# SIMPLIFIED *Keys to* SOIL SERIES

## ISABELA

**This handbook belongs to**

**Name**: _____

**Address**: _____

**Contact number**: _____

# SIMPLIFIED *keys to* SOIL SERIES

## ISABELA

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# Foreword

This guidebook on “Simplified Keys to Soil Series Identification” was developed to make the field identification of soils easier.

Soil identification is an important component in rice farming. When the soil is properly analyzed and identified, the risks of incompatible management recommendations will be lessened and selection of knowledge and technologies to apply will be efficient. That is the reason we have this Simplified Keys to Soil Series for Isabela.

This is a good guide for effective nutrient, tillage, and water management, which are among the main components of the PalayCheck System, a dynamic rice crop management system that presents easy-to-follow practices to achieve respective Key Checks and improve crop yield and input use efficiency.

The guidebook features the different color, texture, pH, coarse fragments, and mottles of the most common soils in Isabela and contains four simple steps in identifying the soil series right in the field. We also included the soil productivity index, soil properties that affect crop growth, soil taxonomic classification, crop suitability analysis, and soil management recommendations.

The concept of simplified keys to soil series was first used in Thailand. In the Philippines, the project “Simplification of the Philippine Soil Series for Rice and Corn” started in 2005 under the Nutrient Management Support System (NuMaSS) to provide management recommendations for soils identified in the field.

We thank the farmers, agricultural technologists, and municipal and provincial agricultural officers for helping us validate the soil series, and for their comments and suggestions during the pre-evaluation of this guidebook. We also acknowledge the Bureau of Soils and Water Management (BSWM) for providing the secondary data of the soils.

We hope that this publication can help you identify suitable crops in your area, learn the limitations of your soils for crop production, and subsequently know the corresponding management recommendations.

**LEOCADIO S. SEBASTIAN**
PhilRice Executive Director

# GUIDE TO SOIL SERIES IDENTIFICATION

1. Choose a vacant area in your field and dig up to 50 cm depth from the surface (see page 72).

2. Get bulk soil sample (500g) from between 30 cm and 50 cm depth.

3. Compare the soil sample with the color chart in the guidebook “Simplified Keys to Soil Series” (see page 73).

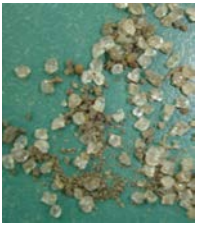
4. Take a half handful of the same soil and check its texture by wetting the soil sample (neither too wet, nor too dry) (see page 74)

5. Take a half handful of the same soil sample and put it in a test tube. Add 7 drops of reagent; shake gently, and compare with pH chart (see page 75).

6. Take note of the presence or absence of coarse fragments such as limestone, rock fragments, lateritic nodules, manganese/Mn (black) and iron/Fe (red) concretions, sand materials, and other observable properties of the soil taken from soil surface up to 50 cm depth.

LATERITIC NODULES

MANGANESE CONCRETIONS

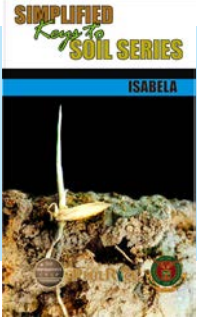


QUARTZ

7. Take note also of other observable soil properties such as polished surface (cutans/ slickensides), softness, hardness, stickiness, etc.

slickensides / polished soil surfaces

8. Run the Simplified keys to soil series guidebook by comparing all examined soil properties starting from page one until soil name is identified.



# The Simplified Keys to Soil Series

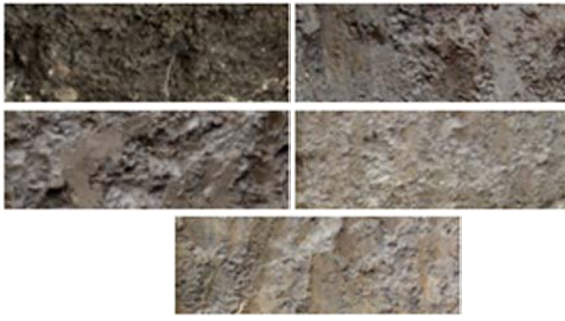
"Simplified Keys to Soil Series" is a tool/guide in identifying soil series in the field following simple steps, for the use of researchers, agricultural technologists, extension workers, farmers, and other stakeholders of the rice industry. Using this guidebook, identification of soils will be more accurate, thus, reducing the risks of incompatible management and technology recommendations. Transfer of technology will also be made easier and more efficient.

This guidebook is easy-to-use. It involves only five basic soil properties (color, texture, pH, coarse fragments, and mottles) at 30-50cm soil depth and four simple steps in identifying the soil series right in the field. Once the soil is identified, suitable crops can be selected, and crop productivity ratings, soil properties that limit production, and soil management recommendations can be determined. Since same soil series behave similarly, the soil management technology in one area can be applied in other areas with the same soil identity.

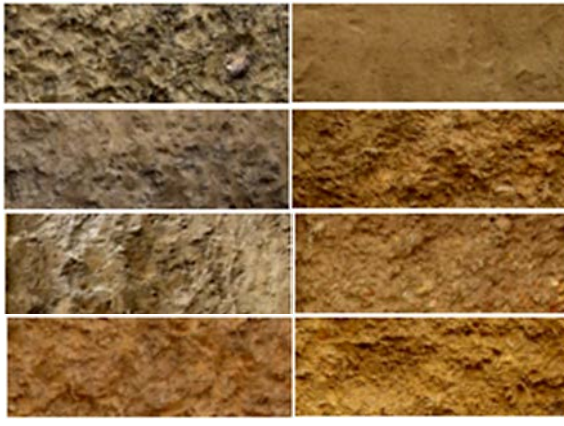
Sixteen soil series found in Isabela (Alaminos, Annam, Bago, Bantog, Bigaa, Cauayan, Faraon, Guimbalaon, Ilagan, Quingua, Rugao, San Manuel, San Juan, Sibul, Sta. Rita, and Tagulod), are included in this guidebook.

# SOIL COLOR GROUPS

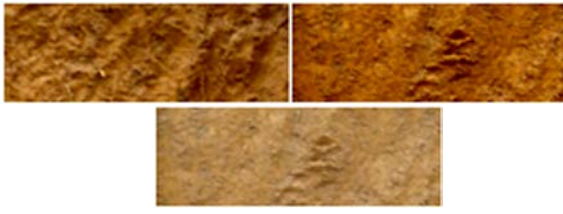
Black/Grayish brown go to page 2



Light brown/Yellowish brown go to page 5



Red/Redish brown go to page 12



## Black/Grayish brown

### Texture

## Black/Grayish brown

### Texture: Clay

| Bantog (Btg) | |
|---|---|
| Coarse Fragments | none |
| pH | 7.0-7.5 |
| Others | mottles (spots of red color); manganese (bagiing) and iron |

*Figure on page 17 (Btg)*

| Faraon (Frn) | |
|---|---|
| Coarse Fragments | limestone |
| pH | 6.5-7.0 |
| Others | limestone rocks |

*Figure on page 17 (Frn)*

| Bigaa (Bga) | |
|---|---|
| Coarse Fragments | none |
| pH | 5.5-6.5 |
| Others | Iron (red) coatings, mottles (red and gray spots) |

*Figure on page 19 (Bga)*

| Sta. Rita (Srt) | |
|---|---|
| Coarse Fragments | none |
| pH | 6.5-7.0 |
| Others | slickensides (polished surfaces); iron concretions |

*Figure on page 18 (Srt)*

## Black/Grayish brown

### Texture: Silty clay loam

| Bago (Bgo) | |
|---|---|
| Coarse Fragments | none |
| pH | 6.0-7.0 |
| Others | quartz (shiny particles); brown mottles; iron and manganese (bagiing) concretions |

*Figure on page 18 (Bgo)*

## Light Brown/Yellowish Brown

**Texture**

## Light Brown/Yellowish Brown

### Texture: Clay

| **Ilagan (Ign)** | |
|---|---|
| Coarse Fragments | partially and highly weathered rock fragments |
| pH | 5.0-6.0 |
| Others | mottles (spots of red color); manganese concretions (bagiing/gansi) |

*Figure on page 21 (Ign)*

| **Tagulod (Tld)** | |
|---|---|
| Coarse Fragments | none |
| pH | 6.5-7.0 |
| Others | iron and manganese concretions (bagiing/gansi); mottle (red and black spots) |

*Figure on page 22 (Tld)*

| **Rugao (Rgo)** | |
|---|---|
| Coarse Fragments | partially and weathered shale |
| pH | 4.5-7.5 |
| Others | mottles (spots of red color); manganese concretions (bagiing/gansi) |

*Figure on page 23 (Rgo)*

## Light Brown/Yellowish Brown

### Texture: Loam

| **Cauayan (Cyn)** | |
|---|---|
| Coarse Fragments | pebbles and granules present |
| pH | 4.5-5.5 |
| Others | lateritic nodules/ plinthite “minuri”; iron and manganese concretions (red and black spots) (bagiing/gansi) |

*Figure on page 20 (Cyn)*

**Light Brown/Yellowish Brown**

## Texture: Silt Loam

| **Guimbalaon (Gbn)** | |
|---|---|
| Coarse Fragments | surface stones and rock outcrops |
| pH | 5.5-6.0 |
| Others | lateritic nodules/ plinthite (minuri); iron (red) coatings; manganese mottles |

*Figure on page 20 (Gbn)*

**Light Brown/Yellowish Brown**

Texture: Sandy Clay

| **San Juan (Sjn)** | |
|---|---|
| Coarse Fragments | riverwashed stones in the subsoil |
| pH | 5.5-9.0 |
| Others | mottles (red and gray spots); quartz (shiny particles) |

*Figure on page 19 (Sjn)*

**Light Brown/Yellowish Brown**

## Texture: Sandy Clay Loam

| **San Manuel (Smn)** | |
|---|---|
| Coarse Fragments | none |
| pH | 5.5-6.5 |
| Others | mottles (red spots); cutans (clay skins) |

*Figure on page 22 (Smn)*

**Light Brown/Yellowish Brown**

Texture: Loamy Sand

| **Quingua (Qga)** | |
|---|---|
| Coarse Fragments | none |
| pH | 7.5-8.0 |
| Others | none |

*Figure on page 21 (Qga)*

## Red/ Reddish Brown

### Texture

**Red/ Reddish Brown**

## Texture: Clay

| **Sibul (Sbl)** | |
|---|---|
| Coarse Fragments | limestone fragments |
| pH | 5.5-6.0 |
| Others | mottles (yellowish brown spots) |

*Figure on page 24 (Sbl)*

**Red/ Reddish Brown**

## Texture: Silty Clay

| **Alaminos** | |
|---|---|
| Coarse Fragments | gravels |
| pH | 4.5 - 5.5 |
| Others | mottles (red spots) |

*Figure on page 24 (Alm)*

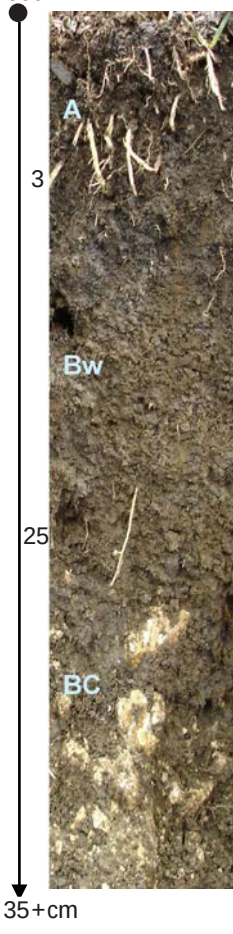
**Red/ Reddish Brown**

Texture: Silt Loam

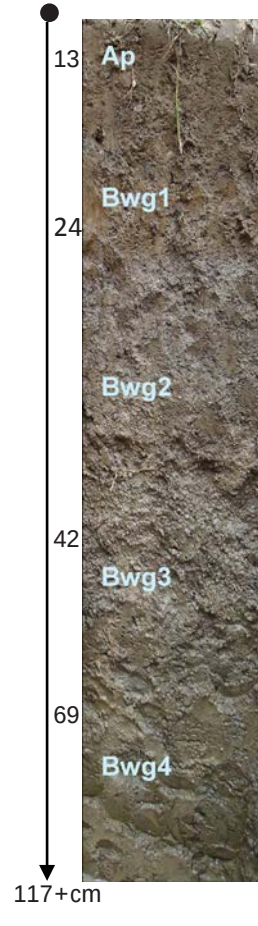
| **Annam (Anm)** | |
|---|---|
| Coarse Fragments | rock fragments |
| pH | 5.5-6.0 |
| Others | mottles (brown spots) |

*Figure on page 23 (Anm)*

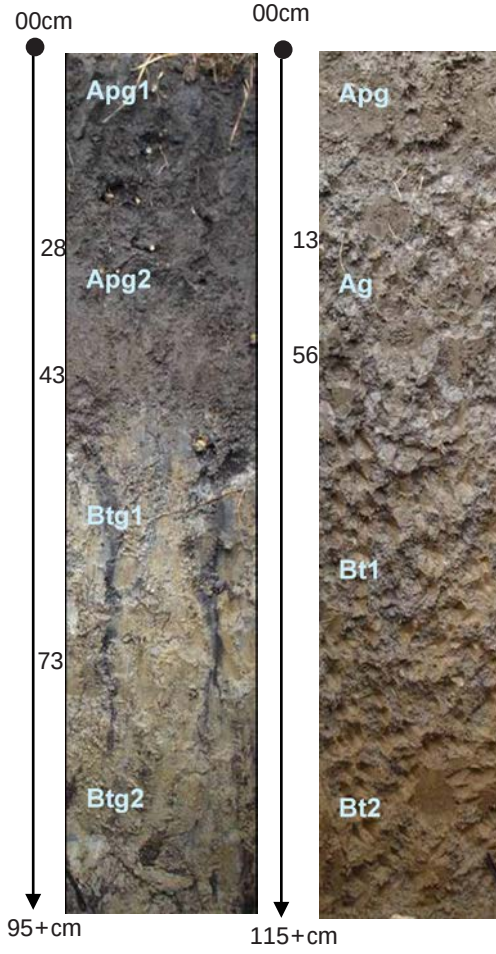
# Soil profiles




**Faraon (Frn)**
*p.28*

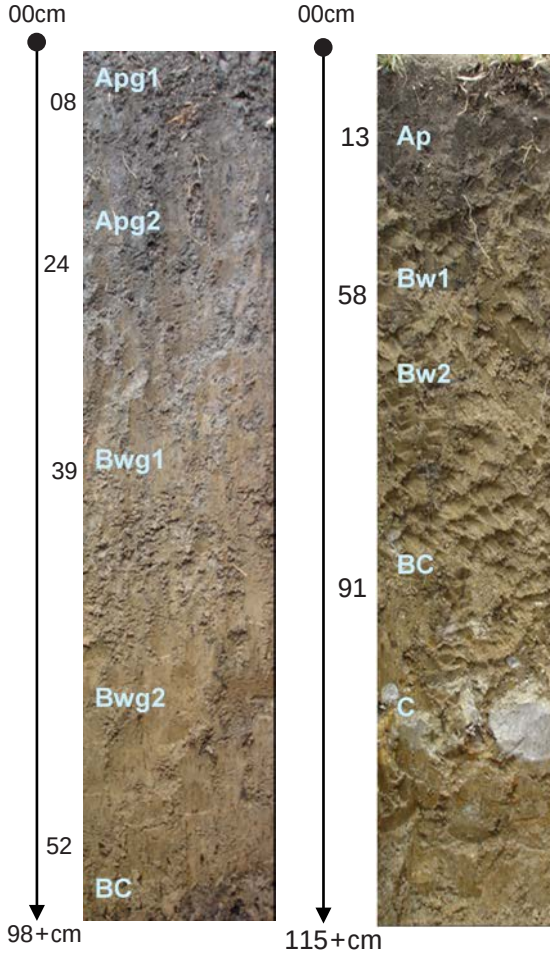



**Bantog (Btg)**
*p.26*



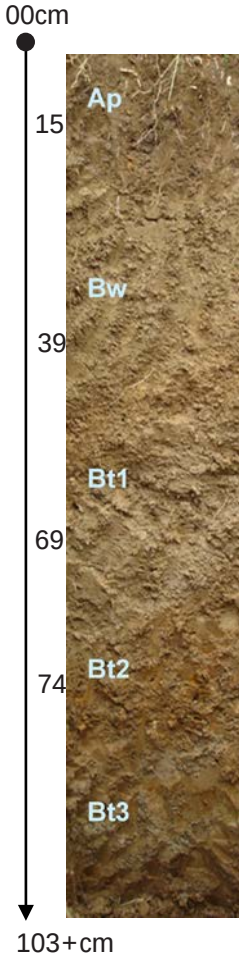

**Bago (Bgo)**
*p.26*

**Sta. Rita (Srt)**
*p.26*




**Bigaa (Bga)**
*p.26*

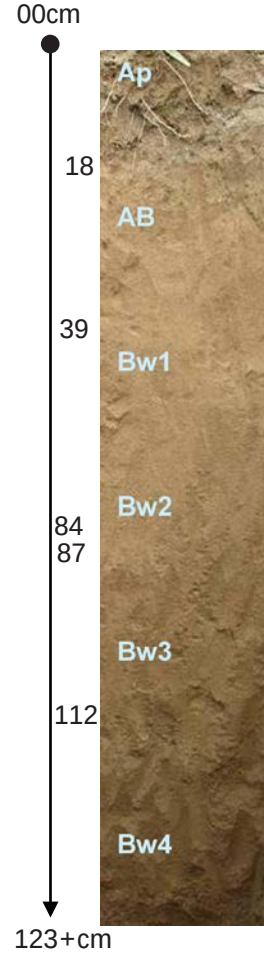
**San Juan (Sjn)**
*p.30*



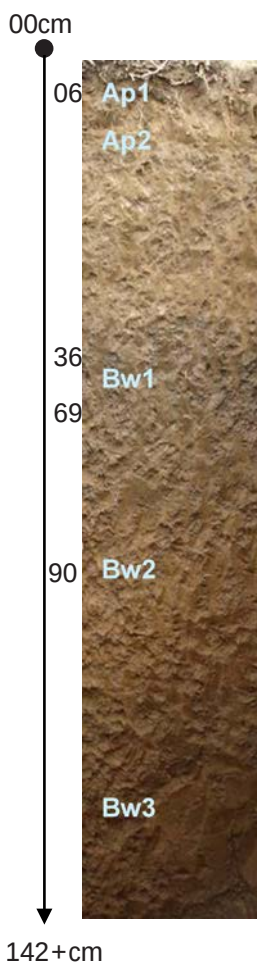

**Guimbalaon (Gbn)**
*p.28*


**Cauayan (Cyn)**
*p.28*

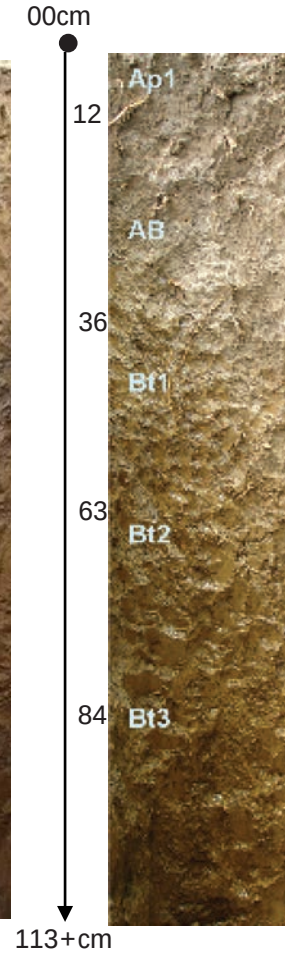

**Ilagan (Ign)**
*p.30*




**Quingua (Qga)**
*p.26*

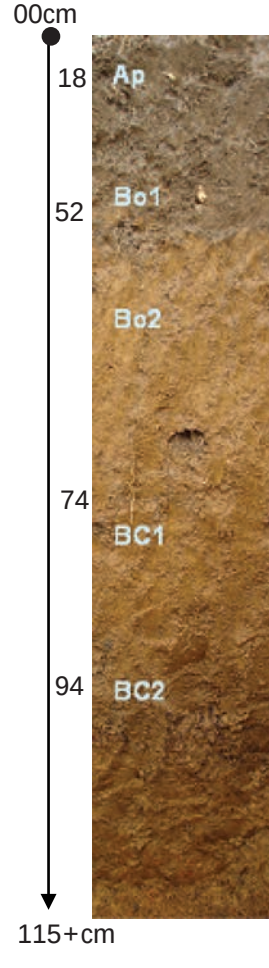



**San Manuel (Smn)**
*p.26*



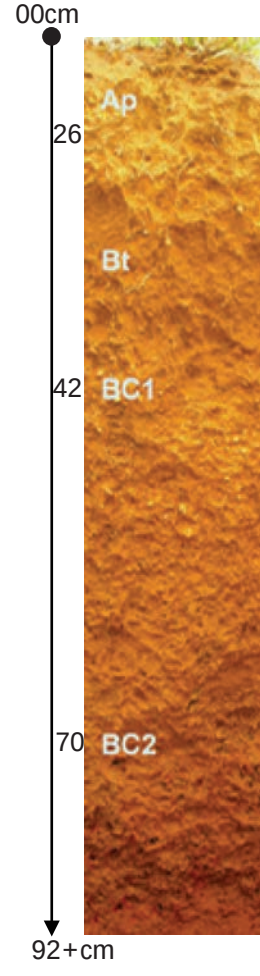

**Tagulod (Tld)**
*p.26*


**Rugao (Rgo)**
*p.30*




**Annam (Anm)**
*p.28*


**Sibul (Sbl)**
*p.30*




**Alaminos (Alm)**
*p.28*

# Soil series Descriptions

Table 1a. Isabela soil series and their properties having bearing on crop growth.

| Soil qualities in relation to crop production | Soils in the low lying plains | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bago | Bantog | Bigaa | Quingua | San Manuel | Sta. Rita | Tagulod |
| Soil pH | slightly acid to neutral | neutral | moderately to slightly acid | neutral | moderately to slightly acid | neutral | slightly acid |
| N level | high | high | low to medium | medium | high | high | medium |
| P level | low | medium | low | low | medium | medium | deficient |
| K level | low | medium | low | medium | medium | medium | low |
| Organic matter | low | very high | low to medium | medium | medium | high | medium |
| Effective soil depth | very deep | deep to very deep | deep to very deep | deep to very deep | deep to very deep | moderately shallow | deep to very deep |
| Cation exchange capacity | low to medium | adequate | medium | high | adequate | high | adequate to marginal |

Table 1a. cont...

| Soil qualities in relation to crop production | Soils in the low lying plains | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bago | Bantog | Bigaa | Quingua | San Manuel | Sta. Rita | Tagulod |
| Base saturation | adequate | adequate | medium | very high | adequate | high | high |
| Soil Texture | sandy clay | very fine clay | fine textured clay | silt loam to silty clay | loam, silt loam, sandy | very fine clay to clay loam | clay |
| Rock fragments | none | none | none | none | none | none | none |
| Source of parent material | old alluvial deposit | recent alluvial deposit | alluvium | recent alluvial deposit | alluvium deposited by water | recent alluvial deposit | alluvial terraces |
| Drainage | poor | poor | somewhat poor | imperfect to good | excellent | poor | somewhat poor |
| Flooding hazard | occasional overflow | seasonal flooding; frequently saturated | occasional overflow | subject to periodic river flooding | moderate seasonal river | occasional overflow | frequent slight seasonal river oveflow |
| Relief/ Topography | level to rolling | level to nearly level | level to nearly level | level to nearly level | level | almost flat | level to nearly level |

Table 1b. Isabela soil series and their properties having bearing on crop growth.

| Soil qualities in relation to crop production | Soils of the Rolling Uplands | | | | |
|---|---|---|---|---|---|
| | **Alaminos** | **Annam** | **Cauayan** | **Faraon** | **Guimbalaon** |
| Soil pH | Very strongly to strongly acid | moderately acid | extremely to strongly acid | slightly acid to neutral | strongly to moderately acid |
| N level | medium | medium | medium | high | moderately high |
| P level | very low | low | low | medium | medium |
| K level | very low | medium | low | medium | low |
| Organic matter | medium | medium | medium | high | medium |
| Effective soil depth | deep | moderately deep to deep | deep to very deep | very shallow | deep |
| Cation exchange capacity | very low | medium to high | low | high | low |

Table 1b. cont...

| Soil qualities in relation to crop production | Soils of the Rolling Uplands | | | | |
|---|---|---|---|---|---|
| | **Alaminos** | **Annam** | **Cauayan** | **Faraon** | **Guimbalaon** |
| Base saturation | very low | medium to high | very low | high | medium |
| Soil texture | fine clay; clay loam | silty clay loam to clay | silt loam to clay loam | clay | silty clay |
| Rock fragments | none | common to many | gravels | limestone fragments | surface stones and rock outcrops |
| Source of parent material | basalts and andesites | basalt and andesite | old alluvium from sand-stone | coralline limestone | igneous rocks: andesites and basalts |
| Drainage | good to excessive | good | moderate | good | good |
| Flooding hazard | none | none | none | none | none |
| Relief/topography | rolling to hilly | rolling to steep | undulating to rolling | steep to very steep | rolling to hilly |

Table 1b. Isabela soil series and their properties having bearing on crop growth.

| Soil qualities in relation to crop production | Soils of the Rolling Uplands | | | |
|---|---|---|---|---|
| | Ilagan | Rugao | San Juan | Sibul |
| Soil pH | low to high | very strongly acid to neutral | moderately acid to neutral | slightly acid |
| N level | moderate | medium | medium | medium |
| P level | low | low | low to high | low |
| K level | medium | medium | high | low |
| Organic matter | medium | medium | medium to high | medium |
| Effective soil depth | moderately deep | deep to very deep | very shallow | shallow |
| Cation exchange capacity | high | high | low to high | medium |

Table 1b. cont...

| Soil qualities in relation to crop production | Soils of the Rolling Uplands | | | |
|---|---|---|---|---|
| | **Ilagan** | **Rugao** | **San Juan** | **Sibul** |
| Base saturation | high | high | high | high |
| Soil texture | clay | clay | heavy sandy clay to sandy clay loam | heavy clay |
| Rock fragments | none | partially and highly weathered shale | riverwashed stones in the subsoil | many small to coarse limestone |
| Source of parent material | shale and sandstone | shale and sand-stone | old alluvium, sand-stone and other kinds | limestone |
| Drainage | good | moderate | moderate to good | good |
| Flooding hazard | none | none | none | none |
| Relief/topography | undulating to hilly | gently sloping to rolling | undulating to hilly | sloping to steep |

# Soil Taxonomic Classification

Soil taxonomy is a system of naming, describing, and categorizing soils. It helps us understand how soils are formed, changed, and how it affects crops and natural resource management. It uses a specific nomenclature that both classifies the soil and gives a distinctive name to the individual soil. Names are constructed from the formative elements (generally originating from Greek and Latin which are used in specific combinations to provide a highly descriptive name to a specific soil type).

Scientists have developed different system of soil classification to group soils of similar properties in one class, allowing them to exchange information on soil found in different areas. In the classification scheme, soil characteristics and information about the soil become more specific as one continues from order, sub-order, great group, sub-group, family to series level. For this purpose, the USDA Soil Taxonomic Classification scheme was employed for technical use of researchers and students. Soil Taxonomic Classification that implies the general features of a given soil indicating its texture, mineralogy, moisture and temperature regime, diagnostic horizons, and soil order is presented in Table 2. These features/properties have something to do with crop growth and serve as basis for transferability of soil management technology.

Table 2. Soil Taxonomic classification of each soil series with interpretation.

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Alaminos (Alm) | Fine, isohyperthermic, Typic Kanhaplustults. | Fine-textured soil having large amount of clay (35-60%); with isohyperthermic temperature regime (>22°C). It is a typical (Typic) representative of the great group Kanhaplustults; Kan, with kandic properties, i.e. low activity clays responsible for poor nutrient retention ability of the soil; hapl, the soil has minimum complexity of horizonation ; ust (ustic) having pronounced wet and dry moisture regime; ults, (Latin, ultimus, meaning last), under the soil order Ultisol, characteristically has low base saturation and low pH. Hence, the soil is relatively infertile. Soils having nearly level to level topography are suitable for tillage with the application of lime However, these soils should be better kept under pasture or forest. |
| Annam (Anm) | Fine loamy to clayey, isohyperthermic, Typic Eutrustox | Loamy to fine- textured soils with soil temperature regime of >22°C (isohyperthermic). It is a typical (Typic) representative of great group Eutrustox. Eutr, means the soil has high base saturation. Ox (French, oxide), it is an oxisol, an intensely weathered soil predominated by the oxides from iron and aluminum due to repeated high precipitation and high temperature. This soil is difficult to manage due to low fertility (medium OM, low P, medium K) and low pH . It has an ustic (ust) moisture regime i.e. pronounced wet and dry season. |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Annam (Anm) (cont...) | Fine loamy to clayey, iso-hyperther-mic, Typic Eutrustox | Soils found in level areas and alluvial basins can be easily tilled and are suitable for diversified crops and rice. In areas with rolling to steep topography, which speeds up run-off and are subjected to erosion, are well-suited for agroforestry, industrial crops, orchard and forest. |
| Bago (Bgo) | Fine, isohy-perthermic Typic Epi-aqualf | Fine -textured soil containing a large amount of clay (35-60%); with isohyperther-mic, temperature regime (>22°C); Typic,. It is a typical representative of the great group Epiaqualfs: aqu, it has an aquic moisture regime, i.e. the soil is saturated to the surface for long periods of time manifested by its gray color, with or without mottles, indicative of poor internal drainage; alfs, an alfisol soil, meaning there is alluvial accumulation of clay in the subsoil horizons from the underlying horizons. It has very slow permeability and very high water holding capacity which implies that there is an adequate soil moisture for plant growth. It has moderate to high fertility (medium OM, low P, low K) with moderate pH. Best suited for lowland rice. |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Bantog (Btg) | Very fine, isohyper-thermic, Vertic En-doaquepts | Very fine-textured soil with high clay content ( >60%) and isohyperthermic (>22°C ) temperature regime. It is a member of the great group Endoaquept with ver-tic properties, i.e. the soil has high content of montmorillonite clay which shrinks and swells appreciably upon wetting and drying producing wide cracks in the soil. It has an aquic (aqu) moisture regime, meaning, the soil is saturated for long periods of time resulting in gray soil color with or without mottles indicating poor internal drainage. It is an inceptisol (epts, Latin, inceptum, beginning) meaning this soil is just beginning to develop and show soil horizons. This soil has very high fertility (high OM, medium P, medium K). Productivity is limited by its vertic properties such as slickensides and high clay content where it tends to become hard when dry. Thus, tillage may be dif-ficult unless the soil is moist or wet. This soil is suitable for irrigated and non-irrigated paddy rice. |
| Bigaa (Bga) | | Very fine-textured soil (>60% clay content) and isohyperthermic (>22°C) temperature regime. It is a representative of great group Endoaquerts found in areas with pro-nounced wet and dry season (ustic). It has an aquic (aqu) moisture regime, i.e., the soil is saturated to the surface for a long period of time manifested by its gray color with or without mottles indicative of poor internal drainage. erts, it is a vertisol (Latin, |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Bigaa (Bga) cont... | Very fine, smectitic, isohyper-thermic, Ustic Epia-querts | verto, meaning invert), Being vertisol, it is dominated by high shrink-swell clays, with deep wide cracks and slickensides when dry. It is compact, very sticky and clay when wet. Though it has moderately high fertility (moderately high OM, low P, low K) and medium pH, productivity is limited due to its vertic properties resulting to difficulty in tillage. Cracks and slickensides could also result in root damage and breakage. These type of soils are unstable for engineering purposes. |
| Cauayan (Cyn) | Very fine, kaolinitic, isohyper-thermic, Typic Plin-thustults | Very fine-textured soil ( >60% clay content) and isohyperthermic ( >22°C) temperature regime. The clay fraction is dominated by kaolinite (kaolinitic) in which individual soil particles of clay may be quite coarse, and the soil may not feel like it has as much clay as is actually present. Kaolinitic soils have poor nutrient retention, soil structure may be quite good, giving the soil better air and the CEC is low. It is a typical representa-tive of great group Plinthustults. Plinth from the word plinthite, (Grk, Plinthos, brick), an iron-rich, humus-poor clay occurring as dark, red hardened mottles that is formed when a horizon is saturated with water at some reason and exposed to repeated wet-ting and drying. It can irreversibly form into hardpan upon continuous wetting and drying and exposure to heat of the sun. It belongs to the order Ultisol (Latin, ultimus, last ) found in areas with pronounced wet and dry season (ust, from the word ustic). |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Cauayan (Cyn) cont.... | | Ultisol soils are strongly weathered soil, thus, have low pH and low fetility (medium OM, low P, low K). This soil has poor internal drainage. Requires application of lime, organic matter and appropriate amount of fertilizer. Crops common in the area may be grown with the combinations of erosion-prevention and water control practices. |
| Faraon (Frn) | Fine isohy-perthermic, Lithic Hap-lustolls | Fine-textured soil (35-60% clay content) and isohyperthermic (>22°C) temperature regime. It is a representative of great group Haplustolls with lithic contact, specifically, it is a shallow soil with hard coralline limestone bedrock at 35 cm. It has a minimum complexity of horizonation (hapl). It is a mollisol (olls, from the Latin mollis, meaning soft) found in areas with pronounced wet and dry season (ust, ustic). Mollisol soils are dark-colored, fertile soils (high OM, medium P, medium K) with high base status and neutral to medium acid pH. This soil has good internal and external drainage and moderate permeability. Most of these soils have good vegetation from shrubs, orchard and/or secondary forest due to their good water holding capacity. However, is best suited for industrial trees and forest species. Agricultural uses are limited to cultivated crops due to its shallow soils, steepness and presence of fragments and boulders. |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Guimbala-on (Gbn) | Fine, iso-hyperther-mic, Typic Kandiudalfs | Fine-textured soil with 35-60% clay content and isohyperthermic (>22°C) temperature regime. It is a typical representative of the great group Kandiudalfs. It is an Alfisol (alfs) found in areas with well-distributed rainfall (Ud from the word Udic), with kan-dic property (kandi), i.e. low activity clays that have poor nutrient retention ability. Alluvial accumulation of clay in the subsoil horizons from the underlying horizons is the characteristic of Alfisol soils. It has relatively low fertility (moderately high OM, medium P, low K) status and low to moderate pH. This is a deep well-drained soil with no stones but has slight sheet erosion in rolling to hilly landscape. It is recommended for fruit trees, crops common in the area may be grown with the combinations of ero-sion-prevention and water control practices. |
| Ilagan (Ign) | Fine, mixed, iso-hyperther-mic, Typic Haplustalfs | Fine-textured soil with 35-60% clay content, with no particular mineral of any kind dominates in the soil (Mixed). The soil temperature is isohyperthermic (>22°C). The soil is a typical (Typic) representative of great group Haplustalfs. It is an Alfisol (alfs) found in areas with pronounced wet and dry season (Ust from the word ustic), with minimum complexity of horizonation (Hapl) . Alfisol soils have an alluvial accumula-tion of clay in the subsoil horizons from the underlying horizons. The natural soil fer-tility is moderate to high (moderately high OM, low P, medium K) with low to high pH. |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Ilagan (Ign) cont... | | This soil is moderately deep and well-drained and has moderate permeability. Crops common in the area may be cultivated but is best suited for pasture and forest. |
| Quingua (Qga) | Fine loamy, mixed, isohyper-thermic, Fluvaquentic Epiaquolls | Fine loamy-textured soil with moderate amount of clay (18 - 35%), with no particular mineral of any kind dominates in the soil (mixed). The soil temperature regime is isohyperthermic (>22°C). Fluvaquentic soil which means it is subjected to periodic flooding with muddy water often enough to prevent complete incorporation of fresh sediments into the surface soil before the next flood. Consequently, the organic matter content decreases irregularly with depth or remains high in deep layers. It is a representative of great group Epiaquolls: a Mollisol (olls), from the Latin, mollis meaning soft. Characteristically are dark-colored soils which are formed under grassland. This is a fertile soil (medium OM, low P. medium K) with high base status and neutral to medium acid pH. It has an aquic (aqu) moisture regime where it is saturated for long periods of time manifested by gray color with or without mottles, indicating poor internal drainage. Suited for intensive cultivation and for other cash crops during dry season when there is no flooding. |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Rugao (Rgo) | Fine isohyperthermic, Aquic Haplustalfs | Fine-textured soil with 35-60% clay content and isohyperthermic (>22°C) temperature regime. Aquic means the soil is wetter than the typical due to fluctuating groundwater during rainy season where some part of the soil within 1 m deep is saturated for several days, but water table recedes during dry periods. It is usually mottled which is indicative of somewhat poor internal drainage. It is a representative of great group Haplustalfs: Hapl, the soil has a minimum complexity of horizonation; ust, it has an ustic moisture regime, i.e. with pronounced wet and dry seasons. It is an Alfisol, alfs, meaning there is alluvial accumulation of clay in the subsoil horizons from the underlying horizons, The soil fertility is moderate to high (medium OM, low P, medium K) with low to high pH. This soil is deep to very deep moderately well-drained with slow to moderate permeability. Crops common in the area may be grown but is best suited for pasture and forests. |
| San Juan (Sjn) | Fine loamy, isohyperthermic Typic Durustalfs | Fine loamy-textured soil (18 - 35 % clay and >15% sand) with isohyperthermic (>22°C) temperature regime. It is a typical (Typic) representative of Durustalfs: Dur, from the word duripan which is a silica-cemented subsurface horizon that damages and prevents the root from penetrating deeper into the subsoil; ust, with ustic moisture regime, spefically having pronounced wet and dry seasons; alfs, an Alfisol, |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| San Juan (Sjn) cont... | | characterized by an alluvial accumulation of clay in the subsoil horizons from the underlying horizons. The natural fertility is moderate to high (medium OM, high P, Low K). Suitable for improved system of pasture, for orchard and woodland. |
| San Manuel (Smn) | Fine loamy, mixed, isohy-perthermic, Fluventic Haplustepts | Fine loamy-textured (18 - 35 % clay and >15% sand) soil, with no particular mineral of any kind dominates in the soil (mixed). Has isohyperthermic (>22°C) temperature regime. It is a representative of the great group Haplustepts which occurs on river floodplains and subject to seasonal river flooding (Fluventic). Hapl, means that the soil has a minimum complexity of horizonation; ust, from the word ustic, a moisture regime characteristically having pronounced wet and dry seasons; epts, It is an Inceptisol (Latin, inceptum or beginning), indicating that this soil is just beginning to develop and show soil horizons. Soil fertility is high (high OM, medium P, medium K), with adequate pH, well-drained and has moderate permeability. This soil is suited for intensive cultivation and for any crops grown in the area. |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Sibul (Sbl) | Fine to very fine isohyperthermic, Typic Eutrudepts | Fine to very fine-textured soil containing above 60% clay with correspondingly low amounts of sand and silt. With isohyperthermic (>22°C) temperature regime. It is a typical (typic) representative of great group Eutrudepts: Eutr, that connotes high base saturation found in areas with udic (ud, well distributed rainfall), moisture regime. It is an Inceptisol, (epts, Latin, inceptum or beginning) meaning this soil is just beginning to develop and show soil horizons, This soil has moderate soil fertility and medium pH, good internal and external drainage and moderate permeability. Where topography is good, this soil is well-suited for any cash crops or diversified crops. Areas with rolling to steep topography, permanent crops such as fruit trees, agroforest and industrial tree species are recommended. |
| Sta. Rita (Srt) | Fine, isohyperthermic, Typic Epiaqualfs | Fine-textured soil (35-60% clay content) and isohyperthermic (>22°C) temperature regime. It is a typical (typic) representative of the great group Epiaqualfs. It is an Alfisol (alfs), meaning there is alluvial accumulation of clay in the subsoil horizons from the underlying horizons. It has aquic (aqu)moisture regime in which the soil is subjected to periods of saturation resulting to gray color with or without mottles indicating poor internal drainage. This soil has moderate to high fertility and adequate pH. |

| Soil series/ symbol | Taxonomic classification | Interpretation based on Taxonomic classification |
|---|---|---|
| Sta. Rita (Srt) cont... | | This is a very deep moderately well-drained soil that has slow permeability as well as run off. Most areas are planted to rice and some are devoted to diversified crops. |
| Tagulod (Tld) | Fine, mixed, isohyperthermic, Typic Epiaqualfs | Fine-textured soil with 35-60% clay content, with no particular mineral of any kind dominates in the soil (mixed). It has an isohyperthermic (>22°C) temperature regime. A typical (typic) representative of the great group Epiaqualfs. It is an Alfisol (alfs), meaning there is alluvial accumulation of clay in the subsoil horizons from the underlying horizons. It has aquic (aqu) moisture regime, specifically, the soil is subjected to periods of saturation resulting in gray soil color with or without mottles indicating poor internal drainage. This soil has moderate fertility and adequate pH. This is a deep to very deep soil that has moderate to slow permeability. It is frequently subjected to slight seasonal run-off and river overflow flooding. It is used chiefly for paddy rice during wet seaon and dry season when irrigation is available. Vegetable and other diversified crops may also be produced when there is insufficient irrigation for paddy. |

# Crop suitability

Soil suitability classification refers to the use of a piece of land on a sustainable basis, based on physical and chemical properties and environmental factors. It is the ultimate aim of soil survey and this may come up through a good judgment and a thorough evaluation of soil properties and qualities like soil depth, texture, slope, drainage, erosion, flooding and fertility. Based from these properties, the suitability of a certain tract of land for crop production is determined.

Suitability ratings denote qualitative analysis of the potential of a certain soil to different crops. It implies what crop(s) would give the highest benefit in terms of productivity and profitability from a given soil type, indicated by S1 as the most suitable, S2 as moderately suitable and S3 as marginally suitable. The symbol N implies that the crop is either currently not suitable (N1) where the effect of limitation is so severe as greatly to reduce the yield and require costly inputs or permanently not suitable (N2) where the limitations cannot be corrected permanently. Crop suitability analysis also provides information on soil properties that limits the production of specified crop(s). The crop suitability analysis for the soils of Isabela is shown on Table 4.

When using a parametric system, the soil index can be equated into percentage shown below. It means that you can attain 75% of the potential yield of the crop when the soil index is highly suitable (S1) while less than 25% of the potential yield when the soil index is not suitable (N).

S1: soil index >75
S2: soil index 50-75
S3: soil index 25-50
N: soil index <25

## GUIDE FOR ABBREVIATIONS

**Suitability ratings:**

| | |
|---|---|
| S1 | Highly suitable |
| S2 | Moderately suitable |
| S3 | Marginally suitable |
| N1 | Currently not suitable |
| N2 | Permanently not suitable |

**Limitations due to:**

| | |
|---|---|
| t | topography; slope |
| w | drainage; flooding |
| s | texture; coarse fragments; soil depth |
| f | soil fertility |
| c | climate |

**Table 4. Crop suitability**

| Soil Type | Topography | Low-land Rice | Rainfed Rice | Rainfed Upland Rice | Corn | Tobacco | Coffee Arabica | Avocado |
|---|---|---|---|---|---|---|---|---|
| Alaminos clay loam | Rolling to moderately steep | N1f | S3f | S3f | S3f | S3cft | S3cftw | S3t |
| Annam clay loam | Steep | N2t | N1 | N1 | N1 | N1 | N2 | N2 |
| Annam clay loam | Rolling to moderately steep | S3fc | S3tc | S3fc | S3f | N1 | N2 | N2 |
| Bago clay loam | Level to nearly level | S3fc | S3c | S3c | N1f | S3cf | N2 | S3w |
| Bago sandy clay loam | Rolling to moder-ately steep | S3fc | S3cf | S3cf | N1f | S3cf | N2 | S2 |

| Soil Type | Topography | Low-land Rice | Rainfed Rice | Rainfed Upland Rice | Corn | Tobacco | Coffee Arabica | Avocado |
|---|---|---|---|---|---|---|---|---|
| Bago sandy clay loam | Undulating to rolling | S3fc | S3cf | S3cf | N1f | S3cf | N2 | S2 |
| Bago sandy loam | Undulating to rolling | S3fc | S3cf | S3cf | N1f | S3cf | N2 | S2 |
| Bantog clay loam | Level to nearly level | S3cfw | S3cw | S3cw | S3w | S3cfw | N2 | N1 |
| Bigaa clay | Undulating to rolling | S2c | S2c | S2c | S2fwt | S2c | N2 | S3w |
| Cauayan clay | Level to nearly level | S3cf | S3cf | S3cf | S3f | S3cw | N2 | N1 |
| Cauayan clay | Undulating to rolling | S3cf | S3cf | S3cf | S3f | S3cw | N2 | N1 |

| Soil Type | Topography | Low-land Rice | Rainfed Rice | Rainfed Upland Rice | Corn | Tobacco | Coffee Arabica | Avocado |
|---|---|---|---|---|---|---|---|---|
| Cauayan clay loam | Level to nearly level | S3cf | S3cf | S3cf | S3f | S3cw | N2 | N1 |
| Cauayan loam | Level to nearly level | S3cf | S3cf | S3cf | S3f | S2c | N2 | S3w |
| Cauayan sandy loam | Rolling to moder-ately steep | S3cf | S3cf | S3cf | S3f | S3ct | N2 | S3t |
| Guimbalaon clay loam | Level to nearly level | S3cf | S3cf | S3cf | S3f | S3ctw | N2 | N1 |
| Ilagan loam | Undulating to rolling | S3cf | S3cf | S3cf | S3f | S3cfw | N2 | S3w |
| Ilagan sandy loam | Very steep | N2 | N2 | N2 | N2 | N2 | N2 | S3w |

| Soil Type | Topography | Lowland Rice | Rainfed Rice | Rainfed Upland Rice | Corn | Tobacco | Coffee Arabica | Avocado |
|---|---|---|---|---|---|---|---|---|
| Quingua clay loam | Level to nearly level | S2c | S2c | S2c | S2c | S3cf | N2 | S2w |
| Quingua sandy loam | Rolling to moderately steep | S1c | S1c | S1c | S1c | S3cf | N2 | S2w |
| Quingua silty clay loam | Level to nearly level | S1f | S1c | S1c | S1c | S3cf | N2 | S2w |
| Rugao clay | Undulating to rolling | S3f | S3f | S3f | S3f | S2cf | N2 | S3f |
| Rugao clay loam | Undulating to rolling | S3f | S3f | S3f | S3f | S2cf | N2 | S3f |
| Rugao sandy clay loam | Gently sloping to undulating | S3f | S3f | S3f | S3f | S2cf | N2 | S3f |

| Soil Type | Topography | Lowland Rice | Rainfed Rice | Rainfed Upland Rice | Corn | Tobacco | Coffee Arabica | Avocado |
|---|---|---|---|---|---|---|---|---|
| Rugao sandy loam | Steep | N1 | N1 | N1 | N1 | N1 | S3 | S3f |
| San Juan clay | Rolling to moderately steep | S3cfwt | S3cwtf | S3cwtf | S3cwt | S3cwtf | N2 | S3f |
| San Manuel loam | Undulating to rolling | S3cf | S3cf | S3cf | S3f | S3cf | N2 | S2 |
| San Manuel sandy loam | Level to nearly level | S3cf | S3cf | S3cw | S3cf | S3cf | N2 | S3f |
| Sta Rita clay | Level to nearly level | S3cw | S3cw | S3cw | S3cw | S3w | N2 | N1 |
| Sibul clay | Sloping to steep | S3s | S3s | S3s | S3w | S3s | N1cs | S3fs |
| Tagulod clay loam | Level to nearly level | S2fw | S2fw | S2fw | S2fw | S2fw | N1cw | S2fw |

| Soil Type | Topography | Banana | Cabbage | Mango | Beans | Peanut | Coffee Robusta |
|---|---|---|---|---|---|---|---|
| Alaminos clay loam | Rolling to moderately steep | S3ft | N1f | S3ft | N1f | N1f | N1f |
| Annam clay loam | Steep | N1 | N2 | N1t | N2t | N1t | N1t |
| Annam clay loam | Rolling to moderately steep | N1 | N2 | N1t | N2t | N1t | N1t |
| Bago clay loam | Level to nearly level | N2 | N1f | S3w | N1f | N1f | S2fw |
| Bago sandy clay loam | Rolling to moderately steep | N2 | N1f | S2 | N1f | N1f | S2fw |
| Bago sandy clay loam | Undulating to rolling | N2 | N1f | S2 | N1f | N1f | S2fw |
| Bago sandy loam | Undulating to rolling | N2 | N1f | S2 | N1f | N1f | S2fw |

| Soil Type | Topography | Banana | Cabbage | Mango | Beans | Peanut | Coffee Robusta |
|---|---|---|---|---|---|---|---|
| Bantog clay loam | Level to nearly level | N2 | S3w | N1w | S3cw | N1w | N2f |
| Bigaa clay | Undulating to rolling | N2 | S3fw | S3w | S3cwt | S3w | S3w |
| Cauayan clay | Level to nearly level | N2 | N1f | N1w | S3cfw | N1fw | N1w |
| Cauayan clay | Undulating to rolling | S3cw | N1f | N1w | S3cfw | N1fw | N1w |
| Cauayan clay loam | Level to nearly level | S3cw | N1f | N1w | S3cwt | N1fw | N1w |
| Cauayan loam | Level to nearly level | S3w | N1f | S2 | S3cwt | N1f | S3w |
| Cauayan sandy loam | Rolling to moderately steep | S3cft | N1f | S3t | S3cft | N1f | S3t |

| Soil Type | Topography | Banana | Cabbage | Mango | Beans | Peanut | Coffee Robusta |
|---|---|---|---|---|---|---|---|
| Guimbalaon clay loam | Level to nearly level | S3cfwt | N1f | N1w | N1f | N1fw | N1w |
| Ilagan loam | Undulating to rolling | S3c | N1f | S2 | S3cf | N1f | S3w |
| Ilagan sandy loam | Very steep | S3cs | N2 | N2 | S3cf | N1f | N2f |
| Quingua clay loam | Level to nearly level | S3c | S2 | S2 | S2cw | S3w | N2f |
| Quingua sandy loam | Rolling to moderately steep | N2 | S2 | S2 | S2cw | S1 | N2f |
| Quingua silty clay loam | Level to nearly level | N2 | S2 | S2 | S2c | S3w | N2f |
| Rugao clay | Undulating to rolling | S3cf | N1f | S3f | N1f | N1f | S3f |

| Soil Type | Topography | Banana | Cabbage | Mango | Beans | Peanut | Coffee Robusta |
|---|---|---|---|---|---|---|---|
| Rugao clay loam | Undulating to rolling | S3cf | N1f | S3f | N1f | N1f | S3f |
| Rugao sandy clay loam | Gently sloping to undulating | S3cf | N1f | S3w | N1f | N1f | S3f |
| Rugao sandy loam | Steep | N2 | N1f | N1t | N1f | N1f | N1t |
| San Juan clay | Rolling to moderately steep | S3cwt | S3wt | N1w | S3fw | N1w | N1w |
| San Manuel loam | Undulating to rolling | N2 | S2 | S2 | S2cft | S2ft | N2f |
| San Manuel sandy loam | Level to nearly level | N2 | S2 | S3f | S3f | S3f | N2f |
| Sta Rita clay | Level to nearly level | S3cw | S3w | S3w | S3w | N1w | N1w |
| Sibul clay | Sloping to steep | S3s | S3s | S3s | S2fw | S2wt | S3fw |
| Tagulod clay loam | Level to nearly level | S2fw | S2fw | S3w | S2fw | S3w | S3w |

| Soil Type | Topography | Sorghum | Cassava | Cotton | Potato | Wheat | Mungbean |
|---|---|---|---|---|---|---|---|
| Alaminos clay loam | Rolling to moderately steep | S3t | S3t | N1f | S3ft | N2c | N1f |
| Annam clay loam | Steep | N1t | N1t | N1t | N1t | N2c | N2t |
| Annam clay loam | Rolling to moderately steep | S2ft | S2fw | S3c | S3f | N1f | N1f |
| Bago clay loam | Level to nearly level | S3f | S2fw | S3fw | S3f | N1f | N1f |
| Bago sandy clay loam | Rolling to moderately steep | S3f | S2fwt | S3f | S3f | N1f | N1f |
| Bago sandy clay loam | Undulating to rolling | S3f | S2ft | N1f | S3f | N1f | N1f |
| Bago sandy loam | Undulating to rolling | S3f | N1w | S3w | S3f | S3cw | S3cw |

| Soil Type | Topography | Sorghum | Cassava | Cotton | Potato | Wheat | Mungbean |
|---|---|---|---|---|---|---|---|
| Bantog clay loam | Level to nearly level | S3w | S3w | N1w | S2cfwt | S3cw | S2cwft |
| Bigaa clay | Undulating to rolling | S2wt | N1w | S3w | S3w | S3cw | S3cfw |
| Cauayan clay | Level to nearly level | S3fw | N1w | N1w | S3w | N2c | S3cfw |
| Cauayan clay | Undulating to rolling | S3fw | N1w | N1w | S3w | N2c | S3cfw |
| Cauayan clay loam | Level to nearly level | S3fw | S3w | N1w | S2cfw | S3cf | S3cfw |
| Cauayan loam | Level to nearly level | S3f | S3t | S3fw | S3t | N2c | S3cft |
| Cauayan sandy loam | Rolling to moder-ately steep | S3wt | N1w | S3ft | S3fw | N2c | N1f |

| Soil Type | Topography | Sorghum | Cassava | Cotton | Potato | Wheat | Mungbean |
|---|---|---|---|---|---|---|---|
| Guimbalaon clay loam | Level to nearly level | N1t | S3s | S3f | S2cft | N2c | S3cf |
| Ilagan loam | Undulating to rolling | S3f | S3s | S3f | N2t | N2c | S3cf |
| Ilagan sandy loam | Very steep | N2t | S3w | N2 | S2cf | N2c | S2cw |
| Quingua clay loam | Level to nearly level | S2w | S3w | S3cw | S2cf | S2wt | S2cw |
| Quingua sandy loam | Rolling to moderately steep | S2w | S3w | S3w | S2cf | S2w | S2c |
| Quingua silty clay loam | Level to nearly level | S2w | S3f | S3w | N1f | N2c | N1f |
| Rugao clay | Undulating to rolling | N1t | S3f | N1f | N1f | N2c | N1f |

| Soil Type | Topography | Sorghum | Cassava | Cotton | Potato | Wheat | Mungbean |
|---|---|---|---|---|---|---|---|
| Rugao clay loam | Undulating to rolling | N1t | S3f | N1f | N1f | N2 | N1f |
| Rugao sandy clay loam | Gently sloping to undulating | N1t | N1t | N1f | N1ft | N2 | N1f |
| Rugao sandy loam | Steep | N1t | N1w | N1f | S2wt | N2 | S3fw |
| San Juan clay | Rolling to moderately steep | S3wt | S2ft | N1w | S2cft | S3c | S2cft |
| San Manuel loam | Undulating to rolling | S2ft | S2f | S2cft | S3f | S3cs | S3f |
| San Manuel sandy loam | Level to nearly level | S2t | N1w | S2ct | S2w | S3cw | S3w |
| Sta Rita clay | Level to nearly level | S3w | N2s | N1w | S2ct | S3t | S2fw |
| Sibul clay | Sloping to steep | S2wt | S3w | S3s | S2cw | S3t | S2fw |
| Tagulod clay loam | Level to nearly level | S2w | | S3w | | | |

# Soil *productivity*

Soil productivity is the quality of the soil that summarizes its potential in producing plants or sequences of plants under defined sets of management practices ; it is also a synthesis of conditions of soil fertility, water control, plant species, soil tilth, pest control and physical environment (Bainroth,1978: Badayos,1990). In economic terms, it is a measure of amount of inputs of production factors required to correct soil limitation(s) in order to attain a certain level of production. It is expressed as the average crop yield under defined sets of management classes (Badayos,1990).

Soil productivity index is used for making comparisons among soils. It is categorized into inherent and potential productivity index. The inherent productivity index is defined as the natural capacity of the soil to produce a given yield while potential productivity index refers to the capability of the soil to produce yield after correctible soil constraints had been remedied. In economics, the predicted inherent yield is calculated by multiplying the inherent index to the maximum potential yield of rice while the predicted maximum possible index to the maximum potential yield.

Table 3. The soil productivity index for rice.

| Soil Series | Inherent Productivity | Potential Productivity |
|---|---|---|
| Alaminos | 0.47 | 0.72 |
| Annam | 0.58 | 0.73 |
| Bago | 0.57 | 0.77 |
| Bantog | 0.81 | 0.91 |
| Bigaa | 0.78 | 0.93 |
| Cauayan | 0.48 | 0.70 |
| Faraon | 0.48 | 0.60 |
| Guimbal-aon | 0.54 | 0.77 |
| Ilagan | 0.72 | 0.84 |
| Quingua | 0.68 | 0.78 |
| Rugao | 0.61 | 0.81 |
| San Juan | 0.57 | 0.67 |
| San Manuel | 0.75 | 0.85 |
| Sibul | 0.36 | 0.46 |
| Sta Rita | 0.65 | 0.83 |
| Tagulod | 0.69 | 0.79 |

# Soil management Recommendations

The goal of soil management is to protect the soil and enhance its performance to increase farm profitability and preserve environmental quality. It is the combination of soil factors to maximize crop production at the lowest possible cost while leaving the soil in a productive state. It involves maintaining the soil in good physical condition, maintaining the soil fertility status, and influencing the biological aspect of the soil; so that maximum benefit results (Harpstead, et. al. 1997).

Soil management recommendations suitable for each soil identified are enumerated in the succeeding pages (Table 4). In making soil management recommendation, soil properties such as texture, mineralogy, moisture and temperature regime, and climate are considered since these factors affect crop growth. However, these properties cannot be changed but control tillage, crop rotations, soil ammendments, and other management choices can be done. Through these choices, the structure, biological activity, chemical content of the soil can be altered and later on influence erosion rates, pest population, and nutrient availability and crop production.

Table 4. Management Recommendations

| Soil qualities in relation to crop production | Soils in the low lying plains | | | |
|---|---|---|---|---|
| | **Bago** | **Bantog** | **Bigaa** | **Quingua** |
| Recommended Crops | lowland/upland rice, sorghum, potato, cassava, tobacco, avocado, mango, coffee (C. robusta), cotton | lowland/ upland rice, corn, tobacco, beans, sorghum, cassava, potato, wheat, mungbean | lowland/upland rice, corn, tobacco, avocado, mango, beans, peanut, coffee (C. robusta), sorghum cotton, potato, wheat | lowland/upland rice, corn, tobacco, avocado, mango, beans, sorghum, cassava, cotton, potato, wheat, sugarcane, peanut, mungbean , cabbage |
| Soil constraints to production | very dense compact layer in the substratum that impedes internal drainage; lack of moisture | surface cracking that makes tillage difficult | surface hardening and cracking during dry season making tillage difficult | frequent flooding |
| Management Recommendations | organic matter incorporation (e.g unburned rice hull); irrigation system | addition of organic matter; proper fertilization | irrigation system; green manuring; incorporation of animal manure; proper fertilization | fertilization; green manuring; protection against floods - close planting of grasses and ipil-ipil |

| Soil qualities in relation to crop production | Soils in the low lying plains | | |
|---|---|---|---|
| | San Manuel | Sta. Rita | Tagulod |
| Recommended Crops | lowland/upland rice, corn, tobacco, avocado, cabbage, mango, beans, peanut, sorghum, cassava, cotton, potato, wheat, mungbean | lowland/upland rice, corn, tobacco, banana, cabbage, mango, beans, peanut, sorghum, potato, wheat, mungbean | rainfed lowland/ upland rice, corn tobacco, avocado, coffee arabica, banana, cabbage, mango, beans, peanut, coffee robusta, sorghum, cotton |
| Soil constraints to production | stream bank erosion; low to medium water holding capacity | surface cracking making tillage difficult | subsoil hardening upon drying |
| Management Recommendations | Phosphate fertilization, green manuring, deep plowing, plant grasses or ipil-ipil along the river banks | irrigation system, judicious fertilization and liming, and addition of organic matter | fertilization; organic matter incorporation; irrigation system; residue management |

| Soil qualities in relation to crop production | Soils in the rolling uplands | | | |
|---|---|---|---|---|
| | **Alaminos** | **Annam** | **Cauayan** | **Faraon** |
| Recommended Crops | rainfed lowland/ upland rice, corn tobacco, avocado, coffee arabica, banana, mango, sorghum, cassava, potato, cacao, coconut | sorghum, cassava, cotton potato, agroforestry, industrial crops, and orchard on hilly land | rainfed lowland/ upland rice, corn avocado, coffee arabica, banana, mango, beans sorghum, cassava, potato, peanut, mungbean | shrubs, orchard, industrial and forest species |
| Soil constraints to production | aluminum toxicity; acidic; run-off | Aluminum (Al) and Iron (Fe) Toxicity; very acidic; very low native fertility; run-off | Al toxicity; acidic; poor nutrient retention; waterlogged due to the presence of hardpan (minuri); large iron concretions hamper plowing and cultivation | shallow soil; steep topography; presence of rock fragments |
| Management Recommendations | Organic matter incorporation; fertilization; liming; Phosphate fertilization | manuring; liming; large initial application of P-fertilizers | liming; organic matter incorporation; appropriate amount of inorganic fertilizer; erosion prevention and water control practices | good vegetation to minimize erosion |

| Soil qualities in relation to crop production | Soils in the rolling uplands | | |
|---|---|---|---|
| | **Guimbalaon** | **Ilagan** | **Rugao** |
| Recommended Crops | rainfed lowland/ upland rice, corn, tobacco, cassava, cotton, potato, cacao, coconut corn, mungbean | rainfed lowland/ upland rice, corn, avocado, tobacco, banana, mango, beans, coffee robusta, sorghum, cassava, potato, mungbean | rainfed lowland/ upland rice, corn, avocado, tobacco, banana, mango, coffee robusta, sorghum, cassava, potato, mungbean, kapok, mango |
| Soil constraints to production | presence of hardpan / minuri; poor nutrient retention capacity; slight sheet erosion | compact substratum prevents rapid infiltration; Al toxicity | subsoil hardening making tillage difficult |
| Management Recommendations | OM incorporation; liming; erosion prevention and water control practices; proper fertilization | green manuring; liming, Phosphate fertilization; soil erosion control measures | soil erosion control measures - terracing and strip cropping; crop rotation with green manuring |

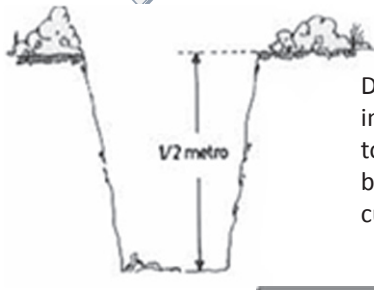
| Soil qualities in relation to crop production | Soils in the rolling uplands | |
|---|---|---|
| | San Juan | Sibul |
| Recommended Crops | rainfed lowland/ upland rice, corn, avocado, tobacco, banana, cabbage, beans, sorghum, cassava, potato, wheat, mungbean | rainfed lowland/ upland rice, corn, avocado, tobacco, banana, cabbage, mango, beans, peanut, coffee robusta, sorghum, cassava, cotton, potato, wheat, mungbean |
| Soil constraints to production | Presence of duripan that damages and prevents the roots from penetrating deeper, retard or stop the infiltration of water | shallow soil |
| Management Recommendations | erosion control system - contouring, cover cropping | Fertilization and organic matter incorporation, cover cropping |

# APPENDICES

# 1 STEPS TO IDENTIFY SOIL SERIES

## Soil sampling

Choose a vacant area in your field. Using a spade/auger, dig up to 50cm from the soil surface.

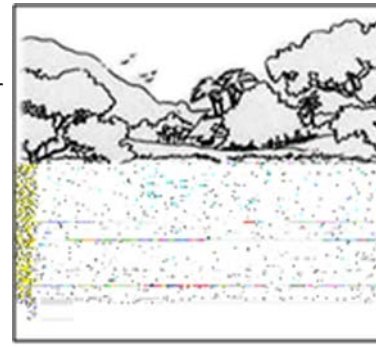



Depth of soil is important. The surface/ top soil is not a good basis since it is always cultivated.

Get bulk soil sample (½ kilo) from 30-50cm depth; place it in a container (plastic/pail). This sample will be used for soil series identification.

## 2 Soil color determination

Soil color is an indirect measure of other characteristics such as drainage, aeration, and organic matter content. Black-colored soils may indicate high fertility and productivity.

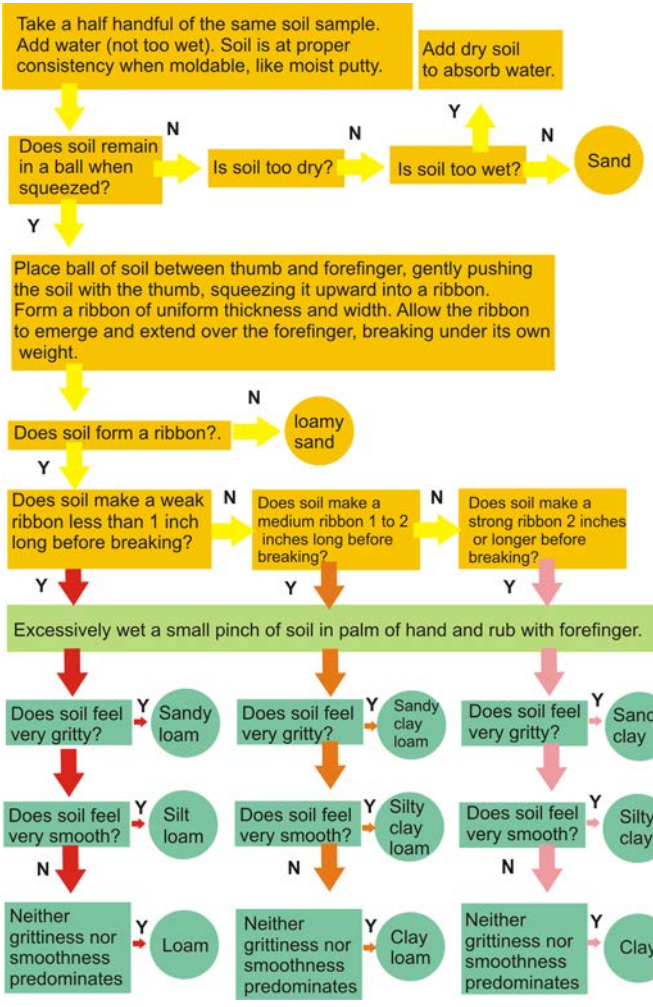


Gray indicates a fairly constant water-saturated condition. Bright brown and red colors are indicative of good aeration and drainage.

Get an ample amount of soil from the sample. The soil should be moist (neither too wet, nor too dry).

Compare the color of the soil sample with the color chart in the guidebook. Take note of the classification of the soil color.

# 3 Texture determination



# 4 **pH Determination** (UPLB procedure)

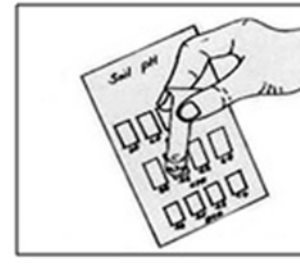
Get soil sample from a 30-50cm depth. Fill the test tube with soil sample up to the scratch mark.

Add 7 drops of CPR (chlorphenol red). Mix by gently swirling the test tube.

If soil pH is 6 or greater, repeat the steps using BTB (brom thymol blue).

If the soil pH is 5 or less, repeat the steps using BCG (brom cresol green).

Match the color of the solution on top of the soil with the corresponding color chart of the pH indicator dye used.



## APPENDIX 2. THE PALAYCHECK SYSTEM

The Palaycheck System is a rice integrated crop management that combines the technologies and learning processes to identify strengths and weaknesses of current crop management practices, make improvements in the next season to increase grain yield, input use efficiency, and profit with environmental concerns.

The PalayCheck System describes the crop management practices (input) to achieve the following Key Checks (output):

1) Used certified seeds of a recommended variety.

2) No high and low soil spots after final leveling.

3) Practiced synchronous planting after a fallow period.

4) Sufficient number of healthy seedlings.

5) Sufficient nutrients at tillering to early panicle initiation, and flowering.

6) Avoided excessive water or drought stress that could affect the growth and the yield of the crop.

7) No significant yield loss due to pests.

8) Cut and threshed the crop at the right time.

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PhilRice is a government corporate entity attached to the Department of Agriculture created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding and cost-reducing technologies so farmers can produce enough rice for all Filipinos.

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