AGL:SF/KOR 13
Technical Report 8

# SOIL SURVEY

# REPUBLIC OF KOREA

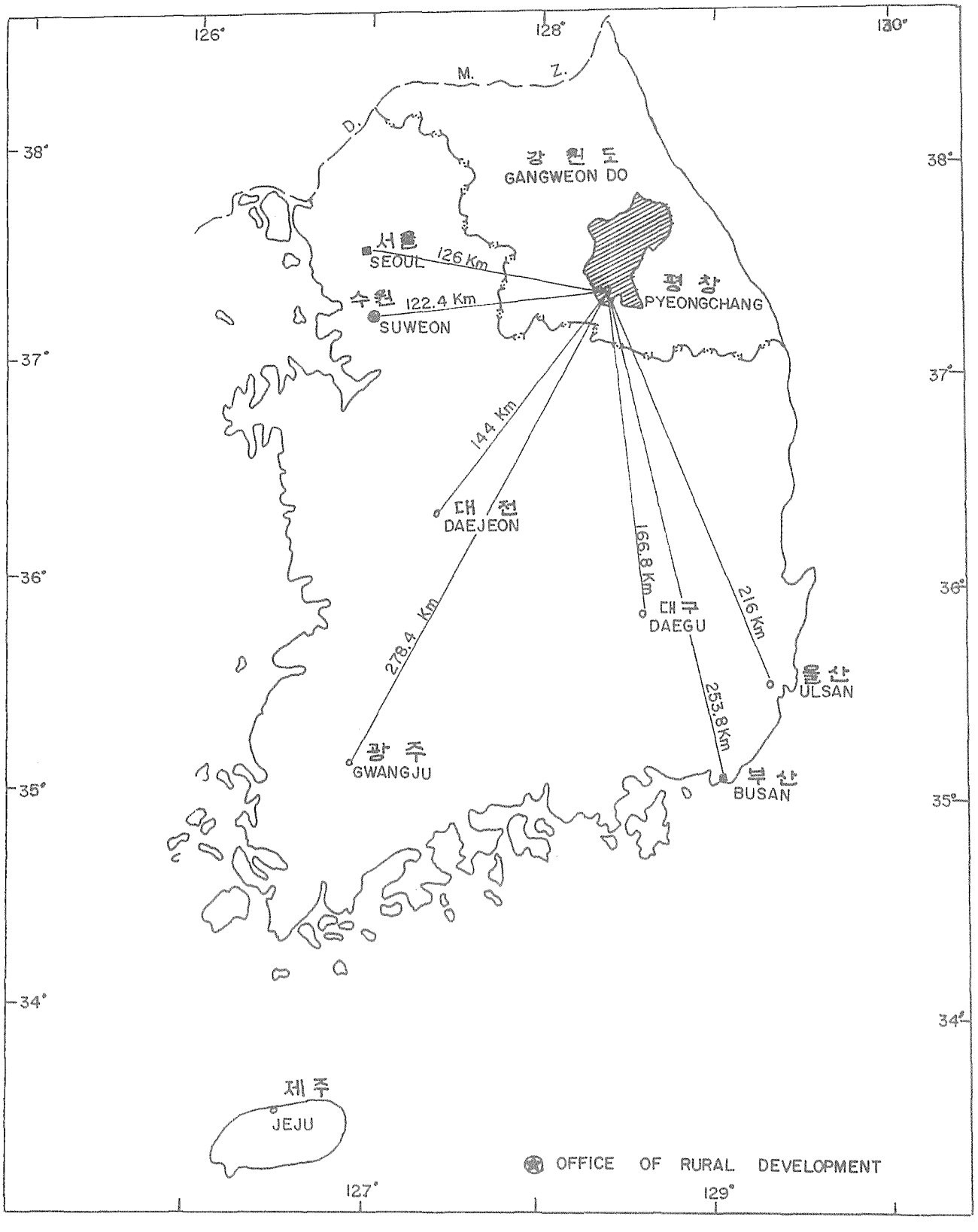
## SOIL SURVEY IN PYEONGCHANG GUN, GANGWEON DO

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

# SOIL SURVEY

# REPUBLIC OF KOREA

# LOCATION MAP OF PYEONGCHANG GUN, GANGWEON DO



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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, 1971

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.
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## ABSTRACT

This report describes soil survey activities in Pyeongchang 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/. The entire area of the Gun (146 300 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 1:250 000, 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. 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.

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

Grateful acknowledgement is made of the keen interest and full support extended throughout the project toward the soil survey team by the Ministry of Agriculture and Forestry, the Government Cooperating Agency and by counterpart staff.

TABLE OF CONTENTS


| | | Page |
|---|---|---|
| Chapter 1 | INTRODUCTION | 1 |
| Chapter 2 | GENERAL DESCRIPTION OF THE AREA | 3 |
| | 2.1 Location | 3 |
| | 2.2 Physiography | 3 |
| | 2.3 Water Supply | 4 |
| | 2.4 Climate | 4 |
| | 2.5 Agriculture | 5 |
| Chapter 3 | HOW THE SURVEY WAS MADE | 7 |
| Chapter 4 | DESCRIPTION OF THE GENERAL SOIL MAP | 8 |
| | 4.1 Introduction | 8 |
| | 4.2 Odae-Weoljeong Association | 8 |
| | 4.3 Sunbul-Mui Association | 8 |
| | 4.4 Cheongsim Association | 9 |
| | 4.5 Hogye-Bonryang Association | 9 |
| | 4.6 Jangseong-Mitan Association | 9 |
| | 4.7 Bancheon-Gaghwa Association | 10 |
| | 4.8 Chahang-Weoljeong Association | 10 |
| Chapter 5 | DESCRIPTION OF SOILS | 11 |
| | 5.1 Introduction | 11 |
| | 5.2 Anmi Series | 11 |
| | 5.3 Bancheon Series | 15 |
| | 5.4 Bonryang Series | 17 |
| | 5.5 Chahang Series | 18 |
| | 5.6 Cheongsim Series | 20 |
| | 5.7 Gaghwa Series | 21 |
| | 5.8 Gwanag Series | 23 |
| | 5.9 Hogye Series | 24 |
| | 5.10 Hwangryong Series | 25 |
| | 5.11 Imog Series | 26 |
| | 5.12 Jangseong Series | 27 |
| | 5.13 Jungdong Series | 28 |
| | 5.14 Maji Series | 29 |
| | 5.15 Mitan Series | 31 |
| | 5.16 Mui Series | 32 |
| | 5.17 Odae Series | 34 |
| | 5.18 Oesan Series | 35 |
| | 5.19 Pyeongan Series | 37 |
| | 5.20 Pyeongchang Series | 38 |
| | 5.21 Riverwash, Cobbly (RC) | 40 |
| | 5.22 Rock Land (RL) | 40 |
| | 5.23 Sinbul Series | 40 |
| | 5.24 Songjeong Series | 42 |

| | | Page |
|---|---|---|
| | 5.25 Subug Series | 43 |
| | 5.26 Ungyo Series | 45 |
| | 5.27 Wangsan Series | 46 |
| | 5.28 Weoljeong Series | 47 |
| Chapter 6 | USE AND MANAGEMENT OF SOILS | 50 |
| | 6.1 Introduction | 50 |
| | 6.2 Capability Groups of Soils | 50 |
| | 6.3 Paddy Land Suitability Group | 56 |
| Appendix | GLOSSARY | 65 |


## LIST OF TABLES


| | | |
|---|---|---|
| 1. | General Weather Conditions (1967-1968) | 5 |
| 2. | Soil Series Classified according to the Current and Previous Systems of Classification | 12 |
| 3. | Guide to Mapping Units | 61 |


## LIST OF MAPS


| | | |
|---|---|---|
| 1. | Location Map of Pyeongchang Gun, Gangweon Do | frontispiece |
| 2. | General Soil Map of Pyeongchang Gun | 69 |

# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| cm | - | centimetre |
| ha | - | hectare |
| m | - | metre |
| mm | - | millimetre |

# Chapter 1

## INTRODUCTION

The detailed soil survey described in this report began in October 1967 and was completed in December 1968. It formed part of the Korean Soil Survey conducted by the Government of the Republic of Korea with the assistance of the United Nations Special Fund 1/. The Government Cooperating Agency was the Ministry of Agriculture and Forestry. The executing agency for the United Nations Special Fund was the Food and Agriculture Organization of the United Nations.

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 Project new research and new cartographic methods have been used in detailed soil surveys, by FAO soil experts and trained counterpart staff. The counterpart personnel were trained in techniques of soil survey, characterization, correlation, and classification by the FAO soil scientists before participating in the field soil survey work.

This report is an inventory of research findings, in maps and in writing, of soil and soil conditions in Pyeongchang Gun. It contains important information which will assist the Gun personnel, landowners, 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: Seong-Yang Ha and Charles E. Downey. It is based on the work of:

Field Survey: Seong-Yang Ha
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1/ The United Nations Special Fund and the Expanded Programme of Technical Assistance were merged to form the United Nations Development Programme on 1 January 1966.

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John F. Derting

Correlation: Byeong-Jae Kim
John F. Derting
Charles E. Downey

The list of technical reports is as follows:

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. Soil Survey in Ulju Gun and Ulsan Si
Technical Report 4. Soil Survey in Gimhae Gun
Technical Report 5. Soil Survey in Dalseong Gun and Daegu Si
Technical Report 6. Soil Survey in Gwangsan Gun, Damyang Gun, and Gwangju Si
Technical Report 7. Soil Survey in Sangju Gun
Technical Report 8. Soil Survey in Pyeongchang Gun, Gangweon Do
Technical Report 9. Soil Survey in Gimje Gun
Technical Report 10. Soil Survey in Buyeo Gun

Each individual detailed Soil Survey Area Report (Reports 3 to 10) is accompanied by a detailed soil map at scale 1:250 000.

# Chapter 2

## GENERAL DESCRIPTION OF THE AREA

### 2.1 LOCATION

Pyeongchang Gun is in the southern part of Gangweon Do which is the northeastern part of the Republic. Its maximum width is 45 km and it is 60 km long north to south. The area is bounded on the north by Myeongju, Yangyang, and Hongcheon Guns, on the east by Jeongseon Gun, on the south by Yeongweol Gun and on the west by Hoengseong Gun. The total extent is approximately 146 300 ha.

### 2.2 PHYSIOGRAPHY

The Pyeongchang Gun includes portions of steep mountains with heights of up to 1 500 m, and extending from northeast to northwest on the northern part of the Gun. These parts include mountains, such as Mt. Odae (1 563 m), Mt. Gyebang (1 577 m), Mt. Heungjeong (1 276 m) and Mt. Taegi (1 266 m). The Taebaeg range extends from north to south across the eastern part of the area. In the southwest sector, between the two chains of mountains, is a vast plateau table land named the Daegwalyeong plain, with gentle to moderately steep slopes.

Granite is one of the most extensive geological materials, occupying approximately 56 900 ha (39 percent) of the area. It mainly occurs in Jinbu and Daehwa Myeons in the northcentral parts, and in places in Pyeongchang Myeon. The mountainous regions and the plateau land in the Daegwalyeong are formed from this granite. Much of the upper part is weathered to saprolite, which ranges from 2 to 10 or more metres in Weoljeong, Chahang, and Songjeong soils. In the Gwanag soils it is thin.

In general, most of the areas formed from this material have complex slopes ranging up to excessively steep, and have many scattered blocks and debris of rocks caused by erosion and disintegration. Accordingly, crop cultivation is limited to small areas such as mountain footslopes and fans. As the upland soils are high in organic matter, they would be suited to crop production should the stones and debris be removed. Forestry products are mainly from pine, with some broad-leaved trees of various sorts. In areas where the land is more than 700 m above sea level, it is normally covered with shrubs.

Granite-gneiss rocks cover about 34 000 ha (23 percent) of the survey area, occurring in the very steep mountains, including such peaks as Mt. Odae, Mt. Gyebang, and Mt. Heungjeong, which have the highest elevations above the sea level. A few scattered areas are used for agricultural purposes, but generally productivity is too low for forest, with only various bushes growing, due to the shallow depth.

Limestone occupies about 21 900 ha (15 percent), and occurs mainly in areas of Mitan and Pyeongchang Myeons in the southcentral part, and between the three-fork

road named Bongrim and the seat of Taehwa Myeon. Most of the limestone is in high mountains, with excessively steep slopes. The soils there are very shallow, and are not well suited for upland crops cultivation or forest crops. Miscellaneous trees and shrubs grow in the higher areas.

Shale covers about 32 175 ha (22 percent) of the Gun, mainly in Cheongshimdae and Yugbaegmaji, and in Geomun Ri, Jinby Myeon, on the east. The soils of these areas are of only limited suitability for forest, including pines and shrubs. Some small scattered mountain footslopes are suited for upland crop cultivation.

Small areas of phyllite occur mainly in Anmi Ri, in the central part and in Daehwa Myeon, occupying about 720 ha (less than 1 percent) of the total survey area.

### 2.2.1 Parent Material

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

The underlying rocks are granite, granite-gneiss, limestone and shale. Granite is most extensive, being distributed throughout the northcentral parts of the Gun. Granite-gneiss is also extensive, especially in the highest mountains. The Chahang, Gwanag, Songjeong, Odae and Weoljeong series developed in materials weathered from granitic rocks. Limestone is extensive in the southcentral part of the Gun. Important soils in this area are in the Jangseong and Pyeongchang series. The Cheongsim series developed over shale.

In colluvial and local alluvial positions soil materials have moved from above and accumulated, forming parent materials for such series as Mui, Mitan, Sinbul and Maji. Each of these has some characteristics of the parent rock. For example, soils from limestone are high in bases and those from granite are low.

Alluvial soils formed on stream floodplains and terraces are not as extensive in Pyeongchang Gun as elsewhere in Korea, but are very important to the agriculture. Bonryang and Subug are representative series in recent alluvium, and the Bancheon series is on older terraces.

## 2.3 WATER SUPPLY

The main streams that furnish water in the area are the Odae and Pyeongchang rivers. The Odae, originating from Mt. Odae, passes through Jinbu Myeon and flows into the area of Yungseon Gun. The Pyeongchang originates from Mt. Gyebang and Mt. Heungjeong and flows into Yongweol Gun. These two form the main upper courses of the Han which passes through Seoul, the nation's capital. In the alluvial plains along these two main rivers are large irrigated paddy fields, mostly in Jinby, Bongpyeong and Daehwa Myeons.

## 2.4 CLIMATE

The average annual temperature is 9°C or lower in the high mountain areas in the northern portion of the Gun, and 12°C or higher in the southern portion where Pyeongchang and Mitan Myeons are seated. The difference of average thawing dates between the northern and southern sections ranges from 10 to 15 days.

Seasonal changes showing the average dates of frost, snowfall and freezing are:

| | |
|---|---|
| First killing frost | 21 October |
| Last killing frost | 1 May |
| First snowfall | 24 October |
| Last snowfall | 16 April |
| First ice | 21 October |
| Last ice | 17 April |

The area has a temperate climate, with cold, dry winters and warm, humid summers. The average temperature and distribution of rainfall, by months, are indicated in Table 1. The soils are moist much of the time from May through September and are moderately dry much of the time from October until April.

At high elevations in the northern part of the Gun, temperatures are much lower than at lower elevations. The principal difference in soil formation which the temperature difference has caused is in the accumulation of organic matter. Soils at high elevations such as the Odae and Chahang series have dark coloured surfaces which are high in organic matter. As can be expected in a climate of this type, most of the soils are highly weathered, leached, strongly acid, and low in fertility.

Table 1

GENERAL WEATHER CONDITIONS (1967-1968)

| Month | Average daily maximum | Average daily minimum | Average total | Precipi-tation | Evapora-tion |
|---|---|---|---|---|---|
| January | 6.0 | -14.8 | - 8.5 | 5.2 | 38.4 |
| February | 11.1 | -19.5 | - 6.9 | 8.8 | 38.9 |
| March | 14.1 | -11.9 | 1.6 | 30.0 | 52.9 |
| April | 22.6 | - 7.7 | 6.3 | 88.5 | 89.1 |
| May | 26.2 | - 0.7 | 14.0 | 43.2 | 169.5 |
| June | 24.7 | 16.4 | 14.8 | 123.0 | 84.4 |
| July | 28.4 | 16.9 | 20.0 | 126.2 | 94.3 |
| August | 29.8 | 14.9 | 22.3 | 124.0 | 98.9 |
| September | 23.3 | 6.0 | 13.3 | 249.2 | 43.2 |
| October | 18.2 | - 2.9 | 8.1 | 62.4 | 70.3 |
| November | 15.2 | 13.6 | 1.3 | 136.9 | 46.0 |
| December | 4.1 | -21.9 | - 9.0 | 8.7 | 29.8 |
| Annual | 18.6 | 3.7 | 6.4 | 84.7 | 71.3 |

## 2.5 AGRICULTURE

Small areas of soils along streams and in narrow valleys within the mountainous areas are suitable for irrigated paddy cultivation. The sloping to hilly areas among the mountains are suited to potatoes and corn, the major agricultural products in the region. Mountain footslopes and plateaus in the highly elevated areas, are mostly suited to short season vegetables, including radish and cabbage, and some

areas are cultivated to potatoes for seed. Valley bottom soils and gently sloping areas where there is protection against southeasterly winds during summer seasons, are of limited suitability for the hop plant. In the vicinity of the Alpine Experiment Station some parts have been developed into pastures, making this the livestock centre of the Gun. Remaining areas, including most of the Gun, are in woodland.

## Chapter 3

## HOW THE SURVEY WAS MADE

This survey was made to learn what kinds of soils are in Pyeongchang 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 of crops growing on the soil; kinds of rock and other materials that are under the soil; and many other facts about them.

Comparisons were made among the profiles studied, and were compared with those where other detailed soil surveys had been carried out. Soils were named and classified according to the 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 characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped.

Bancheon and Mitan, for example, are the names of two soil series in Pyeongchang Gun. These would have essentially the same characteristics as the Bancheon and Mitan soils mapped in other areas of Korea. Soils of one series, however, can differ somewhat in slope or some other characteristic that affects use. Some series vary so much in slope, degree of erosion, or some other features affecting use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil series are divided into mapping units. The name of a mapping unit indicates a feature that affects management. For example, Hogye gravelly loam, 0 to 2 percent slopes, is one of three phases of Hogye gravelly loam, a soil type that is nearly level to sloping in this area.

The soil map in the back of this report was prepared from aerial photographs. The areas shown on a soil map are called mapping units. They define soil characteristics in a greater detail than the soil series and provide information in sufficient detail to be useful in management of farms and fields.

There are also mapped areas that are so rocky or so frequently worked by water that they scarcely can be called soils. These are shown on the soil map like other mapping units, but are given descriptive names, such as riverwash, cobbly, and rocky land. They are called land types rather than soils.

# Chapter 4

## DESCRIPTION OF THE GENERAL SOIL MAP

### 4.1 INTRODUCTION

The general soil map (Map 2) shows the soil associations in the survey area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and is named for the major soils. The soils in one association may occur in another, but in a different pattern.

This map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The seven soil associations in Pyeongchang Gun are described, and some general information is given, on the development and use of the area. Detailed information about soils and land types in each soil association is given in the section 'Description of the soils'.

### 4.2 ODAE-WEOLJEONG ASSOCIATION

Steep and very steep, dark coloured soils

This association, mainly in the centre, north, and west, includes the highest land in the Gun. At high elevations the low temperatures and grass vegetation have caused dark coloured surface soils with high organic matter content to form. The Weoljeong have coarse sandy loam surface layers over a thick layer of granite and granite-gneiss saprolite of the same texture. The Odae have similar surfaces but are underlain by hard rock within 50 cm. They are the most extensive in upper mountain crests covering about 50 percent of the area. The Weoljeong are mainly on the mountain sides and are about 40 percent. Minor soils, mainly of the Sinbul, Chahang, and Mui series, in the small valleys, are the remaining 10 percent.

Forestry is the principal land industry but some of the grassy areas could produce some grazing. The development of forest resources by sound woodland management practices will add to productivity.

### 4.3 SUNBUL-MUI ASSOCIATION

Sloping to steep, dark coloured, deep, loamy soils

This association is in the narrow valleys and alluvial fans of the small streams. The soils are developed in colluvial materials from adjacent mountain

slopes. The Sinbul and Mui soils are about 75 and 15 percent respectively of the association. The Sinbul are very bouldery or stony loam or sandy loam with dark coloured surfaces. The Mui have fewer stones than the Sinbul, but resemble them in most other respects. Mitan and Pyeongsan soils occur in limestone areas. These soils are also similar to both except in having neutral to alkaline reactions and light coloured surfaces. Other minor series include the Gaghwa and Ungyo.

Almost all of this association has been cleared and about 80 percent cultivated to crops, including radish and cabbage. Much corn is grown on the Mitan and Pyeongan which have lower elevations than the Sinbul and Mui. Some corn is grown on the latter two which are on much higher elevations, having a cooler climate and a shorter growing season. Hops are an important crop in the higher elevations, but most cultivation and planting is done by hand, the use of machinery not being practical in these stony, cobbly, and gravelly soils.

## 4.4 CHEONGSIM ASSOCIATION

Steep and very steep, moderately deep, somewhat dark coloured soils

This association is in the southern part of the Gun near the Gun boundary. Cheongsim soils dominate here, covering about 80 percent of the area. A typical Cheongsim soil is loam or silt loam, with many soft shale gravel pieces and cobbles, and underlain by almost solid shale at 50 to 100 cm. The minor soils, mainly Sinbul and Mui, are in the very small valleys. They make up the remaining 20 percent of the area.

Some areas may produce grazing, but generally best returns will come from well managed woodland.

## 4.5 HOGYE-BONRYANG ASSOCIATION

Nearly level to sloping, mainly well drained alluvial plain soils

This association is the alluvial soils in the valleys of the larger streams. Hogye are most extensive, being about 60 percent. They are very gravelly loam with thick dark surface layers. Bonryang soils make up about 20 percent of this soil area, and are sandy loam and fine sandy loam over sand. Minor soils include Maji, Anmi, and Subug. The Maji and Anmi are similar to the Hogye, but differ in reaction and colour.

The Subug are poorly drained and are planted only to rice. On the rest of the soils rice, corn, and many vegetable crops are grown. Improved management including liming and fertilization is needed to increase crop yields.

## 4.6 JANGSEONG-MITAN ASSOCIATION

Sloping to steep, shallow to deep, gravelly to rocky neutral to alkaline soils

This association is mainly in the south along the Pyeongchang river and in the extreme southeast. Jangseong, a steep, to very steep, shallow rocky soil, is dominant,

covering about 70 percent of the association. It is mainly on the upper slopes and crests of the mountains. Pyeongchang soils cover about 15 percent and occupy the lower convex slopes. They are deep soils that are moderately steep or steep with many rocky areas. Mitan soils are about 10 percent of the association, and are moderately steep. They are not rocky, but contain much gravel and many cobbles. The Pyeongan soils cover about 5 percent, being sloping to moderately steep, deep soils with some gravel and cobbles.

Most of the Jangseong are in woodland, and the Pyeongchang, Mitan, and Pyeongan soils are planted to many kinds of crops. They are well suited, but soil erosion is a severe or very severe problem. High yields of grass and legume forage crops are possible on this productive land.

## 4.7 BANCHEON-GAGHWA ASSOCIATION

Gently sloping to steep, well drained clayey soils

The extent of this association is small, occurring mainly as small areas in the larger river valleys. The Bancheon soils are on dissected terraces and cover about 60 percent. The Gaghwa, about 30 percent, are on footslope positions, developed in cobbly clay loam colluvium. Minor soils comprise the remaining 10 percent.

Except for strongly sloping areas, almost everywhere has been cleared and planted to a wide variety of crops. Soil erosion is a problem, while much lime and other fertilizers are needed to obtain maximum production. However, though small, this land is important to the agricultural production of the Gun.

## 4.8 CHAHANG-WEOLJEONG ASSOCIATION

Sloping to steep, dark coloured loamy, well drained soils

This association is on the smoothly rolling high plain around the village of Hoenggye and the Alpine Experiment Station, where the Chahang soils make up about 80 percent of it. They have dark coloured loam surface layers over yellowish brown and strong brown clay loam subsoils. The Weonljeong soils cover about 15 percent, and have dark coloured sandy loam surface over coarse sandy loam substrata.

About 80 percent, mostly of Chahang soils, is cultivated, while about 10 percent is in pasture, and the remaining 10 percent in woodland, mainly small trees. Corn, potatoes, radish, cabbage, and other vegetable crops are grown. The growing season is usually too short for corn to mature and it is used for silage. Grass and legume pastures will produce moderate yields if limed, fertilized, and well managed.

# Chapter 5

# DESCRIPTION OF SOILS

## 5.1 INTRODUCTION

In this section is described the soil series and mapping units of Pyeongchang Gun. The soil series is given first, and then the mapping units of the series. Following the name of each mapping unit there is a symbol in parentheses. This identifies the mapping unit on the detailed soil map. To get full information on any one unit, it is best to first read the description of the series which describes the general concept of a soil and then the description of the mapping unit, which gives more detailed information about the area mapped.

Additional information about the use of the mapping units can be found in the discussion of Capability Unit and Paddy Suitability Groups. Table 3 lists these groupings for each soil.

### 5.1.1 Classification of Soils

Soils are classified so that we may more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to use their relationships to one another and to the whole environment, and to develop principles that help us understand their behaviour and their response to manipulation. First through classification, and then through the use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed surveys so that knowledge about them can be organized and applied in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. They are placed in broad classes to facilitate study and comparison in large areas such as countries, and for international study.

Additional information about the classification of soils is given in 'The Soils of Korea', Technical Report 1 of the Korea Soil Survey Project, FAO, Rome. Table 2 gives the classification of the present and older system.

## 5.2 ANMI SERIES

The Anmi series, consisting of deep, well drained soils in nearly level to sloping small valleys and alluvial fans, is a member of the fine loamy family of Dystric Fluventic Eutrochrepts, having developed in material eroded from the Jangseong, Mitan, Pyeongan, and Pyeongchang soils. The Anmi are often in the same valleys as the Hogye, Maji, and Bonryang soils. Most areas are in the southern part of the Gun.

Table 2

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

| Series | Current Classification | | | 1938 Classification |
|---|---|---|---|---|
| | Family | Subgroup | Order | Great Soil Group |
| Anmi | Fine loamy | Dystric Fluventic Eutrochrepts | Inceptisols | Alluvial soils |
| Bancheon | Fine clayey | Typic Hapludalfs | Alfisols | Red-Yellow Podzolic soils |
| Bonryang | Coarse loamy over sandy | Typic Udifluvents | Entisols | Alluvial soils |
| Chahang | Fine loamy | Typic Haplumbrepts | Inceptisols | Acid Brown Forest soils |
| Cheongsim | Fine loamy | Typic Dystrochrepts | Inceptisols | Acid Brown Forest soils |
| Gaghwa | Fine clayey | Typic Hapludults | Ultisols | Red-Yellow Podzolic soils |
| Gwanag | Loamy skeletal | Lithic Udorthents | Entisols | Lithosols |
| Hogye | Loamy skeletal | Fluventic Hapludolls | Mollisols | Alluvial soils |
| Hwangryong | Sandy skeletal | Typic Udipsamments | Entisols | Alluvial soils |
| Imog | Coarse loamy | Fluventic Hapludolls | Mollisols | Alluvial soils |
| Jangseong | Fine loamy | Lithic Udorthents | Entisols | Lithosols |
| Jungdong | Coarse loamy | Typic Udifluvents | Entisols | Alluvial soils |
| Maji | Loamy skeletal | Fluventic Hapludolls | Mollisols | Alluvial soils |
| Mitan | Clayey skeletal | Dystric Eutrochrepts | Inceptisols | Regosols |
| Mui | Coarse loamy | Umbric Dystrochrepts | Inceptisols | Regosols |
| Odae | Coarse loamy | Lithic Haplumbrepts | Inceptisols | Rankers |

Table 2 (Cont'd)

| Series | Current Classification | | | 1938 Classification |
|---|---|---|---|---|
| | Family | Subgroup | Order | Great Soil Group |
| Oesan | Loamy skeletal | Typic Dystrochrepts | Inceptisols | Lithosols |
| Pyeongan | Fine clayey | Typic Hapludalfs | Alfisols | Red-Yellow Podzolic soils |
| Pyeongchang | Very fine clayey | Typic Hapludalfs | Alfisols | Red-Yellow Podzolic soils |
| Sinbul | Loamy skeletal | Typic Haplumbrepts | Inceptisols | Acid Brown Forest soils |
| Songjeong | Fine loamy | Typic Hapludults | Ultisols | Red-Yellow Podzolic soils |
| Subug | Coarse loamy over sandy skeletal | Fluventic Haplaquents | Entisols | Low-Humic Gley Alluvial soils |
| Ungyo | Fine clayey | Humic Hapludults | Ultisols | Red-Yellow Podzolic soils |
| Wangsan | Fine clayey | Humic Hapludults | Ultisols | Red-Yellow Podzolic soils |
| Weoljeong | Coarse loamy | Typic Haplumbrepts | Inceptisols | Lithosols |

A typical profile follows.

Ap—0 to 20 cm; dark gray (5Y 4/1) loam; few coarse and medium, prominent, reddish brown (5YR 4/4) mottles; massive; friable, sticky, and plastic; many, fine rice roots; clear, smooth boundary; pH 6.5.

B1—20 to 30 cm; brown to dark brown (7.5YR 4/2) silty clay loam; many, fine, distinct black (10YR 2/1) Mn mottles; weak, fine to medium subangular blocky structure; firm, sticky, and plastic; few, fine pores; few, fine rice roots; clear, smooth boundary; pH 7.0.

B2—30 to 60 cm; dark reddish brown (5YR 3/4) gravelly silty clay loam; few, fine, prominent light gray (10YR 6/1) mottles; moderate medium and fine subangular blocky structure; firm, sticky, and plastic; few, fine pores and few coarse worm hole and cast; none roots; diffuse smooth boundary; pH 7.0.

B3—60 to 130+ cm; dark brown (7.5YR 3/2) gravelly silty clay loam; moderate, medium and coarse subangular blocky structure; firm, sticky, and plastic; few, fine pores and few, coarse worm hole and cast; pH 6.5.

The surface colour is commonly brown, dark brown, or dark yellowish brown except in paddy where it is dark grayish brown with strong brown or reddish brown mottles. The substratum colour is reddish brown, dark reddish brown, brown, or dark brown. Its textures are gravelly or nongravelly loam, silt loam, clay loam, or silty clay loam. The gravel and cobble content ranges from 2 to 25 percent, and is most common in the lower horizons. The depth to bed rock ranges from 5 to 50 m.

These soils, medium in organic matter content, are high in natural fertility, and neutral to mildly alkaline. They have high available moisture capacity. The cation exchange capacity is high, base saturation is medium to high, and permeability is moderate.

A wide range of crops grow and the land responds well to good management including complete fertilization.

5.2.1 Anmi Loam, 0 to 2 Percent Slopes (Am)

Most mapped areas have a profile similar to that typical with some tracts being included of patches that have a silt loam or clay loam surface layer, a few small places with slopes ranging from 2 to 7 percent, small tracts with coarse sandy loam textures, and some soils with a high gravel content.

The plough layer can be kept in good tilth and can be worked within a medium range of moisture content without clodding. Runoff is very slow. Corn, barley, sesame, radish, soybean, potato, cabbage, red pepper, and rice are cultivated. Except for an occasional overflow that drains quickly away there are few problems that limit use. High rates of fertilization will promote high yields.

Capability unit 1.
Rice suitability group P2c.

5.2.2 Anmi Loam, 2 to 7 Percent Slopes (AmB)

Most areas have a profile as described for the series. But, in areas mapped as this soil are included patches that have silt loam or clay loam surface layer, small places with lesser or greater slopes, small tracts of gravelly soils, and small tracts with dark coloured surfaces. Runoff is moderate. This soil is planted to crops, such as corn, barley, radish, potato, cabbage, and rice. Sheet erosion is a minor concern but erosion by streams traversing the areas, a moderate problem. Establishing good sod on the banks of these streams would help control this.

Capability unit IIe.
Rice suitability group P2ac.

5.2.3 Anmi Loam, 7 to 15 Percent Slopes (AmC)

In areas mapped as this soil are included patches that have silt loam or clay loam surface layers, small areas with lesser slopes, small tracts of gravelly soils mainly in the upper regions, and small areas with dark surfaces. Radish, potato, barley, cabbage, and in some areas rice, are representative of crops cultivated.

Erosion is a severe problem. In addition to sheet erosion, streams from adjacent higher land traverse it and tend to cut gullies. Establishment of sod on the banks will reduce that effect.

Capability unit IIIe.
Rice suitability group P3ac.

5.3 BANCHEON SERIES

The Bancheon series, consisting of well drained, deep, yellowish red soils on gently sloping to moderately steep terraces, is a member of the fine clayey family of Typic Hapludalfs. This series, developed in old alluvial materials on dissected terraces or benches, is found mostly in the southern part of the Gun.

A typical profile follows.

Ap—0 to 10 cm; brown to dark brown (10YR 4/3) friable silty clay loam; moderate, fine granular structure; sticky and plastic; clear, smooth boundary; pH 5.5.

B21t—10 to 30 cm; yellowish red (5YR 5/6) silty clay; moderate, medium granular structure; friable, sticky, and plastic; gradual, smooth boundary; pH 5.5.

B22t—30 to 75 cm; yellowish red (5YR 5/6) silty clay; moderate, coarse subangular blocky structure with thin discontinuous clay cutans of same colour; moderate, medium subangular blocky structure; firm, sticky, and plastic; tree roots occur throughout the horizon; consistence becomes more firm with depth; gradual, smooth boundary; pH 5.5.

B23t—75 to 100 cm; yellowish red (5YR 5/6) silty clay; strong, medium and fine subangular and some angular blocky

structure; thin, continuous clay cutans; slightly more red in colour; black manganese coatings in major cracks and on most peds; crushed colour yellowish red; gradual, smooth boundary; pH 5.5.

B24t—100 to 130 cm; yellowish red silty clay; strong, medium and fine subangular blocky and some angular blocky structure; thin continuous clay cutans; thin discontinuous black iron or manganese coatings on peds.

The surface layer is brown to dark brown silty clay loam, and where eroded is yellowish red silty clay. The plough layer, generally thin, is gravelly or cobbly in some places. The B horizon is yellowish red to red silty clay to clay and silty clay loam. The areas that have been used for paddy rice have gray mottles in the upper horizons. The substrata are often gravelly or cobbly. Depth to bedrock ranges from 1 to 10 m.

These soils are high in natural fertility, low to medium in organic matter content, and medium to strongly acid. They have high available moisture capacities. Both cation exchange capacity and base saturation are high. A wide range of crops, including barley, are grown.

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

This soil, on gently sloping terraces, usually has a profile similar to that typical. Some small areas with greater slopes are included. A wide range of crops are suited and irrigation water for the production of rice is available in a few areas. These produce high yields when well fertilized and managed.

All land is used for crops such as corn, potato, cabbage, barley, sesame, radish, soybean, and red pepper. Erosion is a moderate problem when regularly planted to these annual crops, but contour cultivation and grassed waterways help its control.

Capability unit IIe.
Paddy suitability group P2ac.

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

This soil is on sloping areas and has had the surface layer washed off in places. Most areas, however, have profiles similar to that described for the series except for the eroded areas, which have yellowish red silty clay or silty clay loam surface layers. With this soil are included small tracts with lesser and greater slopes.

Barley, soybeans, corn, potatoes, and other vegetable crops are suited, and paddy rice can be grown if water is available. Erosion is a problem when annual crops are regularly grown, but bench terraces and contour cultivation are effective means of controlling it. Grassed waterways will prevent erosion in the drainageways.

Capability unit IIIe.
Woodland suitability group P3ac.

5.3.3 Bancheon Silty Clay Loam, 15 to 30 Percent Slopes, Eroded (BcD2)

Most areas have profiles similar to that typical, except for the surface layer, which is yellowish red silty clay or silty clay loam. Small areas with lesser or greater slopes are included. Erosion is a problem when the land is ploughed and planted to annual crops, but bench terraces and contour cultivation are effective means for its control. Grassed waterways constructed in the drainageways will prevent gullying. About 80 percent has been cleared for cultivation, with the remaining 20 percent still in pine forest. Cultivated crops consist of corn, potatoes, and radish.

Capability unit IVe.
Woodland suitability groups P4ac.

5.4 BONRYANG SERIES

The series, consisting of well drained, deep soils developed in recent alluvium on nearly level alluvial plains, is commonly associated with the Jungdong series, and is a member of the coarse loamy nonacid family of Typic Udifluvents.

A typical profile follows.

Ap1—0 to 12 cm; dark grayish brown (2.5Y 4/2) sandy loam; few, fine to medium, distinct dark yellowish brown (10YR 4/4) mottles; massive; friable, slightly sticky, and slightly plastic; common, fine white and yellow mica flakes; clear, smooth boundary; pH 5.5.

C1—12 to 19 cm; dark gray to very dark gray (5Y 3/1-4/1) sandy loam; common, medium to coarse prominent strong brown (7.5YR 5/8) mottles; massive; slightly sticky and slightly plastic; abrupt, smooth boundary; pH 5.5.

C2—19 to 27 cm; dark gray (5Y 4/1) sandy loam; many, fine to medium prominent mottles of dark brown (7.5YR 4/4) and few, fine manganese mottles; weak, fine platy; slightly sticky and slightly plastic; few, fine mica; abrupt, smooth boundary; pH 6.4.

C3—27 to 70 cm; dark yellowish brown (10YR 4/4) sand; structureless, single grain; few, fine mica; diffuse, smooth boundary.

C4—70 to 120+ cm; yellowish brown (10YR 5/4) sand; structureless, single grain; nonsticky and nonplastic; pH 6.5.

The surface layer is generally dark brown to brown, but in rice paddy ranges from grayish brown to dark grayish brown, and has mottles of dark yellowish brown to strong brown. The upper horizon ranges from fine sandy loam to sandy loam in texture, and from 25 to 80 cm in thickness. The lower horizon is dark yellowish brown or yellowish brown sand or loamy sand. Depth to the bedrock ranges from 5 to 50 m.

The Bonryang differ from the Jungdong soils in having coarse texture throughout the profile but mainly in lower horizons.

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

All areas are in cultivated crops, mainly rice.

5.4.1 Bonryang Sandy Loam, 0 to 2 Percent Slopes (Bo)

Most areas have a profile similar to that typical, but some tracts with loam surface layers were included, as were small areas of thick loamy soils, and soils with loamy sand or sand textures throughout.

Because of high water losses due to rapid permeability, it is usually thought poorly suited for rice production. However, as there is ample water available nearby rice cultivation predominates. Losses of plant nutrients with the water are high and more than the usual amounts of fertilizer are required for high yields. Barley, wheat, corn, cabbage, potatoes and similar crops, also grow well.

Capability unit IIs.
Paddy land suitability group P4ac.

## 5.5 CHAHANG SERIES

The series, consisting of sloping to steep, well drained, deep, dark coloured soils on elevations above 800 m, is a member of the fine loamy family of Typic Haplumbrepts. This Chahang, developed in materials weathered from granite and granite-gneiss, is commonly associated with Weoljeong, Mui, Odae, and Ungyo soils. Most of these are located in the northern part of the Gun.

A typical profile follows.

Ap—0 to 20 cm; dark brown (10YR 3/3) loam; moderate, fine to medium granular; friable, slightly sticky, and slightly plastic; few, fine to medium grass roots; abrupt, smooth boundary.

B1—20 to 35 cm; yellowish brown (10YR 5/6) silty clay loam; weak, medium to coarse subangular blocky; friable, sticky, and plastic; few, fine discontinuous pores; clear, smooth boundary.

B2—35 to 70 cm; strong brown (7.5YR 5/6) silty clay loam; moderate, fine to medium subangular blocky; firm, sticky, and plastic; common, fine to medium, discontinuous pores; few, quartz grain; few, fine yellow mica; clear, smooth boundary.

B3—70 to 140+ cm; yellowish brown (10YR 5/6) silty clay loam; massive; slightly sticky and slightly plastic; common grit.

The A horizons are dark brown friable clay loam 20 to 30 cm thick. The subsoil is strong brown or yellowish red silt loam, silty clay loam, or clay loam with weak

subangular blocky structure, and in some places thin patchy cutans. Depth of the dark coloured upper horizon ranges from 25 cm to 50 cm.

Except for their dark coloured surfaces and smaller clay content, they resemble the Songjeong. The Weoljeong have a similar dark surface but have coarse sandy loam textures throughout the profile.

The depth to bed rock ranges from 2 to 4 m, but averages about 3 m. Organic matter content is high, natural fertility moderate and the soils strongly acid. They have moderate to high available water capacities, while cation exchange capacity is high but base saturation low. All of the areas were originally in forest, but recently about 80 percent has been cleared and cultivated to nonirrigated crops. The remaining 20 percent has the original cover of pine trees and some shrubs.

### 5.5.1 Chahang Loam, 7 to 15 Percent Slopes (ChC)

Most areas have profiles similar to that typical for the series. But, in areas mapped as this soil are included patches having a clay loam or sandy loam surface layer, small areas with slopes ranging from 15 to 30 percent, and small areas with cobbles and stones in the profile.

The plough layer is easily kept in good tilth and can be worked without crusting through a medium range of moisture content. Runoff is medium. Cultivated crops such as corn, potato, radish, and cabbage predominate, but erosion is a severe problem when the soil is used in this way. However, graded terraces and grassed waterways will give effective control. The growing of perennial grass and legume forage crops will also help, and improve too, the soil. Much lime and fertilizers are needed for best crop yields.

Capability unit IIIe.

### 5.5.2 Chahang Loam, 15 to 30 Percent Slopes (ChD)

Most mapped areas have a profile similar to that typical for the series. But, patches that have a sandy loam or clay loam surface layer, small areas with some lesser slopes, and few small areas with greater slopes, are included, as are small tracts of soils with some cobbles and stones. Runoff is rapid.

Cultivated crops, such as corn, potato, and radish predominate, with some areas of grassland or forest. Erosion, a very severe problem when the soil is cropped annually, can be protected by perennial hay and pasture, and as it is too steep for the construction of graded terraces bench terraces may also be an effective measure. However, after construction most of the dark surface soil is buried under other soil and lost, with a consequent drop in productive capacity. Strip cropping (the growing of annual crops and perennial forage crops in narrow strips or bands on the contour) is another effective means of soil utilization with only minimal erosion losses.

Capability unit IVe.

### 5.5.3 Chahang Loam, 30 to 60 Percent Slopes (ChE)

Most of the soil has a profile similar to that typical for the series. But, included are patches that have a sandy loam to clay loam surface layer, small areas

with lesser slopes, small tracts of gravelly and stony soils, and soils with coarse sandy loam textures. All of the areas were originally in forest, but recently about 20 percent of the area has been cleared. It is too steep for planting to annual crops, but some grazing could be obtained if properly managed.

Capability unit VIe.

## 5.6 CHEONGSIM SERIES

The Cheongsim series, consisting of somewhat excessively drained, moderately deep, dark coloured soils on steep to very steep mountainous areas, is a member of the fine loamy family of Typic Dystrochrepts. The series, developed in material that weathered from shale and sandstone, is commonly associated with the Weoljeong and the Odae soils.

A typical profile follows.

A1—0 to 15 cm; very dark brown (10YR 2/2) gravelly silt loam; strong, fine and medium granular; very friable; gravel is mostly fine angular silt stone and sandstone; clear, wavy boundary; pH 5.0.

B1—15 to 50 cm; reddish brown (5YR 4/4) friable, very gravelly and stony loam; moderate, very fine, fine and some medium granular; many pores; many, fine oak tree and wild grass roots; gradual, wavy boundary; pH 5.5.

B2—50 to 80 cm; reddish brown (5YR 4/3) friable, gravelly silt loam; weak coarse blocky structure, breaking to fine and medium granular; gravel is fine textured sandstone which can be cut with spade with difficulty; few roots.

The surface layer ranges from brown to dark brown or very dark brown, and from loam to clay loam. Rock outcrops are common. The substrata are massive shale and sandstone, and the depth to bedrock ranges from 50 to 100 cm.

These soils resemble the Daegu as mapped in other areas but are deeper to bedrock. They are high in organic matter, low in natural fertility and strongly acid, having low to medium available moisture capacities. Cation exchange capacity is low to medium and base saturation is low except in surface horizons.

The native trees on this soil were oak, pine, and shrubs. Some land has grasses growing on it.

### 5.6.1 Cheongsim Stony Silt Loam, 30 to 60 Percent Slopes (CsE)

Generally the profiles are similar to that described for the series. However, about 15 to 40 percent of the mapped area is rock outcrop or stones.

On convex slopes, and adjacent to rock outcrops the soil is more shallow than the typical profile, and some small tracts have slopes steeper than 60 percent. Other inclusions are small areas of deep and shallow soils with coarse sandy loam texture.

Runoff is rapid. Forest is general with some parts growing wild grasses. If properly managed low to moderate yields of grass could be obtained. Improved management would increase woodland yields.

Capability unit VIe.

5.6.2 Cheongsim Rocky Silt Loam, 60 to 100 Percent Slopes (CrF)

Most areas have profiles similar to that typical.

About 20 to 50 percent of the mapped areas is rock outcrops, mainly on the ridge tops and the steeper slopes. Usually the soils adjacent to them are more shallow than the typical profile, but some small patches have deep or shallow soils with coarse sandy loam textures.

Forest, including pine, oak, and shrubs, predominates with some areas in wild grass. Except for some woodland products there is little potential for development.

Capability unit VIIe.

## 5.7 GAGHWA SERIES

The series, consisting of well drained, deep, yellowish red to strong brown soils on sloping to steep colluvial slopes, are members of the fine clayey family of Typic Hapludults, and developed in colluvial material eroded from soils derived from granite, and granite-gneiss.

A typical profile follows.

Ap—0 to 20 cm; brown to dark brown (10YR 4/3) cobbly silty clay loam; weak, fine granular; sticky and plastic; common, fine and medium corn roots; abrupt, smooth boundary; pH 5.5.

B21t—20 to 33 cm; strong brown (7.5YR 5/6) cobbly or gravelly silty clay; moderate, fine to medium subangular blocky; firm, sticky, and plastic; patchy thin clay cutans; few, fine tubular pores; few, fine corn roots; diffuse, smooth boundary; pH 5.3.

B22t—33 to 100 cm; yellowish red (5YR 5/6) cobbly or gravelly clay; strong, medium to fine subangular blocky; very sticky and very plastic; broken moderate thick reddish brown (5YR 4/4) clay cutans; few, fine tubular pores; few, coarse earth worm holes and cast; pH 5.0.

C—100+ cm; cobbly to stony clay loam; about 90 percent cobbles and stones.

The surface layer is cobbly silty clay loam, clay loam, silt loam or loam; the colour ranges from brown to dark brown. The subsoil is strong brown to yellowish red, firm, gravelly to cobbly silty clay loam to silty clay. The gravel and cobble content ranges from 5 to 15 percent, and depth to bedrock from 2 to 5 m, averaging about 3 m.

Gaghwa soils are low in natural fertility, medium in organic matter content, and medium to strongly acid. They have high available moisture capacities. Cation exchange capacity is high and base saturation low. This series resembles the Ungyo, but differs in having a more light coloured surface layer.

Most of this soil is used for crops, but small areas of steep slopes are in forest. Yields are favourable for corn, potato, radish, and cabbage.

### 5.7.1 Gaghwa Cobbly Silty Clay Loam, 7 to 15 Percent Slopes (GbC)

Most areas have a profile similar to that typical, but may have somewhat less gravel and cobbles.

Some patches of soils with dark coloured surfaces and small areas of stony soils are included and make up less than 15 percent of the unit. These soils are medium in organic matter content and low in natural fertility. Available water capacity is high, and permeability moderately slow. Crops, such as corn, potato, radish and sometimes cabbage grow well. The main management problem is erosion, but terraces with grassed waterways will aid its control. When perennial hay and pasture crops are grown, this problem is slight.

Capability unit IIIe.
Paddy suitability unit P3ac.

### 5.7.2 Gaghwa Cobbly Silty Clay Loam, 15 to 30 Percent Slopes (GbD)

Most areas of this soil have a profile much like that typical.

Small areas with lesser slopes and some with greater slopes, small tracts of soils with dark coloured surfaces, and a few small places of stony soils, are included.

About 70 percent has been cleared of forest while the remaining 30 percent consists mainly of pine trees. The cultivated crops are corn, potato, and radish. Erosion is a severe problem when annual crops are regularly planted, but grass and legume as an alternative will successfully help to counteract this.

Capability unit IVe.
Paddy land suitability group P4ac.

### 5.7.3 Gaghwa Cobbly Silty Clay Loam, 30 to 60 Percent Slopes (GbE)

Most areas have profiles like that typical, with some areas having more gravel and cobbles. Small stony areas, some surfaces that are dark coloured, and small tracts with slopes greater than 15 percent, are included.

Runoff is generally very rapid. About 50 percent of this soil has been cleared, and the remaining 50 percent is still in forest consisting mainly of pine trees. Cultivated crops consist of corn, radish and potato, but because of the steep slopes and erosion hazard this soil is poorly suited to them. However, some pasture could be produced, and high yields of woodland are possible, owing to favourable physical characteristics and its position on lower concave slopes.

Capability unit VIe.

## 5.8 GWANAG SERIES

The Gwanag series, consisting of somewhat excessively drained, shallow soils on steep to very steep mountainous areas, is a member of the coarse loamy family of Lithic Udorthents. The series developed in residual materials that weathered from granite and granite-gneiss, and is commonly associated with the Weoljeong, and Odae soils.

A typical profile follows.

A1—0 to 9 cm; brown (10YR 5/3) gravelly coarse sandy loam, weak, fine to medium granular; many, fine to medium grass roots; gradual, smooth boundary; pH 5.5.

C—9 to 38 cm; very pale brown (10YR 7/4) very gravelly coarse sandy loam; single grain; pH 5.7.

R—38+ cm; hard granite rock.

The A horizon colour ranges from brown to dark brown, and its texture from gravelly coarse sandy loam to loamy sand. The C horizon is very pale brown, to pale brown gravelly to coarse sandy loam or sand. In places some gravel and fragments of weathered rock occur throughout the solum. Most of the gravel, less than 5 mm, is crystals weathered from the coarse grained granite. The depth to bedrock ranges from 30 to 50 cm.

These soils, high in organic matter content and low in natural fertility, are strongly to slightly acid. They have a very low available moisture capacity. Cation exchange capacity is low and base saturation low. Native trees such as pine and oak and many kinds of shrubs are commonly growing.

### 5.8.1 Gwanag Rocky Loam, 30 to 60 Percent Slopes (GnE)

Except for the rock outcrop which is from 15 to 40 percent of the mapped areas, most of the soil has a profile similar to that typical.

But, in areas mapped are included patches that have a fine sandy loam or loamy sand surface layer, small areas with slopes greater than 60 percent, small areas of much deeper soils, of soils with dark coloured surfaces, and of dark coloured sandy soils in narrow valleys. Woodland, such as pine and oak, predominates, with many shrubs growing on some areas. It has little potential for other than woodland use.

Capability unit VIIe.

### 5.8.2 Gwanag Rocky Sandy Loam, 60 to 100 Percent Slopes (GnF)

Except for the rock outcrops which are from 20 to 50 percent of the mapped areas, this soil generally has a profile similar to that typical.

But, in areas mapped as this soil are included patches that have a fine sandy loam or loamy sand surface layer, small areas with less slopes, small tracts of deeper soils and a few small dark coloured soil surfaces. Woodland, such as pine, oak and shrubs, is dominant and the land has little potential for other uses.

Capability unit VIIe.

## 5.9 HOGYE SERIES

The Hogye series, consisting of gently sloping and sloping, well drained, deep, dark coloured soils, is a member of the loamy skeletal family of Fluventic Hapludolls. These soils, developed in recent alluvial materials on slightly elevated alluvial fan and small valleys, are commonly associated with the Bonryang, and Jungdong series.

A typical profile follows.

Ap---0 to 14 cm; very dark brown (10YR 2/2) gravelly loam; massive; many, fine to medium grass root; few, fine white and yellow mica; gradual, smooth boundary; pH 5.8.

A1---14 to 27 cm; very dark grayish brown (10YR 3/2) gravelly loam; massive; slightly sticky and plastic; few, fine white and yellow mica; clear, smooth boundary; pH 5.8.

C1---27 to 100+ cm; very pale brown (10YR 7/4) very gravelly sandy loam to loamy sand; single grain; pH 5.5.

The surface layer is dark brown where not used for rice paddy but is dark grayish brown to grayish brown, and has dark brown to yellowish brown mottles in paddy lands. The surface texture is gravelly loam, loam, and sandy loam, 15 to 30 cm thick. The substrata are dark yellowish brown, brown, or dark brown gravelly coarse sandy loam to fine sandy loam. Some rice paddies have mottles in the C1 layer. The Hogye, occurring with the Maji, and Bonryang, have a more acid reaction than the Maji, and gravel, which is not present, in the Bonryang.

The Hogye are high in natural fertility and organic matter content, with medium cation exchange capacities and high base saturation. Permeability is moderately rapid. The available water capacity is medium to low. Cultivated crops other than rice are dominant, it being only grown in a few places where water is available.

### 5.9.1 Hogye Gravelly Loam, 0 to 2 Percent Slopes (Hg)

Generally this soil has profiles similar to that typical with some small areas lacking gravel, small tracts of neutral and more sandy soils, and some slopes of more than 2 percent being included. A wide variety of crops are suitable but yields are apt to be low in seasons of low rainfall. Rice is also a fit crop, but much water is required for paddies on this rapidly permeable soil.

Capability unit IIs.
Paddy land suitability group P3c.

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

Most areas have a profile similar to that described as typical, but, small areas of more sandy soils with neutral reaction, and small areas of nearly level and sloping soils are included. This is the most extensive mapping unit of the Hogye series, being about one half of the series. The land is suited to a wide range of crops, and responds well to fertilization. Yields are apt to be low in years of

limited rainfall, and for this reason it is poorly suited to rice which requires much water. Rice paddies are also difficult to construct because of the gravel.

Capability unit IIs.
Paddy land suitability group P4abc.

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

This soil is mainly on alluvial fans rather than on the floodplain. Most areas have profiles much like that typical, with the exception of some having many cobbles in the lower part. Small areas of soils with neutral reactions and some stony soils, are included, as are small sections with lesser slopes than the described range. This is the least extensive soil in the Hogye series. All of it is suited to crops other than rice. Yields are apt to be low in seasons of low rainfall.

Capability unit IIIe.
Paddy land suitability group P4abc.

5.10 HWANGRYONG SERIES

The Hwangryong series, consisting of excessively drained, deep soils on level to nearly level floodplains, is a member of the sandy skeletal family of Typic Udipsamments, and is located adjacent to stream channels. It is commonly associated with the Bonryang and Hogye series.

A typical profile follows.

Ap—0 to 12 cm; brown to dark brown (10YR 4/3) gravelly sandy loam; weak, very fine granular; nonsticky and nonplastic; common, fine yellow mica; gravel content 20 percent; common, fine to medium roots; clear, smooth boundary; pH 6.0.

C—12 to 80 cm; yellowish brown to dark yellowish brown (10YR 5/4-4/4) very gravelly sand, single grain, common fine yellow mica (gravel and cobble content 70 percent).

The Ap horizon is brown to dark brown, but grayish brown or dark grayish brown in paddy. It is very friable, gravelly sandy loam or gravelly loamy sand 10 to 15 cm thick. The C horizon is yellowish brown to dark yellowish brown very gravelly to very cobbly sand or loamy sand; coarse fragments, by volume 50 to 80 percent.

The Hwangryong occur with Hogye, Bonryang, and cobbly riverwash. They differ from Hogye in having: coarse sand or loamy sand textures rather than loam textures, more rapid permeability, less organic matter and lower fertility. They are low in natural fertility and low in organic matter content. Permeability is very rapid, and available water capacity is low. They have low cation exchange capacities and are variable in amount of base saturation.

The soils of the series are not extensive but are the only tillable sort in some mountainous areas. Good yields cannot be expected where they are cultivated for crops such as corn and soybeans. They are used for paddy, and for growing mulberry trees.

5.10.1 Hwangryong Gravelly Sandy Loam, 0 to 2 Percent Slopes (Hr)

Most areas have a profile similar to that described for the series, but small areas of soils without gravel and gravelly loamy soils are included. About 60 percent of the land is irrigated from the nearby streams and used for paddy rice. The rest is in mulberry and other crops because water is not available. Most areas are subject to overflow. The major management problem is to lessen the effects of leaching and to remove stones from the plow layer.

Capability unit IVs.
Paddy suitability group P4bc.

5.11 IMOG SERIES

The Imog series, consisting of well drained, deep, gently sloping to sloping soils, is a member of the coarse loamy family of Fluventic Hapludolls. This series developed in alluvial-colluvial materials on valley bottom or mountain footslopes in concave positions, and in local alluvial fans.

A typical profile follows.

Ap--0 to 9 cm; dark brown (10YR 3/3) coarse sandy loam; weak, fine to medium granular structure; friable, nonsticky and nonplastic; many, medium to coarse pores; common quartz grit and fine gravel; few, fine, yellow mica; few, fine to medium root; abrupt, smooth boundary; pH 6.0.

A3--9 to 46 cm; dark brown (10YR 3/3) coarse sandy loam; weak, medium to coarse subangular blocky breaking to moderate, coarse granular structure; friable, nonsticky, and nonplastic; angular quartz grit and fine gravel; few, fine, yellow mica; few, fine to medium roots; clear, smooth boundary; pH 6.0.

Ab--46 to 79 cm; black (10YR 2/1) coarse sandy loam; weak, medium to coarse subangular blocky and granular structure; common, fine to medium pores; few, large worm casts; quartz grit; common, very fine to fine yellow mica; clear, smooth boundary; pH 6.0.

B1--79 to 90 cm; dark yellowish brown (10YR 4/4) loamy coarse sand; massive breaking to weak, medium to coarse granular structure; firm, nonsticky, and nonplastic; common, fine to medium pores; quartz grit; slightly weathered fine granitic gravel; fine, yellow mica; gradual, smooth boundary; pH 6.0.

C--90 to 120+ cm; very dark brown (10YR 2/2) coarse sandy loam; massive breaking to weak, medium to coarse pores; quartz grit; slightly weathered, fine granitic gravel; fine yellow mica; pH 6.0.

The A horizon ranges from dark brown or very dark brown to black, and from coarse sandy loam to fine sandy loam. It is 70 to 100 cm thick.

The B horizon is dark brown to dark yellowish brown sandy loam or sand with or without gravel. The sediments, the parent materials of this soil, were eroded from the soils of the Odae and Weoljeong series.

The Imog occupy small valleys in areas of Odae and Weoljeong soils and also are found with the Bonryang in the larger alluvial plains. The depth to bedrock ranges from 5 to 10 m.

These are high in organic matter content, medium in natural fertility and strongly acid. They have low to medium available moisture capacity, and are moderately permeable. The cation exchange capacity is low and base saturation high. They are used for a wide range of crops including rice.

### 5.11.1 Imog Sandy Loam, 2 to 7 Percent Slopes (ImB)

Most areas have a profile similar to that typical for the series. But, small areas with slopes greater than 7 percent, small tracts of lighter coloured soils and some gravelly soils also are included. The plough layer is easily kept in good tilth. Runoff is slow. Crops such as corn, potato, radish, sesame, cabbage, and red pepper are generally cultivated, and produce good yields. Paddy rice can also be grown if enough water is available. The main management problem is to reduce the effect of leaching.

Capability unit IIs.
Paddy land suitability group P4abc.

### 5.11.2 Imog Sandy Loam, 7 to 15 Percent Slopes (ImC)

Most areas have profiles similar to that typical for the series, but small areas of light coloured soils, and soils with gravelly loam and sand texture are also included. The plow layer is easily kept in good tilth. Runoff is medium. Most of this soil is well suited to crops including corn, radish, potato, cabbage, and red pepper.

Capability unit IIIe.
Paddy land suitability group P4abc.

## 5.12 JANGSEONG SERIES

The series, consisting of excessively drained, shallow, dark reddish brown rocky soils formed in residuum derived from limestone on steep to very steep mountain areas, is a member of the fine loamy family of Lithic Udorthents. It is commonly associated with the Pyeongchang and the Pyeongan series.

A typical profile follows.

A1—0 to 25 cm; dark reddish brown (5YR 3/3) loam; moderate, medium granular; friable, slightly sticky, and slightly plastic; content of limestone gravel increases in lower part; many, fine to medium grass and pine tree roots; abrupt, irregular boundary; pH 8.0.

R—25+ cm; hard unweathered massive limestone.

The A horizon is brown to dark brown or dark reddish brown loam or clay loam. Rock fragments are common on the surface. The substrata are massive limestone, but are fractured in some places. The depth to bedrock ranges from 25 to 50 cm, but averages about 40 cm.

The Jangseong are moderately high in natural fertility and medium in organic matter content. Permeability is moderate; the available water capacity is low; and cation exchange capacity and base saturation are high. Most of the areas are used for woodlands consisting mostly of pine tree and shrubs.

5.12.1 Jangseong Rocky Silt Loam, 30 to 60 Percent Slopes (JsE)

Most areas have profiles similar to that typical for the series, but about 15 to 40 percent is rock outcrop, and there are many small tracts of soils that are deeper than 50 cm. Small tracts with steeper slopes are also included. Woodland is generally suited, but crops are subject to drought because of low available moisture capacity. Legumes will grow well on this neutral to alkaline soil. Open areas seeded to pasture plants, such as sericea lespedeza, will produce well.

Capability unit VIe.

5.12.2 Jangseong Rocky Silt Loam, 60 to 100 Percent Slopes (JsF)

Most areas have profiles similar to that typical for the series. About 20 to 50 percent of the area is rock outcrop. Some small areas of deeper soils are included in the mapped areas, as are small tracts with less steep slopes. Woodland, as well as grazing land, are generally suited.

Capability unit VIIe.

5.13 JUNGDONG SERIES

The series, consisting of well drained, deep soils on nearly level alluvial plains, are members of the coarse loamy acid family of Typic Udifluvents. These soils are commonly associated with the Bonryang.

A typical profile follows.

Ap—0 to 12 cm; dark gray (10YR 4/1) fine sandy loam; massive; friable, slightly sticky, and slightly plastic; common, fine white mica; common, fine rice roots; diffuse, smooth boundary; pH 5.6.

A1—12 to 27 cm; dark gray (10YR 4/1) loam; few, fine, distinct mottles of dark brown (10YR 3/3); slightly sticky and slightly plastic; few, fine roots and pores; clear, smooth boundary; pH 5.8.

C1—27 to 90 cm; very dark grayish brown to dark brown (10YR 3/2-3/3) loam; few, fine manganese mottles and soft concretions; weak, coarse prismatic, breaking to weak, fine to medium platy; sticky and plastic; common, fine pores; clear, smooth boundary; pH 6.2.

C2—90 to 120 cm; very dark brown (10YR 2/2) loam; massive; sticky and plastic; pH 6.2.

The surface layer is naturally brown to dark brown, but is dark gray and has dark brown mottles in paddy lands. Its texture ranges from fine sandy loam to loam. C horizons are very dark brown to dark yellowish brown loam or sandy loam. The depth to bedrock ranges from 5 to 50 m. The Jungdong are generally slightly to strongly acid, and medium in organic matter content. They have moderate available moisture capacities, and cation exchange capacity is medium to low and base saturation medium or high. They are used for a wide range of crops including rice.

5.13.1 Jungdong Fine Sandy Loam, 0 to 2 Percent Slopes (Jd)

Most areas have a profile like that described for the series. But in the mapping unit are included small areas of a soil that has a sandy loam surface layer, some tracts of soils with sand in the lower horizon, and a few small areas of very sandy soils. A wide range of crops are suited, including barley, sesame, radish, cabbage, soybean, potato, and rice. High yields, when well fertilized and managed in years of favourable rainfall, can be expected. Yields of crops other than rice are usually low in years of limited rainfall.

Capability unit IIs.
Paddy land suitability group P4bc.

5.14 MAJI SERIES

The series, consisting of deep, well drained, dark coloured, neutral soils on nearly level to sloping areas of small valley floodplains and fans, are members of the loamy skeletal family of Fluventic Hapludolls.

A typical profile follows.

Ap—0 to 11 cm; dark brown to very dark brown (10YR 3/3 to 2/2) gravelly sandy loam; moderate, fine granular structure; friable, slightly sticky, and nonplastic; clear, smooth boundary; pH 6.2.

A12—11 to 40 cm; dark brown to very dark brown (10YR 3/3 to 2/2) gravelly sandy loam; very weak, fine to medium subangular blocky breaking to fine granular structure; abrupt, smooth boundary; pH 6.7.

A13—40 to 60 cm; dark brown to very dark brown (10YR 3/3 to 2/2) gravelly sandy loam; very weak, fine granular structure; clear, smooth boundary; pH 6.8.

C1—60 to 100+ cm; dark brown (10YR 3/3) gravelly very fine sandy loam to loam; weak, fine granular; friable; few, fine, yellow mica; pH 6.9.

The surface layer is very dark brown to dark grayish brown or dark brown gravelly and cobbly sandy loam, fine sandy loam, or loam. Its texture tends to be coarser in the lower horizons. The coarse fragment content in the lower A and C horizons ranges

from 35 to 70 percent. The Maji occur with the Hogye, Anmi and Imog soils. They contain more fragments of gravel and cobble than the Anmi or Imog soils, but are very similar to the Hogye except for their neutral to alkaline reaction.

These soils are moderately high in organic matter, high in natural fertility, and neutral to mildly alkaline. They have low to moderate available moisture capacity. The cation exchange capacity is moderately low and base saturation is high.

These soils are used for a wide range of crops including rice.

5.14.1 Maji Gravelly Loam, 0 t 2 Percent Slopes (Mj)

This deep, well drained, loamy skeletal soil has a profile similar to the one described for the series.

In areas mapped as this soil are included patches that have a sandy loam or fine sandy loam surface layer, small areas with greater slopes, small tracts of sandy and loamy soils, small areas of acid soils, and small areas of Anmi soils.

Runoff is very slow. Cultivated crops, such as corn, potato, cabbage, soybean, barley, sesame, and red pepper are usually suited. Their yields are limited in dry seasons because of lack of available moisture in the soil.

Capability unit IIs.
Paddy land suitability group P3bc.

5.14.2 Maji Gravelly Loam, 2 to 7 Percent Slopes (MjB)

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

This soil is found on gently sloping valley bottoms and local valley fans. In its mapped areas are included patches that have a sandy loam or fine sandy loam surface layer, small areas with less or greater slopes than the described range, small tracts of acid soils and of more clayey and loamy soils. Runoff is slow. Crops, such as corn, potato, cabbage, soybean, barley, and sesame are suited. In seasons of limited rainfall their yields are apt to be low because of lack of soil moisture.

Capability unit IIs.
Paddy land suitability group P4abc.

5.14.3 Maji Gravelly Loam, 7 to 15 Percent Slopes (MjC)

Profiles are mostly similar to that typical for the series but some parts have a higher gravel content.

This soil is on sloping small alluvial fans and sloping narrow valleys. In areas mapped as this soil are included patches that have a sandy loam or fine sandy loam surface layer, small areas of acid soils, and of clayey and loamy soils.

Runoff is medium. Crops, such as corn, potato, and radish are suited. Crop yields are somewhat low in dry seasons, and erosion is a problem.

Capability unit IIIe.
Paddy suitability group P4abc.

## 5.15 MITAN SERIES

The Mitan series, consisting of deep, well drained, neutral to alkaline soils on sloping to steep mountain footslopes, is a member of the clayey skeletal family of Dystric Eutrochrepts. This series developed in colluvial materials that weathered from limestone and is commonly associated with soils of Pyeongchang and Jangseong series. They are the principal soils on slopes that are above the Maji soils.

A typical profile follows.

Ap—0 to 13 cm; dark brown (7.5YR 3/2) very channery clay loam; moderate fine and medium granular structure; friable, sticky and plastic; many fine to medium living roots; approximately 50 percent unweathered limestone fragments; most large fragments have been removed from the A horizons in the cultivated areas by farmers; abrupt smooth boundary; pH 8.0.

B—13 to 70 cm; brown to dark brown (7.5YR 4/4) very channery to very angular cobbly clay loam; weak medium subangular blocky structure partly breaking to moderate medium granular; friable, sticky and plastic; approximately 60 percent small limestone fragments; few fine living roots; gradual wavy boundary; pH 8.0.

C—70 to 100 cm; as above with weak medium and fine granular structure, more and larger coarse fragments than above; pH 8.0.

The loam surface layer ranges from brown to dark brown. Many fragments of limestone are on the surface, and occur throughout the profile in many places. The C horizon contains up to 90 percent fragments of limestone.

The Mitan differ from the Sinbul in reaction, being neutral to alkaline rather than acid. The Pyeongan have argillic B horizons and contain less limestone fragments but resemble the Mitan in other respects.

These soils are moderately low in organic matter content, high in natural fertility, and are neutral to mildly alkaline. They have low to medium available moisture capacities, and are moderately permeable. Cation exchange capacity and base saturation are high.

The native trees were pine, oak and some shrubs. About 60 percent of this soil has been cleared, and cultivated to crops, such as red pepper, barley, potato, and soybean.

### 5.15.1 Mitan Channery Silt Loam, 7 to 15 Percent Slopes (MtC)

Most areas have profiles similar to that described for the series. But, small areas with silt loam or silty clay loam surface layers, small areas with steeper slopes, small tracts of less gravelly and stony soils, and soils with clayey textures are also included.

The plough layer is not easily kept in good tilth, but most of the land has been cleared and cultivated. It is suited to crops including red pepper, corn, barley,

breaking to weak, medium to coarse angular blocky; firm, sticky and plastic; common, fine and medium to coarse pores; few, medium worm holes; many subangular shale and some granite gravel and cobbles; many, yellowish mica; few, fine roots; diffuse, smooth boundary; pH 5.0.

B2—61 to 120 cm; strong brown (7.5YR 5/6) sandy loam; slightly sticky and nonplastic; few, rounded gravel and cobble, some boulders; few, fine roots; diffuse, smooth boundary; pH 5.0.

C—120 to 150+ cm; strong brown (7.5YR 5/6) sand.

The thickness of the dark brown surface layer ranges from 20 to 50 cm. Stone, cobble, and gravel content ranges from 10 to 20 percent. The substrata are strong brown, friable sandy loam to sand, containing boulders and cobbles. The Mui occur with the Sinbul and Ungyo soils. The Sinbul have a much higher content of gravel and stone, while the Mui differ from Ungyo chiefly in having a sandy loam B horizon and more coarse fragments. The depth to bedrock ranges from 3 to 9 m, but averages about 5.

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

About 80 percent of the land has been cleared for cultivation, while the other 20 percent is still in forest consisting chiefly of pine trees and shrubs.

### 5.16.1 Mui Stony Loam, 7 to 15 Percent Slopes (MuC)

Most areas have a profile similar to that typical with about 10 to 30 percent covered by stones.

In areas mapped as this soil are included patches that lack stones and cobbles, small parts with steeper slopes, and small tracts of soils with very stony to gravelly loam B horizons.

The plough layer is not easily kept in good tilth. Runoff is medium. Most of the areas have been cleared and cultivated. The soil is suited to cultivated crops such as red pepper, corn, barley, potato and soybean. Erosion is a severe problem, but contour cultivation will reduce soil losses. When perennial legume and grass forage crops are grown, erosion is slight.

Capability unit IIIe.
Paddy suitability group P4abc.

### 5.16.2 Mui Stony Loam, 15 to 30 Percent Slopes (MuD)

Most areas have profiles similar to that typical, with about 10 to 30 percent of the land covered with stones.

In areas mapped as this soil are included patches without stone, small areas with steeper and lesser slopes, and small areas of very stony soils.

Runoff is rapid. About 70 percent has been cleared for cultivation, and is fit for crops such as red pepper, corn, barley, potato, and soybean, but better suited to pasture. Erosion is a very severe problem on these moderately steep soils, but contour cultivation will aid in its control.

Capability unit IVe.
Paddy suitability group P4abc.

5.16.3 Mui Stony Loam, 30 to 60 Percent Slopes (MuE)

Most areas have profiles similar to that typical, but from 10 to 30 percent of the ground is covered with stones.

In areas mapped as this soil are also comprised patches that have a sandy loam to fine sandy loam surface layer, small tracts with lesser slopes, small areas of very stony soils, and small areas of soils with clay loam to clay subsoils.

Runoff is very rapid. The main cover is a forest of coniferous trees, with vegetable crops planted in a few places. This soil is too erodible for regular cultivation but well managed pastures will produce fair yields of forage.

Capability unit VIe.

5.17 ODAE SERIES

The Odae series, consisting of somewhat excessively drained, dark coloured shallow soils on steep to very steep mountainous areas, is a member of the coarse loamy family of Lithic Haplumbrepts. This series developed in residual materials that weathered from granite and granite-gneiss and is commonly associated with the Weoljeong, Mui, and Sinbul soils. Generally they are found in the northern part of Pyeongchang Gun.

A typical profile follows.

A11—0 to 12 cm; very dark brown (10YR 2/2) rocky loam; moderate, fine to very fine granular structure; friable, slightly sticky, and slightly plastic; many, fine to medium root; about 15 percent quartz grit and 5 percent gravel; gradual, wavy boundary; pH 7.0.

A12—12 to 38 cm; dark brown (10YR 3/3) loam; fine to medium granular structure; friable, slightly sticky, and slightly plastic; common, fine to medium roots; 15 percent quartz grit; clear, wavy boundary; pH 6.5.

C—38 to 45 cm; yellowish brown (10YR 5/8) stony light sandy loam; massive breaking to weak, medium granular structure; friable, slightly sticky, and nonplastic; few, fine yellow mica; about 20 percent slightly and unweathered granitic rock; stone and gravel; few, fine roots; pH 6.0.

R—45+ cm; granitic rock.

The surface layer ranges from very dark brown to black or dark brown in colour, and from sandy loam to clay loam, usually with gravels and cobbles. The substrata are yellowish brown to pale brown sandy loam or coarse sandy loam with 10 to 35 percent gravel, cobbles, or stones.

The Odae occur with the Weoljeong soils. They are shallow to hard rock while the Weoljeong are deep. Usually rock outcrop and stony land are associated with this series.

These soils are high in organic matter content, low in natural fertility and strongly acid. They have very low available moisture capacities. The cation exchange capacity and base saturation are low. Forest with coniferous trees predominates, with vegetable crops planted in a few places.

### 5.17.1 Odae Rocky Loam, 30 to 60 Percent Slopes (OdE)

Most areas have a profile similar to that typical, with about 15 to 40 percent of the area in rock outcrop. Small areas with steeper slopes and small areas of deep stony soils in the small valleys of the high mountains also are comprised. Runoff is rapid. This land, poorly suited to agricultural crops, is best suited for woodland. Erosion control is the chief management problem.

Capability unit VIe.

### 5.17.2 Odae Rocky Loam, 60 to 100 Percent Slopes (OdF)

Most areas have profiles like that typical, but about 20 to 50 percent of the area is rock outcrop.

Small areas with slopes ranging from 30 to 60 percent, small areas of deep soil, and small areas of deep stony loam soils are also included.

Runoff is very rapid. Only low yields of forest products can be expected even with good management, while agricultural crops are not suited at all.

Capability unit VIIe.

## 5.18 OESAN SERIES

The series consists of moderately deep, somewhat excessively drained soils on steep to very steep mountain slopes. They are members of the loamy skeletal family of Typic Dystrochrepts, and developed in residual materials derived from schist or gneiss.

A typical profile follows.

> Ap--0 to 14 cm; yellowish red (5YR 4/6) stony loam, weak, fine to medium granular; friable, slightly sticky, and slightly plastic; few, very fine white mica; frequent fine and medium roots; clear, smooth boundary; pH 5.5.

B1--14 to 28 cm; strong brown (7.5YR 5/6) channery loam; weak, fine to medium granular; friable, sticky, and plastic; few, very fine white mica; frequent small subangular gravel; frequent fine and medium roots; abrupt, smooth boundary; pH 5.8.

B2--28 to 52 cm; yellowish brown (10YR 5/8) channery silt loam; common, medium and coarse, prominent dark reddish brown (5YR 3/4) mottles; weak, fine to medium granular; slightly sticky and slightly plastic; few, fine mica; few, fine to medium roots; abrupt, smooth boundary; pH 6.0.

C2--52 to 75 cm; dark yellowish brown (10YR 4/4) channery or flaggy loam; many, coarse, distinct brown to dark brown (7.5YR 4/4) mottles; firm, slightly sticky, and slightly plastic; few, fine mica; very frequent small flat strongly weathered gravel; few, fine roots.

Where only slightly eroded, the surface layer ranges from brown to dark brown, but is yellowish red in eroded areas. Its texture is loam to fine sandy loam 10 to 20 cm thick.

The substrata are strong brown to yellowish brown channery to stony silt loam or loam. The content of rock fragments increases with depth approaching 95 percent at 80-120 cm.

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

Forest of predominantly coniferous trees is general, with vegetable crops planted in a few places.

### 5.18.1 Oesan Stony Loam, 30 to 60 Percent Slopes (OaE)

Most areas have profiles similar to that typical. On the surface, 15 to 30 percent is covered with gneiss, schist fragments and stones. Also included are small areas with greater slopes. Runoff is rapid. This soil, poorly suited to annual cultivation crops because of the steep slopes and erosion hazard, is mainly suited for forest, but would produce some grazing if well managed.

Capability unit VIe.

### 5.18.2 Oesan Stony Loam, 60 to 100 Percent Slopes (OaF)

Most areas have profiles similar to that typical. From 15 to 30 percent of the surface is covered by gneiss, schist fragments and stones. Small areas with lesser slopes are included. Runoff is very rapid. This soil is only suited for woodland.

Capability unit VIIe.

## 5.19 PYEONGAN SERIES

The Pyeongan series, consisting of well drained, deep, reddish brown to yellowish red soils on sloping to steep mountain footslopes, is a member of the fine clayey family of Typic Hapludalfs. This series, developed in colluvial materials derived from limestone, is located on colluvial slopes and terrace edges.

A typical profile follows.

Ap—0 to 17 cm; brown to dark brown (7.5YR 4/4) cobbly clay loam; weak, fine to medium granular structure; friable, sticky, and plastic; many fine pores; few, large worm cast on the surface; abundant fine to medium roots; gradual, smooth boundary; pH 7.5.

B1—17 to 40 cm; reddish brown (5YR 4/4) clay loam; weak, fine to medium subangular blocky structure; friable, sticky, and plastic; patchy thin cutans on some ped faces but mainly in root channels; common, fine pores; abundant, fine to medium roots; gradual, smooth boundary; pH 7.5.

B21t—40 to 70 cm; yellowish red (5YR 4/6) clay; moderate, fine to medium subangular blocky structure; firm, very sticky, and very plastic; patchy thin clay cutans on ped surfaces; common, fine pores; abundant, fine roots; gradual, smooth boundary; pH 6.5.

B22t—70 to 100+ cm; yellowish red (5YR 4/6) gravelly to cobbly clay; moderate, medium to coarse subangular blocky; firm, very sticky, and very plastic; moderately thick patchy clay cutans on ped faces; few, fine pores; few, fine roots; pH 7.5.

The surface layer is brown to dark brown clay loam to loam 10 to 20 cm thick. The subsoil ranges from reddish brown to yellowish red and from clay loam to clay. The Pyeongan soils are on colluvial slopes below soils of the Pyeongchang and Jangseong series, and except for their neutral reaction, resemble the acid Gaghwa and Ungyo soils. The Ungyo have dark coloured surfaces.

These soils are low in organic matter content, high in natural fertility, and are neutral in reaction. They have high available moisture capacities. Cation exchange capacity and base saturation are high. Most areas are used for crops, but small areas of steep slopes are used for forest. The cultivated crops consist of corn, barley, and radish.

### 5.19.1 Pyeongan Cobbly Clay Loam, 7 to 15 Percent Slopes (PaC)

The profile is generally similar to that typical, but, patches that do not have cobbles on the surface, small areas with greater slopes, small areas of acid soils, and a few small areas of dark coloured soils, are also included.

Runoff is medium. Cultivated crops, such as corn, radish, and potato are suitable, but erosion is a severe problem when these are grown year after year. The use of small fields planted on the contour will lessen erosion damage and improve

the soil. Some diversion terraces and grassed waterways would also be helpful. This soil is well suited to perennial legumes, because of its neutral reaction.

Capability unit IIIe.
Paddy suitability group P3ac.

5.19.2 Pyeongan Cobbly Clay Loam, 15 to 30 Percent Slopes (PaD)

Most areas have a profile similar to that described for the series, except that patches without cobbles on the surface, small areas with lesser and greater slopes, small tracts of acid soils, and soils with dark surfaces, are also included.

Runoff is medium. Cultivated crops such as corn, radish and potato are general, but erosion is a very severe problem when the land is cropped continuously. The use of small fields on the contour with grass strips will lessen this effect, which in turn will be minimized if perennial grass and legume forage crops are grown. This soil is well suited to the latter crop because of its neutral reaction. Grassed waterways will help reduce gullying.

Capability unit IVe.
Paddy suitability group P4ac.

5.19.3 Pyeongan Cobbly Clay Loam, 30 to 60 Percent Slopes (PaE)

Most areas have a profile similar to that typical, with some lacking cobbles on the surface and others having some stones.

In areas mapped as this soil are also comprised patches that have a silty clay loam or loam surface layer, small tracts with steeper slopes, as well as minor areas of acid soils and small areas of dark coloured soils.

Runoff is rapid. About 50 percent has been cleared for crops, such as corn and radish. Erosion is a very severe problem when this soil is planted to annual crops. Pasture or woodland use are most suitable and because of its neutral reaction no limestone need to be applied to grow legumes.

Capability unit VIe.

5.20 PYEONGCHANG SERIES

The series consists of well drained, deep, neutral to alkaline yellowish red to red soils on moderately steep to steep mountainous areas. They are members of the fine clayey family of Typic Hapludalfs. This series, developed in residual materials from limestone, is mostly in the south of the Gun.

A typical profile follows.

Ap---0 to 10 cm; yellowish brown (10YR 5/4), clay loam; moderately fine and medium granular structure; friable, sticky, and plastic; common, very fine and fine medium, tubular pores; common, fine to medium soybean roots; abrupt, smooth boundary; pH 6.0.

B1—10 to 30 cm; yellowish red (5YR 4/8) clay; moderately fine to medium subangular blocky structure; firm, very sticky, and plastic; few, fine to medium roots; coarse worm holes; diffuse, smooth boundary; pH 6.3.

B21t—30 to 60 cm; red (2.5YR 4/6), clay; very strong and medium, angular blocky structure; firm, very sticky, and plastic; thin continuous clay cutans; few, fine soybean roots; clear, smooth boundary; pH 6.5.

B22t—60 to 80 cm; red (2.5YR 4/6) clay; black (10YR 2/1) manganese mottles; very strong, coarse and medium angular blocky structure; very firm, very sticky, and very plastic; medium thick continuous clay cutans; clear, smooth boundary; pH 7.7.

B31t—80 to 120 cm; red (2.5YR 4/6) clay; black (10YR 2/1) manganese mottles; few yellowish brown limestone gravel and stones; pH 7.7.

B32t—120 to 150 cm; yellowish red (5YR 4/6) clay; firm, common, fine limestone gravel and stones.

C2—150+ cm; pale brown (10YR 6/3) soft limestone with very fine sandy loam texture; pH 8.0.

The surface layer ranges in colour from yellowish brown to brown and in texture from clay loam to loam. It is 10 to 20 cm thick. The subsoil is yellowish red to red clay with thin clay cutans and black manganese mottles. The C horizon is pale brown, very fine sandy loam. The depth, from the surface to hard rock, ranges from 50 cm to several metres. The Pyeongchang series is associated with the Pyeongan and Jangseong soils, but is finer textured than the Jangseong and has thicker subsoils. They contain also less fragments than Pyeongan and have finer textured subsoils.

These soils, low in organic matter content, high in natural fertility, and neutral in reaction, have a high available water capacity. The cation exchange capacity and base saturation are high.

Cultivated crops are usually grown with a few small areas in forest or grass land.

5.20.1 Pyeongchang Rocky Clay Loam, 15 to 30 Percent Slopes (PcD)

Most areas have a profile like that described for the series, with about 15 to 30 percent of the surface rock outcrop or stones.

In areas mapped as this soil are included patches that have a silty clay loam or silt loam surface layer, and small tracts with steeper slopes. Runoff is medium. Cultivated crops, such as corn, potato, and radish are generally grown and moderate to good yields are obtained, but erosion is a very severe problem. Contour tillage and the use of small fields assist in its control, and grassed drainageways will help prevent gullying. Because of its neutral reaction good yields of legume forage crops will be produced.

Capability unit VIe.

5.20.2 Pyeongchang Rocky Clay Loam, 30 to 60 Percent Slopes (PcE)

Most areas have profiles much like that typical for the series. About 20 to 50 percent of the mapped area is rock outcrop or covered with stones.

In areas mapped as this soil are included patches with silty clay loam or silt loam surface layer, small areas with lesser slopes, and a few small tracts of more shallow soils or of deep cobbly soils.

Runoff is rapid. About 50 percent has been cleared for cultivated crops, such as corn and radish, but erosion is very severe when these are grown. Because of its neutral reaction it is well suited for legume and grass pasture crops.

Capability unit VIe.

5.21 RIVERWASH, COBBLY (RC)

This land consists of areas of stratified alluvium recently deposited by streams on first bottoms and floodplains. Generally these are cobbly sand, but some finer textured strata may be present. The base saturation and cation exchange capacity are low as are natural fertility and organic matter content. Surface runoff is very slow, and the available moisture capacity is low. Land is usually left idle, with only a few areas in poplar trees. Until flooding is controlled this soil has little value for agriculture.

Capability unit VIII.

5.22 ROCK LAND (RL)

These rock lands are colluvial deposits of stones on mountain footslopes, talus slopes, escarpments along the river sides, and rock outcrops on the top of mountains, with about 10 percent shallow stony soils. They are comprised of granite, porphyry, and shale. A few areas consist of granite-gneiss and porphyry conglomerate. Vegetation is poor, with only a few pines growing.

Capability unit VIII.

5.23 SINBUL SERIES

The Sinbul series, consisting of sloping to steep, well drained, deep soils with dark surfaces, are members of the loamy skeletal family of Typic Haplumbrepts. This series developed in colluvial materials derived from granite and granite-gneiss on the high mountainous areas.

A typical profile follows.

Ap—0 to 13 cm; dark brown (10YR 3/3) stony loam; weak, fine and medium granular; friable, sticky, and plastic; many, medium and coarse pores; frequent gravel and cobbles; some boulders scattered on surface; frequent, fine and medium roots; gradual, smooth boundary; pH 5.5.

A12—13 to 39 cm; dark brown to brown (10YR 3/3-4/3) friable gravelly to stony loam; weak, medium and coarse granular; sticky and plastic; few, fine to coarse worm holes; abundant, subangular gravel, cobbles, and stones; frequent, fine to medium roots; clear, smooth boundary; pH 5.5.

B—39 to 80 cm; yellowish brown (10YR 5/6) gravelly to stony loam; weak fine subangular blocky structure; firm, sticky, and plastic; common, fine and medium, tubular pores; abundant gravel, cobble, and stone; few, fine roots; pH 5.5.

C—80 to 100 cm; pale brown (10YR 6/3) very stony loam; structureless; more than 75 percent gravel, cobbles and stones.

Where not eroded, the surface layer varies from dark brown to very dark brown in colour and from stony loam to bouldery loam in texture. Its thickness ranges from 20 to 50 cm. The substratum is yellowish brown to dark yellowish brown, gravelly to stony loam. The gravel and stone content increases with depth. Solum thickness ranges from 60 to 100 cm, and depth to bedrock is more than 3 m. The Sinbul occur with Weoljeong, Odae, and Ungyo soils. The Weoljeong are on the upper portion of high mountains, and the Ungyo on lower slopes.

The Sinbul soils are low to medium in natural fertility, high in organic matter content, and strongly to medium acid. They have moderate available moisture capacities. Cation exchange capacity is medium and base saturation is low or medium. Most of the sloping land is used for crops but small areas of steep slopes are still in forest, consisting mainly of pine tree and some shrubs. The cultivated crops consist chiefly of corn, potato, and radish. Hops are grown in some areas.

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

Most areas have profiles like that typical, with about 15 to 30 percent of the surface being stony. In areas mapped as this soil are comprised patches with a bouldery loam or silt loam surface layer, small tracts with greater slopes, as well as small areas of loamy soils without coarse fragments.

Runoff is medium, with some areas having a high base saturation. Crops, including corn, are suited, but much of the cultivation must be done by hand as stoniness limits the use of oxen or power tools. Erosion and stoniness are the main management problems. Cool climate is another important limiting factor to cultivation.

Capability unit VIe.

### 5.23.2 Sinbul Bouldery Loam, 7 to 15 Percent Slopes (SlC)

Most areas have profiles like that typical, with about 15 to 30 percent of the surface stones or boulders. Because of this, cultivation is done by hand. Grazing land or woodland is better suited than crops.

Capability unit VIe.

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

Most areas have profiles like that typical with about 15 to 30 percent of the surface being stony. In this unit are included some areas that have a bouldery loam or silt loam surface layer, small areas with lesser and greater slopes, and small areas of Ungyo and Mui soils. Some areas have a high base saturation. Runoff is medium. Much of this land is used for crops including hops, although stoniness makes it necessary to cultivate by hand. Grazing or woodland are better suited.

Capability unit VIe.

5.23.4 Sinbul Bouldery Loam, 15 to 30 Percent Slopes (SlD)

Most areas have profiles like that typical with about 15 to 30 percent in stones and boulders. Except for the latter, this soil is similar to Sinbul stony loam, 15 to 30 percent slopes (SiD). The roughness limits cultivation to hand tools, and pasture or woodland are consequently best suited.

Capability unit VIe.

5.23.5 Sinbul Bouldery Loam, 30 to 60 Percent Slopes (SlE)

Most mapped areas have profiles similar to that typical. About 20 to 40 percent of the surface is stones and boulders.

In areas mapped as this soil are included patches with a stony loam or silt loam surface layer, small areas with lesser slopes, and small tracts of less stony soils.

Runoff is rapid, and erosion hazard severe. Because of steep slopes, it is only well suited for woodland. All of the areas are in grass or forest of pine and shrubs. The cool climate is a limiting factor to cultivation, and management is affected by the severe erosion hazard and the presence of boulders.

Capability unit VIe.
Woodland suitability group.

5.24 SONGJEONG SERIES

The Songjeong series, consisting of well drained, deep soils on moderately steep to steep mountainous areas, are members of the fine loamy family of Typic Hapludults. This series developed in residual materials that weathered from granite and granite-gneiss, and is commonly associated with the Weoljeong and Chahang series.

A typical profile follows.

A1—0 to 12 cm; brown to dark brown (10YR 4/3) loam; weak, fine granular, friable, slightly sticky, and slightly plastic; many, fine to medium grass and pine roots; diffuse, smooth boundary; pH 5.4.

B1—12 to 25 cm; yellowish brown to dark yellowish brown (10YR 5/4-4/4) loam; weak, coarse subangular blocky; friable, slightly sticky, and slightly plastic; diffuse, wavy boundary; pH 5.3.

B2t—25 to 70 cm; strong brown (7.5YR 5/8) loam to clay loam; weak, medium to coarse subangular blocky; firm, sticky, and plastic; thin clay skins; few, fine pores; few, fine grass and pine tree roots; clear, smooth boundary; pH 5.7.

B3—70 to 110 cm; brownish yellow to yellowish brown (10YR 5/6-6/6) sandy loam; friable, slightly sticky, and slightly plastic; few, fine pores; pH 6.0.

C—110 to 120+ cm; yellowish brown (10YR 5/4) friable sandy loam.

The surface layer is brown to dark brown friable loam, 10 to 20 cm thick. The subsoil is strong brown or yellowish red, firm loam or clay loam with weak, coarse subangular blocky structure. Thin patchy clay skins are in the subsoil. The substratum is yellowish brown to brownish yellow friable sandy loam saprolite of granite and granite-gneiss. Depth to the bed rock is usually more than 3 m.

These soils are moderate to moderately low in natural fertility, low to medium in organic matter content and medium to strongly acid. They have a medium available water capacity. Cation exchange capacity is medium and base saturation low. Permeability is moderate, and runoff is rapid.

All of the areas originally were in forest, but recently about 50 percent has been cleared and planted to crops other than rice.

### 5.24.1 Songjeong Loam, 15 to 30 Percent Slopes (SoD)

Most areas have profiles as described for the series, but small tracts with dark coloured surfaces, and small areas with greater slopes have been included. About 70 percent has been cleared of forest, the remaining 30 percent consists mainly of pine trees. Cultivation is generally poorly suited and erosion is a severe problem when large areas are planted to crops. This is less pronounced in small fields, with contour boundaries and alternate fields which grow perennial forage crops such as fescue, timothy, and orchard grass.

Capability unit IVe.
Paddy land suitability group P4ac.

### 5.24.2 Songjeong Loam, 30 to 60 Percent Slopes (SoE)

Most areas have profiles similar to that typical, but included are small areas of dark coloured soils with coarse sandy loam textures, and small tracts with less steep slopes. Pine forest is general with only recently about 20 percent being cleared. This soil is too steep for crops, severe erosion usually being the result of cultivation.

Capability unit VIe.

## 5.25 SUBUG SERIES

The series, consisting of poorly drained, deep soils in gently sloping to sloping narrow valleys, is a member of the coarse loamy over sandy skeletal family of

Fluventic Haplaquepts. It developed in mixed alluvial materials derived from granite and granite-gneiss.

A typical profile follos.

Ap—0 to 12 cm; dark gray (5Y 4/1) loam; common, coarse, distinct mottles of dark yellowish brown to olive brown (10YR 4/4-2.5Y 4/4); massive; friable, slightly sticky, and plastic; many, fine to medium white and yellow mica; common, fine to medium rice roots; diffuse, smooth boundary; pH 5.2.

C1g—12 to 29 cm; very dark gray (5Y 3/1) sandy loam; few, fine to medium, distinct mottles of dark brown (10YR 3/3) massive; friable, slightly sticky, and plastic; common, fine to medium yellow and white mica; clear, smooth boundary; pH 5.4.

C2g—29 to 52 cm; dark gray (5Y 4/1) gravelly loam; many, fine to medium, distinct mottles of dark yellowish brown (10YR 4/4) and few, fine, prominent strong brown (7.5YR 5/8) mottles; massive; slightly sticky and plastic; few, fine to medium pores; common, fine to medium yellow and white mica; pH 5.7.

C3g—52 to 100+ cm; dark gray (10YR 4/1) very gravelly loamy coarse sand; single grain (gravel and cobble content 50 percent ); pH 6.0.

The surface layer is dark gray to very dark gray friable loam to sandy loam with yellowish brown to dark brown or olive brown mottles. It contains gravel in some places. The substrata are dark gray to very dark gray gravelly loamy coarse sand to sand with strong brown mottles. Gravel content increases with depth.

These soils are medium in organic matter content, moderate in natural fertility, and strongly acid to neutral. Cation exchange capacity is low and base saturation moderate to high. Workability is fair and permeability rapid. They have low available moisture capacities. Most of the areas are cultivated only to paddy rice because of the poor drainage.

5.25.1 Subug Sandy Loam, 2 to 7 Percent Slopes (SpB)

Most areas have profiles similar to that described for the series. In areas mapped as this soil are comprised patches that have a clay loam or sandy clay loam horizon in the profile, some areas with greater slopes, and small areas of peat soils. All of the areas are well suited to rice. Because of the high water table it is not suited to other crops such as barley and corn. This soil produces moderate yields when well managed. The main management problems are drainage and reducing the effects of leaching.

Capability unit IVw.
Paddy land suitability group P3ab.

5.25.2 Subug Sandy Loam, 7 to 15 Percent Slopes (SpC)

The profile is like that for the series, but includes small tracts with a clay loam or sandy clay loam layer, and small areas of lesser slopes. This soil is usually poorly suited to crops other than rice owing to the poor drainage. The main management problems are drainage and lessening the effects of leaching.

Capability unit IVw.
Paddy land suitability P3ab.

5.26 UNGYO SERIES

The Ungyo series consists of sloping to steep, well drained, deep, dark coloured soils. They are members of the fine clayey family of Humic Hapludults. This series developed in colluvial materials derived from granite and granite-gneiss on dissected mountain footslopes and terrace edges.

A typical profile follows.

Ap—0 to 15 cm; dark brown (10YR 3/3) cobbly silt loam; weak, fine granular; friable, slightly sticky, and slightly plastic; common, fine corn roots; abrupt, smooth boundary; pH 5.5.

B21t—15 to 25 cm; dark yellowish brown (10YR 4/4) silty clay loam; weak, fine and medium subangular blocky; firm, sticky, and plastic; patchy, thin clay cutans; few, fine medium tubular pores; few, fine corn roots; clear, smooth boundary; pH 5.0.

B22t—25 to 65 cm; strong brown (7.5YR 5/6) silty clay loam; moderate, medium to coarse, subangular blocky; firm, sticky, and plastic; moderately thick clay cutans; few, fine and medium tubular pores; few, fine dead corn roots; diffuse, smooth boundary; pH 5.0.

B23t—65 to 100 cm; yellowish red (5YR 5/6) gravelly to cobbly clay loam with some stones, weak, fine to medium, subangular blocky; firm, sticky, and plastic; patchy, thin clay cutans; few, fine, tubular pores; pH 5.0.

C—100+ cm; cobbly and stony clay loam (about 80 percent).

The surface layer ranges from dark brown to very dark brown cobbly loam to cobbly silt loam. It is 15 to 30 cm thick. The subsoil is strong brown to yellowish red silty clay loam to clay loam with few cobbles and gravel. The lower strata are cobbly and stony loam or clay loam.

These soils are high in organic matter content, low to medium in natural fertility, and are strongly acid. They have high available moisture capacities. Cation exchange capacity is medium and base saturation low. Crops are usually grown with only a few steep slopes in forest.

5.26.1 Ungyo Cobbly Silt Loam, 7 to 15 Percent Slopes (UgC)

Most areas have profiles like that typical, but included are patches that have a loam or silty clay loam surface layer, small tracts with greater slopes, and small

areas of very cobbly and stony soils.

Runoff is medium. Cultivated crops, such as corn, potato, and radish are usually suited, but erosion is a severe problem when these are planted. Planting on the contour will reduce soil erosion, which in turn will be minimized if perennial forage crops are grown.

Capability unit IIIe.
Paddy land suitability group P3ac.

5.26.2 Ungyo Cobbly Silt Loam, 15 to 30 Percent Slopes (UgD)

Most areas have profiles similar to that typical, but in areas mapped as this soil are also comprised patches that lack cobbles in the surface layer, small tracts with lesser and greater slopes, and small areas of very stony soils. Most of the soil is poorly suited to cultivation, but corn, potato, and other vegetable crops can be grown. The main management problem is erosion control.

Capability unit IVe.
Paddy suitability group P4ac.

5.26.3 Ungyo Cobbly Silt Loam, 30 to 60 Percent Slopes (UgE)

Most areas have profiles similar to that typical, but included are patches that lack cobbles and gravel in the surface layer, small areas with lesser slopes, and small tracts of very stony soils.

Runoff is rapid. This soil is poorly suited for cultivated crops, but some such as corn are grown. Erosion losses are high when it is used for annual crops. It is better suited to pasture or forest and small tracts of the latter are to be found.

Capability unit VIe.

5.27 WANGSAN SERIES

The Wangsan series, consisting of gently sloping, deep, well drained, dark coloured soils, are members of the fine clayey family of Humic Hapludults. This series is developed in old alluvial materials.

A typical profile follows.

Ap—0 to 15 cm; very dark brown (10YR 2/2) silt loam; weak, fine and medium subangular blocky; friable, sticky, and plastic; few, quartz gravel; few, fine roots; clear, smooth boundary; pH 5.0.

A12—15 to 40 cm; dark yellowish brown (10YR 3/4) silty clay loam; weak, coarse subangular blocky, breaking to weak, fine and medium granular; firm, sticky, and plastic; coarse worm holes; few, fine tubular pores; few, fine roots; gradual, smooth boundary; pH 5.5.

B1t—40 to 52 cm; dark yellowish brown (10YR 4/4) silty clay loam; weak, coarse subangular blocky; firm, sticky, and plastic; patchy thin clay films on some ped faces; common, fine and coarse tubular pores; very few, large worm holes; few, subangular quartz gravel (2-4 mm); gradual, smooth boundary; pH 6.0.

B2t—52 to 80 cm; brown to dark brown (7.5YR 4/4) silty clay loam; moderate, medium and coarse subangular blocky; firm, sticky and plastic; patchy thin cutans on ped faces; few, fine and medium tubular pores; few quartz gravel pieces; few, fine yellow mica; few, large worm casts; gradual, smooth boundary; pH 6.0.

B22t— 80 to 130 cm; yellowish red (5YR 5/6) loam with quartz gravel (5-10 percent); weak, coarse subangular blocky; firm, sticky, and plastic; patchy, moderately thick clay cutans in worm holes and on some ped faces; few, medium and coarse tubular pores; diffuse, smooth boundary; pH 6.0.

B23t—130 to 150+ cm; yellowish red (5YR 5/8) clay; moderate, medium and coarse subangular blocky; firm, very sticky, and very plastic; few, small quartz grit and feldspar crystals; few, fine yellowish mica; pH 6.0.

The surface layer is very dark brown to dark brown silt loam. The subsoil is strong brown and yellowish loam, clay loam or silty clay loam. The substrata are yellowish brown to strong brown silt loam to clay. The Wangsan are in association with the Chahang and Imog soils, but differ from them in having finer textures in the subsoil. Solum thickness ranges from 150 to 200 cm, depth to hard rock from 3 to 5 m. They are low or medium in natural fertility, high in organic matter content, and are medium to strongly acid. They have high available moisture capacities. Cation exchange capacity is high and base saturation low. These soils are planted to corn, soybean, radish, potato, cabbage and similar crops.

### 5.27.1 Wangsan Silt Loam, 2 to 7 Percent Slopes (WgB)

Most areas have profiles similar to that typical for the series. This mapping unit is on the gently sloping areas, and is well suited to a wide range of crops. Irrigation water for the production of rice is available in a few places, which produce high yields when well fertilized and managed. Most of this land is in crops such as cabbage, potato, soybean, and corn.

Capability unit IIe.
Rice suitability group P2ac.

## 5.28 WEOLJEONG SERIES

The series, consisting of deep, somewhat excessively drained soils with dark surfaces on steep to very steep mountainous areas, is a member of the coarse loamy family of Typic Haplumbrepts. These soils are developed in residual materials weathered from granite and granite-gneiss.

A typical profile follows.

Ap--0 to 20 cm; very dark brown (10YR 2/2) to black (10YR 2/1) loam; weak, fine to medium granular; friable, slightly sticky, and slightly plastic; few, fine yellowish mica; few, fine grit; abundant, fine and medium living grass roots; diffuse, smooth boundary; pH 5.5.

A12--20 to 44 cm; very dark gray (10YR 3/1) loam; weak, fine and medium granular structure; friable, slightly sticky, and slightly plastic; few, fine yellowish mica and feldspar crystals; frequent, fine quartz grit and quartz gravel; abundant, fine and medium living grass roots; gradual, smooth boundary; pH 5.5.

B--44 to 71 cm; yellowish brown (10YR 5/6) sandy loam; structureless; frequent, fine to medium quartz gravel with some feldspar crystals; frequent, fine and medium living grass roots; diffuse, smooth boundary; pH 5.0.

C2--71 to 105 cm; yellowish brown (10YR 5/6-5/4) sand; friable, loose, nonsticky, and nonplastic; very frequent, fine and medium angular quartz gravel; some fine feldspar crystals; few, fine living grass roots; clear, smooth boundary; pH 4.5.

C3--105 to 120+ cm; yellowish brown (10YR 5/4) sand; frequent, irregular fragments of soft granite; pH 4.5.

The surface layer is dark brown to black loam or sandy loam. The subsoil is yellowish brown, strong brown and dark yellowish brown sandy loam or fine sandy loam. The substrata are yellowish brown, strong brown and pale yellow coarse sand and loamy sand.

The Weoljeong occur with the Odae, Sinbul, Chahang, and Mangsil soils. The Chahang have loam to clay loam B horizons, the Imog are deep dark coloured colluvial materials. Solum thickness is commonly 80 cm, and ranges from 50 to 100 cm. Depth to hardrock is greater than 150 cm.

These soils are high in organic matter content, low in natural fertility, and strongly acid. Available moisture capacities are low, cation exchange capacity is very low and base saturation low. Pine forest with some hard wood is general with vegetable crops planted in a few places.

5.28.1 Weoljeong Sandy Loam, 30 to 60 Percent Slopes (WjE)

Most areas have profiles like that described for the series, but with about 5 to 15 percent rock outcrop or covered with stones.

Small areas with steeper slopes, soils with loam or clay loam subsoils, and deep stony loam soils in small valleys, are also included.

Runoff is moderate. This soil is mainly in forest, with coniferous trees predominating. Vegetable crops are planted on small areas. Woodland is best suited but some areas will produce grazing.

Capability unit VIe.

5.28.2 Weoljeong Sandy Loam, 60 to 100 Percent Slopes (WjF)

Most areas have profiles similar to that typical with about 5 to 15 percent in rock outcrop or covered with stones. Small areas with lesser slopes, small areas of soils with loam to clay loam subsoils, and deep stony loam soils in the small valleys at a high elevation are also included.

Runoff is rapid. Forest is general, producing only low yields even with good management.

Capability unit VIIe.

# 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 the discussion of capability groups, but are discussed in greater detail in the following section on the paddy suitability group. The sub-section 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, 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 narrow choices for practical use. There are no soils placed in Class V in Pyeongchang 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 each capability class, and are designated by adding a small letter, e, s, or w to the class numeral, for example, IIe. The letter 'e' shows that the main limitation is risk of erosion unless close-growing plant cover is maintained, 's' that the soil is shallow, droughty, or stony; and 'w' that water in or on the soil interfere with plant growth or cultivation.

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 without special management, and irrigation water needs are not excessive. These soils are too wet to produce good yields of other crops without additional drainage. The IVs soils produce good crops of melons and peanut, but they are too droughty to grow most other crops. In Class I there are no subclasses because the soils of this class have few limitations.

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 description of the subclass. Detailed information on the management of paddy soils is given in the paddy suitability section.

### 6.2.1 Class I. Soils Having Few Limitations Restricting Use

#### 6.2.1.1 Capability unit I

The only soil in this unit is level to nearly level, deep, well drained, moderately permeable, and has a high available moisture capacity. Its natural fertility is high, and organic matter content is medium. Soil reaction is neutral to mildly alkaline. It is Anmi loam, 0 to 2 percent slopes.

This soil is well suited for crops, being used for corn, soybeans, potatoes, barley, and vegetables with a few small tracts cultivated to paddy rice. It is highly productive and can be intensively cultivated if well managed. Good management includes minimum tillage, the use of all available crop residues, and proper fertilization.

### 6.2.2 Class II. Soils Having Moderate Limitations

#### 6.2.2.1 Capability unit IIe.

This capability unit consists of gently sloping, deep, well drained, moderately permeable soils that have high available moisture capacity. These soils are:

Anmi loam, 2 to 7 percent slopes.

Bancheon silty clay loam, 2 to 7 percent slopes.

Wangsan silt loam, 2 to 7 percent slopes.

The Anmi and Bancheon are high in natural fertility and low to medium in organic matter content, while the Wangsan is low to moderate in fertility, and high in organic matter content.

Crops are well suited, corn, soybeans, potatoes, and vegetables now growing. They are moderately subject to erosion because of the slopes. The erosion hazard can be controlled by contour farming, terraces, grassed waterways, and diversion channels. Good management also includes minimum tillage, crop residues turned in, and adequate fertilization. Liming is needed for the Bancheon and Wangsan soils.

6.2.2.2 Capability unit IIs

The soils in this capability unit are level to gently sloping, well drained, deep, rapid to moderately rapid in permeability, coarse-textured or gravelly. They are:

Bonryang sandy loam, 0 to 2 percent slopes.

Hogye gravelly loam, 0 to 2 percent slopes.

Hogye gravelly loam, 2 to 7 percent slopes.

Imog sandy loam, 2 to 7 percent slopes.

Jungdong fine sandy loam, 0 to 2 percent slopes.

Maji gravelly loam, 0 to 2 percent slopes.

Maji gravelly loam, 2 to 7 percent slopes.

Most of the soils are dark-coloured, and are high to medium both in natural fertility and organic matter content. The available moisture capacity is generally low or moderate.

These soils are suited and used for corn, potatoes, soybeans, barley, radish, and other crops commonly grown in the Gun. Water for irrigation is available and paddy rice is cultivated on the Bonryang soils, although it is not well suited. Otherwise, only a few small areas of other soils grow it.

Droughtiness because of rapid permeability and low available moisture capacity, is a problem, and plant nutrients are not held well. The Bonryang soils are also subject to damage by overflow from the nearby streams, but the floodwater drains rapidly. Removal of gravel will help reduce water seepage and will make cultivation easier.

6.2.3 Class III. Soils with Severe Limitations

6.2.3.1 Capability unit IIIe

In this unit are mostly sloping, deep, well drained, gravelly to cobbly, eroded soils. They are:

Anmi loam, 7 to 15 percent slopes.

Bancheon silty clay loam, 7 to 15 percent slopes, eroded.

Chahang loam, 7 to 15 percent slopes.

Gaghwa cobbly silty clay loam, 7 to 15 percent slopes.

Hogye gravelly loam, 7 to 15 percent slopes.

Imog sandy loam, 7 to 15 percent slopes.

Maji gravelly loam, 7 to 15 percent slopes.

Mitan channery silt loam, 7 to 15 percent slopes.

Mui stony loam, 7 to 15 percent slopes.

Pyeongan cobbly clay loam, 7 to 15 percent slopes.

Ungyo cobbly silt loam, 7 to 15 percent slopes.

The soils in this unit generally have moderate or high available moisture capacities, and are suitable used for corn, potatoes, soybeans, barley, and other common summer crops. Some areas are in woodland.

Erosion is the chief hazard in cultivated areas, but contour tillage, terraces and grassed waterways will help to retard runoff and thus control it. The Hogye, Imog, and Maji soils are also subject to droughtiness because of their rapid permeability, and do not hold plant nutrients well. Therefore, applying fertilizer needed in split applications, is better than applying a large quantity which is likely to be leached out. Compost added in large amounts will also help reduce leaching and improve fertility.

Yields are somewhat reduced following dry seasons.

These soils are also suitable for pasture. A complete pasture establishment programme including land preparation, liming, fertilization, seeding of adapted plants and regulation of grazing will make long lived, productive pastures. The Mitan and Pyeongan are neutral in soil reaction, and do not need liming.

For orchards and mulberry fields, bench terraces constructed on these soils will assist in erosion control. Growing of green manure crops as intercrops between orchards or mulberry trees will improve fertility, reduce erosion, and increase yields.

### 6.2.4 Class IV. Soil with Very Severe Limitations

#### 6.2.4.1 Capability unit IVe

In this capability unit are mostly moderately steep, deep, well drained, cobbly or rocky, eroded soils. They are:

Bancheon silty clay loam, 15 to 30 percent slopes, eroded.

Chahang loam, 15 to 30 percent slopes.

Gaghwa cobbly silty clay loam, 15 to 30 percent slopes.

Mitan channery silt loam, 15 to 30 percent slopes.

Mui stony loam, 15 to 30 percent slopes.

Pyeongan cobbly clay loam, 15 to 30 percent slopes.

Songjeong loam, 15 to 30 percent slopes.

Ungyo cobbly silt loam, 15 to 30 percent slopes.

Most of the soils have moderate or low available moisture capacities, and are usually in cultivated crops, such as corn, potatoes, soybeans, radish, and other vegetables. Erosion is a severe hazard because of the strong slopes. Good yields can be expected if fertilizer and lime are used. For higher yields of general agricultural crops, the soils should be treated with much lime, phosphorus and compost. Bench terracing will assist in erosion control, and crop residues, left on the surface, provide cover, promote the infiltration of water, and reduce erosion losses. Maintaining grassed waterways will prevent gullying.

Erosion is a small problem when these soils are covered with good grass pasture, but some areas are in pine forest, with many sparse stand of trees. The soil here deteriorates very rapidly, because of the raking and removing of leaves and other surface litter.

6.2.4.2 Capability unit IVs

The only soil in this capability unit, is level to sloping, deep, well drained, very coarse textured, rapidly permeable, and has very low available moisture capacity. It is Hwangryong gravelly sandy loam, 0 to 2 percent slopes.

This soil is low both in natural fertility and organic matter and is generally poorly suited to most cultivated crops, but does well with peanuts, melons, tobacco, some vegetables, poplar, mulberry, and orchards. Some of the soils are in paddy rice, as water is available from the nearby streams, but droughtiness or low available moisture capacity remain the chief hazards. Flooding is only for short periods of time and most damage then is caused by rapidly moving water.

Addition of fine clayey soil will improve the coarse texture and water holding capacity. Split applications of fertilizer will lessen the effects of the leaching caused by the rapid water loss. The Hwangryong soils are easy to cultivate where the gravel is removed from the surface.

6.2.4.3 Capability unit IVw

This unit consists of gently sloping to sloping, poorly drained, deep, rapidly permeable, coarse textured soils that have high water tables and a low available moisture capacity. These, located in small valleys, are:

Subug sandy loam, 2 to 7 percent slopes.

Subug sandy loam, 7 to 15 percent slopes.

The soils of this unit are poorly suited to general cultivated crops because of the high water table, and are used only for paddy rice, the yields of which, are generally low. If adequately drained, they could be cultivated to many kinds of crops, and tile drainage would function well. Erosion is also a problem because of the

slopes, and too, the leaching of plant nutrients due to rapid permeability. Proper fertilization in split applications is needed to reduce the effect of the latter.

### 6.2.5 Class VI. Soils Suitable Only for Pasture or Woodland

#### 6.2.5.1 Capability unit VIe

This capability unit consists of moderately steep to steep, well drained, stony to rocky soils. These, extensive in the Gun, are:

Chahang loam, 30 to 60 percent slopes.

Cheongsim stony silt loam, 30 to 60 percent slopes.

Gaghwa cobbly silty clay loam, 30 to 60 percent slopes.

Jangseong rocky silt loam, 30 to 60 percent slopes.

Mitan channery silt loam, 30 to 60 percent slopes.

Mui stony loam, 30 to 60 percent slopes.

Odae rocky loam, 30 to 60 percent slopes.

Oesan stony loam, 30 to 60 percent slopes.

Pyeongan cobbly clay loam, 30 to 60 percent slopes.

Pyeongchang rocky clay loam, 15 to 30 percent slopes.

Pyeongchang rocky clay loam, 30 to 60 percent slopes.

Sinbul bouldery loam, 7 to 15 percent slopes.

Sinbul stony loam, 7 to 15 percent slopes.

Sinbul stony loam, 15 to 30 percent slopes.

Sinbul bouldery loam, 15 to 30 percent slopes.

Sinbul bouldery loam, 30 to 60 percent slopes.

Songjeong loam, 30 to 60 percent slopes.

Ungyo cobbly silt loam, 30 to 60 percent slopes.

Weoljeong sandy loam, 30 to 60 percent slopes.

Because of the steep slopes, usually shallow depth, rockiness or stoniness, the ground is so erodible that it cannot be cultivated. However, pasture and woodland are suitable if properly managed. Most of the soils are in pine forest or in grassland, but again pasture management is difficult in many places because of the steep slopes. Intensive grazing too, will leave the soils bare and subject to erosion. Care must be exercised here.

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

### 6.2.6 Class VII. Soils Limited to Woodland

#### 6.2.6.1 Capability unit VIIe

This capability unit consists of steep, well drained, deep, rocky, or shallow soils. They are:

Cheongsim rocky silt loam, 60 to 100 percent slopes.

Gwanag rocky sandy loam, 30 to 60 percent slopes.

Gwanag rocky sandy loam, 60 to 100 percent slopes.

Jangseong rocky silt loam, 60 to 100 percent slopes.

Odae rocky loam, 60 to 100 percent slopes.

Oesan stony loam, 60 to 100 percent slopes.

Weoljeong sandy loam, 60 to 100 percent slopes.

The ground of this unit is so steep and rocky that only woodland is suited. Cultivation is not practicable, and grazing is severely limited even under intensive management. To reduce losses from erosion, leaf litter should be left on the surface and the bare areas reforested.

## 6.3 PADDY LAND SUITABILITY GROUP

Rice is the most important crop in Korea. However, this Gun has a very small area of paddy land, only 2 623 ha. This is about 16 percent of the total cultivated area of 16 378 ha.(Yearbook of Agriculture and Forestry Statistics 1968). Rice grows well on soils which are classified as IIw or IIIw in the capability classification. In this section, the use and management of the soils suitable for growing paddy rice are discussed.

Management of paddy land can be planned more effectively if soils are grouped according to those characteristics that affect the growth of rice and management of paddies. For this reason, the soils of Pyeongchang Gun have been placed in four paddy land suitability groups, which are designated by P1, P2, P3, and P4. The numerals indicate progressively greater limitations in the use of land for rice. The four suitability groups for rice paddy used by the Korea Soil Survey are defined as follows:

P1 Very Well Suited:

Land that is suitable for rice paddy without the necessity of special development or management practices. This land 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 land 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 land has severe hazards and limitations.

P4 Poorly Suited:

Land that is of limited or questionable suitability for paddy because of very severe hazards, limitations, and very difficult special management practices.

Suitability subgroups are soil classes within each suitability group; they are designated by adding small letters, a, b, c, or d to the group numeral, for example, P2ac. The letter 'a' shows that the main limitation is slopes; 'b' that the soil is limited mainly because of coarse texture or rapid permeability; 'c' that the soil is well drained or has low water table; and 'd' that the soil is limited mainly because of adverse chemical nature, such as acidity and salt. In Group P1 there are no subgroups, because the soils of this group 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, and are not included in this classification.

## 6.3.1 Group P2. Well Suited

### 6.3.1.1 Paddy suitability group P2ac

This group consists of gently sloping, deep, well drained, moderately permeable soils with medium and heavy textures. These soils have low water tables. They are:

Anmi loam, 2 to 7 percent slopes.

Bancheon silty clay loam, 2 to 7 percent slopes.

Wangsan silt loam, 2 to 7 percent slopes.

The available moisture capacity is high or moderately high, and natural fertility is dominantly moderate or moderately low. The slope and low water table are moderate limiting factors in growing paddy rice. These soils would be well suited to this crop if level-terraced, diked, and supplied with water. They are now being used for corn, potatoes, radish, wheat, and other summer crops commonly grown in the Gun. A few small areas of the Anmi soils are cultivated to paddy rice.

Droughtiness and loss of water because of the good drainage and the slopes are a problem and because of the low water table, frequent irrigation is needed to supply rice plants. Paddy systems need well constructed weir dams to protect the dykes from damage by overflow. Deep ploughing and application of calcium silicate are good cultural practices. Barley or wheat can not be grown in the winter-spring after paddy rice because of the short growing season.

6.3.1.2 Paddy suitability group P2c

The only soil in this group, is level to nearly level, deep, well drained, moderately permeable, medium textured. This soil has high available moisture capacity, high natural fertility, and medium organic matter content. It is Anmi loam, 0 to 2 percent slopes.

Paddy rice is well suited if enough water is available. The low water table and moderate permeability give the only problems in growing rice, but only a few small areas where water is easily available are planted to this crop.

Loss of water and dissolved plant nutrients are a moderate problem. The loss of nitrogen fertilizer can be reduced by making several applications in small amounts during the growing season. Because of the loss of water, a good irrigation system is needed to maintain the water level. Dense planting and spreading compost are good management practices.

6.3.2 Group P3. Moderately Suited

6.3.2.1 Paddy suitability group P3ab

In this paddy suitability group are gently sloping to sloping, moderately well drained, deep, rapidly permeable, coarse textured soils that have high water tables and low available moisture capacities. They are:

Subug sandy loam, 2 to 7 percent slopes.

Subug sandy loam, 7 to 15 percent slopes.

These soils are moderate in natural fertility and organic matter, and are now used for paddy rice because of the high water table. The slope and low available moisture capacity are chief limitations.

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

6.3.2.2 Paddy suitability group P3ac

This group consists of sloping, deep, well or moderately well drained, moderately to moderately slowly permeable soils that have a low water table. They are:

Anmi loam, 7 to 15 percent slopes.

Bancheon silty clay loam, 7 to 15 percent slopes, eroded.

Gaghwa cobbly silty clay loam, 7 to 15 percent slopes.

Pyeongan cobbly clay loam, 7 to 15 percent slopes.

Ungyo cobbly silt loam, 7 to 15 percent slopes.

Most of the soils are presently used for the general crops other than rice, but can be developed for paddy rice with the application of difficult special development

and management practices. For the paddy land use, the ground should be level-terraced and dikes and a water supply developed. Rice paddies on these soils will need well-constructed weir dams to protect the dikes from damage by overflow following intense rains, because the slopes of these soils make them subject to erosion. A well maintained paddy system also permits other general crops to grow without similar losses. Deep ploughing and application of compost should be good practices in growing paddy rice.

6.3.2.3 Paddy suitability group P3bc

This group consists of level to nearly level, deep, well drained, moderately rapidly permeable, gravelly, dark coloured soils that have low water tables. They are:

Maji gravelly loam, 0 to 2 percent slopes.

They are only moderately suited to paddy rice because of the gravel content, low water table, and rapid permeability. Most areas are now used for corn, potatoes, soybeans, barley, vegetables and some other crops, and a few small areas are in rice paddy.

To grow paddy rice, they need a dependable water supply. The losses of water and plant nutrients would be high. The gravel content interferes with cultivation if not removed.

Fine clayey soils and a large amount of compost applied to these soils will lessen the effects of leaching, and improve the available moisture capacity. Proper fertilization, thick planting, and dry-land direct seeding are good rice cultural practices.

6.3.3 Group P4. Poorly Suited

6.3.3.1 Paddy suitability group P4abc

This group consists of gently sloping to sloping, well drained, deep, moderately to moderately rapidly permeable, gravelly soils with a moderate to low available moisture capacity. These soils have low water tables. They are:

Hogye gravelly loam, 2 to 7 percent slopes.

Hogye gravelly loam, 7 to 15 percent slopes.

Imog sandy loam, 2 to 7 percent slopes.

Imog sandy loam, 7 to 15 percent slopes.

Maji gravelly loam, 2 to 7 percent slopes.

Maji gravelly loam, 7 to 15 percent slopes.

Mitan channery silt loam, 7 to 15 percent slopes.

Mui stony loam, 7 to 15 percent slopes.

Mui stony loam, 15 to 30 percent slopes.

Very few areas have been developed into paddy systems, and generally other crops are grown, rice being unsuitable because of the slope and high water requirement. To grow paddy rice, a dependable water supply is required and construction costs would be high, as would the losses of water and plant nutrients in the paddies. Gravel interferes with cultivation if not removed.

Paddies made on these soils will need good weir dams to control erosion of paddy walls, and, too, fine clayey soils to reduce the 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.

6.3.3.2 Paddy suitability group P4ac

This group consists of moderately steep, well drained, deep, moderately to moderately slowly permeable soils that have very low water tables. They are:

Bancheon silty clay loam, 15 to 30 percent slopes, eroded.

Bonryang sandy loam, 0 to 2 percent slopes.

Gaghwa cobbly silty clay loam, 15 to 30 percent slopes.

Pyeongan cobbly clay loam, 15 to 30 percent slopes.

Songjeong loam, 15 to 30 percent slopes.

Ungyo cobbly silt loam, 15 to 30 percent slopes.

Most areas are in cultivated crops such as corn, potatoes, barley, soybeans, and radish, and some are in pine forest. These soils are poorly suited to paddy rice because of the strong slopes and the water problem. They need to be level-terraced for paddy systems, and require dependable sources of water. Dry land direct seeding may be a way of growing rice. Cobbles and gravel need to be removed for easier cultivation. Deep ploughing and application of calcium silicate and compost are good management practices. Erosion of paddy walls would be controlled by weir dams.

6.3.3.3 Paddy suitability group P4bc

These soils are level to nearly level, deep, well drained, rapidly permeable, sandy soils with a very low available moisture capacity and low water tables. They have low clay content and low cation exchange capacity, and are subject to droughtiness. The soils in this paddy suitability group are:

Hwangryong gravelly sandy loam, 0 to 2 percent slopes.

Jungdong fine sandy loam, 0 to 2 percent slopes.

Paddy rice is grown in a few small areas where water is available, and generally only peanuts, melons, mulberry, and some orchard do well.

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

Table 3

GUIDE TO MAPPING UNITS

| Map Symbol | Mapping Unit | Capability Unit | Paddy Suit. Group |
|---|---|---|---|
| Am | Anmi loam, 0 to 2 percent slopes | I | P2c |
| AmB | Anmi loam, 2 to 7 percent slopes | IIe | P2ac |
| AmC | Anmi loam, 7 to 15 percent slopes | IIIe | P3ac |
| BcB | Bancheon silty clay loam, 2 to 7 percent slopes | IIe | P2ac |
| BcC2 | Bancheon silty clay loam, 7 to 15 percent slopes, eroded | IIIe | P3ac |
| BcD2 | Bancheon silty clay loam, 15 to 30 percent slopes, eroded | IVe | P4ac |
| Bo | Bonryang sandy loam, 0 to 2 percent slopes | IIs | P4ac |
| ChC | Chahang loam, 7 to 15 percent slopes | IIIe | |
| ChD | Chahang loam, 15 to 30 percent slopes | IVe | |
| ChE | Chahang loam, 30 to 60 percent slopes | VIe | |
| CsE | Cheongsim stony silt loam, 30 to 60 percent slopes | VIe | |
| CrF | Cheongsim rocky silt loam, 60 to 100 percent slopes | VIIe | |
| GbC | Gaghwa cobbly silty clay loam, 7 to 15 percent slopes | IIIe | P3ac |
| GbD | Gaghwa cobbly silty clay loam, 15 to 30 percent slopes | IVe | P4ac |
| GbE | Gaghwa cobbly silty clay loam, 30 to 60 percent slopes | VIe | |
| GnE | Gwanag rocky sandy loam, 30 to 60 percent slopes | VIIe | |
| GnF | Gwanag rocky sandy loam, 60 to 100 percent slopes | VIIe | |
| Hg | Hogye gravelly loam, 0 to 2 percent slopes | IIs | P3c |
| HgB | Hogye gravelly loam, 2 to 7 percent slopes | IIs | P4abc |
| HgC | Hogye gravelly loam, 7 to 15 percent slopes | IIIe | P4abc |
| Hr | Hwangryong gravelly sandy loam, 0 to 2 percent slopes | IVs | P4bc |
| ImB | Imog sandy loam, 2 to 7 percent slopes | IIs | P4abc |
| ImC | Imog sandy loam, 7 to 15 percent slopes | IIIe | P4abc |
| JsE | Jangseong rocky silt loam, 30 to 60 percent slopes | VIe | |

Table 3 (Cont'd)

| Map Symbol | Mapping Unit | Capability Unit | Paddy Suit. Group |
|---|---|---|---|
| JsF | Jangseong rocky silt loam, 60 to 100 percent slopes | VIIe | |
| Jd | Jungdong fine sandy loam, 0 to 2 percent slopes | IIs | P4bc |
| Mj | Maji gravelly loam, 0 to 2 percent slopes | IIs | P3bc |
| MjB | Maji gravelly loam, 2 to 7 percent slopes | IIs | P4abc |
| MjC | Maji gravelly loam, 7 to 15 percent slopes | IIIe | P4abc |
| MtC | Mitan channery silt loam, 7 to 15 percent slopes | IIIe | P4abc |
| MtD | Mitan channery silt loam, 15 to 30 percent slopes | IVe | |
| MtE | Mitan channery silt loam, 30 to 60 percent slopes | VIe | |
| MuC | Mui stony loam, 7 to 15 percent slopes | IIIe | P4abc |
| MuD | Mui stony loam, 15 to 30 percent slopes | IVe | P4abc |
| MuE | Mui stony loam, 30 to 60 percent slopes | VIe | |
| OdE | Odae rocky loam, 30 to 60 percent slopes | VIe | |
| OdF | Odae rocky loam, 60 to 100 percent slopes | VIIe | |
| OaE | Oesan stony loam, 30 to 60 percent slopes | VIe | |
| OaF | Oesan stony loam, 60 to 100 percent slopes | VIIe | |
| PaC | Pyeongan cobbly clay loam, 7 to 15 percent slopes | IIIe | P3ac |
| PaD | Pyeongan cobbly clay loam, 15 to 30 percent slopes | IVe | P4ac |
| PaE | Pyeongan cobbly clay loam, 30 to 60 percent slopes | VIe | |
| PcD | Pyeongchang rocky clay loam, 15 to 30 percent slopes | VIe | |
| PcE | Pyeongchang rocky clay loam, 30 to 60 percent slopes | VIe | |
| RC | Riverwash cobbly | VIII | |
| RL | Rock Land | VIII | |
| SiC | Sinbul stony loam, 7 to 15 percent slopes | VIe | |
| SlC | Sinbul bouldery loam, 7 to 15 percent slopes | VIe | |
| SiD | Sinbul stony loam, 15 to 30 percent slopes | VIe | |
| SlD | Sinbul bouldery loam, 15 to 30 percent slopes | VIe | |

Table 3 (Cont'd)

| Map Symbol | Mapping Unit | Capability Unit | Paddy Suit. Group |
|---|---|---|---|
| SlE | Sinbul bouldery loam, 30 to 60 percent slopes | VIe | |
| SoD | Songjeong loam, 15 to 30 percent slopes | IVe | P4ac |
| SoE | Songjeong loam, 30 to 60 percent slopes | VIe | |
| SpB | Subug sandy loam, 2 to 7 percent slopes | IVw | P3ab |
| SpC | Subug sandy loam, 7 to 15 percent slopes | IVw | P3ab |
| UgC | Ungyo cobbly silt loam, 7 to 15 percent slopes | IIIe | P3ac |
| UgD | Ungyo cobbly silt loam, 15 to 30 percent slopes | IVe | P4ac |
| UgE | Ungyo cobbly silt loam, 30 to 60 percent slopes | VIe | |
| WgB | Wangsan silt loam, 2 to 7 percent slopes | IIe | P2ac |
| WjE | Weoljeong sandy loam, 30 to 60 percent slopes | VIe | |
| WjF | Weoljeong sandy loam, 60 to 100 percent slopes | VIIe | |

## Appendix

## GLOSSARY

| | |
|---|---|
| Acidity | See reaction, soil. |
| Alluvial | Consisting of or formed in material deposited by water. |
| Alluvium | Soil material that has been transported and deposited by water. |
| Available Moisture Capacity | The capacity of a soil to hold water in a form available to plants. The amount of moisture held in a soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension. Terms for available moisture capacity given in this survey (determined to a depth of 125 cm) are the following: High - 25 cm or more; medium - 15 to 25 cm; low - 7 to 15 cm; and very low - less than 7 cm. |
| Base Saturation | The degree to which soil material that has base exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity: High - 60 to 100 percent; medium - 35 to 60 percent; and low - less than 35 percent. |
| Cation-exchange Capacity | A measure of the total amount of exchangeable cations that can be held by a soil. It is expressed in terms of milliequivalents (me) per 100 g of soil material that is neutral in reaction (pH 7.0) or at some other stated pH value: High - 10 me or more; medium - 6 to 10 me; low - 3 to 6 me; and very low - less than 3 me. |
| Clay | As a soil separate, the mineral soil particles less than 0.002 mm in diameter. As a soil textural class, soil material that is 40 percent or more clay less than 45 percent sand, and less than 40 percent silt. |
| Clay Film | A cutan composed of oriented clay particles. |
| Colluvial | Having been transported by gravity, mass slippage or a combination of slippage and local wash. |
| Colluvium | Soil material, rock fragments or both moved by creep, slide, or local wash and deposited at the base of a steep slope. |
| Consistence, Soil | The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are - |
| | Loose. - Noncoherent; will not hold together in a mass. |

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

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

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

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

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

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

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

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

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

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

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

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

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

Loam — (1) Soil containing a relatively even mixture of sand and silt and a somewhat smaller proportion of clay, generally a desirable quality. May be subdivided into textural classes, such as sandy loam, loam, silt loam, and clay loam. (2) Specifically, soil material containing 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

**Mapping Units** — The units shown on soil maps. They may be mainly soil series, phases of soil series, complexes of soil series, or some other combination such as mixtures of soil series and rock outcrop.

**Massive** — Consisting of large, uniform masses of cohesive soil, in some places with ill-defined and irregular breakage, as in some of the fine-textured alluvial soils; structureless.

**Paddy** — A small field that has been levelled with a bunt capable of retaining a shallow depth of water. Paddies are used principally for growing rice.

**Permeability, Soil** — The quality of a soil that enables it to transmit air and water. The following relative classes of soil permeability, used in this soil survey, refer to estimated rates of movement of water in millimetres per hour through saturated, undisturbed cores under a 2.5 cm head of water: Very slow - less than 1 mm; slow - 1 to 5 mm; moderately slow - 5 to 15 mm; moderate - 15 to 50 mm; moderately rapid - 50 to 150 mm; rapid - more than 150 mm.

**Reaction, Soil** — The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or 'sour,' soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

| | pH |
|---|---|
| Extremely acid | Below 4.5 |
| Very strongly acid | 4.5 to 5.0 |
| Strongly acid | 5.1 to 5.5 |
| Medium acid | 5.6 to 6.0 |
| Slightly acid | 6.1 to 6.5 |
| Neutral | 6.6 to 7.3 |
| Mildly alkaline | 7.4 to 7.8 |
| Moderately alkaline | 7.9 to 8.4 |
| Strongly alkaline | 8.5 to 9.0 |
| Very strongly alkaline | 9.1 and higher |

**Sand** — As a soil separate, individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 mm in diameter. Most sand grains consist of quartz, but sand may be of any mineral composition. As a textural class, soil material that is 85 percent or more sand and not more than 10 percent clay.

**Silt** — As a soil separate, individual mineral particles in a soil that range from the upper limit of clay (0.002 mm) in diameter to the lower limit of very fine sand (0.05 mm). As a textural class, soil material that is 80 percent or more silt and less than 12 percent clay.

**Slope** — Soil slope is measured by using a hand level and is expressed as the percent the vertical distance (change of elevation) is

of the horizontal distance. Slope classes and terms used to describe them are as follows:

| Slope Percent | Class | Mapping Symbol |
|---|---|---|
| 0 - 2 | Nearly level | A |
| 2 - 7 | Gently sloping | B |
| 7 - 15 | Sloping | C |
| 15 - 30 | Moderately steep | D |
| 30 - 60 | Steep | E |
| 60 or more | Very steep | F |

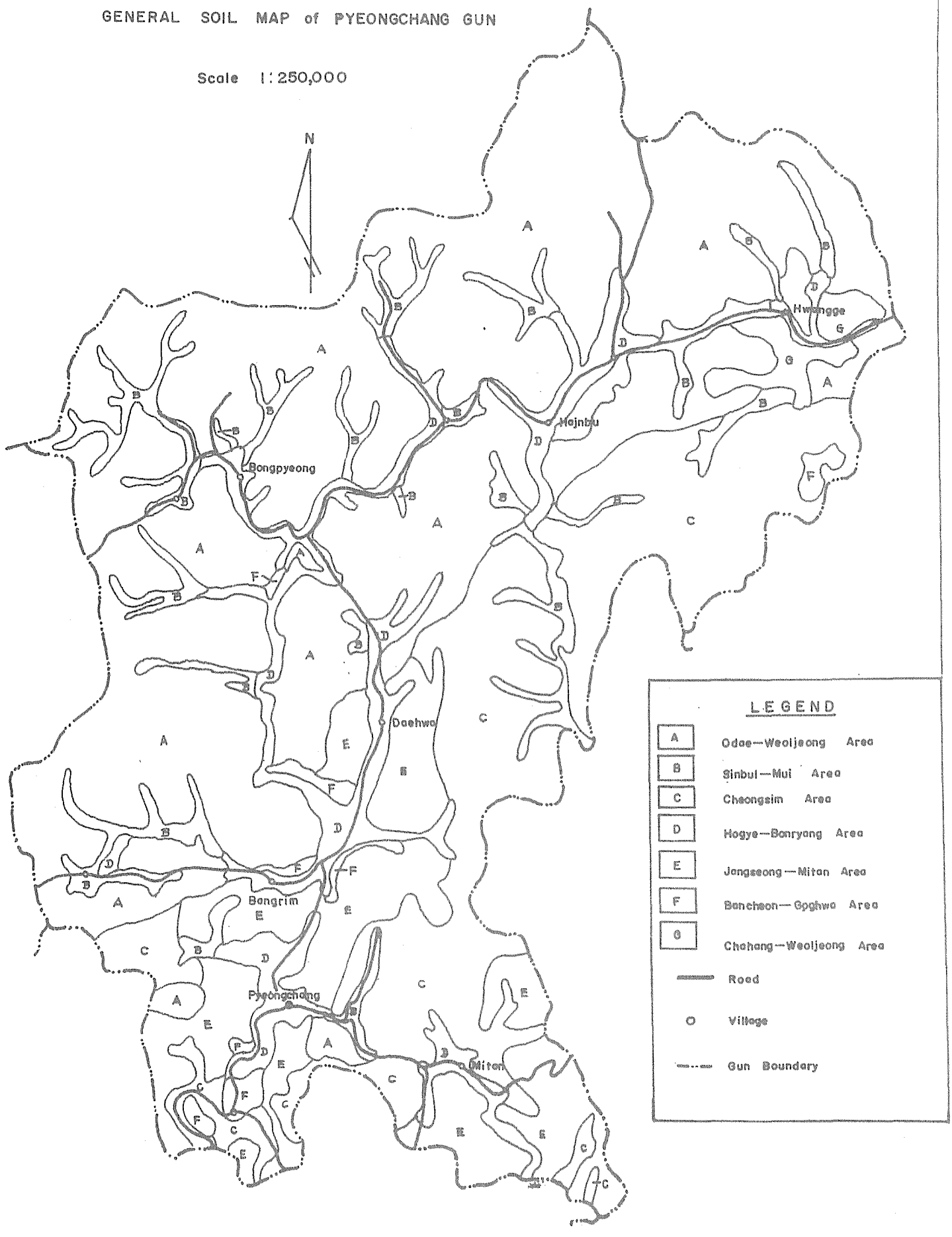
Soil — The thin outer layer of the earth's crust which serves as a medium for the growth of land plants.

Structure, Soil — The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles.

Terrace — An alluvial plain that has elevation above the present floodplain.

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.


GENERAL SOIL MAP of PYEONGCHANG GUN
Scale 1:250,000
N
Hwangge
Hajnbu
Bongpyeong
Daehwa
Bangrim
Pyeongchang
Miten
LEGEND
A Odae—Weoljeong Area
B Sinbul—Mui Area
C Cheongsim Area
D Hogye—Bonryang Area
E Jangseong—Miten Area
F Boncheon—Gpghwa Area
G Chahang—Weoljeong Area
Road
Village
Gun Boundary

MR/B2054/2.71/E/1/150