification but it appears to be true in the aggregate.

Both the farm population, which will increase the demand for land, and urbanization, which will decrease the supply of land, have the expected signs. Given the trend in these two variables, both will tend to cause land use to decline. Since 1967, the absolute number of people in farming has declined, and, of course, urbanization has proceeded at a very rapid pace. Clearly, urbanization and the concomitant demands for infrastructure associated with its increase will not only compete for land now being used in agriculture but, in nearly every instance, urbanization will compete for the most productive land.

Using equation (4) to forecast the land in use in 1985 produces an untenable result. Taking the current estimates of total population and rural population being used by the Agriculture Sector Simulation Project we have a total population of 39,281 million with 14.704 million being rural. The FP variable will be 14.704 in 1985 and the U variable will be 52.6 in 1985. Since both the government investment variable (GI) and the food price variable (FP) were not significantly different from zero we need not estimate their values in 1985. Assuming the price of nonfood goods will increase at approximately the same rate between 1970 and 1985 as it did between

1955 and 1969, we can estimate the PNF variable in 1985. The price of non-food foods increased at a rate of 13 percent per year from 1955 through 1969. This would imply that PNF would be 373 in 1985. Substituting these values into equation (4) along with the estimated parameter values shown in Table 1 yields a total of 3.351 million hectares of land in agriculture use. This means that approximately one million hectares of new land would be brought into production. As has been pointed out, at this point in time, Korea does not have anything like one million hectares of land that is physically capable of producing some kind of agricultural product. Clearly, the physical land constraint will force the land expansion to stop far short of 3.351 million hectares and food prices will begin increasing much faster as the physical limitation is approached. Unless food prices are stabilized by importing substantial quantities of food we would expect a major adjustment in the price of food relative to the price of nonfood goods.

Linear Programming Analysis

A linear programming analysis was made by KASS to determine the upland cropping pattern which would maximize the discounted net cash flow on the 85,000 hectares of land with a slope of less than 10 degrees. Assuming 1965-69 technology and 1969 prices (Appendix 3, Tables 1, 2 and 3), development costs in addition to operating costs (Appendix 3, Tables 4 and 5), unpaid family labor for development of land and 1969 estimates of available farm labor (Appendix 3, Tables 6 through 11), it was determined that, excepting grapes, most fruit crops in most areas would yield a negative discounted (@ 18% interest rate) net cash flow stream (Appendix 3, Table 12). Likewise, unless it becomes possible to raise more than one crop annually on the same land, the net cash flow stream is relatively low for traditional upland crops. However, when budgets were proposed holding all assumptions the same except

price, and using 1970 prices, additional single crops became realistic possibilities. This determination underscores the importance of favorable price relationships if certain kinds of cropping patterns are to be encouraged.

The linear programming solution using 1969 prices favored barley, wheat, sweet potatoes, vegetables, and mulberry, grapes and pears. However, with 1970 prices, additional crops of soybeans, white potatoes and apples were brought into the solution. (Appendix 3, Tables 13 and 14)

The amount of labor required for land development varies with price relationships and differing crop combinations. An average requirement of about 1,500 hours per hectare can be expected. For all regions, the 1969 supply of labor is apparently more than adequate for meeting initial land development requirements as well as the annual crop labor requirements.

An estimate of the hourly labor return was made by dividing the product of the discounted net cash flow and the capital recovery factor by the hours of labor required. The results are summarized in Appendix 3, Table 15. Under the 1969 price assumption, the hourly return ranged by province or region from 80 to 122 won per hour. Under the 1970 price assumption the range was from 169 to 267 won per hour.

Even though the 1969 supply of farm appears adequate for a long range land development program it would be advisable to study carefully long range rural migration expectations for the possible conclusion that in the future, the current unused stock of farm labor will no longer be available. Even with adequate labor supplies attention must be given to alternative use of that labor and to the financial risk that must be borne by the farmer who undertakes long range land development activities. The results of assuming the farmers would be paid for their development labor requirements and for one-half of the monetary development costs are summarized in the linear programming solution in Appendix 3, Table 16. By increasing the net cash flow,

additional crops were brought into solution. In general, however, the increase in hourly labor return with a subsidy program requiring nearly 52 million won was no more than the increase brought about by increasing farm prices from the 1969 to the 1970 levels.

Even though one could argue that the results indicate that if the program were implemented along the lines of the linear programming solution, the situation would be an improvement over no development at all. Closer examination suggests that the relatively low returns to labor perhaps would not be attractive to farmers expected to use their surplus labor in land development activities. Admittedly, the calculations included an 18 percent discount rate which might be adequate for the risk involved, it is the judgment of this investigator that the returns should be higher to make upland development a strong competitor for limited national resources including human energy. Of course, there are ways in which the prospective returns could be higher than those postulated. Perhaps the yield estimates are far below those possible in the coming decade. A 10 percent increase in yields could make a substantial difference in the conclusions reached. Therefore, output increasing technology development perhaps should precede extensive upland development. Likewise, labor saving technology despite current labor surpluses could pay handsome returns in terms of returns per hour of labor expended. Some of the fruit crops combine risk in the long waiting period before maximum productivity is reached, rather low net returns per hectare, and very large labor requirements. In a period of rapid outmigration of farm labor, one needs to be rather careful about specifying labor intensive crops for the distant future if no provision is made for some labor saving technology.

In conclusion, from a purely economic point of view, it would appear that agricultural output for some time can be increased more expediently with

greater attention given to the improvement of output on already developed lands than diverting resources to the development of new uplands.

On the other hand, there may be very good reasons for continuing upland development activities on other than financial grounds. There may, in fact, be considerable need for community development activities which include upland development. That is to say when considered in a total systems context including the need for new roads, consumer services, and general improvement in the quality of life, one might conclude in this sense that community benefits would exceed community costs even though there may be many alternative investment projects which would show a higher rate of return.

Summary of Policy Recommendations

Although the policy recommendations have been spelled out in the text above, they are rather scattered and it would be well to have then summarized briefly for the more casual reader. They will be listed here in approximately the same order they appear in the text above.

The recommendations are:

1. To develop a classification system for forest land which obviates the need to cut down new, partially developed forest land.
2. The land reform laws which outlaw tendency should be relaxed somewhat to allow leasing arrangements which contribute to the mutual welfare of landlords and tenants to exist lawfully.
3. To develop a credit institution to finance private land purchase and development.
4. To institute a regular periodic review of the three Cheongbo limitation on land ownership and when it appears to be inhibiting growth, revise it upwards.

5. In order to make government investment in land development more effective, allocate funds for the development of roads which are capable of moving rototillers and other light equipment to newly developed land.

6. Consider the possibility of importing more food as a means of controlling expected future relative food price increases.

7. Crops most likely to be profitable on newly developed upland are barley, wheat, sweet potatoes, vegetables, mulberry, grapes and pears. The analysis indicates that new upland development in any case is quite marginal from an economic point of view.

8. Since a relatively small increase in yields (10%) will make a substantial difference in the economic viability of upland crops, output increasing technological development should be vigorously pursued.

APPENDICES

Appendix 1

Table 1. Total Land Area Distributed by Types of Use, Korea, 1969.

Classification	Total area	Upland region[1]	Single crop region[2]	Double crop region[3]
Total land area	9,847.7	2,597.8	2,027.0	5,222.9
Paddy				
Single Crop paddy	646.9	105.2	284.7	257.0
Double crop paddy	646.9	32.1	86.0	528.8
Total paddy	1,293.7	137.3	370.5	785.9
Upland	1,036.7	263.7	246.0	527.0
Total cropland	2,330.4	401.0	616.5	1,312.9
Forest land	6,682.6	1,957.3	1,171.6	3,557.2
Convertible[4]	321.2	80.3	74.5	165.9
Forest reserves	5,940.3	1,764.1	944.6	3,231.6
Other	421.1	112.4	152.6	159.6
Industrial	8.5			
Other lands				
Urban area	680.1			
Nonforest conserved and miscellaneous	146.1			

[1]Upland region is made up of provinces of Gangweon, Chungcheong Buk, and Jeju.

[2]Single crop region includes provinces of Kyeonggi, Chuncheong Nam, and Seoul City.

[3]Double crop region includes provinces of Gyeongsang Buk, Gyeongsang Nam, Jeolla Buk, Jeolla Nam, and Pusan City.

[4]Nonfarmed uplands with a slope of less than 24 degrees are classified as convertible forest land.

Source: MAF, Yearbook of Agriculture and Forestry Statistics, 1970, and Kim Byeong Do, Kim Bong Min, and Warren H. Vincent, Projected Land Development and Related Projects of Korea, pp. 5-6 (Progress Report, Agriculture Sector Analysis Study, December 1971).

APPENDIX I TABLE 2 -- AREA AND INDICES OF CULTIVATED LAND - SOUTH KOREA, 1918-1968

Year	Area			Index 1918 = 100		
	Paddy	Upland	Total	Paddy	Upland	Total
	(hectares)			(percent)		
1918	1,149,548	958,071	2,107,619	100.0	100.0	100.0
1919	1,150,550	965,949	2,116,499	100.1	100.8	100.4
1920	1,148,313	961,635	2,109,948	99.9	100.4	100.1
1921	1,150,238	962,766	2,113,004	100.1	100.5	100.3
1922	1,149,968	958,312	2,108,280	100.0	100.0	100.0
1923	1,155,990	962,596	2,118,586	100.6	100.5	100.5
1924	1,160,786	962,842	2,123,628	101.0	100.5	100.8
1925	1,161,202	960,188	2,121,390	101.0	100.2	100.7
1926	1,165,957	955,254	2,121,211	101.4	99.7	100.6
1927	1,176,401	943,705	2,120,106	102.3	98.5	100.6
1928	1,182,992	940,505	2,123,497	102.9	98.2	100.8
1929	1,187,851	937,245	2,125,096	103.3	97.8	100.8
1930	1,195,986	932,847	2,128,833	104.0	97.4	101.0
1931	1,198,219	924,574	2,122,793	104.2	96.5	100.7
1932	1,205,578	922,695	2,128,273	104.9	96.3	101.0
1933	1,208,486	926,626	2,135,112	105.1	96.7	101.3
1934	1,211,764	924,876	2,136,640	105.4	96.5	101.4
1935	1,217,352	923,215	2,140,567	105.9	96.4	101.6
1936	1,219,707	919,259	2,138,966	106.1	95.9	101.5
1937	1,227,204	914,125	2,141,329	106.8	95.4	101.6
1938	1,237,594	916,510	2,154,104	107.7	95.7	102.2
1939	1,245,042	917,536	2,162,578	108.3	95.8	102.6
1940	1,244,830	913,662	2,158,492	108.3	95.4	102.4
1941	1,241,419	908,688	2,150,107	108.0	94.8	102.0
1942	1,233,077	905,336	2,138,413	107.3	94.5	101.5
1943	1,216,711	825,070	2,041,781	105.8	86.1	96.9

(Continued)

APPENDIX I TABLE 2 -- (continued)

Year	Area			Index 1918 = 100		
	Paddy	Upland	Total	Paddy	Upland	Total
	(hectares)			(percent)		
1944-48	--	--	--	--	--	--
1949	1,225,339	827,125	2,053,464	106.7	86.3	97.4
1950	1,148,698	806,357	2,054,055	99.9	84.1	92.7
1951	1,149,644	792,407	1,942,051	100.0	82.7	92.1
1952	1,153,426	789,065	1,942,491	100.3	82.4	92.3
1953	1,152,395	787,107	1,939,501	100.2	82.2	92.0
1954	1,160,964	789,410	1,950,374	101.0	82.4	92.5
1955	1,187,392	807,448	1,994,820	103.3	84.3	94.6
1956	1,188,745	803,122	1,991,867	103.4	83.8	94.5
1957	1,192,929	805,877	1,998,806	103.8	84.1	94.8
1958	1,199,661	812,678	2,012,342	104.4	84.8	95.5
1959	1,202,892	813,334	2,016,226	104.6	84.9	95.7
1960	1,206,245	818,548	2,024,793	104.9	85.4	96.1
1961	1,210,900	821,653	2,032,553	105.3	85.8	96.4
1962	1,223,096	839,573	2,062,669	106.4	87.6	97.9
1963	1,228,103	851,540	2,079,644	106.8	88.9	98.7
1964	1,261,140	909,874	2,171,014	109.7	95.0	103.0
1965	1,286,195	970,190	2,256,386	111.9	101.3	107.1
1966	1,287,111	1,005,965	2,293,077	112.0	105.0	108.8
1967	1,290,517	1,021,392	2,311,910	112.3	106.6	109.7
1968	1,289,317	1,029,448	2,318,765	112.2	107.5	110.0
1969	1,282,969	1,028,105	2,311,077			

Source: Sung Hwan Ban,"The Long-Run Productivity Growth in Korean Agricultural Development, 1910-1968,"Doctoral dissertation, University of Minnesota, 1971

APPENDIX I TABLE 3 -- LAND UTILIZATION - SOUTH KOREA, 1918-1968

Year	Crop Area	Index of Crop Area 1918=100	Multiple Cropping Index
	(hectares)		
1918	2,888,464	100.0	137.0
1919	2,926,402	101.3	138.3
1920	2,938,675	101.7	139.3
1921	2,944,971	102.0	139.4
1922	2,952,210	102.2	140.0
1923	2,956,051	102.3	139.5
1924	2,972,866	102.9	140.0
1925	3,019,559	104.5	142.3
1926	3,046,660	105.5	143.6
1927	3,069,299	106.3	144.8
1928	3,086,359	106.9	145.3
1929	3,150,538	109.1	148.3
1930	3,208,775	111.1	150.7
1931	3,226,385	111.7	152.0
1932	3,212,622	111.2	150.9
1933	3,292,482	114.0	154.2
1934	3,356,958	116.2	157.1
1935	3,365,535	111.6	157.3
1936	3,330,209	115.3	155.7
1937	3,308,762	114.6	154.5
1938	3,302,498	114.3	153.3
1939	3,137,323	108.6	145.1
1940	3,281,462	113.6	152.0
1941	3,289,960	113.9	153.0
1942	3,045,426	105.4	142.4
1943	3,223,047	111.6	157.9
1944			
1945	2,931,619	101.5	
1946	2,713,886	94.0	
1947	2,764,615	95.7	
1948	2,847,985	98.6	
1949	2,924,663	101.3	
1950	2,845,247	98.5	
1951	2,626,136	90.9	

APPENDIX I TABLE 3 -- (continued)

Year	Crop Area	Index of Crop Area 1918=100	Multiple Cropping Index
	(hectares)		
1952	2,733,309	94.6	140.7
1953	2,892,087	100.1	149.1
1954	2,949,916	102.1	151.2
1955	3,008,356	104.2	150.8
1956	3,073,975	106.4	154.3
1957	3,074,031	106.4	153.8
1958	2,984,839	103.3	148.3
1959	3,003,599	104.0	149.0
1960	3,013,001	104.3	148.8
1961	3,107,966	107.6	152.9
1962	3,166,485	109.6	153.5
1963	3,236,442	112.0	155.6
1964	3,345,089	115.8	154.1
1965	3,550,039	122.9	157.3
1966	3,452,696	119.5	150.6
1967	3,497,526	121.1	151.3
1968	3,516,758	121.8	151.7
1969	3,544,804		

Source: Sung Hwan Ban, "The Long-Run Productivity Growth in Korean Agricultural Development, 1910-1968," Doctoral dissertation, University of Minnesota, 1971.

Appendix I Table 4. Projected Shifts in Agricultural Land Use Between 1970 and 1976 and 1981, Korea

Classification	1970	1976	1981
		(000s of hectares)	
Agricultural land area			
Paddy	1,293.7	1,248.7	1,249.0
Upland	1,036.7	1,124.7	1,168.4
Total farm land	2,330.4	2,373.4	2,417.4
Anticipated shifts 1970-81			
Paddy			
Area added through tideland reclamations			27.7
Area lost to other uses			72.4
Upland			
Area added through upland reclamations			237.5
Area lost to other uses			105.8
Total farm land			
Area added through reclamations			265.2
Farmland lost to other uses			178.2

Source: Author's interpretation of data reported by Kim Byeong Do, Kim Dong Min, and Warren H. Vincent, Projected Land Development and Related Projects of Korea, pp. 8-11. (Progress Report, Agricultural Sector Analysis Study, December 1970).

APPENDIX 2

Table 1. Data Used to Estimate Equation (4).

Year	Arable[a] Land	Food Price Index	Nonfood Price Index	Govt.[b] Invest.	Farm[c] Popul.	Farm[d] Income	Urbani-zation[e]
1955	1984.458	25.3	34.2	0	13.330	186.47	33.4
1956	1967.123	34.6	43.2	0	13.454	176.73	39.7
1957	2010.020	41.6	48.9	0	13.592	198.17	40.8
1958	2017.900	37.9	48.9	0	13.750	203.11	41.8
1959	2020.791	37.8	51.7	0	14.126	191.71	41.8
1960	2026.914	43.2	53.8	0	14.559	197.24	41.7
1961	2039.109	47.7	53.5	0	14.509	225.94	43.5
1962	2066.013	51.6	57.3	154.561	15.097	201.54	42.9
1963	2076.566	73.4	63.3	290.693	15.266	226.26	43.8
1964	2178.238	101.7	84.2	403.899	15.553	262.69	44.4
1965	2260.148	100.0	100.0	2436.235	15.811	250.56	44.8
1966	2298.147	107.3	109.4	2151.041	15.781	277.31	46.0
1967	2321.814	116.8	115.5	1331.695	16.078	246.76	46.5
1968	2333.666	129.2	123.7	2014.651	15.908	249.28	48.3
1969	2331.805	146.8	128.6	975.897	15.589	282.00	50.4

[a] 1,000 hectares

[b] 1,000 Won

[c] 100,000 persons

[d] Billion Won

[e] Percent

APPENDIX 3

Table 1 Base Yields and Price for Selected Field Crops, Korea, Selected Areas, (Kg/ha for Yield).

	Barley	Wheat	Soy-Beans	White1/ Potatoes	Sweet Potatoes	Millet	Corn
Gangweon 3-1	1,590	2,050	820	2,260	-	680	1,640
Chungcheong Buk 3-2	1,840	2,350	850	2,080	-	720	-
Jeju Island 3-3	1,480	1,260	-	-	5,540	1,080	-
Gyeonggi 1-1	1,900	2,580	670	2,480	-	-	-
Chungcheong Nam 1-2	2,170	2,450	820	-	-	-	-
Double Cropping 2-0	2,128	2,365	719	2,003	4,739	794	-
Price: W/kg	36.42	24.31	49.45	14.40	12.80	37.33	26.34

Source: 1965-69 Average Yields reported in Yearbook of Agriculture and Forestry, 1970.

Prices for 1969 from KASS reports

Table 2 Base Yields and Price for Selected Fruit Crop and Mulberry Korea Selected Areas, (Kg/ha for Yield)

	Apple	Peach	Grape	Pear	Persimmon	Mulberry
Gangweon 3-1	-	-	-	-	6,590	212
Chungcheong Buk 3-2	7,500	4,400	-	-	-	222
Jeju Island 3-3	-	-	14,430	-	-	-
Gyeonggi 1-1	3,900	-	11,020	-	-	232
Chungcheong Nam 1-2	7,450	3,050	6,020	7,030	-	179
Double Cropping 2-0	12,606	7,809	5,889	9,836	7,411	210
Price W/kg	43.20	32.00	58.93	43.52	27.07	418

Source: 1965-69 average yields reported in Yearbook of Agriculture and Forestry 1970. Prices from KASS reports

Appendix 3 Table 3. Base Yield for Three Selected Vegetables, Korea, Selected Areas, kg/ha

		Chinese Cabbage	Radish	Red Pepper
Gangwoon	3-1	11,670	12,690	1,790
Chungcheong Buk	3-2	11,920	12,800	2,050
Jeju Island	3-3	15,950	19,220	2,560
Gyeonggi	1-1	12,250	13,140	2,170
Chungcheong Nam	1-2	11,670	12,560	1,860
Double Cropping	2-0	11,227	13,484	1,908
Price W/kg		12.26	10.93	305.86

Source: 1965-69 Average Yields reported in Yearbook for Agriculture and Forestry 1970. Prices from KASS reports

Appendix 3 Table 4. Distribution of Farmer's Development Costs by Year for Fruit Crops and Mulberry (Won/Ha)

Year	Lime	Additional Compost	Additional Fertilizer	Plants		Total	
				Fruits	Mulberry	Fruits	Mulberry
1	4,000	5,000	4,000	58,400	4,500	71,400	17,500
2	0	4,000	3,000	0	0	7,000	7,000
3	0	3,000	2,000	0	0	5,000	5,000
4	0	2,000	1,000	0	0	3,000	3,000
5	0	1,000	0	0	0	1,000	1,000
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	4,000	0	0	0	0	4,000	4,000
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	4,000	0	0	0	0	4,000	4,000
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	4,000	0	0	0	0	4,000	4,000

Appendix 3 Table 5. Distribution of Farmer's Development Costs by Year for Grain and Vegetables (Won/Ha)

Year	Lime	Additional Compost	Additional Fertilizer	Total
1	6218	8000	4000	18,218
2	0	6000	3000	9,000
3	0	4000	2000	6,000
4	6218	2000	1000	9,218
5	0	0	0	0
6	0	0	0	0
7	6218	0	0	6,218
8	0	0	0	0
9	0	0	0	0
10	6218	0	0	6,218
11	0	0	0	0
12	0	0	0	0
13	6218	0	0	6,218
14	0	0	0	0
15	0	0	0	0
16	6218	0	0	6,218
17	0	0	0	0
18	0	0	0	0
19	6218	0	0	6,218
20	0	0	0	0

Appendix 3 Table 6. Farm Labor Availability and Utilization by One-Tenth Year Periods, Gyeonggi do. (Hours)

Period	Farm Labor Hours Available	Labor Used on Crops	Other Farms Labor	Unused Farm Labor
1	102,079,017	4,429,056	15,204,675	82,445,286
2	110,255,039	11,317,863	16,422,494	82,514,682
3	129,772,693	27,715,027	15,244,668	86,812,998
4	162,048,275	47,032,329	15,550,412	99,465,534
5	155,021,357	111,490,317	15,396,895	28,134,145
6	112,808,097	88,327,957	15,398,185	9,081,955
7	119,020,012	49,453,282	15,147,913	54,418,817
8	161,555,895	64,162,684	15,647,167	81,746,044
9	122,093,165	68,704,980	15,314,331	38,073,854
10	103,932,480	16,125,586	15,480,749	72,326,145

Appendix 3 Table 7. Farm Labor Availability and Utilization by One-Tenth Year Periods, Chungnam do. (Hours)

Period	Farm Labor Hours Available	Labor Used On Crops	Other Farms Labor	Unused Farm Labor
1	119,024,269	5,122,157	29,522,998	84,379,114
2	128,557,520	14,925,531	31,887,643	81,744,346
3	151,315,130	34,241,729	29,600,650	87,472,751
4	188,948,501	50,046,785	30,194,316	108,707,400
5	180,755,105	128,924,244	29,896,231	21,934,630
6	131,534,389	88,976,120	29,898,736	12,659,533
7	138,777,490	50,991,442	29,412,781	58,373,267
8	188,374,385	69,824,401	30,382,185	88,167,799
9	142,360,791	72,578,618	29,735,916	40,046,257
10	121,185,408	16,701,304	30,059,051	74,425,053

Appendix 3 Table 8. Farm Labor Availability and Utilization by One-Tenth Year Periods, Double Cropping Region. (Hours)

Period	Farm Labor Hours Available	Labor Used on Crops	Other Farms Labor	Unused Farm Labor
1	565,005,943	21,676,891	46,109,451	497,219,601
2	610,260,109	90,524,699	48,802,589	469,932,821
3	718,290,051	214,338,165	46,230,730	457,721,156
4	896,334,949	258,354,035	47,157,926	591,422,988
5	858,041,054	719,141,296	46,692,372	92,207,386
6	624,391,250	422,397,101	46,696,284	155,297,865
7	658,774,110	252,395,883	45,937,313	360,440,914
8	894,209,632	359,908,229	47,451,343	486,850,060
9	675,783,972	377,179,073	46,441,990	252,162,909
10	575,264,832	84,761,718	46,946,666	443,556,448

Appendix 3 Table 9. Farm Labor Availability and Utilization by One-Tenth Year Periods, Gangweon Do Region. (Hours)

Period	Farm Labor Hours Available	Labor Used on Crops	Other Farms Labor	Unused Farm Labor
1	54,980,841	991,303	6,441,147	47,548,391
2	59,384,533	4,558,583	6,957,051	47,868,899
3	69,896,949	14,401,662	6,458,089	49,037,198
4	87,280,929	24,173,219	6,587,611	56,520,089
5	83,496,147	58,462,116	6,522,577	18,511,454
6	60,759,637	50,368,074	6,523,123	3,868,440
7	64,105,440	34,115,925	6,417,100	23,572,415
8	87,015,718	38,630,663	6,628,599	41,756,456
9	65,760,673	30,694,670	6,487,600	28,578,403
10	55,979,136	6,333,632	6,558,100	43,087,404

Appendix 3 Table 10. Farm Labor Availability and Utilization by One-Tenth Year Periods, Chungbug do Region. (Hours)

Period	Farm Labor Hours Available	Labor Used on Crops	Other Farms Labor	Unused Farm Labor
1	64,568,611	2,371,354	2,341,030	59,856,227
2	69,740,235	9,006,045	2,528,534	58,205,656
3	82,085,846	23,420,537	2,347,187	56,318,122
4	102,501,300	36,721,890	2,394,262	63,385,148
5	98,056,524	86,812,319	2,370,625	8,873,580
6	71,355,136	56,786,430	2,370,824	12,197,882
7	75,284,393	42,159,956	2,332,290	30,792,147
8	102,189,852	51,372,552	2,409,159	48,408,141
9	77,228,272	42,535,454	2,357,913	32,334,905
10	65,740,992	9,271,822	2,383,536	54,085,634

Appendix 3 Table 11. Farm Labor Availability and Utilization by One-Tenth Year Periods, Jeju do Region. (Hours)

Period	Farm Labor Hours Available	Labor Used on Crops	Other Farms Labor	Unused Farm Labor
1	16,155,494	1,512,735	2,574,427	12,067,332
2	17,449,469	4,000,537	2,781,706	10,667,226
3	20,538,422	7,383,186	2,582,201	10,573,035
4	25,646,505	8,274,046	2,633,989	14,738,470
5	24,534,392	17,743,375	2,607,986	4,183,031
6	17,853,528	13,719,694	2,608,204	1,525,630
7	18,836,654	7,314,837	2,565,812	8,956,005
8	25,568,578	10,202,810	2,650,378	12,715,390
9	19,323,025	10,627,180	2,594,001	6,101,844
10	16,448,832	2,557,470	2,622,190	11,269,172

Appendix 3 Table 12. Present Value of Twenty Year Net Cash Flow for Selected Enterprises by Region (W/ha)[1/]

Region / Enterprise	Gyeonggi	Chungnam	Double Crop	Gangwoon	Chungbuk	Jeju
Barley	161,831	189,787	185,438	129,736	155,621	118,347
Wheat	111,041	103,687	98,881	81,062	98,033	36,382
Soybeans	45,897	64,000	51,822	64,000	67,619	-
White Potatoes	5,943	-	- 1,910	2,324	- 640	-
Sweet Potatoes	-	-	109,202	-	-	133,550
Millet	-	-	46,059	34,440	38,516	75,212
Corn	-	-	-	3,6[illegible]	-	-
Chinese Cabbage	328,426	311,221	298,085	311,221	318,635	438,158
Radish	435,644	414,876	447,966	419,532	423,472	653,361
Red Pepper	2,702,008	2,311,023	2,371,566	2,222,740	2,550,665	3,193,893
Barley & C. Cabbage	525,027	526,240	517,686	475,451	508,531	582,379
Barley & Radish	646,586	639,407	668,147	584,029	614,134	806,427
Wheat & C. Cabbage	474,248	463,213	454,808	427,070	451,450	509,314
Wheat & Radish	581,445	553,325	581,606	535,362	556,268	724,479
Soybean & C. Cabbage	482,774	400,480	384,707	410,013	421,043	-
Soybean & Radish	516,359	513,647	528,560	518,307	523,695	-
Wheat & White Potatoes	151,829	-	121,348	118,236	132,240	-
Apple	-73,039	-73,833	-74,985	-	-73,844	-
Peach	-	-98,634	-139,933	-	-110,349	-
Grape	691,406	344,989	335,912	-		927,762
Pear	-	-17,717	4,018	-	-	-
Mulberry	155,731	114,105	138,454	140,025	147,878	-

1/ 1969 prices

Appendix 3 Table 13. L.P. Solution for Korea (1969 prices).

Enterprise or Activity	Utilized Land	Not Utilized Land	Discounted Total Net Cash Flow (1000 Won)
C_1 Land	41,173	0	28,038,044
Barley	3,337	0	17,073
Wheat	534	0	56,706
Sweet Potatoes	2,726	0	364,057
Red Pepper	5,353	0	13,557,542
Barley/C. Cabbage	10,706	0	5,677,408
Barley/Radish	10,706	0	7,418,229
Wheat/Wh. Potatoes	7,811	0	947,849
C_2 Land	30,522	13,878	22,161,781
Grapes	4,710		2,210,588
Pears	2,737		10,997
Chinese Cabbage	5,772		1,867,661
Radish	5,772		2,705,494
Red Pepper	5,772		14,574,056
Mulberry	5,759		792,985
Total	71,695	13,878	50,200,725

Appendix 3 Table 14. L.P. Solution for Korea (1970 prices).

Enterprise or Activity	Utilized	Not Utilized	Discounted Total Net Cash Flow (1000 W)
C_1 Land	41,173	0	58,389,609.9
Barley	3,267		732,315.7
Soybeans	308		40.848.1
White Potaotes	296		71,048.9
Sweet Potaotes	10,537		1,565,703.1
Barley/C. Cabbage	10,706		9,456,881.8
Barley/Radish	10,678		12,552,634.8
Soybean/Radish	28		28,068.2
Red Pepper	5,353		33,942,109.3
C_2 Land	33,920	10,481	51,311,747.5
Apples	2,737		103,020.7
Grapes	4,710		2,309,962.3
Pears	3,398		1,354,439.8
Chinese Cabbage	5,772		3,909,154.5
Radish	5,772		5,431,077.8
Red Pepper	5,772		36,487,932.2
Mulberry	5,759		1.716,160.2
Total Land	75,093	10,481	109,701,357.4

Appendix 3 Table 15. Labor Returns from Upland Development Program Under Alternative Assumptions, by Region, W/hour[1/]

Region	Land Development Labor			Annual Crop Labor		
	1969 Prices	1970 Prices	1970 Prices & subsidy	1969 Prices	1970 Prices	1970 Prices & Subsidy
Gyeonggi	102.6	221.5	223.3	155.6	137.0	120.0
Chungnam	84.8	202.9	209.5	136.8	91.2	89.4
Double Crop	80.3	169.0	211.4	148.6	316.4	351.0
Chungbuk	98.7	233.0	229.8	66.0	162.2	123.1
Jeju	122.0	266.9	317.2	102.8	185.6	275.5

1/ Compute as follows:

$$\text{Hourly labor return} = \frac{\text{Discounted Net Cash flow X Capital Recovery Factor}}{\text{Hours of Labor}}$$

Appendix 3 Table 15. L.P. Solution for Korea (1970 prices plus subsidy)

Enterprise or Activity	Utilized	Not Utilized	Discounted Total Net Cash Flow (1000 W)
C_1 Land	41,173	0	78,447,753.5
Barley	1,005		689,875.3
Wheat	615		290,840.7
Soybeans	462		306,169.4
Sweet Potatoes	1,553		1,082,555.9
Red Pepper	5,190		12,528,743.1
Barley/C. Cabbage	10,706		20,767,595.3
Barley/Radish	10,678		29,566,898.9
Soybean/Radish	28		57,526.2
Wheat/W. Potatoes	10,936		13,155,548.7
C_2 Land	38,975	5,426	66,525,491.7
Apples	4,222		2,571,374.3
Peaches	3,570		1,979,674.4
Grapes	4,710		4,757,984.5
Pears	3,398		2,084,149.8
Chinese Cabbage	5,772		7,177,173.7
Radish	5,772		8,434,825.1
Red Pepper	5,772		34,753,569.8
Mulberry	5,759		4,766,740.1
Total	80,148	5,426	149,973,245.2
Government Subsidy (1000 W)	51,300,258.2		