AGL:SF/KOR 13
Technical Report 4

SOIL SURVEY

REPUBLIC OF KOREA

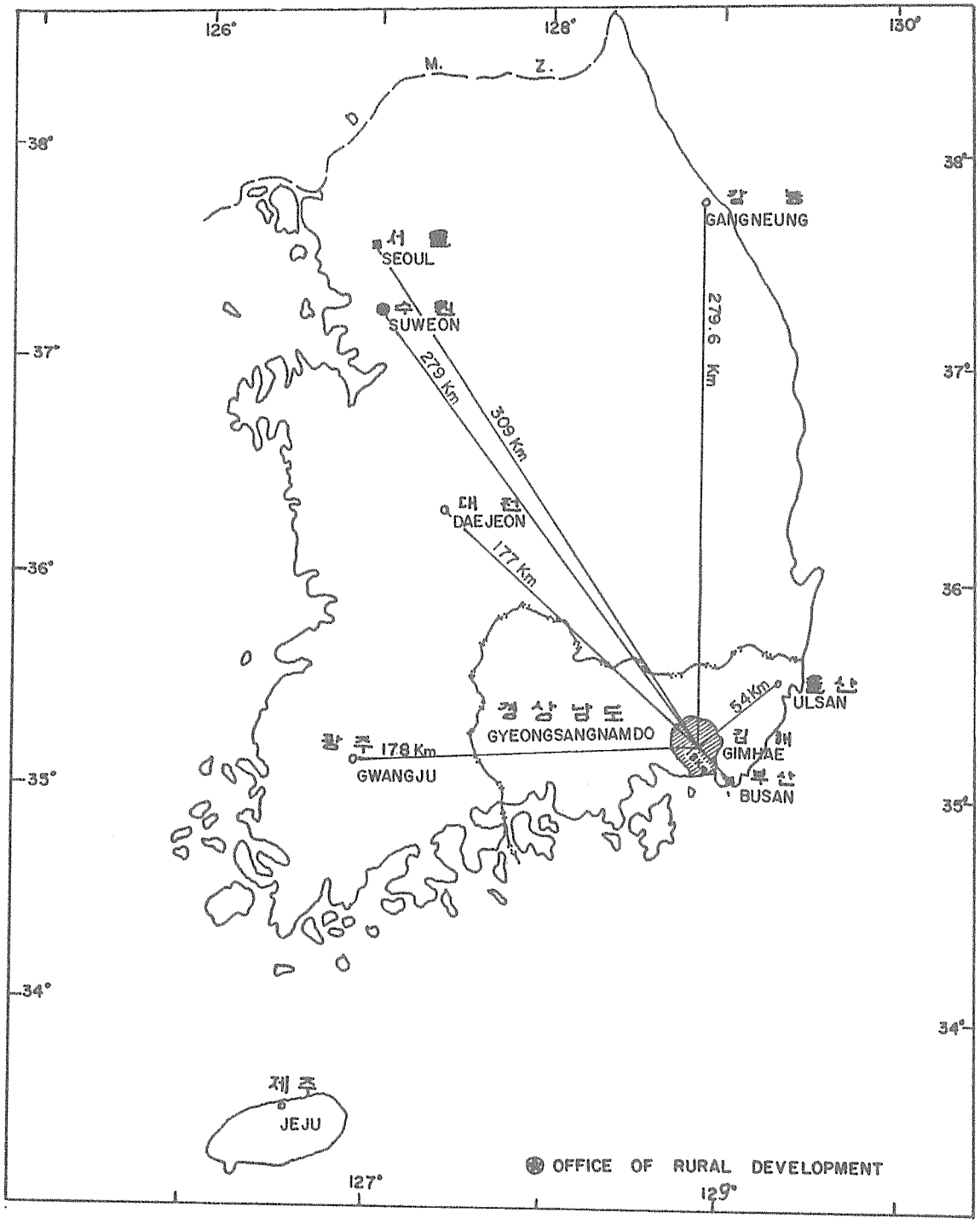
SOIL SURVEY IN GIMHAE GUN, GYEONGSANGNAM DO

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

SOIL SURVEY

REPUBLIC OF KOREA

LOCATION MAP OF GIMHAE GUN, GYEONGSANGNAM DO



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Technical Report 4

SOIL SURVEY

REPUBLIC OF KOREA

SOIL SURVEY IN GIMHAE GUN, GYEONGSANGNAM 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

This technical report is one of a series of reports prepared during the course of the UNDP/SF project identified on the title page. The conclusions and recommendations given in the report are those considered appropriate at the time of its preparation. They may be modified in the light of further knowledge gained at subsequent stages of the project.

FAO. Soil Survey, Republic of Korea. Soil Survey in Gimhae Gun, Gyeongsangnam Do. Rome, 1970. 84 p., 2 maps, 13 photographs. AGL:SF/KOR 13, Technical Report 4.

ABSTRACT

This report describes soil survey activities in Gimhae Gun, 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 (65,114 hectares) 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 80 percent of the cultivated land in the survey area (18,900 hectares of a total of 23,600) 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 (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 March 1968 and was completed in December 1968. It formed part of the Korea Soil Survey conducted by the Government of Korea with the assistance of the United Nations Special Fund The Food and Agriculture Organization of the United Nations was designated executing agency. The Government cooperating 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 including the reclamation and development of new lands for settlement, the improvement and conservation of lands according to their capabilities, the increasing of production, and overall economic development through appraisal of the soil resources.

For the Korea Soil Survey new research methods and new cartographic methods have been used for 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 survey work.

This report is an inventory of research findings, in maps and in writing, of soil and soil conditions in Gimhae Gun. It contains important information which will assist the Gun 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 nonagricultural uses.

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

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

The individual detailed Soil Survey Reports (Technical Reports 3-10) are each accompanied by a soil map at scale 1: 25,000.

Chapter 2

GENERAL DESCRIPTION OF THE AREA

2.1 LOCATION

Gimhae Gun is located in the extreme southern part of Gyeongsangnam Do 1/, between 128° 41' 40" and 129° 1' 8" east longitude, and 35° 03' 28" and 35° 23' 30" north latitude. The gun has an area of 65,114 hectares, (including 2,510 hectares of tidal flats) and measures 29 kilometres from east to west and 46.8 kilometres from north to south. It is bounded on the north by Milyang Gun, on the east by Yangsan Gun, on the south-east by Busan Si, on the west by Changweon Gun, and adjoins the South Sea on the south. In 1966, the population was 199,046. Gimhae Eub is the gun seat and located in the central part.

2.2 PHYSIOGRAPHY AND DRAINAGE

This gun has a compound topography that consists of steep mountain ranges in the north and south-west, and broad delta alluvial plains in the south and south-east. The elevation ranges from sea level in the coast line of the gun to 700 metres (Mucheogsan) in the north. This topography is a part of the relatively rugged and low mountain system descended southward from the terminal bases of Taebaeg Mountain System.

The Nagdong, Joman, Hwapo and Haeban Cheon rivers are the major drainage streams, the north and east being drained by the Nagdong River (forming the northern and eastern boundary), the west by the Hwapo River (flowing northward and joining the Nagdong River), and the centre and south by the Joman River and Haeban Cheon (flowing southward).

Precipitation generally is ample for crops, and comes mainly in the summer, the season when it is most needed. The Nagdong River, one of the five major rivers in Korea, is the main source of irrigation water for rice. (Approximately 10,000 hectares of paddy land are being irrigated by this water source.)

The Hwapo and Joman Rivers, and their tributaries, are also important water sources for rice. In addition there are many reservoirs, farm ponds, and dug wells throughout the area.

2.3 CLIMATE

The temperature is relatively high, being located at the extreme southern part of the inland district of the country. In the climate statistics of 1931 to

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1/ Alternative spellings for the areas are: Gyeongsang Nam Do, and Gyeongsang-namdo.

1960 the temperature averages about 13.8°C. It rises abruptly in April, and reaches 25.4°C in August, but drops suddenly in October, and gradually falls to 1.8°C in January. The average highest temperature of 32.9°C occurs in August of the summer season, and the average lowest temperature of -9.4°C occurs in January of the winter season.

The average annual precipitation is 1,384 mm, the summer of June to September having more than half of it. July has 247.6 mm which is the largest amount of monthly precipitation. This gradually decreases from October, January having only 25 mm which is the lowest amount of monthly precipitation.

Duration of sunshine is 2,471.4 hours, and evaporation is 1,378.9 mm. August has the longest duration of sunshine, and also has the largest amount of evaporation, while 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 21, and the last frost in the spring is March 8. Gimhae Gun's frost free growing season is about 239 days, among the longest in Korea except for Jeju Do. Average date of first snow is December 27, and the last snow is March 4. As can be expected, most of the soils are highly weathered, leached, strongly acid, and low in fertility.

Table 1

CLIMATIC DATA, GIMHAE GUN 1/

Months	Average Temperature (°C)			Average Humidity (%)	Precipitation (mm)	Evaporation (mm)	Sunlight hours
	Monthly	Daily Maximum	Daily Minimum				
Jan.	1.8	14.5	- 9.4	49	25.3	79.9	205.1
Feb.	3.5	15.0	- 7.2	52	44.1	80.2	190.0
Mar.	7.3	18.7	- 3.8	59	88.5	106.6	212.6
Apr.	12.5	22.7	- 3.4	66	113.5	125.0	218.7
May	16.7	26.0	9.8	71	139.3	143.3	241.0
June	19.8	28.3	13.4	80	197.5	129.3	195.7
July	23.7	31.6	17.1	85	247.6	134.3	183.0
Aug.	25.4	32.9	19.1	80	165.0	164.6	231.6
Sept.	21.6	30.2	14.3	74	205.1	123.5	181.5
Oct.	16.6	26.4	6.6	64	73.1	119.6	218.0
Nov.	11.1	22.4	- 0.8	59	43.9	91.2	195.8
Dec.	5.0	17.1	- 5.6	53	38.5	81.4	198.4
Annual	13.8	23.8	5.0	66	1,384.0	1,378.9	2,471.4

1/ Based on a 30 year record, 1931 through 1961, by the Korea Central Meteorological Observatory.

2.4 GEOLOGY

The surveyed area is made up of detrital and tuffaceous sediments belonging to the Silla series of Gyeongsang System, granitic rocks of Bulgugsa series, and andesite porphyry and felsophyre that intrude the above sediments.

The sedimentary rocks are not extensive in distribution as compared with the igneous rocks, and are classified into Chindong formation, Pallyongsan Tuffaceous and Green Breccia in ascending order. The andesitic rocks are also classified into Chusan Andesitic rocks and Dotaedong Andesite Porphyry. However, it seems that both these two andesitic rocks are differentiated by co-magnetic activity, and occur as intrusive masses and extrusive sheets.

The felsophyre which followed the andesitic rocks has also occurred as intrusive and effusive sheets like the andesitic rocks, and was intruded by granitic rocks of late Cretaceous series.

The granitic rocks are subdivided to gabbro, diorite, hornblende granite, biotite granite, masanite and aplite. However, they are closely related to each other structurally or petrographically. Quaternary alluvial deposits cover a relatively wide area of the southern part, forming fertile farm land.

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 are fine-textured igneous rocks which weather slowly, and soils with textures of loam, clay loam, silt loam, and silty clay loam are dominant over these. The coarse grained igneous rocks (granites) are less extensive in Gimhae Gun and have soils of mainly sandy loam textures, although there are some soils with finer textures developed over them.

The soils developed on the fluvio-marine plains have mainly very fine sandy loam, silt loam, and silty clay loam textures inherited mainly from the parent material. The Banggi and Jangyu soils on the stream terraces are gravelly because of the gravelly nature of their parent material. There are many other examples of correlation of the nature of parent material with the nature of the soil weathered in it.

2.5 AGRICULTURE

Farming is the most important enterprise in Gimhae Gun, 39 percent, or 23,700, hectares, being in farms. Rice is the most extensive crop. In 1966, 88 percent of the total land in use was cultivated for this purpose. The remaining farming area is used to grow soybeans and many other common crops.

The area in barley is also extensive, being grown in the winter-spring on most farms when about half the paddy land area is used.

Many farm households raise cattle and hogs as a secondary enterprise. In 1966, a total of 9,898 head of cattle and 11,908 head of hogs and pigs was reported. In the same year, the total number of chickens was 140,813. Most of the cattle are draft animals.

Chapter 3

HOW THE SURVEY WAS MADE

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

Spacing was much closer in the highly productive paddy lands than in the hilly and mountainous areas. There, stones, rock outcrops, gullies, and similar features are important indicators of kind of soil.

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

Soils that have profiles almost alike make up a soil series. All of one series have major horizons that are similar in thickness, arrangement, and other important common characteristics. Each series is named for a town or other geographic feature near the place where first observed or mapped. Bancheon and Banho, for example, are the names of two soil series in Gimhae Gun. These would have essentially the same characteristics as the Bancheon and Banho mapped in other areas.

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. As these differences are important in the use and management of the soils the soil series has been divided into mapping units. The Bonggye series, for example, is divided into mapping units based upon slope and also upon the presence of some cobbles. Thus, there are sloping, moderately steep, and steep mapping units of Bonggye soils with silty clay loam surfaces, as well as moderately steep and steep mapping units of Bonggye soils with cobbly silty clay loam textures.

There is also another difference between the series and the mapping unit. 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. It would of course be most desirable to have a map with these areas of other soils and areas of rock outcrop shown in their true occurrence, but this is not practical.

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

Chapter 4

DESCRIPTION OF THE GENERAL SOIL MAP

4.1 INTRODUCTION

The soils of Gimhae Gun occur in distinctive associations or general soil areas. The general soil map has been prepared to provide those not well acquainted with the nature of the soils with some introductory information.

The map is of little value to persons who wish information on a small farm or rice paddy. The detailed soil map and descriptions of soil series, mapping units, capability units, and paddy suitability groups provide the most detailed information for this purpose.

4.2 DEUNGGU-GIMHAE ASSOCIATION (Area 1)

(Nearly level, generally acid or saline soils of the fluvio-marine plains.)

This soil association covers about 20 percent of the gun on the fluvio-marine plain that was a tidal flat before being diked to prevent flooding. It is located in the southern part of the gun. Most of these soils have been reclaimed recently, with some areas being brought into cultivation as late as about 20 years ago.

The Deunggu series is about 25 percent of the area, the Gimhae 15 percent, the Buyong 12 percent, the Haecheog 10 percent, and the Bongrim series 5 percent.

Riverwash, river beds, water areas and a number of minor soils, including the Sadu and Nagdong series, make up the remainder. The soils, though originally salty and alkaline in reaction, have become very acid and much of the salt has been leached from the root zone. The texture is principally silt loam or light silty clay loam, but the Deunggu and the Haecheog soils have some strata of fine sand and very fine sand.

The water table is controlled by the operations of the drainage gates near Rogsan Ri. Though the water table is lower at some seasons, much of the time it is at or near the surface.

The high water table fits in well with the cropping pattern, which is mainly rice growing. Specialty vegetables are grown, including many large areas cropped in winter,using greenhouses made of bamboo poles and plastic sheeting. Large crops of scallions (onions), potatoes, cabbage, and other vegetables are grown on the minor soils. The city of Pusan is a big market for these products.

The principal problem for the present cropping system is the extreme acidity of the soil. Limestone is being used, but a lot is needed to keep the reaction of these soils in a favourable range. With improvements in drainage and liming a wide variety of crops could be grown.

4.3 MYEONGJI ASSOCIATION (Area 2)

(Nearly level, dark coloured sandy soils.)

This area, small and distinct, is about one percent of the gun, located in the southern tip at the mouth of the Nagdong River. The Myeongji series is the only major soil mapped in the area.

This is nearly level, dark coloured, well or moderately well drained sandy soil with many fragments of limey snail and sea shells. High quality crops of onions (scallions), potatoes, and cabbages are grown. Lack of water during the autumn, winter, and spring months often reduces yields. Special fertilization practices are needed because of low cation exchange capacity. But, through good management including irrigation, production from this soil can be increased.

4.4 GYUAM-HONAM ASSOCIATION (Area 3)

(Nearly level to gently sloping soils of the Nagdong River plain.)

This soil association is the Nagdong River flood plain, and is generally upstream from the area that is periodically inundated by sea water. It includes about 13 percent of the gun.

The sand along the river mapped as beach and riverwash, sandy, is adjacent to the Nagdong soils which are mainly fine sands deposited by the rapidly moving waters. The Nagdong soils grade into the Gyuam soils of coarse, moderately well drained, silt loam textures.

In some areas the river has deposited a mixture of sand, silt, and clay. These areas are the imperfectly drained Sinheung series. Back from the river in the flat flood plains are the fine clayey, poorly drained Honam soils. Also included on the map are sloping soils that lie between the flood plains and the mountains.

The Gyuam soils are the most extensive, covering about 30 percent of the general area, the Honam and Nagdong cover about 10 percent, and the Sinheung about 5 percent. Other soils, including the Banho, Gaghwa, Bancheon, and Hwadong, have the remaining 45 percent.

The Nagdong, and to a lesser extent the Gyuam and Sinheung soils, are cropped to vegetables of many kinds, including greenhouse crops grown in temporary plastic greenhouses. There are many orchards on the Nagdong soils producing high quality pears and apples. Most of the Honam are planted only to rice, also grown on the Sinheung and Gyuam soils. Barley is widely grown except on the Honam soils, usually too wet to produce this crop.

Additional drainage of the Honam would permit them to be planted to many crops other than just rice. Irrigation of general crops would increase yields on the Nagdong soils, offering good possibilities for vegetables and fruit to be marketed in Pusan.

4.5 HOGYE-JISAN ASSOCIATION (Area 4)

(Level to sloping soils of the small valleys.)

This soil association, consisting of small scattered valleys throughout the region (except for the Nagdong River plain and delta), makes up about 10 percent of the gun, with most areas consisting of an alluvial plain and alluvial slopes extending to the higher land on both sides.

The well drained Hwabong and Hwangryong soils are on larger flood plains in the more mountainous areas. Both of these soils are very sandy, the Hwangryong being gravelly as well. The Hogye, mainly in similar terrain, are dark coloured gravelly loam on alluvial slopes, and include many distinct alluvial fans.

The Jisan and Sachon soils are in the valleys of the less mountainous areas. The Jisan is poorly drained and adjacent to the small streams while the Sachon is on the alluvial slopes above the plains. The Hwabong, Hwangryong, and the Hogye tend also to dominate in the area of Mudeung, Taehwa, and Bonggye soils, while the Jisan and Sachon are mainly in the general areas of the Songjeong and Samgag.

The Jangyu soils are on the slightly elevated terraces mainly near creeks in the western part of the gun.

The Hogye is the most extensive soil covering about 25 percent of the area. Other important soils include: Jisan, 18 percent; Sachon, 15 percent; Jangyu, 12 percent; and Hwabong, 12 percent. Minor soils, including Gaghwa and Bancheon, comprise the remaining 18 percent.

Agriculture is varied, the wetter soils of finer texture such as the Sachon, Jisan, and Jangyu are mainly planted to rice and some barley, while the sandy soils are cropped to many vegetables and to barley.

Water brought to some areas would permit an increase in rice production, mainly on the Bancheon and Gaghwa soils.

4.6 BONGGYE-TAEHWA ASSOCIATION (Area 5)

(Sloping to steep, deep, and shallow soils of the hilly areas.)

This association of well drained soils developed over fine textured igneous rock is mainly in the north-western part of the gun, near Jinyeong Eub. Its area is about 13 percent. Most of the area is moderately steep but many of the soils occur on sloping or steep sites. The landscape includes rolling hills and mountains.

The Bonggye and Taehwa soils with thick clayey B horizons, are about 35 percent and 25 percent respectively of the area. The shallow Mudeung soils occupy about 20 percent. Minor soils include those of the Banho, Gaghwa, and Hogye series.

About one third of the land is planted to vegetable and grain crops such as barley. Large orchards of persimmon trees have been established and appear to be productive in the general area of Jinyeong Eub. However, much of the remainder is idle or covered with slow growing poorly shaped pine trees, and as the litter beneath the trees is raked for fuel there is little cover. Erosion is thus a severe problem on forest land and also on the cropped areas.

Many of these soils are capable of producing good yields of forage crops. The development of orchards where bench terracing has been practised appears to be profitable.

4.7 SAMGAG-SONGJEONG ASSOCIATION (Area 6)

(Moderately steep and steep, well drained, sandy and loamy soils overlying coarse textured igneous rock.)

This unextensive area is mainly north-east of Gimhae Eub, covering about 5 percent of the gun. It is hilly rather than mountainous, although there are a few steep slopes.

The Samgag soils cover about 60 percent of the area, the Songjeong about 30 percent of the area, and minor soils including soils of the Jisan and Yongji series cover the remaining 10 percent. The Songjeong have light silty clay loam or clay loam subsoils over sandy loam saprolite, while the Samgag are mainly sandy loam saprolite. Though the underlying rock is exposed as outcrop in places, the saprolite is usually more than three or four metres thick.

The lesser slopes of this area are planted to many kinds of vegetable crops, as well as some tobacco, but yields generally are sparse because of low fertility and lack of moisture. Erosion is a severe problem when these soils are cropped and contributes to the low productivity of many areas.

A thin growth of poorly shaped pine trees is usual. Surface trash is raked for fuel in much of the area, leaving an erosion problem as severe as that of the cultivated land.

This association has many areas suitable for development into forage crops. Other areas could produce good yields of woodland products if the woodland were properly managed.

4.8 MUDEUNG-ROCK LAND AREA (Area 7)

(Steep and very steep, shallow soils, rock outcrops and very stony lands.)

This soil association is mainly in the mountainous areas, in the north-east and south-west parts. It is the largest soil association (more than 35 percent of the total area) and includes the highest and steepest mountains. The shallow Mudeung soils are dominant and cover about 65 percent, some of which are made up of rocky and very rocky mapping units. Areas of Rock Land are numerous and cover about 20 percent. In the high valleys minor soils include the Sinbul, Hwangryong, and Hogye.

Forest or coarse grass, or a mixture of trees and grass, dominate, the forest being composed of a thin stand of poor quality trees. In contrast to the Samgag-Songjeong association area, this area does not appear to have a high erosion hazard. Coarse grass cut for fuel is the only product.

Areas of less sloping and less rocky soil could be developed for pasture but many areas are better suited to woodland. Forest planting and woodland management will be needed to establish cover.

Chapter 5

DESCRIPTION OF SOILS

5.1 INTRODUCTION

This chapter describes the soil series and mapping units of the Gimhae Gun. The series are described in general terms in the first part of the section. With the general descriptions are detailed descriptions of a typical profile representing each series.

Complete descriptions of the series are in Soils of Korea, Technical Report 1 (see Chapter 1). These include technical descriptions of typifying profiles, allowable ranges in characteristics and discussions of similar soils and environmental features.

The soil series is described first, followed by 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.

For 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 Groups and Paddy Land 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

The classes in the current system are briefly defined in the following paragraphs.

(1) Order. The orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxosols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. The exceptions, Entisols and Histosols, are in many different climates. Table 2 shows the five soil orders in this surveyed area, Ultisols, Alfisols, Inceptisols, Entisols, and Mollisols.

Ultisols are mineral soils that have distinct horizons and are commonly on old land surfaces. They contain a clay-enriched B horizon that has low base saturation. See Table 2 for soil series of this order.

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

Table 2

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

Series	Current Classification			1938 Classification
	Family	Subgroup	Order	Great Soil Group
Bancheon	Fine clayey	Typic Hapludalfs	Alfisol	Red-Yellow Podzolic
Banggi	Clayey skeletal	Typic Hapludalfs	Alfisol	Red-Yellow Podzolic
Banho	Fine loamy	Dystric Fluventic Eutrochrepts	Inceptisol	Alluvial
Bonggye	Fine clayey	Typic Hapludults	Ultisol	Red-Yellow Podzolic
Bongrim	Fine silty, acid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Buyong	Fine clayey, nonacid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Deunggu	Fine silty, acid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Gaghwa	Fine clayey	Typic Hapludults	Ultisol	Red-Yellow Podzolic
Gangdong	Fine loamy over sandy, nonacid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Gimhae	Fine silty, acid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Gwanghwal	Coarse silty, nonacid	Fluventic Haplaquents	Entisol	Saline Alluvial
Gyuam	Coarse silty	Aquic Fluventic Eutrochrepts	Inceptisol	Alluvial
Haecheog	Fine silty, acid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Hogye	Loamy skeletal	Fluventic Hapludolls	Mollisol	Alluvial
Honam	Fine clayey	Typic Ochraqualfs	Alfisol	Low-Humic Gley
Hwabong	Sandy	Typic Udipsamments	Entisols	Alluvial
Hwadong	Fine clayey	Aquic Hapludalfs	Alfisol	Red-Yellow Podzolic
Hwangryong	Sandy skeletal	Typic Udipsamments	Entisol	Alluvial
Ihyeon	Coarse silty	Dystric Fluventic Eutrochrepts	Inceptisol	Alluvial
Jangweon	Fine loamy	Typic Fragiochrepts	Inceptisol	Planosols
Jangyu	Loamy skeletal	Aquic Dystric Eutrochrepts	Inceptisol	Alluvial
Jeonbug	Fine silty, nonacid	Aeric Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Jisan	Fine loamy, nonacid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Mudeung	Fine loamy	Lithic Dystrochrepts	Inceptisol	Lithisol
Myeongji	Sandy	Aquic Fluventic Hapludolls	Mollisol	Alluvial
Nagdong	Sandy	Typic Udipsamments	Entisol	Alluvial
Sachon	Coarse loamy nonacid	Aeric Fluventic Haplaquepts	Inceptisol	Alluvial
Sadu	Sandy over loamy	Aquic Udipsamments	Entisol	Alluvial
Samgag	Coarse loamy	Typic Dystrochrepts	Inceptisol	Lithosols
Seogto	Loamy skeletal	Dystric Fluventic Eutrochrepts	Inceptisol	Regosols
Sinbul	Loamy skeletal	Typic Haplumbrepts	Inceptisol	Acid Brown Forest
Sindab	Sandy	Typic Psammaquents	Entisol	Alluvial
Sinheung	Fine loamy, nonacid	Aeric Fluventic Haplaquepts	Inceptisol	Low-Humic Gley Intergrading to Alluvial
Songjeong	Fine loamy	Typic Hapludults	Ultisol	Red-Yellow Podzolic
Sugye	Fine silty, acid	Fluventic Haplaquepts	Inceptisol	Low-Humic Gley
Taehwa	Fine loamy	Typic Hapludults	Ultisol	Red-Yellow Podzolic
Yongji	Fine loamy	Aquic Fluventic Eutorchrepts	Inceptisol	Alluvial-Red-Yellow Podzolic
Yuha	Fine silty	Typic Dystrochrepts	Inceptisol	Low-Humic Gley

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

Entisols are young mineral soils that do not have genetic horizon or have only the beginning of such horizons. Mollisols are mineral soils that have dark cloud surfaces with high organic matter content and high base saturation.

(2) Suborder. Each order is subdivided into suborders, primarily on the basis of soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders have a narrower climate range than the orders. The criteria for suborders chiefly reflect the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. Those properties are mineralogy, chemistry, degree of gleying, soil moisture, texture, and the presence or absence of accumulated soluble material. The suborder is not shown in Table 2.

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

(4) Subgroup. The subgroups are subdivisions of the great group, being defined in terms of reference to them. One of the subgroups represents the central concept of the great group, and others, called intergrades, have properties of one great group that is dominant and also weakly expressed properties of another great group, suborder, or order. Subgroups may also be made where there is some soil property unlike that of the great group, suborder, or order. The names of subgroups are derived by placing one or more adjective before the name of the great group. An example is:

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

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

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

5.2 BANCHEON SERIES

The Bancheon series, consisting of gently sloping, well drained soils formed in old alluvium on terraces and old pediplanes, commonly associated with the Banggi, Jangyu, and Hwadong series, is a member of the fine clayey family of Typic Hapludalfs. The surface, usually a ploughed layer, is brown, dark brown, dark yellowish brown, or strong brown silt loam, loam or silty clay loam.

The subsoil is yellowish brown to yellowish red heavy silty clay loam, silty clay, or heavy clay loam with a moderate, medium, subangular blocky structure. It is usually 1 to 2 metres thick.

The underlying material is yellowish brown to yellowish red clay loam or loam usually with some gravel.

A typical profile follows:

Ap—0 to 11 cm, dark yellowish brown (10YR 4/4) silt loam; moderate, fine granular structure; friable, slightly sticky, and slightly plastic; common, fine roots; clear, smooth boundary; pH 4.5.

B21t—11 to 45 cm, yellowish red (5YR 4/6) silty clay; moderate, coarse and medium subangular blocky; firm, sticky, and plastic; thin, continuous reddish brown (5YR 4/4) clay cutans; common, fine pores; clear, smooth boundary; pH 5.0.

B22t—46 to 75 cm; yellowish red (5YR 5/6-4/6) silty clay; moderate, coarse subangular blocky; firm, very sticky, and very plastic; clear, smooth boundary; pH 5.5.

B33t—75 to 110+ cm, yellowish red (5YR 5/6) silty clay; weak, medium subangular blocky; friable, sticky, and plastic.

These soils are moderate in natural fertility, low in organic matter and strongly acid. They have moderately high available moisture capacity and moderately slow permeability. The cation exchange capacity is medium to high and base saturation is high. All of the areas are in cultivated crops, with a few small areas used for paddy rice.

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

(Capability unit IIe; Paddy suitability group P2ac)

Most areas have profiles similar to the one described for the series.

This soil is suited for a wide range of crops, such as barley, wheat, red pepper, radish, potato, and soybeans. Irrigation water for rice production is available in a few areas. Erosion is a moderate problem when the soil is ploughed and planted to annual crops, but paddy systems, bench terraces, and contour cultivation are effective control methods.

5.3 BANGGI SERIES

These consist of gently sloping and sloping, deep, well drained, yellowish red soils on slightly dissected terraces, and are commonly associated with the Bancheon and Hwadong series. The series belongs to the clayey skeletal family of Typic Hapludalfs.

The ploughed layer is brown to dark brown silt loam, loam, silty clay loam, or clay loam. Areas that are commonly used for growing rice have grayish brown or dark grayish brown colours due to irrigation.

The subsoils are yellowish red, strong brown, yellowish brown, or reddish brown very gravelly clay loam or clay. The thickness is one to two metres.

The underlying material is yellowish red or strong brown very gravelly clay loam or loam. Hard rock, if present, is at a depth of more than two metres below the surface.

A typical profile follows:

Ap1—0 to 10 cm; grayish brown (10YR 5/2) light clay loam; few, fine, distinct strong brown (7.5YR 5/8) mottles; weak, medium and coarse granular structure; friable, slightly sticky, and slightly plastic; many, fine rice roots; clear, smooth boundary; pH 5.5.

Ap2—10 to 20 cm; brown to yellowish brown (10YR 5/3 to 5/4) silt loam to clay loam with many, fine, prominent yellowish red (5YR 5/6) mottles; weak, fine and medium subangular blocky structure; firm, sticky, and plastic; few, fine pores; few, fine rice roots; clear, smooth boundary; pH 6.0.

B21t—20 to 32 cm; mottled yellowish brown (10YR 5/4), strong brown (7.5YR 5/6), dark brown (7.5YR 3/2) gravelly heavy clay loam (15 percent gravel); crushed colour brown to strong brown (7.5 YR 5/4-5/6); weak, medium subangular blocky structure; firm, sticky, and very plastic; gradual, smooth boundary; pH 6.2.

B22t—32 to 80+ cm; yellowish red (5YR 4/6) very gravelly heavy clay loam (about 50 percent gravel); weak, medium subangular blocky; sticky and plastic; pH 6.5.

Natural fertility is moderate to moderately high, organic matter content moderately low, and strongly to medium acid. Available moisture capacity is moderate to low, cation exchange capacity medium, and base saturation high.

Most of the areas are in cultivated crops, with a few small areas being used for paddy rice. Some orchards have been established.

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

(Capability unit IIIe; Paddy suitability group P2ac)

Most areas have a profile as described for the series. However, there are included some areas that have little or no gravel in the profile, and a few small areas that are eroded, having gravelly clay loam surfaces.

These soils are used for a wide range of crops, including rice, barley, wheat, red pepper and soybeans. Some areas are in small pine trees. Erosion is a severe problem when this soil is planted to annual crops and it is the main management concern.

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

(Capability unit IIIe; Paddy suitability group P3ac)

The profile is similar to that described for the series. Included are patches that have loam, or gravelly clay loam surface layers, and a few small areas with little or no gravel in the profile.

These soils are used and well suited for a wide range of crops, including barley, wheat, red pepper, soybeans, and some rice where water is available. Erosion is a severe problem when upland crops are grown. Some areas are in pine trees. The main management concern is erosion control.

5.4 BANHO SERIES

The Banho series consistsof gently sloping, well drained, deep soils. It developed in alluvial-colluvial materials deposited on mountain foot slopes, and is commonly associated with the Seogto, Bonggye, and Yongji series. The series is a member of the fine loamy family of Dystric Fluventic Eutrochrepts.

These soils are brown, dark brown, strong brown, or yellowish brown gravelly loam or gravelly silt loam. The gravel content ranges from 10 to 30 percent. These is little differentiation of horizons other than the formation of a weak blocky structure below the ploughed layer. Hard rock, if present, is below three metres.

A typical profile follows:

Ap—0 to 12 cm; yellowish brown (10YR 5/4) gravelly loam; weak, fine to medium granular structure; friable, slightly sticky, and slightly plastic; common, fine barley roots; clear, smooth boundary; pH 4.7.

B21—12 to 60 cm; brown (10YR 5/3) moist, gravelly loam (gravel content 10 percent); weak, fine and medium subangular, breaking to granular structure; friable, sticky, and plastic; few, fine pores; few, fine roots; gradual, smooth boundary; pH 5.0.

B22—60 to 100+ cm; yellowish brown (10 YR 5/4) moist, gravelly loam (gravel content about 10 percent); moderate, fine to medium granular structure; pH 5.0.

Natural fertility is moderate while organic matter content is moderately high. These soils are strongly acid, have medium available moisture capacities, and are moderately permeable. The cation exchange capacity is moderately low, and base saturation is high. The soils respond well to good management including complete fertilization.

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

(Capability unit IIe; Paddy suitability group P2ac)

Most areas have a profile similar to that described for the series. Included are patches with a fine sandy loam surface layer, and a few small areas with greater slopes.

The plough layer is easily kept in good tilth, and it can be worked without clodding through a medium range of moisture content. The major management problem is erosion control. Removal of gravel is also necessary for easier cultivation.

These soils are suited to a wide range of crops including barley, wheat, pepper, radish, potatoes, and soybeans. Paddy rice will grow but irrigation water for this is not available in many areas.

5.5 BEACH AND RIVERWASH, SANDY (BRS)

(Capability unit VIII)

This unit occurs along the Nagdong river side and along the south coast. More than 90 percent is coarse to fine sand. Gravel and cobbles are sometimes mixed with sandy material. The unit is associated with recent alluvial soils.

Dykes are commonly constructed along the river to protect the arable land from flooding and to confine riverwash, sandy, to stream channels. Areas along the fresh water river provide a source of sand for construction purposes, and in the hot season areas of this unit adjacent to the South Sea are sometimes used for bathing and recreational purposes.

To prevent the loss of streambank and give economic return, poplar trees are grown in some places.

5.6 BONGGYE SERIES

These consist of rolling to steep, well drained, deep soils on hilly and mountainous areas underlain by deeply weathered fine textured acidic-crystalline rocks,(e.g. andesite porphyry), and are commonly associated with the Mudeung, Taehwa and Yuga series. The series is a member of the fine clayey family of Typic Hapludults.

The surface is brown, dark brown, dark yellowish brown, or light yellowish brown silt loam or silty clay loam.

The subsoil, about one metre thick, is yellowish red, red, reddish yellow, or reddish brown silty clay, clay, clay loam, or silty clay loam with a moderate, fine and medium subangular blocky structure.

The underlying material is a mottled reddish yellow, yellowish red or strong brown loam or silt loam with soft rock fragments. Hard rock is present at a depth of 120 cm to several metres.

A typical profile follows:

A1—0 to 8 cm; brown to dark brown (7.5YR 4/4), or reddish brown (5YR 4/4) silty clay loam; strong, fine granular structure; many, fine to medium roots; clear, smooth boundary; pH 4.5.

B1—8 to 25 cm; yellowish red (5YR 4/8) silty clay loam; weak, fine to medium subangular breaking to granular structure; friable, sticky, and plastic; thin, patchy clay cutans; common, fine to medium roots; clear, smooth boundary; pH 4.5.

B21t—25 to 57 cm; red (2.5YR 4/6) clay loam; moderate, medium to coarse subangular structure; firm, sticky, and plastic; thin, patchy clay cutans; common, fine pores; diffuse, smooth boundary; pH 5.0.

B22t—57 to 70 cm; red (2.5YR 4/8) clay loam; fine to medium subangular structure; firm, sticky, and plastic; thin, patchy clay cutans; common, fine pores; few, fine roots; clear, smooth boundary; pH 5.0.

B3—70 to 95 cm; mottled yellowish red (5YR 4/8), reddish yellow (5YR 7/6), red (2.5 YR 4/8) loam; crushed colour yellowish red (5YR 5/8); weak, coarse subangular blocky structure; friable, slightly sticky, and slightly plastic; gradual, smooth boundary; pH 5.4.

C—95 to 120+ cm; mottled, reddish yellow (5YR 7/6), black (5YR 2/1), yellowish red (5YR 5/6) loam; crushed colour brown to strong brown (7.5YR 5/4-5/6); slightly sticky and slightly plastic; pH 5.4.

These soils are moderately low in natural fertility, low in organic matter content, and strongly acid. They have moderate available moisture capacity, and moderate permeability. Cation exchange capacity is medium, and base saturation is low.

Pine forest mixed with alder and an understoreyof azalea predominates. Persimmon trees grow in some places and a few of the lesser slopes are planted to cultivated crops.

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

(Capability unit IIIe; Paddy suitability group P3ac)

The profile of most areas of this mapping unit is similar to the one described for the series. Included are a few small areas with lesser slopes.

The soil is suited to a wide range of crops, such as barley, wheat, soybean, potato, and sweet potato, but erosion is a severe problem when they are grown. The soil responds well to good management, especially fertilization.

Present vegetation consists of pine trees and persimmon. The main management concern is control of erosion and improvement of fertility.

5.6.2 Bonggye Silty Clay Loam, 15 to 30 Percent Slopes, Eroded (ByD2)

(Capability unit IVe; Paddy suitability group P4ac)

The profile is generally similar to the one described for the series. Included are patches that have limited depth to the underlying rock, and a few small areas with gullies.

Surface runoff is rapid, and erosion hazard is severe. This soil is well suited for pasture, and some annual crops may be grown if erosion losses are controlled. Present vegetation consists of pine trees and persimmon. Erosion is the main management problem.

5.6.3 Bonggye Silty Clay Loam, 30 to 60 Percent Slopes, Eroded (ByE2)

(Capability unit VI)

The profile is similar to the one described for the series. Included in areas mapped as this soil are patches that have shallow depth before rock, and some stony soils.

Runoff is very rapid, and erosion hazard is very severe.

Forest consisting of pine and alder with an understory of azalea is general. These soils are best suited to woodland, but when properly managed for grassland, moderate yields can be obtained.

5.6.4 Bonggye Cobbly Silty Clay Loam, 15 to 30 Percent Slopes, Eroded (BbD2)

(Capability unit IVe; Paddy suitability group P4ac)

The profile is similar to the one described for the series except that some cobbles are found on the surface. In this soil are included patches that have gravelly loam, gravelly silt loam surface layer, a few small areas with slopes ranging from 2 to 7 percent, and small areas of severely eroded soil.

Surface runoff is rapid, and erosion hazard severe. Most areas are in forest, which is suited. Erosion is the biggest management concern.

5.6.5 Bonggye Cobbly Silty Clay Loam, 30 to 60 Percent Slopes, Eroded (BbE2)

(Capability unit VIe)

Except for cobbles on the surface, most areas of this soil have a profile similar to the one described for the series. Some areas have silty clay loam, gravelly loam, gravelly clay loam surface layers. Gullies have been formed in other areas. Surface runoff is very rapid, and erosion hazard very severe.

The soil is best suited to woodland, and is mainly in pine. The main concern is the control of erosion. When well fertilized and managed, moderate yields of pasture may be obtained.

5.7 BONGRIM SERIES

The Bongrim series consists of level to nearly level, poorly drained, deep, gray to grayish brown, extremely acid soils developed in low lying broad fluvio-marine plains, once tidal flats but now protected from tidal flooding. The soils are associated with the Gimhae and Deunggu series, but are at slightly lower elevations than the former. The series is a member of the fine silty acid family of Fluventic Haplaquepts.

The upper 50 cm of this soil are grayish brown light silty clay loam with many or common mottles of higher chroma colours and some yellow streaks. The reaction is strongly to extremely acid. The yellow streaks are thought to be iron sulphate.

The underlying material is dark gray light silty clay loam without mottles. The reaction is alkaline.

A typical profile follows:

Ap—0 to 10 cm; grayish brown (2.5Y 5/2) silty clay loam with many medium to coarse, distinct strong brown (7.5YR 5/6) mottles; massive; sticky and plastic; many rice roots; clear, smooth boundary; pH 4.7.

B2—10 to 30 cm; grayish brown (2.5 Y 5/2) light silty clay loam; common, coarse prominent dusky red (2.5YR 3/2), few medium to fine prominent yellowish red (5YR 4/6), and common medium distinct yellow (10YR 7/6) mottles; massive; sticky and plastic; common, fine to medium holes; clear, smooth boundary; pH 4.9.

B3—30 to 48 cm; dark gray (5Y 4/1) light silty clay loam; few, medium to coarse distinct light olive brown (2.5 Y 5/4) mottles; massive; sticky and plastic; reed stems and roots; clear, smooth boundary; pH 5.0.

C—48 to 120+ cm; dark gray to very dark gray (5Y 4/1-3/1) light silty clay loam; no mottles; massive; common, very fine white and yellow mica; no reed; very few, fine shell; pH 8.0.

These soils are low or medium in natural fertility, and moderately high in organic matter content. The cation exchange capacity is medium, and base saturation high. Most areas are in rice paddy, and some parts in reeds.

5.7.1 Bongrim Silty Clay Loam, 0 to 1 Percent Slopes (Bm)

(Capability unit IIIwc; Paddy suitability group P3d)

The profile of this soil is similar to the one described for the series. Included are patches that have silt loam surface layers.

Because of the poor drainage and the very strong acidity, cultivation is poorly suited. Paddy rice can be grown, but its yields are low, for when the soil is drained for crop production, it becomes more acid. This is the result of oxidation of the sulphur compounds.

Much liming is needed to maintain a favourable neutral reaction, and it may be helpful to control drainage so the soil is covered with water as long as possible to control acidity. These soils should be frequently tested for reaction.

5.8 BUYONG SERIES

The Buyong series consists of level to nearly level, poorly drained, deep soils on broad fluvio-marine plains. It is commonly associated with the Deunggu and Jeonbug series, and is a member of the fine clayey nonacid family of Fluventic Haplaquepts.

The upper horizons, usually about 50 cm thick, are grayish brown, dark grayish brown silty clay loam to silty clay mottled with colours of higher chroma having a neutral reaction.

The lower horizons are gray or dark gray silty clay loam to silty clay with a few higher chroma mottles and are mildly alkaline.

A typical profile follows:

Ap1—0 to 12 cm; dark gray (10YR 4/1) silty loam with common, fine to medium, distinct brown to dark brown (10 YR 4/3) and few, fine, prominent strong brown (7.5YR 5/6) mottles; very weak, medium to fine granular and subangular blocky structure; friable, slightly sticky, and slightly plastic; many, fine rice roots; farmer added some coarse sand to improve tilth; abrupt, smooth boundary; pH 6.2.

B21g—12 to 24 cm; dark gray (5Y 4/1) silty clay loam with common, fine, prominent dark brown (7.5YR 3/2) mottled; moderate, coarse to medium subangular blocky structure; firm, sticky, and plastic; common, fine pores; clear, wavy boundary; pH 8.0.

B22g—24 to 32 cm; dark gray (5Y 4/1) heavy silty clay loam with common, fine, prominent dark brown (7.5 YR 3/2) mottles; moderate, medium prismatic structure; friable, sticky, and plastic; clear, smooth boundary; pH 8.0.

B23g—32 to 55 cm; dark gray to gray (5Y 4/1-5/1) heavy silty clay loam with many, fine to medium, prominent dark reddish brown (5YR 2/2) manganese mottles and hard concretions; moderate, medium to coarse subangular blocky structure; firm, sticky, and plastic; common, fine pores; clear, smooth boundary; pH 8.0.

B24g—55 to 85 cm; gray to dark gray (5Y 5/1-4/1) heavy silty clay loam with common, medium, prominent dark yellowish brown to yellowish brown (10YR 4/4-5/4) mottles; moderate, coarse prismatic structure; firm, sticky, and plastic; few, fine pores; clear, smooth boundary; pH 8.0.

Cg—85 to 120+cm; dark gray (5Y 4/1) silty clay loam with few, fine to medium, prominent strong brown (7.5 YR 5/6) mottles; structureless (massive); very sticky and very plastic; pH 8.0.

Natural fertility is moderately high and organic matter medium in content. There is high available moisture capacity. The cation exchange capacity is moderately high and base saturation is high. Paddy rice is generally grown.

5.8.1 Buyong Silty Clay Loam, 0 to 1 Percent Slopes (Bg)

(Capability unit IIIw; Paddy suitability group P1)

The profile described for the series is from this mapping unit. Included in areas mapped as this soil are patches that have silt loam, loam surface layer. The soil is suitable for paddy rice because of poor drainage.

It can also be planted to winter crops in the autumn after paddy rice harvest, if improved drainage is established. It responds well to good management, including complete fertilization.

5.9 DEUNGGU SERIES

This series consists of poorly drained, deep, gray to grayish brown soils developed in fluvio-marine materials on level to nearly level fluvio-marine plains, and is commonly associated with the Gimhae, Haecheog, Buyong, and Gyuam series. Most of these soils are in the southern part of the gun. The series is a member of the fine silty acid family of Fluventic Haplaquepts.

The ploughed layer is gray, grayish brown or live brown silty clay loam or silt loam with strong brown and yellowish red mottles. Beneath the ploughed layer, to a depth of about 50 cm, is gray, dark gray, light gray or dark grayish brown silty clay loam, silt loam, or loam with yellowish red, strong brown mottles.

The substratum is gray, dark gray, or bluish gray loam, silt loam, or fine sandy loam with yellow, yellowish red or strong brown mottles.

A typical profile follows:

Ap—0 to 10 cm; gray (5Y 5/1) silt loam with common, fine, prominent strong brown (7.5 YR 5/6) mottles; weak, fine to medium platy structure; friable, slightly sticky, and slightly plastic; common, fine pores; many, fine roots; abrupt, smooth boundary; pH 6.0.

A31—10 to 16 cm; gray (5Y 5/1) silt loam with common, fine, prominent yellowish red (5YR 5/6) mottles; weak, coarse platy structure; weak, coarse subangular blocky; abrupt, smooth boundary; pH 6.3.

B2g—16 to 25 cm; gray (5Y 5/1) silty clay loam with common, medium to fine, prominent strong brown (7.5YR 5/8) mottles; weak, coarse platy, breaking to weak, medium subangular blocky structure; firm, sticky, and plastic; common, fine pores; common, fine roots; clear, smooth boundary; pH 6.3.

B3g—25 to 45 cm; gray to dark gray (10YR 5/1-4/1) silt loam with many, fine to medium, prominent strong brown (7.5YR 5/6) mottles; crushed colour dark grayish brown (10YR 4/2); weak, coarse prismatic structure; firm, sticky, and plastic; thin, broken clay cutans; common, fine pores; clear, wavy boundary; pH 5.5.

C1g—45 to 120 cm; gray (10YR 5/1) silt loam to silty clay loam with many fine to medium, prominent dark reddish brown (5YR 2/2), strong brown (7.5YR 5/6), and yellow (10YR 8/6) mottles; massive; slightly sticky and slightly plastic; common, medium reed holes; many, very fine white mica; clear, smooth boundary; pH 5.5.

C2g—120 to 150 cm; dark gray (5Y 4/1) to bluish gray, very fine sandy loam with few, medium prominent dark brown (7.5 YR 3/2) mottles; many sea shells in lower part; pH 7.0.

These soils are very strongly acid, moderately high in natural fertility and medium in organic matter. They have moderate available moisture capacities. Cation exchange capacity is medium to high and base saturation is high. The soils are in rice paddy with some few areas being cultivated to other crops.

5.9.1 Deunggu Silty Clay Loam, 0 to 1 Percent Slopes (Du)

(Capability unit IIIwc; Paddy suitability group P3d)

The profile is generally as described for the series, except for the silty clay loam surface layer. Included are patches that have silt loam surface layers. The plough layer is generally in poor tilth, and can be worked without clodding only through a narrow range of moisture content.

Only rice is suited because of poor drainage, but the soil reaction of very strong acidity makes its yields moderate. The main management requirement is to treat the soil with lime.

5.9.2 Deunggu Silt Loam, 0 to 1 Percent Slopes (De)

(Capability unit IIIwc; Paddy suitability group P3d)

The profile is similar to the one described for the series. In areas mapped as this soil are patches that have fine sandy loam surface layers, and some areas that have a C horizon of sand or fine sand.

The plough layer is easily kept in good tilth and can be worked without clodding through a medium range of moisture content.

The soil is suited for rice and vegetables, and can be planted to barley during the winter-spring. Drainage is the main management problem if crops other than rice should be grown.

5.10 GAGHWA SERIES

The series consists of sloping to moderately steep, well drained, deep, yellowish red soils developed in colluvial slopes and terrace edges. These soils are commonly associated with the Bancheon, Banggi, Seogto, Jangyu, and Banho series. The Gaghwa is a member of the fine clayey family of Typic Hapludults.

The ploughed layer is a brown to dark brown cobbly silty clay loam or cobbly clay loam. Some areas have been cleared of cobbles.

The subsoil is dark reddish brown or yellowish red cobbly and gravelly clay or clay loam with subangular blocky structure. Small stones may also be present. This horizon is one to two metres thick.

The underlying material is similar to the subsoil but may contain more coarse fragments. Hard rock is more than two metres below the surface.

A typical profile follows:

Ap—0 to 8 cm; brown to dark brown to reddish brown (7.5YR 4/4–5YR 4/4) cobbly silty clay loam; moderate, fine and medium granular structure; many, fine roots; clear, smooth boundary; pH 5.5.

B11—8 to 30 cm; brown to dark brown (7.5YR 4/4) cobbly silty clay loam; weak, medium subangular blocky structure; friable, sticky, and plastic; common, fine pores; few, fine roots; clear, smooth boundary; pH 5.0.

B12—30 to 47 cm; dark reddish brown (5YR 3/4) cobbly silty clay loam; moderate, medium to fine subangular blocky structure; friable, sticky, and plastic; common, fine pores; few, fine roots; clear, smooth boundary; pH 5.0.

B2—47 to 65 cm; yellowish red (5YR 5/8) cobbly light silty clay; moderate, medium to fine subangular blocky structure; friable, sticky, and plastic; thin, continuous brown to dark brown (7.5YR 4/4) clay cutans; common, fine to very fine pores; clear, smooth boundary; pH 5.0.

BC—65 to 105+ cm; same as above, except 60 percent gravel; pH 4.9

These soils are low in natural fertility, moderately low in organic matter and strongly acid. They have high available moisture capacities, medium cation exchange capacity and low base saturation.

They are used for a wide range of crops including barley, sweet potato, sesame, radish, soybean, red pepper and mulberry. Some small areas of steeper slopes are in pine forest.

5.10.1 Gaghwa Cobbly Silty Clay Loam, 7 to 15 Percent Slopes, Eroded (GaC)

(Capability unit IIIe; Paddy suitability group P3ac)

Most areas have a profile as described for the series, but included are a few small areas with lesser slopes.

This soil is suited for cultivated crops, such as barley, wheat, sweet potato, soybean, and mulberry, or for pasture. The main management problem is erosion control. Complete fertilization and limestone are needed for highest yields.

5.10.2 Gaghwa Cobbly Silty Clay Loam, 15 to 30 Percent Slopes, Eroded (GaD)

(Capability unit IVe; Paddy suitability group P4ac)

Generally this soil has a profile as described for the series, but patches have been included of clay loam or loam surface layers.

It is suited to mulberry and pasture. The main management concern is erosion control. The soil responds well to good management, including complete fertilization.

5.11 GANGDONG SERIES

The Gangdong series of poorly drained, deep soils developed in nearly level to gently sloping alluvial plains and small valleys, is commonly associated with the Jisan, Sindab, and Sinheung series. It is a member of the fine loamy over sandy, non-acid family of Fluventic Haplaquepts.

The soil to a depth of about 80 to 100 centimetres is grayish brown, gray, or dark grayish brown loam or silt loam with yellowish brown, strong brown, or olive brown mottles. A moderate coarse prismatic structure is common in the lower part of this horizon.

Below this layer is gray or dark gray silt loam, loam, sandy loam, or strata of these textures without any mottles. Some thin strata of sand may also be present. In these profiles hard rock is not observed.

A typical profile follows:

Ap—0 to 10 cm; gray (5Y 5/1) loam; common, fine, prominent yellowish red (5YR 4/6) mottles; massive; slightly sticky and slightly plastic; many, fine roots; abrupt, smooth boundary; pH 5.0.

B21g—10 to 19 cm; gray (N5/) loam; few, medium and coarse, prominent strong brown (7.5YR 5/6) mottles; slightly sticky and slightly plastic; few, fine mica; common, fine root; abrupt, smooth boundary; pH 5.0.

B22g—19 to 45 cm; gray (N5/) loam; few, fine, prominent yellowish red (5YR 4/6) mottles; moderate, coarse prismatic structure; slightly sticky and slightly plastic; few, fine mica; few, fine roots; clear, smooth boundary; pH 6.5.

B23g—45 to 80 cm; gray (N5/) silty clay loam; few, very fine distinct light olive brown (2.5Y 5/4) mottles; sticky and plastic; abrupt, smooth boundary; pH 7.3.

C—80 to 120+ cm; dark gray (5Y 4/1) loamy fine sand structureless; slightly sticky and slightly plastic; pH 7.5.

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

5.11.1 Gangdong Loam, 0 to 2 Percent Slopes (Gd)

(Capability unit IIw; Paddy suitability group P2b)

Most areas have a profile similar to the one described for the series. Included are patches that have silty clay loam or clay loam surface layers.

This soil is well suited only to paddy rice, and the main management problem is its drainage for cultivation of other crops. Flooding is a severe problem on some areas where wild grasses and reeds now grow.

5.12 GIMHAE SERIES

The Gimhae series of level to nearly level, imperfectly drained, deep soils developed in broad fluvio-marine plains, is commonly associated with the Bongrim, Deunggu, Haecheog, and Buyong series. This series is a member of the fine silty acid family of Fluventic Haplaquepts.

The upper 50 centimetres of soil is gray to grayish brown light silty clay loam with common or many red, reddish brown or yellowish red mottles. Streaks or mottles of yellow are common, which are thought to be concentrations of iron sulphate.

The lower horizon is gray, dark gray or very dark gray light silty clay loam or silt loam with a few mottles.

Reaction is extremely acid in the upper profile. These soils appear to become more acid upon drying and pH values obtained by laboratory tests are lower than those obtained in field. Some laboratory pH values are as low as pH 3.6.

A typical profile follows:

Ap1—0 to 12 cm; gray (5Y 5/1) silty clay loam with few, fine, prominent strong brown (7.5YR 5/6) mottles; weak, medium to coarse, platy breaking to medium and coarse subangular blocky structure; friable, sticky, and plastic; clear, smooth boundary; pH 4.7.

B21g—12 to 26 cm; gray to grayish brown (10YR 5/1-5/2) silty clay loam; common, coarse prominent dark red (2.5YR 3/6), yellowish red (5YR 5/8), and many fine prominent dark red (2.5YR 3/6) mottles; crushed colour brown to grayish brown (10YR 5/3-5/2); weak, coarse platy structure; many, fine pores; clear, smooth boundary; pH 4.7.

B22g—26 to 41 cm; gray to grayish brown (10YR 5/1-5/2) silty clay loam; many, coarse, prominent dark reddish brown (5YR 3/4), common, medium to coarse distinct yellow (10YR 8/6) and few, medium, prominent dark reddish brown (5YR 3/2) mottles; massive; many, medium reed stems and roots; clear, smooth boundary; pH 4.5.

C1g—41 to 70 cm; dark gray (5Y 4/1) silty clay loam; few, medium prominent very pale brown to yellow (10YR 7/4-7/6) mottles; massive; sticky and plastic; many, fine reed roots and common, medium reed stems; clear, smooth boundary; pH 4.6.

C2g—70 to 100 cm; dark gray to very dark gray (5Y 4/1-3/1) silty clay loam; few, medium to coarse prominent brown (10YR 5/3) mottles; massive; sticky and plastic; common, very fine mica; clear, smooth boundary; pH 8.0.

C3g—100 to 150+ cm; dark gray to very dark gray (5Y 4/1-3/1) silt loam; no mottles; massive; many mica; pH 8.0.

These soils are moderately high in organic matter content, but fertility level is low due to an extremely acid reaction. They have high available moisture capacity, while the cation exchange capacity and base saturation are medium.

The soils are used principally for rice, better drained areas carrying barley and other crops.

5.12.1 Gimhae Silty Clay Loam, 0 to 1 Percent Slopes (Gh)

(Capability unit IIIwc; Paddy suitability group P3d)

The profile is generally as described for the series, with some patches that have silt loam surfaces. These soils are suited for rice, but productivity is low because of acidity. They become more acid as they are drained for crop production.

This, the result of oxidation of the sulphur compounds in the soil, requires much liming to maintain a favourable neutral reaction.

It may be helpful in managing these soils to control drainage so that they are flooded for as long as possible. This reduces the oxidation of sulphur compounds. They should also be tested frequently for reaction and lime material applied to maintain a neutral reaction of the surface layer. Rice is the best adapted crop.

5.13 GWANGHWAL SERIES

This consists of level to nearly level, poorly drained, deep soils with high salt content. The soils, formed in alluvial materials on coastal plains, are commonly associated with the Haecheog, Myeongji, Sadu, and Nagdong series. This series is a member of the coarse silty nonacid family of Fluventic Haplaquepts.

The upper 25 centimetres is gray, dark gray or very dark gray silt loam or very fine sandy loam with yellowish brown and strong brown mottles. The underlying material is gray or very dark gray, very fine sandy loam and silt loam, and has no mottles, or only a few.

A typical profile follows:

A1—0 to 5 cm; grayish brown (10YR 5/2) silt loam with common, fine, distinct gray (5Y 5/1) and strong brown (7.5 YR 5/6) mottles; clear, smooth boundary; pH 6.5.

Bg—5 to 25 cm; dark gray (5Y 4/1) silt loam with common, fine, distinct brown to dark brown (10YR 4/4) mottles; many, fine reed stems and roots; clear, smooth boundary; pH 7.0.

C1g—25 to 45 cm; dark gray (5Y 4/1) silt loam; many, fine reed stems and roots; abrupt, smooth boundary; pH 8.5.

C2g—45 to 120+ cm; dark gray (5Y 4/1) fine sandy loam to very fine sandy loam; pH 8.5.

The soils are moderately high in natural fertility, medium in organic matter content, and mildly to moderately alkaline. Reaction is nearly neutral in the surface and mildly alkaline in the subsoil. These soils appear to become more acid upon drying, and pH values obtained by the laboratory are lower than those obtained in field. Some laboratory pH values are as low as pH 6.3 to 6.7.

They are moderately high in available moisture capacity. Cation exchange capacity is medium, and base saturation is high. Free salts are common and all cultivated areas are in rice paddy.

5.13.1 Gwanghwal Silt Loam, 0 to 1 Percent Slopes (Gw)

(Capability unit IIIwc; Paddy suitability group P3d)

The profile is generally similar to the one described for the series, except that some areas have no salts.

Half of this unit area is in rice paddy, and half remains in reeds. The soil is suitable only for rice because of poor drainage. Yields are low due to excess salts which are injurious to growth. The main management problem is their removal, and the installation of a good drainage system would assist this.

5.14 GYUAM SERIES

This series consists of nearly level, moderately well drained, deep, yellowish brown to grayish brown soils developed in level to nearly level broad alluvial plains. It is commonly associated with the Ihyeon, Honam, Sinheung, Nagdong, and Deunggu series, and is a member of the coarse silty family of Aquic Fluventic Eutrochrepts.

The profile has silt loam or very fine sandy loam textures throughout. The ploughed layer is grayish brown, yellowish brown or dark gray or olive gray where the soil grows paddy rice.

Below the plough layer is a yellowish brown layer twenty to fifty centimetres thick, and below again the soil is gray of various shades.

A typical profile follows:

Ap1—0 to 13 cm; dark gray (5Y 4/1) silt loam; common, fine to medium, prominent yellowish red (5YR 5/6) mottles; weak, medium and fine granular structure; friable, slightly sticky, and slightly plastic; common, fine roots; clear, smooth boundary; pH 5.8.

C1—13 to 32 cm; yellowish brown (10YR 5/4) silt loam; common, fine, distinct brown to dark brown (7.5YR 4/4) mottles; common, fine, distinct dark brown (7.5YR 3/2) manganese mottles; weak, coarse platy structure; friable, slightly sticky, and slightly plastic; common, fine pores; few, fine roots; clear, wavy boundary; pH 6.5.

C2—32 to 53 cm; grayish brown to brown (10YR 5/2-5/3) silt loam; common, coarse, faint brown to dark brown (10YR 4/3) mottles; moderate, coarse prismatic structure; friable, slightly sticky, and slightly plastic; thick, continuous grayish brown (10YR 5/2) coatings; common, fine pores; few, medium worm hole and worm cast; clear, smooth boundary; pH 6.5.

C3—53 to 110 cm; grayish brown (10YR 5/2) silt loam; many, medium, faint brown to dark brown (10YR 4/3) mottles; weak, coarse prismatic structure; friable, slightly sticky, and slightly plastic; thin, broken grayish brown (10YR 5/2) coatings; few, fine pores; clear, smooth boundary; pH 6.8.

These soils are moderate in natural fertility, moderate in organic matter and medium to slightly acid, having high available moisture capacities. The cation exchange capacity is medium, and base saturation is high. Most areas are used for a wide range of cultivated crops including rice.

5.14.1 Gyuam Silt Loam, 0 to 2 Percent Slopes (Gy)

(Capability unit I; Paddy suitability group P2c)

The profile in most areas is similar to the one described for the series. Included are patches that have fine sandy loam, or silty clay loam surface layers.

These soils are suited for, and produce, high yields of a wide range of crops. The plough layer is easily kept in good tilth, and it can be worked without clodding through a medium range of moisture content. They respond well to good management including complete fertilization.

5.15 HAECHEOG SERIES

This series, consisting of level to nearly level, imperfectly drained, deep soils developed in fluvio-marine materials on fluvio-marine plains, is commonly associated with the Gimhae, the Deunggu, and the Myeongji series. It is a member of the fine silty acid family of Fluventic Haplaquepts.

Gray, dark gray, and grayish brown with yellowish brown or strong brown mottles dominate in these soils, but some yellow colours are present, which are thought to be from iron sulphate.

The textures are silty clay loam, silt loam, or fine sandy loam to a depth of 40 to 90 centimetres. Below this is loamy fine sand or fine sand.

The upper horizons are extremely acid, but the reaction changes abruptly to mildly alkaline in the lower horizons.

A typical profile follows:

Ap—0 to 7 cm; dark gray to dark grayish brown (10YR 4/1–4/2) silty clay loam; common, fine to medium, prominent yellowish brown (10 YR 5/6) mottles; weak, fine to medium granular structure; friable, sticky, and plastic; many, fine roots; gradual, smooth boundary; pH 5.8.

B21—7 to 15 cm; grayish brown (2.5Y 5/2) silty clay loam; common, fine to medium, prominent, strong brown to dark brown (7.5YR 5/6–4/4) and few, medium, faint yellow (2.5Y 8/6) mottles; weak, coarse blocky structure; clear, smooth boundary; pH 5.0.

BC—15 to 40 cm; gray (10YR 5/1) silty clay loam; many, coarse prominent, yellow (2.5Y 8/6) and many, coarse to medium, distinct brown to dark brown (10YR 4/3) mottles; massive; very sticky and very plastic; abrupt, smooth boundary; pH 4.5.

C2g—40 to 65 cm; dark gray (N4/) fine sandy loam; few, coarse, prominent yellowish brown (10YR 5/6) mottles; slightly sticky and slightly plastic; common, medium to coarse semi-decomposed reeds stem and roots; gradual, smooth boundary; pH 4.8.

C3g—65 to 150 cm; dark gray (N4/) fine sand loam; pH 8.0.

These soils are generally high to moderately high in natural fertility and medium in organic matter. They have medium available moisture capacities and are moderately permeable in the upper horizons but rapidly permeable in the lower. The cation exchange capacity is medium, and base saturation is medium to high. Most areas are in rice paddy.

5.15.1 Haecheog Silt Loam, 0 to 1 Percent Slopes (Hc)

(Capability unit III wc; Paddy suitability group P3d)

Most areas have a profile similar to that described for the series.

The soil is suited for paddy rice, but productivity is low because of very strong acidity. It becomes more acid when it is drained for crop production. This is the result of the oxidation of the sulphur compounds in the soil. Much liming is needed to maintain a favourable neutral reaction.

In managing this soil, using a water cover for as long as possible may reduce the oxidation of sulphur compounds.

The soils should be frequently tested for reaction, and lime material applied to maintain a neutral reaction of the surface layer.

5.16 HOGYE SERIES

The series consists of gently sloping to sloping, well drained, deep, dark coloured soils on alluvial fans and in small stream valleys, and is commonly associated with the Hwangryong series. It is a member of the loamy skeletal family of Fluventic Hapludolls.

The first 25 to 50 centimetres is a dark brown, very dark brown, or very dark grayish brown gravelly sandy loam, loam, or silt loam.

Below is a dark brown gravelly loam. The gravel content is from 35 to 80 percent, and cobbles are common in it.

A typical profile follows:

Ap—0 to 14 cm; dark brown (10YR 3/3) loam; moderate, fine granular structure; friable, slightly sticky, and slightly plastic; about 10 percent gravel; clear, smooth boundary; pH 6.0.

A12—14 to 31 cm; dark brown (10YR 3/3) gravelly loam; weak, coarse subangular blocky structure; friable, slightly sticky, and slightly plastic; common, fine pores; about 20 percent gravel; clear, smooth boundary; pH 5.5.

A13—31 to 48 cm; very dark grayish brown (10YR 3/2) gravelly heavy loam; weak, medium subangular blocky structure; friable, slightly sticky, and slightly plastic; common, fine pores; about 30 percent gravel; clear, smooth boundary; pH 5.5.

C1—48 to 67 cm; dark yellowish brown to dark brown (10YR 3/4-3/3) gravelly heavy silt loam; structureless; firm, slightly sticky, and slightly plastic; about 10 percent gravel; abrupt, smooth boundary; pH 5.5.

C2—67 to 100 cm; dark yellowish brown (10YR 4/4) gravelly loam; weak to moderate, coarse subangular blocky structure; firm, sticky, and plastic; thin broken brown to dark brown (10YR 4/3) cutan; clear, smooth boundary; pH 5.0.

C3—100 to 120 cm; brown to dark brown (7.5YR 4/4) loam; weak, coarse, subangular blocky structure; slightly sticky and plastic.

The soils are moderate in natural fertility, high in organic matter, and strongly to medium acid. They have medium available moisture capacities, medium cation exchange capacity, and high base saturation. They grow a wide range of crops, including barley, wheat, radish, soybean, potato, and red pepper. About half is cultivated to paddy rice.

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

(Capability unit IIs; Paddy suitability group P4abc)

Most areas have a profile similar to that described for the series. Included are patches that do not have gravel in the surface layers.

The soil is mostly cultivated and some nearly level areas are planted to paddy rice and winter grain crops, in two-crops-a-year-cropping system. It is well suited to most crops but paddy rice requires considerable irrigation because of high seepage losses. The removal of gravel from the plough layer will facilitate tillage, and improve crop yields.

5.16.2 Hogye Gravelly Loam, 7 to 15 Percent Slopes (HgC)

(Capability unit IIIe; Paddy suitability group P4abc)

The profile is generally similar to the one described for the series. Included are patches that have gravel-free loam surface layer.

This soil is usually planted to vegetable and grain crops other than paddy rice. Because of steep slopes and rapid permeability, paddy rice requires irrigation. Drought-resistant crops are best adapted to this soil. The main management problem is gravel removal.

5.17 HONAM SERIES

The series, consisting of level to nearly level, poorly drained, deep soils developed in alluvial materials on broad alluvial plains, is commonly associated with the Gyuam and Sinheung series. It is a member of the fine clayey family of Typic Ochraqualfs.

The ploughed layer is gray, grayish brown, or olive gray silt loam or silty clay loam with strong brown or yellowish brown mottles.

The subsoil is gray, dark gray, or grayish brown silty clay, silty clay loam, clay, or clay loam with strong brown, yellowish brown, or yellowish red mottles. This layer has coarse prismatic structure and is usually more than 80 centimetres thick.

The underlying strata are similar to the subsoil except in having no structure.

The upper horizons are usually strongly acid but the remainder of the profile is about neutral.

A typical profile follows:

Ap—0 to 10 cm; light brownish gray (10YR 6/2) silty clay loam with many, fine, distinct strong brown (7.5 YR 5/6) mottles; weak, fine granular and weak, coarse, subangular blocky structure; friable, sticky, and plastic; many, fine roots; clear, smooth boundary; pH 5.2.

B1—10 to 22 cm; light brownish gray (10YR 6/2) silty clay with many, fine, prominent strong brown (7.5 YR 5/8) mottles; weak, coarse subangular blocky structure; firm, sticky, and plastic; common, fine pores; clear, wavy boundary; pH 6.0.

B21—22 to 60 cm; grayish brown (10YR 5/2) silty clay loam with many, fine prominent yellowish red (5YR 5/8) mottles; strong, coarse prismatic structure; thick, continuous gray to light gray (10YR 6/1) clay cutans; common, fine pores; few, fine, reed stem; clear, smooth boundary; pH 6.0.

B22—60 to 74 cm; gray (10YR 5/1) silty clay with common, fine prominent yellowish red (5YR 5/8) mottles; strong, coarse prismatic structure; sticky and plastic; thick continuous gray to light gray (10YR 6/1) clay cutans; common, medium reed stem; clear, smooth boundary; pH 6.2.

B3g—74 to 100 cm; dark gray (5Y 4/1) silty clay with common, fine prominent red (2.5YR 4/8) and common, medium prominent strong brown (7.5YR 5/8) mottles; moderate, coarse prismatic; firm, very plastic, and very sticky; pH 7.0.

C1g—10 to 130 cm; very dark gray to dark gray (5Y 3/1 to 4/1) clay; very sticky and very plastic; pH 7.2.

These soils are moderately high in natural fertility, medium in organic matter, and have high available moisture capacity. The cation exchange capacity and saturation are high. The soil is mostly in rice paddy.

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

(Capability unit IIIw; Paddy suitability group P1)

Most areas of this soil have a profile much like the one described for the series. Included are patches that have silt loam or loam surface layer. The plough layer is generally in poor tilth, and can be worked only through a narrow range of moisture content without clodding.

Rice yields are high, but drainage is needed to grow other crops. It responds well to good management including complete fertilization.

5.18 HWABONG SERIES

The series consisting of somewhat excessively drained, deep soils developed in alluvial materials on level to nearly level flood plains adjacent to stream and river channels, is commonly associated with the Hwangryong, Nagdong and Sachon series. It is a member of the sandy family of Typic Udipsamments.

These soils consist of a thick deposit of light yellowish brown to dark yellowish brown or brown loamy sand or sand, usually with some fine gravel. The areas used for rice have grayish brown or light brownish gray mottles.

A typical profile follows:

Ap—0 to 9 cm; brown to yellowish brown (10YR 5/3 to 5/4) sandy loam; weak, fine granular; few, fine roots; abrupt, smooth boundary.

C1—9 to 40 cm; yellowish brown (10YR 5/4) loamy sand; single grain; abrupt, smooth boundary.

C2—40 to 100 cm; yellowish brown (10YR 5/6) to brownish yellow (10YR 6/6) coarse loamy sand.

These soils are low in natural fertility and organic matter content. Soil reaction ranges from medium acid to neutral, having a very low cation exchange capacity, with base saturation variable, but generally high. Available moisture capacity is low and the soils are rapidly permeable.

There are a wide range of crops, such as wheat, melons, and rice. Poplars grow in some places.

5.18.1 Hwabong Sandy Loam, 0 to 2 Percent Slopes (Hw)

(Capability unit IVs; Paddy suitability group P4bc)

Most areas have a profile as described for the series. Included are few small areas with poor drainage.

This soil is poorly suited for most crops but melons and peanuts grow well, as do poplar and mulberry trees.

5.19 HWADONG SERIES

The series, consisting of gently sloping, moderately well drained, deep soils developed in old alluvial materials on terraces, is commonly associated with the Bancheon, Banggi, and Jangyu series. It is a member of the fine clayey family of Aquic Hapludalfs.

The ploughed layer is brown to strong brown silty clay loam to clay loam. The upper subsoil is strong brown, yellowish red, or yellowish brown silty clay loam or silty clay.

The lower subsoil is similar to the upper but has grayish brown or gray mottles. In some profiles the gray colours are generally dominant. The subsoil extends to below one metre.

The underlying material usually has less clay than the lower subsoil but has about the same colours.

The areas used for rice culture have gray colours in the upper horizons.

A typical profile follows:

Ap—0 to 9 cm; gray (5Y 5/1) silt loam with common, fine to medium, prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) mottles; crushed colour grayish brown (2.5Y 5/2); massive; friable, sticky, and plastic; many, fine roots; clear, smooth boundary; pH 5.2.

B1—9 to 17 cm; gray (5Y 5/1) silty clay loam with common, fine to medium, distinct yellowish brown (10YR 5/8) mottles; weak, medium to coarse subangular blocky structure; firm, sticky, and plastic; few, fine pores; few, fine roots; clear, smooth boundary; pH 5.5.

B21t—17 to 29 cm; gray (5Y 5/1) silty clay loam; many, medium to coarse, prominent yellowish red (5YR 4/6) and common, fine to medium, prominent yellowish brown (10YR 5/6) mottles, crushed colour light olive brown (2.5Y 5/4); weak, medium to coarse subangular blocky structure; firm, sticky, and plastic; common, fine pores; few, fine roots; clear, smooth boundary; pH 6.0.

B22t—29 to 38 cm; mottled, strong brown (7.5YR 5/8), yellowish brown (10YR 5/8) silty clay loam; crushed colour yellowish brown (10YR 5/8); moderate, medium to coarse subangular blocky structure; thin broken grayish brown (10YR 4/2) clay cutans; common, fine pores; few, fine roots; clear, smooth boundary; pH 6.2.

B23t—38 to 52 cm; mottled, yellowish red (5YR 4/8), strong brown (7.5YR 5/8), gray to dark gray (10YR 5/1-4/1), very dark grayish brown (10YR 3/2) clay loam; crushed colour brown to dark brown (10YR 4/3); moderate, medium to coarse subangular blocky structure; thick, broken gray (10YR 5/1) clay cutans; common, fine pores; very few, fine rice roots; clear, smooth boundary; pH 6.5.

B24t—52 to 67 cm; mottled, dark reddish gray (5YR 4/2), reddish brown (2.5YR 4/4), gray (10YR 5/1), black (5YR 2/1) clay; crushed colour brown to dark brown (7.5YR 4/4); strong, medium subangular blocky structure; firm, very sticky, and very plastic; thick, continuous gray (10YR 5/1) clay cutans; abrupt, smooth boundary; pH 6.5.

B3—67 to 110 cm; yellowish red to strong brown (5YR 5/8-7.5YR 5/8) clay; common, fine, distinct black (5YR 2/1) manganese mottles; moderate, medium to coarse subangular blocky structure; firm, very sticky, and very plastic; thick, continuous gray (10YR 5/1) clay cutans; common, fine pores; abrupt, smooth boundary; pH 6.5.

The soils are moderate to high in natural fertility, moderate to low in organic matter content, strongly to slightly acid, with high available moisture capacities. The cation exchange capacity and base saturation are high. Rice, barley, and wheat, are the main crops.

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

(Capability unit IIe; Paddy suitability group P2ac)

Most areas have a profile as described for the series, with differences in some patches that have loam, silt loam, clay loam, or clay surface layers.

The soil is well suited for a wide range of crops including paddy rice and barley, and produces high yields when well fertilized and managed.

5.20 HWANGRYONG SERIES

The series consists of nearly level excessively drained, deep soils developed in alluvial materials on flood plains adjacent to stream or river channels, and commonly is associated with the Hwabong, Nagdong, Sindab, and Hogye series. It is a member of the sandy skeletal family of Typic Udipsamments.

The surface layer is yellowish brown, brown or light yellowish brown gravelly sandy loam, loamy sand or sand.

The substrata range from brownish yellow to very pale brown very gravelly to very cobbly loamy sand and sand.

Where used for rice paddy it is mottled with grayish brown and dark grayish brown. Most horizons contain 35 to 50 percent rounded gravel through the profile.

A typical profile follows:

Ap—0 to 20 cm; yellowish brown to dark yellowish brown (10YR 5/4 to 4/4) gravelly sandy loam; single grain; common, fine roots; gradual, smooth boundary; pH 5.6.

C1—20 to 47 cm; yellowish brown (10YR 5/4) gravelly loamy sand; weak, fine granular structure; nonsticky and nonplastic; clear, smooth boundary; pH 5.6.

C2—47 to 100+ cm; yellowish brown (10YR 5/4) gravelly coarse loamy sand (gravel content 40 percent); structureless; nonsticky and nonplastic; pH 5.7.

These soils are low in natural fertility and organic matter, and are strongly acid. They have low available moisture capacities, are rapidly permeable, low in cation exchange capacity and are variable in base saturation. A wide range of crops are grown, including orchard fruits, but due to lack of irrigation water, not paddy rice.

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

(Capability unit IVs; Paddy suitability group P4bc)

Most areas have a profile similar to the one described for the series. Included are: patches that have gravelly sandy loam or loam surface layers, a few small areas with slopes ranging from 2 to 7 percent and some areas of gravel-free soil.

This soil is poorly suitable for crops because of the low available moisture capacity, but well suited to poplar trees. Rice and other crops can be grown, but much water would be required for irrigation. Gravel and cobbles should be removed from the plough layer.

5.21 IHYEON SERIES

The series consists of nearly level, well drained, deep soils developed in broad alluvial plains, and is commonly in association with the Bonryang, Gyuam, and Nagdong series. Most of the soils in the gun are along the Nagdong River. The series is a member of the coarse silty family of Dystric Fluventic Eutrochrepts.

The profile consists of brown, dark yellowish brown, or dark brown silt loam or very fine sandy loam, to a depth of 100 centimetres. That used for rice culture has grayish brown or dark grayish brown colours in the upper horizons.

Below 100 centimetres strata of sandy textures are common. Hard rock is more than 3 metres below the surface.

A typical profile follows:

Ap1—0 to 11 cm; brown to dark brown (10YR 4/3) silt loam; common, fine, distinct strong brown (7.5YR 5/8) mottles; weak, fine and medium granular structure; friable, slightly sticky, and slightly plastic; common, fine roots; clear, smooth boundary; pH 5.5.

Ap2—11 to 20 cm; brown to dark brown (10YR 4/3) silt loam; common, fine faint dark yellowish brown (10YR 4/4) mottles; weak, moderate platy structure; firm, slightly sticky, and slightly plastic; few, fine pores; common, fine roots; clear, smooth boundary; pH 5.0.

B—20 to 79 cm; dark yellowish brown to yellowish brown (10YR 4/4-5/4) silt loam; weak, coarse subangular blocky structure; firm, slightly sticky, and slightly plastic; few, fine worm holes and worm cast; few, fine roots; clear, smooth boundary; pH 5.5.

C2—79 to 110 cm; dark yellowish brown (10YR 4/4-3/4) fine sandy loam stratified with very fine sandy loam, silt loam; massive; slightly sticky and slightly plastic; few, fine pores; pH 6.0.

C3—110 to 140 cm; dark yellowish brown (10YR 4/4) silt loam; massive; slightly sticky and slightly plastic; fine yellow and white mica in throughout the profiles.

These soils are high in natural fertility, medium in organic matter, and are medium to slightly acid. They have high available moisture capacities and are moderately permeable. The cation exchange capacity is medium, and base saturation high.

They are used for a wide range of crops including vegetable, potato, barley, and wheat, with some areas of good irrigation supply in paddy rice.

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

(Capability unit I; Paddy suitability P2c)

Most areas have a profile similar to the one described for the series, but patches that have loam, fine sandy loam, or silty clay loam textures have been included.

These soils are suited for a wide range of crops. The plough layer is easily kept in tilth and can be worked through a medium range of moisture content without clodding. All crops commonly grown produce high yields, and respond well to good management, including complete fertilization.

5.22 JANGWEON SERIES

This series of sloping and moderately steep, moderately well drained, deep soils developed in colluvial materials on foot slopes and fans, is commonly associated with Mudeung, Seogto, Gaghwa, and Banho series, and is a member of the fine loamy family of Typic Fragiochrepts.

The ploughed layer is yellowish brown, dark yellowish brown, or brown loam or silt loam with some cobbles and gravel.

The upper subsoil about 20 to 60 centimetres thick, is yellowish brown, dark yellowish brown or brown clay loam or silty clay loam with cobbles and gravel.

The lower subsoil is dense, compact, yellowish brown, brown, or strong brown gravelly to cobbly clay loam or silty clay loam. This layer extends below 120 centimetres.

A typical profile follows:

Ap1—0 to 12 cm; brown to dark brown (7.5YR 4/4) loam; moderate, fine, granular structure; friable, sticky, and plastic; many, fine roots; clear, smooth boundary; pH 5.2.

Ap2—12 to 26 cm; brown (7.5YR 5/4) clay loam with few gravel fragments; moderate, medium to coarse granular structure; friable, sticky, and plastic; clear, smooth boundary; pH 5.7.

B1—26 to 56 cm; grayish brown to brown (10YR 5/2-5/3) gravelly and cobbly loam; few, fine, distinct brown (7.5YR 5/4) mottles; weak, coarse to medium angular blocky breaking to granular structure; friable, sticky, and plastic; few, fine roots; clear, smooth boundary; pH 5.7.

B21—56 to 72 cm; pale brown (10YR 6/3) gravelly cobbly loam; few, fine, distinct brown (7.5YR 5/4) and few, fine, faint, very pale brown (10YR 7/4) mottles; moderate, medium, subangular blocky structure; firm, sticky, and plastic; few, very fine pores; abrupt, smooth boundary; pH 6.0.

B22—72 to 90 cm; pale brown (10YR 6/3) gravelly loam; common, medium, distinct, brown to strong brown (7.5YR 5/6) mottles and few, fine, prominent, dark reddish brown (5YR 3/2) manganese mottles and concretion and few, fine to medium dark brown (10YR 3/3) mottles; crushed colour light yellowish brown to brownish yellow (10YR 6/4-6/6); moderate, coarse platy breaking to moderate coarse angular blocky structure; firm, sticky, and plastic; few, fine pores; clear, wavy boundary; pH 6.2.

B23x—90 to 110+ cm; brown to dark brown (7.5YR 4/2-4/4) gravelly cobbly silt loam; few, medium, distinct strong brown (7.5YR 5/6), dark reddish brown (5YR 3/2), light brownish gray to pale brown (10YR 6/2-6/3) mottles; crushed colour brown to yellowish brown (7.5YR 5/4-10YR 5/4); firm, sticky, and plastic.

These soils are low in natural fertility and organic matter, and are strongly acid. They have low to medium available moisture capacity and are very slowly permeable in the lower subsoil. The cation exchange capacity is medium, and base saturation is high. About half is in forest, and half in cultivated crops.

5.22.1 Jangweon Gravelly Loam, 7 to 15 Percent Slopes (JwE)

(Capability unit IVe; Paddy suitability group P3ac)

The profile is similar to that described for the series. Included are: patches that have loam, silt loam, or stony loam surface layers (some patches have gray colours and high water tables), a few small areas with slopes ranging from 2 to 7 percent, and small areas of very cobbly to stony subsoil.

The soil is suited for barley, wheat, and red pepper. About 60 percent is in forest. Erosion is a severe problem when it is planted to annual crops without control practices. It is particularly harmful here as the fragipan layer is a poor medium for plant root growth.

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

(Capability unit IVe; Paddy suitability group P4ac)

The profile is similar to the one described for the series. Included are: patches that have loam, silt loam, stony surface layer, soils with gray colours and high water tables, and a few small areas with very cobbly subsoil.

About 80 percent is in forest, but is is also suited to grass, and legume crops. Control of erosion is the main management problem.

5.23 JANGYU SERIES

The series consists of gently sloping, moderately well drained, deep soils developed in old alluvium on terraces and fans, and is commonly associated with the Banggi, Bancheon and Hwadong series. It is a member of the loamy skeletal family of Aquic Dystric Eutrochrepts.

This soil has a dark grayish brown, grayish brown, or olive brown clay loam, silty clay loam, silt loam, or heavy loam plough layer.

The upper subsoil is yellowish brown, very gravelly clay loam mottled with gray colours. The lower subsoil is grayish brown very gravelly clay loam or sandy clay loam with yellowish red or strong brown mottles. The subsoil extends to a depth of 100 to 120 centimetres.

A typical profile follows:

Ap—0 to 11 cm; dark grayish brown (2.5Y 4/2) silty clay loam; common, fine, distinct yellowish brown (10YR 5/8) mottles; weak, fine granular structure; firm, sticky, and plastic; many, fine rice roots; clear, smooth boundary; pH 6.0.

B1—11 to 30 cm; dark grayish brown (2.5Y 4/2) silty clay loam; many, fine prominent red (2.5YR 5/8) mottles; moderate, medium and coarse subangular blocky structure; firm, sticky, and plastic; thin broken grayish brown (10YR 5/2) cutans; few, fine rice roots; clear, smooth boundary; pH 6.0.

B21—30 to 47 cm; grayish brown (10YR 5/2) gravelly clay loam; many, medium, distinct strong brown (7.5YR 5/8) mottles; moderate, medium and coarse subangular blocky structure; firm, sticky, and plastic; thin, continuous gray cutans; clear, smooth boundary; pH 6.5.

B22—47 to 68 cm; mottled, strong brown (7.5YR 5/8), grayish brown (10YR 5/2), dark reddish brown (5YR 3/2), gravelly clay (content 30 percent); crushed colour yellowish brown (10YR 5/6); strong coarse subangular blocky structure; thick continuous grayish brown (10YR 5/2) cutans; pH 6.5.

C—68 to 120+ cm; as above except 10 percent gravel; pH 6.5.

These soils are moderate to moderately high in natural fertility, moderate in organic matter, and slightly acid. They have low available moisture capacities. Cation exchange capacity is medium, and base saturation high.

Rice and barley are the main crops grown.

5.23.1 Jangyu Silty Clay Loam, 2 to 7 Percent Slopes (JuB)

(Capability unit IIIe; Paddy suitability group P2ac)

The profile described for the series is typical of most areas of this mapping unit. Included are patches that have loam, or silt loam surface layers, and a few small areas of greater slope.

The soil is suited for a wide range of crops, including rice and barley, responding well to good management, including complete fertilization. The main management problem is erosion control.

5.24 JEONBUG SERIES

The series consists of imperfectly drained, deep soils developed in fluvio-marine materials on level to nearly level broad fluvio-marine plains, and is commonly associated with the Buyong, and Deunggu series. It is a member of the fine silty, nonacid family of Aeric Fluventic Haplaquepts.

The upper layer, about 50 centimetres thick, is dark grayish brown, grayish brown or gray heavy silt loam or light silty clay loam with dark brown to yellowish brown mottles.

The middle layer has mixed colours of brownish yellow, brown, light to dark gray, or grayish brown. Textures are heavy silt loam or light silty clay loam. This layer extends to a depth of about 80 centimetres. Below, the colours are dominantly gray.

A typical profile follows:

Ap1—0 to 9 cm; grayish brown to dark grayish brown (2.5Y 5/2-4/2) heavy silt loam; common, fine to medium, prominent brown to dark brown (7.5YR 4/4) mottles; weak, medium platy; firm, sticky, and plastic; many, fine roots; clear, smooth boundary; pH 5.5.

B1g—9 to 16 cm; dark grayish brown to grayish brown (2.5Y 4/2-5/2) heavy silty loam; common, fine, distinct dark yellowish brown (10YR 4/4) mottles; weak, coarse prismatic; firm, sticky, and plastic; common, fine roots; abrupt, slightly wavy boundary; pH 5.7.

B21g—16 to 39 cm; gray (5Y 5/1) silty clay loam; common, fine, prominent brown to dark brown (10YR 4/3) mottles; moderate, coarse prismatic; firm, sticky, and plastic; thin, continuous gray cutans; common fine pores; clear, smooth boundary; pH 6.8.

B22g—39 to 52 cm; gray (10YR 5/1) silty clay loam; few, fine, prominent dark reddish brown (5YR 3/4) mottles; along the vertical roots channel; moderate, coarse prismatic; firm, sticky, and plastic; thick, continuous light gray to gray (10YR 6/1) cutans; common, fine pores; clear, smooth boundary; pH 6.8.

B23g—52 to 80 cm; mottled gray (10YR 5/1), brownish yellow (10YR 6/6) clay loam; crushed colour dark yellowish brown (10YR 4/4); moderate, coarse prismatic; firm, sticky and plastic; thick continuous light gray to gray (10YR 6/1) cutans; common, fine pores; abrupt, smooth boundary; pH 6.5.

B24g—80 to 95 cm; very dark gray (N3/) silty clay loam with common, medium to coarse, distinct olive (5Y 4/4) mottles; weak, coarse prismatic; sticky and plastic; thin continuous dark gray (5Y 3/1) cutans; clear, smooth boundary; pH 7.0.

The soils are high in natural fertility, moderate to moderately high in organic matter content, and medium to slightly acid. They have high available moisture capacity and are moderately permeable. The cation exchange capacity is medium, and base saturation is high. Rice paddy, and barley in winter, are the main crops.

5.24.1 Jeonbug Silt Loam, 0 to 1 Percent Slopes (Jb)

(Capability unit IIw; Paddy suitability group P1)

The profile described for the series is typical of this mapping unit. Included in areas mapped as this soil are patches that have silty clay loam, clay loam, or loam surface layer.

It is suited for rice, produces high yields, and can be planted to winter crops like barley or wheat, if improved drainage is established. It responds well to good management, including complete fertilization. With improved drainage many crops other than rice may be grown.

5.25 JISAN SERIES

This series, consisting of poorly drained, deep soils developed in alluvial material on gently sloping to sloping narrow valleys, is commonly associated with the Yongji, Sachon, and Banho series. Most of these soils are in the small valleys throughout the gun. This series is a member of the fine loamy nonacid family of Fluventic Haplaquepts.

The soils are gray, dark gray or dark grayish brown heavy loam or clay loam with yellowish red to yellowish brown mottles. This material commonly extends to a depth of more than 3 metres.

A typical profile follows:

Ap—0 to 9 cm; gray to light gray (5Y 6/1) silt loam; common, fine prominent strong brown (7.5YR 5/6) mottles; weak, fine granular structure; friable, slightly sticky, and slightly plastic; many, fine roots; clear, smooth boundary; pH 4.8.

B1g—9 to 22 cm; gray (5Y 5/1) loam; common, fine to medium prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/8) mottles; weak, medium to coarse subangular blocky structure; firm, sticky, and plastic; common, fine roots; clear, wavy boundary; pH 5.3.

B21g—22 to 55 cm; gray (5Y 5/1) loam; common, fine prominent strong brown (7.5YR 5/6) mottles; moderate, coarse prismatic structure; firm, sticky, and plastic; thin continuous light gray to gray (10YR 6/1) cutans; common, fine pores; few, fine roots; clear, smooth boundary; pH 6.5.

B22g—55 to 76 cm; dark gray (10YR 4/1) loam; common, fine, faint yellowish brown (10YR 5/6) and few fine distinct dark brown (7.5YR 3/2) manganese mottles; crushed colour dark brown (10YR 3/3); moderate, coarse prismatic structure; firm, sticky, and plastic; thick continuous gray (10YR 5/1) cutans; common, fine pores; few, fine roots.

B23g—76 to 105 cm; dark gray (10YR 4/1) loam; many medium fine to coarse distinct strong brown (7.5YR 5/8) mottles.

Cg—105+ cm; gravelly to cobbly loam.

These soils are moderate to moderately high in natural fertility, moderately low in organic matter content, and medium acid to neutral. They have high available moisture capacity and are moderately permeable. The cation exchange capacity is medium and base saturation is high. Rice paddy predominates.

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

(Capability unit IIw; Paddy suitability group P2a)

This soil generally has a profile similar to that described for the series. Included are patches that have silt loam, silty clay loam or clay loam surface layer.

Because of poor drainage, only paddy rice grows, yields being moderately high. However, winter crops would grow in the autumn after harvest of paddy rice, if improved drainage were established.

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

(Capability unit IIIe; Paddy suitability group P3a)

The profile is as described for the series, but patches that have a silt loam, or silty clay loam surface layer are included.

This soil is generally suited to paddy rice and other crops if adequately drained. With good drainage established winter grain crops could be grown, following the summer paddy rice.

An additional management problem is erosion control, but not in the well constructed rice paddy.

5.26 MUDEUNG SERIES

The series consists of moderately to very steep somewhat excessively drained, shallow soils developed in residuum on mountainous areas. They are underlained by porphyry, andesite-prophyry, porphyrites, and granitic material, and are commonly associated with the Bonggye, Jangweon, Gaghwa, and Seogto series. Most of these soils are in the mountainous areas throughout the gun. This series is a member of the fine loamy family of Lithic Dystrochrepts.

The surface layer, about 10 to 20 centimetres thick, is brown to dark brown, dark yellowish brown or yellowish brown gravelly silt loam, loam, or very fine sandy loam with a granular structure. Beneath this horizon is a thin layer of similar material but with blocky structure. Hard rock is present within 50 centimetres from the surface.

A typical profile follows:

A11—0 to 15 cm; brown to dark brown (10YR 4/3) loam; moderate, fine granular structure; friable, slightly sticky, and slightly plastic; many, fine roots; clear, smooth boundary; pH 5.7.

B12—15 go 27 cm; brown to dark brown (10YR 4/3) gravelly silt loam; weak, fine to medium subangular structure; friable, slightly sticky, and slightly plastic; common, fine roots; abrupt, smooth boundary.

R—27+ cm; bedrock.

These soils are low in natural fertility, medium in organic matter, and strongly to medium acid. They have low available moisture capacities and are moderately permeable. The cation exchange capacity is medium, and base saturation, low. Forest is general with some small areas of lesser slopes in cultivated crops.

5.26.1 Mudeung Rocky Loam, 15 to 30 Percent Slopes (MdD)

(Capability unit VIe)

Most areas can have up to 20 percent rock outcrops. Between these most soils have a profile that is similar to that described for the series.

This soil is well suited for pasture or woodland. Moderate amounts of grazing can be obtained from this soil when it is well managed for grassland.

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

(Capability unit VIe)

This soil commonly has from 10 to 30 percent rock outcrop. The soil between has a profile much like that described for the series, but on the lower slopes it is often thicker.

Low to moderate yields of grazing can be obtained with good management. If not used for pasture, this soil is suited only for woodland.

5.26.3 Mudeung Rocky Loam, 60 to 100 Percent Slopes (MdF)

(Capability unit VII e)

About 10 to 30 percent of this unit is rock outcrops, the soil between having a profile similar to the one described for the series.

This soil is suited only for woodland. Fair to moderate yields of woodland products can be obtained when well managed.

5.26.4 Mudeung Very Rocky Loam, 30 to 60 Percent Slopes (MvE)

(Capability unit VIIe)

Thirty to fifty percent of this unit is rock outcrop or stony material ordinarily without plants. The soil between the rock outcrops and very stony areas has a profile similar to that described for the series.

Even when well managed this soil will produce only small amounts of woodland products.

5.26.5 Mudeung Very Rocky Loam, 60 to 100 Percent Slopes (MvF)

(Capability unit VIIe)

Thirty to fifty percent of this unit area is rock outcrop or such stony soil that plants do not grow. The remainder of the area has a profile similar to that described for the series.

The soil is suited for woodland and only low returns can be expected even when it is well managed.

5.27 MYEONGJI SERIES

The Myeongji series, consisting of level, moderately well drained, deep soils developed in alluvial material on deltas and marine plains is commonly associated with the Haecheog series and Tidal flat. It is a member of the sandy family of Aquic Fluventic Hapludolls.

The surface layer ranges from 30-60 centimetres in thickness, and is very dark grayish brown, very dark gray, very dark brown or dark brown loamy sand or sandy loam with sea shells.

The C horizon is variable in colour, and is brown, olive brown, pale brown, brownish yellow or light gray sand or loamy sand with sea shells. The soil depth ranges from 200-300 centimetres.

A typical profile follows:

Ap1—0 to 15 cm; very dark grayish brown (10YR 3/2) loamy sand; single grain; friable, nonsticky, and nonplastic; few shells; fine, spinach roots; gradual, smooth boundary; pH 8.0.

Ap2—15 to 40 cm; very dark gray to very dark grayish brown (10YR 3/1 to 3/2) sand; single grain; friable, nonsticky, and nonplastic; few, fine roots; common white shells; abrupt, smooth boundary; pH 8.0.

C1—40 to 68 cm; mottled, very pale brown (10YR 7/4), brownish yellow (10YR 6/8), olive brown (2.5Y 4/4) fine sand; crushed colour yellowish brown (10 YR 5/4); single grain; friable, nonsticky, and nonplastic; clear, wavy boundary; pH 8.0.

C2—68 to 110 cm; light brownish gray (2.5Y 6/2) fine sand; pH 8.0.

These soils are moderately low in natural fertility, low to medium in organic matter content, and neutral to mildly alkaline. They have high phosphate content, and low available moisture capacities. The cation exchange capacity is low, and base saturation is high. Most areas are in cultivated crops, with a few small areas in rice paddy.

5.27.1 Myeongji Loamy Fine Sand, 0 to 2 Percent Slopes (My)

(Capability unit IIIs; Paddy suitability group P4bc)

Most areas have a profile similar to the one described for the series, but some areas lack gray colours in the lower horizons. Included, however, are patches of sandy loam or fine sandy loam.

This soil is suited for a limited range of crops, such as onion, cabbage, spinach, melons, and peanut. Apple, pear, and mulberry also grow well.

The low available moisture capacity is the main management problem. The soil responds well to good management, including complete fertilization.

5.28 NAGDONG SERIES

The Nagdong series, consisting of nearly level, somewhat excessively drained, deep soils developed in alluvial materials on flood plains adjacent to the Nagdong River channel, is commonly associated with the Ihyeon, Gyuam, and Sinheung series and Riverwash Sand. This series is a member of the sandy family of Typic Udipsamments.

The soil is a thick deposit of yellowish brown, brown to very pale brown, loamy fine sand or fine sand without distinctive horizons, but a thin strata of sandy loam or silt loam may be present. The depth of hard rock is more than 5 metres.

A typical profile follows:

Ap—0 to 24 cm; yellowish brown (10YR 5/6) loamy fine sand, single grain; nonsticky and nonplastic; many, fine white mica; abrupt, smooth boundary; pH 5.0.

C1—24 to 60 cm; pale brown (10YR 6/3) fine sand; single grain; friable, nonsticky, and nonplastic; gradual, smooth boundary; pH 5.5.

C2—60 to 120 cm; very pale brown (10YR 7/3) fine sand; single grain; friable, nonsticky, and nonplastic.

These soils are low in natural fertility and organic matter, and are strongly acid to neutral. They have low available moisture capacities and are rapidly permeable. The cation exchange capacity is very low, and base saturation is medium. The soils are used for many kinds of crops, but only crops tolerant to sandy soils grow well.

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

(Capability unit IIIs; Paddy suitability group P4bc)

Most areas have profiles similar to the series but many profiles have coarse sand strata, with a few having profiles with sandy loam and loam strata, or gray colours and poor drainage.

These soils are suited for peanuts , rye, sorghum, buckwheat, and many kinds of vegetables and melons. The main management concerns are selection of adapted crops and increasing the fertility. A few areas are used for rice. Irrigation would increase yields of most crops grown.

5.29 RIVERWASH, COBBLY (RC)

(Capability Unit VIII)

This unit is mapped along the Nagdong river. More than 90 percent of the total area is composed of gravel and cobbles, the rest being made up of coarse sandy beach and sandy riverwash. The gravel and cobbles are mainly granite and andesite porphyry. Many dykes have been constructed to protect the arable land from flooding and to confine river wash, cobbly, to the stream channels. When cobbles and sand are deposited by flood water, the soil is adversely affected. Small areas of other soils, mostly sandy, stony, or rocky, are included because they could not be shown separately on the map.

The materials are sometimes used for construction purposes, such as road fill and subgrade. In some areas they are sources of sand and gravel for the preparation of concrete for dam and bridge constructions. Poplar trees are grown to a limited extent.

5.30 SACHON SERIES

The Sachon series, consisting of gently sloping and sloping, moderately well drained, deep soils developed in alluvial materials in narrow valleys, fans and footslopes, is commonly associated with the Jisan, Yongji, and Samgag series. It is a member of the coarse loamy nonacid family of Aeric Fluventic Haplaquepts.

The ploughed layer is very dark grayish brown, dark grayish brown, grayish brown, or gray sandy loam or loam.

Below the ploughed layer is a layer, 20–40 centimetres thick, of yellowish brown or strong brown light loam or light sandy loam with dark grayish brown to gray mottles.

The underlying material is similar in texture but the principal colours are grayish brown, gray or dark grayish brown with some mottles of higher chroma. The depth to hard rock is more than 3 metres.

A typical profile follows:

Ap1—0 to 10 cm; grayish brown (10YR 5/2) loam; common, fine yellowish brown (10YR 5/6) mottles; weak, fine granular; friable, slightly sticky, and slightly plastic; gradual, smooth boundary.

Ap2—10 to 20 cm; gray (10YR 5/1) loam; common, fine, faint yellowish brown (10YR 5/6) mottles; weak, coarse prismatic; slightly sticky and slightly plastic; clear, smooth boundary; pH 5.8.

A3—20 to 28 cm; gray (10YR 5/1) loam; few, fine faint yellowish brown (10YR 5/6) mottles; weak, coarse prismatic; firm, sticky, and plastic; abrupt, smooth boundary; pH 6.2.

B1—28 to 44 cm; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) moist, sandy clay loam; weak, coarse prismatic; firm, sticky, and plastic; common, fine pores; clear, smooth boundary; pH 6.5.

C1—44 to 70 cm; grayish brown (10YR 5/2) sandy loam; common, fine to medium, distinct strong brown (7.5YR 5/8) mottles; weak, coarse prismatic structure; firm, slightly sticky, and slightly plastic; thin, continuous cutans; many, fine to very fine pores; pH 6.8.

C2(B)—70 to 100 cm; light brownish gray (10YR 6/2) sandy clay with common, medium to coarse faint yellowish brown (10YR 5/6) mottles; pH 6.8.

These soils are medium in natural fertility, organic matter, and are strongly acid. They have low available moisture capacities and are rapidly permeable. The cation exchange capacity is low, and base saturation is high. Most areas are in rice paddy, being cultivated to barley or wheat during the winter-spring.

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

(Capability unit IIe; Paddy suitability group P3ab)

The profile described for this series is typical of the mapping unit. Included are some areas of soils with sandy clay loam subsoils, and small areas with gravel, cobbles, and stones.

The soil has a thick root zone and is easy to work. Surface runoff is medium and erosion hazard is not a problem in management. All of the areas are cultivated chiefly to paddy rice and winter barley.

Main management problems are the control of erosion and the effect of droughtiness. Additional drainage is needed in some places for the maximum production of barley.

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

(Capability unit IIIe; Paddy suitability group P3ab)

The profile is as described for the series. Included are patches of soils that contain gravel, cobbles, and stones, and some areas with sandy clay loam subsoil.

The surface runoff is medium. The soil is used to grow rice in the summer and barley during the winter and spring. The main management problems are erosion, leaching, and droughtiness. Additional drainage is needed to grow crops other than rice.

5.31 SADU SERIES

The Sadu series, consisting of moderately well drained, deep soils developed in broad fluvio-marine plains, is commonly associated with the Deunggu, Haecheog, and Myeongji series. It is a member of the sandy over loamy family of Aquic Udipsamments.

Except for upper horizons which may be gleyed because of rice culture, the upper horizons are pale yellow, brownish yellow or strong brown fine sand or loamy fine sand. This horizon extends from 40 to 80 centimetres.

The lower horizon is a dark gray, gray, grayish brown, or dark grayish brown, silty clay loam, clay loam, loam, or silt loam with few, yellow, olive yellow or brownish yellow mottles.

These soils are slightly acid to neutral but become more acid when dried, and pH values obtained in laboratory tests are lower than those obtained in the field. Some laboratory pH values are as low as 4.6.

A typical profile follows:

Ap1—0 to 10 cm; dark gray to dark grayish brown (10YR 4/1-4/2) faine sandy loam with common, fine to medium, prominent yellowish red (5YR 4/6) mottles; weak, coarse prismatic structure; many, fine white and yellow mica; many, fine rice roots; clear, smooth boundary; pH 5.7.

Ap2—10 to 20 cm; some as above except common, rice roots; abrupt, smooth boundary; pH 6.0.

C1—20 to 60 cm; light gray to pale yellow (2.5Y 7/2 to 7/4) fine sand with common, medium, distinct strong brown to brown (7.5YR 5/6 to 5/4) and few, fine, prominent reddish brown (5YR 4/4) mottles; single grain or weak, fine granular structure; clear, smooth boundary; pH 6.0.

C2—60 to 72 cm; brownish yellow (10YR 6/6) fine sand; many, coarse, prominent yellowish red (5YR 5/8) mottles; crushed colour strong brown (7.5YR 5/8); many, fine white and yellow mica; abrupt, wavy boundary; pH 5.8.

IIC1G—72 to 100 cm; dark gray to dark grayish brown (10YR 4/1-4/2) silty clay loam; common, fine to medium and coarse, prominent dark reddish brown (5YR 3/2) mottles and common, medium and coarse, distinct yellow to brownish yellow (10YR 7/6-6/6) mottles on face of reed stems; many, medium and coarse reed stem and roots; slightly sticky and slightly plastic; clear, smooth boundary; pH 6.5.

IIC2g—100 to 120+ cm; gray to dark gray (5Y 5/1-4/1) fine sandy loam; few, coarse, distinct yellow to olive yellow (2.5Y 7/6-6/6) mottles on the face of semi-decomposed reed stem and roots; pH 6.7.

These soils are low to moderate in natural fertility and low in organic matter. They have low available moisture capacities. The cation exchange capacity is low, and base saturation is high. The soils are used for rice, and small areas are used for onions, cabbage, and melons.

5.31.1 Sadu Fine Sandy Loam, 0 to 1 Percent Slopes (Sd)

(Capability unit IIIw; Paddy suitability group P2b)

The profile described for the series is the one for this mapping unit. Included are patches that have sandy loam, loam, or silt loam surface layer, a few small areas with poor drainage, and small areas of soils that are extremely acid in the substrata.

This soil is suited for vegetables and rice. It responds well to good management, including complete fertilization. The small areas that are wet will drain well if open ditches are dug.

5.32 SAMGAG SERIES

The Samgag series consists of moderately to very steep, somewhat excessively drained weakly developed soils over granite saprolite, in mountainous areas, commonly associated with the Songjeong, Sachon, and Gaghwa, and a member of the coarse loamy family of Typic Dystrochrepts.

The upper layer, about 30 centimetres thick, is dark yellowish brown or strong brown sandy loam, with a thin surface layer of pale brown or grayish brown in uneroded areas.

Below the upper layer is granite saprolite with overall colours of brownish yellow, yellowish brown, or strong brown, and coarse sandy loam textures. The colours of the individual mineral grains are variable.

Below this layer and at a depth of 50 to 150 centimetres the colours of mineral grains are dominant but paler. The texture of this material is loamy coarse sand or coarse sand. The depth to hard rock is usually more than 2 metres.

A typical profile follows:

Ap—0 to 8 cm; dark yellowish brown (10YR 4/4) sandy loam; weak, fine to medium granular structure; friable, slightly sticky, and slightly plastic; few, fine roots; abrupt, smooth boundary.

C—8 to 150+ cm; mottled, white (10YR 8/2) brownish yellow (10YR 6/6) fine gravelly coarse sandy loam saprolite; crushed colour very pale brown (10YR 7/3); firm, slightly sticky, and slightly plastic; few, medium roots.

(This description from an eroded area shows less soil colour development than is common.)

These soils, moderately low in natural fertility and organic matter, are strongly acid. They have low available moisture capacities, and are rapidly permeable. The cation exchange capacity and base saturation are low. Forest predominates with some small areas in cultivated crops.

5.32.1 Samgag Sandy Loam, 15 to 30 Percent Slopes, Eroded (SgD2)

(Capability unit IVe)

Most areas have a profile as described for the series, but small patches have rock almost at the surface. Some areas also have gravelly sandy loam or loamy sand surface layers, and a few small areas are gullied land.

The soil is poorly suited for cultivation because of poor physical characteristics and erosion hazard. Some special crops such as tobacco are grown and produce high yields. Under good management some pasture and grazing can be obtained. Pine trees grow well.

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

(Capability unit VIe)

The soil in most places has a profile similar to the one described for the series. About 10 to 20 percent of this unit area is rock outcrops. Included are: patches that have gravelly sandy loam surface layers, small areas with slopes ranging from 15 to 30 percent, and small areas of gullies. Most areas are in forest and suited to woodland.

Because of steepness and a severe hazard of erosion, use of this soil for crops is not practical. When properly managed, moderate amounts of grazing can be obtained. The main management problem is erosion control.

5.32.3 Samgag Rocky Sandy Loam, 60 to 100 Percent Slopes, Eroded (SmF2)

(Capability unit VIIe)

The profile generally is as described for the series. About 10 to 25 percent of this unit area is rock outcrops. Included are: patches that have gravelly sandy loam, very rocky sandy loam, and gravelly sand surface layer, and a few small areas of gullied land.

Erosion is the chief hazard to management. These soils are best suited to woodland.

5.33 SEOGTO SERIES

The Seogto series consisting of sloping to moderately steep, well drained, deep soils developed in colluvial materials on mountain footslopes and terrace edges, is commonly associated with the Mudeung soils. This series is a member of the loamy skeletal family of Dystric Fluventic Eutrochrepts.

The ploughed layer is brown, dark brown, or dark grayish brown gravelly to stony loam or sandy loam. The larger fragments are often removed from the surface and piled on the field borders or paddy walls.

The subsoil is similar to the ploughed layer but has blocky structure. The bedrock is one to several metres below the surface.

A typical profile follows:

A11—0 to 10 cm; dark grayish brown (10YR 4/2) cobbly to stony silt loam; moderate, fine granular structure; friable, slightly sticky, and slightly plastic; about 15 percent coarse fragments; clear, smooth boundary; pH 6.0.

A12—10 to 27 cm; brown to dark brown (10YR 4/3) gravelly, cobbly, or stony heavy silt loam; weak, fine to medium granular structure; friable, sticky, and plastic; many, fine grass roots; about 30 percent coarse fragments; gradual, smooth boundary; pH 6.0.

B—27 to 53 cm; yellowish brown (10YR 5/6 to 5/4) stony to cobbly silty clay loam; weak, fine to medium subangular blocky structure; friable, sticky, and plastic; common, fine roots; about 50 percent coarse fragments; gradual, wavy boundary; pH 5.3.

C—130+ cm; same as the upper horizon except for being more cobbly (about 70 percent); few, fine roots; pH 5.3.

The soils are moderate in natural fertility and organic matter, and are medium acid. They have low available moisture capacities and are moderately permeable. The cation exchange capacity is low, and base saturation is medium. Pine forest mixed with an understory of shrub oak predominates, with some areas in cultivated crops, a small part being rice paddy.

5.33.1 Seogto Gravelly Loam, 7 to 15 Precent Slopes (StC)

(Capability unit IIIe; Paddy suitability group P4abc)

The profile in most areas is similar to the one described for the series. Included are patches that have boulders on the surface.

The soil is difficult to work because of coarse fragments, but all of this unit area is in cultivated crops. Barley, wheat, red pepper, radish, potatoes, and soybeans are suited. Gravel, cobbles and erosion control are the main management problems.

5.33.2 Seogto Bouldery Loam, 7 to 15 Percent Slopes (SbC)

(Capability unit VIe)

The profile is similar to the one described for the series. Boulders are common on and in the soil. Included are a few small areas with slopes ranging from 2 to 7 percent.

Surface runoff is medium. The soil is best suited for woodland, but some grazing could be obtained with good pasture management. Boulders, stones, and erosion hazard, are the main management problems.

5.33.3 Seogto Bouldery Loam, 15 to 30 Percent Slopes (SbD)

(Capability unit VIe)

The profile of this mapping unit is similar to the one described for the series. Boulders are common on and in the soil. A few small areas with a fragipan in the subsoil are included.

Surface runoff is rapid and erosion hazard is severe. This soil is suited for woodland, but some pasture may be obtained with good management. Boulders, stones, and erosion hazard are the main management problems.

5.33.4 Seogto Stony Loam, 7 to 15 Percent Slopes (SsC)

(Capability unit VIe)

The profile is similar to the one described for the series. Stones are common on the surface areas.

The soil is very difficult to work because of the high content of coarse fragments. Surface runoff is medium. About 80 percent of this unit is in pine trees, and 20 percent in cultivated crops. The soil is poorly suited to cultivation, but well suited for pasture crops and woodland. Other than the cobbles and stones, erosion control is the main management problem.

5.33.5 Seogto Stony Loam, 15 to 30 Percent Slopes (SsD)

(Capability unit VIe)

The profile is similar to the one described for the series. Stones are common on the surface. Patches that have loam, gravelly loam or rocky loam surface layer, are included.

The soil is very difficult to work because of high stone content. Surface runoff is medium to rapid, and erosion hazard severe. With good management some pasture can be obtained. This soil is suited for woodland. Chestnut, persimmon, and jujube trees may grow well. Erosion control is the main management problem.

5.34 SINBUL SERIES

The Sinbul series, consisting of sloping and moderately steep, well drained, deep, dark brown soils developed in colluvial materials on high mountain footslopes, is commonly associated with the Mudeung and Seogto series. This series is a member of the loamy skeletal family of Typic Haplumbrepts.

The surface layer is 25 to 50 centimetres thick and is very dark brown, very dark grayish brown, or dark brown stony and cobbly loamy silt loam, or silty clay loam.

The subsoil is brown, yellowish brown, or dark yellowish brown stony, and cobbly silt loam or silty clay loam with blocky structure. Stone and cobble content is from 35 to 70 percent. The subsoil commonly extends to below 100 centimetres.

The underlying material is similar to the subsoil but lacks structure. Bedrock is below 3 metres.

A typical profile follows:

A11—0 to 20 cm; very dark brown to black (10YR 2/2–2/1) stony, cobbly loam; weak, fine granular structure; friable, slightly sticky, and slightly plastic; many, very fine to medium roots; gradual, wavy boundary; pH 6.0.

A12—20 to 38 cm; dark brown to very dark grayish brown (10YR 3/3 to 3/2) stony and cobbly loam; weak, fine to medium granular structure; friable, sticky, and slightly plastic; many, fine to medium roots; gradual, wavy boundary; pH 5.5.

B—38 to 90 cm; yellowish brown (10YR 5/6) stony, cobbly silty clay loam (cobble content 70 percent); weak, fine to medium blocky structure breaking to fine to medium granular; friable, sticky, and plastic; few, fine to medium roots; pH 5.0.

The soils are moderately low in natural fertility, high in organic matter, strongly to medium acid, and have moderate available moisture capacities. The cation exchange capacity is medium, and base saturation low. Oak forest with an understory is general with some areas in cultivated crops, such as potato and soybean.

5.34.1 Sinbul Stony Loam, 7 to 15 Percent Slopes (SiC)

(Capability unit VIe)

Most areas of this soil have a profile as described for the series but some areas have a thinner dark coloured surface. Runoff is rapid, and erosion hazard severe.

Because of many stones, this soil is not suited to cultivated crops, but all of the areas are for woodland. Stoniness and erosion are the main management problems. Cold climate is another important limiting factor to cultivation.

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

(Capability unit VIe)

The profile of most areas is as described for the series, but some areas have a thinner dark coloured surface. Runoff is rapid and erosion hazard severe.

Because of the steep stony slopes, the soil is not suited to cultivated crops, only to woodland. Erosion and stoniness are the main problem in management. Cold climate is another important limiting factor to cultivation.

5.35 SINDAB SERIES

The series consists of nearly level, poorly drained, deep, gray to dark gray soils formed in alluvial materials on depressed flood plains. It is commonly associated with the Sinheung, Hwabong, and Hwangryong series, and is a member of the sandy family of Typic Psammaquents.

The soil is dark gray to gray sand or loamy sand with some yellowish brown to olive brown mottles in the upper part. Some fine gravel is usually present. Ground water table remains at or near the surface.

A typical profile follows:

Ap—0 to 10 cm; yellowish brown (10YR 5/6) coarse sandy loam; common, medium to coarse, distinct dark gray (N4/) mottles; single grain; friable, nonsticky, and nonplastic; many, fine to medium quartz gravel; many, fine roots; abrupt, smooth boundary; pH 6.5.

C1g—10 to 23 cm; dark gray (N4/) coarse loamy sand and fine sandy loam; common, coarse distinct light olive brown (2.5Y 5/4) mottles; abrupt, smooth boundary; pH 7.0.

C2g—23 to 120+ cm; gray (5Y 5/1) stratified coarse loamy sand and fine sandy loam; no mottles; many, medium quartz pebbles.

These soils are low in natural fertility, low in organic matter content, and strongly acid to neutral. They have low available moisture capacity and are rapidly permeable. Cation exchange capacity is low and base saturation is high. Rice paddy predominates.

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

(Capability unit IVw; Paddy suitability group P3b)

Most areas have a profile similar to that described for the series.

Due to poor drainage and high ground water table, the soil is suited only for rice. Drainage is the chief management problem. If artificially drained the water table should be controlled, but the soil would be droughty for most crops, because of the low water holding capacity.

5.36 SINHEUNG SERIES

The series consists of nearly level, imperfectly drained, deep soils developed in broad alluvial plains, in association with the Honam, Gangdong, Gyuam, and Ihyeon series. The broad alluvial plain near the Nagdong River holds most of this soil. It is a member of the fine loamy nonacid family of Aeric Fluventic Haplaquepts.

The ploughed layer is grayish brown to dark grayish brown, gray or light olive brown silt loam, or loam with strong brown, yellowish brown mottles. Beneath the ploughed layer is grayish brown, dark grayish brown or gray loam, silt loam or silty clay loam with strong brown, or yellowish brown mottles. The C horizon is dark gray, gray, grayish brown or olive brown silt loam or loam.

A typical profile follows:

Ap1—0 to 13 cm; grayish brown (2.5Y 5/2) silt loam with common, fine, distinct yellowish brown (10YR 5/4) mottles; massive; friable, slightly sticky, and slightly plastic; few, fine mica; many, fine roots; abrupt, smooth boundary; pH 6.0.

B21g—13 to 24 cm; grayish brown (10YR 5/2) silt loam with many, coarse, faint dark gray (N4/) and common, fine, prominent strong brown (7.5YR 5/6) mottles; massive breaking to weak, medium subangular blocky structure; firm, slightly sticky, and slightly plastic; common, fine roots; few, fine mica; clear, smooth boundary; pH 6.5.

B22g—24 to 90 cm; dark grayish brown (10YR 4/2) silty clay loam with common, fine, faint yellowish brown (10YR 5/4) mottles; weak, coarse prismatic structure; firm, sticky, and plastic; thin, continuous light brownish gray (10YR 6/2) cutans; common, fine pores; few, fine mica; gradual, smooth boundary; pH 6.3.

B3g—90 to 130 cm; gray (10YR 5/1) silty clay loam; common, fine, prominent yellowish brown (5YR 5/6) mottles; sticky and plastic; pH 6.5.

Cg—130 to 150 cm; dark gray (5Y 4/1) silt loam; massive; sticky and plastic; pH 7.5.

These soils are high in fertility, moderate in organic matter content, and strongly to medium acid. They have moderate to available moisture capacities and are moderately permeable. The cation exchange capacity is medium, and base saturation is high. The soils are used for rice and barley. Some areas are only in reeds.

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

(Capability unit IIw; Paddy suitability group P1)

Profiles generally resemble that described for the series, but some areas have a surface layer of silty clay loam, clay loam or fine sandy loam.

This soil is well suited to paddy rice, and if adequately drained, is suited to a wide range of crops. Drainage is the chief management problem in growing crops other than paddy rice.

5.37 SONGJEONG SERIES

The series consists of sloping to steep, well drained, deep yellowish red soils developed over granite saprolite in rolling to hilly areas, and is commonly associated with the Samgag series. It is a member of the fine loamy family of Typic Hapludults.

The surface layer is 10-20 centimetres thick, and brown to dark brown loam. Where eroded, it is yellowish red clay loam less than 10 centimetres thick. The subsoil is yellowish red, reddish brown, or red clay loam, loam, silt loam, or sandy clay loam. Structure is mainly expressed weakly and clay cutans are generally thin and discontinuous.

The substrata are strong brown, or yellowish brown loam, sandy loam, and extremely weathered granitic saprolite. The depth to granite saprolite is 60-120 centimetres. Depth to hardrock is more than 3 metres.

A typical profile follows:

A1—0 to 9 cm; brown to dark brown (7.5 YR 4/4) loam; weak, fine granular structure; friable, slightly sticky, and slightly plastic; many, fine grass roots; abrupt, smooth boundary; pH 5.0.

B21—9 to 24 cm; yellowish red (5YR 5/8) clay loam; weak, fine to medium subangular blocky structure breaking to weak, fine granular structure; friable, sticky, and plastic; thin, broken, clay cutans; common, fine mica; few, fine roots; clear, smooth boundary; pH 4.8.

B22-24 to 47 cm; red (2.5YR 5/6) clay loam; moderate, fine and medium subangular blocky structure; friable, sticky, and plastic; thin red clay cutans; common, fine mica; few, fine roots; gradual, wavy boundary; pH 5.0.

B3—47 to 77 cm; yellowish red (5YR 5/8) sandy clay loam; weak, coarse to medium subangular blocky structure; thin broken red clay cutans; friable, slightly sticky, and slightly plastic; common, fine mica; clear, smooth boundary; pH 5.0.

C—77 to 100+ cm; strong brown (7.5YR 5/8) sandy loam granite saprolite; somewhat hard, nonsticky, and plastic; pH 5.0.

These soils are moderately low to low in natural fertility, low in organic matter content, and strongly acid. They have a moderate available moisture capacity. The cation exchange capacity is medium and base saturation is low. Permeability is moderate. Most areas are in pine forest or in grassland, and some areas are in cultivated crops.

5.37.1 Songjeong Loam, 7 to 15 Percent Slopes, Eroded (SoC2)

(Capability unit IIIe; Paddy suitability group P3ac)

Profiles of this mapping unit in most areas are similar to the one described for the series. Patches that have sandy loam, or gravelly loam surface layers are included, as are a few small areas with slopes ranging from 2 to 7 percent. Surface runoff is moderately rapid and erosion hazard is severe.

This soil is moderately suited for cultivated crops including barley, wheat, soybeans, and for pasture. The main management concern is control of erosion and the increase of fertility.

5.37.2 Songjeong Loam, 15 to 30 Percent Slopes, Eroded (SoD2)

(Capability unit IVe; Paddy suitability group P4ac)

Most areas have a profile similar to the one described for the series. Patches that have sandy loam, or gravelly loam surface layers, with a few small areas of severely eroded soils are included.

Surface runoff is rapid and erosion hazard severe. Moderate amounts of forage, if well managed as grassland could be produced. The present vegetation consists of pine trees, with a few areas planted to barley, wheat, and similar crops. The main management problems are fertility and erosion.

5.37.3 Songjeong Loam, 30 to 60 Percent Slopes, Eroded (SoE2)

(Capability unit VIe)

Profiles of this mapping unit are similar to that described for the series. Patches that have sandy loam, or gravelly loam surface layers, and a few small areas with severely eroded soils and stony soils, are included.

Surface runoff is rapid and erosion hazard is severe. Present vegetation consists of pine trees, oaks, and alders. This soil is mainly suited for forest, but some areas would produce grass for pasture if well managed. Control of erosion is the main management concern.

5.38 SUGYE SERIES

The Sugye series consists of nearly level, poorly drained, deep, gray soils developed on alluvial plains, and is commonly associated with the Gangdong and Buyong series. The series is a member of the fine silty acid family of Fluventic Haplaquepts.

The ploughed layer is gray, grayish brown, or dark grayish brown silt loam or silty clay loam with olive brown mottles.

Beneath the ploughed layers is gray, dark gray, olive gray or dark grayish brown silty clay loam or silt loam with yellowish brown mottles.

The C horizon is dark gray or gray silty clay loam or silt loam. The depth to hard rock is greater than 3 metres.

A typical profile follows:

Ap1—0 to 9 cm; grayish brown (2.5Y 5/2) silt loam with common, fine, prominent yellowish red to strong brown (5YR 5/8-7.5YR 5/8) mottles; slightly sticky and slightly plastic; massive; many, fine roots; clear, smooth boundary; pH 5.5.

B21g—9 to 23 cm; grayish brown (2.5Y 5/2) silt loam with many, medium to coarse prominent yellowish brown (10YR 5/8) mottles; weak, coarse platy structure; few, fine pores; slightly sticky and slightly plastic; common, fine roots; abrupt, smooth boundary; pH 5.8.

B22g—23 to 46 cm; dark gray (5Y 4/1) silt loam with common, fine, faint olive (5Y 5/4) mottles; weak, coarse prismatic structure; common, fine pores; continuous, thin, light olive brown (2.5Y 5/4) cutan on vertical ped face; sticky and plastic; clear, smooth boundary; pH 7.0.

B23g—46 to 68 cm; dark gray (5Y 4/1) firm silty clay loam with many, fine, faint olive (5Y 5/4) mottles; moderate, coarse prismatic structure; continuous thin olive brown (2.5Y 4/4) coatings; common, fine pores; abrupt, smooth boundary; pH 7.0.

Bg—68 to 100 cm; very dark gray to dark gray (5Y 3/1-4/1) silty clay loam; no mottles; weak, coarse prismatic structure; continuous gray (N5/) cutans; few, fine pores; sticky and plastic.

These soils are moderate in natural fertility and organic matter, and are medium to slightly acid. They have high available moisture capacity and are moderately permeable. The cation exchange capacity is medium, and base saturation is high. Most areas are in rice paddy.

5.38.1 Sugye Silty Clay Loam, 0 to 2 Percent Slopes (Sk)

(Capability unit IIw; Paddy suitability group P1)

This soil has a profile similar to that described for the series. Patches that have loam or clay loam surface layers, and some areas with gravelly silty clay loam subsoil, are included.

These soils are suited only to rice because of poor drainage. Other crops could be cultivated to this soil if adequate drainage was provided. The main management concerns are the provision of drainage and complete fertilization.

5.39 TAEHWA SERIES

The Taehwa series, consisting of moderately steep and steep, well drained, deep, yellowish brown soils on hilly to mountainous areas underlain by porphyry and andesite porphyry materials, are commonly associated with the Bonggye and Mudeung series. This series is a member of the fine loamy family of Typic Hapludults.

The surface layer is brown to dark brown, yellowish brown or dark yellowish brown silt loam, loam, or very fine sandy loam and is 10 to 20 centimetres thick.

The subsoils are yellowish brown, reddish yellow silt loam, loam, fine sandy loam or clay loam.

The C horizon is saprolite of distinctly mottled brownish yellow, very pale brown, strong brown and yellowish brown fine sandy loam, loam or silt loam. The thickness to saprolite ranges from 50 to 100 centimetres, and depth to hard rock is more than 2 metres.

A typical profile follows:

Ap—0 to 7 cm; dark reddish brown (5YR 3/4) silt loam; strong, fine to medium granular structure; friable, slightly sticky, and slightly plastic; many, fine roots; clear, smooth boundary; pH 5.5.

B21t—7 to 20 cm; yellowish red (5YR 4/8) silty clay loam; moderate, medium subangular blocky structure; firm, sticky, and plastic; thin, patchy clay cutans; few, fine roots; pH 5.0.

B22t—20 to 45 cm; yellowish red to red (5YR 4/8 to 2.5YR 4/8) silty clay loam; moderate to weak, coarse subangular blocky structure; firm, sticky, and plastic; thin, patchy clay cutans; clear, smooth boundary; pH 5.0.

B3—45 to 110 cm; mottled, red (2.5YR 4/8), light yellowish brown (2.5Y 6/4) silt loam to light silty clay loam; crushed colour yellowish red (5YR 5/8); weak, very coarse blocky structure; friable, sticky, and plastic; moderate, thick, patchy red clay cutans; gradual, smooth boundary; pH 4.8.

C—110 to 120+ cm; light yellowish brown silt loam; some streaks of reddish clay film; pH 4.8.

These soils are moderately low in natural fertility and organic matter and are strongly acid. They have a moderate available moisture capacity and are moderately permeable. The cation exchange capacity is medium to low and base saturation is low.

Most areas are in pine forest and black alder with an understory of azalea and shrub.

5.39.1 Taehwa Loam, 15 to 30 Percent Slopes, Eroded (TaD2)

(Capability unit IVe)

Profiles of this soil are as described for the series. Patches that have clay loam or gravelly loam surface layers, and small areas of only slightly eroded soil, are included. Surface runoff is rapid, and erosion hazard severe.

This soil is usually suited to woodland, with a few sloping areas suitable for cultivation, being planted to barley, buckwheat and similar crops. Main concerns of management are the control of erosion and the increase of fertility.

5.39.2 Taehwa Loam, 30 to 60 Percent Slopes, Eroded (TaE2)

(Capability unit VIe)

The profile is similar to that described for the series. Patches that have clay loam or gravelly loam surface layers, a few small areas with moderately deep to shallow soils, and a few small areas with gullies, are included in this soil.

Surface runoff is rapid, and erosion hazard is severe. Most areas are in forest of pines and alder with an understory of azalea, bush clover, and other shrubs. The soil is best suited to woodland or pasture, and the main problem in management is the control of erosion.

5.39.3 Taehwa Rocky Loam, 15 to 30 Percent Slopes, Eroded (TrD2)

(Capability unit IVe)

About 10 to 20 percent is rock outcrops and areas with stony surface layers. The remaining profiles are similar to the one described for the series. Patches that have gravelly clay loam or gravelly loam surface layers, small areas with slopes ranging from 7 to 15 percent, small areas of only slightly eroded soil, and small areas of shallow soils are included.

Surface runoff is rapid, and erosion hazard is severe. Most areas are in forest of pines and alder with an understory of azalea, bush clover and other shrubs. A few small areas are cultivated to barley and similar crops. These soils are suited to woodland. The main management problem is erosion control.

5.39.4 Taehwa Rocky Loam, 30 to 60 Percent Slopes, Eroded (TrE2)

(Capability unit VIe)

About 10 to 20 percent of this unit area is rock outcrops with the soil profile between them being similar to that described for the series. Patches that have gravelly clay loam, or gravelly loam surface layers, small areas with slightly eroded soil and small areas of shallow soils, are included in that mapped.

Surface runoff is rapid and erosion hazard is very severe. The soil is generally best suited to woodland, and is in forest consisting mainly of pines and alder with an understory of azalea, bush clover, and other shrubs. In managing the soil the main concern is the control of erosion.

5.40 TIDAL FLAT (TF)

This area is periodically covered with sea water, and is at present too wet and salty to grow plants other than a few reeds. Most of it is flooded daily but some higher areas only when the tide is at its peak.

The tidal flat areas are located in the southern part of the gun adjacent to the sea. The soil material is dark gray, dark grayish brown, or black silt loam, silty clay loam, or very fine sandy loam. It contains many salts and is alkaline in reaction.

In its present condition this land is of little value. However if it were protected from flooding and drained, it would be much like the soils of the Gwanghwal series. These soils are too salty for good crop yields but drainage can improve them.

5.41 YONGJI SERIES

The series consists of gently sloping and sloping, moderately well drained, deep soils developed in alluvial material on small valleys and fan terraces, and is commonly associated with the Jisan, Gangdong, Sachon, and Banho series. It is a member of the fine loamy family of Aquic Fluventic Eutrochrepts.

The ploughed layer is grayish brown, very dark grayish brown, or gray loam or silt loam with strong brown or yellowish brown mottles.

The subsoils are brown to dark grayish brown silt loam, silty clay loam, loam, or clay loam.

The substrata are mottled brown, dark brown, gray or grayish brown, gravelly clay loam with black to very dark brown manganese mottles and concretions.

A typical profile follows:

Ap1—0 to 10 cm; grayish brown to light olive brown (2.5Y 5/2 to 5/4) silt loam; common, fine, distinct strong brown (7.5YR 5/6) mottles; weak, coarse granular structure; friable, slightly sticky, and slightly plastic; gradual, smooth boundary; pH 5.3.

Ap2—10 to 21 cm; grayish brown to dark grayish brown (10YR 5/2 to 4/2) silt loam; common, fine distinct brown to dark brown (7.5YR 4/4) mottles; weak, medium subangular blocky structure; firm, sticky, and plastic; abrupt, smooth boundary; pH 5.3.

B21—21 to 56 cm; dark grayish brown (10YR 4/2) silt loam; many, fine, distinct black (N2/) mottles; crushed colour brown to dark brown (10YR 4/3); weak, very coarse prismatic structure; firm, sticky, and plastic; thin, discontinuous gray (N5/) clay cutans; few, fine pores; gradual, smooth boundary; pH 6.8.

These soils are moderate in fertility and in organic matter, and are strongly acid to neutral. They have moderate available moisture capacities and are moderately permeable. The cation exchange capacity and base saturation are medium to high. These soils are used for rice and other crops.

5.41.1 Yongji Loam, 2 to 7 Percent Slopes (YjB)

(Capability unit IIe; Paddy suitability group P2ac)

The profile described for the series is generally typical. Patches that have silt loam surface layers are mapped as this soil. It is suited for rice and barley, the plough layer being fairly easy to keep in good tilth. Without clodding or crusting it can be worked through a medium range of moisture.

Usually water for growing rice is available and the soils are practically all planted to rice. Many areas are also cropped to barley. These areas produce high yields when well fertilized and managed.

5.41.2 Yongji Loam, 7 to 15 Percent Slopes (YjC)

(Capability unit IIIe; Paddy suitability group P3ac)

Most areas have a profile as described for the series. Patches that have clay loam or silty clay loam surface layers, and very small areas with slopes ranging from 15 to 30 percent are included.

This soil is suited for rice and barley. The main management concerns are irrigation, fertilization, and erosion of paddy walls.

5.42 YUHA SERIES

The Yuha series, consisting of sloping to steep, well drained, deep soils underlain by tuff conglomerate, porphyry and andesite porphyry on hills and low mountain areas, is commonly associated with the Bonggye, Taehwa, Banho, and Mudeung series. The Yuha series is a member of the fine silty family of Typic Dystrochrepts.

The ploughed layer is brown to dark brown or reddish brown silt loam to light silty clay loam.

Below the ploughed layer is yellowish brown strong brown, yellowish red, reddish brown pinkish white and yellow silt loam or silty clay loam saprolite. The substrata are silt loam saprolite with pinkish, white, black, yellowish red and reddish brown mixed colours. The depth to bedrock ranges from 1 to 2 metres.

A typical profile follows:

Ap1—0 to 12 cm; brown to dark brown (7.5YR 4/4) silt loam; weak, fine to medium granular structure; friable, slightly sticky, and slightly plastic; fine roots; abrupt, smooth boundary; pH 7.5.

B—12 to 40 cm; yellowish brown (10YR 5/4) silt loam saprolite; common, fine, distinct pinkish white (5YR 8/2) and few, medium to coarse prominent black (5YR 2/1) and yellowish red (5YR 4/6) mottles; crushed colour brown to yellowish brown (10YR 5/3-5/4); friable, slightly sticky, and plastic; pH 4.5.

C1—40 to 110+ cm; white (5YR 8/2) and yellowish brown (10YR 5/6) saprolite; massive.

These soils are moderate to low in natural fertility, low in organic matter content, and are strongly acid. They have high available moisture capacity and are moderately permeable. The cation exchange capacity is medium and base saturation is low to medium. The lesser slopes are used for crops such as barley and soybeans; the steeper slopes being in forest of natural pine with some mixed shrub.

5.42.1 Yuha Silt Loam, 7 to 15 Percent Slopes, Eroded (YhC2)

(Capability unit IIIe; Paddy suitability group P3ac)

The profile described for this series is typical of most of the mapping unit.

This soil is suited for pastures and orchards. The main management concerns are controlling erosion, improving tilth, and raising the low fertility.

5.42.2 Yuha Silt Loam, 15 to 30 Percent Slopes, Eroded (YhD2)

(Capability unit IVe; Paddy suitability group P4ac)

Most areas have a profile similar to that described for the series. Included are a few small areas with gullies.

This soil is best suited for pasture or forest, but can be used for cultivated crops by establishing bench terraces or using other soil conservation practices. The main management concerns are controlling erosion and raising the low fertility.

5.42.3 Yuha Silt Loam, 30 to 60 Percent Slopes, Eroded (YhE2)

(Capability unit VIe)

Most areas have a profile similar to the one described for the series. In areas of this soil are included patches that have gravelly silt loam or loam surface layers, and a few small areas with rock outcrops.

The soil is suited for forest or pasture. Erosion is a serious hazard to management.

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.

The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive land-forming that would change the shape, depth, or other characteristics 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 Gimhae Gun. 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 lower-case 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 of this class 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 of irrigation. These soils are too wet to produce good yields of other crops without additional drainage. The VIs soils produce good crops of melons and peanuts, but they are too droughty to grow most other 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' are 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, Technical Report 1 (see Chapter 1).

Table 3 gives the approximate number of hectares and proportionate extent of land capability units for all of the land in the gun.

Table 3

APPROXIMATE NUMBER OF HECTARES AND

PROPORTIONATE EXTENT OF LAND CAPABILITY UNITS

Capability Unit	Hectares	Percentage
I	3006	4.6
IIe	1966	3.0
IIs	1701	2.6
IIw	2735	4.2
IIIe	4877	7.5
IIIs	1783	2.8
IIIw	4821	7.4
IIIwc	6797	10.4
IVe	4177	6.4
IVs	1312	2.0
IVw	228	0.4
VIe	15039	23.1
VIIe	6559	10.0
VIII	7515	11.6
Unclassified (River bed, urban, water reservoirs, etc.)	2598	4.0
	65111	100.0

6.2.1 Class I Soils Having Few Limitations Restricting Use

1. Capability Unit I. In this capability unit are well to moderately well drained, deep soils with silty surface layers. These soils have high available moisture capacities, moderate or high natural fertility, and medium organic matter content. The unit covers 3,006 hectares or about 4.6 percent of total areas of the gun. They are:

   Gyuam silt loam, 0 to 2 percent slopes.
   Ihyeon silt loam, 0 to 2 percent slopes.

   The soils are well suited to a wide range of crops including paddy rice, are highly productive and can be intensively cultivated if well managed. Good management includes all available crop residues turned in, adequate fertilization, and applying lime as needed.

   Neither artifical drainage nor special practices for erosion control are required.

6.2.2 Class II Soils Having Moderate Limitations

1. Capability Unit IIe. In this capability group are gently sloping, deep, moderately well to well drained, moderately permeable, fertile soils. This unit covers 1957 hectares or about 3 percent of the total area of the gun. These soils are:

   Bancheon silty clay loam, 2 to 7 percent slopes
   Banho gravelly loam, 2 to 7 percent slopes
   Hwadong silty clay loam, 2 to 7 percent slopes
   Sachon sandy loam, 2 to 7 percent slopes
   Yongji loam, 2 to 7 percent slopes.

   All but the Sachon soils have high available moisture capacities, the latter being low in this characteristic, but somewhat high in water table and moderately well drained. In the Bancheon soils the content of organic matter is low, and in the rest of the soils it is moderate or moderately high.

   The soils of this unit are suited to soybean, rice, corn, barley, and wheat or many other crops commonly grown in this gun because of their moderate or high available moisture capacity.

   They are moderately subject to erosion if ploughed and not protected. Most of these soils are strongly acid throughout their profiles and require liming for maximum production.

   The erosion can be controlled by contour farming, diversion channels, terraces, and grassed waterways. Good management also includes minimum tillage, crop residues ploughed under to keep the supply of plant nutrients high and applying lime as needed. Many areas have been graded into rice paddy systems. Rice is grown on most areas of these soils each year. Erosion and runoff are controlled in the well constructed paddy system. To protect the paddy walls from damage by floodwater and to regulate the water level in the paddy fields, well constructed weir dams are needed.

ii. Capability Unit IIs. This soil covers 1,701 hectares or about 2.6 percent of the total gun area. It is gently sloping, well drained, deep, rapidly permeable and dark coloured. It has gravelly loam or gravelly sandy loam textures. Available moisture capacity is low to medium, with moderate natural fertility and high organic matter content. This soil is:

Hogye gravelly loam, 2 to 7 percent slopes.

The soil is suited to soybean, barley, wheat, vegetables and many other crops, and also well suited for orchard and mulberry fields. It is moderately subject to droughtiness because of the high water seepage through the rapidly permeable, gravelly coarse sandy or loamy soils. Removal of gravel will help reduce this water seepage, and will make cultivation easier. Frequent application of fertilizer is good to control rapid leaching of plant nutrients, but it is not practicable to remove the gravel.

iii. Capability Unit IIw. This capability unit consists of deep, imperfectly or poorly drained, moderately or moderately rapidly permeable, nearly level to gently sloping soils with high water tables. This unit covers 2,735 hectares or about 4.2 percent of the gun. They are:

Gangdong loam, 0 to 2 percent slopes
Jeonbug silt loam, 0 to 1 percent slopes
Jisan loam, 2 to 7 percent slopes
Sinheung loam, 2 to 7 percent clopes
Sugye silty clay loam, 0 to 2 percent slopes.

These soils generally have high available moisture capacities, but the Gangdong is low in this characteristic because of the fine loam over sandy soils. The Jisan soils are moderately low in organic matter content, but the other soils are medium or moderately high. The Sinheung soils are high in natural fertility, and the rest have moderate or moderately high fertility.

In the nearly level areas, water remains on the surface for long periods, unless ditches have been constructed to remove it. Because of their wet nature these soils are suitable for paddy rice, but poorly suited to most other crops, only some of the Jeonbug and Sinheung soils are planted to winter barley or wheat after paddy rice. Drainage ditches or some other drainage installations will permit the growing of many kinds of crops. The terraced paddy field system, built on most of the soils, is an effective erosion control system. Weir dams will prevent damage to paddy walls by overflow.

6.2.3 Class III Soils with Severe Limitations

i. Capability Unit IIIe. In this capability unit are sloping, deep, well drained soils. These soils cover 4,877 hectares or about 7.5 percent of the gun. They are:

Banggi clay loam, 2 to 7 percent slopes
Banggi clay loam, 7 to 15 percent slopes
Bonggye silty clay loam, 7 to 15 percent slopes, eroded
Gaghwa cobbly silty clay loam, 7 to 15 percent slopes, eroded
Hogye gravelly loam, 7 to 15 percent slopes
Jangyu silty clay loam, 2 to 7 percent slopes
Jisan loam, 7 to 15 percent slopes
Sachon sandy loam, 7 to 15 percent slopes.

Seogto gravelly loam, 7 to 15 percent slopes
Songjeong loam, 7 to 15 percent slopes, eroded
Yongji loam, 7 to 15 percent slopes
Yuha silt loam, 7 to 15 percent slopes, eroded.

The gently sloping mapping units of the Banggi and Jangyu series are placed in this unit because the two soils have moderately low to low available moisture capacities and gravelly to very gravelly subsoils. The remaining soils are sloping.

The Jangyu soils are moderately well drained, and the Jisan soils are poorly drained. Most of the soils in this unit have moderate or low available moisture capacities except for the Gaghwa, Jisan, and Yuha which are high. Natural fertility is moderate or low, but the Jisan soils have a high fertility. Hogye and Jisan soils have high or moderately high organic matter content, and the rest of the soils are moderate to low in the organic matter. They are moderately permeable except for the rapidly permeable Sachon soils.

They are subject to erosion if not protected with special conservation practices or perennial plants. The Banggi, Hogye, Seogto, and Jangyu soils are also subject to droughtiness in dry seasons. The Jisan soils have a high water table which limits the choice of plants unless drained.

Most areas in this unit are in cultivated crops, with a few small areas in forest. Paddy rice is grown on the Jisan, Jangyu, Yongji, and some of the Banggi, Hogye and Sachon soils.

In many places grassed waterways and erosion control dams are needed to carry runoff away safely without causing gullying and damage of paddy walls. Farming on contour or terrace is also a good measure to reduce losses from erosion. For the higher yields of general crops other than rice, application of phosphate, compost, and lime is needed. Gravel and cobbles should be removed from gravelly or cobbly plow layers of Hoggye, Seogto, and Gaghwa soils. Drainage ditches and other drainage systems need to be installed on the poorly drained Jisan soils and moderately well drained Jangyu and Yongji soils. Water sources should be developed in the farms where soils are subject to droughtiness.

The Bonggye, Gaghwa, Hogye, Sachon, Seogto, Songjeong, and Yuha soils are also suitable for orchard, mulberry, and pasture. Bench terraces constructed on those soils will allow orchard and mulberry trees to grow without serious erosion problems. Growing green manure crops between the orchards or between mulberry trees is desirable to improve soil fertility. For pasture, liming and adequate fertilizers are necessary for higher yields.

ii. Capability Unit IIIs. In this capability unit are level or nearly level, deep, moderately well and somewhat excessively drained soils that have low available moisture capacities and rapid permeability. These soils are on the alluvial plains, marine plains and flood plains along the Nagdong River, and occupy 1,783 hectares or approximately 2.8 percent of the gun areas. They are:

Myeongji loamy fine sand, 0 to 2 percent slopes
Nagdong loamy fine sand, 0 to 2 percent slopes.

The soils of this capability unit are subject to severe droughtiness unless irrigated. They are low or moderately low in natural fertility and low or medium in organic matter content. The Myeongji soils are neutral to mildly alkaline, and the Nagdong soils are strongly acid to neutral.

Crops that grow on the soils without irrigation include melons, peanuts, onions, and cabbage. Apple, pear, and mulberry trees also grow well. Alfalfa and other deep-rooted crops would also produce high yields. For higher yields of those crops, split application of fertilizer should be practiced to reduce the effects of the leaching through the coarse textured soils. A large amount of compost will be very helpful to improve the soils. The growing of green manure crops as intercrops in the orchards and mulberry fields will increase yields and reduce erosion losses.

iii. Capability Unit IIIw. In this capability unit are nearly level, poorly drained or imperfectly drained, deep soils that occupy the fluvio-marine and broad alluvial plains. These soils cover 4,821 hectares or about 7.4 percent of the total areas of gun. They are:

Buyong silty clay loam, 0 to 1 percent slopes
Honam silty clay loam, 0 to 2 percent slopes
Sadu fine sandy loam, 0 to 2 percent slopes.

The Buyong and Honam soils have high available moisture capacities, slow permeability, moderately high natural fertility, and medium organic matter content. But the Sadu soils have low available moisture capacity, rapid permeability, low or moderate natural fertility, and low organic matter content. All the soils in this unit have high water tables, and are used only for paddy rice. They are well suited to it, and produce high yields of this crop. With improved drainage accomplished by ditches or tile and good management, they also can be planted to crops, such as barley, wheat, soybean, and corn. However, drainage is difficult in many areas because of the low elevations and lack of outlets and the slow permeability of the subsoil. Pumping to lower the water table may be feasible in some areas. The Sadu soils need liming and compost. Bedding or hill row culture of the Buyong and Honam soils is advisable to grow general crops. Wet resistant crops, such as soybean, will grow well on these soils.

iv. Capability Unit IIIwc. In this capability unit are nearly level, deep, poorly or very poorly drained soils that have high water tables and an unfavourable chemical nature. These soils are in the coast plains and broad fluvic-marine plains, and cover 6,797 hectares or about 10 percent of the gun total area. They are:

Bongrim silty clay loam, 0 to 1 percent slopes
Deunggu silty clay loam, 0 to 1 percent slopes
Deunggu silt loam, 0 to 1 percent slopes
Gimhae silty clay loam, 0 to 1 percent slopes
Gwanghwal silt loam, 0 to 1 percent slopes
Haecheog silt loam, 0 to 1 percent slopes

The Gwanghwal soils have high salt content, and are moderately to mildly alkaline, but the remainder are very strongly to extremely acid. All tend to become more acid after drainage or when dried, and have high to moderately high available moisture capacities. They have very slow to moderately slow permeability, but the lower horizons of the Haecheog soils are rapidly permeable because of the fine sand or loamy fine sand textures.

Natural fertility of the Bongrim and Gimhae soils is low or moderate, but the remainder have high or moderately high fertility. Organic matter content in all of the soils are generally medium or moderately high.

The soils of this capability unit are only moderately suited to most kinds of cultivated crops because of the high water table and unfavourable chemical nature that limits crop production. They are mostly used for growing paddy rice, but its yields are generally low or very low. To increase the rice yields, much liming, tile drainage and bedding or hill row culture are needed. In the Bongrim, Gimhae, and Haecheog soils, it may be helpful to control drainage so that the soils are flooded as long as possible to reduce the oxidation of sulphur compounds. Deunggu soils also need deep ploughing and silicate fertilizer. Gwanghwal soils should be frequently irrigated with fresh water to remove the salts. The installation of the drains will hasten this removal. For general crops other than rice, all of these soils need improved drainage installations, and should be treated with much lime. Bedding or hill row culture and wet resistant varieties are desirable.

6.2.4 Class IV Soils with Very Severe Limitations

i. Capability Unit IVe. This capability unit consists mostly of moderately steep, deep, moderately well and well drained, mainly eroded soils that have moderate to high available moisture capacities. This unit covers 4,177 hectares or about 6 percent of total area of the gun. These soils are:

Bonggye silty clay loam, 15 to 30 percent slopes, eroded
Bonggye cobbly silty clay loam, 15 to 30 percent slopes, eroded
Gaghwa cobbly silty clay loam, 15 to 30 percent slopes
Jangweon gravelly loam, 7 to 15 percent slopes
Jangweon gravelly loam, 15 to 30 percent slopes
Samgag sandy loam, 15 to 30 percent slopes, eroded
Songjeong loam, 15 to 30 percent slopes, eroded
Taehwa loam, 15 to 30 percent slopes, eroded
Taehwa rocky loam, 15 to 30 percent slopes, eroded
Yuha silt loam, 15 to 30 percent slopes, eroded.

The Samgag and Jangweon soils have low available moisture capacities, but the Jangweon soils are very slowly permeable because of the fragipan layer, while the Samgag soils have rapid permeability. The rest of the soils are generally moderately permeable. In the eroded soils, the original surface layer has been washed away and the light-coloured subsoil is now exposed. As a result, these soils are low in content of organic matter and in the natural fertility.

The erosion hazard on the soils of this unit is too severe to grow annual crops continually. Perennial hay and pasture crops will control the erosion, and produce high yields if they are well managed with liming and proper fertilization.

Very few of these soils are in rice paddy because of the strong slopes or stoniness. Some orchards have been established on the soils of Bonggye, Songjeong, Taehwa, and Yuha series. Bench terraces built on these soils for establishment of orchards will help control erosion.

The growing of cover crops, such as green manure crops will also reduce erosion losses. Maintaining grass sod in drainage channel will prevent gullying. Many areas of the soils with stands of trees are being eroded very rapidly mainly because of the raking and removing of the leaves and other surface litter.

For higher yields of the general agricultural crops, the soils should be treated with much lime, phosphorus, and compost. Terracing is also necessary because of the strong slopes.

Crop residue, left on the surface, provides cover, promotes the infiltration of water, and reduces losses from erosion.

ii. Capability Unit IVs. This capability unit consists of level to nearly level, deep, well drained, very coarse textured, rapidly permeable soils on alluvial fans and flood plains. These soils have very low available moisture capacities, and suffer a very severe moisture problem. This unit covers 1,312 hectares or about two percent of the gun. These soils are:

Hwabong sandy loam, 0 to 2 percent slopes
Hwangryong gravelly loamy sand, 0 to 2 percent slopes.

All the soils of this unit are low both in natural fertility and organic matter content.

They are poorly suited to the general cultivated crops, but well suited to peanut, melons, poplar, mulberry trees and orchards. At present, these soils are used to some extent for growing barley, wheat, soybean, and some other crops. However, the yields of those crops are generally low as they are subject to droughtiness because of the rapid permeability, and also subject to damage by the rapidly moving flood water. But flooding is only for short periodsof time.

The Hwangryong soils can be improved by picking up the large gravel and cobbles. Fine clayey soil needs to be added to the soils of this unit to improve the coarse texture and water holding capacity. Proper fertilization in split doses is required for good stands of all crops.

iii. Capability Unit IVw. The only mapping unit in this capability unit occupies 228 hectares or about 0.4 percent of the gun. The soil is level to nearly level, poorly drained, deep, rapidly permeable, coarse-textured, and has high water table. It is found on the depressed flood plains. Outlets for drainage are poor. The available moisture capacity, the natural fertility and the organic matter content of the soil are low. It is:

Sindab sandy loam, 0 to 2 percent slopes.

The soil is used only for growing paddy rice because water table remains on the surface, but its yields are generally low. Other crops cannot be grown except for rice and parsley. Increasing drainage or lowering water table is not practicable because of the lack of suitable drainage outlets. It is also subject to droughtiness when drained because of its rapid permeability and low available moisture capacity. Proper fertilization in split applications is needed for high yields because of the leaching of fertility elements through the coarse textured soils.

6.2.5 Class VI Soils Suitable only for Pasture or Woodland

Capability Unit VIe. In this capability unit are rolling or sloping to steep, deep or shallow, well drained, rocky, stony, bouldery, cobbly, eroded soils. Mostly in mountain areas, these soils are the most extensive in the gun, covering 15,039 hectares or about 23 percent.

They are:

Bonggye silty clay loam, 30 to 60 percent slopes, eroded
Bonggye cobbly silty clay loam, 30 to 60 percent slopes, eroded
Mudeung rocky loam, 15 to 30 percent slopes
Mudeung rocky loam, 30 to 60 percent slopes
Samgag rocky sandy loam, 30 to 60 percent slopes, eroded
Seogto stony loam, 7 to 15 percent slopes
Seogto stony loam, 15 to 30 percent slopes
Seogto bouldery loam, 7 to 15 percent slopes
Seogto bouldery loam, 15 to 30 percent slopes
Sinbul stony loam, 7 to 15 percent slopes
Sinbul stony loam, 15 to 30 percent slopes
Songjeong loam, 30 to 60 percent slopes, eroded
Taehwa loam, 30 to 60 percent slopes, eroded
Taehwa rocky loam, 30 to 60 percent slopes, eroded
Yuha silt loam, 30 to 60 percent slopes, eroded.

All of the soils in this unit are deep, except for the shallow Mudeung soils, and are moderately permeable. They are mostly strongly acid, moderate to low in natural fertility and organic matter except for the Sinbul soils which are high in this. Available moisture capacity is high in the Yuha soils, but low or medium in the remainder.

The soils of this capability unit are so erodible that they are unsuitable for cultivation, but suitable for pasture and woodland if properly managed.

Most of the areas are in poor forest and in grassland, but managing meadow will be difficult in many places because of the steep slopes. Intensive grazing will leave the soils bare and subject to further erosion. Pasture establishment and good management will increase yields and control this.

Farmers should select areas of these soils that are best suited to trees or pasture. They then need to improve the wooded areas by protecting them from grazing. Trees can be planted where necessary, or the areas can be cleared and improved for pastures. Many of these soils have a surface layer that is strongly acid. This reaction is favourable to pine trees, but much liming and fertilization are needed to develop the soils for pasture. Some of the soils like the Sinbul stony soils can be developed into orchard or mulberry fields.

6.2.6 Class VII Soils Limited to Woodland

Capability Unit VIIe. This capability unit consists of steep to very steep, well drained, rocky to very rocky soils that are dominantly shallow over bedrock. These soils cover 6,559 hectares or about 10 percent of total area of the gun. They are:

Mudeung rocky loam, 60 to 100 percent slopes
Mudeung very rocky loam, 30 to 60 percent slopes
Mudeung very rocky loam, 60 to 100 percent slopes
Samgag rocky sandy loam, 60 to 100 percent slopes, eroded.

The soils of this capability unit are so rocky, steep, or badly eroded that they are suited only for woodland. Cultivation is not practicable, and grazing is severely limited even under intensive management, thus woodland only is suitable. To reduce losses from erosion, leaf litter should be left on the surface, and reforestation is required for the bare mountains.

6.2.7 Nonproductive Soils

i. Capability Unit VIII. This capability unit consists of miscellaneous land units and soil materials that are shallow and rocky, coarse, or periodically flooded with salt water. Useful plants do not grow. These areas include 7515 hectares in the gun. They are:

Beach and riverwash, sandy
Riverwash, cobbly
Rock land
Tidal flat.

ii. Rock Land RL. Rock land consists of colluvial deposits of stones on mountain foot slopes, escarpments along river valleys, and rock outcrops on the tops of mountains with not more than 10 percent of shallow stony soils. The rocks are mostly andesite and andesite porphyry.

Vegetation is poor. Shrubs and small trees grow, in places, among the rocks.

6.3 PADDY LAND SUITABILITY GROUPS

Rice is the most important crop in Korea, growing well on soils that are too wet for most other crops. These wet soils are classified as IIw or IIIw in the capability classification. About 18,902 hectares or 79.8 percent of the total cultivated areas (23,686 hectares) in the gun are used for paddy rice. In this section, the use and management of these soils are discussed.

Management of paddy land can be planned more effectively if soils are grouped according to those characteristics that affect the growth. For this reason, the soils of Gimhae Gun have been placed in four paddy land suitability groups, which are designated P1, P2, P3, and P4. The numerals indicate progressively greater limitations in the use of land for rice. The four suitability groups 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 soils classes within each suitability group; they are designated by adding lowercase 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 of soil used for growing paddy rice. Steep, gullied, stony or rocky soils are unsuitable for paddy rice, and are not included in this classification.

Paddy suitability groups are discussed more fully in Soils of Korea, Technical Report 1 (See Chapter 1).

Table 4 gives an overall view of the relative suitability for rice production of land in the gun. All 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 nearly half of the land, an unusually high proportion in Korea. However, only about 20 percent of the gun is suitable for paddy without difficult or very difficult special development and management.

Table 4

APPROXIMATE NUMBER OF HECTARES AND

PROPORTIONATE EXTENT OF PADDY SUITABILITY GROUPS

Paddy Suitability Group	Hectares	Percent
P1	3978	6.1
P2a	1133	1.7
P2ac	2590	4.0
P2b	2445	3.7
P2c	3006	4.6
P3a	89	0.1
P3ab	950	1.5
P3ac	1979	3.1
P3b	228	0.4
P3d	6797	10.4
P4abc	3139	4.8
P4ac	3121	4.8
P4bc	3095	4.7
Not suited for paddy	32564	50.1
	65114	100.0

6.3.1 Paddy Suitability Group P1

This group consists of level to nearly level, deep, poorly or imperfectly drained, very slowly permeable soils that have high water table, and cover 3,978 hectares or approximately 6 percent of total area of the gun.

These soils are:

Buyong silty clay loam, 0 to 1 percent slopes
Honam silty clay loam, 0 to 2 percent slopes
Jeonbug silt loam, 0 to 1 percent slopes
Sinheung loam, 0 to 2 percent slopes
Sugye silty clay loam, 0 to 2 percent slopes

The soils are dominantly fine textured, and generally have high available moisture capacities. Most are high in natural fertility and high or medium in organic matter content.

They need few management practices other than proper fertilization and good cultural practices that are commonly needed for any paddy soils. Deep plowing will help obtain somewhat higher yields. Calcium silicate fertilizer will reduce lodging of this crop. The high water table is a limitation to growing winter grain crops, such as barley or wheat, during the winter-spring season. Early season culture, good varieties, and high level fertilization are also appropriate measures to obtain high yields.

6.3.2 Paddy Suitability Group P2a

The only soil in this group is gently sloping, deep, poorly drained, moderately permeable soil that has high water table and moderate to high available moisture capacity. This soil covers 1,133 hectares or about 1.7 percent of the gun. It is:

Jisan loam, 2 to 7 percent slopes.

The slope is only limitation that affects paddy size and shape. Paddy systems constructed on the gently sloping soils have small paddies with irregular shapes, and are subject to losses of irrigation water and runoff unless dykes are properly maintained. Well-constructed weir dams are needed to control runoff of paddy walls and to regulate the water level for growing paddy rice. Deep plowing with adequate fertilization would increase yields, and application of calcium silicate will resist lodging of rice plants.

6.3.3 Paddy Suitability Group P2ac

This group consists of gently sloping, deep, well drained, moderately to slowly permeable soils with medium and heavy textures. These soils have low or no water tables, and cover 2,590 hectares or about 4 percent of the gun. They are:

Bancheon silty clay loam, 2 to 7 percent slopes
Banggi clay loam, 2 to 7 percent slopes
Banho gravelly loam, 2 to 7 percent slopes
Hwadong silty clay loam, 2 to 7 percent slopes
Jangyu silty clay loam, 2 to 7 percent slopes
Yongji loam, 2 to 7 percent slopes.

The Bancheon and Banggi soils have moderately high and high available moisture capacities, but the rest of the soils are low or moderately low. Natural fertility is dominantly moderate or moderately low. At present, the Jangyu soils are mostly used for paddy rice, but the rest are partly used for rice, as water is usually not available for the other soils. When water becomes available, rice will do very well.

The soils of this group are subject to some droughtiness and loss of water because of the slope and good drainage. Because of the low water table, frequent irrigation is needed to supply rice plants with enough water. Paddy systems need well constructed weir dams to protect the paddy dykes from damage by overflow.

Deep ploughing and application of calcium silicate are good cultural practices. The Hwadong soils need application of sand because of the high clay content. Winter grain crops like barley or wheat grow well during the winter and spring after paddy rice. Crops other than rice will also do well during the summer.

6.3.4 Paddy Suitability Group P2b

This group consists of level to nearly level, poorly drained to moderately well drained, loamy soils over sandy soils, and sandy soils over loamy soils. These soils have high water tables, and cover 2,445 hectares or about 4 percent of total area of the gun. They are:

Gangdong loam, 0 to 2 percent slopes
Sadu fine sandy loam, 0 to 1 percent slopes.

These soils have low available moisture capacities and rapid permeability, but have a high water table that is favourable for growing paddy rice. They are moderate to low in natural fertility, and low to moderately low in organic matter content.

Most of the soils are used and suitable for paddy rice because water is available, but they are subject to droughtiness if drained because of their rapid permeability and low available moisture capacity. The addition of fine clay, and compost, and split application of nitrogen are necessary to reduce the effects of leaching. Occasional growing of green manure crops will also improve fertility.

6.3.5 Paddy Suitability Group P2c

The soils in this group are level to nearly level, deep, well drained, moderately permeable, medium textured. They have high available moisture capacity, high natural fertility, and medium organic matter content. This group covers 3,006 hectares or approximately 4.5 percent of the gun. They are:

Gyuam silt loam, 0 to 2 percent slopes
Ihyeon silt loam, 0 to 2 percent slopes.

Loss of water and dissolved plant nutrients are a moderate problem. The loss of nitrogen fertilizer can be reduced by making several applications of it in small amounts during the growing season. Because of the loss of water, a good irrigation system is needed to maintain water level. Dense planting and spreading compost are good management practices. Barley grows well during the winter. Other summer crops, such as soybean,may be grown instead of paddy rice.

6.3.6 Paddy Suitability Group P3a

The only soil in this group, is sloping, poorly drained, deep, moderately permeable, having a high water table and high available moisture capacity. About one percent (8 hectares) of the gun is in this group. It is:

Jisan loam, 7 to 15 percent slopes.

The soil is now being suitably used for paddy rice, but the strong slopes are a limitation affecting paddy size and shape, and causing damage to dikes and loss of irrigation water following excessive rains. Weir dams are needed to control the run-off and regulate the water level required for the growth of paddy rice. Deep ploughing and proper fertilization will increase rice yields.

6.3.7 Paddy Suitability Group P3ab

This group consists of gently sloping to sloping, moderately well drained, deep, rapidly permeable, medium textured soils that have high water tables and low available moisture capacities. This group covers 950 hectares or 1.5 percent of the gun area. These soils are:

Sachon sandy loam, 2 to 7 percent slopes
Sachon sandy loam, 7 to 15 percent slopes.

Natural fertility and organic matter are moderate. The soil is used and suitable for paddy rice because of the high water table. Slope and low available moisture capacity are the chief limitations.

Paddy dikes with well-built weir dams are needed to control erosion. Nitrogen should be applied to the soils in several applications during the growing season. The addition of fine clay will also reduce the leaching of plant nutrients. Dense planting and dry land direct seeding are good rice culture practices.

6.3.8 Paddy Suitability Group P3ac

This group consists of sloping, deep, well or moderately well drained, moderately to moderately slowly permeable soils that have no, or a low, water table. These soils cover 1,979 hectares or about 3 percent of the gun total area. They are:

Banggi clay loam, 7 to 15 percent slopes
Bonggye silty clay loam, 7 to 15 percent slopes, eroded
Gaghwa cobbly silty clay loam, 7 to 15 percent slopes, eroded
Jangweon gravelly loam, 7 to 15 percent slopes
Songjeong loam, 7 to 15 percent slopes, eroded
Yongji loam, 7 to 15 percent slopes
Yuha silt loam, 7 to 15 percent slopes, eroded.

The Yongji soil alone is used for paddy rice. Available moisture capacity in the Yongji and Gaghwa soils are high, but the rest of the soils are low or moderate in this characteristic.

General crops other than rice, with some areas in forest or orchard are grown. Paddy rice will require difficult special development and management practices. For the paddy land, the soils should be level terraced and diked as well as a water supply developed. Paddies made on these soils will also need well-constructed weir dams to protect the dykes from overflow damage following intense rains. The paddy system also permits other general crops to grow on the soils without losses from erosion. Deep ploughing and application of compost would be good management practices.

6.3.9 Paddy Suitability Group P3b

The only soil in this group is level to nearly level, deep, poorly drained, rapidly permeable, sandy soil with low available moisture capacity and a high water table. It is usually on lower positions than the stream bed, and covers 228 hectares or approximately four tenths of one percent of the total gun area.

It is:

Sindab sandy loam, 0 to 2 percent slopes.

This soil is used and suited for paddy rice because of the high water table. But it is subject to droughtiness if drained because of the rapid permeability and very low available moisture capacity. Application of clayey soil and compost, and split application of fertilizer will reduce the leaching of plant nutrients and increase the crop yields. The occasional growing of green manure crops will improve the soil.

6.3.10 Paddy Suitability Group P3d

This group consists of level to nearly level, deep, poorly or imperfectly drained, slowly permeable, very strongly to extremely acid, salty soils. These soils are on the fluvio-marine plains near the coastal areas, covering 6,797 hectares or about 10 percent of the gun total area. They are:

Bongrim silty clay loam, 0 to 1 percent slopes
Deunggu silty clay loam, 0 to 1 percent slopes
Deunggu silty loam, 0 to 1 percent slopes
Gimhae silty clay loam, 0 to 1 percent slopes
Gwanghwal silt loam, 0 to 1 percent slopes
Haecheog silt loam, 0 to 1 percent slopes.

Paddy rice dominates and is suitable, but the high salt content in the Gwanghwal soils and the high acidity in the others, are limitations that reduce crop yields.

Much liming to correct the acidity, and frequent irrigation to remove the salt, are needed. They also need to be treated with silicate fertilizer. Salt-tolerant crops will grow well.

6.3.11 Paddy Suitability Group P4abc

This group consists of gently sloping to sloping, well drained, deep, moderately to moderately rapidly permeable, gravelly soils with moderate to low available moisture capacity. These soils have low or no water table, and cover 3,139 hectares or about 5 percent of the gun. They are:

Hogye gravelly loam, 2 to 7 percent slopes
Hogye gravelly loam, 7 to 15 percent slopes
Seogto gravelly loam, 7 to 15 percent slopes.

Very few areas have been developed into paddy system. They are poorly suitable for growing paddy rice, because of the slope and high water requirement. For its growth a dependable water supply is needed involving high construction costs. The losses too of water and plant nutrients would be high. The gravel interferes with cultivation if not removed.

Paddies made on these soils will need good weir dams to control erosion of paddy walls. They need too the addition of clayey soils and removal of gravels to reduce effects of leaching of plant nutrients. Proper fertilization, thick planting, and dry land direct seeding are good rice cultural practices. Compost added will also improve yields.

6.3.12 Paddy Suitability Group P4ac

This group consists of moderately steep, well drained, deep, moderately to moderately slowly permeable soils that have very low or no water table. This group covers 3,121 hectares or about four percent of the gun. These soils are:

Bonggye silty clay loam, 15 to 30 percent slopes, eroded
Bonggye cobbly silty clay loam, 15 to 30 percent slopes, eroded
Gaghwa cobbly silty clay loam, 15 to 30 percent slopes, eroded
Jangweon gravelly loam, 15 to 30 percent slopes
Songjeong loam, 15 to 30 percent slopes, eroded
Yulla silt loam, 15 to 30 percent slopes, eroded.

At present, most of the soils are in poor forest, with some areas in orchard and cultivated crops other than rice. Because of the strong slopes and the water problem paddy rice is not a good proposition. The land needs level-terracing and requires a dependable source of water. Direct seeding may be a way of growing rice on these soils. Cobbles and gravel need to be removed away for easier cultivation. Deep ploughing, and application of calcium silicate and compost are good management practices. Occasional growing of green manure crops will improve the soil fertility.

Erosion of paddy walls would be controlled by weir dams. Winter grain crops will grow well.

6.3.13 Paddy Suitability Group P4bc

The soils in this paddy suitability group are:

Hwabong sandy loam, 0 to 2 percent slopes
Hwangryong gravelly loamy sand, 0 to 2 percent slopes
Myeongji loamy fine sand, 0 to 2 percent slopes
Nagdong loamy fine sand, 0 to 2 percent slopes.

These soils are level to nearly level, deep, well drained, rapidly permeable, sandy soils with very low available moisture capacity and low water tables, covering 3,095 hectares or about 5 percent of the gun. They have low clay content and low cation exchange capacity, and are subject to droughtiness. Paddy rice is grown in a few small areas where water is available, but the remainder is poorly suited to cultivated crops other than peanut, melons, mulberry, and some orchard. To grow paddy rice on these soils, irrigation systems should be installed.

The loss of water and plant nutrients can be controlled to some extent by applying clayey soil. Split application of fertilizer will reduce their leaching.

Appendix 1

GLOSSARY

Acidity	See reaction, soil.
Acid Sulphate Soil	A wet soil containing iron sulphates and iron carbonates that is, or becomes, extremely acid when drained.
Alluvial	Consisting of, or formed in, material deposited by water.
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 centimetres) are the following: High - 25 centimetres or more; medium - 15 to 25 centimetres; low - 7 to 15 centimetres; and very low - less than 7 centimetres.
Base Saturation	The degree to whichs oil 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 milliequivalents (me.) per 100 grams 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 millimetres 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 of oriented clay particles.
Colluvial	Having been transported by gravity, mass slippage or a combination of slippage and local wash.
Colluvium	Soil material, rock fragments or both moved by creep, slide, or local wash and deposited at the base of a steep slope.
Consistence, Soil	The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are: Loose - Noncoherent; will not hold together in a mass;

Friable - When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump;

Firm - When moist, crushed under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable;

Plastic - When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger;

Sticky - When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material;

Hard - When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger;

Soft - When dry, breaks into powder or individual grains under very slight pressure.

Cutan — A coating or film, on the outside of a soil aggregate or mass. It may consist of clay, silt, oxides of iron or manganese, organic matter, or other materials.

Depth of Soil — Thickness of soil over a specified layer, generally a layer that does not permit the growth of roots. Classes used in this soil survey to indicate depth are the following: Deep - 1 metre or more; moderately deep - 50 centimetres to 1 metre; and shallow - less than 50 centimetres.

Erosion — The washing of soil from the soil surface. It includes washing of a continuous thin layer from the surface, known as sheet erosion, as well as the formation of small valleys known as gully erosion.

Family (soil) — A level of classification of closely related soils immediately above the series level. The soils of a family are usually very similar in their management characteristics.

Fluvio-marine — Deposited by joint action of streams and sea.

Fragipan — A dense and brittle pan, or layer, that owes its hardness mainly to extreme density or compactness rather than to content of much clay or cementation. Fragments that are removed are friable, but the material in place is so dense that roots cannot penetrate it and water moves through it very slowly by following vertical channels and cleavage planes.

Horizon, Soil — A layer of soil, approximately parallel to the surface, that has distinct characteristics.

Loam — (1) Soil containing a relatively even mixture of sand and silt and a somewhat smaller proportion of clay, generally a desirable quality. May be subdivided into textural classes, such as sandy loam, loam, silt loam, and clay loam.

Loam (cont'd)

(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 leveled, 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 centimetre 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 millimetre) in diameter to the lower limit of very fine sand (0.05 millimetre). 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 Suitability Group	Hectares	Percent
BeB	Bancheon silty clay loam, 2 to 7 percent slopes.	IIe	P2ac	222	0.34
BiB	Banggi clay loam, 2 to 7 percent slopes.	IIIe	P2ac	203	0.32
BiC	Banggi clay loam, 7 to 15 percent slopes.	IIIe	P3ac	110	0.17
BhB	Banho gravelly loam, 2 to 7 percent slopes.	IIe	P2ac	265	0.41
BRS	Beach and riverwash sandy.			709	1.08
ByC2	Bonggye silty clay loam, 7 to 15 percent slopes, eroded.	IIIe	P3ac	95	0.15
ByD2	Bonggye silty clay loam, 15 to 30 percent slopes, eroded.	IVe	P4ac	452	0.70
ByE2	Bonggye silty clay loam, 30 to 60 percent slopes, eroded.	VIe		451	0.70
BbD2	Bonggye cobbly silty clay loam, 15 to 30 percent slopes, eroded.	IVe	P4ac	411	0.63
BbE2	Bonggye cobbly silty clay loam, 30 to 60 percent slopes, eroded.	VIe		1,321	2.12
Bm	Bongrim silty clay loam, 0 to 1 percent slopes.	IIIwc	P3d	463	0.71
Bg	Buyong silty clay loam, 0 to 1 percent slopes.	IIIw	P1	1,472	2.25
Du	Deunggu silty clay loam, 0 to 1 percent slopes.	IIIwc	P3d	1,212	1.85
De	Deunggu silt loam, 0 to 1 percent slopes.	IIIwc	P3d	1,649	2.52
GaC	Gaghwa cobbly silty clay loam, 7 to 15 percent slopes, eroded.	IIIe	P3ac	1,271	1.93
GaD	Gaghwa cobbly silty clay loam, 15 to 30 percent slopes, eroded	IVe	P4ac	1,614	2.47

Map Symbol	Mapping Unit	Capability Unit	Paddy Suitability Group	Hectares	Percent
Gd	Gangdong loam, 0 to 2 percent slopes.	IIw	P2b	137	0.21
Gh	Gimhae silty clay loam, 0 to 1 percent slopes.	IIIwc	P3d	1,707	2.61
Gw	Gwanghwal silt loam, 0 to 1 percent slopes.	IIIwc	P3d	765	1.17
Gy	Gyuam silt loam, 0 to 2 percent slopes.	I	P2c	2,674	4.10
Hc	Haecheog silt loam, 0 to 1 percent slopes.	IIIwc	P3d	1,001	1.54
HgB	Hogye gravelly loam, 2 to 7 percent slopes.	IIs	P4abc	1,701	2.61
HgC	Hogye gravelly loam, 7 to 15 percent slopes.	IIIe	P4abc	166	0.25
Hn	Honam silty clay loam, 0 to 2 percent slopes.	IIIw	P1	1,041	1.60
Hw	Hwabong sandy loam, 0 to 2 percent slopes.	IVs	P4bc	592	0.91
HdB	Hwadong silty clay loam, 2 to 7 percent slopes.	IIe	P2ac	220	0.34
HL	Hwangryong gravelly loamy sand, 0 to 2 percent slopes.	IVs	P4bc	720	1.10
Ih	Ihyeon silt loam, 0 to 2 percent slopes.	I	P2c	332	0.51
JwE	Jangweon gravelly loam, 7 to 15 percent slopes.	IVe	P3ac	202	0.32
JwD	Jangweon gravelly loam, 15 to 30 percent slopes.	IVe	P4ac	118	0.18
JuB	Jangyu silty clay loam, 2 to 7 percent slopes.	IIIe	P2ac	857	1.32
Jb	Jeonbug silt loam, 0 to 1 percent slopes.	IIw	P1	474	0.72
JiB	Jisan loam, 2 to 7 percent slopes.	IIw	P2a	1,133	1.74
JiC	Jisan loam, 7 to 15 percent slopes.	IIIe	P3a	89	0.13
MdD	Mudeung rocky loam, 15 to 30 percent slopes.	VIe		385	0.58
MdE	Mudeung rocky loam, 30 to 60 percent slopes.	VIe		5,738	8.78

Map Symbol	Mapping Unit	Capability Unit	Paddy Suitability Group	Hectares	Percent
MdF	Mudeung rocky loam, 60 to 100 percent slopes.	VIIe		3,273	5.01
MvE	Mudeung very rocky loam, 30 to 60 percent slopes.	VIIe		901	1.40
MvF	Mudeung very rocky loam, 60 to 100 percent slopes.	VIIe		2,370	3.63
My	Myeongji loamy fine sand, 0 to 2 percent slopes.	IIIs	P4bc	647	1.00
Nd	Nagdong loamy fine sand, 0 to 2 percent slopes.	IIIs	P4bc	1,136	1.75
RC	Riverwash cobbly.			273	0.42
RL	Rock land.			4,023	6.18
ScB	Sachon sandy loam, 2 to 7 percent slopes.	IIe	P3ab	436	0.67
ScC	Sachon sandy loam, 7 to 15 percent slopes.	IIIe	P3ab	514	0.80
Sd	Sadu fine sandy loam, 0 to 1 percent slopes.	IIIw	P2b	2,308	3.55
SgD2	Samgag sandy loam, 15 to 30 percent slopes, eroded.	IVe		215	0.33
SmE2	Samgag rocky sandy loam, 30 to 60 percent slopes, eroded.	VIe		1,791	2.75
SmF2	Samgag rocky sandy loam, 60 to 100 percent slopes, eroded.	VIIe		15	0.02
StC	Seogto gravelly loam, 7 to 15 percent slopes.	IIIe	P4abc	1,272	1.94
SsC	Seogto stony loam, 7 to 15 percent slopes.	VIe		46	0.07
SsD	Seogto stony loam, 15 to 30 percent slopes.	VIe		2,045	3.14
SbC	Seogto bouldery loam, 7 to 15 percent slopes.	VIe		355	0.54
SbD	Seogto bouldery loam, 15 to 30 percent slopes.	VIe		553	0.85

Map Symbol	Mapping Unit	Capability Unit	Paddy Suitability Group	Hectares	Percent
SiC	Sinbul stony loam, 7 to 15 percent slopes.	VIe		6	0.01
SiD	Sinbul stony loam, 15 to 30 percent slopes.	VIe		105	0.16
Sn	Sindab sandy loam, 0 to 2 percent slopes.	IVw	P3b	228	0.35
Sh	Sinheung loam, 0 to 2 percent slopes.	IIw	P1	698	1.07
SoC2	Songjeong loam, 7 to 15 percent slopes, eroded.	IIIe	P3ac	54	0.08
SoD2	Songjeong loam, 15 to 30 percent slopes, eroded.	IVe	P4ac	394	0.60
SoE2	Songjeong loam, 30 to 60 percent slopes, eroded.	VIe		739	1.14
Sk	Sugye silty clay loam, 0 to 2 percent slopes.	IIw	P1	293	0.48
TaD2	Taehwa loam, 15 to 30 percent slopes, eroded.	IVe		385	0.60
TaE2	Taehwa loam, 30 to 60 percent slopes, eroded.	VIe		598	0.92
TrD2	Taehwa rocky loam, 15 to 30 percent slopes, eroded.	IVe		254	0.40
TrE2	Taehwa rocky loam, 30 to 60 percent slopes, eroded.	VIe		842	1.30
TF	Tidal flat.			2,510	3.85
YjB	Yongji loam, 2 to 7 percent slopes.	IIe	P2ac	823	1.26
YjC	Yongji loam, 7 to 15 percent slopes.	IIIe	P3ac	190	0.30
YhC2	Yuha silt loam, 7 to 15 percent slopes, eroded.	IIIe	P3ac	56	0.08
YhD2	Yuha silt loam, 15 to 30 percent slopes, eroded.	IVe	P4ac	132	0.20

Map Symbol	Mapping Unit	Capability Unit	Paddy Suitability Group	Hectares	Percent
YhE2	Yuha silt loam, 30 to 60 percent slopes, eroded.	VIe		64	0.10
	WR			183	0.28
	Other			2,415	3.71
	Total area of gun.			65,114	100.00

Plate 1
Large gully in area of Gaghwa soils

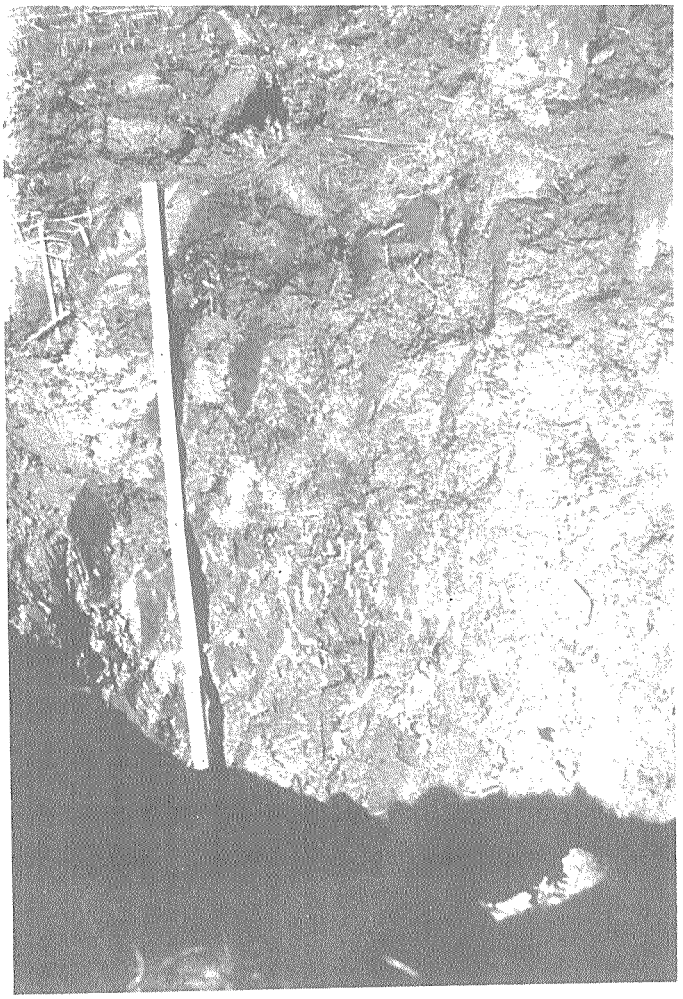


Plate 2

Profile of Gimhae silty clay loam. The light coloured streaks below the plough layer are yellow mottles of iron sulphates

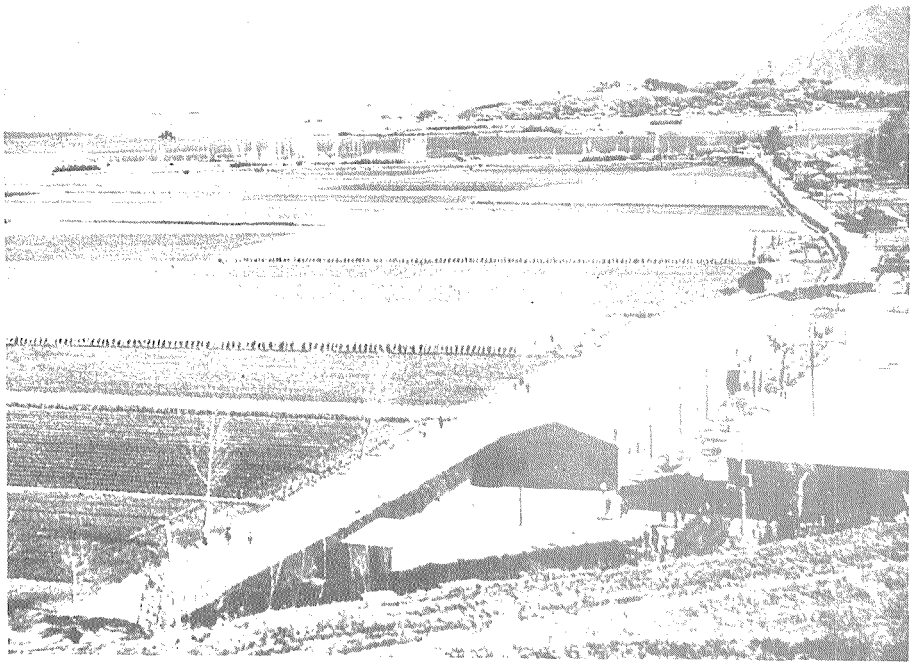


Plate 3
An area of Gimhae soils near Bongnam Ri. These soils produce rice and other crops during the summer. In the winter, temporary greenhouses of bamboo poles and plastic sheeting are erected and many vegetable crops grown

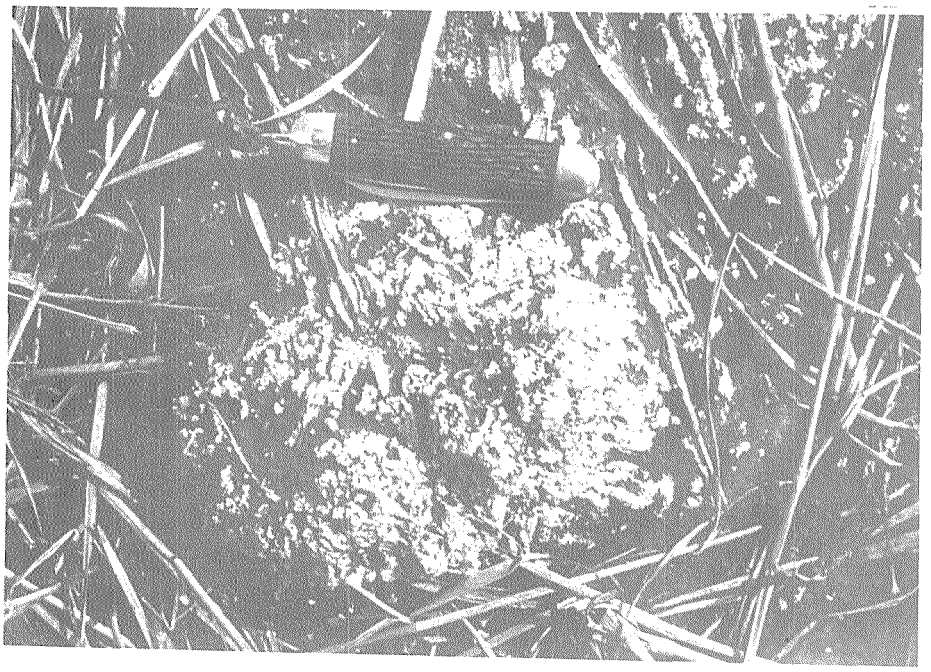


Plate 4
Salt crystals on Gwanghwal soils. These salt crystals are formed on the surface during periods of dry weather (Class III wc)

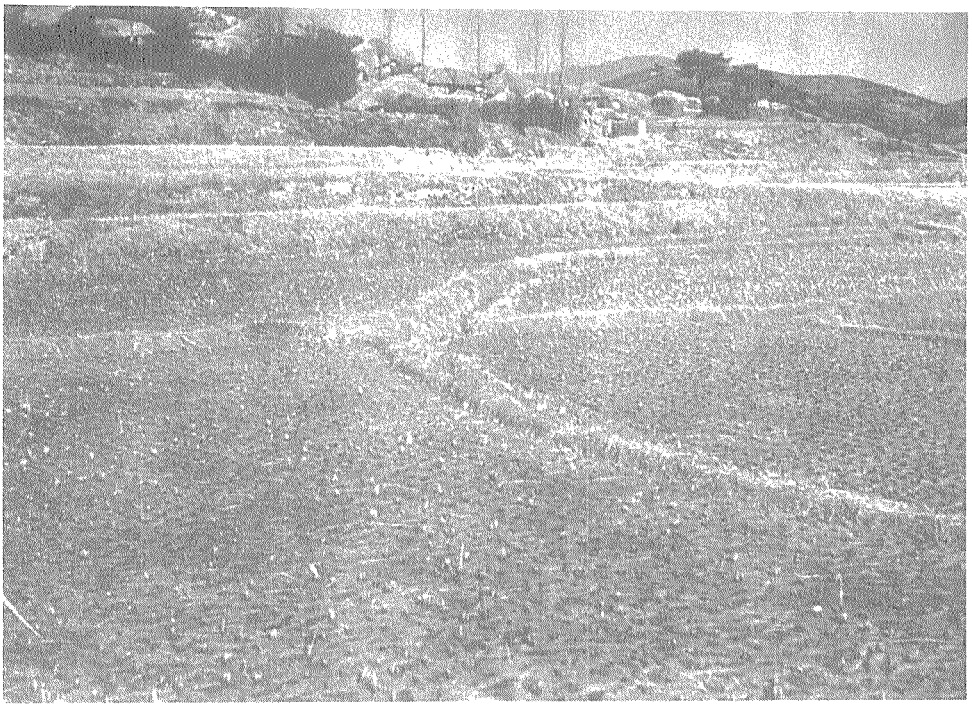


Plate 5
Wet Jisan soils. Jisan soils in the small valley in the foreground are usually too wet for crops other than rice. The village in the background is on Gaghwa soils

Plate 6
Characteristic view of class VIe land: Mudeung rocky loam. The rocks on this soil are usually most numerous at the top of the mountain, as in this picture. This area has a good covering of grass which protects it from erosion

Plate 7
Onions growing on Myeongji soil. Onions (Scallions) are the principal crop on this sandy, calcareous soil.

Plate 8
Area of Samgag and Songjeong soils. Small village south of Gimhae. The hill in the background is dotted with graves. Small areas of these steep soils are levelled into benches and planted to barley, soybean, and vegetable crops.

Plate 9
Characteristic view of class II w land consisting of Sinheung soils. These soils have produced a crop of rice. The field in the foreground has been ploughed for next year's crop. The field to the left has been planted to cabbage.

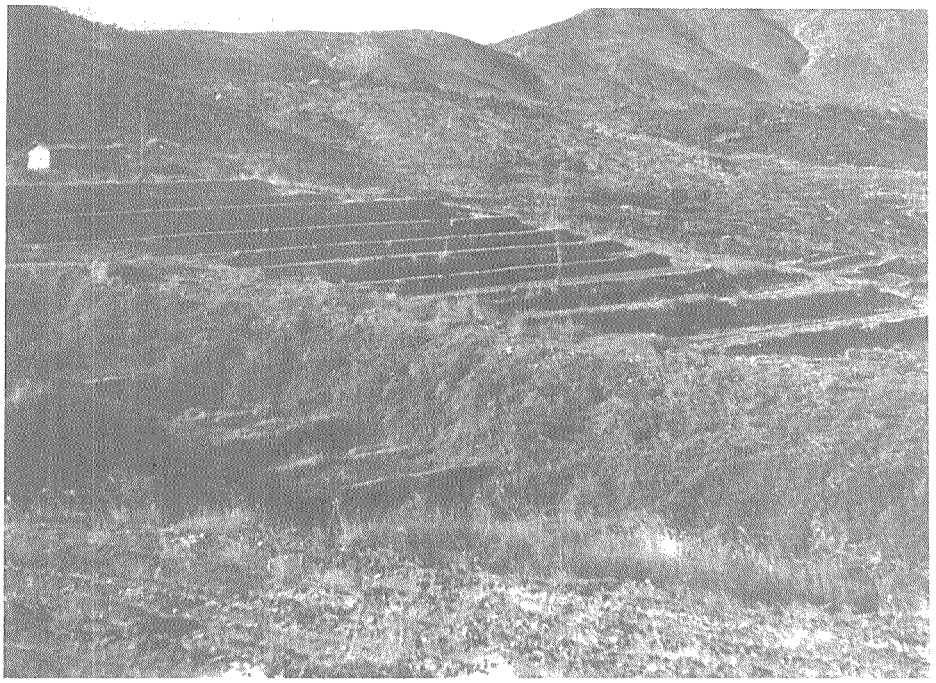


Plate 10
Bench terraces built on class III e land, mainly Yuha soils. Bench terraces are helpful in controlling erosion.

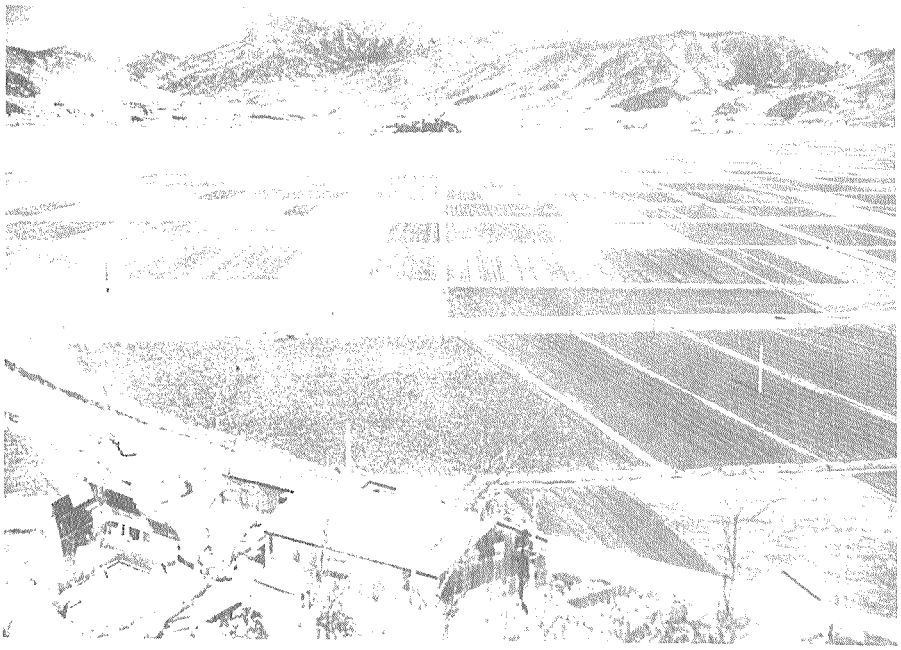


Plate 11
Class III wc and III w land consisting of Deunggu and Buyong soils. This area was drained and planted to rice about 1950. It is Northeast of Bongrim Ri.

Plate 12

Cobbles and, small stones in paddy walls. Cobbles and small stones make up much of the paddy walls of rice paddies built on Gaghwa soils. Rearrangement of paddies for more efficient cultivation is difficult and costly because of these coarse fragments.

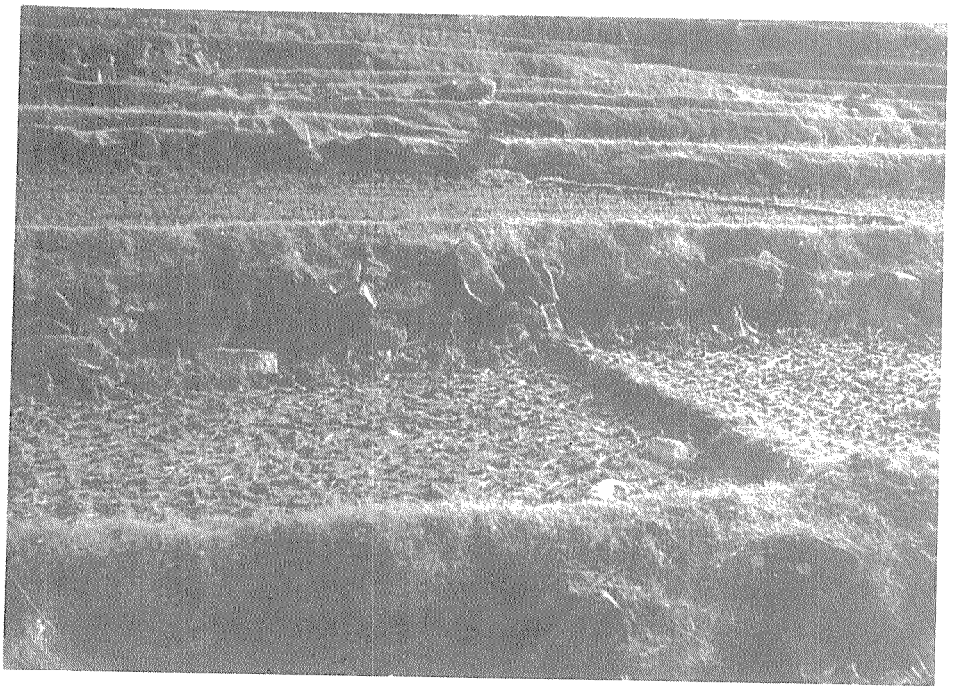
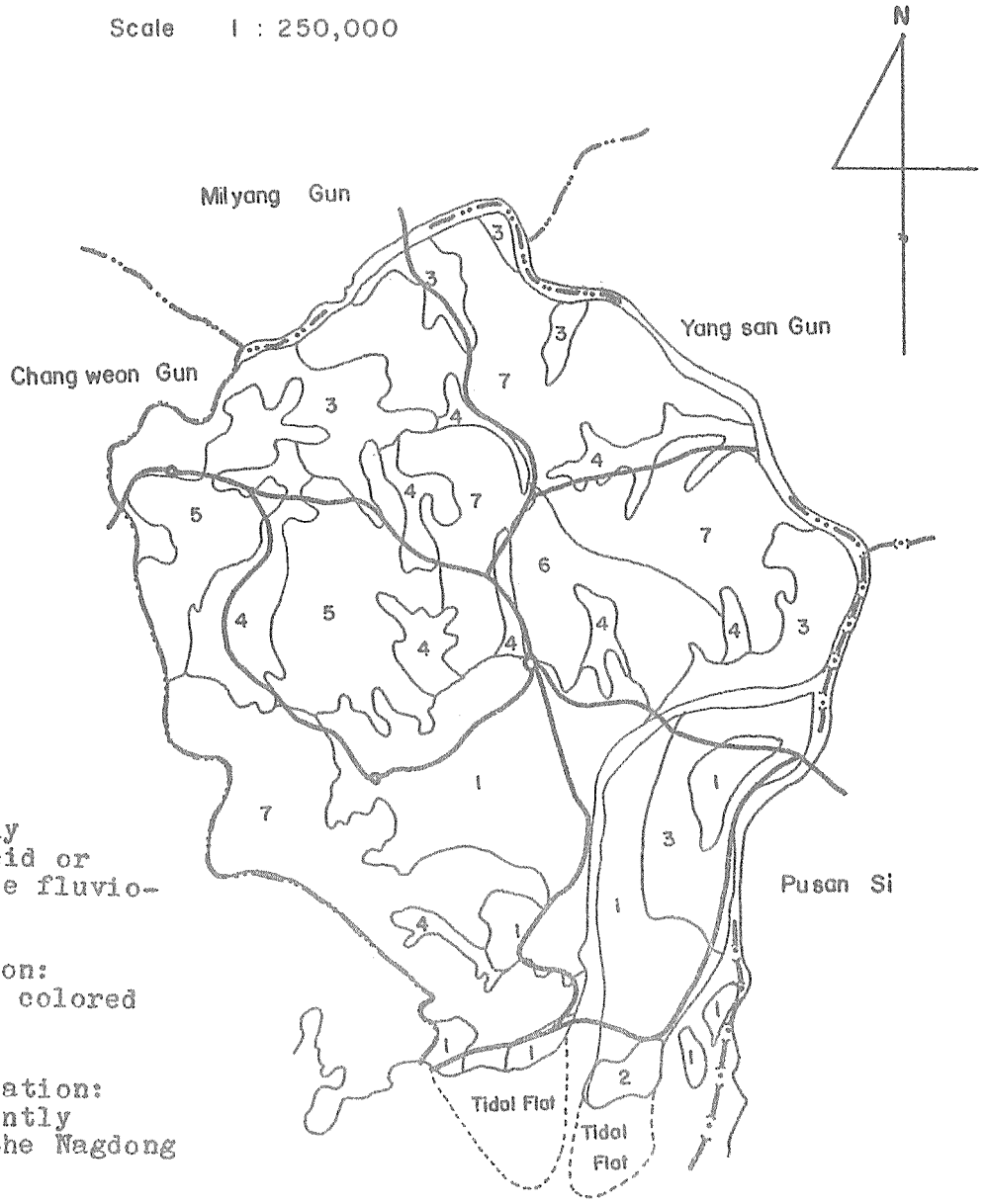


Plate 13
Persimmon trees on class VI e land consisting of Taehwa soils. Many orchards of these trees have been planted on Gaghwa soils. Bench terraces have been built to aid in erosion control. The area is southeast of Jinyong. Slopes are 30 to 60 percent eroded.

GENERAL SOIL MAP OF GIMHAE GUN

Scale 1 : 250,000



SOIL ASSOCIATIONS

[1] Deunggu-Gimhae Association: Nearly level generally acid or saline soils of the fluvio-marine plains.

[2] Myeongji Association: Nearly level, dark colored sandy soils.

[3] Gyuam-Honam Association: Nearly level to gently sloping soils of the Nagdong River plain.

[4] Hogye-Jisan Association: Level to sloping soils of the small valleys.

[5] Bonggye-Taehwa Association: Sloping to steep, deep, and shallow soils of the hilly areas.

[6] Samgag-Songjeong Association: Moderately steep and steep, well drained, sandy and loamy soils overlying coarse textured igneous rock.

[7] Mudeung-Rock Land Area: Steep and very steep shallow soils, rock outcrops and very stony lands.