AGL:SF/KOR 13
Technical Report 3

SOIL SURVEY

REPUBLIC OF KOREA

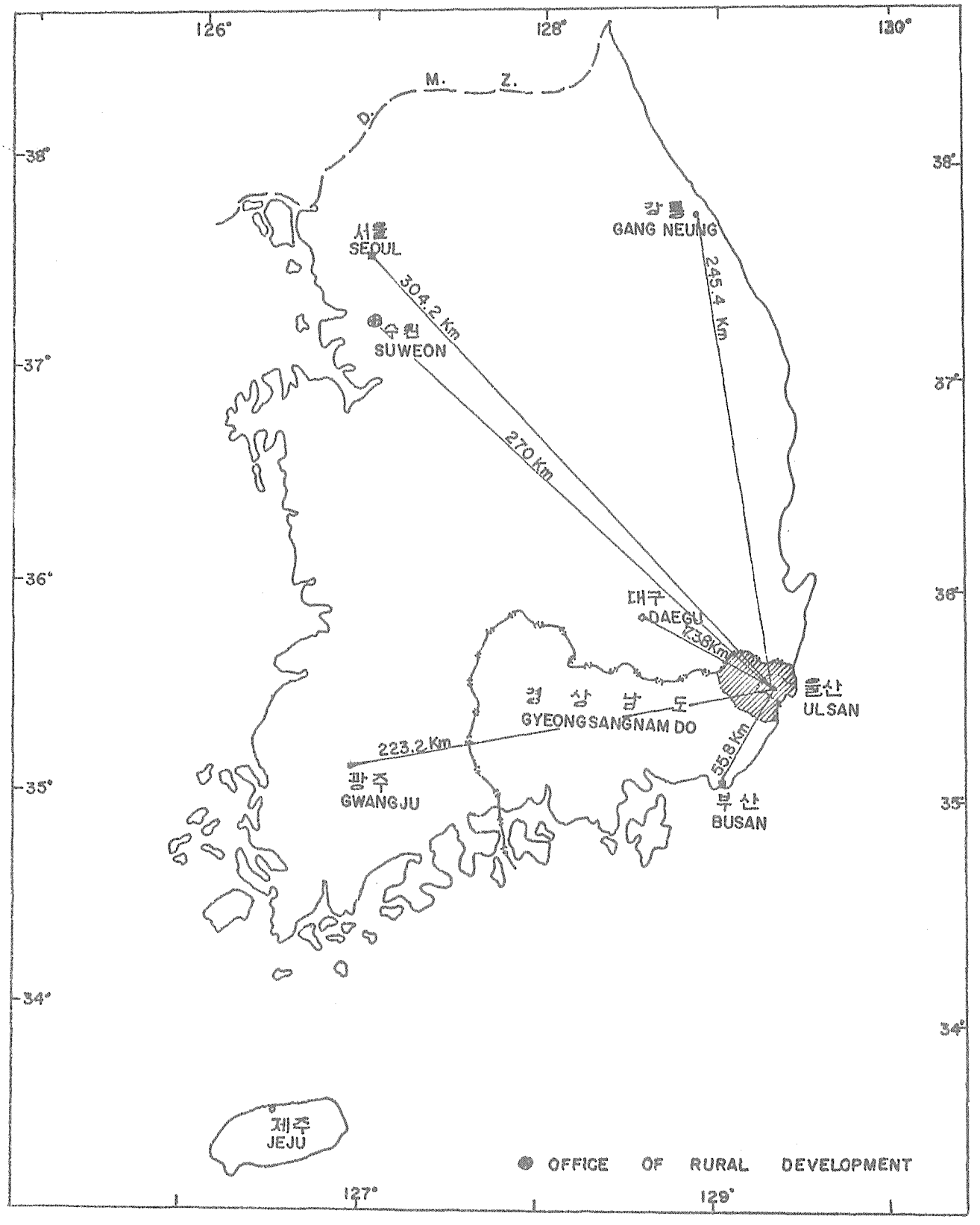
SOIL SURVEY IN ULJU GUN AND ULSAN S

UNITED NATIONS DEVELOPMENT PROGRAMME
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

SOIL SURVEY

REPUBLIC OF KOREA

LOCATION MAP OF ULJU GUN AND ULSAN SI



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Technical Report 3

SOIL SURVEY

REPUBLIC OF KOREA

SOIL SURVEY IN ULJU GUN AND ULSAN SI

Report prepared for
the Government of the Republic of Korea
by
the Food and Agriculture Organization of the United Nations
acting as executing agency for
the United Nations Development Programme

UNITED NATIONS DEVELOPMENT PROGRAMME

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 1970

FAO. Soil Survey, Republic of Korea. Soil Survey in Ulju Gun and Ulsan Si. Rome, 1970. 103 p. 2 maps, AGL:SF/KOR 13 Technical Report 3.

ABSTRACT

This report describes soil survey activities in Ulju Gun and Ulsan Si, which were part of the Korea Soil Survey conducted by the Government of Korea with the assistance of the United Nations Special Fund 1/ and the Food and Agriculture Organization of the United Nations. The entire area of the Gun and Si (100,200 ha) was mapped in detail, including paddy lands, upland crop fields and forest lands. Together with the accompanying map, which is printed at a scale of 1:25,000, the report presents an inventory of soil and soil conditions in the surveyed area. Individual soils are described and laboratory data for representative profiles are given. The report includes soil descriptions and interpretations and provides data and recommendations for specific land resource analysis and planning.

The basic information about the soils is interpreted for application to the various aspects of agriculture in the area, including land use adjustment, reclamation and development, increasing production, and the improvement and conservation of lands according to their capabilities.

To express general land use potential the soils are placed in seven land capability classes. Suitability for rice is shown by four paddy suitability groups. About one-third of the surveyed area was found to be suitable for cultivated crops; 17 percent with slight to moderate limitations, 6 percent with severe limitations, and 10 percent with very severe limitations in use. The remainder is too steep, rocky, or badly eroded for cultivation. Rice paddies have been or could be constructed on about one-fourth of the surveyed area, but less than 10 percent is well suited. About 9 percent is suitable with difficult development and management practices and 7 percent is of questionable suitability for paddy.

1/ The United Nations Special Fund and the Expanded Programme of Technical Assistance were merged to form the United Nations Development Programme on 1 January 1966.

Grateful acknowledgement is made of the keen interest and full support extended throughout the project towards the soil survey team by the Ministry of Agriculture and Forestry (Government co-operating Agency), and by the counterpart staff.

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Chapter 1

INTRODUCTION

The detailed soil survey described in this report began in December 1964 and was completed in June 1967. It formed part of the Korea Soil Survey conducted by the Government of Korea with the assistance of the United Nations Special Fund 1/. The Food and Agriculture Organization of the United Nations was designated executing agency. The Government co operating agency was the Ministry of Agriculture and Forestry.

The purpose of this report is to provide basic soil information required for the development and management of the various aspects of Korean agriculture including: the reclamation and development of new lands for settlement, the improvement and conservation of lands according to their capabilities, the increasing of production, and overall economic development, through appraisal of the soil resources.

When the Korea Soil Survey Project began, new research and new cartographic methods were introduced for detailed soil surveys, by FAO soil experts and counterpart staff. The counterpart personnel were trained in techniques of soil survey, characterization, correlation, and classification by the FAO soil scientists before participating in the field soil survey work.

This report is an inventory of research findings in maps and writing, of soil and soil conditions in Ulju Gun and Ulsan Si, and contains important information which will assist the Gun and city personnel, owners and others, in the wise use of the land, whether for agriculture, forestry, urban development, building sites, or recreational and other nonagricultural uses.

Technical Reports

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The list of reports issued by the Soil Survey Project, including the present volume, is given below.

Technical Report I. The soils of Korea (with map at scale 1:1 000 000)
Technical Report 2. Soil Reconnaissance of Korea (with map at scale 1:250 000)
Technical Report 3. Ulju Gun and Ulsan Si
Technical Report 4. Gimhae Gun
Technical Report 5. Dalseong Gun and Daegu Si
Technical Report 6. Gwangsan Gun, Damyang Gun, and Gwangju Si
Technical Report 7. Sangju Gun
Technical Report 8. Pyeongchang Gun
Technical Report 9. Gimje Gun
Technical Report 10. Buyeo Gun

The individual detailed Soil Survey Reports (Technical Reports 3-10) are each accompanied by a detailed soil map at scale 1:250000.

Chapter 2

GENERAL DESCRIPTION OF THE AREA

2.1 LOCATION

The survey area, consisting of Ulju Gun and Ulsan Si, is in the north-eastern part of Gyeongsangnam Do, one of the most southern provinces of Korea. The area is bounded on the north by Weolseong Gun, on the west by Cheongdo Gun, Milyang Gun, Yangsan Gun, on the south by Dongrae Gun, and adjoins East Sea on the east. Ulsan Bay is a small part of the East Sea extending into the area near the Ulsan Si.

The surveyed area has a total area of 100,200 ha (83,121 ha for Ulju Gun and 17,079 ha for Ulsan Si) and a population of 223,783, approximately half of which is concentrated in Ulsan Si (Year Book of Agriculture and Forestry Statistics for 1967).

2.2 CLIMATE

The climate of Ulju Gun area is temperate with slightly cold, dry winters and hot, humid summers. Temperature and precipitation data are shown in Table 1.

As this table shows, the highest average monthly temperature is 25.1 degrees (C) in August, and the lowest is 0.4 degrees (C) in January. September is the wettest month with average monthly rainfall of 208.8 mm and January driest, with precipitation of 24.2 mm. The precipitation during the summer of June, July, August, and September, covers about 60 percent of that expected annually. The average date of last freeze in the spring is 10 April, and the first freeze in the autumn is 24 November.

The climate has not caused major differences among the soils because it is nearly uniform throughout the Gun. As can be expected, most of the soils are highly weathered, leached, strongly acid, and low in fertility.

2.3 GEOLOGY

The surveyed area geologically belongs to upper Jurassic Cretaceous Silla-series, Cretaceous granite, and Tertiary system of Tertiary period. The area is underlain by porphyry, shale, granite, granite gneiss, gabbro, diorite, conglomerate, and some limestones. The effects of these rocks on the soils is discussed in the section of formation and classification of soils.

2.3.1 Parent Materials

Parent material is the unconsolidated mass from which soil develops. Soils in the Ulju Gun developed from residuum that weathered from underlying rocks, or from alluvium deposited by water.

Table 1

AVERAGE TEMPERATURE AND PRECIPITATION FOR THE SURVEY AREA

Month	Average Temper. (°C)	Temperature Maxi. (°C)	Temperature Mini. (°C)	Average Precipitation (mm)	Duration of Sunshine (hr)
Jan.	0.4	5.8	-4.9	24.2	208.6
Feb.	2.1	7.8	-3.1	46.3	190.3
Mar.	6.0	11.7	0.5	68.0	206.2
Apr.	11.5	17.6	5.7	88.4	216.0
May	16.3	22.4	11.2	106.3	241.0
June	20.0	25.1	15.9	154.1	193.3
July	24.3	28.6	21.1	203.7	187.5
Aug.	25.1	29.7	21.9	166.9	210.9
Sept.	20.5	25.1	16.3	208.8	169.2
Oct.	14.8	20.9	9.5	65.0	209.7
Nov.	9.0	15.1	3.6	46.3	192.7
Dec.	3.2	8.7	-1.9	39.8	199.8
Annual	12.8	18.2	8.0	1,217.7	2,425.2

Average temperature and precipitation is based on a 30-year record, 1931 through 1961, by the Korea Central Meteorological Observatory.

Table 2

SOIL SERIES CLASSIFIED ACCORDING TO THE CURRENT AND THE OLDER SYSTEMS OF CLASSIFICATION

Series	Current Classification			1938 Classification
	Family	Subgroup	Order	Great Soil Group
Bancheon	Fine clayey	Typic Hapludalfs	Alfisol	Red-Yellow Podzolic 1/
Banggi	Clayey skeletal	Typic Hapludalfs	Alfisol	Red-Yellow Podzolic 1/
Banho	Fine loamy	Dystric Fluventic Eutrochrepts	Inceptisol	Alluvial
Bonggye	Fine clayey	Typic Hapludults	Ultisol	Red-Yellow Podzolic
Cheongog	Fine clayey	Typic Rhodudults	Ultisol	Reddish-Brown Lateritic
Chundo	Fine clayey	Ultic Hapludalfs	Alfisol	Gray Brown Podzolic
Daegu	Loamy skeletal	Lithic Eutrochrepts	Inceptisol	Lithosol
Dalcheon	Fine clayey	Typic Hapludults	Ultisol	Red-Yellow Podzolic
Daldong	Fine silty over sandy non-acid	Aeric Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Deogha	Fine silty	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Gwangju	Fine clayey	Typic Hapludults	Ultisol	Red-Yellow Podzolic
Hagseong	Fine silty over sandy, non-acid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Hogye	Loamy skeletal	Fluventic Hapludolls	Mollisol	Alluvial
Hwabong	Sandy	Typic Udipsamments	Entisol	Alluvial
Hwadong	Fine clayey	Aquic Hapludalfs	Alfisol	Red-Yellow Podzolic 1/
Hwangryong	Sandy skeletal	Typic Udipsamments	Entisol	Alluvial
Iweon	Coarse loamy	Typic Dystrochrepts	Inceptisol	Regosol

Table 2 (Cont'd)

Series	Current Classification			1938 Classification
	Family	Subgroup	Order	Great Soil Group
Jeongja	Fine loamy	Lithic Eutrochrepts	Inceptisol	Lithosol
Jisan	Fine loamy, non-acid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Mangsil	Fine loamy	Humic Hapludults	Ultisol	Acid Brown Forest
Mudeung	Fine loamy	Lithic Dystrochrepts	Inceptisol	Lithosol
Sachon	Coarse loamy, non-acid	Aeric Fluventic Haplaquepts	Inceptisol	Alluvial
Samgag	Coarse loamy	Typic Dystrochrepts	Inceptisol	Lithosol
Seoggye	Coarse loamy, non-acid	Aeric Fluventic Haplaquepts	Inceptisol	Alluvial
Sinbul	Loamy skeletal	Typic Haplumbrepts	Inceptisol	Red-Yellow Podzolic
Sindab	Sandy	Typic Psammaquents	Entisol	Alluvial
Sinhyeon	Fine loamy	Typic Hapludults	Ultisol	Red-Yellow Podzolic 1/
Sinjeong	Fine loamy	Typic Dystrochrepts	Inceptisol	Lithosol
Sirye	Fine clayey	Typic Hapludalfs	Alfisol	Red-Yellow Podzolic 1/
Taehwa	Fine loamy	Typic Hapludults	Ultisol	Red-Yellow Podzolic
Tongcheon	Loamy skeletal	Aquic Dystrochrepts	Inceptisol	Alluvial

1/ R.Y.P. soils with high base saturation.

The dominant underlying rocks include porphyry, shale, sandstone, granite, granite gneiss, gabbro, and tuff conglomerate. Porphyry and shale are most extensive. They are distributed all over the area except for a part of the east coast and north eastern part of the gun. The upper and middle parts of Gaji and Sinbul mountains are underlain by these rocks.

These materials are generally weathered and broken to rock fragments, and their weathered layers are thin.

Soils of the Daegu and Sirye are underlain by shale,and Mudeung, Mangsil, and Taehwa series are the principal soils underlain by porphyry. About 15 percent of the area is underlain by granite.

The greatest extent of this rock is in the north-eastern parts of the gun. It is also scattered over the other areas in small amounts together with small areas of granite gneiss. Generally granite underlies the low hills which are at elevation of less than 300 m above sea level. Most of the cultivated upland soils are developed in this material. The soils of the Dalcheon and Samgag series are the principal soils derived from this kind of parent rock.

Basic igneous rocks, chiefly gabbro, underlie the iron mining areas north of Ulsan Si of Cheongog Ri, Nongso Myeon, the hilly areas south of Jeongja Ri, and Gangdong Myeon on the east coast. They were the source of parent material for the Cheongog and Jeongja soils. Tuff conglomerate occurs chiefly on the hilly areas north of Deogha, and Cheongryang Myeon on the east coast.

The soils of the Sinjeong series are the principal soils derived from this kind of rocks. About 10 percent of the soils of the area are formed in alluvium. Of this area about 3.7 percent consists of soils formed in old alluvium. Much of this came from soil in the nearby uplands. Alluvial soils are mainly on river terraces, flood plains, and bottom lands (alluvial plains). Some of them are in local valleys in mountainous areas.

Near the east coast, soils of the Daldong, Deogha, and Hagseong series formed in fluvio-marine deposits, and near the mouth of Taehwa River. But the Sinhyeon soils developed in very strongly dissected old fluvio-marine material on low hills near the east coast.

Soils of the Sinbul series formed in colluvium weathered from porphyry and shale in high mountainous areas. Soils of the Banho, Iweon, and Saohon series developed in alluvium and colluvium on hill and mountain foot slopes.

2.4 WATER SUPPLY

There are three main sources of surface water in the survey area consisting of the Taehwa and Haeya Rivers and Dongcheon Creek (see physiography). Farms have been developed along or near these sources, and those utilizing water from them are extensive and fertile, being known as a granary of this gun and si. Although not much water flows, the Taehwa and Haeya rivers have never run dry, although Dongcheon Creek is completely dry except during the rainy season. This may be the result of poor forest conservation around the creek and its tributaries.

A reservoir dam that can store 25.5 million metric tons of water has been completed at Sayeon Ri of Beomseo Myeon in 1965, and supplies 100,000 metric tons of water per day for the Ulsan industrial complex. The reservoir covers 240 ha.

2.5 AGRICULTURE

Agriculture is the main source of income in the area. In recent years the newly established, large scale industrial complex, including the Korea Fertilizer and Honam Oil Refinery plants, has become another great source of income for the population, especially in the Ulsan Si.

Of the area, 59 percent is woodland, 18 percent cultivated land, and 23 percent other land.

Of 20,656 ha of the cultivated lands 14,520 ha or 70 percent is used for paddy rice. Sixty percent of the rice paddies are fully irrigated, 30 percent partly irrigated, and 10 percent have only natural rainfall.

Paddy rice is the main crop grown in Ulju Gun and Ulsan Si. According to information given by farmers, rice yields average 3,000 kg per ha. The figure shows that crop yields have improved as a result of: control of insects and diseases, building of dikes to control floods, and improved seed varieties. Yields have increased as agricultural management is improved . Seeding usually begins early in May, and the transplanting dates extend from 10 June to 30 June. The harvest is usually finished by late October.

Barley and wheat are second and third most important crops grown in these areas. About 48 percent of the total area of rice paddy is cropped to barley and occasionally to wheat during the winter. These soils produce somewhat lower yields than the farms not used for rice paddy, and may be the result of poor drainage and poor weed control.

Ulju Gun and Ulsan Si have 6,136 ha of land cultivated only for crops other than rice. Principal crops grown are barley, wheat, soybeans, and potatoes. The seeding dates for winter varieties usually extend from mid-October to early in November. Barley and wheat are generally harvested early in June.

According to farmers' reports, barley and wheat yields average 2,000 kg and 1,800 kg per ha respectively.

Chapter 3

HOW THE SURVEY WAS MADE

This survey was made to learn what kinds of soils are in the survey area, where they are located, and how they can be used. The entire soil landscape was observed including: steepness, length, and shape of slope, kinds of native plants or crops and kinds of rock. Many holes were dug or bored to expose soil profiles. Holes were made and profiles were observed at an average interval of about 200 m, depending on the nature of the landscape.

Spacing was much closer in the highly productive paddy lands than in the hilly and mountainous areas, where stones, rock outcrops, gullies, and similar features are important indicators of kind of soil and actual observation of profiles was at greater intervals.

Comparisons were made among the profiles studied, and were compared with those in other areas where detailed surveys have been made. The soils were named and classified according to the soil classification system used in Korea and other countries.

Soils that have profiles almost alike make up a soil series. All of one series have major horizons that are similar in thickness, arrangement, and other important common characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped.

Dalcheon and Hogye, for example are the names of two soil series in the survey area . These soils would have essentially the same characteristics as the Dalcheon and Hogye mapped in other areas in Korea.

Soils of one series, however, can differ somewhat in texture of surface soil including the amount and size of coarse fragments, in slope, and in the amount and size of coarse fragments, in slope, and in the amount of erosion that is evident. As these differences are important in the use and management of the soils, that soil series has been divided into mapping units.

In preparation of the detailed maps there was the problem of delineating areas where different kinds of soils are so intricately mixed, or were in bodies of such small size, that it was not practical to show the exact boundaries of each mapping unit. These areas were mapped as a soil complex and contain profiles that are similar to two or more series. The Daegu-Sirye complex units are examples of this kind of a mapping unit, having profiles similar to both series.

Some series are divided into mapping units based upon slope, the Baegsan series, for example. Thus there are gently sloping, moderately steep, and steep mapping units of Baegsan series.

Another difference between the series and the mapping unit is that the series include a group of profiles that have a definite but limited range in their

properties. The mapping unit, however, describes all of the important properties of the soils that are within the limits of the area shown on the map.

Usually within a mapped area there are some profiles that resemble other series more than the series named in the mapping units. In mapping units such as Daegu (rocky silt loam, 30 to 60 percent slopes, eroded) the part of the area that is rock outcrops obviously does not have a profile.

Other areas of land which do not have developed soils are also shown on the soil map, but they are given descriptive names, such as rock land, or beach and riverwash, sandy, and are called land types rather than soils.

Chapter 4

DESCRIPTION OF GENERAL SOIL MAP

4.1 INTRODUCTION

The general soil map in the back pocket of this report shows the soil associations in the survey area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, being named after the major soil. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful for a general idea of the soils in an area, a comparison of different parts of an area and the location of large tracts that are suitable for a certain kind of farming or other land use.

This map is obviously suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, as well as other characteristics that affect management.

The six soil associations shown on the general soil map are placed into three main groups as shown on the legend of the general soil map. The first are the soils of the alluvial plains; the second the soils of the low hills, terraces and fans, and the third the soils of the high mountains.

4.2 SOILS OF THE ALLUVIAL PLAIN

4.2.1 Area 1. Jisan-Hwadong Association

Except for those soils on the marine plain, the sloping flood plain soils dominate this association. While this association is only about 16 percent of the survey area it is the most important association for agricultural production.

The Jisan soils are the most extensive soils covering about one half of the association mainly in the upper part of the stream valleys. They are gently sloping to moderately steep, loamy, poorly drained and well suited for rice production.

In the middle parts of the stream valleys, coarser soils and soil material dominates. Here the Riverwash is comprised of sandy and gravelly units, about 12 percent, and Hwangryong soils, about 6 percent. These are most extensive. The Hwangryong soils are well drained, very gravelly sands with low available moisture capacities. The Hwadong-Honam soils, about 11 percent of the area, are on elevations above the flood plain. The Hwadong soils are moderately well drained, slowly permeable, and productive. Minor soils are Baegsan, Banho, Sachon, Hogye, Tongcheon, Seoggye, and Sindab. Together they form the remaining 21 percent.

Rice is the principal crop grown and most yields are high. The Hwadong, Hwangryong, Baegsan, Banho, Sachon, Hogye, and Tongcheon soils are usually cropped to barley following the rice crop. Some areas of these better drained soils are cropped to sweet potatoes and other vegetables during the summer growing season. The Hwangryong and Toncheon soils are rapidly permeable and have low or very low available moisture capacities.

Much water is required for rice production. The production of other non irrigated crops are limited by drought. All of these soils need frequent applications of lime and other fertilizers for highest production. Increased production in this area will need to come from better soil management as the entire area, except the riverwash, is now in crops. This might include such practices as the irrigation of crops like barley, wheat and vegetables.

4.2.f Area 2. Daldong-Hagseong Association

Level soils on the river deltas dominate this association. The elevations range from sea level or slightly below mean sea level to slightly above sea level. These soils, about 4 percent of the total area, are silt loam and silty clay loam with high water tables. The principal area is the Taehwa River deltas below Ulsan Si and a smaller area is in the southern part along the Hoeya River.

The Daldong soils are loam and sandy loam; the Hagseong, silt loam soils with loamy sand in their lower horizons; the Deogha soils are silty clay loam to silt loam. All have neutral to alkaline reactions and are poorly drained.

Between the main part of this area and the sea is the tidal flat. The tidal flat is much like the other soils of this association except it has a high sodium saturation and is partly covered with sea water. The Hagseong, Daldong, and Deogha soils usually have moderate amounts of sodium in their lower horizons but the upper horizons are leached relatively free of excess salts.

Practically all, excepting the tidal flat, are planted to rice. High yields are obtained.

Additional drainage would permit the growing of many alternative crops with similar results. Water pumps would be needed in most areas to obtain better drainage. Some additional lower lying soils could be brought into production by dyking the tidal flat and leaching the soil of the excess salts.

4.3 SOILS OF THE LOWER HILLS AND TERRACES

4.3.1 Area 3. Iweon-Gwangju Association

Mainly sloping but some gently sloping and moderately steep clayey and sandy soils dominate this association. It covers about 7 percent of the survey area and is composed of alluvial fans and terraces in the major valleys and along the east coast.

The Iweon soils cover about 40 percent of the association and are the most extensive. They consist of sandy alluvial fans with some gravel, cobbles, and stones, the result of sedimentation of coarse textured materials eroded from the adjacent land. Most areas are in agricultural use but have low available moisture capacities and are only moderately productive.

The Bancheon and Gwangju soils cover about 40 percent of the association. They are mainly gently sloping to sloping, well drained, productive clayey soils with elevations of 5–20 m above the alluvial plain. The Bancheon and Gwangju soils are simular except the Gwangju has more silty upper horizons.

In many places the soils on the terrace edges or escarpments include small areas that are shallow to shale. These areas were mapped as the Bancheon-Daegu complex and comprise about 10 percent of the general areas. In other places the escarpments are gravelly clay and mapped in the Banggi series. Other places mainly near the sea have neutral to alkaline subsoils with shells and are part of the Chundo series. The Banggi and Chundo and other minor soils are present in about 10 percent of the general areas.

Upland crops such as barley, wheat, soybeans are dominant. Some lower lying soils are in rice paddy and are also cropped to barley, but many soils of this area are too high for diversion of river water to irrigate paddies. Small streams are used for irrigation water supply but are not dependable. Because their coarse texture results in rapid permeability, high losses of irrigation water are usual.

Production could be increased in this association by the more liberal use of fertilizers and lime. Erosion control is important on the Bancheon-Gwangju soils. Diversion terraces and waterways constructed on these soils would reduce erosion losses. Irrigation of upland crops could increase yields of crops. The Iweon soils are capable of producing good orchard and mulberry crops.

4.3.2 Area 4. Daegu, Sirye, Sinjeong Association

Shallow to deep, sloping to moderately steep soils dominate this association. The topography is rolling to hilly and a moderate to low relief with elevations ranging from about sea level to 200 m.

The Daegu soils, about 40 percent of the association, include the more sloping areas, and have a thin gravelly silt loam or loam layer over shale.

The Sirye soils are thicker with silty clay loam to silty clay over shale. They are extensive and comprise about 20 percent of the area.

The Sinjeong soils are mainly in the northeast part of the area adjacent to the East Sea and one small part of the area south of the centre of Ulsan Si. These soils have thick gravelly loam subsoils over tuff conglomerate.

A thin stand of small poorly shaped pine trees grows on much of the area; small areas of the better soils produce low to moderate yields of upland crops; but most are eroded. Controlling this is the major problem. The use of limestone with additional fertilizer would increase plant growth and yields, and assist in erosion control.

Because of the erosion problem and low available moisture capacity these soils are poorly suited for the production of crops. With the use of fertilizer and lime good pasture could be established. However pastures on the Daegu soils will produce only little forage in the fall and spring dry seasons. Areas of severely eroded and gullied land require much fertilizer. Return from pasture would be small compared to the cost of establishment. In these areas afforestation would be more profitable, but careful management is necessary to obtain satisfactory yields and to control erosion.

4.4 SOILS OF THE HIGH MOUNTAIN AREA

4.4.1 Area 5. Daegu-Mudeung Association

Shallow, steep, and some moderately steep soils of great relief with many outcrops of rock dominate this association. It is the largest area, covering 54 percent of that surveyed. The soils of the Daegu series are about 50 percent of this association and are the most extensive.

The Mudeung soils cover about 30 percent and the Taehwa soils are about 10 percent of the area.

Generally the Mudeung and Taehwa soils are small areas distributed in such a fine pattern that they could not be shown as distinct areas on the general or detailed map. Because of this they were mapped in mapping unit complexes of Mudeung, Taehwa, and Daegu. In some of the few sloping and moderately steep areas the deeper Sirye and Bonggye soils dominate.

In the highest elevation in the western part of the area, mainly around Mt. Sinbul the dark coloured Mangsil and Sinbul soils dominate. The grass vegetation and low temperatures are responsible for this. These soils with other minor soils are the remaining 10 percent of the association.

The Daegu soils are 10 to 50 cm of silt loam to silty clay loam over shale rock. The Mudeung soils have similar depth of loam over porphyry. The Taehwa soils are similar to the Mudeung except that they have 50-150 cm of loam over the porphyry.

Most of the area shows a thin stand of poorly shaped pine trees with some shrubs and grasses. The poor growth of vegetation and the practice of removing the forest litter from the soil surface permits much erosion. Gullies have dissected more than 10 percent of the area leaving an almost valueless soil.

This area has little potential for use other than woodland or pasture. With liming, fertilization, seeding of better grasses, and pasture management a moderate amount of grazing may be obtained. In dry seasons pastures will produce only small amounts of forage. But if forest litter were left this would do much to reduce erosion losses in the wooded areas, and to increase forest production because of better water absorption. Many places will require special treatment to stabilize the soil and reduce erosion. Replanting of the woodland to adapted useful species is necessary to obtain economic return.

4.4.2 Area 6. Samgag-Dalcheon Association

Moderately steep to steep, rocky soils of great relief and with mainly low (some soils with moderate) available moisture capacities dominate the area. It covers 15 percent of the survey and is located in the moderately high and high mountain areas of granite rock.

The Samgag soils are about 80 percent and are the most extensive soil.

The Dalcheon soils are about 10 percent of the total area, being small areas of lesser slopes generally on the lower elevations.

Sachon, Iweon, and Jisan are minor soils totaling about 10 percent of the general area.

The Samgag soils are mainly eroded, gullied, and are deep coarse sandy loam, or loamy sand granite saprolite, containing mica and much quartz. The soil of most areas is the remaining C horizon that once was similar to soils of the Dalcheon series, the clay loam B horizon being washed away exposing the granite saprolite. The Dalcheon soils are sloping to steep with moderately deep clay loam or silty clay loam subsoils over sandy loam saprolite.

Little use is being made of these soils, but some upland crops are grown on the less eroded places. However most of the land is covered with a thin stand of poorly shaped pine trees with grass and shrubs in some areas. Erosion has been and remains the greatest problem.

The formation of gullies and sheet erosion has lowered the usefulness and possible production and in most places the process actively continues. In addition to the harmful effects and lowered production, erosion lowers the potential production of many lower lying soils through the deposition of coarse sand or fine gravel.

A thick stand of useful adapted species of trees would do much to control this and obtain some return from the land. Some of the less eroded and less rocky soils are capable of producing some pasture if limed, fertilized, seeded to adapted species, and well managed. Pasture yields in spring and Autumn dry seasons would be negligible because of the low available moisture capacity.

Areas of the Dalcheon and some of the Samgag soils with more favorable characteristics could produce moderate yields of tobacco, fruits, sweet potatoes, sorghum, millet, melon, and similar crops. But much fertilizer is needed. When these crops are grown soil erosion is apt to be severe unless land is managed to reduce erosion losses by the application of soil conservation practices.

Chapter 5

DESCRIPTION OF SOILS

5.1 INTRODUCTION

This chapter describes the soil series and mapping units of Ulju Gun, including the city of Ulsan (Ulsan Si). The ha and proportionate extent of each mapping unit are shown in Table 3, and their location and distribution are given in the soil maps at the back of the report.

The soil series is described first, and then the mapping units in that series. To get full information on any one mapping unit, it is necessary to read the description of the series to which it belongs.

The soil map at the back of this publication shows the location and distribution of each mapping unit. The Guide to Mapping Units (Appendix 2) gives the paddy suitability group and capability unit to which each mapping unit has been assigned.

5.1.1 Classification of the Soils

The Classes in the Current System are briefly defined in the following paragraphs.

1. Order

The orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxosols, and Histosols.

The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. The exceptions, Entisols and Histosols, are in many different climates. Table 3 shows the five soil orders in this surveyed area, Ultisols, Alfisols, Inceptisols, Entisols, and Mollisols.

Ultisols are mineral soils that have distinct horizons and are commonly on old land surfaces. They contain a clay-enriched B horizon that has low base saturation. (See Table 3 for soil series of this order).

Alfisols are soils containing a clay-enriched B horizon that has high base saturation.

Inceptisols are mineral soils in which horizon has definitely started to develop. They generally are on young, but not recent land surfaces.

Entisols are young mineral soils that do not have a genetic horizon or have only the beginning of such an horizon.

Mollisols are mineral soils that have dark coloured surfaces with high organic matter content and high base saturation.

2. Suborder

Each order is subdivided into suborders, primarily on the basis of soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders have a narrower climate range than the orders.

The criteria for suborders chiefly reflect the presence or absence of water-logging or soil differences resulting from the climate or vegetation. Those properties are mineralogy, chemistry, degree of gleying soil moisture, texture, and the presence or absence of accumulated soluble material.

3. Great Group

Each suborder is divided into great groups on the basis of uniformity in the presence, absence, and arrangement of diagnostic horizons and features. The diagnostic horizons are those that contain alluvial clay, iron, and humus; or are thick, dark coloured surface horizons; or horizons which have a pan that interferes with water movement or root development. The features are colours of dark brown and dark red that are associated with basic rocks; major differences in chemical composition; and wide differences in base saturation.

4. Subgroup

The subgroups are subdivisions of the great group and are defined in terms of reference to them. One of the subgroups represents the central concept of the great group, and others called intergrades, have properties of one great group that are dominant and also weakly expressed properties of another great group, suborder, or order.

Subgroups may also be made where there is some soil property unlike that of the great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group.

An example is:

5. Families

Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behaviour of soils when used for engineering. Among the properties considered are texture, consistence, permeability, reaction, mineralogy, soil temperature, and thickness of horizons.

6. Series

The series consists of a groups of soils that formed in a particular kind of parent material and having genetic horizon that, except for texture of surface soil, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are colour, structure, reaction, consistence, and mineralogical and chemical composition.

In Table 2, the soil series in this surveyed area are classified according to the current system of soil classification.

5.2 Bancheon Series

The Bancheon series consists of very deep or deep, well drained, slowly permeable fine clayey soils formed in old alluvium. These soils are in very gently sloping to steep, slightly to moderately dissected river terraces and alluvial fans. This series is a member of the fine clayey family of Typic Hapludalfs.

The typical profile of Bancheon loam is:

Ap——0 to 11 cm; Brown to dark brown (7.5YR 4/4 moist) loam; moderate, fine to coarse granular structure; friable, sticky and plastic; common, fine to medium roots; abrupt, smooth boundary; pH 7.0.

B1——11 to 41 cm; Strong brown (7.5YR 5/8) clay loam; weak, medium to coarse subangular blocky breaking to medium granular structure; slightly firm, sticky, and plastic; few, fine to medium roots; clear, wavy boundary; pH 5.0.

B21t—— 41 to 52 cm; Yellowish red (5YR 4/8) clay or clay loam; strong medium to coarse subangular blocky and angular blocky breaking to fine to medium subangular and angular blocky structure; slightly firm, very sticky, and very plastic; few, fine roots; gradual, smooth boundary; pH 5.0.

B22t—— 52 to 79 cm; Yellowish red (5YR 5/8) clay or clay loam; moderate, medium to coarse angular blocky and subangular blocky structure; firm, very sticky, and very plastic; thin continuous red (2.5TR 4/6) cutans; few, fine round quartz and white feldspar grains; abrupt, smooth boundary; pH 5.0.

B3t——79 to 110 cm; Red (2.5YR 4/8) and strong brown (7.5YR 5/6) clay; moderate, coarse to very coarse platy structure; firm, sticky, and plastic; common, coarse white strongly weathered feldspar and sometimes round quartz gravel; smooth boundary; pH 5.0.

C1——110 to 155 cm; Red (2. 5YR 4/6) and strong brown (7.5YR 5/8) sandy clay; weak to moderate, coarse to very coarse platy structure; firm, sticky, and plastic; gradual, wavy boundary; pH 6.5.

C2—— 155+ cm; Reddish yellow (5YR 6/8) sandy clay loam; massive; friable, slightly sticky, and slightly plastic; many, fine, to medium, coarse sand or gravel; strongly weathered feldspar; pH 6.5.

The plough layers are generally thin, gravelly or cobbly in a few places, and range from loam to light clay loam or silty clay loam in texture. The upper subsoil ranges from strong brown to yellowish red or yellowish brown in colour, and from clay loam to clay or silty clay in texture. The lower subsoil is similar in colour to the upper soil, and ranges from clay to clay loam or silty clay loam in texture. The lowest substrata are often gravelly or cobbly, and buried paleosols may underlie the soil. Depth to bed rock ranges from one to ten metres or more.

The Bancheon soils are associated with the Gwangju soils on low, rolling, moderately dissected uplands. The Bancheon soils are more firm, and contain more clay than the Gwangju soils.

Daegu and Samgag soils are on the lower side slopes. Where the alluvial material has been eroded the underlying rocks are exposed.

The soils of Bancheon series are strongly acid, low in natural fertility and in organic matter content. Permeability is moderately slow. Available moisture capacity is high. Cation exchange capacity is medium, and base saturation is medium to high. They are easy to work and respond well to management.

The soils are mostly in valleys along the major rivers. Essentially all of the areas with suitable slopes are in agricultural use. Crops such as barley are grown during the winter and soybean, sweet potato, sesame, upland rice, red bean, cabbage, corn, and pepper are produced during the summer and autumn. Fruits including apple, pear, and persimmon are frequently grown on more sloping areas. Soils on low position are planted to paddy rice in summer and to barley in the winter. A few areas are covered with forest consisting chiefly of pine and oak with an under-story of low, wild bushes such as azalea.

5.2.1 Bancheon-Daegu Complex, 7 to 15 Percent Slopes, Eroded (BDC2)

These soils adjoin each other, and are mapped as one unit. They occupy, chiefly in valleys along the major rivers in the gun, sloping areas of dissected old river terraces and alluvial fans. About 75 percent of this unit is Bancheon soil, and about 25 percent is Daegu soil.

The soil profiles of this complex are similar to those described for their respective series. In this unit some severely eroded areas and only slightly eroded areas are included because of their similarity and small size; and areas of a soil having a very thin, red, clayey surface layer. There are small areas too of Gwangju soil: silty, yellowish brown , or strong brown.

Runoff in the complex is slow, and erosion hazard is severe. Most of the soils are considered poor or fair land suited only to non-irrigated crops. Daegu soil is not suitable for growing paddy rice

With average management, crop yields are generally low, but they may be increased through better methods. The main concern in management is controlling erosion. The shallow soil depth in Daegu soil and drought during dry season are the chief limitation.

(Capability unit IIIe)

5.2.2 Bancheon-Daegu Complex, 15 to 30 Percent Slopes, Eroded (BDD2)

These soils occupy small tracts of moderately steep to steep, moderately to strongly dissected, narrow, rolling uplands, river terraces and alluvial fans. About 70 percent of this unit is Bancheon loam, and 30 percent Daegu cobbly silt loam. Bancheon soil is deep, well drained, and formed in old alluvium. Daegu soil is shallow, excessively drained, and formed in residuum. The Daegu soil occurs in areas where the old alluvium has been eroded and the weathered shale is near the surface.

The profiles of the two soils are similar to those described for their respective series. Where only slightly eroded, the Bancheon soil has a dark brown to yellowish brown loam surface layer. Where irrigated, colours are usually mottled grayish brown.

With the soils of this unit are some areas of soil only slightly eroded, small areas of soils with very gravelly texture, some areas less than 100 cm deep over shale particularly on the stronger slopes, small areas with yellowish brown colour and very firm subsoils located especially on rather gently sloping relief at the heads of drainage ways, and some areas of silty clay loam surface layer.

These soils are rather difficult to cultivate because of steep slopes and stones on the surface layer and throughout the profiles. They require special management to prevent accelerated erosion and to produce satisfactory yields.

The soil is suitable for mulberry trees and orchards rather than for agricultural use. The shallow Daegu soil is probably best suited to shallow rooted trees, such as alder. The deep Bancheon soil can be expected to produce moderately high yields if good management is practised.

(Capability unit IVe).

5.2.3 Bancheon-Daegu Complex; 30 to 60 Percent Slopes, Eroded (BDE2)

These two soils occur on steep to very steep, strongly dissected terrace edges near the Taehwa River. About 60 percent of this unit is the deep Bancheon loam or silt loam, and 40 percent is the shallow Daegu cobbly loam or cobbly silt loam.

The profiles of the soils of this complex are similar to the ones described for their respective series.

Included in this mapping unit are small areas that are only slightly eroded, and some areas of a soil with red clayey subsoil exposed at the surface.

Essentially, all of this unit is used for permanent types of vegetation, such as planted pine trees and wild grasses, and a small extent for growing bamboo, fruit trees and some vegetables. These soils require some special management to retard accelerated erosion.

(Capability unit VIe)

5.3 BANGGI SERIES

The Banggi series consists of deep, well drained, loamy skeletal soils formed in alluvial material. These soils are in gently sloping to sloping, slightly dissected old alluvial fans and low terraces. They occupy small areas in the western part of the gun. This series is a member of the clayey skeletal family of Typic Hapludalfs.

A typical soil profile of Banggi clay loam is:

Ap——0 to 14 cm; Dark grayish brown (10YR 4/2) clay loam; weak, fine to medium granular structure; friable, slightly sticky, and slightly plastic; many, fine grass roots; clear, wavy boundary; pH 6.3.

B1——14 to 24 cm; Yellowish brown (10YR 5/6) gravelly silty clay loam; weak, medium subangular blocky structure; firm, sticky, and plastic; common, fine grass roots; gradual, smooth boundary; pH 6.0.

B21——24 to 57 cm; Yellowish brown (10YR 5/6) very gravelly silty clay;

weak, medium subangular blocky structure; friable, stioky, and plastic; few fine grass roots; clear, smooth boundary; pH 5.8.

C1——57 to 95 cm; Yellowish brown (10YR 5/6) very gravelly silty clay loam; weak angular blocky structure; friable, sticky, and plastic; few, fine grass roots; clear, smooth boundary; pH 5.5.

C2——95 to 150 cm; Very gravelly to very cobbly silty clay loam.

The surface soil ranges from dark grayish brown to dark brown in colour, and from gravelly silty clay loam to gravelly clay loam or clay loam in texture. The subsoil is yellowish brown, yellowish red, or strong brown gravelly to cobbly clay loam, silty clay loam, or silty clay. The substratum is very gravelly to very cobbly silty clay loam, beginning at depths of 50 cm to 100 cm.

These soils are more yellow coloured and contain gravels that are not present in the associated Bancheon series.

The Banggi soils are strongly acid or medium acid in the surface and strongly acid in the subsoil. Natural fertility is low and organic matter content, medium. Permeability is rapid to moderate in the surface and slow to moderately rapid in the subsoil. Available moisture capacity is low to moderate. Cation exchange capacity is medium, and base saturation is high to medium. These soils respond well to good management, especially fertilization.

The Banggi soils occupy old alluvial plains and low terraces chiefly along the tributaries of Taehwa River.

Most of the soils are cultivated for paddy rice and barley in a two crop per year cropping system. Some of the areas are planted only to crops such as barley, wheat, soybean, and cabbage.

5.3.1 Banggi Clay Loam, 2 to 7 Percent Slopes (BiB)

This soil occupies small tracts of gently sloping old alluvial plains and low terraces chiefly along the Taehwa River. In most places much gravel has been removed by farmers for easier cultivation.

The profile of this soil is like the one described for the series. A few small areas of soils with gravelly surface layer are included in the mapped areas.

This soil is well suited for all the crops commonly grown in the gun. Most of the areas are planted to paddy rice during the summer and barley in the winter. A few small areas are used for apple orchards, barley, and similar crops. Pine trees are growing on this soil in some places. Crop yields are low, but moderately high yields of paddy rice may be expected if an irrigation system is established, and compost and phosphate are applied.

(Capability unit IIIe; Paddy suitability group P2ac)

5.3.2 Banggi Clay Loam, 7 to 15 Percent Slopes (BiC)

This soil occupies small tracts of sloping old alluvial plains and low terraces, and is limited to areas near Gacheon-Ri, Samam Myeon of the gun. A lot of gravel has been removed from the plough layer by farmers.

Profile of this mapping unit is similar to the one described for the series, but this soil has a somewhat shallower sufface layer than the Banggi clay loam, 2 to 7 percent slopes (BiB). A few small areas that have a gravelly to cobbly surface layer are included in this mapping unit.

Most of the soil is suited to barley and similar crops, and a very few areas are cultivated for paddy rice grown only with rainfall water. Crop yields are low, but they may be increased if adequate amounts of compost and fertilizers are applied. Removal of the stones from the surface facilitates cultivation.

(Capability unit IIIe; Paddy suitability group P3ac)

5.4 BANHO SERIES

The Banho series consists of deep, well drained, moderately permeable fine loamy soils formed in colluvium originating from areas underlain by shale and porphyry rocks. These soils occur on gently sloping to moderately steep, concave mountain foot slopes. This series is a member of the fine loamy family of Dystric Fluventic Eutrochrepts.

A typical profile of Banho gravelly loam is:

Ap——0 to 10 cm; Dark brown (10YR 3/3) gravelly loam; moderate, fine to medium subangular blocky breaking to very fine to fine, granular structure; friable; common, fine pores; common, very fine to fine roots; clear, smooth boundary; pH 5.5.

A3——10 to 22 cm; Dark brown (10YR 3/3) gravelly loam; moderate, medium to coarse or fine subangular blocky breaking to very fine to fine granular structure; slightly firm, slightly sticky, and slightly plastic; common, fine to medium pores; few, roots as above; clear, smooth boundary; pH 5.0.

B2——22 to 60 cm; Dark brown (10YR 3/3), very gravelly loam; moderate, medium to coarse subangular blocky structure; firm, sticky, and plastic; any fine to coarse pores; clear, smooth boundary; pH 7.0.

B3——60 to 120 cm; Brown (7.5YR 5/2), dark brown (10YR 3/2), grayish brown (10YR 5/2), dark yellowish brown (10YR 3/4), very gravelly loam; massive; firm, sticky, and plastic; patchy thin clay cutans; common, fine to medium pores.

The Ap horizons are dark brown to brown, yellowish brown, occasionally yellow, clay loam, loam or silt loam and usually contain gravel or cobbles. The B2 horizon ranges from dark brown to brown or yellowish brown and from clay loam to loam or silt loam. Gravel content ranges from 5 to 30 percent. The B3 horizon is variable in colour and contains many gravels.

The Banho soils are on slopes below the Mudeung, Taehwa, Bonggye, Daegu, Sirye, and Jisan soils. The Banho soils have fewer gravels than the very gravelly Hogye soils.

They are strongly acid, medium in natural fertility, and medium in organic matter content. Available moisture capacity is medium to high and response to

fertilization is good. Cation exchange capacity is high and base saturation is high.

The Banho soils are mainly in northern and western parts of the gun. Most of the areas are cultivated for agricultural crops, such as barley, soybean, sesame, radish and cabbage. Paddy rice and barley are cultivated on some gently sloping soils that can be irrigated from a nearby reservoir.

5.4.1 Banho Gravelly Loam, 2 to 7 Percent Slopes (BlB)

This deep, well drained soil occupies long narrow areas of gently sloping, concave mountain foot slopes.

Most of this unit has a profile that is similar to that described for the series. Included in areas mappod as this soil are some areas that have little or no gravel or cobbles, and small areas of the imperfectly drained Jisan soil at the lower part of the slope.

Nearly all of the soils are cultivated for crops, such as barley, soybean, sesame, red pepper, radish, cabbage. A few areas on lower slopes are planted to paddy rice in the summer and to barley during the winter. The main problem in managing this soil is erosion.

(Capability unit IIe; Paddy suitability group P2ac)

5.4.2 Banho Gravelly Loam, 7 to 15 Percent Slopes. (BlC)

This deep, well drained soil occupies sloping, slightly dissected mountain foot slopes.

The profile of most mapped areas has a slightly thinner surface layer than that described for the series, but it is otherwise similar. Some small areas of less or greater slopes than the described range are included. Small areas of the associated Mudeung and Daegu soils are included on some of the upper slopes and some small areas that have little or no gravel or cobbles.

Most of the region of this soil is cultivated for crops, such as barley, soybean, sesame, red pepper, radish, and cabbage. It is well suited to non-irrigated crops rather than paddy rice. A few small areas on lower position are planted to paddy rice in the summer and to barley over the winter. Erosion is a moderate hazard and careful management is needed.

(Capability unit IIIe; Paddy suitability group P3ac)

5.4.3 Banho Gravelly Loam, 15 to 30 Percent Slopes (BlD)

This deep, well drained soil occupies moderately steep, concave mountain foot slopes.

The profile of the unit has a shallower surface layer than that described for tho series but it is otherwise similar; it includes some eroded areas and small areas of the shallow Mudeung and Daegu soils.

Most of the areas are in forest, and a few small parts are cultivated to barley, sesame, red pepper, and similar crops. In managing this soil the main

concern is removing stones from plough layer, and raising the low fertility. Erosion hazard is severe and careful management is required. Bench terracing, contouring, and grassed water-ways will help its control in cultivated fields.

(Capability unit IVe; Paddy suitability group P4ac)

5.4.4 Banho Silt Loam, 2 to 7 Percent Slopes (BhB)

This deep, well drained fine loamy soil is on gently sloping mountain foot slopes. The surface layer is brown to dark brown, friable silt loam, but the profile of this soil otherwise is similar to the one described as representative for the series.

With this soil are included some areas of moderately deep soils derived from shale and sandstone, a few areas of the Daegu and Sirye soils, and some eroded areas.

The surface layer of the soil is in fair tilth, and the root zone is deep. Infiltration is slow, and runoff, medium. Most of the areas are cultivated to non-irrigated crops, but a few small areas are used for growing paddy rice in the summer and barley during the winter. The soil is suited to a wide range of crops and erosion is only a slight hazard.

(Capability unit IIe; Paddy suitability group P2ac)

5.4.5 Banho Silt Loam, 7 to 15 Percent Slopes (BhC)

This deep, well drained, fine loamy soil occurs on sloping mountain foot slopes and terraces, and has a brown to dark brown, friable silt loam surface layer. But the profile of this soil otherwise is similar to the one described as representative for the series.

Included with this soil are some areas of moderately deep soils derived from shale and sandstone and a few small areas of the Daegu and Sirye soil.

Infiltration is slow, and runoff is rapid. Tilth is fair, and root zone is deep. The hazard of erosion is moderate.

This soil is suitable for a wide range of crops. Most of the areas are cultivated to nonirrigated crops, but a few small areas on the lower position are irrigated from a reservoir to grow paddy rice in the summer after harvest of barley as a winter crop.

(Capability unit IIIe; Paddy suitability group P3ac)

5.4.6 Banho Silt Loam, 15 to 30 Percent Slopes (BhD)

This deep, well drained fine loamy soil is on moderately steep foot slopes and terraces. The profile of this soil is similar to the one described as representative for the series.

Included in this unit are some areas of moderately deep soils derived from shale and sandstone, and a few areas of the Daegu and Sirye soils. Some eroded areas are also included.

The strong slopes and slow infiltration make runoff rapid and the hazard of erosion severe, therefore it is not suited to regular cultivation of annual crops. It is however, suitable for mulberry, orchard, or pasture. About 30 percent of the area is wooded, and the rest is cultivated or left idle.

(Capability unit IVe; Paddy suitability group P4ac)

5.5 BEACH AND RIVERWASH, COBBLY (BRC)

This unit occupies about 1,706 ha of the area, chiefly in the upper valleys and along the Taehwa and Hoeya rivers, the Dongcheon and the East coast.

More than 90 percent of the total extant is composed of gravels and cobbles and the rest is made up of beach coarse sand and sandy river wash.

The gravels and cobbles are mainly granite and shale with occasional porphyry and sandstone. Some gabbro rocks can be found along the beaches.

Many dykes have been constructed to protect the arable land from flooding and to confine riverwash, cobbly, to the stream channels. These materials have a very adverse affect on agriculture on associated soils. Cobble and sand are deposited on them by flood waters. Small areas of other soils, sandy, stony and rocky, are included in this unit, because they could not be shown separately on the map.

These materials are sometimes used for construction purposes, such as road fill and subgrade, and can be a source of sand and gravel used for preparation of concrete for dam and bridge construction as well as other uses. Poplar tree and bamboo are grown to a limited extent.

(Capability unit VIII)

5.6 BEACH AND RIVERWASH, SANDY (BRS)

This unit occupies about 575 ha of the area and occurs along the Dongcheon, Taehwa and Hoeya rivers (and their tributaries), and along the East coast.

More than 90 percent of the total extent is mixed coarse to fine sand, sometimes stratified. Gravel and cobbles are sometimes mixed with the sand materials. It is also associated with recent alluvial soils on inland alluvial plains.

These sandy materials, when deposited during floods, have a very adverse affect on the agricultural value of good agricultural soils. Dykes are commonly constructed along the larger rivers to protect the arable land from flooding and to confine riverwash and sand to the stream channels.

Areas along fresh water rivers provide a source of sand for construction purposes, and in the hot season the areas of this unit adjacent to the East Sea are sometimes used for bathing and recreation purposes. To prevent streambank erosion and give some economic return , poplar trees and bamboo are sometimes grown, but yields are very low.

Small areas of gravelly and cobbly land are included in this unit because they could not be indicated on the map.

(Capability unit VIII)

5.7 BONGGYE SERIES

The Bonggye series consists of deep, well drained, fine clayey soils developed in residuum weathered from porphyry. These soils occur on sloping, moderately dissected hills and mountain foot slopes throughout the area. Depth to bedrock ranges from 2 to 5 m, but dominantly less than 3 m. This series is a member of the fine clayey family of Typic Hapludults.

A typical profile of Bonggye silty clay loam is:

Ap——0 to 6 cm; Yellowish red (5YR 4/6) silty clay loam; weak, fine medium granular structure; friable, sticky, and plastic.

B1——6 to 35 cm; Yellowish red (10YR 4/6) silty clay loam; weak, coarse subangular blocky structure; friable, sticky, and plastic.

B2——35 to 90 cm; Red (2.5YR 4/6) silty clay loam; crushed colour brownish yellow (10YR 6/8); weak coarse subangular blocky; friable; clay cutans.

B3——90 to 100+ cm; Yellowish red (5YR 4/6) silty clay loam; weak, coarse subangular blocky structure; friable, sticky, and plastic.

In the eroded areas the surface layer ranges from clay loam to silty clay loam containing gravels in some places and from yellowish red to red in colour. But, where only slightly eroded, it is brown to dark brown or strong brown. The subsoil is yellowish red to red silty clay loam or gravelly silty clay loam. The substratum is pale coloured, with fine loamy materials over the weathered bed rock which begins at 100 to 150 cm. The Bonggye soils differ from the Taehwa soils in having yellowish red to clay loam to silty clay loam subsoils rather than brown to dark brown silt loam to fine sandy loam subsoils. They are deeper and redder than the Mudeung soils.

Soils of the Bonggye series are strongly acid, low in natural fertility, and in organic matter content. They have high available moisture capacities. Cation exchange capacity is high and base saturation is low. Permeability is slow. They respond well to management, especially fertilization. Present vegetation is Korean pine and bushclovers. The less sloping areas are suited to cultivation for barley, wheat, bean, sweet potato, and similar crops.

5.7.1 Bonggye Silty Clay Loam, 7 to 15 Percent Slopes, Eroded (ByC2)

This moderately deep, well drained soil is on sloping, moderately dissected mountain foot slopes throughout the area. The profile of this soil is similar to the one described as representative for the series. The combined thickness of the A and B horizons is more than 100 cm.

This soil is suited to a wide range of crops, such as barley, wheat, soybean, potato, and buck wheat, but erosion is a severe problem when these crops are grown. It responds well to good management, especially fertilization. Present

vegetation consists chiefly of Korean pine and bushclovers. In managing it the main concern should be the control of erosion and improvement of fertility.

Included with this soil are some areas of Taehwa and Mudeung soils, and some areas of a soil that has a brown to dark brown, only slightly eroded surface layer. These soils are too small to be shown on the map as separate areas.

(Capability unit IIIe; Paddy suitability group P3b)

5.8 CHEONGOG SERIES

The Cheongog series consists of deep to very deep, well drained fine clayey soils formed in residuum derived from dark coloured basic crystalline material (gabbro), occurring around the iron mining areas in Cheongog-Ri north of Nongso Myeon and along a part of the east coast. These soils are on sloping to steep moderately dissected hills and low mountain sides. This series is a member of the fine clayey family to Typic Rhodudults.

The typical profile of Cheongog silty clay loam is:

A1—0 to 9 cm; Yellowish red (5YR 4/8) silty clay loam; moderate, very fine to fine granular structure; very friable, sticky, and plastic; many, fine pores; many, fine to very fine roots; gradual, smooth boundary; pH 6.0.

A3—9 to 29 cm; Dark red (2.5 YR 3/6) silty clay loam; moderate fine to medium subangular blocky breaking to very fine to fine granular structure; slightly firm, sticky, and plastic; many, fine pores; many, fine to very fine roots; gradual, smooth boundary; pH 5.5.

B1—29 to 64 cm; Dark red (2.5YR 3/6) silty clay loam; moderate, coarse, medium, and fine subangular blocky structure; firm, sticky, and plastic; patchy thin clay cutans; many, fine pores; many, fine to very fine roots; gradual, smooth boundary; pH 5.5.

B21—64 to 76 cm; Dark red (2.5YR 3/6) silty clay; strong, fine to medium, subangular to angular blocky structure; firm, sticky, and plastic; patchy thin clay cutans; common, very fine to fine, medium roots; clear, wavy boundary; pH 5.0.

B22—76 to 131 cm; Dark red (2.5YR 3/6) clay; moderate, coarse to fine angular blocky structure; very fine, sticky, and plastic; few, very fine pores; few, fine, medium roots; clear, wavy boundary; pH 5.0.

B23—131 to 180 cm; Dark red (2.5YR 3/6) and reddish black (10YR 2/1) clay; moderate, medium to very fine angular blocky structure; firm, sticky, and plastic; few, fine pores; few, fine, medium roots; pH 5.0.

Where eroded, the surface layer is yellowish red to dark red clay loam or silty clay loam, but is brown to dark brown or dark yellowish brown silt loam or clay loam in the slightly eroded areas. The subsoil ranges from dark red to dusky red in colour and from clay to silty clay loam in texture. The substratum is strongly weathered and clayey textured. The Cheongog soils are deeper and more dark coloured than Dalcheon soils.

These soils are strongly acid, and are low in natural fertility and in organic matter content. Permeability is slow. Available moisture capacity is medium to high. Cation exchange capacity is high and base saturation is medium.

Most of this soil is cultivated chiefly to barley, wheat, soybean, buckwheat, and similar crops. A few small areas are planted to rice, some areas are being mined for iron, and some small areas are in forest consisting chiefly of Korean pine.

5.8.1 Cheongog Silty Clay Loam, 15 to 30 Percent Slopes, Eroded, (CgD2)

This very deep, well drained, fine clayey soil occupies moderately steep, moderately dissected hills and low mountain sides in the northern part of Nongso-Myeon of the gun and along a part of the east coast.

The profile of this soil is like the one described as representative for the series. Included in this unit are some areas that are only slightly eroded. In these areas the surface layer is brown to dark brown silt loam to clay loam. Also included are small areas of the Bonggye soil, and some sloping or steep areas.

The Cheongog soils are cultivated chiefly to barley, wheat, and similar crops. A few small areas are planted to paddy rice. These soils are not well suited to paddy rice because of the moderately steep slopes. The main problem in managing these soils is controlling accelerated erosion. Contour tillage and bench terracing will assist in erosion control. Establishment of mulberry, orchard, and pasture also would help conserve the soils.

(Capability unit IVe; paddy suitability group P4ac)

5.9 CHUNDO SERIES

The Chundo series consists of deep, well drained, slightly acid to alkaline, fine clayey soils developed in old fluvio-marine deposits. These soils occur on gently sloping to sloping, slightly dissected old alluvial fan and low terraces chiefly along the east coast. This series is a member of the fine clayey family of Ultic Hapludalfs.

The typical profile of Chundo loam is:

Ap——0 to 18 cm; Dark brown (10YR 3/3) loam; moderate, fine to coarse granular structure; friable, sticky, and plastic; many, very fine to fine pores; few, fine roots; abrupt, smooth boundary; pH 8.5.

Al——18 to 46 cm; Very dark grayish brown (10YR 3/2) silty clay loam; weak, medium to coarse subangular blocky breaking to weak, medium granular structure; slightly firm, sticky, and plastic; many, fine to medium pores; few, fine roots; gradual, smooth boundary; pH 7.5.

Bl——46 to 60 cm; Dark brown (10 YR 3/3) silty clay; weak, medium to coarse subangular blocky breaking to fine granular structure; slightly firm, very sticky, and very plastic; few, fine roots; gradual, smooth boundary; pH 7.0.

B2——60 to 80 cm; Dark yellowish brown (10YR 3/4) silty clay loam; moderate, medium and coarse subangular blocky breaking to fine, subangular blocky structure; slightly firm, very sticky, and very plastic; many, very fine to fine pores; gradual, smooth boundary; pH 6.5.

B3——80 to 106 cm; Yellowish brown (10YR 5/4) silty clay; weak, medium to coarse breaking to fine subangular blocky structure; slightly firm, very sticky, and very plastic; common, very fine to fine pores; clear, smooth boundary; pH 6.0.

C1——106 to 150 cm; Grayish brown (10YR 5/2) loam; weak, very coarse subangular blocky structure; firm, sticky, and plastic; few, fine to medium pores; abrupt, smooth boundary; pH 6.0.

The Chundo soils have a surface layer of dark brown, dark grayish brown, or very dark grayish brown loam, clay loam, or silty clay loam. The subsoil is dark brown, yellowish brown or very dark yellowish brown silty clay, clay loam, or silty clay loam.

The C horizon ranges from loam to loamy sand to sand.

These soils differ from the Bancheon soils in reaction, and in having darker subsoil, and a more coarse C horizon.

The natural fertility is moderate, and organic matter content is medium. Available moisture capacity is high and permeability is moderately slow. Cation exchange capacity is high to medium, and base saturation is high. Depth to bedrock is very deep.

Nearly all of the areas are in cultivated crops, such as barley, wheat, soybean, etc. These soils will produce good crops of paddy rice if sufficient water is available. Deep ploughing and surface application of fertilizer is necessary for high yields. These soils respond well to good management.

5.9.1 Chundo Loam, 2 to 7 Percent Slopes (CdB)

This deep, well drained, moderately slowly permeable soil occupies gently sloping fans and low terraces along the east coast. The profile of this unit is similar to the one described as representative for the series.

Included in this unit are small areas that have a clay loam to sandy clay loam surface layer. Also included are some areas of lesser or greater slopes than the described range.

Most of this soil is in cultivated crops, such as barley, wheat, soybean, etc. The crop yields are high for these grain crops. This soil may be planted to paddy rice, but its yields would be moderate. In managing this soil the main concern is obtaining sufficient irrigation water and controlling overflow and erosion.

(Capability unit IIe; Paddy suitability group P2ac)

5.9.2 Chundo Loam, 7 to 15 Percent Slopes. (CdC)

This deep, well drained, moderately slowly permeable soil occupies sloping fans and low terraces near the east coast.

The profile is similar to the one described as representative for the series.

Most of this soil is planted to barley, wheat, soybean, and similar crops. A few small areas are cultivated to paddy rice. The crop yields are moderate. The main problem in managing this soil is to obtain sufficient irrigation water and to control erosion.

Included in this unit are small areas that have a clay loam or sandy clay loam surface layer. Also included are some areas of lesser or greater slopes than the described range.

(Capability unit IIIe; Paddy suitability group P3ac)

5.10 DAEGU SERIES

Daegu series consists of excessively drained, shallow, very rapidly permeable, fine loamy soils formed in residuum weathered from interbedded, gray shales. These soils occur on sloping to very steep mountainous areas. This series is a member of the loamy skeletal family of Lithic Eutrochrepts.

The typical profile of Daegu cobbly silt loam is:

All--0 to 4 cm; Yellowish brown (10YR 5/4), cobbly silt loam; moderate, very fine to fine granular structure; very friable and slightly sticky; many, fine to medium grass and pine roots; abrupt, smooth boundary; pH 5.5.

B--4 to 14 cm; Strong brown (7.5YR 5/6) gravelly clay loam; moderate, medium subangular blocky breaking to moderate, fine to medium granular structure; slightly firm, sticky, and plastic; common, fine pores; roots as above; clear, wavy boundary; pH 5.2.

B1--14 to 28 cm; Brown to dark brown (7.5YR 4/4) gravelly clay loam; moderate, medium subangular blocky breaking to moderate, fine to medium granular structure; slightly firm, sticky, plastic; many, fine pores; roots as above; few, fine, black concretions; clear, wavy boundary; pH 5.0.

C1--28 to 45 cm; Reddish brown (5YR 4/3) strongly weathered angular blocky shale material.

The surface soils are light yellowish brown, yellowish brown, brown, dark brown or strong dark brown, loam to silt loam and sometimes gravelly or rocky. Depth to bedrock ranges from 20 to 50 cm.

The Daegu soils differ from the Sirye soils in being shallow to hard rock. They occur on similar slopes as the Sirye in a fine complex pattern.

They are strong to medium in acidity and low in natural fertility and organic matter content. Available moisture capacity is low. Cation exchange capacity, and base saturation is medium to high. They are difficult to work, but respond well to fertilization.

The soils of Daegu series are mostly in mountainous areas, and occur in all parts.

Most of the area is in forest consisting chiefly of scattered pine trees, alders, and acacia.

5.10.1 Daegu Rocky Silt Loam, 7 to 15 Percent Slopes, Eroded, (DgC2)

This shallow, excessively drained, rocky soil occupies sloping hills and is scattered over the area. About 25 to 50 percent of the areas of this soil are bedrock exposures.

The profile of this unit other than in the bedrock areas is similar to the one described for the series. This unit includes small areas of soils that are deeper. Also included are small areas of gullied land, and some gently sloping areas.

Most of the areas are in forest consisting of small Korean pine trees, alders, and acacia. A few small areas are planted to barley and wheat.

This shallow soil is best suited to pasture and woodland. During seasons of low rainfall, pasture stops growing. Yields even under good management would be low due to limitations of available moisture capacity and natural fertility. In managing this soil the main problem is erosion control, stoniness, and shallow soil.

(Capability unit VIe)

5.10.2 Daegu Rocky Silt Loam, 15 to 30 Percent Slopes, Eroded (DgD2)

This shallow, excessively drained, rocky soil occupies moderately steep mountainous areas. About 25 to 50 percent of this area is rock outcrops.

The profile of the soil between rock outcrops is similar to that described as representative for the series.

This unit includes many shallow gullies and some severely eroded areas. Also included are small areas of soils that are deeper, and also some steep areas.

Nearly all of this soil is in forest consisting of small Korean pines with some acacia and alders. It is suited to woodland and pasture rather than agricultural crops. The soil of this unit is rather difficult to cultivate because of rock outcrops, steep slopes, and stoniness. The rapid surface runoff makes for a severe erosion hazard.

(Capability unit VIe)

5.10.3 Daegu Rocky Silt Loam, 30 to 60 Percent Slopes, Eroded (DgE2)

This shallow, excessively drained, slowly permeable soil occupies extensive tracts of steep to very steep, strongly dissected mountainous areas, and occurs throughout the area. About 25 to 50 percent of this area is rock outcrops.

The profile otherwise is similar to that described as representative for the series. Included in this unit are many shallow gullies and some areas of a severely eroded soil. Also included are small areas of the Mudeung and Sirye soils.

All of this soil is in poor pine forest with some alders and acacia, and grassland. Because of steepness and a severe hazard of erosion, crops are not

practical, but woodland is. Erosion is the main problem.

(Capability unit VIIe)

5.10.4 Daegu Rocky Silt Loam, 15 to 30 Percent Slopes, Gullied (DgD4)

The mapping unit consists of excessively drained soil that has about 25 to 50 percent rock outcrops and many shallow and deep gullies. The soil occupies extensive areas of sloping to steep hills and mountainous areas. Severe erosion has removed most of the A and B horizon.

Surface soil and reddish brown B horizon still remain in a few areas. The slightly weathered C horizon is variable in colour, reddish brown, light yellowish brown, yellowish red or reddish gray. Here the profile of this soil is similar to the one described for the series.

Surface runoff is very rapid, and erosion hazard is severe. All of the soil is in pine forest and grassland, and is suited to woodland and pasture in some sloping areas. The main problem is to retard runoff and control erosion.

(Capability unit VIIe)

5.10.5 Daegu Rocky Silt Loam, 30 to 60 Percent Slopes, Gullied (DgE4)

This soil occupies extensive tracts of the area on steep to very steep uplands, but otherwise is very similar to the Daegu rocky silt loam, 15 to 30 percent slopes, gullied (DgD4).

All is in poor pine forest and grassland. Because of steepness and a severe erosion hazard, pasture is not practical, but it is suited to woodland. The main concern in managing the soil is to control runoff and erosion.

(Capability unit VIIe)

5.10.6 Daegu-Sirye Complex, 7 to 15 Percent Slopes, Eroded (DSC2)

These two soils adjoin each other and are mapped as one unit. The Daegu soil has a cobbly silt loam surface layer, cobble clay loam subsoil and hard shale rock at a depth of less than 50 cm. The Sirye soil has a silt loam surface layer and a gravelly silty clay loam subsoil. The depth to hard rock is from 50 to 150 cm. About 60 percent is Daegu cobbly silt loam and 40 percent is Sirye silt loam. They occupy sloping, moderately dissected hills throughout the area.

The profiles of Daegu and Sirye soils are similar to those described as representive for their series. Soil profiles with characteristics intermediate between the Daegu and Sirye series are common in the transition zone. Some only slightly eroded areas are included in this mapping unit. Also included are amall gullied areas, and some areas of Daegu soil that have few or no cobblestones.

Most of the areas are in cultivated crops, such as barley and soybeans, and the remaining parts in pine forest. The crop yields are generally low, but they can be increased somewhat if good management is provided. The yields on areas

of Daegu soils are so because of low available moisture capacity. In managing this soil the main problem is controlling erosion and removing cobblestones from plough layer.

(Capability unit IVe)

5.10.7 Daegu-Sirye Complex, 15 to 30 Percent Slopes, Eroded (DSD2)

This complex consists of about 80 percent Daegu cobbly silt loam or loam and 20 percent Sirye silt loam or loam. These occupy moderately steep, strongly dissected mountainous areas.

The profiles of Daegu and Sirye soils are similar to those described as representative for their respective series except that in this unit the soils have a somewhat shallower surface layer.

Included in this complex are: small gullied areas and some severely eroded areas, some areas of Daegu soil that have little or no stones, small areas of Mudeung soil, and some steep areas.

Most of the areas are in pine forest. Bench terraces are used a little in the growing of barley, soybean, and similar crops. The main problem in managing this soil is to control accelerated erosion and to remove cobbles from plough layer. These soils should be protected from erosion by the cultivation of perennial close growing crops. The crop yields are generally low, but can be increased if good management is practised.

(Capability unit VIe)

5.11 DALCHEON SERIES

The Dalcheon series consists of deep, well drained, moderately slowly permeably, fine clayey soils. These soils formed in residuum weathered from acidic rocks, granite and granite-gneiss. They occupy sloping to steep, eroded hills and low mountain sides. This series is a member of the fine clayey family of Typic Hapludults.

The typical profile of the Dalcheon loam is:

A11——0 to 7 cm; Brown (7.5YR 5/4) loam; moderate, very fine to fine granular structure; very friable; many roots; abrupt, smooth boundary; pH 5.0.

A12——7 to 16 cm; Strong brown (7.5YR 5/6) loam; moderate, very fine to medium granular structure, friable, slightly sticky, and slightly plastic; many, fine pores; few, fine white mica; many roots; clear, wavy boundary; pH 5.5.

A3——16 to 25 cm; Strong brown (7.5YR 5/6) loam; weak, medium, subangular blocky breaking to moderate, fine to medium granular structure; friable, slightly sticky, and slightly plastic; many, fine pores; common, fine white mica; clear, wavy boundary; pH 5.5.

B21——25 to 33 cm; Yellowish red (5YR 5/6) loam; moderate, medium to coarse subangular blocky breaking to moderate, very fine subangular blocky structure; firm, sticky, and plastic; many, fine pores; patchy thin clay cutans; common, fine mica; clear, wavy boundary.

B22——33 to 50 cm; Yellowish red (5YR 4/6) clay loam; moderate, medium to coarse subangular blocky structure; firm, sticky, and plastic; common, fine to medium pores; patchy thin clay cutan; common, fine, white mica; clear, wavy boundary; pH 4.5.

C1——50 to 125 cm; Mottled brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) loam; extremely weathered massive granite-gneiss; firm; many, yellowish red clay flows and black manganese films on rock faces; common white feldspar crystal; greenish mica; pH 4.5.

The surface layer is brown, strong brown loam, or silt loam. The subsoil ranges from yellowish red to red in colour and from loam to silty clay loam or clay loam. Depth to bedrock ranges from 3 to 4 m.

The soils of the Dalcheon series differ from the Samgag soils in having a strong brown to yellowish red clay loam upper horizons over soft weathered saprolite. The entire profile of Samgag soils is similar to the C horizon of this series. These soils are strongly acid, low both in natural fertility, and organic matter content. They have a medium available moisture capacity. Cation exchange capacity is medium to high and base saturation is low.

Most of the areas are in forest consisting chiefly of pine trees, acacia, and alders with an understory of azalea. A few areas are in cultivated crops, such as barley, wheat, and cabbage.

5.11.1 Dalcheon-Samgag Complex, 7 to 15 Percent Slopes, Eroded (DGC2)

About 80 percent of the area is Dalcheon soil, and about 20 percent is Samgag soil. The Dalcheon soil occupies the sloping hills and low mountain sides, and the Samgag occurs on strongly dissected hills and mountainous areas.

The profiles of the soils in this complex mapping unit are similar to those described as representative for their respective series. Depth to hard rock ranges from 2 to 5 m. Some only slightly eroded areas with dark brown surfaces are included in this mapping unit, some small areas that have been severely eroded, and small areas with stones and rock outcrops.

Most of the areas are covered with pine forest. A few areas are planted to soybeans and buckwheat. The crop yields are low, but moderately high yields may be expected if bench terraces are constructed to control erosion and conserve available moisture.

This soil is suited to pasture and woodland. Some areas may be cultivated to paddy rice if paddies are constructed. Water losses through seepage may be high on the Samgag soil.

(Capability unit IVe; Paddy suitability group P4abc)

5.11.2 Dalcheon-Samgag Complex, 15 to 30 Percent Slopes, Eroded (DGD2)

These two soils occur in the same area in a fine pattern and are mapped as one unit. This complex consists of about 60 percent Dalcheon loam and about 40 percent Samgag coarse sandy loam.

They occupy moderately steep to steep, slightly to strongly dissected hills, low mountain sides, and mountainous areas.

The profiles have a slightly thinner surface layer than those described for their respective series. Soil profiles with characteristics intermediate between Dalcheon and Samgag series are common in the mapped areas. Depth to hard, underlying rock is commonly more than 2 m, but is occasionally less then 50 cm. The Samgag soil lacks the clay loam B horizon of the Dalcheon series. Included in the mapped regions are: some severely eroded areas, some small parts with dark brown surfaces that have not been eroded, some areas of rocky and stony soils, and some steep areas.

Most of this unit is covered by pine forest, and a few areas are cultivated to soybean and buckwheat.

The crop yields are very low. This soil is better suited to woodland than tilled crops but some areas may be cultivated to paddy rice if bench paddies are properly built and sufficient water is available. A good paddy system is difficult to establish and difficult to maintain on this moderately steep soil. In managing it the main problem is to control accelerated erosion.

(Capability unit IVe)

5.12 DALDONG SERIES

The Daldong series consists of neutral, deep, poorly drained, moderately permeable, fine silty soils. These are in the nearly level coastal plain chiefly along the east coast and Ulsan Bay. This series is a member of the fine silty over sandy, nonacid family of Aeric Fluventic Haplaquepts.

The typical profile of the Daldong silt loam is:

Ap1—0 to 15 cm; Dark grayish brown (2.5YR 4/2) silt loam with common, fine to medium, distinct mottles of yellowish brown (10YR 5/6); weak, fine to medium granular structure; friable, slightly sticky, and slightly plastic; many, fine to medium roots; abrupt, wavy boundary; pH 5.5.

Ag—15 to 20 cm; Very dark gray (5YR 3/1) silt loam with common, medium, prominent mottles of yellowish brown (10YR 5/6); weak, subangular blocky structure; slightly firm, slightly sticky, and slightly plastic; common, fine roots; abrupt, smooth boundary; pH 7.0.

B21—20 to 38 cm; Gray (10YR 5/1) silt loam with common, fine to medium, distinct mottles of dark yellowish brown (10YR 4/4); moderate, fine to coarse subangular blocky structure; slightly firm, sticky, and plastic; continuous, thin gray clay cutans; many, very fine to coarse pores; few, fine roots; diffuse, smooth boundary; pH 7.5.

B22—38 to 67 cm; Grayish brown (10YR 5/2) silt loam; with common, fine to medium, distinct mottles of dark yellowish brown (10YR 3/4); moderate, fine to coarse subangular blocky structure; slightly firm; continuous, thin, gray clay cutans; few, very fine to fine roots; diffuse, smooth boundary; pH 7.5.

C1—67 to 150 cm; Light gray to gray (5YR 6/1) fine sandy loam with common, medium to coarse distinct mottles of brown to dark brown (7.5YR 4/4); friable, non sticky, and non plastic; common, fine to medium pores; pH 7.9.

C2——150 to 200+ cm; Dark gray (2.5Y 4/0) fine sandy loam; pH 8.0.

The Daldong soils have a surface layer of grayish brown, dark grayish brown, dark yellowish brown silt loam, loam, or fine sandy loam.

The B horizon is gray, grayish brown, dark grayish brown, dark brown silt loam, light clay loam, or sandy loam, and extends from 40 to 120 cm. The C horizon is light gray, dark gray, grayish brown, or dark grayish brown fine sandy loam, silt loam, loamy sand, or sand. Some areas have sea shells in the profile.

The Daldong soils are coarser than the Deogha soils. They usually occur with the Hagseong soils. The surface soil is neutral to slightly acid, but the subsoil and substratum are moderately alkaline. The Daldong soils are high in natural fertility and low to medium in organic matter content. Available moisture capacity is medium to high. The base exchange capacity is moderately high, and it is well saturated with bases.

Nearly all of the areas are planted only to paddy rice. Some better drained areas are planted to paddy rice in the summer and barley during the winter. The principal crops are paddy rice, barley and a few field vegetables. The crop yields are moderately high.

5.12.1 Daldong Silt Loam, 0 to 1 Percent Slopes (Dd)

This deep, poorly drained, marine alluvial soil occupies large tracts of nearly level coastal plains mainly along the east coast and Ulsan Bay.

The profile is similar to the one described as representative for the series.

Included in this unit are some areas of better drained soils, and small areas that have silty to clay substratum. Also included are some areas that have a surface layer ranging from silty clay loam to sandy clay loam in texture, and some that have excessive amounts of sodium in the subsoil.

Most of the soil is cultivated only to paddy rice because of the poor drainage. Paddy rice and winter barley or wheat are grown each year in some better drained areas, but is it not suited to winter grain crops unless additional drainage systems are established. The cultivated area near the sea is not affected by high tide because of the dyke that has been constructed.

In managing this soil the main problem is drainage. Irrigation with fresh water is required to remove the sodium where there is high salt content. Because of poor drainage, most areas are suitable only for growing rice. Ditches will promote drainage and permit growing winter grain crops.

(Capability unit IIw; Paddy suitability group P1)

5.13 DEOGHA SERIES

The Deogha series consists of deep, poorly drained, slowly permeable, fine clayey soils developed in fluvio-marine materials. These soils occupy level to nearly level fluvio-marine plains, chiefly near the mouth of Taehwa River and along the coast of Ulsan Bay. This series is a member of the fine silty family of Fluventic Haplaquepts.

The typical profile of the Deogha silty clay loam is:

Ap——0 to 12 cm; Dark gray (10YR 4/1) and strong brown (7.5YR 5/4) silty clay loam; massive; friable, sticky, and plastic; pH 8.0.

Bg——12 to 24 cm; Dark gray (10YR 4/1) silty clay loam with many, medium distinct mottles of brown to dark brown (7.5YR 4/4); weak, medium prismatic structure; firm, sticky, and plastic; pH 8.0.

C1g——24 to 60 cm; Gray to grayish brown (2.5Y 5/1) silty clay loam or clay loam with few, fine and medium distinct mottles of yellowish brown (10YR 5/4) and (10YR 5/6); moderate, medium subangular blocky structure; firm, sticky, and plastic; pH 8.0.

C2——60 to 100 cm; Dark gray (N4) silty clay loam with few, medium, distinct mottles of strong brown (7.5YR 5/8); firm; sea shells; pH 8.0.

The surface layer is dark gray grayish brown to dark grayish brown silt loam, clay loam or silty clay loam. The subsoil ranges from silty clay loam to silty clay in texture. The substratum is gray to dark gray or grayish brown silty clay or clay, and occurs commonly below the ground water table at depths of 100 to 200 cm. Sea shells are common in the C horizon.

The Deogha soils are associated with the Daldong soils. They are finer in texture in the lower horizons than the Daldong.

The Deogha soils are medium acid to mildly alkaline in the surface layer and subsoil, moderately alkaline in the C horizon, moderate in natural fertility and low to medium in organic matter content. Available moisture and cation exchange capacity is high.

These soils are cultivated only to paddy rice because of the poor drainage. The rice yields are high.

5.13.1 Deogha Silty Clay Loam, 0 to 1 Percent Slopes (Dh)

This soil is the only mapping unit of the Deogha series in the area, and occupies a level to nearly level fluvio-marine plain, chiefly along the coast of Ulsan Bay. The profile of this soil is the one described for the series.

Included are: some areas of a silt loam surface layer over silty clay loam, and small areas with silt loam throughout the profile. This soil has a thick root zone, and is easy to work. The cultivated surface soil is not affected at high tide because of the dike. Surface runoff is very slow.

This soil is best suited to, and is used for paddy rice, but also would be suitable for non-irrigated crops if adequate drainage were provided.

(Capability unit IIIw; Paddy suitability group P1)

5.14 GWANGJU SERIES

The Gwangju series consists of very deep, well drained, slowly permeable fine clayey soils, developed in silty material over old alluvium. These soils occupy gently sloping to sloping, old alluvial pediplains chiefly in river

valleys throughout the area. This series is a member of the fine clayey family of Typic Hapludults.

The typical profile of Gwangju silty clay loam is:

A11——0 to 5 cm; Brown to dark brown (7.5YR 4/4) silty clay loam; moderate, very fine to fine granular structure; very friable, slightly sticky, and slightly plastic; many roots; clear, smooth boundary; pH 4.5.

A12——5 to 15 cm; Brown to dark brown (7.5YR 4/4) silty clay loam; weak, fine to medium subangular blocky breaking to moderate, fine granular structure; friable, sticky, and plastic; few, very fine pores; many roots; clear, smooth boundary; pH 4.5.

B1——15 to 55 cm; Yellowish red (5YR 4/6) silty clay; moderate, fine to medium subangular blocky structure; slightly firm, sticky, and plastic; common, very fine to fine pores; patchy, thin clay cutans; few roots; gradual, wavy boundary; pH 5.0.

B2——55 to 69 cm; Yellowish red (5YR 4/8) silty clay; moderate, fine to coarse subangular blocky structure; slightly firm, sticky, and plastic; common, very fine pores; few roots; clear, wavy boundary; pH 5.0.

IIB2——69 to 115 cm; Yellowish red (5YR 4.5/6) silty clay loam; strong, fine to coarse angular and subangular blocky structure; firm, very sticky and very plastic; very few pores; continuous, thin clay cutans; very few roots; gradual, wavy boundary; pH 5.0.

IIB3——115 to 170 cm; Red (2.5YR 4/8) to yellowish red (5YR 4/8) silty clay loam; moderate, very coarse prismatic structure breaking to moderate, angular and subangular blocky structure; very firm, very sticky, and very plastic; continuous fine clay cutans; very few pores; gradual, wavy boundary; pH 4.5.

IIC——170+ cm; Brownish yellow (10YR 6/6) silty clay loam; massive; firm, very sticky, and very plastic; common, continuous clay cutans; pH 4.5.

The surface layer is brown to dark brown silty clay loam or silty clay. The subsoil is yellowish red, strong brown, red, or dark red, and silty clay, silty clay loam, or clay. The C horizon is weathered old alluvial materials with silty clay loam or clay texture, and contains gravels or cobbles in some places.

The Gwangju soils occur with Bancheon, Jisan, and Hwadong soils and differ from the Bancheon soils in having a very silty surface layer.

The Gwangju soils are strongly acid, moderately fertile, and with medium organic matter content. Available moisture capacity is high. Cation exchange capacity is medium to moderately high, and base saturation is low.

Most of the areas are in cultivated crops, and a few small areas are in pine forest. Some areas on lower position are graded into paddies, being cultivated to paddy rice in the summer and to barley or wheat during the winter.

5.14.1 Gwangju-Bancheon Complex, 2 to 7 Percent Slopes (GBB)

This complex consists of about 70 percent Gwangju and about 30 percent Bancheon silty clay loams. These soils occupy gently sloping alluvial plains and terraces of river valleys.

The profiles are similar to the ones described for their respective series. Included with the soils of this complex are: some areas of a soil that have a silty clay surface layer, and clay subsoil, small areas that contain some gravels in the C horizon, small areas with level slopes, and small areas of Jisan and Hwadong soils.

Surface runoff is slow, and erosion hazard is slight.

These soils are well suited to non-irrigated crops or to paddy rice if a paddy system is established. Most of the areas are in non-irrigated crops, a few in paddy, and small areas in pine forest. Main concern in management is the control of erosion and the maintainance of a high fertility level.

(Capability unit IIe; Paddy suitability group P2ac)

5.14.2 Gwangju-Bancheon Complex, 7 to 15 Percent Slopes (GBC)

This complex consists of about 60 percent Gwangju and about 40 percent Bancheon silty clay loams. These soils occur in the mapped areas in a fine intricate pattern, occupying sloping terraces chiefly in valleys of the Taehwa, Haeya, and Dongcheon rivers.

The profiles are very similar to those described for their respective series. Included with the soils of this complex are: some areas of a soil with silty clay surface layer, and a soil with yellowish red to red or dark red clay, silty clay or silty clay loam subsoil, small areas that contain stones, and small areas of Jisan and Hwadong soils, with some eroded areas.

Surface runoff is slow, and erosion hazard is slight.

These soils are suited to cultivation, and paddy rice can be grown if a paddy system is made. Most of the areas are in cultivated crops, such as barley, wheat, and buckwheat. A few small areas are in forest chiefly consisting of pines. Erosion control is the principal problem in maintaining the productivity of the soil. Bench terraces and grassed waterways will reduce erosion losses to safe levels.

(Capability unit IIIe; Paddy suitability group P3ac)

5.14.3 Gwangju-Bancheon Complex, 7 to 15 Percent Slopes, Eroded (GBC2)

This complex, consisting of about 60 percent Gwangju and about 40 percent Bancheon eroded soils, occupies small tracts of sloping terraces and alluvial fans chiefly in the river valleys of Taehwa, Haeya and Dongcheon rivers.

The profiles of this mapping unit are like the ones described for their respective series except that the surface layer is very thin or absent in cultivated areas. There are many shallow gullies and a few deep ones.

Included are some areas of soils with gravelly silty clay loam or silty clay surface layers, with yellowish red to red or dark red silty clay, silty clay or clay subsoil, and areas that contain gravel in the C horizon with small areas of Jisan and Hwadong soils.

Surface runoff is slow, and erosion hazard is severe.

The soils of this unit are well suited to the Pine Forest growing there. Non-irrigated crops and paddy rice can be grown if special management is provided, but that is not recommended. A few small areas are planted to barley during the winter and to paddy rice in the summer. Some terraces are being used to reduce soil losses while growing barley, wheat, potatoe, sesame, and other similar crops. The main problem in management is controlling accelerated erosion and increasing fertility.

(Capability unit IIIe; Paddy suitability group P3ac)

5.15 HAGSEONG SERIES

The Hagseong series consists of deep, poorly drained, moderately permeable, fine silty soils formed in fluvio-marine materials. These soils occupy level to nearly level fluvio-marine plains mainly along the coast of Ulsan Bay. This series is a member of the fine silty over sandy, nonacid family of Fluventic Haplaquepts.

The typical profile of the Hagseong silt loam is:

Ap——0 to 14 cm; Brown to dark brown (10YR 4/3) silt loam; common, fine and medium, distinct dark gray (5Y 4/1), dark yellowish brown (10YR 4/4) mottles; weak, fine and medium granular; friable, sticky, and plastic; few, very fine pores; many, fine and medium roots; diffuse, smooth boundary; pH 6.5.

B11——14 to 25 cm; Very dark grayish brown (2.5Y 3/2) silt loam; few, fine and medium, faint yellowish brown (10YR 5/4) mottles, coarse subangular blocky; friable, sticky, and plastic; few, very fine and fine pores; very few and very fine mica; common, fine and medium roots; diffuse, smooth boundary; pH 8.0.

B12—— 25 to 39 cm; Dark gray (5Y 4/1) silt loam; common, fine and medium, prominent dark yellowish brown (10YR 4/4) mottles; dark grayish brown (2.5Y 4/2) crushed colour; moderate, fine to coarse subangular blocky; slightly firm, sticky, and plastic; common, fine and medium pores; very few and very fine mica; few roots; clear, smooth boundary; pH 8.0.

B21g——39 to 47 cm; Grayish brown (2.5Y 5/2) silt loam; many, fine and medium, distinct strong brown (7.5YR 5/6) mottles; moderate, fine to coarse subangular blocky; slightly firm, slightly sticky and slightly plastic; common, fine and medium pores; very few, very fine mica; few roots; clear, smooth boundary; pH 8.2.

B22g——47 to 56 cm; Grayish brown (2.5Y 5/2) silt loam; few, fine and medium faint dark yellowish brown (10YR 4/4) mottles; moderate fine to coarse subangular blocky; firm, slightly sticky, and slightly plastic; common, fine and medium pores; very few and very fine mica; roots; clear, smooth boundary; pH 8.2.

B3g——56 to 68 cm; Grayish brown to dark grayish brown (2.5Y 4.5/2) loam; common, fine and medium distinct yellowish brown (10YR 5/8) mottles; moderate, fine and medium subangular blocky; firm, slightly sticky, and slightly plastic; common pores; very few and very fine mica; clear, smooth boundary; pH 8.3.

C1g——68 to 95 cm; Very dark gray (5Y 3/1) silt loam; massive; firm, slightly sticky, and slightly plastic; few, fine and medium discontinuous vertical random pores; very few, very fine mica; clear, smooth boundary; pH 8.0.

C2g——95 to 120 cm; Dark olive gray (5Y 3/2) loamy sand; single grain; very few, very fine mica; pH 8.5.

The surface layer ranges from olive gray to grayish brown or very dark grayish brown in colour, and from silt loam to loam or silty clay loam in texture. The C horizon is dark gray to gray or very dark gray silt loam, loam, loamy sand or sand, and contains some sea shells. The ground water table generally begins about 50 cm below the surface.

The surface layer is slightly acid to mildly alkaline, and the C horizon is moderately alkaline. These soils are medium to high in natural fertility, and are medium to low in organic matter content. Available moisture capacity is moderate to high. Cation exchange capacity is high and it is well saturated with bases. Because of the poor drainage and high ground water table, paddy rice is the only crop planted on this soil.

The Hagseong soils are associated with the Daldong and Deogha soils.

5.15.1 Hagseong Silt Loam, 0 to 1 Percent Slopes (Ho)

This deep, poorly drained, moderately slowly permeable fine silty soil occupies level to nearly level fluvio-marine plains chiefly along the coast of Ulsan Bay and near the mouth of Taehwa River.

The profile of this unit is as representative for the series. Some areas that have a surface layer of brown to dark brown silt loam or clay loam are included in this mapping unit. Excessive salts are not a general problem on this soil. Also included are small areas of the Sindab, Honam, Daldong, and Deoghwa soils.

All of the areas are in paddy fields, for with the poor drainage it is suitable only for growing rice. The cultivated areas near the sea are not affected by high tide because of the dyke, but the paddy fields should be frequently irrigated with fresh water to remove the salty materials.

(Capability unit IIw; Paddy suitability group P1)

5.16 HOGYE SERIES

The Hogye series consists of deep, well drained, moderately permeable, loamy skeletal soils that formed in recent alluvium. These soils are in nearly level to sloping slightly elevated alluvial fans and local valleys in mountainous areas north-east of Ulsan Si. This series is a member of the loamy skeletal family of Fluventic Hapludolls.

The typical profile of Hogye gravelly loam is:

Ap——0 to 9 cm; Dark yellowish brown (10YR 3/4) gravelly loam; weak, fine to medium granular structure; friable, slightly sticky, and slightly plastic; very few, fine pores; common, very fine roots; clear, smooth boundary; pH 5.2.

A12——9 to 35 cm; Dark brown (10YR 3/3) gravelly silt loam; weak, fine to coarse subangular blocky structure; slightly firm, slightly sticky, and slightly plastic; patchy, thin clay cutans; many, very fine to coarse pores; common, very fine roots; clear, wavy boundary; pH 5.7.

C1——35 to 77 cm; Dark brown (10YR 3/3) very gravelly to cobbly loam; massive; friable, slightly sticky, and slightly plastic; few, very fine pores; abrupt, smooth boundary; pH 6.3.

C2——77 to 100+ cm; Very gravelly layer; pH 7.0.

The surface layer ranges from dark yellowish brown to dark brown, except for rice paddies where it ranges from dark grayish brown to dark gray or gray in colour. The texture ranges from gravelly silt loam to gravelly loam or gravelly sandy loam. The C horizon is dark brown, dark grayish brown gravelly to very gravelly silt loam, loam, light clay loam or sandy loam. There are few cobbles and stones in the upper horizons, but in the lower horizons they are the principal component of the soil.

The Hogye soils are strongly acid, and are moderate in natural fertility and high in organic matter content. Available moisture capacity is low to medium. Cation exchange capacity is moderately low, and base saturation is medium to high.

The Hogye soils are suited to cultivation, and most of the areas are planted to grain crops and vegetables. Some areas with nearly level slopes are planted to paddy rice in the summer and to barley or wheat during the winter. Pine trees, bamboo, and cotton are growing in some places. Crops on these soils respond to good management.

5.16.1 Hogye Gravelly Loam, 2 to 7 Percent Slopes (HgB)

This deep, well drained, moderately permeable, alluvial soil occupies nearly gently sloping, alluvial plains and local valleys along the Dongcheon River.

The profile is similar to the one described for the series. Included with this soil are: a few small areas that have a surface layer from which most gravel has been removed by farmers, some areas of the sandy soils with and without gravel, and small areas that have a very gravelly to very cobbly loam surface layer.

Most of the areas of this soil are cultivated, and some areas that are nearly level are planted to paddy rice and winter grain crops in a two crop a year cropping system. The soil is well suited to non-irrigated crops, and paddy rice can be grown on it. But it is not recommended to grow paddy rice because of high seepage losses. Pine tree and bamboo are growing in some places, and a few areas are planted to cotton.

The removal of stones from the plough layer will facilitate tillage and improve yields.

(Capability unit IIs; Paddy suitability group P4abc)

5.16.2 Hogye Gravelly Loam, 7 to 16 Percent Slopes (HgC)

This deep, well drained, moderately permeable, gravelly fine loamy soil, occupies sloping alluvial plains and local valleys in mountainous areas near the Dongcheon, northeast of the Ulsan Si.

The profile is as described for the series.

Included are a few areas that have a surface layer from which most stones have been removed by farmers. Also included area small areas that have a very gravelly to very cobbly loam surface layers, and some small areas of the sandy soils.

It is mainly planted to vegetable and grain crops other than paddy rice. Because of steep slopes and rapid permeability is is not suitable for paddy rice. Drought resistant crops adapt best. Some areas are covered by Korean pine trees and bamboo. The main problem in managing this soil is the removal of stones and the control of erosion.

(Capability unit IIIe; Paddy suitability group P4abc)

5.17 HONAM SERIES

The Honam series consists of deep, poorly drained, slowly permeable, fine clayey soils formed in alluvium. These soils occur on level to gently sloping alluvial plains chiefly in the western parts of the area. This series is a member of the fine clayey family of Typic Ochraqualfs.

The typical profile of the Honam silt loam is:

Ap——0 to 10 cm; Gray (5Y 5/1) and dark grayish brown (10YR 4/2) silt loam and loam with many, medium faint mottles of strong brown (7.5YR 5/6); massive; friable, slightly sticky, and slightly plastic; pH 5.5.

B21t——10 to 70 cm; Gray (5YR 5/1) clay loam with common, medium, distinct mottles of dark reddish brown (2.5YR 2/4); strong, coarse angular blocky structure; slightly firm, sticky and plastic; common, medium pores; pH 7.5.

B22t——70 to 100+ cm; Grayish brown (2.5Y 5/2) clay with common, fine, distinct mottles of light yellowish brown (10YR 6/4); slightly firm, sticky, and plastic; pH 8.0.

The surface layer is gray, dark grayish brown, or very dark grayish brown silt loam, loam or clay loam. The B horizon is gray, grayish brown or very dark gray clay loam, clay, or loam with mottles of dark grayish brown or dark reddish brown. It contains coarse fragments and manganese concretions. The C horizon is more variable in colour and mottling than in the upper horizon.

The Honam soils are less drained than the Bancheon soils. These soils usually occur as poorly drained areas with the Hwadong soils and are mapped only in a complex with the Hwadong soils.

They are medium to strongly acid, moderate in natural fertility and medium in organic matter content. Available moisture capacity is high. Cation exchange capacity and base saturation are high.

The greater part of these soils are in paddy, and are cultivated to paddy rice. Barley and wheat are grown in a few areas with better drainage. Crops grown on these soils respond well to good management.

5.18 HWABONG SERIES

The Hwabong series consists of deep, excessively drained, very rapidly permeable, sandy soils developed in recent alluvium. These soils are in level to gently sloping flood plains mainly adjacent to Taehwa river channels. This series is a member of the sandy family of Typic Udipsamments.

The typical profile of the Hwabong loamy sand is:

Ap——0 to 11 cm; Brown to dark brown (10YR 4/3) loamy sand; weak, granular structure; very friable, few, very fine to fine pores; many, fine, white mica; many, very fine to medium roots; abrupt, smooth boundary.

C1——11 to 150+ cm; Yellowish brown (10YR 5/4) sand; single grain; loose; pH 6.7.

The Hwabong soils have a surface layer of brown, dark brown, yellowish brown or dark yellowish brown loamy sand or sand. The C horizon is yellowish brown, dark yellowish brown or very pale brown sand, coarse sand and occasionally gravelly sand.

These soils are associated with Hwangryong soils and Riverwash sandy, and they differ from the Hwangryong soils in being free of gravel throughout the profile.

The Hwabong soils are slightly acid to neutral, and low in natural fertility and in organic matter content. Available moisture capacity and cation exchange capacity are very low and the soils are rapidly permeable.

Most of the areas of this soil are planted to grain crops and vegetables other than paddy rice. Mulberry, poplar, and chestnut trees are grown in some areas.

5.18.1 Hwabong Loamy Sand, 0 to 2 Percent Slopes (Hw)

This deep, excessively drained, very rapidly permeable sandy soil occupies nearly level flood plains near the Taehwa River channels. It has a profile similar to the one described for the series. Some areas that have thin strata of very gravelly loamy sand are included in the mapped areas. Also included are small areas of riverwash sandy and some areas that have a surface layer of very gravelly coarse sand.

The area is generally planted to grain and vegetable crops, but poplars, mulberry, and chestnut trees are growing too.

Unless large amounts of water are available, this soil is not suitable for paddy rice because of the very rapid permeability and excessive drainage. It is suited to wheat, rye, and barley. Melons yield well. Special management practices are needed to lessen the effects of droughtiness, leaching of plant nutrients, low fertility, and erosion.

(Capability unit IVs; Paddy suitability group P4bc)

5.19 HWADONG SERIES

The Hwadong series consists of very deep to deep, moderately well drained, slowly permeable, fine clayey soils developed in old alluvium. These soils occupy nearly level to gently sloping, slightly dissected low terraces and alluvial plains chiefly in the western parts of the gun. This series is a member of the fine clayey family of Aquic Hapludalfs.

The typical profile of Hwadong silty clay loam is:

Ap1—0 to 10 cm; Brown to dark brown (10YR 4/3) silty clay loam with common, coarse distinct mottles of yellowish red (5YR 4/6); weak, medium to coarse subangular blocky structure; friable, sticky, and plastic; few, medium pores; many, very fine to medium roots; clear, smooth boundary; pH 6.4.

B1—10 to 20 cm; Grayish brown to dark grayish brown (10YR 4.5/2) silty clay loam with common, coarse, distinct mottles of dark reddish brown (2.5YR 3/4) and yellowish red (5YR 5/8); weak, medium to coarse subangular blocky structure; firm, sticky, and plastic; common pores; few, very fine roots; clear, wavy boundary; pH 6.2.

B21t—20 to 39 cm; Yellowish brown (10YR 5/4) silty clay loam with few, medium distinct mottles of yellowish red (5YR 4/8); moderate, medium subangular blocky breaking to fine subangular blocky structure; friable, sticky, and plastic; many, fine pores; few, very fine roots; abrupt, smooth boundary; pH 6.5.

B22t—39 to 62 cm; Strong brown (7.5YR 5/6) silty clay with common, coarse, distinct mottles of pale brown (10YR 6/3) and few mottles of brownish yellow (10YR 6/6); patchy thin clay cutans; friable, very sticky, and plastic; many, fine to medium pores; very few, very fine roots; abrupt, smooth boundary; pH 6.6.

B3g—62 to 120 cm; Light gray (10YR 7/1) silty clay loam with common, coarse distinct mottles of brownish yellow (10YR 6/6) and few mottles of reddish yellow (5YR 6/6) on ped faces; weak, coarse subangular blocky structure; firm, very sticky and very plastic; few, medium pores; pH 6.3.

The Hwadong soils have a surface layer of brown to dark brown, grayish brown to dark grayish brown, yellowish brown or gray silty clay loam, silt loam, or clay loam. The B horizon is strong brown, yellowish red silty clay, silty clay loam or clay in the upper part, and has mottles of pale gray, light gray brownish yellow, reddish yellow, strong brown, yellowish brown or grayish brown in the lower part.

The Hwadong are less drained than the Bancheon soils, and have gray mottles in the lower subsoil that are not present in the Bancheon, but are better drained and less mottled than the Honam soils. These usually occur with the Bancheon and Honam soils.

The Hwadong soils are medium to strongly acid, moderate in natural fertility, and medium in organic matter content. Available moisture capacity is high. Cation exchange capacity and base saturation are high.

Most of the areas are cultivated to paddy rice in the summer and to barley or wheat in the winter each year. The principal crops grown are rice, barley, wheat, and vegetables.

5.19.1 Hwadong-Honam Complex, 2 to 7 Percent Slopes (HHB)

This complex is made up of about 70 percent Hwadong and 30 percent Honam soils. Both are so intricately mixed that they cannot be separated at the map scale used.

They occupy gently sloping low terraces and alluvial plains chiefly in western parts of the area. The Honam soil usually occurs on lower positions than the Hwadong series.

The profiles of the soils are similar to those described as representative for their respective series. Included are small areas of the Jisan and Tongcheon soils, some areas that have a clay loam surface layer, and some areas of nearly level soils.

Most of the areas are planted to paddy rice in the summer and to barley during the winter. The crop yields are moderately high. A few areas of Honam soil with poor drainage are planted only to paddy rice. Response to added lime or fertilizer is good. The main concern of management is to improve the drainage in the Honam, and to control erosion in the Hwadong soil.

(Capability unit IIe; Paddy suitability group P2ac)

5.19.2 Hwadong-Honam Complex, 7 to 15 Percent Slopes (HHC)

These soils are on gently sloping to sloping terraces and alluvial plains adjacent to the larger streams in the area.

The profiles are like those described as representative for their respective series. In some places the subsoil is a gravelly clay loam. Included in this unit are small areas of the Hwangryong, Tongcheon, and Bancheon soils, and some areas with clay loam or loam surface layer.

Most of the areas are planted to paddy rice and winter barley in a two crop a year cropping system. Response to added lime and fertilizer is good. Erosion hazard is the main problem in management.

(Capability unit IIIe; Paddy suitability group P3ac)

5.20 HWANGRYONG SERIES

The Hwangryong series consists of deep, excessively drained, very rapidly permeable, sandy skeletal soils formed in alluvium on level to nearly flood plains chiefly along the major rivers in the area. This series is a member of the sandy skeletal family to Typic Udipsamments.

The typical profile of Hwangyong gravelly sandy loam is:

Ap1——0 to 12 cm; Light olive brown (2.5Y 5/4) fine sandy loam with few, fine distinct strong brown (7.5YR 5/6) mottles; single grain; friable; common, fine roots; many, random pores; few, very fine yellow mica; clear, smooth boundary; pH 5.2.

Ap2——12 to 32 cm; Mottled, strong brown (7.5YR 5/8) and pale olive (5Y 6/4) coarse sandy loam; weak, medium to coarse blocky breaking to fine to medium granular structure; friable; few, fine roots; few mica; few, fine pores; abrupt, smooth boundary; pH 5.9.

C1——32 to 100 cm; Light olive brown (2.5Y 5/4) gravelly coarse sand; single grain; very friable.

The surface layer ranges in colour from brown to dark brown, but in rice paddy ranges from grayish brown to very dark grayish brown. Texture of the surface layer is sandy loam to loamy sand or gravelly sandy loam to gravelly loamy sand. Gravels and cobbles have been removed from the surface of many areas to permit easier cultivation.

The C horizon is yellowish brown to dark yellowish brown or grayish brown in paddy, and ranges from very gravelly sand to very gravelly loam. It usually begins at depth of about 30 to 50 cm below the surface. The Hwangrong soils are not uniform in profile, and are stratified in many places because they have been deposited by floodwaters.

These are usually associated with the Hwabong soils and Riverwash sandy. They contain gravels in the C horizon that are not present in the Hwabong soils, and are more rapidly permeable than the Hogye soils.

The Hwangryong soils are neutral to medium acid and are low in natural fertility and organic matter. Available moisture capacity is very low. Cation exchange capacity is low and base saturation is high.

These are mostly in rice paddy, and some areas are cultivated to non-irrigated crops such as barley, wheat or vegetables. Paddy rice and winter grain crops are grown in a few small areas in a two crop a year cropping system.

5.20.1 Hwangryong Gravelly Loamy Sand, 0 to 2 Percent Slopes (HI)

This deep, excessively drained, very rapidly permeable, sandy skeletal soil occupies level to nearly level flood plains chiefly along the major rivers in the area.

The profile is similar to the one described for the series except for having a gravelly surface layer. There is much variation in the soils of this mapping unit. Included are soils with much more silt and clay than typical for the Hwangryong series, some areas of gently sloping soils, and a few areas of the soils with sand substrata.

Most of the areas are cultivated to paddy rice; while some areas are used for growing barley and wheat. It is suited to growing poplars. A few small areas are cultivated to paddy rice and barley in a two crop a year cropping system.

Lack of soil moisture is a problem on most areas of this soil. Deep rooted legumes like alfalfa and lespedeza are able to root down to the water table. Melons and similar crops will grow well, but cultivation is difficult because of the stones.

The areas of more silty and clayey textures included in this mapping unit are much more productive than typical areas and have a greater potential use.

(Capability unit IVs; Paddy suitability group P4bc)

5.20.2 Hwangryong Sandy Loam, 0 to 2 Percent Slopes (Hk)

This deep, excessively drained, and sandy soil is on level to nearly level flood plains mainly along the major rivers of the area. The profile of this soil is similar to the one described as representative for the series. Gravels and cobbles have been removed from the surface for easier cultivation.

Included with this soil are: some areas of loamy sand or loam surface layer, some areas having much more silt and clay than the typical ones for the series and some areas of greater slopes than the described range.

The surface layer generally is in good tilth, and the root zone is thin. Infiltration is high, runoff is slow.

The gravel-free Hwangryong soil is suited to growing poplars, but most of the areas are in paddy rice, with a few small parts being cultivated to barley or wheat and other similar crops.

Lack of soil moisture and frequent flooding are management problems on most areas.

The areas of more silty and clayey soils included in this mapping unit are most productive and have a greater potential for crop production than the typical Hwangryong soils.

(Capability unit IVs; Paddy suitability group P4bc)

5.21 IWEON SERIES

The Iweon series consists of deep, well drained, moderately permeable, stony sandy loam to stony loam soils developed in old alluvium-colluvium washed from areas underlain by granite. These occur on gently sloping to moderately steep, dissected colluvial slopes, mountain foot slopes, and terrace edges. They are generally in fans and footslopes below the Samgag and Dalcheon types. This series is a member of the coarse loamy family of Typic Dystrochrepts.

The typical profile of the Iweon stony sandy loam is:

A1——0 to 12 cm; Yellowish brown (10YR 5/4) sandy loam; moderate, very fine to medium granular structure; very friable, slightly sticky, and non plastic; few, very fine, pores; many, fine to medium roots; clear, wavy boundary; Ph 4.5.

A3——12 to 27 cm; Brown to dark brown (10YR 4/3) stony loam; moderate fine to medium granular structure; friable, slightly sticky, and slightly plastic; common, fine to very fine pores; many, fine to medium roots; clear, wavy boundary; pH 4.5.

B21——27 to 56 cm; Strong brown (7.5YR 5/8) gravelly sandy loam; moderate, fine to medium subangular blocky breaking to weak, fine to very fine granular structure; slightly firm, slightly sticky, and slightly plastic; common, fine to medium pores; common, fine to medium roots; clear, wavy boundary.

B22——56 to 81 cm; Strong brown (7.5YR 5/6) stony sandy loam; moderate, fine to medium subangular blocky structure; slightly firm, slightly sticky, and slightly plastic; common, very fine to medium pores; few, fine to medium roots; diffuse, smooth boundary; pH 4.7.

C1——81 to 110 cm; Brownish yellow (10YR 6/8) loam with common, medium mottles of strong brown (7.5YR 5/8); massive; very firm, slightly sticky, and alightly plastic; patchy thin cutans; many, very fine to medium pores; very few, medium roots; pH 5.0.

The A horizon ranges in colour from brown to dark brown or yellowish brown, in areas not used for growing paddy rice, but is gray, dark gray, or grayish brown, and mottled with strong brown, in areas regularly planted to paddy rice. The textures are sandy loam, stony sandy loam, stony loam, and stony silt loam. The B horizon is strong brown, yellowish brown, yellowish red in non-irrigated areas, and grayish brown, brown, or dark brown, with mottles of strong brown in rice paddy. The C horizon ranges from brownish yellow to reddish yellow or yellowish brown in colour, and from loam to very stony coarse sandy loam or very gravelly loam in texture. Depth to bedrock ranges from 1 to 6 m. The Iweon series differs from the Banho series in coarser sandy loam textures.

The Iweon soils are strongly acid, and low in natural fertility and in organic matter content. Available moisture capacity is low or medium. The cation exchange capacity is medium to low and has a low saturation with bases.

Most areas are planted to barley, wheat, and paddy rice.

The rest of the areas is chiefly in pine forest. Crop yields are generally low.

5.21.1 Iweon Stony Sandy Loam, 2 to 7 Percent Slopes (IwB)

This deep, well drained, moderately permeable, fine loamy soil occupies gently sloping mountain foot slopes. It has a profile similar to the one described for the series, but stone content of the A1 horizon varies from almost none to very many. It is sometimes free of gravel and cobble throughout the profile. Included in this unit are: some areas that have a surface layer of gravelly loam and stony silt loam or loam with mottles of strong brown, many areas of eroded soil, and a few small areas of Samgag and Dalcheon soils.

Generally the soil is cultivated to barley, wheat or other non-irrigated crops, to which it is well suited. The eroded areas are not suitable for cultivation, but well suited to woodland, and are mostly in pine forest. Some areas on lower positions are used to grow paddy rice in the summer and barley or wheat in the winter.

Control of erosion, removal of stones from plough layer, and low available moisture are the chief problems in management.

(Capability unit IIe; Paddy suitability group P4abc)

5.21.2 Iweon Stony Sandy Loam, 7 to 16 Percent Slopws (IwC)

This deep, well drained, moderately permeable coarse sandy loam soil occupies sloping, dissected colluvial slopes, mountain foot slopes and terrace edges. In many areas the surface layer is gravelly to stony . Otherwise, the profile of this soil resembles the one described as representative for the series. Included in the areas mapped are: some of a stone-free sandy loam surface layer, small areas with a surface layer of gravelly loam and stony silt

loam or loam with few mottles of strong brown, small areas of the Samgag and Dalcheon soils, and small areas of yellow gravelly and cobbly sandy loam surface layer.

Nearly all of this soil is suitable for growing the non-irrigated crops now being cultivated. Some areas are used to grow paddy rice after winter crops, such as barley or wheat. Erosion hazard is the chief problem in management. Removal of stones from plough layer will facilitate cultivation.

(Capability unit IIIe; Paddy suitability group P4abc)

5.21.3 Iweon Stony Sandy Loam, 15 to 30 Percent Slopes (IwD)

This deep, well drained, moderately permeable coarse sandy loam soil is in moderately steep, dissected colluvial slopes, mountain foot slopes and terrace edges. In most places the surface layer is gravelly to stony. Otherwise it has a profile similar to the one described as representative for the series. In some areas it is free of gravels and cobbles throughout the profile.

Included with this soil are: small areas of the Samgag and Dalcheon soils, small areas of yellow gravelly and cobbly sandy loam surface layer, and a gravelly loam or stony silt loam surface layer.

The soil is cultivated to soybeans, winter barley, or other non-irrigated crops. Crop yields are generally low. In a few places paddy rice is grown in the summer following barley during the winter, and there is a little pine forestry.

The main problems of management are; erosion control, removal of stones, and leaching of crop nutrients.

(Capability unit IVe; Paddy suitability group P4abc).

5.22 JEONGJA SERIES

The Jeongja series consists of shallow, excessively drained, fine loamy soils formed in residuum weathered from basic crystalline rocks. These soils occur on steep to very steep, strongly dissected mountainous areas chiefly limited to Gangdong Myeon area along a part of the east coast. This series is a member of the fine loamy family of Lithic Eutrochrepts.

The typical profile of the Jeongja rocky loam is:

A11—0 to 11 cm; Dark reddish gray (5YR 4/2) gravelly to cobbly loam; weak, medium and coarse, subangular blocky structure breaking readily to moderate, fine granular; friable, slightly sticky, and plastic; common, fine and medium pores; about 15 percent slightly weathered gravel and angular and subangular gabbro cobbles; many, fine medium and coarse roots; gradual, smooth boundary; pH 6.0.

A12—11 to 38 cm; Dark reddish brown (5YR 3/2) gravelly and cobbly clay loam; moderate, fine and medium granular structure; friable, slightly sticky, and plastic; few, fine pores; many, fine and medium roots; abrupt, smooth boundary; pH 6.0.

R— —38+ cm; Hard gabbro bedrock materials.

Where eroded, the Jeongja soils have a surface layer of dusky red to reddish brown rocky loam to rocky clay loam. In the only slightly eroded areas the surface layer is brown to dark reddish brown. The substratum is dark coloured gabbro at depths of less then 100 cm.

The Jeongja soils are associated with the Sinhyeon and Sinjeong soils. They are underlain by basic crystalline rocks while the Mudeung soils are over porphyry.

These soils are medium acid, and are moderately low to low in natural fertility, and medium to low in organic matter content. Available moisture capacity is low, and permeability is moderately rapid. Cation exchange capacity is low to medium, and base saturation is low.

Nearly all is in Korean pine forest with a few small areas cultivated to barley or wheat. But these soils are better suited to woodland use.

5.22.1 Jeongja Rocky Loam, 30 to 60 Percent Slopes, Eroded (JjE2)

This shallow, excessively drained, fine loamy soil occupies steep to very steep, strongly dissected mountainous areas along a part of the east coast. The profile of this unit is similar to the one described for the series. Small areas of lesser slopes have greater clay content in the subsoil than the typical profile. Most areas have lost their original surface layer through erosion. About 25 to 50 percent of the land is rock outcrop.

Included in this mapping unit are small areas of the Sinhyeon and Sinjeong soils, and some areas of only slightly eroded soil. Here the surface layer is brown to dark brown.

The largest area consists chiefly of Korean pine trees; shallow rooted trees are adapted to this soil. Erosion is a severe hazard to management, and the shallow root zone is also detrimental, but it is better suited to woodland rather than to cultivation.

(Capability unit VIIe)

5.23 JISAN SERIES

The Jisan series consists of deep, poorly drained, moderately permeable, fine loamy soils developed in alluvium in sloping to steep narrow valleys. This series is a member of the fine loamy, nonacid family of Fluventic Haplaquepts.

The typical profile of the Jisan loam is:

Ap1——0 to 4 cm: Grayish brown (2.5Y 5/2) loam with common, fine mottles of yellowish brown (10YR 5/8); massive; friable, slightly stioky, and slightly plastic; many roots; pH 5.5; clear, smooth boundary.

Ap2——4 to 13 cm; Very dark gray (5Y 3/1) silt loam with common, medium mottles of brownish yellow (10YR 6/6) and few, medium mottles of black (2.5Y 2/0); massive; friable, sticky, and plastic; few, fine pores; many roots; clear, smooth boundary; pH 5.7.

B1——13 to 18 cm; Dark gray (5Y 4/1) silt loam with common, medium mottles of yellow (10YR 7/8); weak, medium, angular blocky structure; firm, sticky, and plastic; few, fine pores; clear, smooth boundary; pH 7.8.

B2——18 to 76 cm; Gray (5Y 5/1) silt loam with many, medium mottles of brownish yellow (10YR 6/8); moderate, very coarse subangular blocky structure; very firm, sticky, and plastic; common, medium pores; abrupt, smooth boundary; pH 7.8.

C——76 to 110 cm; Black (5YR 2/1) silty clay loam; massive, very firm, very sticky, and very plastic; few, medium pores; pH 6.8.

The surface layer is grayish brown, dark grayish brown, dark gray, very dark gray or yellowish brown in colour, and ranges from silt loam to loam or silty clay loam in texture. The B horizon is dark gray, gray, grayish brown, yellowish brown or yellow in colour, and ranges from silt loam to loam or silty clay loam in texture. The C horizon ranges from gray to dark gray or black in colour, and in texture from silty clay loam to loam or silt loam. The C horizon contains gravels in some places.

The Jisan soils are most common in small alluvial valleys in the general areas of Dalcheon and Samgag soils.

The soil reaction is slightly acid to neutral, the natural fertility is moderate to high, and organic matter content is medium. The available moisture capacity is high. Cation exchange capacity is medium and base saturation, high.

Because of poor drainage, most of these soils are suitable only for growing paddy rice. A few small areas are used for a two crop a year cropping system chiefly for growing paddy rice and winter barley. All crops respond well to fertilization.

5.23.1 Jisan Loam, 2 to 7 Percent Slopes (JiB)

This deep, poorly drained, moderately permeable, fine loamy soil occupies gently sloping fans and valleys, mainly in the general areas of Dalcheon and Samgag soils.

It has a profile similar to the one described as representative for the series. Included in this mapping unit are: some areas that have a silt loam or silty clay loam surface layer, small areas of the Honam, Hwadong, Dalcheon, and Sirye soils, and a few small areas of a gravelly surface soil.

All areas are only suitable for the growing of paddy rice because of poor drainage. Paddy rice is planted, and its yields are high. This soil can also be planted to winter barley or wheat in the fall after harvest of paddy rice if improved drainage is established.

Erosion is a slight hazard in cultivated areas. The establishment of good drainage and the control of erosion are the main problems in management.

(Capability unit IIw; Paddy suitability group P2a)

5.23.2 Jisan Loam, 7 to 15 Percent Slopes (JiC)

This deep, poorly drained, moderately permeable, fine loamy soil occupies sloping fans and small valleys in the general areas of Dalcheon and Samgag soils.

The profile resembles the one described as representative for the series. Included in this mapping unit are some areas that have a silt loam or silty clay loam surface layer, with some small areas of a gravelly surface soil.

Most is in rice paddy, and produces high yields. With establishment of adequate drainage system, winter grain crops could be grown. An additional problem in managing the soil is the control of erosion which is slight in a well constructed paddy system.

(Capability unit IIIe; Paddy suitability group P3a)

5.23.3 Jisan Laom, 15 to 30 Percent Slopes (JiD)

This deep, poorly drained, moderately slowly permeable fine loamy soil occupies small tracts of moderately steep to steep, small valleys, and fans.

The profile is similar to the one described for the series. Included with this soil are small areas that have a surface layer of silt loam or silty clay loam, small areas of Daegu and Sirye soils, and a few small areas of a gravelly surface soil.

The crop is paddy, for which it is suited because of poor drainage. Winter grain crops, such as barley and wheat, can be grown if improved drainage is provided.

The main concern of management is to control erosion and retard runoff.

(Capability unit IVe; Paddy suitability group P4a)

5.24 MANGSIL SERIES

The Mangsil series consists of deep, well drained, moderately permeable, fine loamy soils formed in residuum weathered from porphyry, which are mainly on sloping to steep, mountain tops, commonly more than 500 m above sea level. This series is a member of the fine loamy family of Humic Hapludults.

The typical profile of the Mangsil stony silt loam is:

A1---0 to 20 cm; Very dark brown (10YR 2/2) stony silt loam; strong, very fine granular structure; very friable; many roots; gradual, irregular boundary; pH 5.5.

A3---20 to 40 cm; Very dark grayish brown to dark grayish brown (10YR 3.5/2) stony silt loam; weak, fine to medium subangular structure; friable, slightly sticky, and slightly plastic; common, fine roots; clear, wavy boundary; pH 5.3.

B1---40 to 50 cm; Dark grayish brown (10YR 4/2) stony silty clay loam; moderate, medium to fine subangular blocky structure; friable; gradual, smooth boundary; pH 5.1.

B2t- -50 to 100+ cm; Strong brown (7.5YR 5/6) stony clay loam; moderate, medium subangular blocky breaking to fine granular structure; friable, sticky, and plastic; common, very fine pores; few, grass roots; pH 5.4.

The surface layer ranges in texture from stony silt loam to stony loam, and its colour from black to very dark brown. The B horizon is dark grayish brown, yellowish brown cobbly silty clay to cobbly silty clay loam. Depth to bedrock ranges from 1 to 5 m, but is dominantly less than 2 m.

The Mangsil soils occur usually with the Mudeung, Sinbul, and Samgag soils or with rock land. These soils are deep, and have a black coloured surface layer, while the Mudeung soils are shallow and brown to dark brown in the surface layer.

The Mangsil soils are very strongly acid, moderate in natural fertility, and high in content of organic matter. Available moisture capacity is high. Cation exchange capacity is medium and base saturation is low.

Most areas are in grassland or in forest consisting chiefly of few Korean pine trees. A few small less steep areas are used to grow potatoes, cabbage, radish, and similar vegetables. These high mountain soils produce good yields of cool season crops.

5.24.1 Mangsil-Mudeung Stony Comples, 7 to 15 Percent Slopes (MMC)

This complex consists of about 80 percent Mangsil soil and 20 percent Mudeung soil. These are underlain by the same rocks but differ in thickness over the unweathered substrata. Both are so intricately mixed that their exact boundaries could not be shown on the map at the scale used, and so are mapped as one unit. They occupy sloping crests in mountainous areas throughout the gun. About 7 to 35 percent of the surface is covered by stones.

The profiles otherwise are similar to those described as representative for their respective series. Included in this mapping unit are some small valleys of Sinbul soils, small areas of Samgag soils, and rock land. The surface runoff is medium to rapid.

Most of the soil is in grassland or in Korean pine forest. A few small less sloping areas are planted to potatoes, cabbage, and similar crops.

The cool climate on the high mountainous areas is another important limiting factor to cultivation. Management is affected by erosion and stoniness.

(Capability unit IVe)

5.25 MUDEUNG SERIES

The Mudeung series consists of very shallow to shallow somewhat excessively drained, loam to silt loam soils formed in residuum derived from porphyry and porphyrite.

These soils occupy sloping to very steep, strongly dissected hills and mountainous areas. This series is a member of the fine loamy family of Lithic Dystrochrepts.

The typical profile of the Mudeung gravelly loam is:

A----0 to 40 cm; Brown to dark brown (10YR 4/3) gravelly heavy loam; moderate, fine to medium granular structure; friable, slightly sticky; common, very fine to fine pores; many roots; clear, smooth boundary; pH 4.5.

R----40+ cm; Hard rock.

The surface layer is gravelly to stony loam or sometimes stony silt loam with many rock outcrops. Its colour ranges from brown to dark brown, but in the eroded areas it is yellowish brown to dark yellowish brown. Depth to bed rock ranges from 10 to 50 cm.

The Mudeung soils usually occur with the Mangsil or with rock land. They are shallower than the Mangsil soils, and differ from the Samgag in having hard rock materials at a shallow depth.

The Mudeung soils are strongly acid, low in natural fertility, and in content of organic matter. Permeability is moderate, and available moisture capacity is low. Cation exchange capacity is medium and base saturation is low.

Most is grassland and forest consisting chiefly of Korean pine trees and alders with an understory of shrub and azalea. A few small areas of less than 16 percent slopes are cultivated for growing barley, wheat and soybeans.

5.25.1 Mudeung Rocky Loam, 30 to 60 Percent Slopes (MdE)

This very shallow, somewhat excessively drained rocky soil, occupies large areas on the steep, strongly dissected slopes in mountainous areas. About 25 to 50 percent of the area is rock outcrops. In most places the surface layer is gravelly to cobbly. Otherwise the profile between the rock outcrops is as described for the series.

Included in the areas mapped are: some areas of a gravelly to stony sandy loam or gravelly to stony silt loam surface soil, small areas of an eroded soil of yellowish brown to dark yellowish brown, and a few small areas of Samgag, Taehwa, and Mangsil soils.

The Mudeung soil has a thin root zone; surface runoff is rapid, erosion is slight in areas with grass cover but would be severe if they were cultivated.

This soil is well suited to woodland or pasture but not for cultivation. All of the areas are in grassland, and some pines grow between rocks.

(Capability unit VIe)

5.25.2 Mudeung-Mangsil Stony Complex, 15 to 30 Percent Slopes (MMD)

This complex consists of about 60 percent Mudeung, a very shallow soil and 40 percent Mangsil, a deep soil. These two occur in the same area in a fine pattern, and are mapped as one unit. They are found on moderately steep, strongly dissected hills and high mountainous areas. About 7 to 30 percent of the surface is covered by stones.

Otherwise the profiles of this unit are those described as representative for their respective series. Included in this mapping unit are some areas of rock land, some areas that have a gravelly to stony clay loam or sandy loam surface layer, and some rock outcrops and gullies. The surface runoff is rapid.

All areas are in pine forest or grassland. Better woodland and pastureland management practices will provide good returns and keep the soil from eroding.

(Capability unit VIe)

5.25.3 Mudeung-Mangsil Stony Complex, 30 to 60 Percent Slopes (MME)

This complex consists of about 80 percent Mudeung, a very shallow soil, and 20 percent Mangsil, a deep soil. Both these are underlain by porphyry or porphyrite, and adjoin each other in the same mapped areas. They occupy steep hills and high mountainous areas at an elevation of about 500 m.

In most places the surface layer is gravelly to stony. Otherwise the profiles of this unit are similar to those described for their respective series. There are some rock outcrops and some gullies, and some areas of Samgag soils and rockland. The runoff is rapid.

This soil is well suited to woodland, and all of the areas are in Korean pine forest and grassland.

Management is affected by erosion, runoff, and stoniness. The cool climate on the high mountainous areas is another important limiting factor to cultivation.

(Capability unit VIe)

5.25.4 Mudeung-Taehwa-Daegu Rocky Complex, 15 to 30 Percent Slopes, Eroded (MTD2)

These soils occupy sloping to moderately steep hills and mountainous areas, and consist of about 30 percent Mudeung, 20 percent Taehwa, 20 percent Daegu, and 30 percent rock outcrop. The soils differ in thickness of favorable soil material over the substratum. In most places the surface layer is gravelly to stony.

They otherwise have profiles similar to those described for their respective series. Included in this mapping unit are: some uneroded areas and some gullied areas, small areas of the Samgag soil, and small areas of greater slopes than the described slope range. The surface runoff is medium to rapid.

Most of the areas of these soils are in forest of Korean pines and oak, with an understory of azalea. The soils are best suited to woodland.

Controlling erosion is a main problem in management of the soils. The low fertility and stoniness are also important limitations on their use.

(Capability unit VIe)

5.25.5 Mudeung-Taehwa-Daegu Rocky Complex, 30 to 60 Percent Slopes, Eroded (MTE2)

These soils occupy large tracts of steep hills and mountainous areas. They are the most extensive, covering about 16,800 ha (17 percent) of the area. Mudeung and Taehwa are underlain by porphyry, and Daegu soil by shale and sandstone. Of this complex, about 40 percent is the Mudeung loam, 20 percent is the Taehwa sandy loam, 10 percent is the Daegu, and 30 percent is rock outcrops.

Otherwise the profiles are similar to those described for their respective series. Included with this complex are: some gullied areas and some uneroded areas, small areas of the Samgag and Iweon, and small valleys of the Jisan soils.

The areas are in grassland or in pine forest with an understory of bushes and azalea. Forest however is poor because of severe erosion in steep and strongly dissected land. The soils are better suited to woodland, and the main management problems are severe erosion and stoniness.

(Capability unit VIIe)

5.26 ROCK LAND (RL)

These rock lands are colluvial deposits of stones on mountain foot slopes, escarpments along the river sides, and rock outcrops on the top of mountains with not more than 10 percent shallow stony soils. The rocks are granite, porphyry and shale. A few areas consists of granite gneiss, porphyry-conglomerate, and gabbro.

Vegetation is poor, and some pines grow between the rocks.

(Capability unit VIII)

5.27 SACHON SERIES

The Sachon series consists of deep, moderately well drained, moderately permeable coarse loamy soils, formed in alluvium to colluvium washed from areas underlain by granite and porphyry. They occur on gently sloping to moderately steep, narrow valleys, fans, and mountain foot slopes in hilly or mountainous areas. This series is a member of the coarse loamy, nonacid family of Aeric Fluventic Haplaquepts.

The typical profile of the Sachon sandy loam is:

Ap——0 to 12 cm; Grayish brown (2.5Y 5/2) loam with few, fine faint mottles of strong brown (7.5YR 5/8); massive; friable, slightly sticky and slightly plastic; common, fine to medium roots; clear, smooth boundary; pH 5.0.

A1——12w to 20 cm; Olive gray (5Y 5/2) loam with common, medium prominent mottles of brown to dark brown (7.5YR 4/4); weak, coarse angular blocky structure; firm, slightly sticky, and slightly plastic; few, fine to medium pores; common, fine to medium root;abrupt, smooth boundary; pH 5.5.

B2——20 to 42 cm; Grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/8) loam; moderate, medium to coarse platy structure; firm, sticky and plastic; many, fine to medium pores; few, fine roots; clear, smooth boundary; pH 6.0.

B3——42 to 75 cm; Gray (5Y 5/1) sandy loam with common, medium faint mottles of yellowish brown (10YR 5/8) and brown to dark brown (7.5YR 4/2); weak, coarse platy structure; friable, slightly sticky, and non plastic; common, medium pores; gradual, wavy boundary; pH 6.5.

C1——75 to 96 cm; Grayish brown (10YR 5/2) sandy loam with common, medium faint mottles of dark brown (7.5YR 3/2); massive; friable; common, medium pores; abrupt, smooth boundary; pH 6.5.

C2——96 to 115 cm; Very dark gray (N3/) loam; massive; friable, sticky, and slightly plastic; gradual, smooth boundary; pH 6.5.

C3——115 to 152 cm; Very dark gray (10YR 3/1) loamy sand or sand; single grain; pH 6.5.

The A horizon is loam or sandy loam, and ranges from grayish brown to very dark grayish brown or olive gray in colour. The B horizon ranges from dark gray to dark grayish brown or strong brown in colour, and from loam to sandy loam or sandy clay loam in texture. The C horizon is dark grayish brown, grayish brown, or very dark gray loam, sandy loam, or sand, which may be coarser with depth beginning at depth of 100 to 150 cm.

The Sachon soils occur dominantly with the Iweon and Jisan soils and differ from the Iweon soils in being free of stones and less drained.

They are moderate in natural fertility, medium in content of organic matter, and medium to slightly acid. Available moisture capacity is medium, and base saturation is medium to high.

All areas are suitable for cultivation, and are used to grow paddy rice in summer and barley or wheat during the winter. Crops on these soils respond to good management.

5.27.1 Sachon Sandy Loam, 2 to 7 Percent Slopes (ScB)

This deep, moderately well drained, moderately permeable, coarse loamy soil occupies small tracts of gently sloping narrow alluvial plains.

The profile resembles the one described for the series. Some areas with level to nearly level soil are included in these mapped areas and also small areas of the Iweon and Jisan soils. There are too, areas with silty clay loam surface layer, and small areas with sandy clay loam or sand subsoil.

This soil has a thick root zone, and is easy to work. Surface runoff is medium, and erosion hazard is not a problem of management.

All of the areas are cultivated chiefly to paddy rice and winter barley in a two crop a year cropping system, to which this soil is well suited.

Main management problems problems are the prevention of leaching, and droughtiness. Additional drainage is needed in some places.

(Capability unit IIe; Paddy suitability group P3ab)

5.27.2 Sachon Sandy Loam, 7 to 15 Percent Slopes (ScC)

This deep, moderately well drained, moderately permeable coarse loamy soil occupies small tracts of gently sloping, slightly dissected narrow local valleys, fans, and mountain foot slopes in hilly or mountainous areas.

The profile is similar to the one described for the series. Included are small areas of the Iweon and Jisan soils, some areas of silty clay loam surface layer, and sandy clay loam or sand subsoil. The surface runoff is medium, and erosion hazard is not a problem. This soil has a thick root zone, and is easy to work.

All of the areas grow paddy rice in the summer and barley or wheat during the winter. Main management problems are: controlling erosion, preventing leaching of crop nutrient, and lessening the effect of droughtinees.

(Capability unit IIIe; Paddy suitability group P3ab)

5.27.3 Sachon Sandy Loam, 15 to 30 Percent Slopes (ScD)

This deep, well drained, moderately permeable, coarse loamy soil occupies very small tracts of moderately steep, slightly dissected narrow valleys, and mountain foot slopes in mountainous areas.

The profile is the same as described for the series. Included in this unit are: small areas of coarse sandy soils with poor drainage, small areas of a silty clay loam surface layer, and of a sandy clay loam or sand subsoil. The surface runoff is medium, and erosion hazard is severe.

It is planted to paddy rice in the summer and to barley during the winter. The management is affected by erosion. Other important problems are leaching and drought.

(Capability unit IVe; Paddy suitability group P4ab)

5.28 SAMGAG SERIES

The Samgag series consists of deep, somewhat excessively to well drained, coarse loamy soils formed in saprolite, and weathered from granite and granite-gneiss. These soils occupy moderately steep to very steep hills and mountainous areas. This series is a member of the coarse loamy family of Typic Dystrochrepts.

The typcial profile of Samgag coarse sandy loam is:

A1——0 to 12 cm; Light yellowish brown (10YR 6/4) coarse sandy loam; moderate, very fine to fine granular structure; very friable, non sticky, and non plastic; many fine to medium roots; gradual, smooth boundary; pH 4.5.

A3——12 to 23 cm; Strong brown (7.5YR 5/6) coarse sandy loam; moderate, medium to coarse granular structure; friable, slightly sticky and non plastic; few, fine to very fine pores; common, fine to medium roots; clear, smooth boundary; pH 5.0.

C1——23 to 32 cm; Reddish yellow (7.5YR 6/6) very gravelly, coarse sandy loam; moderate, fine granular structure; friable, non sticky, and non plastic; patchy thin clay cutans; pores as above; few, fine roots; clear, smooth boundary; pH 5.2.

C2——32 to 150+ cm; Reddish yellow (7.5YR 7/8) coarse sandy loam saprolite; massive; firm, non sticky and non plastic; yellowish red matrix with white mica; pH 5.5.

The Samgag soils have a surface layer of light yellowish brown, brown, dark brown, yellowish brown or strong brown gravelly to stony sandy loam to sandy loam. Rock outcrops are common on the surface. The substratum is variably weathered crystalline saprolite ranging in texture from coarse sandy loam to loamy sand or sand. Depth to hard bedrock ranges form 2 to 10 m, but averages 5 m.

The Samgag soils are more sandy, more deeply weathered, and more light coloured in the surface layer than the Mudeung soils. They lack the B horizon or subsoil present in the Dalcheon soils, are strongly acid, have a low natural fertility, and a low organic matter content. Permeability is very rapid, and available water capacity is medium or low. Cation exchange capacity and base saturation are low.

Most of the areas are covered with Pine forest with an understory of small shrubs including bushclovers. Soybean and tobacco are grown on some sloping areas. These soils are suitable for woodland. High yields of pasture are difficult to obtain because of lack of soil moisture in the dry seasons.

5.28.1 Samgag Rocky Sandy Loam, 15 to 30 Percent Slopes, Eroded (SmD2)

This deep, somewhat excessively drained, moderately rapidly permeable, eroded soil, occupies moderately steep to steep mountainous areas. It is underlain by soft saprolite of granite and granite-gneiss. About 25 to 50 percent of the areas are rock outcrops. Gravels and stones are common in many places.

This unit otherwise has a profile similar to the one described for the series. Some profiles with weak, coarse subangular blocky structure in upper horizons, discontinuous reddish yellow to yellowish red clay films, and coarse sandy clay loam textures are included, with small areas of soils of shallow to hard rock, and some areas of gullied land.

The areas are mainly suitable, and are in forest, consisting of Korean pines. A few small areas are cultivated to soybeans, buckwheat, and similar crops. The crop yields are low. The main problem in management is to control accelerated erosion.

(Capability unit VIe)

5.28.2 Samgag Rocky Sandy Loam, 30 to 60 Percent Slopes, Eroded (SmE2)

This deep, somewhat excessively drained, moderately rapidly permeable, eroded soil, is on steep to very steep mountainous areas. About 25 to 50 percent of the areas are rock outcrops, and the surface layer is frequently stony to gravelly.

The profile otherwise is similar to the one described as representative for the series. Included with this soil are: some soils with upper horizons of weak, coarse subangular blocky structure, discontinuous reddish yellow to yellowish red clay films, and coarse sandy clay loam texture, and small areas of soils that are shallow to hard rock with some areas of gullied land.

The areas are in poor pine forest, which is suited to woodland if well managed. The strong slopes and rapid runoff make the hazard of further erosion severe.

(Capability unit VIe)

5.28.3 Samgag Soils, 15 to 30 Percent Slopes, Gullied (SgD4)

This unit consists of Samgag rocky, stony to gravelly sandy soil with many deep and shallow gullies, occupying large tracts of moderately steep hills and mountainous areas.

The profile has mostly been destroyed by erosion, and only some material similar to the C2 horizon of the typical profile remain. In 20 to 40 percent of the area even the C2 horizon has been eroded exposing the underlying rock. Most of the areas are strongly dissected by an intricate pattern of deep and shallow gullies. The eroded coarse material is deposited on lower lying finer textured soils, lowering their potential productivity.

The first management consideration should be vegetative cover to reduce the erosion. This soil has only a limited potential for woodland even when well managed.

(Capability unit VIIe)

5.28.4 Samgag Soils, 30 to 60 Percent Slopes, Gullied (SgE4)

This unit consisting of Samgag rocky, stony to gravelly sandy soil with many deep to shallow gullies, occupies very large tracts of steep uplands, scattered throughout the mountainous areas.

The profile, other than areas with stony to gravelly surface layer and gullies, is similar to the one described for the series, but most of the A and B horizons have been removed through severe erosion and 30 to 60 percent of the areas are stony and rock land. These areas are almost completely dissected by an intricate pattern of deep and shallow gullies. The coarse sediment eroded is deposited on finer textured soils in the lower positions, lowering their potential production.

This soil is not suited to cultivation, but for woodland. Sufficient soil cover to halt erosion is the principal management problem.

(Capability unit VIIe)

5.28.5 Samgag Very Rocky Soils, 15 to 30 Percent Slopes, Gullied (SvD4)

This mapping unit occupies moderately steep to steep strongly dissected hills and mountainous areas chiefly in the north-east. Many areas have eroded to the underlying hard bedrock which is exposed in gullies. About 50 to 90 percent of the surface is covered by rock outcrops. In the areas between the gullies some of the lower soil horizon described in the typical profile remains. Runoff is very rapid, and erosion hazard is severe. Plant cover is difficult to establish.

The soil is not suited to cultivation, but may produce some woodland products if properly managed. Scattered pines are growing on some areas.

(Capability unit VIIe)

5.28.6 Samgag Very Rocky Soils, 30 to 60 Percent Slopes, Gullied (SvE4)

This mapping unit occupies small tracts of steep to very steep, strongly dissected hills and mountainous areas, chiefly in the north-east.

Between the gullies, the profile of this unit resembles the one described in the series. The areas are so severely eroded and cut into the deep gullies, that most of the C horizon and many hard underlying rocky are exposed. About 50 to 90 percent is rock outcrops.

The surface runoff is very rapid, and erosion hazard severe.

The unit is suitable for woodland. Scattered pine trees are growing between rocks.

(Capability unit VIIe)

5.29 SEOGGYE SERIES

The Seoggye series consists of deep, imperfectly drained, rapidly permeable, coarse loamy soils formed in alluvium on flood plains. These soils occupy the level to nearly level alluvial plains near the river channels, chiefly along the Taehwa River. This series is a member of the coarse loamy, nonacid family of Aeric Fluventic Haplaquepts.

The typical profile of Seoggye sandy loam is:

Ap——0 to 12 cm; Brown to dark brown (10YR 4/3) sandy loam with few, fine to medium faint mottles of yellowish red (5YR 4/6); weak, medium to coarse angular blocky breaking to fine and coarse granular structure; friable; few, very fine to fine pores; many, fine mica; many roots; abrupt, wavy boundary; pH 5.5.

B21g——12 to 41 cm; Olive gray (5Y 5/2) loam with many, fine to coarse prominent mottles of red (2.5YR 4/8); weak, very coarse to medium angular blocky breaking to fine to medium subangular blocky structure; slightly firm and slightly plastic; patchy thin clay films; common, medium to fine pores; many, fine mica; common roots; clear, smooth boundary; pH 5.5.

B22g——41 to 50 cm; Brown to dark brown (7.5YR 4/4) and grayish brown (2.5Y 5/2) fine sandy loam with few, fine distinct mottles of dark red (2.5YR 3/6); weak, medium to fine subangular blocky structure; friable; common, very fine to fine pores; many, fine mica; few roots; abrupt, wavy boundary; pH 5.5.

B23g——50 to 73 cm; Grayish brown (2.5Y 5/2) loam with many coarse distinct mottles of dark brown (7.5YR 3/2); weak, fine to coarse subangular blocky structure; many, fine to medium pores; many, fine mica; few roots; abrupt, smooth boundary; pH 5.5.

C1——75 to 83 cm; Yellowish brown (10YR 5/4) very fine sandy loam with few, fine distinct mottles of reddish brown (5YR 4/4); weak, fine to coarse subangular blocky structure; friable; few, very fine to medium pores; many, fine mica; clear, smooth boundary.

C2g——83 to 130 cm; Grayish brown (2.5Y 5/2) loam with many, fine to coarse distinct mottles of yellowish red (5YR 4/6); weak, fine to coarse subangular blocky structure; slightly firm; common, very fine to medium pores; many fine mica; clear, smooth boundary; pH 6.0.

C3g——130+ cm; Dark brown (10YR 3/3) sandy loam with very fine to fine mottles of olive gray (5Y 5/2); massive; flightly firm; many pores; many, fine mica; pH 5.5.

The surface layer ranges from brown to dark brown in colour, but in the paddy ranges from grayish brown to dark grayish brown. Its texture is sandy loam, loam, fine sandy loam, loamy coarse sand or silt loam. The C horizon is grayish brown, dark yellowish brown or dark brown, sandy loam, loam, or coarse sand containing few gravels in some places.

The Seoggye soils occur with Riverwash sandy or cobbly, Hwabong, Jisan, and Hwangryong soils. These soils are less drained and contain more gravels in the substrata than the Hwabong soils, are slightly acid, low to moderate in natural fertility, and low to medium in content of organic matter. Available moisture capacity is low. Cation exchange capacity is low and base saturation is high. Surface runoff is low.

Most of the areas are cultivated to paddy rice during the summer and barley in the winter, while paddy soil with poor drainage is used only for growing rice.

5.29.1 Seoggye Fine Sandy Loam, 0 to 2 Percent Slopes (Se)

This deep, imperfectly drained, rapidly permeable coarse loamy soil occupies small tracts of the level to nearly level alluvial soil on flood plains near the rivers or streams in the area.

The profile is similar to the one described for the series. Included with this soil are: some areas of loam or loamy coarse sand surface layer, some areas having a gravelly substratum, small areas of sand or cobbly soil, and soils with poor drainage. Surface runoff is low.

The Seoggye soil is well suited to non-irrigated crops, but generally is cultivated to paddy rice in the summer and to barley in winter. The areas of poorly drained soils are used only for growing rice each year. The main concerns in management are to reduce the leaching of plant nutrients, and to control erosion.

(Capability unit IIw; Paddy suitability group P2b)

5.30 SINBUL SERIES

The Sinbul series consists of deep, well drained, moderately permeable, loamy skeletal soils that formed in colluvium containing many porphyry and porphyrite stones and gravel. These soils occur on the sloping to steep, high mountain valleys chiefly in Sinbul and other mountains with elevations of more than 500 m.

This series is a member of the loamy skeletal family of Typic Haplumbrepts.

The typical profile of the Sinbul stony loam is:

A1——0 to 25 cm; Very dark grayish brown (10YR 3/2) cobbly to stony loam; strong, fine to coarse granular structure; very friable and slightly sticky; many roots; abrupt, wavy boundary; pH 5.3.

C——25 to 140+ cm; Yellowish brown (10YR 5/4) very gravelly to stony clay loam; massive; slightly firm, slightly sticky; and slightly plastic; pH 4.5.

Where not eroded, the surface layer ranges from very dark brown to very dark grayish brown in colour and from stony silty clay loam to stony loam in texture. The substrata are very gravelly to stony clay loam or light clay loam.

The Sinbul soils are in valleys below Mangsil soil and Rock land. These lack a clay B horizon, and contain more stones than the Mangsil soils, are strongly acid, low or moderate in natural fertility, and medium or high in content of organic matter. Available moisture capacity is moderate. Cation exchange capacity is medium, and base saturation low.

The areas are in grassland or forest, consisting chiefly of oaks and an understory of strubs. These soils are well suited to woodland.

5.30.1 Sinbul Stony Loam, 15 to 30 Percent Slopes (SiD)

This deep, well drained, moderately permeable soil occupies the moderately steep, small valleys of the Sinbul and other mountains at elevations of 500 m and more.

The profile is similar to the one described for the series. Included in this unit are: some areas that have a very dark brown, stony to cobbly silty clay loam surface layer, small areas of Mangsil soil, and rock land. Runoff is rapid, and erosion hazard is severe.

Because most of the areas have moderately steep slopes and many stones, the soil is not suited to cultivated crops. All of the areas are in grassland or in oak forest with an understory of shrubs.

Erosion and stoniness are the main problems in management. Cool climate is another important limiting factor to cultivation.

(Capability unit VIe)

5.30.2 Sinbul Bouldery Loam, 30 to 60 Percent Slopes (SIE)

This deep, well drained, moderately permeable soil occupies steep valleys in Sinbul, and other mountains, with elevations of more than 500 m.

The profile is as described for the series. Small areas of Mangsil and Mudeung soils are included in this mapping unit, as are small areas of rock land, and some areas that have boulders in the soil.

Runoff is rapid, and erosion hazard is severe.

This soil is not suited to cultivated crops because of steep slopes, but it is well suited to woodland. All of the areas of this soil are in grassland or in forest with oaks and an understory of shrubs. Cool climate is a limiting factor to cultivation. Management is affected by erosion and stoniness.

(Capability unit VIe)

5.31 SINDAB SERIES

The Sindab series consists of deep, poorly drained, rapidly permeable, sandy soils formed in alluvium. These soils are in the level to very gently sloping flood plains. Because of sedimentation of river channels the stream beds are higher than the flood plains and the water remains on the surface. This series is a member of the sandy family of Typic Psammaquents.

The typical profile of the Sindab loamy coarse sand is:

Ap——0 to 3 cm; Brown to dark brown (10YR 4/3) loamy coarse sand; single grain; friable; many roots; abrupt, smooth boundary; pH 6.3.

Ap2——3 to 8 cm; Light yellowish brown (10YR 6/4) loamy coarse sand; single grain; loose; many roots; abrupt, smooth boundary; pH 6.3.

C1——8 to 23 cm; Dark gray (10YR 4/1) loamy coarse sand; single grain; loose; common roots; clear, smooth boundary; pH 6.0.

C2——23 to 60 cm; Gray (10YR 5/1) sand; single grain; loose; abrupt, smooth boundary; pH 6.0.

C3——60 to 120 cm; Very dark gray (10YR 3/1) sandy loam; massive; slightly firm, slightly sticky, and slightly plastic; pH 6.0.

The surface layer is brown, dark brown, yellowish brown, grayish brown or gray to dark gray, and ranges from loamy coarse sand to coarse sand or sandy loam. The C horizon is loamy coarse sand to sandy loam or loamy sand, and contains few gravels in some places. It begins at depth of 20 to 50 cm below the surface.

The Sindab soils occur with Seoggye soils and Riverwash sandy, and have sand and loamy sand textures, while the Seoggye soils have sandy loam.

They are slightly to medium acid. Natural fertility is low or moderate, and organic matter content is medium. Available moisture capacity is low, cation exchange capacity is low, and base saturation is medium to high.

Most of the areas are only cultivated to paddy rice, suitable because of high ground water tables.

5.31.1 Sindab Sandy Loam, 0 to 2 Percent Slopes (Sn)

This deep, poorly drained, rapidly permeable sandy soil occupies small tracts of the level to very gently sloping depressed areas near the river sides.

The profile resembles the one described for the series. Included are: some areas that have a gravelly sand or gravelly sandy loam surface layer, small areas that contain some gravels in the C horizon, and areas of sandy loam and Riverwash sandy.

Paddy rice, because of poor drainage and high ground water table, is the only crop. The response to fertilization is poor because of coarse texture. Flood control and the leaching of crop nutrients are main management problems.

(Capability unit IVw; Paddy suitability group P3b)

5.32. SINHYEON SERIES

The Sinhyeon series consists of deep, well drained, moderately slowly permeable, fine loamy soils, occupying the sloping to steep, strongly dissected, elevated fluvio-marine plain on the northern part of the east coast. This series is a member of the fine loamy family of Typic Hapludults.

The typical profile of the Sinhyeon loam is:

A1---0 to 10 cm; Pale brown (10YR 6/3) loam; weak to moderate, fine and medium granular structure; friable, slightly sticky, and slightly plastic; many fine to medium pores; many roots; gradual, smooth boundary; pH 5.0.

B1t---10 to 33 cm; Yellowish brown (10YR 5/4) sandy clay loam with few, fine prominent mottles of dark red (2.5YR 3/6); weak, medium to coarse subangular blocky breaking to fine to medium blocky structure; friable, slightly sticky, and plastic; moderate, thick cutans; common, fine to medium pores; common roots; gradual, smooth boundary; pH 5.0.

B21t---33 to 61 cm; Brownish yellow (10YR 6/8) clay loam; weak and moderate, medium to coarse subangular blocky structure; slightly firm, slightly sticky, and slightly plastic; patchy thin clay films; few, fine to very fine pores; common roots; abrupt, smooth boundary; pH 5.0.

B22t---61 to 82 cm; Light yellowish brown (10YR 6/4) silt loam with many, medium to coarse distinct mottles of light brownish gray (10YR 6/2); moderate to strong, fine and medium subangular blocky structure; slightly firm, sticky, and plastic; patchy thin clay films; common, fine pores; few roots; abrupt, wavy boundary; pH 5.5.

B3---82 to 101 cm; Reddish yellow (7.5YR 6/8) gravelly loam; weak, medium to coarse subangular blocky, breaking to fine granular structure; firm, slightly sticky, and slightly plastic; few, fine pores; abrupt, wavy boundary; pH 5.0.

C1---101 to 130 cm; Brownish yellow (10YR 6/8) and light gray (N7/0) silt loam; weak, medium to coarse platy structure; slightly firm, sticky, and plastic; patchy thin clay films; few, fine pores; clear, smooth boundary; pH 5.0.

C2---130+ cm; Light gray (N7/) loam with many, medium to coarse distinct mottles of yellow (10YR 7/8); massive; slightly firm, slightly sticky, and plastic; few, fine pores; stratified with gravels, sands, and seashells.

The surface layer ranges from pale brown to grayish brown or from brown to dark brown in colour, its texture from loam to clay loam or silt loam. The upper subsoil is strong brown to yellowish brown or reddish yellow sandy clay loam, clay loam, or silty clay loam, and the lower subsoil is light yellowish brown or reddish yellow silt loam to gravelly loam or sandy clay loam, and contains some

seashells. The C horizon ranges from silt loam to loam, and is stratified with sand, gravels and seashells.

They differ from Banggi soils in being less red coloured and in having deep subsoil, seashells, and less gravels. The Sinhyeon soils are more pale coloured, and occur on higher elevation than Chundo soils.

Natural fertility and organic matter content are low. These soils are strongly acid to moderately alkaline. Available moisture capacity is high. Cation exchange capacity is medium to high, and base saturation is medium to high.

Most of the areas are in forest consisting chiefly of pines with an understory of shrubs and azalea. Some sloping areas are cultivated to barley, wheat, buckwheat and other vegetables.

5.32.1 Sinhyeon Loam, 15 to 30 Percent Slopes, Eroded (SyD2)

This deep, well drained, moderately slowly permeable, fine loamy soil, occupies sloping to steep areas near the east coast of the gun.

Where not eroded, it has a profile similar to the one described for the series. Included in the soil are: some small severely eroded and some slightly eroded areas, areas of clay loam or silt loam surface soil, and some areas with gentle slopes.

Runoff is rapid and erosion hazard is severe. This soil has a thick root zone, and is fair to work.

The soil is suited to woodland, with some sloping areas suitable for a few cultivated crops.

Poor pine forest with an understory of shrubs and azalea, predominate. Barley, wheat, buckwheat, and other vegetables are planted.

The main problem in management is the control of erosion.

(Capability unit IVe; Paddy suitability group P4ac)

5.32.2 Sinhyeon Soils, 30 to 60 Percent Slopes, Gullied (SyE4)

This unit consists of areas from which erosion has removed most of the original surface layer and some of the subsoil. Gullies are common.

The pr file between the gullies resembles the one described for the series.

Most of this soil is well suited to woodland, and is in pine forest with an understory of shrubs and azalea. Erosion is the chief hazard to management.

(Capability unit VIIe)

5.33 SINJEONG SERIES

The Sinjeong series consists of deep, well drained, moderately permeable, fine loamy soils formed in residuum derived chiefly from tuff conglomerate. These soils occur in sloping and steep hills or low mountainous areas chiefly along the

east coast of the area . This series is a member of the fine loamy family of Typic Dystrochrepts.

The typical profile of the Singjeong gravelly loam is:

A3——0 to 6 cm; Yellowish brown (10YR 5/6) gravelly loam; moderately very fine to medium granular structure; friable, slightly sticky, and non-plastic; many, fine to medium pores; many fine to coarse roots; gradual, wavy boundary; pH 5.5.

B2——6 to 33 cm; Strong brown (7.5YR 5/6) gravelly loam; moderate, fine to medium subangular blocky structure; slightly firm, slightly sticky, and slightly plastic; many, very fine to medium pores; common, fine to coarse roots; clear, wavy boundary; pH 5.0.

C1——33 to 53 cm; Strong brown (7.5YR 5/6), gravelly loam; weak, fine to coarse blocky breaking to fine to medium granular structure; slightly firm, slightly sticky, and non plastic; many, medium to coarse manganese concretions; common, very fine to medium pores; few, fine to coarse roots; clear, smooth boundary; pH 5.0.

C2——53 to 120+ cm; Brownish yellow (10YR 6/6), gray (7.5YR 6/0), yellow (10YR 8/6), strong brown (7.5YR 5/8), brownish yellow (10YR 6/8), and crushed colour olive yellow (2.5Y 6/6) very gravelly and cobbly silt loam; massive; slightly sticky and slightly plastic; common, very fine to fine pores; pH 4.5.

The Sinjeong soils have a surface layer of brown to dark brown, yellowish brown gravelly clay loam to loam. The subsoil is present in only a few areas. The C horizon is pale coloured saprolite of moderately coarse texture, sometimes with a hard bedrock.

They are strongly to medium acid, moderate to low in natural fertility, and low in organic matter content. Available moisture capacity is medium or low. Cation exchange capacity is medium, and base saturation is low.

Most of the areas are in pine forest, but a few areas with gentle slopes are cultivated.

5.33.1 Sinjeong Gravelly Loam, 15 to 30 Percent Slopes, Eroded (SxD2)

The profiles of this soil are similar to the one described for the series. Included are: areas of a soil that is severely eroded and gullied, areas of less or greater slopes than the described range, and some areas of Daegu soils. Another important addition is a soil with a gravel-free clay loam or loam surface layer.

Runoff is rapid.

Most of the areas are well suited to woodland, and are in pine forest. Some sloping areas are planted to barley or wheat. Erosion and stoniness affect management.

(Capability unit IVe; Paddy suitability group P4ac)

5.33.2 Sinjeong Gravelly Loam, 30 to 60 Percent Slopes, Eroded (SxE2)

This soil has a profile similar to the one described as representative for the series. Some areas are included that have: a gravel-free clay loam or loam surface layer, severely eroded or uneroded, and small areas of Daegu soils.

Surface runoff is rapid.

Pine forest or grassland dominate and suit the areas. Cultivation is not practical because this soil is steep and its runoff rapid. Erosion and stoniness affect management.

(Capability unit VIe)

5.34 SIRYE SERIES

The Sirye series consists of deep, well drained fine clayey soils developed in residuum weathered from gray shale and fine grained sandstone, occurring on sloping to steep mountainous areas. This series is a member of the fine clayey family of Typic Hapludalfs.

The typical profile of Sirye silt loam is:

Ap—0 to 5 cm; Yellowish brown (10YR 5/8) silt loam; moderate, very fine granular structure; very friable, slightly sticky, and slightly plastic; many, fine to very fine pores; many, fine and medium roots; pH 5.6.

A3—5 to 25 cm; Yellow (10YR 7/6) silt loam; moderate, fine to medium subangular blocky breaking to fine granular structure; slightly firm, sticky. and plastic; many, very fine to fine pores; root as above; gradual, wavy boundary; pH 5.6.

B1t—23 to 47 cm; Strong brown (7.5YR 5/8) gravelly silty clay loam; strong, fine and medium and coarse subangular blocky structure; firm, sticky, and plastic; patchy, thin and moderately thick cutans; common, very fine to fine pores; common, very fine, fine, and medium roots; gradual wavy boundary; pH 5.9.

B2t—47 to 75 cm; Yellowish red (5YR 5/6) and strong brown (7.5YR 5/8) gravelly silty clay; strong, medium to coarse subangular blocky structure; very firm, sticky, and very sticky; few, fine to very fine pores; patchy, thin clay cutans; few, very fine to fine roots; clear, wavy boundary; pH 5.8.

B3t—75 to 118 cm; Yellowish brown (10YR 5/8) gravelly silty clay loam; massive; firm, sticky and plastic; patchy moderately thick clay cutans; pores as above; roots as above; pH 5.9.

This Sirye soil has a surface layer of yellowish brown, brown to dark brown silt loam or silty clay loam. The C horizon is yellowish brown, brown, or reddish yellow gravelly silty clay loam, gravelly clay loam, or gravelly clay.

The Sirye soils are deeper than the Daegu soils, and are in a fine complex pattern. The Sirye soils are mapped only in a complex with the Daegu.

The soils of Sirye series are strongly to moderately acid, and are low both in natural fertility and organic matter. They have moderately slow permeability

and medium available moisture capacity. The cation exchange capacity is medium to high and is moderately saturated with bases. The surface runoff is rapid. Depth to bedrock ranges from 50 to 150 cm. These soils respond well to fertilization, and large parts are cultivated with crops such as barley, wheat, and soybean. Many areas too, are in pine forest.

5.35 TAEHWA SERIES

The Taehwa series consists of deep, well to excessively drained, moderately permeable, fine loamy soils formed in residuum derived from porphyry or granitic porphyry. It occurs on moderately steep to steep hills and mountainous areas. Depth to bedrock ranges from 2 to 5 m. In some places rock outcrops are common on the surface. This series is a member of the loamy family of Typic Hapludults.

The typical profile of Taehwa fine sandy loam is:

A1——0 to 5 cm; Brown to dark brown (10YR 4/3) fine sandy loam; moderate, very fine to fine granular structure; friable, slightly sticky, and slightly plastic; many roots; abrupt, smooth boundary; pH 5.5.

A3——5 to 16 cm; Yellowish brown (10YR 5/4), fine sandy clay loam; weak, fine to medium subangular blocky and moderate, fine to medium granular structure; friable, sticky, and plastic; few, fine pores; many roots; clear, wavy boundary; pH 5.1.

B1——16 to 28 cm; Yellowish brown (10YR 5/4) gravelly fine sandy clay loam; moderate, fine to medium subangular blocky structure; friable, sticky and plastic; few, fine pores; common roots; clear, wavy boundary; pH 5.0.

B21t——28 to 47 cm; Strong brown (7.5YR 5/8) fine sandy clay loam; moderate, fine to medium angular blocky structure; friable, sticky, and plastic; common, fine pores; patchy, thin clay cutans; common roots; clear, wavy boundary; pH 5.0.

B22t——47 to 56 cm; Strong brown (7.5YR 5/8) gravelly fine sandy clay loam; moderate, coarse subangular blocky structure; firm, slightly sticky, and slightly plastic; common, fine to medium pores; continuous, thin, strong brown (7.5YR 5/8) clay cutans; few, fine roots; clear, wavy boundary; pH 5.0.

C1——56 to 87 cm; Distinctly mottled strong brown (7.5YR 5/8) and brownish yellow fine sandy loam saprolite; firm; few, medium pores; few, fine roots; gradual, wavy boundary; pH 5.0.

C2——87 to 168+ cm; Distinctly mottled brownish yellow (10YR 6/8), very pale brown (10YR 8/3), and strong brown (7.5YR 5/6) loamy fine sand saprolite; firm; few roots; pH 5.0.

The surface layer is fine sandy loam, fine sandy clay loam, silt loam or loam, and contains some gravel in places. The B horizon is yellowish brown to strong brown or yellowish red gravelly fine sandy loam to light clay loam.

The B horizon contains gravels, and ranges from fine sandy loam to light clay loam. The C horizon is saprolite of porphyritic material, ranging from sandy loam to sandy loam or loamy fine sand.

The Taehwa soils are commonly associated with the Bonggye and Mudeung soils. The Taehwa are deeper than the Mudeung and differ from the Samgag in having a somewhat finer texture.

They are strongly acid, low in natural fertility and in organic matter content. Available moisture capacity is medium. Cation exchange capacity is medium, and base saturation is low.

The areas are in grassland, and forest of scattered Korean pine trees and oak, with an understory of shrub and azalea. A few small areas are cultivated, chiefly to barley, wheat, and soybean.

5.35.1 Taehwa-Bonggye Complex, 15 to 30 Percent Slopes, Eroded (TBD2)

This complex consists of about 60 percent Taehwa sandy loam and about 40 percent Bonggye silty clay loam which differ in the texture of the subsoil. They both adjoin each other (mapped as one unit) and are in moderately steep hills and mountainous areas. Many areas have been eroded, and the surface layer is yellowish brown to strong brown or yellowish red. The profiles otherwise are similar to those described as representatives for their respective series. Small areas of Bonggye soil that have a clay loam surface layer are included, along with some areas of an only slightly eroded soil, and small areas of Mudeung soils. Surface runoff is rapid, and erosion hazard is very severe.

Pine or black alder forest, with an understory of azalea, bush clover, and shrub, dominate. A few sloping areas are suitable to cultivation, and are planted to barley, buckwheat or similar crops.

The main concern in managing the soils is erosion.

(Capability unit IVe; Paddy suitability group P4ac)

5.35.2 Taehwa-Bonggye Rocky Complex, 15 to 30 Percent Slopes, Eroded (TGD2)

This complex consists of about 50 percent Taehwa, 25 percent Bonggye, and 25 percent rock outcrops. These soils differ in texture of the subsoil, occurring in such a way that they cannot be mapped separately. Most areas have been eroded, and the surface layer is mainly yellowish brown to strong brown or yellowish red clay loam.

Otherwise between rocks these soils have profiles similar to those described as representative for their respective series.

Included in this mapping unit are: some areas of Taehwa soil that have a silty clay loam, silt loam or loam surface layer with gravels in some places, some areas of Bonggye soil with a clay loam surface layer, small areas of Mudeung rocky loam, and a few small areas of an only slightly eroded soil. Here the surface layer is brown to dark brown.

Surface runoff is rapid, and erosion hazard is severe.

Forest, consisting of pines and alders with an understory of azalea, bush-clover and other shrubs, is the main feature, while a few small sloping areas are cultivated to barley and buckwheat. These soils are best suited to woodland.

The main problem in management is the control of erosion .

(Capability unit IVe).

5.35.3 Taehwa-Bonggye-Mudeung Rocky Complex, 15 to 30 Percent Slopes, Gullied (TMD4)

This mapping unit consists of a complex of the Taehwa, Bonggye, and Mudeung soils and rock outcrops, occupying very large tracts of moderately steep hills and mountainous areas. The Taehwa and Bonggye soils have many deep or shallow gullies, and are so severely eroded that most of the A and B horizons have been removed, and the C horizon is generally exposed. The soils otherwise have profiles similar to those described for their respective series. Included in this complex are some areas of lesser or greater slopes than the described range.

Surface runoff is rapid, and erosion hazard is severe. Plant cover is difficult to establish on the gullied land.

Most of these soils are left idle, and are not suitable for cultivation, but may produce some wood products if properly managed. A few small areas are cropped to millet or buckwheat.

Management is affected by severe erosion.

(Capability unit VIIe)

5.35.4 Taehwa-Bonggye-Mudeung Rocky Complex, 30 to 60 Percent Slopes, Eroded (TME2)

This mapping unit consists of about 40 percent Taehwa, 20 percent Bonggye, 20 percent Mudeung soils, and 20 percent rock outcrops. The soils differ in thickness over the unweathered substratum and in soil texture, and are so intricately mixed that it is impractical to map them separately at the scale used. They occupy large tracts chiefly in steep hills and mountainous areas.

The profiles are similar to those described for their respective series.

Runoff is rapid, and erosion hazard is severe.

Forest, consisting chiefly of pines and alders with an understory of azalea, bushclover, and other shrubs, grows, and is best suited. In managing these soils the main concern is erosion control.

(Capability unit VIe)

5.35.5 Taehwa-Bonggye-Mudeung Rocky Complex, 30 to 60 Percent Slopes, Gullied (TME4)

The soils of this complex are similar to those of Taehwa-Bonggye-Mudeung rocky complex, 15 to 30 percent slopes, gullied (TMD4) except for steeper slopes.

Surface runoff is rapid and erosion hazard is severe.

Most of the areas of this complex are left idle but may produce some wood products if properly managed. Plant cover is difficult to establish on the gullied land. Management is affected by severe erosion.

(Capability unit VIIe)

5.36 TIDAL FLAT (TF)

This mapping unit consists of a very deep, poorly to very poorly drained soil with fine texture, occupying level to nearly level fluvio-marine plains near the estuary of Taehwa river and Dongcheon, which flow into the Ulsan Bay. Previously submerged in sea water, it is now drained and protected from flooding by an artificial dyke.

The soil ranges from very dark gray to dark grayish brown or black in colour, and from silt loam to clay loam in texture, and is stratified throughout the profile. Seashells usually occur at depth of 10 cm.

The soil is moderately to strongly alkaline and saline, permeability is slow, and runoff is very slow to ponded.

None of it is suited to either cultivation or woodland. Only a few small areas are used for salt field. Reeds of 1 to 2 m tall are densely growing in some parts. When this soil is leached of these salts it will be similar to the Daldong soils.

5.37 TONGCHEON SERIES

The Tongcheon series consists of deep, moderately well drained, moderately rapidly permeable, coarse loamy soils formed in recent alluvium on level to nearly level alluvial plains. This series is a member of the loamy skeletal family of Aquic Dystrochrepts.

The typical profile of the Tongcheon sandy loam is:

Ap---0 to 17 cm; Very dark gray (10YR 3/1) sandy loam; few, fine and medium faint brown to dark brown (10YR 4/3) mottles; very dark gray (10YR 3/1) crushed colour; slightly sticky and non plastic, friable; few, fine and medium coarse continuous, vertical, inped, simple tubular pores; common, very fine mica; common, medium roots; clear, smooth boundary; pH 5.5.

B1---17 to 27 cm; Dark grayish brown (10YR 4/2) sandy loam; common, medium distinct brown to dark brown (7.5YR 4/4) mottles; grayish brown to dark grayish brown (10YR 5/2 to 4/2) crushed colour; weak, medium and coarse subangular blocky; slightly sticky and slightly plastic; firm; patchy thin clay film and accumulation of Fe oxides on structural face and in big earth worm holes; common, fine and medium, open tubular pores; many, fine mica; few, fine to medium rice dead roots; gradual, smooth boundary; pH 5.0.

B2---27 to 51 cm; Dark grayish brown (10YR 4/2) brown to dark brown (7.5YR 4/4) loam; brown to dark brown (7.5YR 4/4) crushed colour; moderate, medium and coarse subangular blocky; firm, sticky, and plastic; continuous, thin clay films; common, medium coarse continuous vertical, tubular pores; some (0.15 percent) rounded hard gravel; common, fine mica; few, fine rice dead roots; abrupt, smooth boundary; pH 5.5.

C1---51 to 112 cm; Dark reddish brown (5YR 2/2) loam; sticky and plastic; friable; patchy thin clay films; common, medium tubular pores; rounded gravels (40-50 percent) and cobbles; few, fine mica; gradual, smooth boundary; pH 5.5.

C2---113 to 150 cm; Brown to dark brown (7.5YR 4/4) sandy loam; very coarse gravels and cobbles (50-90 percent); pH 5.5.

The surface layer ranges in colour from grayish brown to very dark grayish brown or olive gray, and its texture from loam to sandy loam. The subsoil is brown to dark brown, dark grayish brown, yellowish brown or strong brown sandy loam to loam, and contains gravels in some places. The C horizon is grayish brown to dark grayish brown, brown to dark brown or strong brown in colour, and ranges from gravelly sandy loam to gravelly loamy sand. It usually begins at a depth of 50 to 100 cm below the surface.

The Tongcheon soils occur with Hwangryong and Sachon, and differ from the Sachon soil in being finer textured, less deep, and more mottled.

The Tongcheon soils are strongly to medium acid. Natural fertility is moderate, and organic matter content is medium. Available moisture capacity is low. Cation exchange capacity and base saturation are medium.

All of the areas are in cultivated crops. Paddy rice is grown during the summer, and barley in the winter.

5.37.1 Tongcheon Sandy Loam, 0 to 2 Percent Slopes (TC)

This soil has a profile similar to the one described for the series. With this soil are included some areas having a surface layer of grayish brown to very dark grayish brown loam, and some areas of a soil that have a gravel-free C horizon.

All areas are in cultivated crops. The soil is well suited to barley or wheat but planted to paddy rice in the summer and barley in the winter. Because of the moderately rapid permeability much water is required for rice. In managing this soil the main concerns are reducing the leaching of plant nutrients, growing drought tolerant crops, or introducing irrigation.

(Capability unit IIs; Paddy suitability group P3o).

Chapter 6

USE AND MANAGEMENT OF SOILS

6.1 INTRODUCTION

In this section of the soil survey, the system of capability classification used by the Korea Soil Survey Project is explained. The soils in each capability unit, the suitability and limitations of the soils for cultivated crops and pasture are described, and the management practices required for higher yields are also given.

The soil characteristics favourable for paddy rice differ from those for other crops. They are considered under capability groups, but are discussed in greater detail in section 6.3 on the paddy suitability groups. That section also describes the suitability of some soils for woodland.

6.2 CAPABILITY GROUPS OF SOILS

The capability classification is a grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on the limitations of the soils, the risk of damage when they are used, and the way they respond to treatment when planted to common field crops or sown to pasture crops.

The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive land-forming that would change the shape, depth, or other characteristics, and without consideration of possible but unlikely major reclamation projects.

Capability classes. The broadest groupings, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. There are no soils placed in class V or VIII in Ulju Gun and Ulsan Si. Classes are described as follows:

Class I	Soils that have few limitations that restrict their use.
Class II	Soils that have moderate limitations that reduce the choice of plants or require special management practices.
Class III	Soils that have severe limitations that restrict the choice of plants or require very careful management or both.
Class IV	Soils that have very severe limitations that restrict the choice of plants or require very careful management or both.
Class V	Soils that have little or no erosion hazard but have other limitations, impractical to remove, that limit their use to pasture or woodland.

Class VI — Soils that have severe limitations making them generally unsuitable for cultivation and limiting their use to pasture or woodland.

Class VII — Soils that have severe limitations making them unsuitable for cultivation or pasture and limit their use to woodland.

Class VIII — Soils and landforms that do not produce vegetation of commercial value.

Capability subclasses are soil groups within each capability class, and are designated by adding a small letter, e, s, or w to the class numeral. For example, IIe. The letter 'e' shows that the main limitation is risk of erosion unless close-growing plant cover is maintained, 's' shows that the soil is shallow, droughty, or stony; and 'w' that water in or on the soil interferes with plant growth or cultivation.

The classification does not reflect the value of the land. The class IIw and IIIw lands are well suited to paddy rice, and produce high yields of rice without special management of irrigation. These soils are too wet to produce good yields of other crops without additional drainage. The VIs soils produce good crops of melons and peanuts, but they are too droughty to grow most other things. In class I there are no subclasses because the soils have few limitations.

The soils of a subclass are so similar in their important characteristics that they have similar management, productivity and crop responses.

The land capability groups are discussed more fully in The Soils of Korea, The Korea Soil Survey Project, Technical Report 1, FAO, Rome.

6.2.1 Class II. Soils Having Moderate Limitations

6.2.1.1 Subclass IIe. Soils subject to moderate erosion if not protected by conservation practices or vegetation

This subclass consists of deep, moderately to moderately slowly permeable, generally well drained soils on gentle slopes. In general these soils are fertile and have high available moisture capacities. They cover 3,796 ha or 3.8 percent of the area. They are:

Baegsan loam, 2-7 percent slopes.
Banho gravelly loam, 2-7 percent slopes.
Chundo loam, 2-7 percent slopes.
Gwangju-Bancheon complex, 2-7 percent slopes.
Hwandong-Honam complex, 2-7 percent slopes.
Sachon sandy loam, 2-7 percent slopes.

Erosion is a moderate hazard on these soils, but can be controlled by simple conservation practices, such as contour farming. Or by growing cover and green manure crops, such as milk vetch or hairy vetch in the cropping system. Diversion channels, terraces, and grassed waterways are needed for erosion control in some areas.

Many areas have been graded into rice paddies. Rice is grown in the summer and barley in the winter on most areas. Erosion is controlled in a well constructed paddy system. Some small structures to permit water to overflow from

the paddy without erosion of the paddy walls are needed. Moderate losses of irrigation water through seepage can be expected on the soils of the Banho and Baegsan series.

These soils, well fertilized and well managed, are capable of producing high yields of most crops.

Except for the areas of Honam soils in the Hwadong-Honam complex they are also good for orchard and vineyard production.

While capable of producing high yield of pasture and forage crops, they are usually planted to high value grain and vegetable crops.

6.2.1.2 Subclass IIs. Soils subject to moderate drought problems

These soils are deep, moderately rapidly permeable, well drained, and have moderate available moisture capacities. They have coarse sandy loam and gravelly loam textures. While droughtiness is the major problem, erosion is also a problem on the sloping soils. These soils are of small extent, covering 1,529 ha or 1.5 percent of the area. They are:

Hogye gravelly loam, 2-7 percent slopes.
Hogye gravelly loam, 7-15 percent slopes.
Iweon stony sandy loam, 2-7 percent slopes.
Iweon stony sandy loam, 2-15 percent slopes.
Tongcheon sandy loam, 0-2 percent slopes.

The soils are suitable for a wide range of grain crops including barley, wheat, and soybeans. Onion, melon, squash, peaches, apples, and pears grow well.

A large amount of water is required to grow rice because of the high water losses through these rapidly permeable, coarse sandy and loamy soils. Much grading is needed to construct rice paddies on the sloping mapping units.

Fertilizers are needed for the maximum production of grain and vegetable crops. Overflow is a problem on the Tongcheon soils and on some areas of other soils but the flood water drains rapidly. Diversion ditches and dykes reduce the flood hazard.

6.2.1.3 Subclass IIw. Soils having high water tables which limit the choice of crops unless drained

This subclass consists of deep, moderately permeable silty to sandy loam soils with high water tables. They have moderate and high available moisture capacities, and areas with slopes of less than 2 percent are subject to overflow, except where protected by levee systems. These soils are important, covering 11,205 ha or 11.6 percent of the area. They are:

Daldong silt loam, 0-1 percent slopes.
Deogha silty clay loam, 0-1 percent slopes.
Hagseong silt loam, 0-1 percent slopes.
Jisan loam, 2-7 percent slopes.
Jisan loam, 7-15 percent slopes.
Seoggye fine sandy loam, 0-2 percent slopes.

Most areas are planted to paddy rice and produce good yields when well fertilized and managed. Except for the gently sloping and sloping soils, paddies area easy to construct. The water requirement for growing rice is low because the high water tables prevent seepage.

They are also too wet for consistent production of high yields of most other crops unless a drainage system is installed. With this, barley could be grown during the winter, or the cropping system could be changed to grow crops other than rice during the summer season.

If drained the Daldong, Hagseong, and Jisan soils would be the best, having high available moisture capacities. The Sachon and Seoggye soils have low available moisture capacities. Yields of crops on these soils after they are drained may be lower than on others of this subclass, because of deficient moisture.

6.2.2 Class III. Soils with Severe Limitations

6.2.2.1 Subclass IIIe. Soils subject to severe erosion if not protected with special conservation practices or perennial plants or both.

This subclass consists mainly of deep, moderately to slowly permeable, well drained, sloping soils with high available moisture capacities. Included are gently sloping and sloping mapping units of the Banggi series with moderate available moisture capacities.

The areas of the Daegu soils in the Bancheon-Daegu complex are shallow and best used for pasture.

The Honam soils of the Hwadong-Honam complex dry slowly after wet seasons, but generally can be managed in much the same manner as the other soils of the group. Soils of this subclass are important in the area, covering 6,057 ha or 6.0 percent. They are:

Bancheon-Daegu complex, 7-15 percent slopes, eroded.
Banggi clay loam, 2-7 percent slopes.
Banggi clay loam, 7-15 percent slopes.
Banho gravelly loam, 7-15 percent slopes.
Banho silt loam, 7-15 percent slopes.
Bonggye silty clay loam, 7-15 percent slopes, eroded.
Chundo loam, 7-15 percent slopes.
Gwangju-Bancheon complex, 7-15 percent slopes.
Gwangju-Bancheon complex, 7-15 percent slopes, eroded.
Hwadong-Honam complex, 7-15 percent slopes.
Sachon sandy loam, 7-15 percent slopes.

These soils are used to grow many kinds of crops. Because of the slopes much grading is required to construct rice paddies, and even with this, they are necessarily small and irregular in shape. Additional paddies are dependent upon the development of irrigation water facilities.

Because of the gravelly subsoil of the Banggi soils they are less suitable than the other soil. A well constructed system will control erosion, but structures are usually needed to permit excess water to flow from the paddy without eroding the walls.

The other crops grown on these soils include barley, soybeans, wheat, potatoes. Liming is particularly important for high yields of soybeans on these acid soils. Soil erosion can be controlled by using small fields and constructing diversion ditches to remove the runoff water.

Grass channels or waterways will prevent the formation of gullies in the channels. The growing of perennial hay and pasture crops will control erosion, but because of the small amount of livestock presently on the farms, there is little use for these crops.

6.2.3 Class IV. Soils With Very Severe Limitation

6.2.3.1. Subclass IVe. Soils with very severe erosion hazards

Most of these soils are moderately steep, well drained, deep soils, and have moderate to high available moisture capacities. They are moderately productive when well managed, and are important in the area, covering 6,772 ha or 6.8 percent. They are:

Baegsan loam, 15-30 percent slopes.
Bancheon-Daegu complex, 15-30 percent slopes, eroded.
Banho gravelly loam, 15-30 percent slopes.
Cheongog silty clay loam, 15-30 percent slopes, eroded.
Daegu-Sirye complex, 7-15 percent slopes, eroded.
Dalcheon-Samgag complex, 7-15 percent slopes, eroded.
Iweon stony sandy loam, 15-30 percent slopes.
Jisan loam, 15-30 percent slopes.
Mangsil-Mudeung stony complex, 15-30 percent slopes.
Sanchon sandy loam, 15-30 percent slopes.
Sinhyeon loam, 15-30 percent llopes, eroded.
Sinjeong gravelly loam, 15-30 percent slopes, eroded.
Taehwa.Bonggye rocky complex, 15-30 percent slopes, eroded.

The erosion hazard is too severe for the growing of annual crops continuously, but perennial hay and pasture crops will control that and produce high yields. Once established these crops will provide much forage for dairy and animals.

Large quantities of lime, as well as other fertilizers are needed to grow good grass, legume, meadow, and pasture crops. Alfalfa, serecia lespedeza, Korean lespedeza, Ladino clover, alsike clover will do well if properly managed.

On the somewhat wet Jisan and Sachon soils, Alsike and Ladino clovers will grow well. These soils are too wet to produce good crops of alfalfa and lespedeza.

Red clover would generally grow well but this crop seldom lives beyond the second season. Few of these soils are graded for paddy because of the steep slopes and stoniness.

Good orchards of apples, peach, and persimmon have too been established. Soil erosion is destructive to the soil in clean tilled orchards and planting of cover crops as well as the application of other erosion control measures are necessary. Bench terracing with good grass sod on the slopes is also an effective erosion control measure. Maintaining grass sod in drainage channels will prevent the formation of gullies.

Many areas of these soils supporting a sparse stand of trees are eroding very rapidly, mainly because of the raking and removing of the dead leaves and other surface litter. Good woodland management practices will prevent these losses and provide some income.

6.2.3.2 Subclass IVs. Soils with very severe moisture problems

This subclass consists of well drained, very coarse textured, rapidly permeable level to gently sloping soils of alluvial fans and flood plains. These soils have a very low available moisture capacity. Over-flow is a minor problem but it is of short duration. Most damage is done by rapidly moving flood waters. While not extensive these soils are important on many farms. They cover 2,230 ha or 2.2 percent of the area. They are:

Hwabong loamy sand, 0-2 percent slopes.
Hwangryong gravelly sandy loam, 0-2 percent slopes.

Although these soils have large water losses when used for paddy, some areas adjacent to dependable water supplies are planted to paddy rice and produce good crops.

Because of its ability to withstand drought, rye will yield better than wheat or barley. Watermelons and cucumbers grow well, particularly on the Hwabong soils. Deep rooted legumes like alfalfa would also grow but may be damaged when flooded.

Orchards of apples and pear have been successful on these soils. Some areas are used to produce mulberry leaves for silkworm production. Poplar trees also grow well.

The Hwangryong soils can be improved by picking up the large gravels and cobbles. Clayey soil is often added to the surface of these soils to improve texture and water holding capacity. Irrigating with dirty water also adds fine textured materials. Irrigation would increase the yields of many crops.

6.2.3.3 Subclass IVw. Soils with severe wetness problems

This subclass consists of poorly drained very coarse textured, rapidly permeable, level to gently sloping soils of the flood plains. Overflow after heavy rains is also a problem.

These soils have a very low available moisture capacity and would be droughty except for the high water table. The only soil in this group is Sindab sandy loam, 0 to 2 percent slopes covering 450 ha or 0.5 percent of the area.

Rice is grown on almost everywhere as the water table is too high for other crops. If drained, and planted to other crops, yields are apt to be low because of drought hazard. Drainage systems are difficult to maintain because of the tendency of the sand to flow into and fill them.

6.2.4 Class VI. Soils Suitable Only for Pasture or Woodland

6.2.4.1 Subclass VIe. Soils with a very severe erosion problem

The soils are shallow, sloping to steep, and mainly rocky. They are well drained and generally have low to medium available moisture capacities, and because of these unfavorable characteristics are suitable only for pasture or woodland use.

These are the most extensive soils in the area covering 32,951 ha or 32.9 percent of the area. They are:

Bancheon-Daegu complex, 30-60 percent slopes, eroded.
Daegu rocky silt loam, 7-15 percent slopes, eroded.
Daegu rocky silt loam, 30-60 percent slopes, eroded.
Daegu-Sirye complex, 15-30 percent slopes, eroded.
Dalcheon-Samgag complex, 15-30 percent slopes, eroded.
Mudeung rocky loam, 30-60 percent slopes.
Mudeung-Mangsil stony complex, 15-30 percent slopes.
Mudeung-Mangsil stony complex, 30-60 percent slopes.
Mudeung-Taehwa-Daegu rocky complex, 15-30 percent slopes, eroded.
Samgag rocky sandy loam, 15-30 percent slopes, eroded.
Samgag rocky sandy loam, 30-60 percent slopes, eroded.
Sinbul stony loam, 15-30 percent slopes.
Sinbul bouldery loam, 30-60 percent slopes.
Sinhyeon soils, 30-60 percent slopes, gullied.
Sinjeong gravelly loam, 30-60 percent slopes, eroded.
Taehwa-Bonggye-Mudeung rocky complex, 30-60 percent slopes, eroded.

Because of the steep slopes, the application of lime and other fertilizers is difficult as is the preparation of seed beds for better kinds of plants. However, with liming, fertilization, and better kinds of pasture plants, considerable grazing could be obtained. Many areas are now covered with shrubby pine trees and produce only a small amount of firewood.

The establishment of good grass cover would protect these soils from erosion. If these soils are used for woodland, good management will reduce erosion losses and boost forest product enterprises.

6.2.5 Class VII. Soils Limited to Woodland

6.2.5.1 Subclass VIIe. Soils with severe erosion problems

These soils are so rocky, steep, or so badly eroded that they are suited only for woodland. While they are of limited value they cover 29,632 ha or 29.6 percent of the area. They are:

Daegu rocky silt loam, 15-30 percent slopes, gullied.
Daegu rocky silt loam, 30-60 percent slopes, gullied.
Jeongja rocky loam, 30-60 percent slopes, eroded.
Mudeung-Taehwa-Daegu rocky complex, 30-60 percent slopes, eroded.
Samgag soils,15-30 percent slopes, gullied.
Samgag soils,30-60 percent slopes, gullied.
Samgag very rocky soils, 15-30 percent slopes, gullied.
Samgag very rocky soils 30-60 percent slopes, gullied.
Taehwa-Bonggye-Mudeung rocky complex, 15-30 percent slopes, gullied.
Taehwa-Bonggye-Mudeung rocky complex, 15-30 percent slopes, gullied.

Good woodland cultural practices are needed to prevent erosion on these soils and increase production. The practice of raking litter leaves the soil bare and subject to erosion. Advanced erosion and gullies reduce further the productivity of these soils.

6.2.6 Class VIII. Non Productive Soils

The land types in this class include:

Beach and riverwash, cobbly.
Beach and riverwash, sandy.
Rock land.
Tidal flat.

Suggestions for these mapping units can be found in the description of the mapping unit.

6.3 PADDY LAND SUITABILITY GROUPS

Rice is the most important crop in Korea. It grows well on soils that are too wet for most other crops. These wet soils are classified as IIw or IIIw in the capability classification. In this section, the use and management of the soils suitable for growing paddy rice are discussed.

Management of paddy land can be planned more effectively if soils are grouped according to those characteristics that affect its growth and management. For this reason, the soils of the survey area suitable for the production of paddy rice have been placed in four paddy land suitability groups, which are designated by P1, pP2, P3, and P4.

The numerals indicate progressively greater limitations in the use of land for rice.

The four suitability groups for rice paddy used by the Korea Soil Survey are defined as follows:

P1 Very well suited:

Land that is suitable for rice paddy without the necessity of special development or management practices. This soil has no special limitations or hazards.

P2 Well suited:

Land that is suitable for rice paddy with the application of simple special development and management practices. This has moderate hazards and limitations.

P3 Moderately suited:

Land that is suitable for rice paddy with the application of difficult special development and management practices. This has severe hazards and limitations.

P4 Poorly suited:

Land that is of limited or questionable suitability for paddy because of very severe hazards, limitations, and very difficult special management practices.

Suitability subgroups are soil classes within each suitability group; they are designated by adding small letters, a, b, or c to the group numeral, for example P2ac. The letter 'a' shows that the main limitation is slope; 'b', that the soil is limited mainly because of coarse texture or rapid permeability; 'c', the height of the water table. In group P1 there are no subgroups, because the soils of this group have no special limitations.

Some of the soils in subclass IIw and IIIw of the capability system are classified as P1. The high water table is a desirable characteristic rather than a limitation of soil used for growing paddy rice.

Steep, gullied, stony, or rocky soils are unsuitable for paddy rice, and are not included in this classification.

Paddy suitability groups are discussed more fully in The Soils of Korea , The Korea Soil Survey Project, Technical Report 1, FAO, Rome.

6.3.1 Group P1. Very Well Suited

6.3.1.1 Paddy Suitability Group P1

This land is very well suited for paddy without the necessity of special development or management practice and without special limitations or hazards.

6.3.1.2 Paddy Suitability Group P1a

The soils in this group are nearly level, medium and fine textured, moderately and moderately slowly permeable, and with high water tables. These soils are extensive, covering 2,814 ha or about 2.8 percent of the area.

They are:

Dh Deogha silty clay loam, 0-1 percent slopes.
Dd Daldong silt loam, 0-1 percent slopes.
Ho Hagseong silt loam, 0-1 percent slopes.

These soils need few management practices other than adequate fertilization and good cultural practices that are needed for rice production on any soil. Somewhat higher yields will be obtained when the soil is ploughed deep, (usually about 18 cm), and fertilizer is applied. Calcium silicate fertilizer reduces lodging of this crop.

The high water table is a limitation to the growing of a crop such as barley or wheat during the winter and spring season. Some areas of salty soils mainly adjacent to the sea have been included in the Buyong series. These soils are less productive than other soils in this group.. Frequent irrigations with salt free water, selection of salt tolerant rice varieties, close spacing, and high level fertilization, will increase yields.

6.3.2 Group P2. Well Suited

6.3.2.1 Paddy Suitability Group P2

Land that is suited for paddy with the application of simple development and management practices and with moderate hazards and limitations for use as rice paddy.

6.3.2.2 Paddy Suitability Group P2a

The soil in this group is gently sloping to sloping, medium textured and moderately permeable. Seepage from adjacent higher land usually maintains a high water table. This group is extensive, covering 3,439 ha or 3.4 percent of the area. The only soil in this group is:

JiB Jisan loam, 2 to 7 percent slopes.

Deep ploughing with fertilization will increase yields. The application of calcium silicate will assist in the formation of a stiff straw and resist lodging. Some structure such as a weir dam is needed to regulate the water level and prevent the erosion of the paddy walls. While some barley is grown on this soil yields are limited by wetness in most years.

6.3.2.3 Paddy Suitability Group P2b

The soil in this group is nearly level, moderately to moderately rapidly permeable, medium to coarse textured, has a high water table, and is subject to damaging floods after heavy rains. The only soil in this group is:

Seoggye fine sandy loam, 0 to 2 percent slopes, covering 316 ha or 0.3 percent of the area.

The loss of water and dissolved plant nutrients is a moderate problem. Water loss can be reduced by the addition of clayey soil to the paddy. This also increases the cation exchange capacity and reduces nutrient loss. A split application of nitrogen fertilizer is also helpful in reducing this loss.

Because rice plants do not form tillers readily in this soil, more close than usual spacing of rice plants is necessary to obtain adequate density. Barley is grown as a winter and spring crop between the rice but yields are often low because of wetness.

6.3.2.4 Paddy Suitability Group P2ac

The soils in this group are gently sloping, moderately to moderately slowly permeable, and with low or no water tables. This group is 3,858 ha or 3.8 percent of the area. They are:

BiB Banggi clay loam, 2 to 7 percent slopes.
BlB Banho gravelly loam, 2 to 7 percent slopes.
BhB Banho silt loam, 2 to 7 percent slopes.
CdB Chundo loam, 2 to 7 percent slopes.
GBB Gwangju-Bancheon complex, 2 to 7 percent slopes.
HHB Hwadong-Honam complex, 2 to 7 percent slopes.

At present only the soils of the Hwadong-Honam complex are used extensively for rice paddy as water is usually not available for paddies on the other soils.

Because of the soil and water conditions water seepage losses are moderate, requiring frequent watering to maintain optimum water depth. Deep ploughing and application of calcium silicate are good cultural practices. Water control structures are needed to maintain water depth and prevent erosion of paddy walls. Barley is successfully grown between rice crops, and crops other than rice will grow during the summer season.

6.3.3 Group P3. Moderately Suited

6.3.3.1 Paddy Suitability Group P3

This land is suitable for paddy with the application of difficult, special development, and management practices, and with severe hazards and limitations for use as rice paddy.

6.3.3.2 Paddy Suitability Group P3a

The soil in this group is sloping, moderately permeable, and medium textured. Seepage water from higher adjacent soils maintains a high water table. The only mapping in this group covers 3,178 ha or 3.8 percent of the area. It is:

(JIC) Jisan loam, 7 to 15 percent slopes.

Erosion of paddy walls by excess water is a problem that can be controlled by the installation of weir dams or other structures. Deep ploughing, (about 18 cm), and the application of calcium silicate, are good management practices. Barley can be grown during the winter seasons between rice crops but yields may be low some years because of the wetness of this soil.

6.3.3.3 Paddy Suitability Group P3b

The soil in this group is nearly level, rapidly permeable, deep sand with a high water table, and a low available moisture capacity. Most areas have some protection from flooding by levee systems. Clay contents and cation exchange capacity are very low. The soil in this group is:

(Sn) Sindab sandy loam, 0 to 2 percent slopes.

It covers 450 ha or 0.5 percent of the area. Because of the high water table it is usually not difficult to maintain the optimum water depth for rice. However water constantly seeps into and away from paddies carrying with it dissolved plant nutrients. The application of fine clay soil will reduce this loss of phosphorus and potassium fertilizer. The nitrogen losses can be controlled by applying small amounts of it often during the growing season.

As the rice grown on this soil does not form tillers readily, thicker than usual planting is required to obtain the desired density of stand.

Better drainage is difficult to obtain, as most of these soils are in valleys where the streams are elevated because of sand, and other material eroded from the watersheds. Without better drainage, paddies will remain too wet for crops other than rice.

6.3.3.4 Paddy Suitability Group P3c

The soil in this group is nearly level, moderately to moderately rapidly permeable, medium to coarse textured with a generally low water table. The soil is:

(Tc) Tongcheon sandy loam, 0 to 2 percent slopes.

It covers 1,112 ha or about 1.1 percent of the area.

Losses of water and dissolved plant nutrients are moderate to severe. The application of clayey earth will reduce this. The loss of nitrogen fertilizer can be lowered by making a split application. Deep ploughing is difficult because of the presence of gravel and cobbles in horizons below the plough layer.

Thicker than usual transplanting is necessary to obtain the optimum number of rice plants as the plants do not form tillers readily. Some low areas are damaged by flood waters after very heavy rains. Barley grows well between rice crops. Other crops such as millet, soybeans, and similar crops may be grown instead of rice.

6.3.3.5 Paddy Suitability Group P3ac

The soils of this group are sloping, moderately to slowly permeable, generally with low or no water tables. The Honam soil of the Honam-Hwadong complex has a high water table during part of the year. The soils cover 3,940 ha or 3.9 percent of the area. They are:

BiC Banggi clay loam, 7 to 15 percent slopes.
BlC Banho gravelly loam, 7 to 15 percent slopes.
BhC Banho silt loam, 7 to 15 percent slopes.
ByC2 Bonggye silty clay loam, 7 to 15 percent slopes.
CdC Chundo loam, 7 to 15 percent slopes.
GBC Gwangju-Bancheon complex, 7 to 15 percent slopes.
GBC2 Gwangju-Bancheon complex, 7 to 15 percent slopes, eroded.
HHC Hwadong-Honam complex, 7 to 15 percent slopes.

Other than the Hwadong-Honam complex, few are presently being used for rice paddy because dependable water supplies are not available. It is possible to grow a good crop of barley between rice crops, or the paddy area can be planted to many non paddy crops instead of rice.

The use of the paddy system for all crops will assist in erosion control. A small weir notch dam or similar structure will prevent the erosion of the paddy wall. In rice culture, deep ploughing and the application of calcium silicate are good cultural practices.

6.3.4. Group P4. Poorly Suited

6.3.4.1 Paddy Suitability Group P4

Land that is of limited or questionable suitability for use as rice paddy because of very severe hazards and limitations, and the need for very difficult, special management practics.

6.3.4.2 Paddy Suitability Group P4a

The soil in this group is moderately steep, moderately permeable, medium textured soil. It usually has a high water table as a result of seepage from adjacent higher land. The soil, (JiD) Jisan loam, 15 to 30 percent slopes, is of minor extent, covering 301 ha or 0.3 percent of the area.

Some areas lack adequate water supplies and may be better planted by direct seeding. Deep ploughing and the application of calcium silicate are good management practices. Small weir dams or similar structures will prevent erosion of paddy walls. While barley can be grown yields are reduced in wet seasons due to poor drainage.

6.3.4.3 Paddy Suitability Group P4ac

Moderately steep, moderately to slowly permeable, medium and fine textured soils with very deep or no water tables, compose this group.

While this group is extensive covering 3,474 ha or about 3.5 percent of the area, little of it is presently used for paddy because of unfavourable soil characteristics and lack of water. The soils are:

BhD	Banho gravelly loam, 15 to 30 percent slopes.
BhD	Banho silt loam, 15 to 30 percent slopes.
CgD2	Cheongog silty clay loam, 15 to 30 percent slopes, eroded.
SyD2	Sinyyeon loam, 15 to 30 percent slopes, eroded.
SxD2	Sinjeong gravelly loam, 15 to 30 percent slopes, eroded.
TBD2	Taehwa-Bonggye complex, 15 to 30 percent slopes, eroded.

Water losses on these soils are moderate but may be high in the areas which contain Taehwa soils. Direct seeding and the use of dryland nursery may be a feasible way of planting rice. Deep ploughing and the application of calcium silicate are good management practices. Erosion of paddy walls can be lessened by building small weir dams or similar structures. Winter barley could be grown between rice crops and other summer crops are possibilities in place of rice.

6.3.4.4 Paddy Suitability Group P4abc

The soils in this group are gently sloping to moderately steep, moderately rapidly permeable soils with gravelly to stony sandy loam or clay loam textures. They have moderate to low available moisture capacities, with deep or no water tables. The soils cover 2,111 ha or 2.1 percent of the area. They are:

DGC2	Dalcheon-Samgag complex, 7 to 15 percent slopes, eroded.
DGD2	Dalcheon-Samgag complex, 15 to 30 percent slopes, eroded.
HgB	Hogye gravelly loam, 2 to 7 percent slopes.
HgC	Hogye gravelly loam, 7 to 15 percent slopes.
IwB	Iweon stony sandy loam, 2 to 7 percent slopes.
IwC	Iweon stony sandy loam, 7 to 15 percent slopes.
IwD	Iweon stony sandy loam, 15 to 30 percent slopes.
ScB	Sachon sandy loam, 2 to 7 percent slopes.
ScC	Sachon sandy loam, 7 to 15 percent slopes.

Because of their unfavourable characteristics few paddies have been established on the soils other than the soils of the Sachon series. Expected water and plant nutrient losses would be high. The gravels, cobbles, and stones interfere

with cultivation but have been removed from some areas. Deep ploughing is difficult because of gravels and stones in the lower horizons. Small weir notch dams or other structures will prevent erosion of paddy walls. Barley and other winter crops grown between rice crops produce well. These soils when levelled into paddy will produce high yields of other summer crops as well as rice.

6.3.4.5 Paddy Suitability Group P 4bc

The soils in this group are nearly level, coarse sandy, with low water tables and low available moisture capacities. They have low clay contents and low cation exchange capacities. Flooding is somewhat of a problem. Most of the damage is from the fast moving flood water. The soils cover 2,230 ha or 2.2 percent of the area. They are:

Hw Hwabong loamy sand, 0-2 percent slopes.
Hy Hwangryong sandy loam, 0-2 percent slopes.
HI Hwangryong gravelly sandy, 0-2 percent slopes.

A good dependable water supply is needed as the water in paddies drains rapidly and the soil dries rapidly because of its low available moisture capacity. This water also takes with it dissolved plant nutrients. Fortunately many of these soils are near good dependable water supplies. The loss of water and plant nutrients can be decreased by applying clayey soil to the paddy. Losses of nitrogen fertilizer can be controlled by making several small applications during the growing season.

Thick planting of rice is necessary as the plants do not form tillers readily when grown on this soil. Gravels and cobbles on the surface of some of these soils can be picked up so that they will not interfere with rice culture. Barley is grown between rice crops but the yields are only moderate, the soils being droughty. Irrigation, similar to basin irrigation, may be a worthwhile practice for the production of barley, as well as other crops grown in the paddy instead of rice.

Table 3

EXTENT (HA) OF MAPPING UNITS

	Soils	Ulju Gun		Ulsan Si	
		Area	Percent	Area	Percent
BDC2	Bancheon-Daegu complex, 7 to 15 percent slopes, eroded.	112	0.1	18	0.1
BDD2	Bancheon-Daegu complex, 15 to 30 percent slopes, eroded.	313	0.4	105	0.6
BDE2	Bancheon-Daegu complex, 30 to 60 percent slopes, eroded.	132	0.2	72	0.4
BiB	Banggi clay loam, 2 to 7 percent slopes.	360	0.4	14	0.1
BiC	Banggi clay loam, 7 to 15 percent slopes.	89	0.1		
BlB	Banho gravelly loam, 2 to 7 percent slopes.	182	0.2	67	0.4
BlC	Banho gravelly loam, 7 to 15 percent slopes	459	0.6	86	0.5
BlD	Banho gravelly loam, 15 to 30 percent slopes.	301	0.4	24	0.1
BhB	Banho silt loam, 2 to 7 percent slopes.	194	0.2	103	0.6
BhC	Banho silt loam, 7 to 15 percent slopes.	556	0.7	126	0.7
BhD	Banho silt loam, 15 to 30 percent slopes.	166	0.2	26	0.2
BRC	Beach and riverwash, cobbly.	1,553	1.9	153	0.9
BRS	Beach and riverwash, sandy.	338	0.4	237	1.4
ByC2	Bonggye silty clay loam, 7 to 15 percent slopes, eroded.	398	0.5	242	1.4
CgD2	Cheongog silty clay loam, 15 to 30 percent slopes, eroded.	117	0.1	7	

Table 3 (cont'd)

	Soils	Ulju Gun Area	Uljū Gun Percent	Ulsan Si Area	Ulsan Si Percent
CdB	Chundo loam, 2 to 7 percent slopes.	77	0.1	38	0.2
CdC	Chundo loam, 7 to 15 percent slopes.	24	(1)	1	
DgC2	Daegu rocky silt loam, 7 to 15 percent slopes, eroded.	87	0.1	516	3
DgD2	Daegu rocky silt loam, 15 to 30 percent slopes, eroded.	1,169	1.4	228	1.3
DgE2	Daegu rocky silt loam, 30 to 60 percent slopes, eroded.	7,821	9.4	626	3.7
DgD4	Daegu rocky silt loam, 15 to 30 percent slopes, gullied.	754	0.9	638	3.7
DgE4	Daegu rocky silt loam, 30 to 60 percent slopes, gullied.	1,386	1.7	503	3
DSC2	Daegu-Sirye complex, 7 to 15 percent slopes, eroded.	150	0.2	284	1.7
DSD2	Daegu-Sirye complex, 15 to 30 percent slopes, eroded.	332	0.4	54	0.3
DGC2	Dalcheon-Samgag complex, 7 to 15 percent slopes, eroded.	235	0.3	128	0.7
DGD2	Dalcheon-Samgag complex, 15 to 30 percent slopes, eroded.	728	0.9	191	1.1
Dd	Daldong silt loam, 0 to 1 percent slopes.	221	0.3	901	5.3
Dh	Deogha silty clay loam, 0 to 1 percent slopes.	346	0.4	389	2.3
GBB	Gwangju-Bancheon complex, 2 to 7 percent slopes.	820	1	411	2.4
GBC	Gwangju-Bancheon complex, 7 to 15 percent slopes.	818	1	503	3
GBC2	Gwangju-Bancheon complex, 7 to 15 percent slopes, eroded.	19	(1)	2	
Ho	Hagseong silt loam, 0 to 1 percent slopes.	304	0.4	653	3.8

Table 3 (cont'd)

	Soils	Uljju Gun		Ulsan Si	
		Area	Percent	Area	Percent
HgB	Hogye gravelly loam, 2 to 7 percent slopes.	226	0.3	191	1.1
HgC	Hogye gravelly loam, 7 to 15 percent slopes.	10	(1)	15	0.1
Hw	Hwabong loamy sand, 0 to 2 percent slopes.	93	0.1	88	0.5
HHB	Hwadong-Honam complex, 2 to 7 percent slopes.	1,322	1.6	270	1.6
HHC	Hwadong-Honam complex, 7 to 15 percent slopes.	530	0.6	87	0.5
HI	Hwangryong gravelly sandy loam, 0 to 2 percent slopes.	1,125	1.4	27	0.2
Hk	Hwangryong sandy loam, 0 to 2 percent slopes.	642	0.8	255	1.5
IwB	Iweon stony sandy loam, 2 to 7 percent slopes.	275	0.3	37	0.2
IwC	Iweon stony sandy loam, 7 to 15 percent slopes.	1,461	1.7	127	0.7
IwD	Iweon stony sandy loam, 15 to 30 percent slopes.	868	1	27	0.2
JjE2	Jeongja rocky loam, 30 to 60 percent slopes, eroded.	321	0.4	26	0.2
JiB	Jisan loam, 2 to 7 percent slopes.	1,616	3.1	823	4.9
JiC	Jisan loam, 7 to 15 percent slopes.	2,454	2.9	724	4.2
JiD	Jisan loam, 15 to 30 percent slopes.	276	0.3	25	0.1
MMC	Mangsil-Mudeung stony complex, 7 to 15 percent slopes.	133	0.2	3	
MdE	Mudeung rocky loam, 30 to 60 percent slopes.	5,810	7	278	1.6
MMD	Mudeung-Mangsil stony complex, 15 to 30 percent slopes.	506	0.6	20	0.1

Table 3 (cont'd)

	Soils	Uljn Gun Area	Uljn Gun Percent	Ulsan Si Area	Ulsan Si Percent
MME	Mudeung-Mangsil stony complex, 30 to 60 percent slopes.	748	0.9		
MTD2	Mudeung-Taehwa-Daegu rocky complex, 15 to 30 percent slopes eroded.	1,883	2.3	355	2.1
MTE2	Mudeung-Taehwa-Daegu rocky complex, 30 to 60 percent slopes, eroded.	15,271	18.3	1,515	8.9
RL	Rock land	2,300	2.8	173	1
ScB	Sachon sandy loam, 2 to 7 percent slopes.	371	0.4	30	0.2
ScC	Sachon sandy loam, 7 to 15 percent slopes.	539	0.6	70	0.4
ScD	Sachon sandy loam, 15 to 30 percent slopes.	40		11	0.1
SmD2	Samgag rocky sandy loam, 15 to 30 percent slopes, eroded.	1,799	2.2	116	0.7
SmE2	Samgag rocky sandy loam, 30 to 60 percent slopes, eroded.	3,881	4.7	327	1.9
SgD4	Samgag soils, 15 to 30 percent slopes, gullied.	1,091	1.3	361	2.1
SgE4	Samgag soils, 30 to 60 percent slopes, gullied.	2,482	3	726	4.3
SvD4	Samgag very rocky soils, 15 to 30 percent slopes, gullied.	41	(1)		
SvE4	Samgag very rocky soils, 30 to 60 percent slopes, gullied.	38	(1)		
Se	Seoggye fine sandy loam, 0 to 2 percent slopes.	204	0.2	112	0.7
SiD	Sinbul stony loam, 15 to 30 percent slopes.	126	0.2		
SlE	Sinbul bouldery loam, 30 to 60 percent slopes.	132	0.2	3	
Sn	Sindab sandy loam, 0 to 2 percent slopes.	398	0.5	52	0.3

Table 3 (cont'd)

Soils		Ulju Gun Area	Ulju Gun Percent	Ulsan Si Area	Ulsan Si Percent
SyD2	Sinhyeon loam, 15 to 30 percent slopes, eroded.	52	0.1	17	0.1
SyE4	Sinhyeon soils, 30 to 60 percent slopes, gullied.	215	0.3	121	0.7
SxD2	Sinjeong gravelly loam, 15 to 30 percent slopes, eroded.	236	0.3	348	2
SxE2	Sinjeong gravelly loam, 30 to 60 percent slopes, eroded.	687	0.8	219	1.3
TBD2	Taehwa-Bonggye complex, 15 to 30 percent slopes, eroded.	1,818	2.2	763	2.1
TGD2	Taehwa-Bonggye rocky complex, 15 to 30 percent slopes, eroded.	314	0.4	179	1.1
TMD4	Taehwa-Bonggye-Mudeung rocky complex, 15 to 30 percent slopes, gullied.	1,343	1.6	221	1.3
TME2	Taehwa-Bonggye-Mudeung rocky complex, 30 to 60 percent slopes, eroded.	4,013	4.8	296	1.7
TME 4	Taehwa-Bonggye-Mudeung rocky complex, 30 to 60 percent slopes, gullied.	1,819	2.2	760	4.5
TF	Tidal flat.	394	0.5	41	0.2
Tc	Toncheon sandy loam, 0 to 2 percent slopes	1,079	1.3	33	0.2
WR	Reservoir	330	0.4	74	0.4
	Other	248	0.3	187	1.1
	Total	83,121	100	17,079	100

(1) Less than 0.05

Appendix 1

GLOSSARY

Acidity:	See reaction, soil.
Acid Sulphate Soil:	A wet soil containing iron sulphates and iron carbonates, that is or becomes extremely acid when drained.
Alluvial:	Consisting of or formed in material deposited by water.
Alluvium:	Soil material that has been transported and deposited by water.
Available Moisture Capacity:	The capacity of a soil to hold water in a form available to plants. The amount of moisture held in a soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension. Terms for available moisture capacity given in this survey (determined to a depth of 125 cm) are the following: High - 25 cm or more; medium - 15 to 25 cm; low - 7 to 15 cm; and very low - less than 7 cm.
Base Saturation:	The degree to which soil material that has base exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity: High - 60 to 100 percent; medium - 35 to 60 percent; and low - less than 35 percent.
Cation-exchange Capacity:	A measure of the total amount of exchangeable cations that can be held by a soil. It is expressed in terms of milli-equivalents (me) per 100 grammes of soil material that is neutral in reaction (pH 7.0) or at some other stated pH value: High - 10 me or more; medium - 6 to 10 me; low - 3 to 6 me; and very low - less than 3 me.
Clay:	As a soil separate, the mineral soil particles less than 0.002 mm in diametre. As a soil textural class, soil material that is 40 percent or more clay less than 45 percent sand, and less than 40 percent silt.
Clay Film:	A cutan composed of oriented clay particles.
Colluvial:	Having been transported by gravity, mass slippage or a combination of slippage and local wash.
Colluvium:	Soil material, rock fragments or both moved by creep, slide, or local wash and deposited at the base of a steep slope.
Consistence, Soil:	The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are -

Loose – Noncoherent; will not hold together in a mass.

Friable – When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm – When moist, crushed under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic – When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky – When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard – When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft – When dry, breaks into powder or individual grains under very slight pressure.

Cutan: A coating or film, on the outside of a soil aggregate or mass. It may consist of clay, silt, oxides of iron or manganese, organic matter, or other materials.

Depth of Soil: Thickness of soil over a specified layer, generally a layer that does not permit the growth of roots.

Classes used in this soil survey to indicate depth are the following: Deep – 1 m or more; moderately deep – 50 cm to 1 m; and shallow – less than 50 cm.

Erosion: The washing of soil from the soil surface. It includes washing of a continuous thin layer from the surface, known as sheet erosion, as well as the formation of small valleys known as gully erosion.

Family (soil): A level of classification of closely related soils immediately above the series level. The soils of a family are usually very similar in their management characteristics.

Fluvio-marine: Deposited by joint action of streams and sea.

Fragipan: A dense and brittle pan, or layer, that owes its hardness mainly to extreme density or compactness rather than to content of much clay or cementation. Fragments that are removed are friable, but the material in place is so dense that roots cannot penetrate it and water moves through it very slowly by following vertical channels and cleavage planes.

Horizon, Soil: A layer of soil, approximately parallel to the surface, that has distinct characteristics.

Loam: (1) Soil containing a relatively even mixture of sand and silt and a somewhat smaller proportion of clay, generally a desirable quality. May be subdivided into textural classes, such as sandy loam, loam, silt loam, and clay loam. (2) Specifically, soil material containing 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Mapping Units: The units shown on soil maps. They may be mainly soil series, phases of soil series, complexes of soil series, or some other combination such as mixtures of soil series and rock outcrop.

Massive: Consisting of large, uniform masses of cohesive soil, in some places with ill-defined and irregular breakage, as in some of the fine-textured alluvial soils; structureless.

Paddy: A small field that has been levelled, with a bund capable of retaining a shallow depth of water. Paddies are used principally for growing rice.

Permeability, Soil: The quality of a soil that enables it to transmit air and water. The following relative classes of soil permeability used in this soil survey, refer to estimated rates of movement of water in millimetres per hour through saturated, undisturbed cores under a 2.5 cm head of water: Very slow - less than 1 mm; slow - 1 to 5 mm; moderately slow - 5 to 15 mm; moderate - 15 to 50 mm; moderately rapid - 50 to 150 mm; rapid - more than 150 mm.

Reaction, Soil: The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour" soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Sand: As a soil separate, individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 mm in diameter. Most sand grains consist of quartz, but sand may be of any mineral composition. As a textural class, soil material that is 85 percent or more sand and not more than 10 percent clay.

Silt: As a soil separate, individual mineral particles in a soil that range from the upper limit of clay (0.002 mm) in diameter to the lower limit of very fine sand (0.05 mm). As a textural class, soil material that is 80 percent or more silt and less than 12 percent clay.

Slope: Soil slope is measured by using a hand level and is expressed as the percent the vertical distance (change of elevation) is of the horizontal distance. Slope classes and terms used to describe them are as follows:

Slope Percent	Class	Mapping Symbol
0 - 2	Nearly level	A
2 - 7	Gently sloping	B
7 -15	Sloping	C
15-30	Moderately steep	D
30-60	Steep	E
60 or more	Very steep	F

Soil: The thin outer layer of the earth's crust which serves as a medium for the growth of land plants.

Structure, Soil: The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles.

Terrace: An alluvial plain that has elevation above the present flood plain.

Texture, Soil: The relative proportions of sand, silt and clay in a soil mass.

Water Table: The upper surface of ground water; the highest part of the soil or underlying rock that is wholly saturated with water.

Appendix 2

GUIDE TO MAPPING UNITS

Map Symbol	Mapping Unit	Capability Unit	Paddy Suit. Group
BDC2	Bancheon-Daegu complex, 7 to 15 percent slopes, eroded.	IIIe	
BDD2	Bancheon-Daegu complex, 15 to 30 percent slopes, eroded.	IVe	
BDE2	Bancheon-Daegu complex, 30 to 60 percent slopes, eroded.	VIe	
BiB	Banggi clay loam, 2 to 7 percent slopes	IIIe	P2ac
BiC	Banggi clay loam, 7 to 15 percent slopes.	IIIe	P3ac
BlB	Banho gravelly loam, 2 to 7 percent slopes.	IIe	P2ac
BlC	Banho gravelly loam, 7 to 15 percent slopes.	IIIe	P3ac
BlD	Banho gravelly loam, 15 to 30 percent slopes.	IVe	P4ac
BhB	Banho silt loam, 2 to 7 percent slopes.	IIe	P2ac
BhC	Banho silt loam, 7 to 15 percent slopes.	IIIe	P3ac
BhD	Banho silt loam, 15 to 30 percent slopes.	IVe	P4ac
BRC	Beach and Riverwash, cobbly	VIII	
BRS	Beach and Riverwash, sandy	VIII	
ByC2	Bonggye silty clay loam, 7 to 15 percent slopes, eroded.	IIIe	P3b
CgD2	Cheongog silty clay loam, 15 to 30 percent slopes, eroded.	IVe	P4ac

Map Symbol	Mapping Unit	Capability Unit	Paddy Suit. Group
CdB	Chundo loam, 2 to 7 percent slopes.	IIe	P2ac
CdC	Chundo loam, 7 to 15 percent slopes.	IIIe	P3ac
DgC2	Daegu rocky silt loam, 7 to 15 percent slopes, eroded.	VIe	
DgD2	Daegu rocky silt loam, 15 to 30 percent slopes,eroded.	VIe	
DgD4	Daegu rocky silt loam, 15 to 30 percent slopes, gullied	VIIe	
DgE2	Daegu rocky silt loam, 30 to 60 percent slopes, eroded.	VIIe	
DgE4	Daegu rocky silt loam, 30 to 60 percent slopes, gullied	VIIe	
DSC2	Daegu-Sirye complex, 7 to 15 percent slopes, eroded.	IVe	
DSD2	Daegu-Sirye complex, 15 to 30 percent slopes, eroded.	VIe	
DGC2	Dalcheon-Samgag complex, 7 to 15 percent slopes, eroded.	IVe	P4abc
DGD2	Dalcheon-Samgag complex, 15 to 30 percent slopes, eroded.	IVe	
Dd	Daldong silt loam, 0 to 1 percent slopes.	IIw	P1
Dh	Deogha silt loam, 0 to 1 percent slopes.		
GBB	Gwangju-Bancheon complex, 2 to 7 percent slopes.	IIe	P2ac
GBC	Gwangju-Bancheon complex, 7 to 15 percent slopes.	IIIe	P3ac
GBC2	Gwangju-Bancheon complex, 7 to 15 percent slopes, eroded.	IIIe	P3ac
Ho	Hagseong silt loam, 0 to 1 percent slopes.	IIw	P1
HgB	Hogye gravelly loam, 2 to 7 percent slopes.	IIs	P4abc

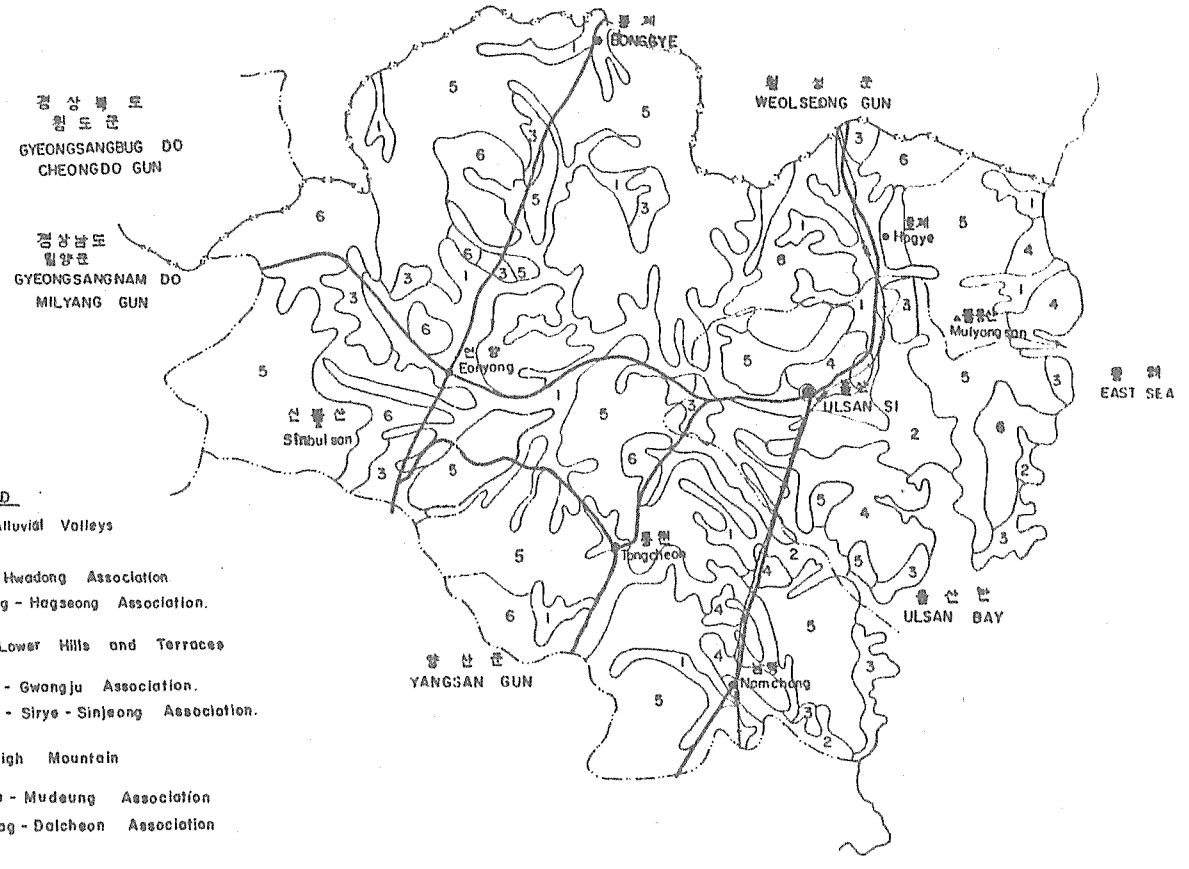
Map Symbol	Mapping Unit	Capability Unit	Paddy Suit. Group
HgC	Hogye gravelly loam, 7 to 15 percent slopes.	IIIe	P4abc
Hw	Hwabong loamy sand, 0 to 2 percent slopes.	IVs	P4bc
HHB	Hwadong-Honam complex, 2 to 7 percent slopes.	IIe	P2ac
HHC	Hwadong-Honam complex, 7 to 15 percent slopes.	IIIe	P3ac
HI	Hwangryong gravelly loamy sand, 0 to 2 percent slopes.	IVs	P4bc
Hk	Hwangryong sandy loam, 0 to 2 percent slopes.	IVe	P4bc
IwB	Iweon stony sandy loam, 2 to 7 percent slopes.	IIe	P4abc
IwC	Iweon stony sandy loam, 7 15 percent slopes.	IIIe	P4abc
IwD	Iweon stony sandy loam, 15 to 30 percent slopes.	IVe	P4abc
JjE2	Jeongja rocky loam, 30 to 60 percent slopes, eroded.	VIIe	
JiB	Jisan loam, 2 to 7 percent slopes.	IIw	P2a
JiC	Jisan loam, 7 to 15 percent slopes.	IIIe	P3a
JiD	Jisan loam, 15 to 30 percent slopes.	IVe	P4a
MMC	Mangsil-Mudeung stony complex, 7 to 15 percent slopes.	IVe	
MdE	Mudeung rocky loam, 30 to 60 percent slopes.	VIe	
MMD	Mudeung-Mangsil stony complex, 15 to 30 percent slopes.	VIe	
MME	Mudeung-Mangsil stony complex, 30 to 60 percent slopes.	VIe	
MTD2	Mudeung-Taehwa-Daegu rocky complex, 15 to 30 percent slopes, eroded.	VIe	

Map Symbol	Mapping Unit	Capability Unit	Paddy Suit. Group
MTE2	Mudeung-Taehwa-Daegu rocky complex, 30 to 60 percent slopes, eroded.	VIIe	
RL	Rock land.	VIII	
ScB	Sachon sandy loam, 2 to 7 percent slopes.	IIe	P3ab
ScC	Sachon sandy loam, 7 to 15 percent slopes.	IIIe	P3ab
ScD	Sachon sandy loam, 15 to 30 percent slopes.	IVe	P4ab
SgD4	Samgag soils, 15 to 30 percent slopes, gullied.	VIIe	
SgE4	Samgag soils, 30 to 60 percent slopes, gullied.	VIIe	
SmD2	Samgag rocky sandy loam, 15 to 30 percent slopes, eroded.	VIe	
SmE2	Samgag rocky sandy loam, 30 to 60 percent slopes, eroded.	VIe	
SvD4	Samgag very rocky soils, 15 to 30 percent slopes, gullied	VIIe	
SvE4	Samgag very rocky soils, 30 to 60 percent slopes, gullied.	VIIe	
Se	Seoggye fine sandy loam, 0 to 2 percent slopes.	IIw	P2b
SiD	Sinbul stony loam, 15 to 30 percent slopes.	VIe	
SIE	Sinbul bouldery loam, 30 to 60 percent slopes.	VIe	
Sn	Sindab sandy loam, 0 to 2 percent slopes.	IVw	P3b
SyD2	Sinhyeon loam, 15 to 30 percent slopes, eroded.	IVe	P4ac
SyE4	Sinhyeon soils, 30 to 60 percent slopes, gullied.	VIIe	

Map Symbol	Mapping Unit	Capability Unit	Paddy Suit. Group
SxD2	Sinjeong gravelly loam, 15 to 30 percent slopes, eroded.	IVe	P4ac
SxE2	Sinjeong gravelly loam, 30 to 60 percent slopes, eroded.	VIe	
TBD2	Taehwa-Bonggye complex 15 to 30 percent slopes, eroded.	IVe	P4ac
TGD2	Taehwa-Bonggye rocky complex, 15 to 30 percent slopes, eroded.	IVe	
TMD4	Taehwa-Bonggye-Mudeung rocky complex, 15 to 30 percent slopes. gullied.	VIIe	
TME2	Taehwa-Bonggye-Mudeung rocky complex, 30 to 60 percent slopes, eroded.	VIe	
TME4	Taehwa-Bonggye-Mudeung rocky complex, 30 to 60 percent slopes, gullied.	VIIe	
TF	Tidal flat	VIII	
TC	Tongcheon sandy loam, 0 to 2 percent slopes.	IIs	P3c

GENERAL SOIL MAP

ULJU GUN AND ULSAN SI SURVEY AREA GYEONGSANGNAM DO



LEGEND

Soils of the Alluvial Valleys

1 Jisan - Hwadong Association

2 Daldong - Hagseong Association.

Soils of the Lower Hills and Terraces

3 Iweon - Gwangju Association.

4 Daegu - Sirye - Sinjeong Association.

Soils of the High Mountain

5 Daegu - Mudeung Association

6 Samgag - Dalcheon Association

Road

Rail Road

Do Boundary

Si and Gun Boundary

Village

SCALE 1:250,000

0 5 10 15 20 km

0 5 10 Miles