AGL:SF/KOR 13
Technical Report 5

SOIL SURVEY

REPUBLIC OF KOREA

SOIL SURVEY IN DALSEONG GUN AND DAEGU SI, GYEONGSANGBUG DO

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

SOIL SURVEY

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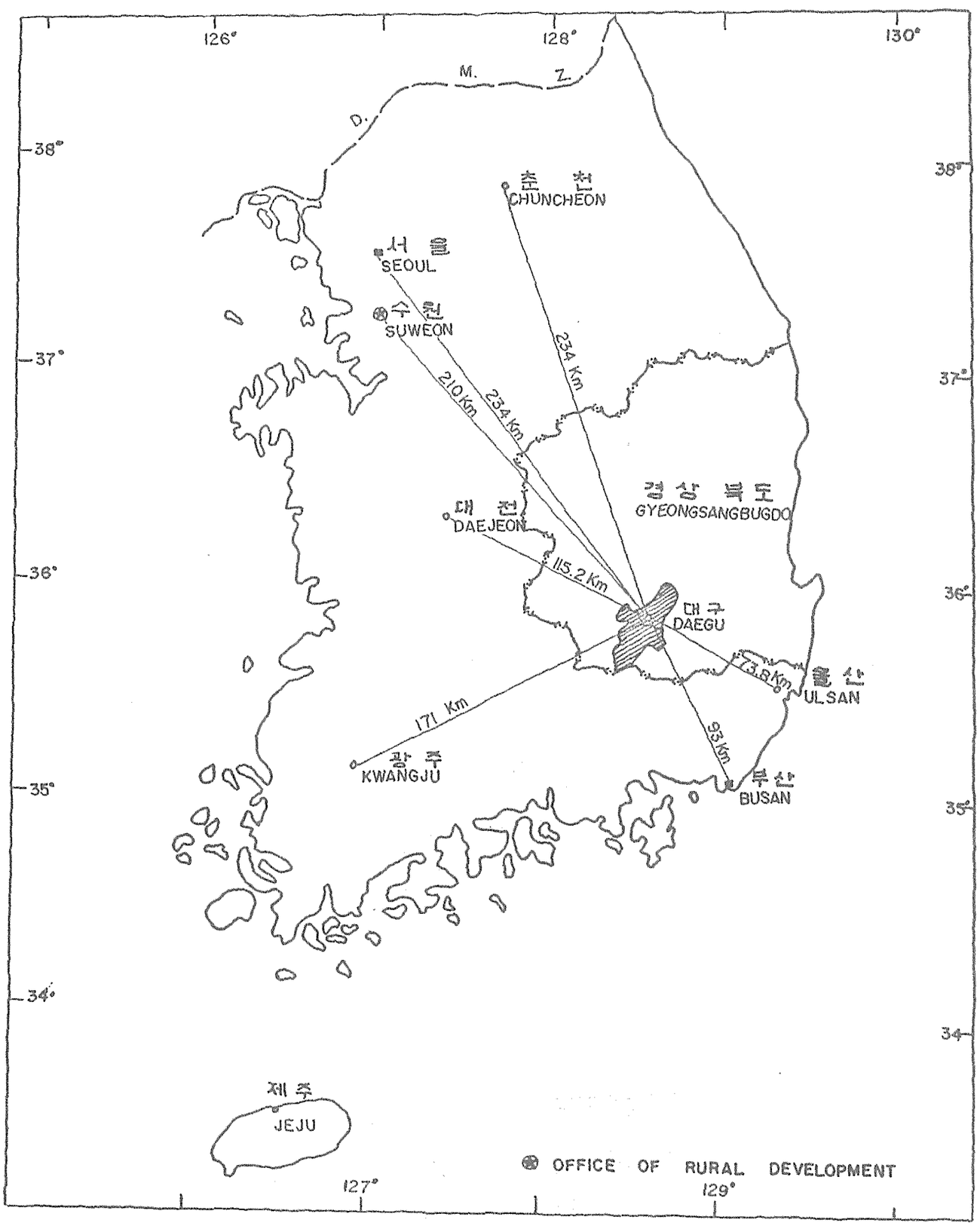
LOCATION MAP OF DALSEONG GUN AND DAEGU SI, GYEONGSANGBUG DO



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SOIL SURVEY

REPUBLIC OF KOREA

SOIL SURVEY IN DALSEONG GUN AND DAEGU SI, GYEONGSANGBUG DO

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 Dalseong Gun and Daegu Si, Gyeongsangbug Do. Rome, 1970. 76 p. 2 maps. AGL:SF/KOR 13. Technical Report 5.

ABSTRACT

This report describes soil survey activities in Dalseong Gun and Daegu 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 (75,466 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 show general land use potential the soils of the area are placed in seven land capability classes showing limitations and choices for practical use. The soils in each capability class are given, the suitability and limitations for cultivated crops and pasture are described, and management practices required for higher yields are suggested. About 12,000 ha or 60 percent of the cultivated land is used for paddy rice. Management of the soils for paddy rice is discussed and the soils are placed in four paddy suitability groups, indicating progressively greater limitations in the use of the land for rice.

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 (the Government cooperating agency) and by the counterpart staff.

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Chapter 1

INTRODUCTION

The detailed soil survey described in this report began in December 1965 and was completed in July 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 the report is to provide basic soil information required for the development and management of the various aspects of Korean agriculture, 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.

For the Korea Soil Survey new research methods and new cartographic methods have been used in the detailed soil survey of the area, by FAO soil experts and trained 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 in writing, of soil and soil conditions in Daegu Si and Dalseong Gun. It contains important information which will assist the Gun and the Si personnel, land owners and others, in the wise use of the land, whether it is for agriculture, forestry, urban development, building sites, or recreational and other non-agricultural uses.

The report has been compiled by the following: Charles E. Downey, and Byeong-Jae Kim. It is based on the work of:

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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.

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Technical Reports

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

Technical Report 1.	The Soils of Korea (with map at scale 1:1000000)
Technical Report 2.	Soil Reconnaissance of Korea (with map at scale 1:250000)
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 consists of Daegu Si and Dalseong Gun, in the south-eastern part of Gyeongsangbug Do, one of the eastern provinces of Korea. The area is bounded on the north by Gunwe Gun, on the west by Chilgog Gun and Goryeong Gun, on the south by Changpyeong Gun and on the east by Gyeongsan Gun.

The total surveyed area was 75,199 ha (17,832 ha for Daegu Si and 57,367 ha for Dalseong Gun). The population is 1,021,028 of which more than three fourths is concentrated in Daegu Si (Year Book of Statistics for Dalseong Gun and Daegu Si, 1967).

Dalseong Gun is located in the southern part of Gyeongsangbug Do, between 128°44' and 128°31'8'' east longitude, and 35° and 36° north latitude. It has an area of 59,160 ha, and measures 23 kilometres from east to west and 56 kilometres from north to south. Daegu city is located in the north central part of Dalseong Gun.

2.2 CLIMATE

Temperature of this area is characteristic of a continental climate due to its location in a basin. During the years 1931 to 1960, the average temperature was about 12.5°C. This varies widely for the latitude. It dropped to -20°C in January 1923, and rose to 40°C in October 1942. The average highest monthly temperature is 35°C, (August), and the average lowest monthly temperature is -1.6°C, (January).

The average annual precipitation is 979.3 mm, with the summer of June to September having more than half. July has 200.2 mm, the largest amount of monthly precipitation, which gradually decreases from October. January has only 15.8 mm, the lowest monthly amount. Duration of sunshine is 86 days, and evaporation is 1,457.3 mm. August has the longest duration of sunshine, and also the largest amount of evaporation. February, with the shortest duration of sunshine, also has the smallest amount of evaporation. The average date of first frost in the Autumn is November 11, and the last frost in the spring is April 18. The frost free growing season in the surveyed area is about 200 days.

The area has a temperate climate, with cold, dry winters and hot, humid summers. The average temperature and distribution of rainfall, by months, are indicated in Table 1. In this climate the soils are moist much of the time from May through September and are moderately dry much of the time from October through April. The surface soil is frozen to a depth of 10 to 20 cm during January.

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

2.3 GEOLOGY, DRAINAGE AND PHYSIOGRAPHY

Rock formations in the surveyed area are classified in the Silla and Nagdong series and are divided into four major physiographic areas.

One of these is underlain by granite, granite gneiss, and diorite, with intrusions of acidic and basic crystalline rocks. It covers the northern part of the surveyed region and has steeper topography than the remainder. The Geumho river, which crosses the northern part, is a boundary between this physiographic area and lower land underlain by shale, sandstone and conglomerate.

Another physiographic area, in the eastern part of Dalseong gun, is hilly and rolling, being underlain by porphyry, and andesite porphyry, with some gabbro or dark basic crystalline rock.

The remaining area with distinct physiography is underlain by grey or yellow shale, sandstone, and conglomerate. It is in the south and west and is characterized by deposition of recent alluvial materials.

The Nagdong river is the western boundary of the surveyed area. It frequently overflows the low land. The Sincheon stream flows from south to north and joins with it.

2.3.1 Parent Material

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

The dominant underlying rocks include porphyry, shale, and sandstone granite, granite gneiss, gabbro, and conglomerate. Porphyry and shale are most extensive and are distributed all over the area except for the north. The upper and middle parts of Bisul and Warong mountains are underlain by these rocks. The materials are generally weathered and broken to rock fragments, and their weathered layers are thin. Soils of the Daegu and Sirye series are underlain by shale and those of the Mudeung, Mangsil, and Bonggye series by porphyry. About 11 percent of the area is underlain by granite, the greatest extent of this rock being in the northern parts of the Gun, although it is also scattered over the other areas in small amounts with small areas of granite gneiss. Generally granite underlies the hills or mountains which are at elevation of more than 300 m above sea level, and 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 in the south-eastern part of Dalseong Gun, Gachang Myeon. They were the source of parent material for the Bonggye soils. Conglomerate occurs chiefly on the hilly areas south and west of Daegu Si.

More than 25 percent of the soils are formed in alluvium. Of this area about 30 percent consists of soils formed in old alluvium, and 70 percent of soils formed in recent alluvium. Much of this came from soil in the nearby uplands. Alluvial soils are mainly on river terraces, flood plains, and bottom lands. Some of them are in narrow valleys in mountainous areas.

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

2.4 WATER SUPPLY

There are three main sources of water in this surveyed area, consisting of the Nagdong and Geumho rivers and Sincheon stream. Farms have been developed along or near these sources. Those using this water are extensive and fertile, and are known as a granary of this Gun and Si.

The Nagdong and Geum rivers have never been dry, even in 1965, the driest year on record in the area. The Sincheon stream is completely dry during the droughty season. This may be the result of poor forest conservation. Some areas which camot get water from existing water reservoirs can be supplied from these rivers by pumping. Low land is subject to both drought and overflow.

2.5 AGRICULTURE

Agriculture is an important source of income. Most farmers produce grain crops (dominantly rice and barley) and vegetables for home use. Near Daegu Si vegetables are important commercial crops. Some farmers also have livestock.

Principal crops in the surveyed area are rice, barley, wheat, soybeans, red beans, green beans, cabbage, cucumbers, peanuts, melons, red peppers, garlic, onions, perilla, corn, tomatoes, sweet potatoes, potatoes and fruits, (including apples, peaches, pears, plums, grapes, and persimmons). Daegu is especially famous for apples. About 20,000 ha (roughly 30 percent of the total area) are used for farming.

Table 1

CLIMATIC DATA

Year	Temperature (°C) Average	Highest	Lowest	Humidity (%) Average	Lowest	Max. snow depth (cm)	Evaporation (mm)	Precipitation (mm)	Light hours (h)
1952	12.5	18.3	7.7	66.0	20	23.5	1,509.8	848.4	2,377.6
1953	12.6	18.4	7.9	67.0	16	55.4	1,386.5	922.6	2,359.1
1954	12.8	18.2	8.4	69.7	15	0.6	1,315,3	956.9	2,057.1
1955	13.0	18.8	8.1	68.0	16	8.0	1,467.4	759.1	2,277.9
1956	11.6	17.3	6.9	66.7	12	2.7	1,320.1	1,211.2	2,304.8
1957	12.1	17.9	7.0	65.5	17	12.J	1,330.1	973.7	2,351.9
1958	13.0	18.6	8.1	67.0	16	17.5	1,333.3	1,276.1	2,446.9
1959	13.6	19.1	9.1	66.0	15	5.0	1,331.3	1,192.3	2,394.9
1960	13.4	19.2	8.7	66.0	17	9.8	1,510.3	886.0	2,638.0
1961	13.5	19.0	9.1	68.0	19	5.2	1,332.3	1,457.7	2,324.9
1962	13.0	18.9	8.1	65.0	10	7.8	1,454.1	874.3	2,436.3
1963	12.1	17.8	7.5	67.0	13	2.8	1,251.6	1,031.8	2,151.9
1964	13.5	19.2	8.9	68.6	18	7.1	1,495.7	904.1	2,509.1

Table 2

CLIMATIC DATA FOR YEAR 1964

Jan.	1.6	6.5	-2.7	67	20	-	45.2	28.6	149.6
Feb.	-0.6	3.8	-3.9	65	29	2.1	59.9	51.5	174.2
Mar.	6.0	12.3	0.8	62	22	7.1	110.7	62.9	242.8
Apr.	12.9	18.3	8.6	79	30	-	97.1	170.1	145.1
May	18.8	25.8	13.3	67	18	-	175.6	65.5	264.0
June	21.8	27.9	17.0	69	24	-	195.9	50.3	255.7
July	27.1	32.8	23.0	73	33	-	215.4	257.1	242.0
Aug.	28.0	34.0	24.0	69	25	-	247.1	11.8	275.7
Sept.	21.2	26.0	17.9	79	34	-	116.5	174.1	162.8
Oct.	14.5	20.3	9.6	70	23	-	86.8	18.4	180.7
Nov.	8.0	14.2	2.2	64	24	-	80.6	13.6	214.3
Dec.	2.1	8.0	-3.3	59	22	1.2	64.9	0.2	202.2

Data obtained from Statistical Year Book of Daegu Si, 1964.

Chapter 3

HOW THE SURVEY WAS MADE

This survey was made to learn what kinds of soils are in the region, where they are located, and how they can be used. The entire soil landscape,including steepness, length, and shape of slopes; kinds of native plants or crops, and kinds of rock, were observed.

Holes were made and profiles were observed at an average interval of about 200 m, varying according to 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 the kind of soil.

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

Soils that have profiles almost alike make up a soil series. All the soils of one series have major horizons that are similar in thickness, arrangement, and other important 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.

Ihyeon and Yuga, for example, are the names of two soil series in Dalseong Gun. These soils have essentially the same characteristics as the Ihyeon and Yuga soils 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 of erosion that is evident. Where these differences are important in the use and management of the soils the soil series has been divided into mapping units.

The Daegu series, for example, is divided into mapping units based upon slope and also upon the extent of erosion. Thus there are sloping, moderately steep, and steep mapping units of Daegu rocky loam soils.

Another difference between the series and the mapping unit is that the series includes a group of profiles that have a definite but limited range in their properties. The mapping unit, however, must describe 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 Mudeung rocky loam, 30 to 60 percent slopes, the part of the area that is rock outcrops obviously does not have a profile. Of course it would be most desirable to have a map with these areas of other soils and areas of rock outcrop shown in their true occurrence, but it is not practical to show these small areas on the map. In some mapped areas soils of two or more distinct series are present. These mapped areas are named for the dominant series as soil complexes. Daegu-Mudeung rocky complex, 15 to 30 percent slopes, eroded, is such a mapping unit. Profiles of the Daegu and the Mudeung series are present in these areas.

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 THE GENERAL SOIL MAP

4.1 INTRODUCTION

The general soil map (map 2, backpocket) shows the soil associations in Dalseong Gun and Daegu Si.

A soil association is a landscape that has a distinctive pattern of soil. It normally consists of one or more major soils and at least one minor, and is named for the major soils. The soils in one association may occur in another, but in a different pattern and in different proportions.

A map showing soil associations is useful for the location of large tracts that are suitable for a certain kind of farming or other land use. For planning the management of a farm or field such a map is not suitable because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

4.2 YUGA-IHYEON-HWADONG ASSOCIATION (A)

This association is mainly along or near the Nagdong and Geumho rivers and their tributaries. It occupies large areas, being about 35 percent of the survey area. About 80 percent of the association is made up of recent soils of the flood plains. The remainder is on stream terraces. The sandy and gravelly types of riverwash on the flood plains are about 10 percent of the soil association, nearest the streams.

The Nagdong and Hwangryong soils usually are adjacent to the riverwash types and each are about 8 percent of the association. The Ihyeon is also mainly near the stream and is about 18 percent of the association.

The Yuga and Honam soils are in areas somewhat distant from the streams. The former is the most extensive soil in the valley, being about 20 percent of the association. The Honam soils occupy about 10 percent and other minor soils are about 6 percent. The Nagdong and Ihyeon are well drained and are sandy loam and silt loam respectively. The Yuga and Honam soils are poorly drained light silty clay loam and heavy silty clay loam respectively.

The soils on the stream terraces above the flood plain make up the remaining area. The Hwadong soils are extensive being about 14 percent of the area, the Bancheon and Banggi are less extensive having about 3 percent each. The Bancheon soils have reddish brown to red silty clay or silty clay loam upper horizons. The lower horizons are usually silty clay loam, clay loam or loam. Except for grey colours in the lower subsoil, the Hwadong are similar to the Bancheon. The Banggi soils are also similar to the Bancheon, differing from them mainly in having a lot of gravel in the profile.

Except for urban areas, practically all of this area is cropped to food and fibre crops. The Honam, Ihyeon, and Yuga soils are mainly planted to rice and parsley. Sandy soils such as the Nagdong grow vegetables; for instance cabbage, cucumber, and melon crops. Some of the Hwadong and similar terrace soils are planted to rice, but as irrigation water is not usually available in the higher regions, many areas are planted to soybeans, barley, tobacco, and similar crops. The Ihyeon, Hwadong, Bancheon, and other better drained soils used for growing rice are commonly cropped to barley in the winter.

Problems that limit the use of these soils for maximum production of crops include: inadequate supplies of irrigation water, flooding, sand and gravel deposits, poor drainage, and inadequate fertilization. Flooding is a problem except on the terrace soils. Many levees or dykes have been built to prevent this but these often lose their effectiveness because of sand accumulation in the stream beds which fill the channels. Flood water overflows, often carrying with it much sand, which is deposited on the soil. The result is reduced productivity. Sand is also washed into drainage and irrigation ditches, making drainage very difficult. Many areas suffer so and only rice and parsley can be grown successfully most years.

The problem of sedimentation in this area can best be solved by conservation and forestry management of the areas on the watersheds above the alluvial soils. Better forestry and land management will result in decreased sedimentation and in some parts less flooding.

To increase drainage additional ditches are required and existing ditches need to be cleaned. Properly installed tile drainage would improve the Yuga soils, but most areas of the Honam soils are too slowly permeable for it to be practical. With these improvements many kinds of crops may be grown.

Ground limestone, nitrogen, phosphorus, and potassium fertilizer are needed for maximum crop yields.

4.3 DAEGU ASSOCIATION (B)

(Sloping to steep, excessively drained, shallow, soils)

This association covers about 40 percent of the survey area. Daegu soils are the most extensive, covering about 90 percent of the association. Minor soils include those of the Habin and Sirye series and cover the remaining part. The typical Daegu soil consists of about 10-50 cm of silt loam to clay loam over hard rock. The Habin are similar to the Daegu, but have red colours. The Sirye soils are deeper, ranging from 50 to 150 cm in depth.

Except for about 10 percent in cultivated crops, this area is covered with small pine trees with some wild grasses. Barley, wheat, tobacco, and soybeans are the principal crops grown on the tilled ground.

Erosion is a severe problem, damaging upland soils of the area, and depositing infertile materials in the lower alluvial plain. There is much damage to the soils as well as to the drainage channels. Erosion is prevalent in forests in this area because the ground surface is bare and unprotected.

These shallow to moderately deep soils have only a low available moisture supplying capacity. Because of this, trees grow at only a moderate rate. The moderately steep to steep areas would produce moderate amounts of pasture or hay if well managed. Much limestone, nitrogen, and phosphorus fertilizers are needed

to obtain a profitable crop of grass. Tree growth would be greatly improved, and erosion would be greatly reduced, if the forest litter were left on the surface to form a protective mat to increase infiltration of rain water and reduce erosion losses.

4.4 SAMGAG ASSOCIATION (C)

(Moderately steep to very steep, somewhat excessively to well drained, deep soils).

This association is in two areas, one in the south central part and the other in the extreme north-east. It occupies about 12 percent of the area of the gun and si. The Samgag are the dominant soil, covering about 80 percent; Dalcheon make up about 10 percent. Togye, Gaghwa, and other minor soils occupy the remaining 10 percent.

The Samgag are in yellowish red sandy loam saprolite. The Dalcheon, somewhat less eroded are yellowish red silty clay loam or clay loam, 20-80 cm over sandy loam saprolite. They are similar to the Samgag soils. The entire area has many gullies, some of which are bare and actively eroding. Other areas have been partially covered with trees and vegetation which controls this.

Small, crooked pine, acacia, and alder trees, cover a great deal of the area, and offer little return other than low quality fuel. Small regions of the better soils are ploughed and planted to grain crops, but yields are generally low. Some small orchards of peaches and apples and vineyards have been established, and are moderately productive. Because of the increased demand for food, these areas may be used for agriculture in the future.

Erosion is the most severe problem along with low available moisture capacity and low fertility. Bench terraces have been constructed in orchards to lessen erosion losses, and the development of hay and pastures will help its control and give considerable return.

4.5 TOGYE-GAGHWA ASSOCIATION (D)

(Gently sloping to moderately steep well drained soils)

The association is on the colluvial-alluvial slopes below areas of the Samgag-Dalcheon soils. It covers about 3 percent of the survey area. The Togye soils make up about 75 percent of this association and the Gaghwa about 15 percent. Minor soils including the Iweon cover the remaining 10 percent.

The Togye are well drained sandy loam, moderately to rapidly permeable, and have medium available moisture capacities. The Gaghwa are somewhat cobbly clay loam or silty clay loam, well drained, and with high available moisture capacities.

Most of this association is planted to crops such as barley, wheat, radish, red pepper, melon, cabbage, and tobacco. Some of the Gaghwa is graded into paddies for rice, and other less sloping areas would make good rice paddies if levelled. It would also be possible to construct paddies on the Togye soils, but these would have a high irrigation water requirement because of moderate to rapid permeability. The steeper parts could be used for pasture and hay land if considerable lime and fertilizer were applied.

4.6 BANHO-JANGWEON ASSOCIATION (E)

(Sloping to very steep, moderately well to well drained soils)

This association is in the south-west and south-east of Dalseong Gun. It is about 5 percent of the survey area. The Banho soils are the most extensive, and make up about 50 percent of the association; the Jangweon soils about 40 percent; and Mudeung and other minor soils about 10 percent. The Banho and Jangweon soils have similar textures, being gravelly loam or clay loam. The latter are compact in the subsoil, having a slowly permeable fragipan layer which restricts water movement and root development. Because of this the Jangweon soils have only moderate available moisture capacities and moderate yield potential. The Banho soils have high available moisture capacities and high yield potential.

The land is generally covered with small trees such as pine, chestnut, oak, and alder. Some areas are used for growing soybeans, barley, and sesame and a small part for growing paddy rice. Crop yields are generally low on the Jangweon soils but better on the Banho soils.

Erosion and low fertility are problems in management of the soils. Liming and application of fertilizers will increase yields of present crops. Erosion control practices such as bench terracing, level terracing and contour cultivation will also increase yields. More rice paddies could be established if irrigation water were available. Many areas could be developed into pasture and hay land, which would reduce erosion to a minimum.

4.7 MUDEUNG ASSOCIATION (F)

(Steep to very steep, shallow to deep soils)

This association is in the Bisul mountain areas in the south-eastern part of the gun. The soils cover about 5 percent of the surveyed area. Mudeung is the principal soil and makes up about 80 percent of the association; the Bonggye soils 15 percent; and other minor soils including Daegu soils, 5 percent. The Mudeung is shallow, usually having about 50 cm of loamy material over hard bedrock. They all have low available moisture capacities and are low in fertility. The Bonggye soils are more productive, consisting of deep, yellowish red clay, with high available moisture capacity.

This area is mainly in pine trees with little possibility of anything alse. The small areas of less sloping, deep Bonggye soils would produce good fruit and similar crops, as well as pasture and hay crops.

Chapter 5

DESCRIPTION OF SOILS

5.1 INTRODUCTION

This section describes the soil series and mapping units of Daegu Si and Dalseong Gun.

The soil series is described first, and then the mapping units of the series. Following the name of each mapping unit there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. To get full information on any one mapping unit, it is best to first read the description of the series which describes the general concept of a soil, and then the mapping unit which gives more detailed information about the area mapped, such as slope, presence of other soils, rock outcrops, and other factors affecting use.

Additional information about the use of the mapping units can be found in the discussion of Capability Unit and Paddy Suitability Groups (Sections 6.2 and 6.3). The Guide to Mapping Units (Appendix 2), lists these groupings for each soil.

5.1.1 Classification of Soils of Daegu Si and Dalseong Gun

The following section gives the classification employed, and Table 3, classification according to the current and old systems.

i. Entisols are soils without distinctive horizon other than an Ochric epipedon or weakly expressed surface horizons.

Psamments are entisols with texture of loamy fine sand or coarser.

Udipsamments are psamments in a humid climate.

Typic Udipsamments are the common or typical ones and without characteristics listed in the other subgroups of this great group.

Sandy Skeletal: Hwangryong series.

Sandy Skeletal: Nagdong series; Togye series.

ii. Inceptisols are soils without distinctive horizons other than a cambic horizon or umbric epipedon.

Aquepts are inceptisols that are saturated with water or have grey colour resulting from such saturation.

Haplaquepts are aquepts with only a pale coloured surface and a cambic horizon.

Aeric Fluventic Haplaquepts are haplaquepts with a dominantly brown horizon indicating better drainage (and the presence of air) in the upper horizons and with an irregular decrease in organic matter indicating that the soils were deposited by water.

Fine loamy, non-acid: Sinheung series

Fine silty, non-acid: Yuga series

iii. Ochrepts are other inceptisols with only an Ochric epipedon or weakly expressed surface horizon and a cambic horizon.

Dystrochrepts are ochrepts with a low base saturation (lacking a horizon within 75 cm of the surface with a base saturation of more than 60 percent).

Typic Dystrochrepts are the common or typical ones and without characteristics listed in other subgroups of this great group.

Coarse loamy: Iweon series.

Lithic Dystrochrept are dystrochrepts with hard rock within 50 cm of the surface.

Fine loamy: Mudeung series.

Eutrochrepts are ochrepts with a high base saturation (have some horizon within 75 cm of the surface with base saturation of 60 percent or more).

Dystric Fluventic Eutrochrepts are eutrochrepts that lack carbonate in the soil mass and have an irregular decrease in organic matter indicating the soils were deposited by water.

Loamy skeletal: Seogto series.

Coarse silty: Ihyeon series

Fine loamy: Banho series.

Lithic Eutrochrept are eutrochrepts with hard rock within 50 cm of the surface.

Loamy skeletal: Daegu series

Coarse loamy: Habin series.

Fragiochrepts are Ochrepts with fragipans

Typic Fragiochrepts are the usual or common ones.

Fine loamy: Jangweon series.

iv. Mollisols are soils with thick dark coloured surface horizons and having a high base saturation.

Udolls are mollisols in a humid, temperature climate.

Hapludolls are udolls without other distinctive horizons.

Fluventic Hapladolls are hapludalfs with an irregular decrease in organic matter indicating that the soils were deposited by water.

Loamy skeletal: Hogye series.

v. Alfisols are soils with a subsoil enriched in clay (argillic horizons) and having a base saturation of more than 35 percent at 125 cm below the top of the agrillic horizons or in the layer above hard rocks if shallow.

Aqualfs are alfisols that are saturated with water or that have grey colour resulting from such saturation.

Ochraqualfs are aqualfs with horizon other than an ochric epipedon or pale coloured surface and the argillic horizons that are common to all alfisols.

Typic Ochraqualf are the common or typic ones and without characteristics listed in the other subgroups.

Fine clayey: Honam series.

Aeric Ochraqualfs are haplaquepts with a dominantly brown horizon indicating better drainage (and the presence of air) in the upper horizons.

Fine clayey: Geugrag series.

vi. Udalfs are other alfisols in a humid temperature climate.

Hapludalfs are udalfs without other distinctive horizons.

Typic Hapludalfs are the common and typical ones and without characteristics listed in the other subgroups.

Clayey skeletal: Banggi series

Fine clayey: Bancheon series; Sirye Series.

Aquic Hapludalfs are hapludalfs with some grey colours in the lower part indicative of a seasonal water table.

Fine clayey: Hwadong series.

vii. Ultisols are soils with a subsoil enriched in clayey (agrillic) horizons and having a base saturation of less than 35 percent 125 cm below the top of the argillic horizons, or in the layer above the hard rocks, if shallower.

Udults are ultisols in a humid temperate climate.

Hapludults are udults with subsoils that are not dark red, dark reddish brown or dusky red (having colours with values of 4 or more moist, or 5 or more dry).

Typic Hapludults are the common or typical ones and without characteristics listed in the other subgroups below.

Fine clayey: Bonggye series; Dalcheon series; Gaghwa series.

Humic Hapludults are hapludults with a dark coloured surface that is similar to an umbric horizon except that it is too thin to qualify as an umbric horizon.

Fine loamy: Mangsil series.

Table 3

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

Series	Current Classification		1938 classification great soil group
	Family	Subgroup	
Bancheon	Fine clayey	Typic Hapludalfs	Red-Yellow Podzolic
Banggi	Clayey skeletal	Typic Hapludalfs	Red-Yellow Podzolic
Banho	Fine loamy	Dystric Fluventic Eutrochrepts	Alluvial soils
Bonggye	Fine clayey	Typic Hapludults	Red-Yellow Podzolic
Daegu	Loamy skeletal	Lithic Eutrochrepts	Lithosols
Dalcheon	Fine clayey	Typic Hapludults	Red-Yellow Podzolic
Gaghwa	Fine clayey	Typic Hapludults	Red-Yellow Podzolic
Geugrag	Fine clayey	Aeric Fluventic Ochraqualfs	Red-Yellow Podzolic - Low-Humic Gley
Habin	Coarse loamy	Lithic Eutrochrepts	Lithosols
Hogye	Loamy skeletal	Fluventic Hapludolls	Alluvial soils
Honam	Fine clayey	Typic Ochraqualfs	Low-Humic Gley
Hwadong	Fine clayey	Aquic Hapludalfs	Red-Yellow Podzolic
Hwangryong	Sandy skeletal	Typic Udipsamments	Alluvial soils
Ihyeon	Coarse silty	Dystric Fluventic Eutrochrepts	Alluvial soils
Iweon	Coarse loamy	Typic Dystrochrepts	Regosols
Jangweon	Fine loamy	Typic Fragiochrepts	Planosols
Mangsil	Fine loamy	Humic Hapludults	Acid-Brown Forest Soils
Mudeung	Fine loamy	Lithic Dystrochrepts	Lithosols
Nagdong	Sandy	Typic Udipsamments	Alluvial soils
Samgag	Coarse loamy	Typic Dystrochrepts	Lithosols

Table 3 (Cont'd)

Series	Current Classification		1938 classification
	Family	Subgroup	great soil group
Sinheung	Fine loamy	Aeric Fluventic Haplaquepts	Low-Humic Gley - Alluvial soils
Sirye	Fine clayey	Typic Hapludalfs	Red-Yellow Podzolic
Togye	Sandy	Typic Udipsamments	Alluvial soils
Yuga	Fine silty	Aeric Fluventic Haplaquepts	Low-Humic Gley

5.2 BANCHEON SERIES

The Bancheon series, members of the fine clayey family of Typic Hapludalfs, consists of gently sloping to sloping, well drained, deep, yellowish red soils. The series is developed in old alluvial materials on dissected terraces or benches and is commonly associated with the Hwadong and the Banggi series. They are generally found in an area south-east of the centre of Daegu Si.

A typical profile follows:

Ap---0 to 13 cm; reddish brown (5YR 4/4) silty clay loam; moderate, medium granular structure; friable, sticky, and plastic; common, fine living grass roots; abrupt, smooth boundary; pH 5.7.

B21t---13 to 40 cm; red (2.5YR 4/6) clay loam with common, fine and medium, faint red (2.5YR 4/8) mottles; moderate, medium to coarse subangular blocky and weak, coarse prismatic structure; friable, sticky, and plastic; few, fine to medium living grass roots; few, medium pores; clear, smooth boundary; pH 6.0

B22t---40 to 53 cm; mottled yellowish red (5YR 4/8), red (2.5YR 4/8), crushed colour red (2.5YR 5/8) clay loam; moderate, medium angular blocky and weak, coarse prismatic structure; firm, sticky, and plastic; thick continuous red (2.5YR 4/6) clay cutans on ped face; gradual, wavy boundary; pH 5.8.

B23t---53 to 120+ cm; mottled yellowish red (5YR 4/8), red (2.5YR 5/8) and olive yellow (2.5Y 6/8) clay loam; weak, coarse prismatic breaking to moderate, medium angular blocky structure; friable to firm, slightly sticky, and slightly plastic; 30 percent soft shale fragments of clay loam texture; pH 5.8.

The surface colour ranges from brown to dark brown in the only slightly eroded places, but is reddish brown in the eroded areas. The subsoil ranges from light clay to heavy clay loam or silty clay loam. Where paddy rice has been grown grey mottles are found in the upper horizons. Some of these soils are underlain by deep, brown, fine clayey paleosols. The bedrock is less than 3 m below the surface.

These soils are moderate to high in natural fertility, low to medium in organic matter content, and medium to slightly acid. They have high available moisture capacities.

The cation exchange capacity is medium to high and saturation is high. Most of the areas are in cultivated crops including paddy rice.

5.2.1 Bancheon Silty Clay Loam, 2 to 7 Percent Slopes (BcB)

(Capability unit IIe; Paddy land suitability group P2ac)

This soil is on gently sloping terraces. The profile is generally as described for the series. Some areas of soils with a sandy loam surface layer are included in the mapped areas. It is suited to a wide range of crops. Irrigation water for the production of rice is available in a few areas. Erosion is a moderate problem when this soil is ploughed and planted to annual crops, but paddy systems, bench terraces, and contour cultivation are effective means of control.

5.2.2 Bancheon Silty Clay Loam, 7 to 15 Percent Slopes, Eroded (BcC2)

(Capability unit IIIe; Paddy land suitability group P3ac)

This sloping soil is on the edges between the gently sloping areas and the alluvial plains. The profile is usually similar to the one described for the series, except that the plough later has more clay, ranging in texture from heavy silty clay loam to clay loam. Some areas of gullied land are also included.

This unit is suitable for annual crops if bench or graded terraces are constructed. Without these conservation practices, erosion is a serious problem. Thus, perennial hay or pasture crops are needed to protect the soil. Paddies for rice production are costly to establish because of the large amount of earth moving required for construction. This soil is difficult to till because of the heavy textured surface horizon.

5.3 BANGGI SERIES

The series consists of gently sloping to sloping, well drained, very deep, yellowish red soils developed in old alluvium on terraces. These soils, members of the clayey skeletal family of Typic Hapludalfs, are generally associated with the Bancheon series, but differ from the latter soils in having much gravel. They are usually located south of Daegu Si.

A typical profile follows:

Ap——0 to 8 cm; strong brown (7.5YR 4/3) clay loam; moderate, fine and medium granular structure; friable, sticky, and slightly plastic; gradual, smooth boundary; pH 5.2.

B21t——8 to 20 cm; reddish brown (5YR 4/4) gravelly clay loam; moderate, fine subangular blocky structure; firm, sticky, and plastic; gradual, smooth boundary; pH 5.7.

B22t——20 to 120 cm; dark red (2.5YR 3/6) gravelly clay loam; moderate, fine and medium, angular blocky structure; common, fine and coarse manganese concretions; pale yellow angular and round gravel or cobbles are about 30 percent of the mass; pH 5.4.

The surface layer ranges from brown to reddish brown in colour. The subsoils are reddish brown to dark red gravelly clay loam to cobbly clay.

These soils are moderate to moderately low in natural fertility, low in organic matter content, and have medium to low available moisture capacity. The cation exchange capacity is medium and it is well saturated with bases. Most areas are in cultivated crops other than paddy rice. Orchards of apple, peach, plum, and persimmon, have been established in many places.

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

(Capability unit IIIe; Paddy land suitability group P2ac)

This unit is on gently sloping terraces. Most areas have a profile similar to that typical for the series. In this unit are included small areas with a

sandy clay loam surface layer, a yellowish brown clay loam subsoil, and some areas with a brown cobbly loam surface layer and strong brown silty clay loam subsoil. Crops, such as sweet potatoe, soybean, barley, red pepper, and sesame, are widely grown. Apple, peach, plum, and persimmon are also suited. The soil can be used for paddy rice if graded into a paddy system.

The presence of cobbles is a major problem in management, and erosion hazard is severe when this soil is planted to annual crops.

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

(Capability unit IIIe; Paddy land suitability group P3ac)

This soil is on rolling areas, and the profile is similar to that described for the series. Some areas, gravel-free throughout the profile are also included in this unit. The soil is widely cultivated to crops, such as sweet potatoe, red pepper, sesame and tobacco. Erosion is a severe problem. If bench and graded terraces are made and perennial hay and pasturecrops grown, these measures will protect soil from severe erosion.

5.4 BANHO SERIES

The Banho series consists of sloping to moderately steep, well drained, deep, yellowish brown soils on mountain foot slopes or at the base of steeper slopes. The soils are members of the fine loamy family of Dystric Fluventic Eutrochrepts. The series is developed in colluvium-alluvium eroded from soils of the Daegu and Mudeung series and is generally below them and above the Yuga on the landscape. These soils are mainly in the southern part of Daegu Si but are thinly distributed throughout the Gun except for the northern part.

A typical profile follows:

Ap——0 to 7 cm; brown to dark brown (10YR 4/3) loam; moderate, fine and medium granular structure; many, fine grass roots; friable, slightly sticky, and slightly plastic; clear, smooth boundary; pH 6.5.

C11——7 to 20 cm; dark yellowish brown (10YR 4/4) gravelly clay loam; weak, medium and fine subangular blocky structure breaking to moderate, fine granular structure; firm, sticky, and plastic; gradual, smooth boundary; pH 5.9.

C12——20 to 120+ cm; dark brown (10YR 3/3) gravelly clay loam; moderate to weak, medium and fine subangular blocky structure; firm, sticky, and plastic; gravel, cobble, and clay increases with depth; pH 6.2.

The surface layer ranges in colour from brown to dark brown and in texture from sandy loam to loam, with small to moderate amounts of gravel and cobble. The subsoil ranges from yellowish brown to dark yellowish brown, and from loam to gravelly and cobbly clay loam. The bedrock depth ranges from 2 to 4 m or more below the surface. These soils are high in natural fertility, medium in organic matter content, and are slightly acid to neutral. The have a high available moisture capacity. Cation exchange capacity and base saturation are high.

Generally the soils are in cultivated crops, with some small areas in forest.

5.4.1 Banho Loam, 7 to 15 Percent Slopes (BhC)

(Capability unit IIIe; Paddy land suitability group P3ac)

This unit is on mountain foot slopes. Most areas have a profile similar to that described for the series. Small areas of soils that have stony or cobbly loam surface layers are included.

This soil is suited to annual crops if erosion is controlled, but best suited to perennial crops and apple and peach orchards. Paddy rice can also be grown if the soil is graded into a paddy system, and irrigated. The removal of gravel and cobbles from the surface will permit easier cultivation. Erosion is the main management problem.

5.4.2 Banho Loam, 15 to 30 Percent Slopes (BhD)

(Capability unit IVe; Paddy land suitability group P4ac)

This soil is on the mountain foot slopes. Most areas have a profile similar to that described for the series. In some places stones and large boulders are common on the surface. In other places the surface layer is sandy loam, and stone free. About 50 percent of the area is cultivated to general crops, and the rest is in forest. This soil is best suited for growing perennial forage crops, such as fescue, orchard grass, and alfalfa. Small areas can be cropped to annual crops for a season, without severe erosion losses.

5. BONGGYE SERIES

The Bonggye series consists of steep, well drained, moderately deep yellowish red soils in hilly and mountainous areas. These soils, members of the fine clayey family of Typic Hapludults, are developed in residuum derived from igneous rocks, and generally are associated with the Mudeung and Jangweon series. The soils are mostly located at the south-eastern part of Daegu Si and in Dalseong Gun.

A typical profile follows:

A1—0 to 5 cm; yellowish red (5YR 4/6) clay loam; moderate, fine granular structure; friable, sticky, and plastic; gradual, smooth boundary; pH 5.5.

B21t—5 to 27 cm; red (2.5YR 4/8) firm clay; moderate fine and medium subangular blocky structure; firm, sticky, and plastic; clear, smooth boundary; pH 5.5.

B22t—27 to 42 cm; yellowish red (5YR 5/6) clay loam; moderate, medium subangular blocky structure; firm, sticky, and plastic; red (2.5YR 4/8) clay cutans; clear, smooth boundary; pH 5.7.

B31t—42 to 50 cm; brownish yellow (10YR 6/6) clay loam; moderate, medium subangular blocky structure; firm, sticky, and plastic; thick red (2.5YR 4/8) clay skin; crushed colour yellowish red (5YR 4/6); medium acid; clear, smooth boundary; pH 6.1.

B32—50 to 70+ cm; brownish yellow (10YR 6/6) sandy loam; friable; yellowish red (5YR 4/6) clay cutans; common medium black concretion; porphyry parent materials.

The surface layer ranges from dark brown to brown in only slightly eroded soils. The subsoil ranges from stony clay loam to clay in texture, and from red to yellowish red in colour. Some areas are underlain by unconsolidated materials. Bedrock is 70 to 100 cm below the surface. These soils are moderately low in natural fertility, low in organic matter content, and strongly to medium acid. They have medium available moisture capacities. The cation exchange capacity is high and base saturation is low. These soils are mainly covered with Korean pine, oak and alder, but some areas are cultivated to soybeans, sesame, mulberry, and similar crops.

5.5.1 Bonggye Rocky Silty Clay Loam, 30 to 60 Percent Slopes, Severely Eroded (BrE3)

(Capability unit VIIe)

This well drained, moderately deep soil occupies small tracts of moderately steep to steep hilly and mountainous areas in the southeastern part of Daegu Si. About 10 to 25 percent of the area is rock outcrops. Most areas have a profile typical for that of the series.

With this soil are included: small areas of 15 to 30 percent slopes, a few small areas of eroded soil, some areas of shallow soils, small areas of gullied land, and some small areas that have high base saturation.

Surface runoff is rapid, and erosion hazard is severe. Some areas of sloping and less eroded soil are suitable for pasture, but generally forest, consisting of Korean pine, oak, and alder, dominates. The main management problem is to control erosion and retard runoff.

5.6 DAEGU SERIES

The Daegu series consists of sloping to steep, excessively drained, shallow, brown soils developed in residuum weathered from shale or fine grained sandstone. They are members of the loamy skeletal family of Lithic Eutrochrepts, and are commonly associated with the Mudeung and Sirye series. They are found mainly on the lower hills of the area, but not in the extreme northern part.

A typical profile follows:

A1——0 to 7 cm; brown to dark brown (10YR 4/3) loam; moderate fine and medium granular structure; friable, slightly sticky and slightly plastic; many fine grass roots; clear, smooth boundary.

B——7 to 20 cm; yellowish brown (10YR 5/6) fine gravelly clay loam; moderate medium fine subangular blocky structure; firm, sticky, and plastic; clear, smooth boundary.

C1——20 to 25 cm; dark yellowish brown (10YR 3/4) weathered shale fragment with fine loamy soils.

R——25+ cm; weathered olive brown shale bedrocks.

The A horizon ranges from brown to light yellowish brown, but it is reddish brown in eroded places, the C horizon from yellowish brown to strong brown or reddish brown, and from clay loam to silty clay loam.

This soil is high in natural fertility, low in organic matter and medium to slightly acid. Available moisture capacity is low. The cation exchange capacity is high and base saturation is medium to high. The soils are moderately permeable in upper horizons, but the underlying shale is not. Most areas are in forest of pine tree, alder, oak, and acacia. Some areas are in cultivated crops.

5.6.1 Daegu Rocky Loam, 7 to 15 Percent Slopes (DgC)

(Capability subclass VIe)

This mapping unit is on the lower parts of the mountain slopes. Most areas have a profile as described for the series, but between 2 to 15 percent of the mapped area is outcrop of shale rock. Some areas of deeper soils have also been included. The soil is occasionally planted to rye, buckwheat, and other crops, but erosion is a problem when it is cultivated to annual crops. Peach trees have been planted but do not do well. Contour cultivation will reduce soil losses to some extent.

Because of the shallow underlying rock, bench terraces or rice paddy are not suited. Pasture and other perennial forage crops are, but will produce only small amounts of forage during dry seasons. Well managed woodland will protect the soil from erosion but low yields can be expected.

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

(Capability unit VIe)

This mapping unit is on the lower parts of the mountain slopes. It has a profile similar to that described for the series, but in most places the original surface layer has eroded away. About 2 to 15 percent of the area is shale outcrop. The land grows wild grass and small trees, but with good soil treatment and management fair yields of perennial pasture crops are possible. Properly managed woodland will prevent erosion and produce some woodland crops.

5.6.3 Daegu Rocky Loam, 15 to 30 Percent Slopes (DgD)

(Capability unit VIe)

This soil is on moderately steep to steep slopes. The profile is similar to that described for the series. About 2 to 15 percent of the land is outcrop of shale rock. The areas where the subsoil has been exposed, or mixed with surface soil by erosion, are included in this mapping unit. The rooting zone is thin, and erosion hazard high. The soil is poorly suited for agricultural crops, but with good management practices, pasture and woodland crops can be grown.

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

(Capability Unit VIe)

This unit is on moderately steep to steep slopes. The profile is similar to that described for the Daegu series, except that the surface layer has been removed by erosion. From 2 to 15 percent of the mapped area is shale outcrop. The erosion hazard is very high unless these areas are stabilized. Although almost all are now in forest they produce a large volume of sediment. Improved forest,

well managed, will control erosion and enable this soil to produce more and better woodland products.

5.6.5 Daegu Rocky Loam, 30 to 60 Percent Slopes (DgE)

(Capability VIIe)

This mapping unit is in steep mountainous areas. The profile is similar to that described in the series. About 2 to 25 percent of the mapped area is rock outcrop.

In this mapping unit are included some severely eroded areas with clay loam surface layers and some shallow gullies. Only forest is suited but improved management practices will stabilize the soil and increase production.

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

(Capability unit VIIe)

This mapping unit is found on steep mountains. It has a profile similar to that described in the series, but in most places the original surface layer has been removed by erosion. From 2 to 25 percent of the mapped area is shale outcrop, and some shallow gullies are included. Only forest or pasture are suited, and management practices will stabilize and increase production from the soil.

5.6.7 Daegu-Mudeung Rocky Complex, 15 to 30 Percent Slopes, Eroded (DMD2)

(Capability unit VIIe)

The mapping unit is on moderately steep to steep slopes, mainly in the southern part of Daegu Si. The soils are shallow over hard rock, the Daegu being developed in shale, and the Mudeung in porphyry. Profiles are similar to those described for the respective series but as they occur in such an intricate pattern they were not mapped separately. Of the soil area about 60 percent is Daegu and 40 percent Mudeung. Only forestry is possible, with some areas of thicker soils having the potential for pasture.

5.6.8 Daegu-Mudeung Rocky Complex, 15 to 30 Percent Slopes, Severely Eroded (DMD3)

(Capability unit VIIe)

This unit is on moderately steep mountainous areas chiefly in the southern part of Daegu Si. The Daegu soils are over shale and the Mudeung over porphyry. These soils have profiles as described in their series descriptions. They are in such a fine intricate pattern that their exact locations were not shown on the maps as separate areas. About 60 percent of the soil area is Daegu and 40 percent Mudeung. Some areas have shallow gullies.

Because of erosion hazard, rockiness, and low available moisture capacity, their use is limited to pasture and forest. These soils respond well to good management, but yields will be low in years of normal or less than normal rainfall. However, well managed forests will give moderate returns.

5.6.9 Daegu-Mudeung Rocky Complex, 30 to 60 Percent Slopes, Eroded (DME2)

(Capability unit VIIe)

This unit is made up of steep, rocky, very shallow soils, mainly in the southern part of Daegu Si.

Daegu soils were derived from shale and the Mudeung from porphyry. From 10 to 50 percent of the mapped area is rock outcrop. Most areas have profiles as described for their series. As these two soils are in a fine pattern they are mapped as one unit, with about 60 percent of the soil area Daegu, and 40 percent Mudeung. Shallow gullies are included in the mapped areas. Use of these soils is limited chiefly to woodland and grass land. Because of unfavourable soil characteristics only moderate yields can be expected.

5.6.10 Daegu-Mudeung Rocky Complex, 30 to 60 Percent Slopes, Severely Eroded (DME3)

(Capability unit VIIe)

This unit is on moderately steep to steep mountain slopes, chiefly in the southern part of Daegu Si. The bedrock is prominent as most of the surface soil has been washed away. 20 to 60 percent of the mapped areas is rock outcrop with some deep and shallow gullies being included. Daegu soils are chiefly derived from shale and Mudeung from porphyry, the soils having profiles as described in their series descriptions. About 60 percent is Daegu and 40 percent Mudeung. Because of steep slopes and erosion these soils are better suited to growing trees than grasses. Only moderate yields can be expected even with good woodland management.

5.6.11 Daegu-Mudeung Very Rocky Complex, 30 to 60 Percent Slopes, Eroded (DVE2)

(Capability unit VIIe)

This unit is on moderately steep to steep mountainous areas, chiefly in the southern part of Daegu Si. The Daegu soils overlie shale, and Mudeung, porphyry.

These soils, having profiles as described in their series descriptions, occur on the same areas and are mapped as one unit. Of the soil area, about 60 percent is Daegu and 40 percent Mudeung. Some gullied lands are included. Because of steep slopes and erosion, these soils are better suited to forest than to pasture.

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

(Capability unit IVe)

This mapping, chiefly in the southern part of Daegu Si, is composed of sloping upland soils. They are developed in shale and fine grained sandstone, and differ from each other mainly in the depth of soil over hard rock. The Sirye soil is deeper and has a true subsoil, while the Daegu soil is shallow and lacks subsoil development. The profiles are as described in their series descriptions but as they occur together in such an intricate pattern, they could not be shown separately on the map.

The Daegu soils are dominant on the upper portions of the low mountains and the Sirye mainly on the lower slopes. Both are of equal extent. Some areas of

shallow gullies, and some areas of gently sloping soils are included.

These soils are used for the growing of barley, wheat, sweet potato red pepper, sesame, and soybean. Some areas are in forest. Yields are generally low, but higher yields may be expected in the deep Sirye soils. The construction and maintenance of bench terraces and the application of fertilizer will help to increase yields and prevent the main problem, erosion. The areas will produce good pasture and forage crops.

5.7 DALCHEON SERIES

The Dalcheon series consists of moderately steep to steep, well drained, slowly permeable, yellowish red soils developed in residuum derived from granite and granite gneiss. These soils, members of the fine clayey family of Typic Hapludults, are found on the dissected hills or low mountains in the north and south of the area, and are commonly associated with Samgag soils.

A typical profile follows:

A11——0 to 11 cm; strong brown (7.5YR 5/6) silt loam; moderate, very fine and fine granular structure; friable, slightly sticky and slightly plastic; many fine to medium living grass and plant roots; gradual, smooth boundary; pH 5.4.

A12——11 to 19 cm; strong brown (7.5YR 5/6) silt loam; weak, fine to medium subangular structure breaking to moderate fine granular; friable, slightly sticky, and slightly plastic; many, fine to medium living grass and plant roots; clear, smooth boundary; pH 5.3.

B1——19 to 29 cm; yellowish red (5YR 5/8) silty clay loam; moderate, fine to medium subangular blocky structure; friable, sticky, and plastic; few, fine living plant roots; thin, discontinuous clay cutan; clear, smooth boundary; pH 5.4.

B21——29 to 62 cm; red (2.5YR 4/8) silty clay; strong medium angular blocky structure; firm, very sticky, and plastic; few, fine living plant roots; thin discontinuous reddish yellow (5YR 6/8) clay cutans; clear, smooth boundary pH 5.4.

B31——62 to 93 cm; red (2.5YR 5/8) silt loam; strong medium to coarse angular blocky structure; firm, sticky, and plastic; few, fine living plant roots; thick continuous reddish yellow (5YR 6/8) clay cutans; clear, smooth boundary; pH 5.6.

B32——93 to 140+ cm; reddish yellow (5YR 6/8) silt loam; strong, medium to coarse angular blocky structure; firm, slightly sticky, and plastic; thick continuous red (2.5YR 5/6) clay cutans; common, medium black (Mn) concretions, weathered saprolite; pH 5.6.

The surface layer is yellowish red to strong brown in the eroded areas, but is brown to dark brown loam to sandy clay loam in the slightly eroded areas. The B horizons are yellowish red or red silty clay loam, silty clay, sandy clay loam, or clay loam.

The soils are moderate in natural fertility, low to medium in organic matter content, medium to strongly acid, and have moderate to high available moisture capacities. The cation exchange capacity is medium and base saturation low.

Forest of pine tree, oak, and alder dominates, but small areas are in cultivated crops.

5.7.1 Dalcheon-Samgag Rocky Complex, 15 to 30 Percent Slopes, Eroded (DRD2)

(Capability unit VIe)

This complex is on sloping to moderately steep mountains, mainly in the north part of the surveyed areas. The soils are developed in materials weathered from granite and granite gneiss and differ from each other mainly in texture. Between 2 to 25 percent of the mapped areas is rock outcrop. The Dalcheon soils are clayey, and the Samgag soils are coarse sandy loam.

Profiles are as described in their series descriptions with about 60 percent Dalcheon, and the remainder Samgag.

The Samgag soils are on the upper, convex and the Dalcheon on the lower, concave slopes. Some areas of eroded soil, a few small areas of gullied land, and small areas of sloping soil, are included.

Forest of pine and oak is well suited, and good yields of forage and pasture crops could be obtained. If areas are planted to annual crops bench terraces will help prevent erosion, but construction is difficult in the stony parts.

5.7.2 Dalcheon-Samgag Rocky Complex, 15 to 30 Percent Slopes, Severely Eroded (DRD3)

(Capability unit VIIe)

The soils of this complex unit are on moderately steep mountains, in the northern part of the surveyed area, are developed in materials weathered from granite and granite gneiss, and differ from each other mainly in texture.

The Dalcheon soil is clayey while the Samgag is coarse sandy loam. These soils have profiles as described in their series descriptions. From 2 to 25 percent of the mapped areas is rock outcrop. In the soil area about 60 percent is Dalcheon and 40 percent Samgag.

The Samgag are dominant on the upper convex, and the Dalcheon on the lower concave, slopes. In some areas the surface is eroded away. Deep and shallow gullies are included in this unit.

These soils are capable of producing good yields of forage and pasture crops. Well managed woodland will give a good return. In areas that are planted to annual crops bench terraces will reduce soil erosion. These, however, are difficult to build in the more rocky areas.

5.7.3 Dalcheon-Samgag Rocky Complex, 30 to 60 Percent Slopes, Eroded (DRE2)

(Capability unit VIe)

This complex unit occurs on the steep mountains, mainly in the northern part of the surveyed area. The soils are developed in materials weathered from granite and granite gneiss and differ from each other mainly in the depth of subsoil

development. The Dalcheon has clayey, and the Samgag coarse sandy loam, texture. These soils have profiles as described in their series descriptions. About 25 to 50 percent of the mapped area is rock outcrop. The soils are approximately equal in extent.

The Samgag are dominant on the upper convex slopes and short steep slopes adjacent to streams. Some areas of a severely eroded soil and gullied land are included in this mapping unit. Because of a very severe erosion hazard and the steep slopes, these soils are not suited to cultivation, but they are to pasture and woodland.

5.7.4 Dalcheon-Samgag Rocky Complex, 30 to 60 Percent Slopes, Severely Eroded (DRE3)

(Capability unit VIIe)

This complex unit occurs on the steep mountains, mainly in the northern part of the surveyed area. The soils are developed in materials weathered from granite and granite gneiss and differ from each other mainly in texture; the Dalcheon soils are clayey and the Samgag soils, coarse sandy loam.

The profiles are as described for the series. From 25 to 50 percent of the mapped areas is rock outcrop, about 50 percent of the soil area is Dalcheon and 40 percent Samgag. The Samgag tend to dominate on the upper convex and short steep slopes adjacent to streams, while the Dalcheon are more common on the lower concave slopes.

Because of steep slopes and the erosion problem, these soils are suitable only for pasture or woodland, and if well managed, high yields can be obtained. Erosion control is needed to conserve the soils.

5.8 GAGHWA SERIES

The Gaghwa series consists of sloping, well drained, deep, yellowish red cobbly to gravelly soils on dissected colluvial slopes and terrace edges. These soils, members of the fine clayey family of Typic Hapludults, have developed in colluvium, and are generally on slopes below the Samgag and Dalcheon series. They are found generally in the northern part of the surveyed area.

A typical profile follows:

A11——0 to 7 cm; brown to dark brown (7.5YR 4/4) cobbly silty clay loam with moderate, fine and very fine granular structure; friable, sticky, and plastic; many, medium living roots; about 15 percent gravel; clear, smooth boundary; pH 5.7.

A12——7 to 22 cm; strong brown (7.5YR 5/6) cobbly clay loam; moderate, medium granular structure; friable, sticky, and plastic; common, fine living roots; about 15 percent stone; clear, wavy boundary; pH 5.7.

B1——22 to 50 cm; strong brown (7.5YR 5/6) cobble clay loam; weak, medium and coarse subangular blocky structure; firm, sticky, and plastic; clear, wavy boundary; pH 6.0.

B21t——50 to 75 cm; yellowish red (5YR 4/8) cobbly clay loam; strong, fine and medium, subangular blocky structure; firm, very sticky, and plastic;

few, fine tubular pores; continuous reddish brown (5YR 4/4) clay cutans; diffuse boundary; pH 6.3.

B22t——75 to 150 cm; reddish brown (5YR 4/4) cobbly clay; strong, medium and coarse subangular blocky structure; firm, sticky, and plastic; coarse black concretions; pH 6.6.

The surface layer is brown to dark brown, but is yellowish red in the eroded areas. The subsoil is yellowish red to red or dark red, clay loam to silty clay loam.

These soils, moderate to moderately high in natural fertility, medium in organic matter content, from strongly acid to neutral in reaction, have high available moisture capacities and slow permeability. The cation exchange capacity is high and base saturation is low. About 40 percent of this series produces rice, and on the remainder general crops are grown.

5.8.1 Gaghwa Cobbly Loam, 7 to 15 Percent Slopes, Eroded (GaC2)

(Capability unit IIIe; Paddy land suitability group P3ac).

This unit is on sloping, moderately dissected colluvial positions and terraces, mainly in the northern part of the surveyed area. It is developed in colluvial materials.

The profile is usually similar to the one described for the series. A few areas have steeper slopes, and some areas have high base saturation.

Crops such as barley, wheat, radish, red pepper, melon, sweet potato, cabbage are suited, as are orchards, including apple, peach, plum, and persimmon. The soils are also suited to paddy rice. Erosion is a severe problem when not cultivated to rice, but soil losses can be reduced by terracing and growing meadow crops.

5.9 GEUGRAG SERIES

The Geugrag series consists of deep, moderately well drained soils, formed in old alluvium on level broad alluvial plains. These soils are members of the fine clayey family of Aeric Ochraqualfs, and occur in the central part of the surveyed area.

A typical profile follows:

Ap1——0 to 8 cm; dark grayish brown (2.5Y 4/2) silt loam; few, fine faint yellowish brown (10YR 5/8) mottles; moderate, medium granular structure; friable, slightly sticky, and slightly plastic; many medium and fine grass roots; clear, smooth boundary; pH 5.7.

Ap2g——8 to 18 cm; grey (5Y 5/1) silt loam; common, coarse prominent yellowish red (5YR 4/6) mottles; crushed colour is dark greyish brown (10YR 4/2); moderate, medium subangular blocky breaking to moderate, medium granular structure; few, fine and medium grass roots; abrupt, smooth boundary;; pH 6.0.

B1——18 to 33 cm; greyish brown (2.5Y 5/2) silty clay loam; moderate, medium subangular blocky structure; firm, sticky, and plastic; common, fine tubular pores; clear, smooth boundary; pH 6.8.

B21g--33 to 48 cm; greyish brown (2.5Y 5/2) silty clay loam; common, fine and coarse, faint yellowish brown (10YR 5/6) mottles; strong, medium subangular blocky structure; firm, sticky, and plastic; clear, smooth boundary; pH 7.1.

B22--48 to 120+ cm; yellowish brown (10YR 5/6) and grey (10YR 5/1) silty clay; crushed colour brown (10YR 5/3); moderate, coarse, prismatic structure; firm, sticky, and plastic; thick continuous grey (10YR 5/1) clay cutan on ped faces; pH 7.5.

The surface layer ranges from silt loam to silty clay loam or silty clay, and is from 10 to 22 cm thick. The colour, grey to dark grey or greyish brown, is mottled with yellowish red, strong brown, reddish brown, and yellowish brown. The subsoil ranges from silty clay to clay, and is greyish brown to dark greyish brown or yellowish brown. It is mottled with strong brown, yellowish brown and dark grey. The substratum is similar to the subsoil except in having more mottles.

The Geugrag soils are associated with Honam, and are mapped only in a complex with them. These soils are better drained, have more brown colours, are higher in elevation than the Honam, and are greyer, more mottled, and lower in elevation than the Hwadong.

The Geugrag are slightly acid to neutral, moderately high in natural fertility, and are medium in organic matter. Permeability is slow, and available moisture capacity is high. Cation exchange capacity and base saturation are high.

All of the areas of these soils are in paddy, under a good irrigation system, and are cultivated to rice in the summer and barley or wheat during the winter.

5.10 HABIN SERIES

The Habin series consists of sloping to steep, excessively drained, shallow, dusky red to reddish brown soils developed in residuum of red shale or reddish brown sandstone. These soils, members of the coarse loamy family of Lithic Eutrochrepts, occur on mountainous areas, are commonly associated with the Daegu soils, and occasionally with the Mudeung soils.

A typical profile follows:

A1--0 to 6 cm; dusky red (10R 3/3); rocky loam; moderate, fine to medium granular and weak, fine subangular blocky structure; friable, slightly sticky, and slightly plastic; moderately weathered gravelly red shale; many, fine and medium living grass roots; abrupt, smooth boundary; pH 5.3.

C1--6 to12 cm; reddish brown (2.5YR 4/4) very gravelly rocky clay loam; moderate, fine to medium subangular blocky structure; firm, sticky, and plastic; abrupt, smooth boundary; pH 5.3.

C2--12 to 25 cm; red shale; pH 7.0.

D--25+ cm; hard, red shale bedrock.

The surface layer ranges from dark brown to reddish brown and dusky red in colour, and loam to silt loam in texture. The surface is rocky and the bedrock

ranges from 15 to 50 cm below the surface.

These soils are low in natural fertility, low in organic matter, and are medium to strongly acid. They have low or very low available moisture capacities, and are slowly permeable. The cation exchange capacity is medium and base saturation is medium to high. The vegetation consists of pine trees, alders, oaks, acacia, and shrubs.

5.10.1 Habin Rocky Loam, 15 to 30 Percent Slopes, Eroded (HbD2)

(Capability unit VIe)

This soil is on sloping to moderately steep mountain slopes west of Daegu Si and includes yellowish brown silt loam shallow soils. The profiles of most soils are as described for the series. In about 25 percent of the mapped area the bed rock is exposed by erosion, while some areas have cobbles and gravel on the surface.

The land grows only grass and small trees, and a good covering of them is needed to prevent sheet erosion. If well managed, moderate yields can be obtained.

5.10.2 Habin Rocky Loam, 30 to 60 Percent Slopes, Eroded (HbE2)

(Capability unit VIe)

This mapping unit occurs on moderately steep to steep mountains, west of Daegu Si. The profile is much like that described for the series. Some cobbles and gravel are on the surface.

Rock outcrops make up about 25 percent of this unit. The soil is in idle land, growing only wild grass and small trees, and requires a covering of grass to prevent severe erosion.

5.11 HOGYE SERIES

The series consists of gently sloping, well drained, deep, dark brown soils developed in alluvium on fans or plains. They are members of the loamy skeletal family of Fluventic Hapludolls and are commonly associated with the Hwangryong soils.

A typical profile follows:

Ap——0 to 12 cm; dark yellowish brown (10YR 3/4) gravelly loam; moderate, fine granular structure; friable, slightly sticky, and slightly plastic; clear, wavy boundary; pH 5.1.

A11——12 to 19 cm; dark brown (10YR 3/3) gravelly loam; weak, medium to coarse subangular blocky structure; firm, sticky, and plastic; clear, wavy boundary; pH 5.3.

A12——19 to 60 cm; dark brown (7.5YR 3/2) gravelly and cobbly clay loam; weak, medium and fine subangular blocky structure; firm, sticky, and plastic; gradual, wavy boundary; pH 5.4.

C——60 to 120 cm; dark brown (10YR 3/3); very gravelly and cobbly loam; massive; firm, sticky, and plastic; pH 5.5.

The surface layer ranges from dark yellowish brown to dark brown, the subsoil from yellowish brown to dark brown in colour and gravelly loam to gravelly clay loam in texture. Grey mottles occur in the upper horizon in areas where paddy rice is grown. These soils are high in natural fertility, and high in organic matter content. The available moisture capacity is medium and permeability is moderate to rapid. Cation exchange capacity is medium, and base saturation is high. Cultivated crops are predominant but some small areas have been graded into paddy systems for rice.

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

(Capability unit IIs; Paddy land suitability group P4abc)

This soil occurs on nearly level to gently sloping alluvial fans or plains along the streams. Most areas have a profile similar to that typical for the series. Some small areas with yellowish brown sandy loam surface layer, and small areas of soil with a brown loam surface layer and yellowish brown gravelly sandy loam substrata, are included.

This soil is mostly well suited for barley, radish, cabbage, red pepper, melon, soybean, squash, and onion, but poorly suited for paddy rice because of low available moisture capacity. The main management problem is the removal of gravel and minimization of leaching.

5.12 HONAM SERIES

The series consisting of level to nearly level, poorly drained, deep, grey soils of developed alluvium on broad alluvial plains or local broad valleys, are members of the fine clayey family of Typic Ochraqualfs. The series is commonly associated with the Ihyeon and Hwadong soils, chiefly found in the Nagdong river valley.

A typical profile follows:

Ap——0 to 9 cm; grey (5Y 5/1) silty clay loam with common, fine to medium, yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) mottles; moderate, medium granular structure; friable, sticky, and plastic; clear, smooth boundary; pH 5.7.

Ag——9 to 18 cm; dark grey (5Y 4/1) silty clay loam with common, fine yellowish brown (10YR 5/6) mottles; moderate, coarse prismatic structure; firm, sticky, and plastic; abrupt, smooth boundary; pH 6.0.

B21t——18 to 30 cm; greyish brown (2.5Y 5/2) silty clay loam with common, medium to coarse yellowish brown (10YR 5/6) mottles; moderate, coarse prismatic structure breaking to moderate, medium subangular blocky; firm, sticky, and plastic; clear, smooth boundary; pH 6.7.

B22t——30 to 57 cm; olive grey (5Y 5/2) silty clay loam with common, fine, prominent strong brown (7.5YR 5/6) mottles; moderate, coarse prismatic structure breaking to moderate, medium subangular blocky; firm, sticky, and plastic; abrupt, smooth boundary; pH 6.9.

B23t--57 to 120+ cm; grey (N5/) silty clay loam with many, fine prominent strong brown (7.5YR 5/6) mottles; moderate, coarse prismatic structure; firm, sticky, and plastic; pH 7.2.

The surface layer ranges in colour from grey to dark grey, and in texture from silt loam to silty clay loam. The subsoil is greyish brown to dark greyish brown silty clay loam to silty clay. It is high in natural fertility, and medium in organic matter content. Available moisture capacity is high, and permeability low. Cation exchange capacity and base saturation are high. Rice is the main crop with about half of the area being planted to barley after its harvest.

5.12.1 Honam Silty Clay Loam, 0 to 2 Percent Slopes (Hn)

(Capability unit IIIw; Paddy land suitability group P1)

This soil is on the broad alluvial plains in the Nagdong River valley. Most areas have a profile as described for the series. Included are some small areas that have a grey loam surface layer and dark grey silt loam and sandy loam subsoil with iron mottles.

Paddy rice predominates with barley or wheat grown in the winter. The crops are suitable but improved drainage is needed for the latter two.

5.12.2 Honam-Geugrag Complex, 0 to 2 Percent Slopes (HG)

(Capability unit IIIw; Paddy land suitability group P1)

These soils, on broad alluvial plains developed in recent alluvial material near the Nagdong river, include some areas of soils with sandy surface layers. The Honam soil is poorly, and the Geugrag soil moderately,drained. Both occur together in the same area in such an intricate pattern that they were mapped as one unit.

The profiles are similar to those described for their respective series. The Geugrag soil usually occurs on the higher parts of this unit.

The soils of this complex are best suited for paddy rice, and barley or wheat as winter crops, if adequately drained.

5.13 HWADONG SERIES

The Hwadong series consisting of gently sloping to sloping, moderately well drained, deep, greyish brown soils formed in old alluvium on low terraces or elevated alluvial plains, commonly occurs with the Bancheon series. These soils are members of the fine clayey family of Aquic Hapludalfs. Most areas are located south of Daegu Si.

A typical profile follows:

Ap--0 to 15 cm; greyish brown (2.5Y 5/2) silty clay loam with few, fine, faint light olive brown (2.5Y 5/4) mottles; moderate, medium granular structure; friable, sticky, and plastic; clear, smooth boundary; pH 5.2.

Ag—15 to 20 cm; greyish brown (2.5Y 5/2) clay loam with many, medium and coarse prominent yellowish red and dark yellowish brown (10YR 4/4) mottles; massive, breaking to moderate, medium, subangular blocky structure; firm, sticky, and plastic; clear, smooth boundary; pH 5.6.

B21t—20 to 40 cm; dark grayish brown (10YR 4/2) clay loam with common, fine, faint yellowish brown (10YR 5/6) mottles; moderate, medium and coarse prismatic structure; firm, sticky, and plastic; neutral; gradual, smooth boundary.

B22t—40 to 90 cm; brownish yellow (10YR 6/6) clay loam with many, medium, faint yellowish brown (10YR 5/4) mottles; moderate, medium to fine subangular blocky structure; very sticky and very plastic; thin clay cutans on ped faces; clear, smooth boundary; pH 6.5.

B23t—90 to 120+ cm; reddish yellow (7.5YR 6/8) clay loam with many, medium, distinct pale brown (10YR 6/3) mottles; moderate, coarse prismatic structure; very sticky and very plastic; pH 6.6.

The surface layer ranges from greyish brown to grey. The upper subsoil from grey in paddy to reddish brown in other areas. The lower subsoil is mottled in shades of brown and grey. The solum ranges from 1 to 4 m in depth. The reaction of the horizons varies from neutral to medium acid.

These soils are high in natural fertility and medium in organic matter content in the surface horizon. They have high available moisture capacity and are slowly permeable. The base exchange capacity and the base saturation are high. Rice is grown in the summer and barley in the winter.

5.13.1 Hwadong Silty Clay Loam, 0 to 2 Percent Slopes (Hd)

(Capability unit I; Paddy suitability group P2c).

This soil occurs on elevated alluvial plains or old alluvial terraces. Most areas have a profile typical for the series.

Small areas of loam or sandy loam surface layer, and small areas of a soil that has a silt loam surface layer and silty clay loam subsoil, are included in the mapped areas.

This soil is best suited to paddy rice and other crops, such as soybeans. Winter barley and wheat also grow well. There is no particular management requirement except for adequate fertilization and liming.

5.13.2 Hwadong Silty Clay Loam, 2 to 7 Percent Slopes (HdB)

(Capability unit IIe; Paddy land suitability group P2ac)

The soil occurs on gently sloping alluvial plains or old alluvial terraces. The profile is mostly as described for the series. Small areas of a soil with silt loam surface layer and silty clay subsoil are included.

Paddy rice and other crops, such as soybeans, are usually well suited. Barley or wheat does well in the winter. Erosion hazard is moderate.

5.13.3 Hwadong-Bancheon Complex, 7 to 15 Percent Slopes (HBC)

(Capability unit IIe; Paddy land suitability group P3ac)

The soils consisting of about 60 percent Hwadong and 40 percent Bancheon are found on sloping alluvial terraces, mainly in the southern part of Daegu Si.

Hwadong soils are less well drained than Bancheon. Profiles are generally similar to the Hwadong and the Bancheon series but occur in such a fine intricate pattern that they were mapped as one unit. The Bancheon tend to be on the upper slopes and the Hwadong on the lower slopes. Some areas with silt loam surface layer and silty clay subsoil are included.

These soils are suited to paddy rice or soybeans in the summer, and to winter crops such as barley or wheat. Erosion is a severe problem.

5.14 HWANGRYONG SERIES

The Hwangryong series consists of level, somewhat excessively drained, deep, yellowish brown soils formed in recent alluvial materials on flood plains. They are adjacent to river channels and in narrow mountain valleys, and are members of the sandy skeletal family of Typic Udipsamments.

A typical profile follows:

A1——0 to 25 cm; yellowish brown (10YR 5/4) gravelly loamy sand; single grain; loose, non sticky, and non plastic; common, fine and coarse roots; clear, smooth boundary; pH 5.5.

C——25 to 150+ cm; yellowish brown (10YR 5/4) very gravelly and cobbly coarse sand; single grain; moderate round gravel; loose, non sticky, and non plastic; pH 5.6.

The surface layer is dark yellowish brown, yellowish brown, and pale brown gravelly loamy sand. The substrata are yellowish brown or pale brown, very gravelly medium to coarse sand or very cobbly loamy sand. A thick or moderately thick strata of fine sandy loam may be present. Grey mottles are in the surface layer of areas used for paddy rice.

These soils, usually associated with Nagdong and Hogye series, and riverwash, sandy or riverwash cobbly, are very rapidly permeable.

They are low in natural fertility, low in organic matter and strongly to medium acid. The available moisture capacity and cation exchange capacity are very low. The base saturation is medium or variable. More than half of the area is in cultivated crops such as barley, wheat, rye, melon, and sesame. Rice is grown in some places.

5.14.1 Hwangryong Sandy Loam, 0 to 2 Percent Slopes (Hy)

(Capability unit IVs; Paddy land suitability group P4bc).

This soil occurs along the larger streams on level to nearly level broad flood alluvial plains and in small mountain valleys. It has a profile as described for the series. Some areas with sandy loam surfaces are included.

Most of the areas are in crops, such as barley, wheat, cucumber, melon, and sesame. There are orchards, but the soil is better suited to growing poplars. Adequate irrigation and the application of sufficient fertilizers will increase yields. Rice can be grown but a lot of water is required due to high seepage losses.

5.15 IHYEON SERIES

The series consists of nearly level, well drained, deep, brown soils formed in recent alluvium on flood plains, and commonly occurs with the Nagdong and the Hwangryong series. The Ihyeon soils, members of the coarse silty family of Dystric Fluventic Eutrochrepts, are extensive throughout the surveyed area, but chiefly along the Nagdong River and its tributaries.

A typical profile follows:

Ap——0 to 18 cm; brown to dark brown (10YR 4/3) silt loam; moderate, medium and fine granular structure; friable, non sticky, and non plastic; many fine and very fine, white and yellow mica flakes; many fine grass roots; abrupt, smooth boundary; pH 5.8.

B——18 to 120+ cm; dark yellowish brown (10YR 4/4) silt loam; massive breaking to weak, coarse subangular blocky structure; friable, slightly sticky, and slightly plastic; crushed colour brown to dark brown (10YR 4/3); many very fine and fine white and yellow mica flakes; few fine grass roots; pH 6.5.

The surface layer ranges from brown to dark brown silt loam, the C horizon from dark yellowish brown to yellowish brown or dark brown in colour and from silt loam to silty clay loam in texture. Occasionally the substrata have thin strata of sandy loam, silty clay or clay loam.

These soils are high in natural fertility and medium in organic matter content. The reaction varies from medium acid to neutral. They have high available moisture capacities, and the cation exchange capacity is medium and well saturated with bases. The land is in cultivated crops with about 40 percent planted to paddy rice.

5.15.1 Ihyeon Silt Loam, 0 to 2 Percent Slopes (Ih)

(Capability unit I; Paddy land suitability group P2o).

Most areas have a profile typical for the series, but some areas have loam surface and silty clay loam substrata.

This soil is well suited to a wide range of crops, and rice adapts well if water is available.

5.16 IWEON SERIES

The series consists of gently sloping to sloping, well drained, deep soils in colluvial-alluvial materials on mountain foot slopes. These soils, often adjacent to the Togye series, are members of the coarse loamy family of Typic Dystrochrepts. They are mostly in the northern part of the survey area.

A typical profile follows:

Ap1g——0 to 12 cm; dark grey to greyish brown (10YR 4/1-5/2) sandy loam; few, fine to medium distinct strong brown (7.5YR 5/6) mottles; weak, fine to medium granular structure; friable, non sticky, and non plastic; many, fine grass roots; common, fine, white and yellow mica; clear, smooth boundary; pH 5.2.

Ap2g——12 to 27 cm; greyish brown (10YR 5/2) sandy loam; many, medium and coarse, prominent yellowish red (5YR 4/8) mottles; crushed colour is brown (10YR 4/3); weak, coarse subangular blocky structure; friable, slightly sticky, and slightly plastic; common, fine to coarse pores; mica as above; clear, smooth boundary; pH 5.5.

B1——27 to 37 cm; dark grey to dark greyish brown (10YR 4/1-4/2) sandy loam; many, coarse prominent, reddish brown (5YR 4/3) mottles; crushed colour is brown to dark yellowish brown (10YR 4/3); friable, non sticky, and non plastic; weak, coarse prismatic structure; common, fine and medium pores and roots; abrupt, smooth boundary; pH 6.2.

B2——37 to 120+ cm; yellowish brown (10YR 5/4) loam; weak, coarse prismatic breaking to weak, medium subangular blocky structure; few, fine and medium, soft manganese concretions; thin cutans; weak, coarse prismatic breaking to weak, medium subangular blocky structure; firm, sticky, and plastic; few worm casts; some gravel.

The Ap horizon ranges from pale brown to brown in non-irrigated areas, and from dark greyish brown to dary grey in paddy; the B horizon from strong brown to yellowish red in colour, and from loam to sandy clay loam in texture. The depth to bedrock is more than 150 cm.

Natural fertility is low to moderately low and organic matter medium. Available moisture capacities are also low. Cation exchange capacity is medium, and base saturation is low. The soils are mainly used for production of rice in summer and barley in winter, with some crops of red pepper, corn, tobacoo, and sweet potatoes.

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

(Capability unit IIe; Paddy land suitability groups P4abc).

This mapping unit occurs on gently sloping concave relief in the northern part of the surveyed area. The profile is similar to that described in the series description. Some areas with loam surface and sandy clayey loam subsoil, and some having angular granitic stones on the surface, are included.

This unit is well suited to crops such as barley, wheat, red pepper, corn, tobacco, and sweet potatoe. Erosion is a moderate problem when these crops are planted. Contour cultivation of small fields, with grassed waterways, are effective means of erosion control.

5.16.2 Iweon Stony Sandy Loam, 7 to 15 Percent Slopes (IwC)

(Capability unit IIIe; Paddy land suitability group P4abc).

This mapping unit occurs on sloping concave relief in the northern part of the surveyed area. The profile is usually similar to that described as typical for

the series. Small eroded areas and a few areas with sandy clay loam surface, some areas of moderately steep soils, and a few deep and shallow gullies, are included with this soil.

The unit is suited to crops, such as red pepper, sesame, wheat, tobacco, sweet potato, and soybeans. Erosion is a severe problem when the soils are cropped to these annuals year after year. Contour cultivation with small fields, and grassed waterways, are effective means of erosion control.

5.17 JANGWEON SERIES

The Jangweon series consists of sloping to steep, moderately well drained, moderately deep soils with a fragipan in colluvium derived chiefly from shale and porphyry materials on mountain foot slopes, mainly in the south-eastern part of Daegu Si. They are members of the fine loamy family of Typic Fragiochrepts.

A typical profile follows:

A1——0 to 18 cm; dark yellowish brown (10YR 4/4) gravelly loam; very pale brown (10YR 7/4) when dry; weak, fine granular structure; friable, slightly sticky, and slightly plastic; many, fine grass roots; clear, smooth boundary; pH 5.7.

B21——18 to 35 cm; dark yellowish brown (10YR 4/4) gravelly loam; yellowish brown (10YR 5/6) when dry; moderate, medium blocky structure; friable, sticky, and plastic; common, fine grass roots; abrupt, smooth boundary; pH 5.3.

B22x——35 to 75 cm; strong brown (7.5YR 5/6) gravelly clay loam with common, medium, and coarse prominent yellowish red (5YR 4/8) mottles; weak, coarse platy breaking to weak, medium blocky structure; firm, sticky, and plastic; few, medium manganese concretions; few, fine grass roots; clear, smooth boundary; pH 5.5.

B23x——75 to 130 cm; mottled light yellowish brown (10YR 6/4), yellowish brown (10YR 5/8), and dark reddish brown (5YR 3/4) gravelly clay loam; strong, medium platy structure; firm, sticky, and plastic; crushed colour is brown to dark brown (7.5YR 4/4); no roots; pH 6.1.

C1——130 to 200 cm; same as above except having more gravel.

The A horizons are very pale brown to brown and the B horizons are yellowish brown to strong brown loam to clay loam. The depth to bedrock is more than 150 cm.

These soils are moderate to moderately low in natural fertility and medium in organic matter content. Plant roots growing on this soil penetrate only the horizons above the fragipan layer. The available moisture capacity of the plant rooting zone is low to medium. The base exchange capacity is medium and base saturation is low. These soils are used for crops, with about 30 percent in forest of pine, oak, and alder.

5.17.1 Jangweon Gravelly Loam, 7 to 15 Percent Slopes (JwC)

(Capability unit IVe; Paddy suitability group P3ac).

Most areas have a profile typical for the series. Small areas of soils with yellowish brown sandy loam surfaces and yellowish red sandy clay loam subsoil,

some areas of soils with a surface layer that is brown stony loam, and areas without moderate blocky structure in the subsoil have been included in this mapping area. These areas do not have a well developed fragipan, and there is angular stone on the surfaces in some parts.

The soil is suited to crops such as barley, wheat, red pepper, and tobacco, with about 30 percent in forest. Erosion is a severe problem when these annual crops are planted without erosion control practices. Erosion is particularly harmful as the fragipan layer is a poor medium for plant root growth.

5.17.2 Jangweon Gravelly Loam, 15 to 30 Percent Slopes (JwD)

(Capability unit IVe; Paddy land suitability group P4ac)

This mapping unit occurs in the moderately steep mountain foot slopes. The profiles generally correspond to that typical. Stones and boulders are relatively common on the surface. Soils with surface layers of sandy loam are included in this unit.

About half of the soil is cultivated for crops, such as tobacco, barley, wheat, and red pepper. The remainder is in forest. Erosion control is difficult when soils are ploughed and planted to annual crops, thus they are best suited to grass, legume, or pasture crops.

5.17.3 Jangweon-Mudeung Complex, 30 to 60 Percent Slopes (JME)

(Capability unit VIe)

These two soils have developed in weathered products of porphyry materials, and occur on the steep colluvial positions. The Jangweon soil is deep and has a fragipan in the subsoil while the Mudeung is shallow and lacks subsoil development. Profiles are as described in their series descriptions. As they occur in such an intricate pattern, they were mapped together.

The Mudeung soils tend to dominate on the upper convex portions of the slopes, and the Jangweon soils on the concave portion adjacent to the drain. The Jangweon are more extensive, covering about 60 percent of the area.

These soils are suited for woodland and some areas could be developed into pasture for livestock production.

5.18 MANGSIL SERIES

The Mangsil series consists of steep, well drained, deep, dark coloured soils derived chiefly from porphyry, gabbro, and similar rocks in concave positions. These soils are members of the fine loamy family of Humic Hapludults. They are small areas with the Mudeung soil in the south-eastern part of Daegu Si, and are mapped in a complex with it.

A typical profile follows:

A11——0 to 10 cm; very dark brown (10YR 2/2), stony loam; moderate, very fine granular structure; very friable, slightly sticky, and slightly plastic; many, fine grass roots; clear, wavy boundary; pH 5.4.

A12——10 to 25 cm; very dark brown (10YR 2/2) stony loam; moderate, very coarse granular and moderate, medium subangular blocky structure; very friable, slightly sticky, and slightly plastic; many, fine grass roots; clear, wavy boundary; pH 5.7.

A3——25 to 40 cm; very dark greyish brown (10YR 3/2) loam; weak, coarse subangular blocky structure; friable, slightly sticky, and plastic; many, fine pores; common roots; abrupt, smooth boundary; pH 5.3.

B21t——40 to 52 cm; brown to dark brown (10YR 4/3) mixed with dark brown (10YR 3/3) stony clay loam; moderate, coarse subangular blocky structure; friable, sticky, and plastic; many, fine pores; few, fine grass roots; clear, wavy boundary; pH 5.7.

B3t——93 to 150 cm; yellowish brown (10YR 5/6) stony clay loam; weak, coarse subangular blocky structure; firm, sticky, and plastic; common, fine pores; stones are weathered, slightly hard porphyry; clear, smooth boundary; pH 5.9.

The A horizons are very dark brown to black stony loam or silt loam while the B are yellowish brown to brown stony clay loam or clay. The bedrock ranges from 100 cm to 200 cm below the surface.

Natural fertility and organic matter content are high, and available moisture capacity is moderate to high. The base saturation is low and the cation exchange capacities are medium to high. The present vegetation is tall grass, pine, and oak. These soils are sometimes planted to vegetable crops, such as cabbage, potatoes, and radish.

5.19 MUDEUNG SERIES

The series consists of steep to very steep, somewhat excessively drained, shallow soils in residuum derived from porphyry, gabbro, and similar rocks on mountainous areas. They are members of the fine loamy family of Lithic Dystrochrepts, occur with the Mangsil and Jangweon series, and are extensive in an area southeast of Daegu Si.

A typical profile follows:

A11——0 to 6 cm; very dark greyish brown (10YR 3/2) stony loam; pale brown (10YR 6/3) when dry; moderate, very fine granular structure; very friable, slightly sticky, and plastic; many, fine roots; clear, wavy boundary; pH 6.2.

A12——6 to 20 cm; brown to dark brown (7.5YR 4/2) cobbly clay loam; moderate, coarse and fine granular structure; friable, slightly sticky, and plastic; many, fine roots; clear, wavy boundary; pH 6.1.

B——20 to 30 cm; 95 percent angular blocky gabbro porphyry stones with brown to dark brown (7.5YR 4/2) clay loam in joints among rocky; pH 6.1.

R——30+ cm; hard rock.

The surface layer is very dark greyish brown to dark brown stony loam to stony loam to stony silt loam. Bedrock is less than 50 cm below the surface.

These soils are moderate to moderately low in natural fertility, and moderately high in organic matter content. They have low available moisture capacity. The base saturation and the cation exchange capacities are low to medium. All of the areas are in forest of pine, oak, alder, acacia, and similar trees.

5.19.1 Mudeung Rocky Loam, 15 to 30 Percent Slopes, Eroded (MdD2)

(Capability unit VIe)

The soil occurs on moderately steep mountains. Most areas have a profile similar to the one described for the series, but about 2 to 25 percent is rock outcrop. Some areas with severely eroded surfaces, some areas of deep, well drained, dark coloured soil formed in colluvium, are included.

The soil is suited to woodland, but yields, even when well managed, are apt to be low. Erosion control is a major management problem.

5.19.2 Mudeung Rocky Loam, 15 to 30 Percent Slopes, Severely Eroded (MdD3)

(Capability unit VIe)

This mapping unit occurs on moderately steep mountainous areas. It has a profile similar to that typical for the series, except for areas where the surface layer has been eroded away. The substrata are exposed in places, and about 2 to 25 percent of the area is rock outcrop. The mapped areas include parts with active sheet and gully erosion as well as some areas with thick surface soils.

Erosion has been severe on these soils, and most is idle or growing grasses and small trees. With treatment some grazing could be obtained, but even with good management woodland yields are apt to be low.

5.19.3 Mudeung Rocky Loam, 30 to 60 Percent Slopes, Eroded (MdE2)

(Capability unit VIe)

The profile is similar to the one described for the Mudeung series. About 2 to 25 percent of the area is rock outcrop.

Most of this soil is in forest of pine, oak, or alder with open areas in grass.

5.19.4 Mudeung Rocky Loam, 30 to 60 Percent Slopes, Severely Eroded (MdE3)

(Capability unit VIIe)

The profile is similar to the one described for the series, but many areas have a thinner surface layer. About 2 to 25 percent is in rock outcrop.

Shallow and deep gullies are included in this mapping unit. Most areas are in forest, to which this soil is best suited. Erosion control is a major management problem.

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

(Capability unit VIe)

The soils of this complex mapping unit occur on steep solluvial or concave slopes. The Mudeung soil is shallower and does not have subsoil with clay accumulation, while the Mangsil is deeper and has subsoil with clay accumulation.

Both have profiles as described in their respective series descriptions. Some areas of less sloping soils are included in this mapping unit.

The Mudeung tend to dominate on the upper portion of the mountain and are more extensive, covering about 60 percent of the total area. About 2 to 25 percent of the area is rock outcrops, boulders and stones. Grass, pine trees and shrubs dominate land use. This unit is well suited to woodland.

5.20 NAGDONG SERIES

The series consists of level to nearly level, somewhat excessively drained, very deep soils in recent alluvium on broad flood plains. These soils are members of the family of Typic Udipsamments and are commonly associated with Riverwash, sandy, and the Hwangryong, and Ihyeon soils. The Nagdong are extensive in the major river valleys.

A typical profile follows:

Ap——0 to 18 cm; brown to dark brown (10YR 4/3) loamy fine sand; weak, fine granular structure; friable, non sticky, and non plastic; many, very fine white and yellow mica flakes; gradual, smooth boundary; pH 6.2.

C1——18 to 120+ cm; dark yellowish brown (10YR 4/4) loamy fine sand; single grains; very friable, non sticky, and non plastic; many, very fine white and yellow mica flakes; pH 6.7.

The surface layer ranges from brown to dark brown or yellowish brown and from fine sandy loam to loamy fine sand. The C horizon is yellowish brown to dark yellowish brown, or brown, loamy fine sandy to fine sand. The depth to the stratified sand, silt, and clay is more than 150 cm. The depth to hard bedrock is more than 4 m from the surface. These soils are moderately high to moderate in natural fertility and low in organic matter content. The available moisture capacity is low. They have low cation exchange capacity and high base saturation.

Most areas are in cultivated crops including some in rice paddy.

5.20.1 Nagdong Loamy Fine Sand, 0 to 2 Percent Slopes (Nd)

(Capability unit IIIs; Paddy land suitability group P4bc)

This is in level broad alluvial plains, in recent alluvium near the Nagdong river and its tributaries. Most soils have profiles similar to that described for the series. In this unit are included some areas with very fine sandy loam or loam surface layers, and silt loam or very fine sandy loam substrata.

Crops, such as cabbage, onion, tomato, melon, radish, peanut, eggplant, lettuce, rye, wheat, and soybeans are well adapted. Yields are high in seasons

of much rainfall, but may be very low in dry seasons. Fertilizer and irrigation will promote high yields.

5.21 RIVERWASH

5.21.1 River Wash, Cobbly (RC)

(Capability unit VIII)

This land consists of areas of stratified alluvium recently deposited by streams on first bottom and flood plains. Generally this is cobbly sand but some heavier strata are present. The base saturation and base exchange capacities, natural fertility and organic matter content, are all low. The surface runoff is very slow, and available moisture capacity is low. The land is left idle with a few areas growing poplar trees. Until flooding is controlled this soil has little agricultural value.

5.21.2 River Wash, Sandy (RS)

(Capability unit VIII)

This land consists of stratified alluvium recently deposited by streams on first bottoms and flood plains.

It is generally sandy but some heavier textures are common. Flooding is so frequent that there is no vegetation. The natural fertility and organic matter content are low, and the surface runoff is very slow. The base saturation and cation exchange capacities are low. This land has no agricultural value until the flooding is controlled.

5.22 ROCK LAND (RL)

(Capability unit VIII)

These lands are colluvial deposits of stones on mountain foot slopes, talus slopes, escarpments along the river sides, and rock outcrops on the top of mountains, with about 10 percent shallow stony soils. The rocks are granite, porphyry and shale. A few areas consist of granite gneiss and porphyry-conglomerate; vegetation is poor; some pines are growing between rocks.

5.23 SAMGAG SERIES

The Samgag series, consisting of moderately steep to steep, somewhat excessively drained, deep, yellowish brown soils in residuum derived from granite and granite gneiss on the high mountainous areas, are members of the coarse loamy family of Typic Dystrochrepts, and associated with Dalcheon soils. They are mostly located in the northern part of the survey area.

A typical profile follows:

A1——0 to 10 cm; light yellowish brown (10YR 6/4) rocky sandy loam; moderate, fine granular structure; friable, slightly sticky, and slightly plastic; many, fine and medium roots; abrupt, smooth boundary; pH 6.0.

B21——10 to 34 cm; light yellowish brown (10YR 6/4) loam; moderate, fine granular structure; friable, sticky, and plastic; many, fine and medium roots; gradual, wavy boundary; pH 5.7.

B3——34 to 62 cm; very pale brown (10YR 7/3), reddish yellow (7.5YR 7/8) sandy loam; weak to moderate fine granular and weak to moderate, fine subangular blocky structure; friable, sticky, and plastic; few, medium roots; few, distinct reddish yellow (7.5YR 7/8) cutans; abrupt, smooth boundary; pH 6.8.

C2——62 to 100+ cm; soft saprolite retaining the original rocks structure; the crystals are very pale brown (10YR 6/3) and reddish yellow (7.5YR 7/8); the texture is a coarse sand to fine gravel which crushes to a fine sandy loam; friable, slightly sticky, and slightly plastic; few roots; gradual, wavy boundary; pH 6.9.

The surface layer ranges from light yellowish brown to yellowish brown in colour, and from rocky sandy loam to loam or silt loam in texture.

These soils are low in natural fertility and in organic matter content, and are medium to strongly acid. They have low available moisture capacities. The base saturation and the cation exchange capacities are low. Forest of pine, oak, alder, acacia, maple, and bush clover are general.

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

(Capability unit VIe)

Most areas have a profile as described in the series, with some that have greater clay content, better available moisture capacity, and a less acid profile. From 2 to 25 percent of the area is rock outcrops, with a few gullies. Also included are small areas of a sloping, and a severely eroded, soil.

Covering these soils with grass and building bench terraces are effective measures to control erosion, and good pastures could be developed by liming, fertilizing and seeding to adapted species of forage plants. Forest, at present, is widespread.

5.23.2 Samgag Rocky Sandy Loam, 15 to 30 Percent Slopes, Severely Eroded (SmD3)

(Capability unit VIe)

The profile is similar to that described for the series, but generally this soil is more eroded, with some areas being less sandy than usual. From 2 to 25 percent of the areas is rock outcrop. Sheet or rill eroded areas and shallow to deep gullies are included in the mapping unit. Soils have a medium available moisture capacity with some being less acid than typical. These would produce the better forage crops. However, most areas are idle or in grass land and in forest.

Erosion is a problem, and covering with grass or constructing bench terraces will do much to reduce it. If limed, fertilized and seeded to good species of adapted forage crops, this soil would produce good yields of pasture.

5.23.3 Samgag Rocky Sandy Loam, 15 to 30 Percent Slopes, Gullied (SmD4)

(Capability unit VIIe)

The profile is similar to that described for the series, but most of the A and B horizons has been removed by erosion, and gullies are common. From 2 to 25 percent of the area is rock outcrop, with some areas having less sandy textures. These soils have a moderate available moisture capacity, some being less acid than the typical profile. Growth is confined to grass and forest.

Erosion is a major problem, but a grass covering and bench terraces will reduce erosion. The latter are costly to build on this soil.

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

(Capability unit VIe)

Most areas have profiles as described for the series, with some less sandy and less acid than that typical. From 2 to 25 percent are rock outcrop with numerous gullies, both deep and shallow being included.

The land is idle, but with some parts in grass and forest. Erosion is very severe. Pastures could be developed on some of the less sandy soils and good woodland growth could be obtained if the areas were properly managed.

5.23.5 Samgag Rocky Sandy Loam, 30 to 60 Percent Slopes, Severely Eroded (SmE3)

(Capability unit VIIe)

Except for having thinner A and B horizons most areas have profiles much like that typical. Other areas have a less sandy and less acid profile. Large stones cover 20 to 50 percent of the area with some deep and shallow gullies being included.

Forest and grass are suited but erosion is a very severe problem. Covering with grass or trees will help control this. With good fertilization, reseeding and management, moderate grass yields could be obtained, and well managed forest will produce moderate yields of forest products.

5.23.6 Samgag Rocky Sandy Loam, 30 to 60 Percent Slopes, Gullied (SmE4)

(Capability unit VIIe)

At one time the soil had a profile much like the typical one, but since, it has been eroded, and the upper horizons have been washed away. Many large and small gullies have cut into the C horizon. Large stones cover about 30 percent of the area and more than 30 percent is rock outcrops. Some shallow gullies are included.

The area is suited to forest and grass. Erosion is very severe.

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

(Capability unit VIIe)

This unit consists of areas from which erosion has removed all of the original surface soil and most of the original subsoil. The present surface layer was originally a substratum. Some areas have textures like the typical profile of the Samgag series but other areas have less sandy and more clayey textures than the lower horizons of the Samgag.

There are intricate patterns of shallow and deep gullies in most areas, and a few gullies have cut deep into partly weathered rock materials. Some rock outcrops are included in this mapping unit as are small areas of 15 to 30 percent slopes.

Most areas are unused or in grass and small trees. The erosion hazard is very severe and these areas produce a large amount of sediment unless stabilized. The areas with heavier textures have a medium available moisture capacity, and well managed woodland on these areas could produce moderate yields.

5.24 SINHEUNG SERIES

The Sinheung series consisting of level, imperfectly drained, deep soils formed in recent alluvium on plains, are members of the fine loamy family of Aeric Fluventic Haplaquepts and are associated with the better drained Ihyeon and Nagdong soils. They are found along the streams of the surveyed area.

A typical profile follows:

Ap——0 to 15 cm; yellowish brown (10YR 5/4) loam; single grain; friable, non sticky, and non plastic; many, fine grass roots; abrupt, smooth boundary.

C11g——15 to 35 cm; dark grey (N4/) loam; common, coarse, faint olive brown (2.5Y 4/4) and few, medium, faint dark yellowish brown (10YR 4/4) mottles; crushed colour is dark greyish brown (2.5Y 4/2); friable, non sticky, and non plastic; massive; abrupt, smooth boundary.

C12——35 to 45 cm; mottled very pale brown (10YR 7/4) yellowish brown (10YR 5/8), and grey (10YR 5/1) loamy sand; few, fine, manganese mottles; many coarse hard manganese concretions; crushed colour is light olive brown (2.5Y 5/4); single grain; friable, non sticky, and non plastic; abrupt, smooth boundary.

C13——45 to 55 cm; mottled brownish yellow (10YR 6/8) and greyish brown (10YR 5/2) loam; few, medium manganese concretions; single grains; friable, slightly sticky, and slightly plastic; abrupt, smooth boundary.

C14——55 to 60 cm; mottled brown (10YR 5/3) and very dark greyish brown (10YR 3/2) loamy sand; crushed colour is brown to dark brown (10YR 4/3); many, very coarse manganese concretions; single grains; friable, non sticky, and non plastic; abrupt, smooth boundary.

C15——60 to 120+ cm; yellowish brown (10YR 5/4) loamy sand; single grains; friable, non sticky, and non plastic.

The surface layer is dark greyish brown to yellowish brown fine sandy loam to silt loam. The substrata are yellowish brown or brown, mottled with greyish brown or dark greyish brown, fine sandy loam to silt loam.

The soils are moderate in natural fertility and low to medium in organic matter content. They have medium to low available moisture capacities. The base saturation is high and the cation exchange capacity is medium. Rice and parsley are grown.

5.24.1 Sinheung Loam, 0 to 2 Percent Slopes (Sh)

(Capability unit IIw; Paddy land suitability group P1)

This mapping unit is in alluvial plains near the Nagdong River and its tributaries. The representative profile described in the series is similar to that of this unit. Some areas with loamy fine sand, loam surface layer, stratified fine sand, loam and sandy loam substrata, have been included, as have some areas of poorly drained soils.

Paddy rice and other crops, including barley and wheat, are well suited if ditches to remove excess water could be dug. With better drainage and heavy fertilization, high yields can be expected.

5.25. SIRYE SERIES

The Sirye series consists of gently sloping to sloping, well drained, moderately deep, yellowish red soils in residuum derived chiefly from shale and fine grained sandstone on hilly areas. These soils, members of the fine clayey family of Typic Hapludalfs, are generally associated with the Daegu soils and are found chiefly in the southern part of the surveyed area.

A typical profile follows:

Ap——0 to 15 cm; brown to dark brown silty clay loam; moderate, fine granular structure; friable, slightly sticky, and slightly plastic; common, fine pores and roots; clear, smooth boundary; pH 5.4.

B1——15 to 40 cm; yellowish red (5YR 5/8) silt loam; moderate, fine and medium subangular blocky structure; friable, sticky, and plastic; few, fine and medium roots; some strongly weathered shale fragments; clear, smooth boundary; pH 5.2.

B2t——40 to 60 cm; yellowish red silty clay loam with few, fine, faint reddish brown (5YR 4/4) iron mottles and very few, fine Mn concretions; moderate, fine and medium subangular blocky structure; slightly firm, sticky, and plastic; thin continuous clay films; common, fine pores and roots; clear, smooth boundary; pH 5.5.

B3t——60 to 70 cm; mottled brownish yellow (10YR 6/8) light, reddish brown (2.5YR 5/4) and red (2.5YR 5/8) clay loam; massive; thick, light reddish yellow (7.5YR 6/6) clay films; abrupt, smooth boundary; pH 5.7.

70+ cm; strongly weathered shale bedrock.

Surface layers are brown to reddish brown clay loam or silty clay loam. The subsoil is generally silty clay loam to silty clay or clay loam, and ranges from yellowish red to red in colour. The depth to bedrock from the surface ranges from 50 to 150 cm.

Natural fertility is moderate and organic matter content low to medium. Available moisture capacity is medium while the base saturation is medium and the cation exchange capacity is medium to high. Most areas are in cultivated crops other than paddy rice. Persimmon, grapes, peach, and plum are grown in some areas.

5.25.1 Sirye Silty Clay Loam, 2 to 7 Percent Slopes, Eroded (SrB2)

(Capability unit IIIe; Paddy suitability group P2ac)

The profiles are much like that described for the series, but including some severely eroded areas with surface layers of silty clay, sloping soils, and a few small areas of gullied land.

This soil is suited to crops such as soybean, sesame, squash, sweet potato, barley, wheat, melon, strawberry, mulberry, and to paddy rice, if water is available for irrigation. Erosion is a major problem in management.

5.26 TOGYE SERIES

The Togye series consists of gently sloping to moderately steep, well drained, deep, yellowish brown soils in recent colluvium chiefly derived from granite on mountain foot slopes. These soils, members of the family of Typic Udipsamments, are commonly associated with Iweon and Samgag in the Northern part of Daegu Si.

A typical profile follows:

Ap——0 to 20 cm; brown to dark brown (10YR 4/3) loamy coarse sand; structurelass; friable, non sticky, and non plastic; common, fine to medium yellow and white mica; many, fine roots; gradual, smooth boundary; pH 4.8.

C1——20 to 120+ cm; yellowish brown to dark yellowish brown (10YR 5/4-4/4); loamy sand; structureless; friable, non sticky, and non plastic; common, medium to coarse pores; pH 5.7.

The surface layer ranges from brown to dark brown or yellowish brown in colour and from sandy loam to loam in texture. The substrata are yellowish brown to dark yellowish brown or brown in colour, and sandy loam to loamy sand in texture. These soils are low in natural fertility and organic matter content and have a very low available moisture capacity. The cation exchange capacity is low and the base saturation is variable.

Mulberry, tobacco, sesame, cabbage, radish, and corn are grown.

5.26.1 Togye Loamy Coarse Sand, 2 to 7 Percent Slopes (ToB)

(Capability unit IVs; Paddy land suitability group P4abc)

This mapping unit occurs on gently sloping mountain foot slopes. Most areas have a profile similar to that typical, but some areas with loam and sandy loam

textures were included. Other areas have stones on the surface and in the profile.

Because of low available moisture capacity, the only good crops produced are mulberry, sesame, and tobacco. An important management consideration is the reduction of leaching.

5.26.2 Togye Loamy Coarse Sand, 7 to 15 Percent Slopes (ToC)

(Capability unit IVs)

This unit occurs on sloping mountain foot slopes. Most areas have a profile similar to the typical one, but some have a stratum of sandy loam and loam, and some have stones that cover up to 20 percent of the area. Some areas with sandy loam to loam substrata are included.

This soil is poorly suited to cultivation because of very low available moisture capacity, but good crops of mulberry, sesame, and tobacco, are produced. The main management problem is to lessen the effects of leaching.

5.26.3 Togye Sandy Loam, 15 to 30 Percent Slopes (ToD)

(Capability unit IVe)

This mapping unit occurs on moderately steep mountain foot slopes. Most areas have a typical profile, with some areas having sandy loam or loam strata, or large stones covering up to 30 percent of the soil. Mulberry, sesame, and tobacco, are cultivated with difficulty because of strong slopes and presence of stones. Erosion is a problem when these soils are planted to annual crops.

5.27 YUGA SERIES

The series, consisting of gently sloping to sloping, moderately well drained, deep soils developed in alluvial - colluvial materials eroded chiefly from areas of Daegu soils, are members of the fine silty non acid family of Aeric Fluventic Haplaquepts, and are usually associated with Banho or Jangweon soils. The series is common in the southern part of the surveyed area.

A typical profile follows:

Ap--0 to 7 cm; dark yellowish brown (10YR 4/4) silty clay loam with few, fine, strong brown (7.5YR 5/6) mottles; massive; friable, sticky, and plastic; common, medium pores; abrupt, smooth boundary; pH 5.6.

Apir--7 to 14 cm; olive grey (5Y 4/2) silty clay loam with common, medium, prominent, dark reddish brown (2.5YR 3/4) mottles; friable, slightly sticky, and slightly plastic; common, fine roots; abrupt, smooth boundary; pH 6.6

B21--14 to 23 cm; olive brown (2.5Y 4/4) silty clay loam with common, fine, faint brown to dark yellowish brown (10YR 4/4) mottles; weak, medium subangular blocky structure; slightly firm, sticky, and plastic; few, fine roots and common, medium pores; clear, smooth boundary; pH 6.6.

B22——23 to 50 cm; olive grey to olive (5Y 5/2-5/3) silty clay loam with common, fine, faint yellowish brown (10YR 5/4) mottles; weak, coarse prismatic structure; slightly firm, sticky, and plastic; common, medium pores; few, fine roots; neutral; gradual, smooth boundary; pH 7.6.

B23——50 to 77 cm; greyish brown to light olive brown (2.5Y 5/2-5/4) silty clay loam with many, fine, faint, strong brown (7,5YR 5/6) mottles; weak, medium to coarse prismatic structure; firm, sticky, and plastic; common, medium pores; gradual, smooth boundary; pH 7.6.

B32——77 to 100 cm; greyish brown to light olive brown (2.5Y 5/2-5/4) silt loam with many, fine faint, dark yellowish brown (10YR 4/4) mottles; weak, coarse prismatic structure; pH 7.6.

C1——100 to 150 cm; very stony and cobbly loam.

The surface layer ranges from yellowish brown to grayish brown or grey in colour and from silty clay loam to silt loam in texture. The subsoil is greyish brown to olive grey or dark greyish brown silty clay loam with yellowish brown or yellowish red mottles. Stony and cobbly loam is often present at 60 to 100 cm.

These soils are moderately high in natural fertility and organic matter content. They have a high available moisture capacity. The cation exchange capacity and base saturation are high. Rice and barley are the principal crops, with onion and garlic as minor additions.

5.27.1 Yuga Silty Clay Loam, 2 to 7 Percent Slopes (YuB)

(Capability unit IIw; Paddy land suitability group P2a).

This unit occurs in sloping narrow valleys. The representative profile described for the series is similar to its profile with some areas of silt loam or loam surface layers, and silt loam or loam substrata being included.

The soil is generally well suited to paddy rice and other crops, including barley and wheat. Drainage is a problem when cultivated to general crops other than rice.

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 given.

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

6.2 CAPABILITY GROUPS OF SOILS

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. They 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 of the soils, and without consideration of possible but unlikely major reclamation projects.

Capability classes. The broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitation and narrower choices for practical use. There are no soils placed in class V in the Dalseong Gun, Daegu Si area. Classes are described as follows:

Class I — Soils have few limitations that restrict their use.

Class II — Soils have moderate limitations that reduce the choice of plants or require special management practices.

Class III — Soils have severe limitations that reduce the choice of plants, require special management practices or both.

Class IV — Soils have very severe limitations that restrict the choice of plants or require very careful management or both.

Class V — Soils have little or no erosion hazard, but have other limitations, impractical to remove, that limit their use to pasture or woodland.

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

Class VII Soils have severe limitations that make 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 a capability class, separated to show the kind of limitation, as well as the degree. Subclasses are designated by adding a small letter, e, s, w, or c 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' that the soil is shallow, droughty, or stony; 'w' that water in or on the soil interferes with plant growth or cultivation; and 'c' that the soil chemistry (high salt content and high acidity, etc) is a limiting factor. There are no subclasses in class I because the soils have few limitations.

The classification does not necessarily 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, and irrigation requirements are low. These soils are too wet to produce good yields of other crops without additional drainage. The IVs soils produce good crops of melons and peanuts but they are too droughty to grow most other crops.

The soils of a subclass are so similar in their important characteristics that they have similar management, productivity and crop responses. Some individual soils within a subclass may have secondary problems. Some wet soils designated as 'w' were sloping and have a secondary problem of erosion. These problems are explained in the subclass. Some management suggestions are given in the mapping unit description of this report. Detailed information on the management of paddy soils is given in the paddy suitability section.

The land capability groups are discussed more fully in The Soils of Korea, (see Chapter 1), Technical Report 1.

Table 4 gives the approximate number of hectares and proportionate extent of land capability units for all of the land in the survey area:

Table 4

APPROXIMATE NUMBER OF HECTARES AND PROPORTIONATE EXTENT OF LAND CAPABILITY UNITS

Capability Units	Hectares	Percent
1	4100	8.1
IIe	3000	4.0
IIs	1000	1.3
IIw	5200	6.9
IIIe	1600	2.1
IIIw	2500	3.3
IIIs	1990	2.6
IVe	3700	4.9
IVs	3200	4.2
VIe	15000	19.9
VIIe	26000	34.5
VIIIe	4300	5.7
Water reservoirs	460	0.6
Other (River beds, urban, etc.)	1416	1.9
	75466	100.0

6.2.1 Class I: Soils That Have Few Limitations

In this class are deep, moderate to moderately slowly permeable, well to moderately well drained, nearly level soils. They are fertile, and have high available moisture capacities. Their extent is approximately 6100 ha or 8.1 percent of the surveyed area.

They are:

Hwadong silty clay loam, 0 to 2 percent slopes
Ihyeon silt loam, 0 to 2 percent slopes.

These soils are easy to work, and can be used intensively if good management practices are used. The soils are medium to strongly acid, and if lime and fertilizer are added, they will produce good yields of most of the crops grown in the area. Rice and barley are grown on Hwadong soils. The Ihyeon are used to grow vegetables, fruits, and corn. Fruits are generally well suited.

6.2.2 Class II: Soils That Have Moderate Limitations

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

This subclass consists of deep, slowly to moderately slowly permeable, well to moderately well drained soils on gentle slopes. In general these soils are

fertile and have high available moisture capacities. They cover approximately 3000 ha or 4.0 percent of the area.

They are:

Bancheon silty clay loam, 2 to 7 percent slopes
Hwadong silty clay loam, 2 to 7 percent slopes
Hwadong-Bancheon complex, 7 to 15 percent slopes
Sirye silty clay loam, 2 to 7 percent slopes.

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

Many areas have been graded into rice paddies, and rice is generally grown. Erosion is controlled in a well constructed paddy system, but some small structures are needed to permit water to overflow without erosion of the walls. Moderate losses of irrigation water through seepage can be expected on the Iweon soils.

These soils that have been well fertilized and well managed are capable of producing high yields of most crops and are usually planted to high value grain and vegetables.

ii. Subclass IIs: Soils subject to moderate drought problems

The soils are deep, rapidly permeable, well drained, and have moderate available moisture capacity. They have gravelly loam, gravelly sandy loam or sandy loam textures. Droughtiness and overflow are the major problems in many areas. These soils cover a small extent, about 1000 ha or 1.3 percent of the area.

They are:

Hogye gravelly loam, 2 to 7 percent slopes.
Iweon stony sandy loam, 2 to 7 percent slopes.

They are suitable for a wide range of crops, including barley, wheat, melon, soybeans, onion, and squash. Peaches, apples, and pears also grow well. Because of the high water losses through these rapidly permeable, coarse sandy or loamy soils, rice growing is difficult. Much grading is needed for rice paddies, and fertilizers are required for the maximum production of grain and vegetable crops. Dikes to control overflow should be established.

iii. Subclass IIw: Soils having high water tables which limit the choice of crops unless drained.

This subclass consists of deep, moderately permeable silty to loamy soils wi high watertables, and moderate available moisture capacities. The Sinheung, and some of the less sloping areas of the Yuga soil, are subject to overflow except where protected by levee systems. These soils are important, and cover about 5200 ha or 6.9 percent of the area.

They are:

Sinheung loam, 0 to 2 percent slopes
Yuga silty clay loam, 2 to 7 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 are easy to construct.

The water requirement for growing rice is low because high water tables prevent water seepage. The soils are too wet for consistent production of high yields of most other crops, unless a drainage system were introduced. With this, barley could be grown during the winter or the system could be changed to grow crops other than rice during the summer.

6.2.3 Class III: Soils That Have Severe Limitations

i. Subclass IIIe: Soils subject to severe erosion if not protected with special conservation practices or perennial plants or both

The subclass consists mainly of moderately deep to 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 soils of this subclass are important for upland crops, covering about 1500 ha or 2.1 percent of the areas.

They are:

Bancheon silty clay loam, 7 to 15 percent slopes, eroded
Banggi clay loam, 2 to 7 percent slopes
Banggi clay loam, 7 to 15 percent slopes
Banho silt loam, 7 to 15 percent slopes
Gaghwa cobbly loam, 7 to 15 percent slopes, eroded
Iweon stony sandy loam, 7 to 15 percent slopes.

These soils are used to grow many kinds of crops. Some areas are in rice paddies but because of the slope much grading is required to construct them, and then they are small and irregular in shape. Development of additional paddies is mainly dependent upon more irrigation facilities. Because of the gravelly subsoil of the Banggi soils, they are less suitable than others for rice paddies.

Crops grown on these soils include barley, soybean, wheat, and potatoes. The application of ground limestone is particularly important for higher yields of soybeans. 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. Perennial hay and pasture crops will also control erosion, but because of the small amount of livestock on the farms, there is little use for these crops.

ii. Subclass IIIw: Soils with high water tables and slow permeability which limit the choice of plants unless drained

In this subclass are deep, slowly permeable, imperfectly drained soils with high available moisture capacities. They are on level, broad plains, and occupy about 2500 ha or 3.3 percent of the area.

They are:

Honam silty clay loam, 0 to 2 percent slopes
Honam-Geugrag complex, 0 to 2 percent slopes.

These soils have high water tables and are used for rice production, being too wet for other crops. They are well suited to paddy rice and high yields are obtained. With improved drainage and good management, they also could produce high yields of barley, wheat, corn, and many locally adapted crops. However, this is difficult, because the subsoil will permit only slow drainage and as the soils are along the river dikes, pumping would be necessary.

iii. Subclass IIIs: Soils subject to severe drought problem

The only soil in this subclass is deep, rapidly permeable, and covers about 1990 ha or 2.6 percent of the area on the flood plains. It is occasionally subject to overflow and has low available moisture capacity.

It is:

Nagdong fine sandy loam, 0 to 2 percent.

The soil is good to work, and is suited to upland crops such as peanut, radish, melon, water melon, lettuce, soybean, rye, wheat, barley, cucumber, tomato, spinach, carrot, and cabbage. A large amount of water is required to obtain high yields. Fertilizers are needed for the maximum production of crops.

6.2.4 Class IV: Soils With Very Severe Limitations

i. Subclass IVe: Soils with very severe erosion hazards

Most of these soils are moderately steep, well drained, moderately deep, and have moderate to high available moisture capacities. They are moderately productive when well managed, and are important, covering 3700 ha or 4.9 percent of the area.

They are:

Banho silt loam, 15 to 30 percent slopes
Daegu-Sirye complex, 7 to 15 percent slopes, eroded
Jangweon gravelly loam, 7 to 15 percent slopes
Jangweon gravelly loam, 15 to 30 percent slopes
Togye sandy loam, 15 to 30 percent slopes.

The erosion hazard is too severe for the growing of annual crops, but perennial hay and pasture crops will control this and produce high yields. Large amounts of lime, as well as other fertilizers,are needed to grow good grass, legume meadow and pasture crops. Alfalfa, sericea lespedeza, Korean lespedeza, ladino clover, alsike clover, and red clover will make good growth if properly managed.

Few of these soils are graded for paddy because of the steep slopes and stoniness. Good orchards of apple, peach, and persimmon have been established but soil erosion is destructive in clean tilled orchard, and planting cover crops as well a as the application of other erosion control measures is necessary. Bench terracing with good grass sod on the slopes is also an effective control measure, while 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 this and provide a better income.

ii. Subclass IVs: Soils with very severe moisture problems

This subclass consists of well drained, very coarse textured, rapidly permeable, level to sloping soils on alluvial fans and flood plains.

The soils have very low available moisture capacities. Overflow is also a problem on the Hwangryong but it is of short duration. Most of the flood damage is by the rapidly moving flood waters. Soils in this subclass are not extensive, but are important on many farms, They cover about 3200 ha or 4.2 percent of the area.

They are:

Hwangryong sandy loam, 0 to 2 percent slopes
Togye sandy loam, 2 to 7 percent slopes
Togye sandy loam, 7 to 15 percent slopes.

Although these soils have large water losses when used for rice paddy, some areas adjacent to dependable water supplies are planted to paddy rice and produce good crops. Rye gives better yields than wheat or barley. Water melon and cucumber grow well, particularly on the Togye. Deep-rooted legumes like alfalfa would also grow well, but they may be damaged when flooded.

Orchards of apples and pears have been successful and some parts produce mulberry leaves for silkworm production. Poplar trees also grow well.

Clayey soil is often added to the surface of these soils to improve texture and water holding capacities. Irrigation with dirty water also adds fine textured materials. Irrigation would increase the yields of many crops. The Hwangryong soil can be improved by picking up large gravel and cobbles.

6.2.5 Capability Class VI: Soils Suitable Only For Pasture and Woodland

i. Subclass VIe: Soils with a very severe erosion problem

These soils, shallow, sloping to steep and mainly rocky, are well drained and generally have low to medium available moisture capacities. Because of these unfavourable characteristics, they are suitable only for pasture or woodland use. They are extensive in the area, covering about 15000 ha or 19.9 percent of the area.

They are:

Daegu rocky loam, 7 to 15 percent slopes
Daegu rocky loam, 7 to 15 percent slopes, eroded
Daegu rocky loam, 15 to 30 percent slopes
Daegu rocky loam, 15 to 30 percent slopes, eroded
Daegu-Mudeung rocky complex, 15 to 30 percent slopes, eroded
Dalcheon-Samgag rocky complex, 15 to 30 percent slopes, eroded
Dalcheon-Samgag rocky complex, 30 to 60 percent slopes, eroded
Habin rocky loam, 15 to 30 percent slopes, eroded
Habin rocky loam, 30 to 60 percent slopes, eroded
Mudeung rocky loam, 15 to 30 percent slopes, eroded
Mudeung rocky loam, 15 to 30 percent slopes, severely eroded
Mudeung rocky loam, 30 to 60 percent slopes, eroded
Mudeung-Mangsil stony complex, 30 to 60 percent slopes

Samgag rocky sandy loam, 15 to 30 percent slopes, eroded
Samgag rocky sandy loam, 15 to 30 percent slopes, severely eroded
Samgag rocky sandy loam, 30 to 60 percent slopes, eroded
Jangweon-Mudeung complex, 30 to 60 percent slopes.

Because of steep slopes, the application of lime and other fertilizer is difficult as is the preparation of seedbeds for better kinds of plants. However, with liming, fertilization, and better pasture plants, considerable grazing may be obtained. Many areas are covered with shrubby pine trees and produce only a small amount of firewood. The establishment of a good grass cover would protect these soils and if they were used for woodland, good management will reduce erosion losses and aid in the production of useful forest products.

6.2.6 Class VII: Soils Limited to Woodland

i. Subclass VIIe: Soils with severe erosion problem

These extensive soils are so rocky, steep or badly eroded that they are suited only for the production of woodland products. They are of limited value, and cover about 26000 ha or 34.5 percent of the area.

They are:

Bonggye rocky silty clay loam, 30 to 60 percent, severely eroded
Daegu rocky loam, 30 to 60 percent slopes
Daegu rocky loam, 30 to 60 percent slopes, eroded
Daegu-Mudeung rocky complex, 15 to 30 percent slopes, severely eroded
Daegu-Mudeung rocky complex, 30 to 60 percent slopes, eroded
Daegu-Mudeung rocky complex, 30 to 60 percent slopes, severely eroded
Daegu-Mudeung very rocky complex, 30 to 60 percent slopes, eroded
Dalcheon-Samgag rocky complex, 15 to 30 percent slopes, severely eroded
Dalcheon-Samgag rocky complex, 30 to 60 percent slopes, severely eroded
Mudeung rocky loam, 30 to 60 percent slopes, severely eroded
Samgag rocky sandy loam, 15 to 30 percent slopes, gullied
Samgag rocky sandy loam, 30 to 60 percent slopes, severely eroded
Samgag rocky sandy loam, 30 to 60 percent slopes, gullied
Samgag soils, 30 to 60 percent slopes, gullied.

Good woodland cultural practices are needed to prevent erosion and increase production. The practice of raking leaf litter leaves the soil bare and subject to erosion. Advanced erosion and gullying reduce further the productivity.

6.2.7. Capability Class VIII: Non Productive Soils

This capability unit consists of miscellaneous land units and soil materials that are so shallow and rocky, or are sandy and cobbly and so frequently flooded, that useful plants do not grow. These areas include about 4300 ha or 5.7 percent of the survey area.

They are:

Riverwash, sandy
Riverwash, cobbly
Rock land.

6.3 PADDY SUITABILITY GROUPS

Rice is the most important crop in Korea and grows well on soils that are too wet for growing most other things. These wet soils are classified as IIw or IIIw in the capability classification. About 12,000 ha or 60 percent of the total cultivated areas are used for paddy rice. 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 the growth of paddy rice and management of paddies. For this reason, soils of Dalseong Gun and Daegu Si have been placed in four paddy land suitability groups, which are designated by P1, P2, 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, c, or d to the group numeral, for example, P2ac. The letter 'a' shows that the main limitation is slopes; 'b' that the soil is limited mainly because of coarse texture or rapid permeability; 'c' that the soil is well drained or has low water table; and 'd' that the soil is limited mainly because of adverse chemical nature, such as acidity and salt. In group P1 there are no subgroups, because the soils have no special limitations.

Some of the soils in subclass IIw and IIIw of the capability system are classified as P1 because the high water table is a desirable characteristic. 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, Korea Soil Survey Project, Technical Report 1, FAO, Rome.

Table 5, approximate number of hectares and proportionate extent of paddy suitability groups, gives an overall view of the relative suitability for rice production of land in the gun. All of the land is included in the table, regardless of its present use and the availability of irrigation water. The table

shows that paddy construction would be physically possible on one third of the land. However, only about 23 percent of the area is suitable for paddy without difficult or very difficult special development and management.

Table 5

EXTENT (HA) OF PADDY SUITABILITY GROUPS

Paddy Suitability Group	Hectares	Approximate Percent
P1	5017	6.8
P2a	4862	6.4
P2ac	3344	4.4
P2c	4342	5.8
P3ac	1062	1.3
P4abc	5183	4.8
P4ac	763	2.3
P4bc	2202	2.9
Not suited for paddy	48601	65.3
	75466	100.0

6.3.1 Paddy Suitability Group P1

The soils in this group are nearly level, fine textured, slowly permeable and with high water tables. These soils are moderately extensive, covering 5,107 ha or about 6.8 percent of the area.

They are:

Honam silty clay loam, 0 to 2 percent slopes
Honam-Geugrag complex, 0 to 2 percent slopes
Hwadong silty clay loam, 0 to 2 percent slopes
Sinheung loam, 0 to 2 percent slopes.

These soils need few management practices other than that needed for rice production on any soils. Somewhat higher yields can be obtained when the soils are ploughed deep, usually about 18 cm, and fertilizer is applied. (Calcium silicate fertilizer reduces lodging.) The high water table is a limitation to the growing of a crop such as barley or wheat during the winter and spring season. Measures to obtain high yields are early season culture, selection of special varieties, and high level fertilization.

6.3.2 Paddy Suitability Group P2a

The soils in this group are gently sloping to sloping, medium textured, and moderately slowly permeable. Seepage from adjacent higher land usually maintains a high water table. This group is moderately extensive, covering 4,862 ha or about 6.4 percent of the area.

The only soil in this group is:

Yuga silty clay 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 erosion of the paddy walls. Some barley is grown on this soil, but its yield in most years is limited by wetness.

6.3.3 Paddy Suitability Group P2ac

The soils in this group are gently sloping, moderately slowly permeable to slowly permeable, and with low water tables. This group covers 3,344 ha or about 4.4 percent of the area.

They are:

Bancheon silty clay loam, 2 to 7 percent slopes
Banggi clay loam, 2 to 7 percent slopes
Hwadong silty clay loam, 2 to 7 percent slopes
Sirye silty clay loam, 2 to 7 percent slopes, eroded.

At present only the soils of Hwadong series are used extensively for rice paddy, as water is usually not available for paddies on the other soils. Because of the low water table, frequent addition of water is needed to maintain optimum water depth in paddy. Deep ploughing and application of calcium silicate are good cultural practice. Water control structures are needed to maintain water depth and prevent erosion of paddy walls. Barley is successfully grown during the winter after paddy rice, and crops other than rice will also grow well during the summer season.

6.3.4 Paddy Suitability Group P2c

The only soil in this group is nearly level, moderately permeable, coarse silty textured, and has low water table. It covers about 4,342 ha or 5.8 percent of the area.

It is:

Ihyeon silt loam, 0 to 2 percent slopes,

Losses of water and dissolved plant nutrients are moderate problems, but the loss of nitrogen fertilizer can be reduced by split application. Because of great water less, a good supply is needed to maintain the water level. Dense planting and spreading compost are good management practices. Some areas of low elevation are damaged by flood waters after heavy rains. Barley grows well after rice. Other crops, such as millet and soybeans, may be grown instead of rice.

6.3.5 Paddy Suitability Group P3ac

The soils of this group are sloping, moderately to slowly permeable, and have low water tables. They cover about 1,062 ha or about 1.3 percent of the area.

They are:

Bancheon silty clay loam, 7 to 15 percent slopes, eroded
Banggi clay loam, 7 to 15 percent slopes
Banho silt loam, 7 to 15 percent slopes
Gaghwa cobbly loam, 7 to 15 percent slopes, eroded
Hwadong-Bancheon complex, 7 to 15 percent slopes.

Except for the Hwadong-Bancheon complex, few of these soils are presently being used for rice paddy, mainly because dependable water supplies are not available. It is possible to grow a good crop of barley in the winter-spring after rice, or the rice paddy area can be planted to many non-paddy crops instead. The use of the paddy system for all crops will assist in erosion control. A small weir notch dam or similar structure will prevent erosion of the paddy wall.

6.3.6 Paddy Suitability Group P4abc

The soils in this group are gently sloping to sloping, moderately rapidly permeable soils with gravelly to stony sandy loam or gravelly loam textures. They have moderate to low available moisture capacities with low or no water tables. The soils cover 5,183 ha or about 4.8 percent of the area.

They are:

Hogye gravelly loam, 2 to 7 percent slopes
Iweon stony sandy loam, 2 to 7 percent slopes
Iweon stony sandy loam, 7 to 15 percent slopes
Jangweon gravelly loam, 7 to 15 percent slopes
Nagdong fine sandy loam, 0 to 2 percent slopes
Togye sandy loam, 2 to 7 percent slopes
Togye sandy loam, 7 to 15 percent slopes.

Except for the Nagdong soils, grading is needed to construct paddies to grow rice and because of unfavourable characteristics, few of these have been established. Expected water and plant nutrient losses would be high, the gravel, cobbles, and stones would interfere with cultivation. Deep ploughing is generally difficult because of gravel and stones in the lower horizons, but these have been removed in some areas. Small weir notch dams or similar structures will prevent erosion of paddy walls.

Barley and other winter crops grown during the winter-spring produce good yields. These soils when levelled into paddies will produce high yields of other summer crops as well as rice.

6.3.7 Paddy Suitability Group P4ac

The only soil in this group is moderately steep, moderately slowly permeable, medium textured, and has a very low water table. It covers about 763 ha or about 2. percent of the region.

It is:

Banho silt loam, 15 to 30 percent slopes.

Direct seeding and use of dryland nursery may be a reasonable way of planting rice on these soils. Deep ploughing and the application of calcium silicate are good management practices. Erosion of paddy walls would be lessened by building small weir dams or similar structures. Winter barley could be grown between rice crops and other summer crops could be grown instead of rice.

6.3.8 Paddy Suitability Group P4bc

The only soil in this group is a nearly level, coarse sandy soil with low available moisture capacity and a low water table. It has low clay content and low cation exchange capacity.

It is:

Hwangryong sandy loam, 0 to 2 percent slopes.

Flooding is a problem, with most damage from the fast moving water. The soil covers about 2,202 ha or about 2.9 percent of the area.

A good dependable water supply is needed, as the soil dries rapidly because of its low available moisture capacity. The water also takes with it dissolved plant nutrient. Fortunately, many areas are near good dependable water supplies, and the loss of water and plant nutrients can be lessened by applying clayey soils to the paddy.

Leaching of nitrogen fertilizer can be controlled by making several applications of small amounts during the growing season. Thick planting of rice is necessary as the plants do not form tillers readily when grown on this soil. Gravel and cobbles on the surface of some areas can be removed so that they will not interfere with rice culture.

Barley is grown after rice crops, but the yields are only moderate as these soils are 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 6

EXTENT OF MAPPING UNITS

Published Map Symbol	Soils	Extent (ha)	Percent
BcB	Bancheon silty clay loam, 2 to 7 percent slopes.	573	0.75
BcC2	Bancheon silty clay loam, 7 to 15 percent slopes, eroded.	250	0.33
BiB	Banggi clay loam, 2 to 7 percent slopes.	493	0.65
BiC	Banggi clay loam, 7 to 15 percent slopes.	190	0.25
BhC	Banho silt loam, 7 to 15 percent slopes.	250	0.33
BhD	Banho silt loam, 15 to 30 percent slopes.	1,763	2.34
BrE3	Bonggye rocky silty clay loam, 30 to 60 percent slopes, severely eroded.	360	0.48
DgC	Daegu rocky loam, 7 to 15 percent slopes.	2,913	3.86
DgC	Daegu rocky loam, 7 to 15 percent slopes, eroded.	163	0.22
DgD	Daegu rocky loam, 15 to 30 percent slopes.	3,812	5.05
DgD2	Daegu rocky loam, 15 to 30 percent slopes, eroded.	2,291	3.04
DgF	Daegu rocky loam, 30 to 60 percent slopes.	4,715	6.25
DgE2	Daegu rocky loam, 30 to 60 percent slopes, eroded.	3,107	4.12
DmD2	Daegu-Mudeung rocky complex, 15 to 30 percent slopes, eroded.	157	0.21

Published Map Symbol	Soils	Extent (ha)	Percent
IMD3	Daegu-Mudeung rocky complex, 15 to 30 percent slopes, severely eroded.	740	0.98
DME2	Daegu-Mudeung rocky complex, 30 to 50 percent slopes, eroded.	3,397	4.50
DME3	Daegu-Mudeung rocky complex, 30 to 60 percent slopes, severely eroded.	1,013	1.34
DVE2	Daegu-Mudeung very rocky complex, 30 to 60 percent slopes, eroded.	5,569	7.38
DSC2	Daegu-Sirye complex, 7 to 15 percent slopes, eroded	64	0.08
DRD2	Dalcheon-Samgag rocky complex, 15 to 30 percent slopes, eroded.	159	0.21
DRD3	Dalcheon-Samgag rocky complex, 15 to 30 percent slopes, severely eroded.	126	0.17
DRE2	Dalcheon-Samgag rocky complex, 30 to 60 percent slopes, eroded.	395	0.52
DRE3	Dalcheon-Samgag rocky complex, 30 to 60 percent slopes, severely eroded.	140	0.19
GaC2	Gaghwa cobbly loam, 7 to 15 percent slopes, eroded.	276	0.36
HbD2	Habin rocky loam, 15 to 30 percent slopes, eroded.	656	0.87
HbE2	Habin rocky loam, 30 to 60 percent slopes, eroded.	1,041	1.38
HgB	Hogye gravelly loam, 2 to 7 percent slopes.	917	1.22
Hn	Honam silty clay loam, 0 to 2 percent slopes.	2,301	3.05
HG	Honam-Geugrag complex, 0 to 2 percent slopes.	200	0.27
Hd	Hwadong silty clay loam, 0 to 2 percent slopes.	1,822	2.41
HdB	Hwadong silty clay loam, 2 to 7 percent slopes.	2,210	2.93
HBC	Hwadong-Bancheon complex, 7 to 15 percent slopes.	156	0.21

Published Map Symbol	Soils	Extent (ha)	Percent
Hy	Hwangryong sandy loam, 0 to 2 percent slopes.	2,202	2.92
Ih	Ihyeon silt loam, 0 to 2 percent slopes.	4,342	5.75
IwB	Iweon stony sandy loam, 2 to 7 percent slopes.	99	0.13
IwC	Iweon stony sandy loam, 7 to 15 percent slopes.	103	0.14
JwC	Jangweon gravelly loam, 7 to 15 percent slopes.	826	1.09
JwD	Jangweon gravelly loam, 15 to 30 percent slopes.	619	0.82
JME	Jangweon-Mudeung stony complex, 30 to 60 percent slopes.	64	0.08
MdD2	Mudeung rocky loam, 15 to 30 percent slopes, eroded.	248	0.38
MdD3	Mudeung rocky loam, 15 to 30 percent slopes, severely eroded.	357	0.47
MdE2	Mudeung rocky loam, 30 to 60 percent slopes, eroded.	1,610	2.14
MdE3	Mudeung rocky loam, 30 to 60 percent slopes, severely eroded.	340	0.45
MME	Mudeung-Mangsil rocky complex, 30 to 60 percent slopes.	190	0.25
Nd	Nagdong fine sandy loam, 0 to 2 percent slopes.	1,991	2.64
RS	Riverwash, sandy	1,078	1.43
RC	Riverwash, cobbly.	1,159	1.53
RL	Rock land	1,112	1.48
SmD2	Samgag rocky sandy loam, 15 to 30 percent slopes, eroded.	69	0.09
SmD3	Samgag rocky sandy loam, 15 to 30 percent slopes, severely eroded.	113	0.15

Published Map Symbol	Soils	Extent (ha)	Percent
SmD4	Samgag rocky sandy loam, 15 to 30 percent slopes, gullied.	324	0.43
SmE2	Samgag rocky sandy loam, 30 to 60 percent slopes, eroded.	876	1.16
SmE3	Samgag rocky sandy loam, 30 to 60 percent slopes, severely eroded.	909	1.21
SmE4	Samgag rocky sandy loam, 30 to 60 percent, gullied.	1,921	2.55
SgE4	Samgag soils, 30 to 60 percent, gullied.	3,711	4.91
Sh	Sinheung loam, 0 to 2 percent slopes.	396	0.52
SrB2	Sirye silty clay loam, 2 to 7 percent slopes, eroded.	68	0.09
ToB	Togye sandy loam, 2 to 7 percent slopes.	278	0.36
ToC	Togye sandy loam, 7 to 15 percent slopes.	759	1.01
ToD	Togye sandy loam, 15 to 30 percent slopes.	498	0.66
YuB	Yuga silty clay loam, 2 to 7 percent slopes.	4,862	6.44
	Water	471	0.62
	Other	1,652	2.19
Total		75,466 1/	100

1/ Revised area figure from 1967 Statistical Yearbook.

Appendix 1

GLOSSARY

Acidity: See reaction, soil.

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 diameter. 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 or 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 gently 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 metre or more; moderately deep – 50 cm to 1 metre; 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 places 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 millimetres 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
BcB	Bancheon silty clay loam, 2 to 7 percent slopes.	IIe	P2ac
BcC2	Bancheon silty clay loam, 7 to 15 percent slopes, eroded.	IIIe	P3ac
BiB	Banggi clay loam, 2 to 7 percent slopes.	IIIe	P2ac
BiC	Banggi clay loam, 7 to 15 percent slopes.	IIIe	P3ac
BhC	Banho loam, 7 to 15 percent slopes.	IIIe	P3ac
BhD	Banho loam, 15 to 30 percent slopes.	IVe	P4ac
BrE3	Bonggye rocky silty clay loam, 30 to 60 percent slopes, severely eroded.	VIIe	
DgC	Daegu rocky loam, 7 to 15 percent slopes.	VIe	
DgC2	Daegu rocky loam, 7 to 15 percent slopes, eroded.	VIe	
DgD	Daegu rocky loam, 15 to 30 percent slopes.	VIe	
DgD2	Daegu rocky loam, 15 to 30 percent slopes, eroded.	VIe	
DgE	Daegu rocky loam, 30 to 60 percent slopes.	VIIe	
DgE2	Daegu rocky loam, 30 to 60 percent slopes, eroded.	VIIe	
DMD2	Daegu-Mudeung rocky complex, 15 to 30 percent slopes, eroded.	VIe	
DMD3	Daegu-Mudeung rocky complex, 15 to 30 percent slopes, severely eroded.	VIIe	

Map Symbol	Mapping Unit	Capability Unit	Paddy Suit. Group
DME2	Daegu-Mudeung rocky complex, 30 to 60 percent slopes, eroded.	VIIe	
DME3	Daegu-Mudeung rocky complex, 30 to 60 percent slopes, severely eroded.	VIIe	
DVE2	Daegu-Mudeung very rocky complex, 30 to 60 percent slopes, eroded.	VIIe	
DSC2	Daegu-Sirye complex, 7 to 15 percent slopes, eroded.	IVe	
DRD2	Dalcheon-Samgag rocky complex, 15 to 30 percent slopes, eroded.	VIe	
DRD3	Dalcheon-Samgag rocky complex, 15 to 30 percent slopes, severely eroded.	VIIe	
DRE2	Dalcheon-Samgag rocky complex, 30 to 60 percent slopes, eroded.	VIe	
DRE3	Dalcheon-Samgag rocky complex, 30 to 60 percent slopes, severely eroded.	VIIe	
GaC2	Gaghwa cobbly loam, 7 to 15 percent slopes, eroded.	IIIe	P3ac
HbD2	Habin rocky loam, 15 to 30 percent slopes, eroded.	VIe	
HbE2	Habin rocky loam, 30 to 60 percent slopes, eroded.	VIe	
HgB	Hogye gravelly loam, 2 to 7 percent slopes.	IIs	P4abc
Hn	Honam silty clay loam, 0 to 2 percent slopes.	IIIw	P1
HG	Honam-Geugrag complex, 0 to 2 percent slopes.	IIIw	P1
Hd	Hwadong silty clay loam, 0 to 2 percent slopes.	I	P2c
HdB	Hwadong silty clay loam, 2 to 7 percent slopes.	IIe	P2ac

Map Symbol	Mapping Unit	Capability Unit	Paddy Suit. Group
HBC	Hwadong-Bancheon complex, 7 to 15 percent slopes.	IIe	P3ac
Hy	Hwangryong sandy loam, 0 to 2 percent slopes.	IVs	P4bc
Ih	Ihyeon silt loam, 0 to 2 percent slopes.	I	P2c
IwB	Iweon stony sandy loam, 2 to 7 percent slopes.	IIs	P4abc
IwC	Iweon stony sandy loam, 7 to 15 percent slopes.	IIIe	P4abc
JwC	Jangweon gravelly loam, 7 to 15 percent slopes.	IVe	P4abc
JwD	Jangweon gravelly loam, 15 to 30 percent slopes.	IVe	P4ac
JME	Jangweon-Mudeung complex, 30 to 60 percent and steeper slopes.	VIe	
MdD2	Mudeung rocky loam, 15 to 30 percent slopes, eroded.	VIe	
MdD3	Mudeung rocky loam, 15 to 30 percent slopes, severely eroded.	VIe	
MdE2	Mudeung rocky loam, 30 to 60 percent slopes, eroded.	VIe	
MdE3	Mudeung rocky loam, 30 to 60 percent slopes, severely eroded.	VIIe	
MME	Mudeung-Mangsil stony complex, 30 to 60 percent slopes.	VIe	
Nd	Nagdong fine sandy loam, 0 to 2 percent slopes.	IIIs	P4abc
Rs	Riverwash, sandy.		
RC	Riverwash, cobbly.		
RL	Rock land.		

Map Symbol	Mapping Unit	Capability Unit	Paddy Suit. Group
SmE2	Samgag rocky sandy loam, 30 to 60 percent slopes, eroded.	VIe	
SmE3	Samgag rocky sandy loam, 30 to 60 percent slopes, severely eroded.	VIIe	
SmF4	Samgag rocky sandy loam, 30 to 60 percent and steeper slopes, gullied.	VIIe	
SgE4	Samgag soils, 30 to 60 percent slopes, gullied.	VIIe	
Sh	Sinheung loam, 0 to 2 percent slopes.	IIw	P1
SrB2	Sirye silty clay loam, 2 to 7 percent slopes, eroded.	IIe	P2ac
ToB	Togye loamy coarse sand, 2 to 7 percent slopes.	IVs	P4abc
ToC	Togye loamy coarse sand, 7 to 15 percent slopes.	IVs	P4abc
ToD	Togye loamy coarse sand, 15 to 30 percent slopes.	IVe	
YuB	Yuga silty clay loam, 2 to 7 per-	IIw	P2a

GENERAL SOIL MAP of DAEGU SI & DALSEONG GUN