REPORT ON THE SOIL RESOURCES OF THE
AFIGYA – KWABRE DISTRICT, ASHANTI REGION, GHANA

(CSIR / WAAPP NO. 017)

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1.0 INTRODUCTION

1.1 Background and justification

Soil information is basic to several economic sectors such as farming, establishment of pastures, forestry, construction of fish pond, mining activities, etc. Soil maps provide a quick summary of soil information that assists in determining the suitability or potential of an area for any agricultural and other related land-use. They are guides to investors and planning tools for agricultural planners.

Currently, information to users on request at the Soil Research Institute is extracted from Regional or Detailed Reconnaissance Soil surveys on a scale of 1:250,000. A lot of information is swallowed at this scale.

For effective planning, the provision of a more detailed (1:50,000 – 1:100,000) soil map and accompanying report for the districts will provide adequate information, which would be more accessible and satisfy the needs of most end-users.

The work, which was carried out on Afigya-Kwabre District in the Ashanti Region, seeks to provide a more detailed soil and related information that will fill the gaps under the 1:250,000 mapping scale. The current work provides a semi-detailed mapping scale of 1:50,000 which would assist in the preparation of any development plan for the district and also provide quick information on potential agricultural and other land use areas.

1.2 Location and extent

The Afigya-Kwabre District is located north of Kumasi. It shares boundaries with Atwima and Offinso Districts to the west, Ejura - Sekyeredumase to the north, Kwabre to the east and Kumasi Metropolitan Assembly to the south (Map 1). The district capital is at Kodie. Other major
settlements include Kwaman, Ahenkro, Adwumakasekese, Nkwantakese, Boamang, Abroma, Soko, Tetrem and Kyekyewere. The district covers an area of about 43,987 hectares.

Map 1: Location of Afigya – Kwabre District

1.3 Objectives

The objectives of this work are to:

- describe the morphological characteristics of the soils within the district
- map the distribution of the soils
- evaluate the soils for the production of major crops in the District
• recommend fertility improvement measures for the production of major crops in the District

1.4 Method of study

Basic soil information was compiled from the detailed reconnaissance soil survey of the Kumasi Region and the Afram River Basin published by the CSIR-Soil Research Institute (Adu, 1992; Adu & Mensah Ansah, 1995)

A digitized base map of the District was prepared with the following overlays: soil map on a scale of 1:250,000, contours from the Survey Department of Ghana, rivers and streams, roads and settlements. Several transects were selected on each soil unit (existing information) for soil and land use observation and recording (Map 2). Soil observation was carried out at intervals of 100 metres along each transect to ensure that the various soils along the catena or the slope were captured. In the field, the co-ordinates of each observed point was recorded by means of Global Positioning System (GPS). Profile pits were dug, described and sampled for laboratory analyses.

The observed points were plotted on the base map in the Arc-GIS software. With the aid of the digital elevation model generated from the contour layer (Map 3), soils coinciding with specific elevations were delineated, mainly the upland on one hand and the lower slope / the lowland on the other.
Map 2: Soil association units and observation points
2.0 THE PHYSICAL ENVIRONMENT

2.1 Climate

The Afigya-Kwabre District is located in the Moist Semi-Deciduous Forest Zone. The zone is characterized by relatively high rainfall (about 1400 mm per annum) with a bimodal pattern. The major season rains occur between March and mid-July with a peak in May/June. There is a short dry spell from mid-July to mid-August. The minor rainy season starts from mid-August to about the end of October with a peak in September. A long dry period is experienced from November to February with possibilities of occasional rains. Due to lack of meteorological information on the District, Kumasi rainfall data is used to represent conditions in the District (Figure 1). The Total annual rainfall is approximately 1400mm

Temperatures are normally high throughout the year with very little variations. The mean monthly temperature range from 25°C in July/August to 28°C in March/April. Climatic data on Kumasi from the Meteorological Services Department is presented in the appendix.

![Mean monthly rainfall for Kumasi in millimetres](image)

Figure 1. Mean monthly rainfall for Kumasi
2.2 Vegetation and land use

The original vegetation is forest and this has largely been degraded by lumbering and farming. The closed forest consisting of a continuous canopy of tall and medium-height trees with little or no undergrowth no longer exists. The area now largely consists of farm patches with isolated stands of individual trees or small areas of tree-clusters. Forest reserves occurring in the district are the Gianima and Asufu reserves and a small portion of the Afram Head-Waters Forest Reserve to the north eastern corner. The reserves are generally degraded and re-forestation, mainly teak, was observed being undertaken in some parts.

Crops cultivated in the district include, cocoa, oil palm, citrus, avocado pear, plantain, maize, cassava, cocoyam, cowpea, vegetables etc.

2.3 Relief and drainage

The relief in the district is generally undulating with altitude ranging between 240 – 300 metres (800-1000ft). However, the northern part reaches up to 365 metres (1,200ft) above sea level. Isolated hills in the south around Buoho also have altitude up to 365 metres (1,200ft). The district is drained by many rivers and streams, notably among them are the Ofin and its tributaries and the Abankro rivers. Numerous streams are distributed all over the district (Map 3).
Map 3: Relief and drainage
3.0 **SOILS OF THE DISTRICT**

3.1 **Soil Association units**

The soils of Afigya-Kwabre District are developed over granite, Lower Birimian - phyllite and coarse-grained Voltaian sandstone. It is significant to note that about 96% of the District is underlain by granite. Soil associations or units over each of these parent materials are listed as follows: (Map 2)

<table>
<thead>
<tr>
<th>Soils developed over granite and associated rocks</th>
<th>Sub - Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kumasi – Ofin Compound Association</td>
<td>26,498.5 Ha</td>
</tr>
<tr>
<td>Bomso – Ofin Compound Association</td>
<td>2,398.0 Ha</td>
</tr>
<tr>
<td>Boamang – Suko Simple Association</td>
<td>13,111.6 Ha</td>
</tr>
<tr>
<td>Nyanao – Opimo Association</td>
<td>483.7 Ha</td>
</tr>
<tr>
<td><strong>Sub - Total</strong></td>
<td><strong>42,491 (96.5%)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soils developed over Lower Birimian rocks</th>
<th>Sub - Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bekwai – Oda Compound Association</td>
<td>416.2 Ha</td>
</tr>
<tr>
<td><strong>Sub - Total</strong></td>
<td><strong>416.2 Ha</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soils developed over Voltaian rocks (sandstone)</th>
<th>Sub - Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bediesi – Sutawa Association</td>
<td>168.9 Ha</td>
</tr>
<tr>
<td>Yaya – Pimpimso Association</td>
<td>910.7 Ha</td>
</tr>
<tr>
<td><strong>Sub -Total</strong></td>
<td><strong>1,079.6 (2.5%)</strong></td>
</tr>
</tbody>
</table>

The soil associations in most cases comprise both upland and lowland / valley soils as mapped in Map 2. The mapping unit is upgraded by separating the upland soils from the lowland in Map 4. The description of the soils is based on the mapping units in Map 4.
Map 4. Soil mapping unit
3.2 Description of the soil mapping units

3.2.1 Soils developed over granite

Soils developed over granite are grouped under four major soil associations as indicated in Map 2. These are Kumasi-Ofin compound Association, Bomso – Ofin Compound Association, Boamang – Suko Simple Association and Nyanao – Opimo Association.

*Kumasi-Ofin and Bomso-Ofin Compound Associations*

Kumasi – Ofin and Bomso - Ofin Compound Associations have similar set of soils comprising Kumasi / Bomso, Asuansi, Akroso, Nta and Ofin / Densu series. In a catena, the summits and upper slopes are usually occupied by red gravelly sandy clay, Kumasi series or a similar profile which contains a high amount of mica flakes, Bomso series. The adjoining middle slopes have soil morphological characteristics similar to Kumasi series but differ only in colour. It is occupied by strong brown to yellowish red gravelly sandy clay, Asuansi series. The middle to lower slope is occupied by imperfectly drained yellowish brown, gravel-free sandy clay loam, Akroso series. The valley is occupied by grey loamy sands on the fringes, Nta series and poorly drained alluvial coarse sand, Ofin series and clay, Densu series in bottom sites. Diagrammatic representation of the soils along the slope is shown in Figure 2.

![Diagram of soil profiles](image)

Figure 2: The Diagrammatic representation of Kumasi - Ofin and Bomso - Ofin Associations along the slope
Kumasi and Asuansi series (WRB, 2006: Haplic Lixisol (Ferric))

Kumasi and Asuansi series are soils occupying summits, upper and middle slopes. They are similar in morphological characteristics except that Kumasi series is well drained with red subsoil colour while Asuansi is moderately well drained with yellowish red colour. They are the most extensive soil unit in the district and are distributed throughout from the north to the south. The soils occur over gentle undulating topography with slopes of 5 – 8%.

The soils of this unit consist of sandy loam top soil with underlying gritty clay loam and clay subsoil which contain many quartz gravel, stones and ironstone concretions (Figures 3 and 4). The coarse fragments decrease with depth.

Due to the light-textured (sandy loam) topsoil, the soils of this unit rapidly dry up early in the dry season or whenever there is an appreciable break in rainfall. Their gravelly subsoil is also a limitation that reduces the moisture and nutrient holding capacity of the soil but due to the medium to heavy textures (sandy clay loam to clay) these limitations are ameliorated and the soils have satisfactory nutrient and moisture-holding capacity. The soils are also susceptible to erosion.

They are suitable for a wide range of crops including tree crops such as cocoa, oil palm, citrus, coconut, plantain, maize, cassava, cowpea and vegetables.
Figure 3: Soil profile of Kumasi series
Figure 4: Soil profile of Asuansi series

**Akroso series (Gleyic Lixisol)**

Akroso series is imperfectly drained, colluvial soil occupying middle to gentle lower slopes. The soil is deep (> 120 cm) and free of concretions and gravels (Figure 5). The topsoil is dark grayish brown sandy loam. It is friable with moderate fine granular structure. The underlying subsoil is yellowish brown to brownish yellow loamy sand to sandy clay loam. Deep in the profile, mottles do occur. The soil is gravel-free and has a satisfactory moisture holding capacity. They are suitable for a wide range of crops including tree crops such as cocoa, oil palm, citrus, coconut, plantain, maize, cowpea and vegetables.
Figure 5: Soil profile of Akroso series

Nta - Ofin series (WRB, 2006: Gleyic Arenosol; Gleyic Fluvisol)

*Nta* and *Ofin series* occur on gentle lower slopes of 1-3% and it is developed from colluvial and alluvial materials originating from granite. This soil unit consists of *Ofin series*, which is a recently deposited coarse sands or stratified sands and clays within nearly flat but narrow valley bottoms along streams and *Nta series* which is colluvio-alluvial sand deposits occurring further away from the stream channel and towards the fringes of the lowland.

*Nta* soil is deep, imperfect to poorly drain with loamy sand textures throughout its profile (Figure 6). *Ofin* soil is poor to very poorly drained coarse sand with subsoil often containing quartz gravel and stones.

*Nta* and *Ofin* series are subject to water-logging in the rainy season. In the dry season, they dry out rapidly because of the sandy texture (over 80% sand). As a result, permeability is rapid and
water holding capacity is low. They require controlled drainage during the rainy season and irrigation in the dry season for continuous production of crops. Commonly grown crops are rice, sugar cane and vegetables. With respect to tree crops, oil palm can be grown. These soils are also mined for building construction. While Nta soils are mined for sand, Ofin soils are mined for gravel. In the district, most of the Nta soils have been mined, leaving the sites degraded.

**Figure 6: Soil profile of Nta series**

**Bomso – Ofin Compound Association** occurs in a narrow strip to the south eastern part of the District stretching from Pampatia to Heman. It has a strongly sloping terrain (10 – 15% slope).

**Boamang and Suko series**  *(WRB, 2006: Plinthic lixisol; Haplic Lixisol)*

Boamang – Suko Simple Association are deep, well to moderately well drained gravel – free upland soils found on summits and middle slopes. This soil association is also quite extensive and next to Kumasi – Ofin compound Association in extent. This soil unit comprises two associated upland soils namely, Boamang series occurring on flat summits and Suko series on
the middle slopes. The unit is distributed all over the district. Boamang series is deep, uniform reddish brown, well drained sandy clay loams, free from concretions, gravels and stones (Figure 7). Suko series occurs on the slopes and has characteristics similar to Boamang except for colour and the moderately well drainage. Both soils occur on gradients of 0 – 5%.

Figure 7: Soil profile of Boamang series

The Boamang – Suko soil unit is highly suitable for arable crops and tree crops / forest trees. The soils in the unit have an effective depth of about 100cm. The sandy loam topsoil and sandy clay loam subsoil which are relatively free of gravel and concretions make tillage easy by either machines or simple hand implements. As a result of the sandy nature of the topsoil, these soils are highly susceptible to erosion when cleared of vegetation. Settlements occurring on these soils easily develop gullies with exposed building foundations. Erosion control on farmlands and settlements is therefore paramount in this soil unit.
The soils are considered very good for tree and arable crops such as oil palm, cocoa, citrus, avocado pear, cola, plantain, banana, cocoyam, maize, cassava, beans, groundnut, ginger and all kinds of vegetables and crops adapted to the climatic regime of the District.

**Nyanao (WRB, 2006: Lithic Leptosol)**

The Nyanao unit consists of steep sided rocky isolated granitic hills which occur around Buoho in the southern part of the district (Figure 8). Shallow soils occur in between the rock exposures where trees and plants are able to grow. On the steep slopes of the hills, moderately deep, well drained reddish brown sandy clay soils containing pieces of granitic rocks and quartz gravel / stones (Tinkong and Adiembra series) may occur. Adiembra series is the paler version of Tinkong. The Catholic sanctuary (grotto) at Buoho occurs on this unit with teak grown all over the area (Figure 9).

**Figure 8: Nyanao soil unit at Buoho**

**Figure 9: Catholic sanctuary on Nyanao unit at Buoho**

Generally, Nyanao soil unit is not suitable for any meaningful agricultural venture due to the shallow soils and very steep slopes which are up to about 60%. However, small patches of cultivation are possible where Tinkong and Adiembra series occur. The unit is economically utilized with the establishment of quarries at Buoho.
Opimo series (WRB, 2006: Haplic Lixisol)

Opimo series are red, drift soils found at the base of the granitic hills. The drift material is deep and could reach up to 2 metres but could sometimes be shallow with a thickness of about 30 cm. The drift material is underlain by a stone-line below which is the partially or little weathered bed-rock.

3.2.2 Soils developed over Lower Birimian Rocks (phyllite)

The soil association developed over the Lower Birimian phyllite is the Bekwai – Oda compound Association. It occurs over gentle to undulating topography and covers a relatively small area to the west of Akom and on the left bank of the Ofin River in the southern part of the District. In a catenary arrangement the soils consist of red, gravelly silty clay, Bekwai series on summits; a paler version of Bekwai series with a higher content of quartz gravels, Nzima series, occurs on upper and middle slopes but sometimes extends to the summit. It is the predominant soil in the association. The lower slopes are occupied by deep moderately well to imperfectly drained, non-gravelly yellowish brown silty clay loam to silty clays, Kokofu series. The valleys are occupied by poorly drained light grey sandy clay, Oda series or sand Temang series (Figure 10).

Figure 10: The diagrammatic representation of Bekwai – Oda compound Association along the slope
Bekwai – Nzima series (WRB, 2006: Cutanic Lixisol (Ferric))

The soils of this unit are developed over Lower Birimian phyllite. Bekwai series is red, well drained sedentary soil found on summit and upper slopes where slope gradients lie between 3 – 12%. Nzima series is the dominant soil in this soil association (Figure 11). It is the less well drained middle and upper slope associate of Bekwai series. Sometimes it replaces Bekwai series at the summit.

The soils are deep (>120 cm) and have silty loam topsoil. The underlying subsoil is silty clay loam to silty clay and contains many quartz gravel, stones and ironstone concretions.

Both Bekwai and Nzima series have satisfactory rooting depth and good drainage conditions for crop development. However, their physical limitation is the appreciable amount of gravel in the subsoil. The medium to heavy textures possessed by the soils is able to hold adequate amount of water for a reasonable period of time. The soils are suitable for cultivation of a wide range of arable and tree crops such as cocoa, coffee, citrus, oil palm, avocado pear, mangoes, maize, cassava, yams, cocoyam, plantain, banana, pawpaw, pineapples and all kinds of vegetables.

![NZIMA SOIL SERIES](image)

**Figure 11: Soil profile of Nzima series**
Kokofu series (WRB, 2006: Haplic or Gleyic Lixisol)

Kokofu series, normally, is non-gravelly colluvial soil occupying lower slopes of 2-4% in the Bekwai – Oda soil catena. The soil is deep (>120cm) and moderately well or imperfectly drained. It is normally free of gravel but sometimes a gravel layer or stone-line may occur deep in the profile at about 80cm. Textures range from sandy loam to silt loam in the topsoil to sandy clay loam, clay loam and silty clay loam in the subsoil (Figure 12). The soil is easy to work, has good water-holding capacity and adequate depth for root development. Due to its lower slope position, it is able to store moisture much longer than Bekwai and Nzima series, which are located upslope. It is suitable for all crops mentioned under Bekwai and Nzima series.

**KOKOFU SOIL SERIES**

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ap</td>
<td>0 – 10</td>
<td>Yellowish Brown; Loam; Moderate Fine and Medium Granular; Friable</td>
</tr>
<tr>
<td>Bt</td>
<td>10 – 60</td>
<td>Strong Brown; Clay; Moderately Medium Subangular Blocky; Firm</td>
</tr>
<tr>
<td>Btv 1</td>
<td>60 – 105</td>
<td>Reddish Yellow; Common Distinct Red Plinthic Mottles; Clay; Moderate Medium Subangular Blocky; Firm; Many Medium Quartz Gravel</td>
</tr>
</tbody>
</table>

Figure 12: Soil profile of Kokofu series
**Oda and Temang series (WRB, 2006: Haplic Gleysol (Eutric))**

These soils are found in the valley bottoms. They are deep and poorly drained. Oda series consist of clay loam and clay while Temang series is sand and loamy sand. They occur together in the valley and could not be mapped separately.

Oda soils are poorly drained and so are subject to water-logging during the rainy seasons. They have high water holding capacity due to their high clay content (over 30%). They therefore remain wet during the dry season. Temang series is also poorly drained but dries out quicker during the dry season due to the sandy texture. These soils are suitable for rice and vegetable farming. However, drainage structures are required during the rainy season to drain off excess water. In the dry season, supplementary irrigation may be required for crop production.

**3.2.3 Soils developed over Voltaian Sandstone**

The sandstone occurs to the north-eastern corner of the District, precisely to the east of Kyekyewere. Two soil associations namely, Bediesi – Sutawa and Yaya – Pimpimso Associations occur over the sandstone (Map 2).

The Bediesi – Sutawa Association is dominated by red, well drained sedentary loams and clay loams, **Bediesi series**, on summits and upper slopes and yellowish brown to strong brown moderately well drained colluvial sandy clay loams, **Sutawa series** on middle slopes. They are the dominant soils on the upland with minor areas of rock outcrops or exposures (**Yaya series**) and red, well drained concretionary sandy loams (**Pimpimso series**) are found. The lower slopes are occupied by loamy sands (**Kaple series**) while the valley bottom is sand (**Bejua series**).

The Yaya - Pimpimso Association is mainly associated with hilly terrain. The major soils of this association are rock outcrops Yaya and concretionary sandy loams Pimpimso series.

**Bediesi – Sutawa series (WRB, 2006: Haplic Nitisol (Rhodic); Gleyic Lixisol)**

*Bediesi series* occurs on summits and upper slopes and also as translocated material on slopes of moderately steep hills. It is deep (>150 cm), well drained, non-concretionary and non-gravelly. The topsoil is sandy loam with underlying red sandy loam to sandy clay loam subsoil.
There is a variant that is loamy sand throughout. This could be transported material from upslope (Figure 13).

*Sutawa series* occurs on middle slopes below Bediesi series. The profile is deep (>130cm), moderately well to imperfectly drained. The topsoil is dark brown sandy loam of about 10 cm thick. The underlying subsoil is strong brown sandy loam to sandy clay loam (Figure 114).

There could be patches of shallow or rock outcrops (Yaya series), moderately deep, well drained reddish concretionary sandy loams (Pimpimso series) and loamy sands (Kaple series) and sand (Bejua series) in lower slopes and valley bottoms respectively.

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**BEDIESI SOIL SERIES**

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ah</td>
<td>0 – 10</td>
<td>Very Dusky Red, Sandy Loam; Weak Fine Granular; Friable</td>
</tr>
<tr>
<td>AE</td>
<td>10 - 24</td>
<td>Dark Reddish Brown, Sandy Loam; Weak Fine Granular; Friable</td>
</tr>
<tr>
<td>Bt 1</td>
<td>24 - 48</td>
<td>Dark Red, Sandy Clay Loam; Weak To Moderate Nutty And Sub-Angular Blocky Structure</td>
</tr>
<tr>
<td>Bt 2</td>
<td>48 – 125</td>
<td>Red, Clay Loam; Moderate Fine Nutty And Sub-Angular Blocky Structure</td>
</tr>
<tr>
<td>Bt 3</td>
<td>125 – 170</td>
<td>Red, Clay Loam, Weak To Moderate Fine Nutty and Sub-Angular Blocky Structure</td>
</tr>
</tbody>
</table>

Figure 13: Soil profile of Bediesi series


**Figure 34: Soil profile of Sutawa series**

**Yaya – Pimpimso Association (WRB, 2006: Lithic Leptosol; Hyperskeletic Leptosol)**

This soil unit occurs to the north eastern corner of the District and is mainly associated with hilly terrain. The major soils in this unit are Yaya and Pimpimso series.

*Yaya series* consists of the rock outcrops mainly found on scarp summits, slopes and commonly eroded uplands of the Voltaian sandstone area. They also occur on steep-sided rocky valleys. In between the rocky surfaces are shallow soils consisting of about 10cm brown, slightly humous sandy loam topsoil overlying hard massive rock. Frequently, ferruginized rock brash and fragments of stones are incorporated in the topsoil.

There is usually a sparse vegetative cover of short grasses and shrubs with stunted trees growing in between cracks and gullies where there is sufficient unconsolidated material for the roots to establish themselves. The soil has little agricultural value and should be put under forest reserve.
*Pimpimso series* occurs in association with Yaya series. It normally occurs on steep upper slopes. The profile consists of fine sandy loam topsoil containing many ironstone concretions and little ferruginized rock brash. The underlying subsoil consists of deep yellowish red coarse sandy clay loam containing abundant ironstone concretions and many ferruginized rocks brash. In some profiles ironpan boulders or ironpan may be encountered within the subsoil.

*Pimpimso series* do not hold moisture satisfactorily and so become droughty early in the dry season. Agricultural practices should aim at conserving moisture particularly in the dry season, controlling erosion and reducing excessive leaching out of nutrients in the wet season. Pimpimso soils are marginal for mechanical cultivation, but are ideally suited for hand cultivation. Shallow rooted crops such as maize, groundnuts, tiger nuts, shallots, cowpeas, bambara beans, pepper, sweet potatoes, soya beans, garden egg and okro may be profitably produced on these soils.
4.0 General evaluation of the soils for crop production

4.1 Introduction

The soils have been evaluated on the basis of biophysical parameters. The simple limitation concept of soil suitability evaluation was adopted (FAO, 1976, 1983). Normally, land evaluation is a two-stage approach involving evaluation of biophysical characteristics in the first stage and followed by a socio-economic analysis in the second stage. The soil survey activities carried out were oriented towards the biophysical characteristics. The biophysical evaluation was done by matching crop growth requirement with the qualities or characteristics of the land mapping units of the District. In the process, the most limiting factor of the land mapping unit determines its final suitability rating with regard to its use for crops generally produced in the District. The crop growth requirements used were adapted from Sys et al. (1993)

4.2 Evaluation Process

The evaluation process involves a first order, which is the highest level of classification, indicating whether the land or soil unit is suitable or not suitable and these are represented by the letters S (suitable) and N (not suitable).

There are different classes of suitability which indicate the degree of suitability and are indicated as follows: S1 – highly suitable, S2 – moderately suitable, S3 – marginally suitable, N1 – currently not suitable and N2 – permanently not suitable. S1 (highly suitable) has little or no limitation to the intended land use. S2 (moderately suitable) has moderately severe limitations that can be corrected or managed at a moderate acceptable cost for a reasonable crop yield. The limitations increase in severity from S3 to N2 with corresponding increase and unacceptable cost of amendments.

The types of limitations, which are referred to as Land Suitability Subclasses, indicate the kind of limitation, therefore, the main improvement measures required to upgrade the productivity of
the soils. They are represented by lower case letters. For this study the following subclasses were used in the evaluation to reflect the kind of limitations associated with the mapping units.

w: wetness (drainage class and flooding hazard indicative of oxygen availability)

s: physical soil limitation (depth, stoniness, texture; that influence soil/water and nutrient retention, rooting condition and workability)

t: topography (steep hilly terrain)

Final suitability units are derived by combining soil units having similar suitability classification. Map 5 shows the soil suitability or land management units.
Map 4: Soil suitability units
4.3 Description of the soil suitability units

Highly Suitable (Bediesi – Sutawa / Boamang – Suko, Opimo)
$S1$

Deep, well to moderately well drained, sandy loam topsoil over sandy clay loam subsoil. Slopes are gentle to moderately steep (3 - 8 %). The light – textured topsoil (sandy loam) quickly dries up at the onset of the dry season or whenever there is an appreciable break in rainfall. The unit is also susceptible to erosion. The sandy clay loam subsoil has a moderate moisture retention capacity. The unit is suitable for the production of a wide range of crops such as cocoa, oil palm, citrus, coconut, plantain, cassava, maize, cowpea and vegetables. Soil management practices should include erosion prevention measures. Organic matter application and management is important in improving soil aggregation and minimizing erosion.

Moderately Suitable - Gravelly Subsoil (Bomso – Asuansi, Kumasi – Asuansi, Bekwai – Nzima)
$S2s$

These are moderately suitable lands for crop production. Deep, well to moderately well drained sandy loam top and gritty clay loam subsoils. Their limitation is the moderate amount of gravel and concretions in the subsoil. The unit is cultivated to a wide range of crops such as cocoa, oil palm, citrus, coconut, plantain, cassava, maize, cowpea and vegetables. Erosion prevention practices are also important on these soils.

Moderately Suitable - Imperfect Drainage (Akroso and Kokofu)
$S2w$

This unit occurs on lower slopes as transition between the well drained upland and the poorly drained flat lowland. The soils are deep, imperfectly drained and gravel-free. They have good physical characteristics for plant growth and can be used in the same way as the well drained upland units for production of arable food and tree crops grown in the forest zone.
Marginally Suitable – drainage and texture (Nta - Ofin; Oda - Temang)
S3sw

This unit consists of the poorly drained lowlands. In the dry season, they dry out and so require irrigation during the period for crop production, particularly vegetables and rice. In the rainy season, they need to be drained before it could be cultivated. In recent times oil palm is commonly cultivated on these soils.

Marginal to Not Suitable - Gravelly subsoil and shallow depth (Yaya – Pimpimso )
S3s – N2s

This soil unit consists of marginally suitable soils that are moderately shallow (about 50 cm depth) and contain abundant rock brashes and / or ironstone concretions in the subsoil. There are patches of rock exposures or encountered at shallow depth (<20 cm), which are unsuitable for cultivation.

Permanently Not Suitable – topography, rockiness (Nyanao soil unit)
N2ts

This unit is steep, hilly and rocky terrain of granitic rocks occurring in the south of the District. They are not suitable for crop production. They are economically exploited with the establishment of quarries at Buoho.

4.4 Soil Fertility Status of the District

Table 1: Mean properties of upland soils under granite

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Soil pH</th>
<th>Org. M g kg⁻¹</th>
<th>TN</th>
<th>Ca g kg⁻¹</th>
<th>Mg g kg⁻¹</th>
<th>K g kg⁻¹</th>
<th>Na g kg⁻¹</th>
<th>T. Acidity</th>
<th>ECEC cmol(+).kg⁻¹</th>
<th>Base Sat (%)</th>
<th>Avail P mg kg⁻¹</th>
</tr>
</thead>
</table>
Soil Reaction and Exchangeable Cations: The soils are generally strongly acidic (Table 1).

Exchangeable cations are generally low but relatively higher in the top soil. Total acidity is moderate.

Organic Matter and Available Phosphorus: Mean organic matter status is moderate corresponding with moderate value for total nitrogen. Available phosphorus is generally very low.

Soil management

The soil fertility level of the District is low and serious efforts must be made to improve it. Application of only mineral fertilizer (N-P₂O₅-K₂O:- 15:15:15; 20:20:20 etc) will gradually degrade the soil further. Calcium and magnesium are required in large amounts by plants. Generally these materials are not applied leading to serious drop in the soil pH with continuous cultivation. Some recommendations are prescribed below for general information. Specific problems may necessitate the need to contacting Soil Research Institute.

Improving the soil environment:

The pH level of the soils should be raised to between 5.5 and 6.5. Use of agriculture lime (CaCO₃) and gypsum/MgSO₄ will improve the soil pH. Calcium and magnesium levels will also increase. Level of available phosphorus will also improve after liming. To avoid over liming 1.0 t/ha lime + 1.0 t/ha gypsum should be broadcast and incorporated into the soil (ploughing, hoeing etc) 1 to 2 weeks to planting. In the absence of gypsum about 60 kg MgSO₄/ha can be added to the lime. In addition to liming the soil other agronomic practices should be done. For example application of 5 bags of 15:15:15 N-P₂O₅-K₂O/ha + 2 bags of SA in the case of maize (general recommendation given by MOFA). The major aim of liming is to improve the growing environment and does not replace application of mineral/organic fertilizers.
Improving the soil organic matter status.

Soil organic matter is key to the sustainable use of the soil. Improving the soil organic matter increases the nutrient level of the soil, and retention of both nutrient and water. Microbial activity is high when the soil organic matter level is good.

**Poultry manure:** Application of poultry manure (pm) provides all the nutrients required by plants and additionally improves the organic matter status of the soil. Applying 4.0 t/ha pm to maize will result in good maize yield. Best yield is achieved at 6.0 t/ha pm and above. A fertilizer sack containing dry poultry manure weighs 30 kg hence 1.0 t pm is equivalent to about 33 bags. Poultry manure (6.0 t/ha) should be broadcast at least a week (preferably 2 weeks) before planting. Lower rates should be applied by placement when the plant is 1-2 weeks old. Rates below 4.0 t/ha may require application of about 2 bags of sulphate of ammonia (SA) or 1 bag of urea (in the case of urea the material must be buried) as top dressing 5/6 weeks after planting. Other crops (e.g. plantain and banana) may not require any top dressing.

**Cover crops:** Farmers generally allow their fields to fallow after a period of cultivation. Fast growing leguminous crops can be grown. To avoid the aggressive leguminous crop from persisting on the plot slash the cover crop when it starts flowering and allow it to stay on the surface of the soil as mulch. Planting can be done through the mulch layer. Cover crops can also be grown under plantations (oil palm, plantain etc.). Under oil palm slashing to avoid regeneration is not necessary. Examples of cover crops:- Mucuna, pueraria, centrosima, cow pea.

### 4.5 Other management practices

**Integrated nutrient management:** Instead of applying only poultry manure or mineral fertilizer these two materials can be combined. Plants normally perform better when these materials are combined. To be on the safer side advice can be sought from Soil Research Institute. Generally instead of applying 5.0 t/ha pm or 5 bags of 15-15-15 + 2 bags SA (MOFA recommendation) a farmer may instead apply 2.0 t/ha pm + 2 bags 15-15-15 + 1 bag SA.

**Intercropping:** Most crops can be intercropped with pigeon pea. Depending on the spacing of the major crop (maize, cassava, plantain etc) plant pigeon pea at 2 or 4 m. The crop grows
throughout the year and produces large amount of litter rich in plant nutrients. Intercropping with cow pea is another method of improving the soil.
5.0 CONCLUSIONS

1. The district is endowed with good soils for agricultural development. Coupled with favourable climatic conditions of the forest zone, a wide range of crops are grown. Agricultural development potential is high in terms of the production of,

- Tree crops – cocoa, oil palm, citrus, coconut
- Arable (food) crops – maize, plantain, cassava, cocoyam
- Vegetables – tomatoes, garden eggs, pepper, okro
- Forestry

2. About 96% of the soils are developed from granite except a small area to the north-east and south west where they are developed over sandstone and Lower Birimian phyllite respectively.

The topsoils are mainly sandy loams and so are susceptible to erosion. Erosion prevention measures are important in the cultivation of the soils. Practices such as cover cropping, mulching, avoidance of burning etc., to protect the topsoil are very useful.

3. The rocky hills in the southern part of the District around Buoho are economically beneficial. Quarries have been established on the rocky hills which provide rock chippings for road and building construction. It was also observed that residential buildings were expanding on the rocky unit. Recognizing the rocks as an economic venture that will be exploited far into the future the District administration should create a reasonable buffer zone that will permit easy exploitation and avoidance of potential conflict.
References


Appendix

1. **Soil series and Soil association**

The landscape consists of many individual soils which differ by the parent material from which they were formed and also by their physiographic position (summit, upper, middle and lower slopes and valley bottom). The individual soil is known as soil series. Soil series are defined as soils with similar profile morphology derived from similar parent materials under similar conditions of climate, vegetation, relief and drainage.

Where the soil series (individual soils) are combined into larger assemblages for mapping purposes they are known as soil associations. Thus, the soil map produced for this work is on soil association.

2. **Classification of the soils**

<table>
<thead>
<tr>
<th>World Reference Base (2006)</th>
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<tbody>
<tr>
<td>Boamang series</td>
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<tr>
<td>Bediesi series</td>
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<tr>
<td>Suko series</td>
</tr>
<tr>
<td>Sutawa series</td>
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<tr>
<td>Bomso series</td>
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<tr>
<td>Kumasi series</td>
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<tr>
<td>Asuansi series</td>
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<tr>
<td>Akroso series</td>
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<tr>
<td>Nta series</td>
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<tr>
<td>Ofin series</td>
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<tr>
<td>Nyanao series</td>
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<tr>
<td>Opimo series</td>
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<tr>
<td>Bekwai series</td>
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<tr>
<td>Nzima series</td>
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<tr>
<td>Kokofu series</td>
</tr>
</tbody>
</table>
Oda series  |  Haplic Gleysol (Eutric)
---|---
Yaya series  |  Lithic Leptosol
Pimpimso series  |  Hyperskeletic Leptosol

### Rated characteristics of the soil units

<table>
<thead>
<tr>
<th>Soil unit</th>
<th>Rooting Depth(cm)</th>
<th>Drainage (subsoil)</th>
<th>Texture (subsoil)</th>
<th>Gravel content</th>
<th>Soil Limitation</th>
<th>General Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boamang – Suko</td>
<td>80 – 120 (S1)</td>
<td>Well to moderately well (S1)</td>
<td>SCL, CL (S1)</td>
<td>NIL (S1)</td>
<td>NIL (S1)</td>
<td>S1</td>
</tr>
<tr>
<td>Kumasi – Asuansi</td>
<td>100 (S1)</td>
<td>Well to moderately well (S1)</td>
<td>SCL, CL (S1)</td>
<td>10 – 15% quartz &amp; ironstone (S2)</td>
<td>Gravelly subsoil</td>
<td>S2</td>
</tr>
<tr>
<td>Bomso – Asuansi</td>
<td>100 (S1)</td>
<td>Well to moderately well (S1)</td>
<td>SCL, CL (S1)</td>
<td>10 – 15% quartz &amp; ironstone (S2)</td>
<td>Gravelly subsoil</td>
<td>S2</td>
</tr>
<tr>
<td>Akroso</td>
<td>100 (S1)</td>
<td>Imperfect (S2)</td>
<td>SCL, CL (S1)</td>
<td>Very few (S1)</td>
<td>Drainage</td>
<td>S2</td>
</tr>
<tr>
<td>Nta-Ofin</td>
<td>20 – 40 (S3)</td>
<td>Imperfect to poor (S3)</td>
<td>SCL, LS, CS (S3)</td>
<td>NIL to very few (S1)</td>
<td>Drainage, texture</td>
<td>S3sw</td>
</tr>
<tr>
<td>Nyanao</td>
<td>&lt;20 (N2)</td>
<td>-</td>
<td>SL (S2)</td>
<td>Shallow depth</td>
<td>N2s</td>
<td></td>
</tr>
<tr>
<td>Opimo</td>
<td>&gt;100 (S1)</td>
<td>Well (S1)</td>
<td>SCL, CL (S1)</td>
<td>NIL (S1)</td>
<td>NIL</td>
<td>S1</td>
</tr>
<tr>
<td>Location</td>
<td>Depth Range</td>
<td>Condition</td>
<td>Soil Type</td>
<td>Other Description</td>
<td>Subsoil Type</td>
<td>Notes</td>
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<tr>
<td>Bekwai – Nzema</td>
<td>120 (S1)</td>
<td>Well to Moderately well (S1)</td>
<td>SiCL, SiC (S1)</td>
<td>10 – 15% quartz &amp; ironstone (S2)</td>
<td>Gravelly subsoil</td>
<td>S2s</td>
</tr>
<tr>
<td>Kokofu</td>
<td>80 – 100 (S1)</td>
<td>Imperfect (S2)</td>
<td>CL (S1)</td>
<td>NIL (S1)</td>
<td>Drainage</td>
<td>S2w</td>
</tr>
<tr>
<td>Oda – Temang</td>
<td>100 (S1)</td>
<td>Poor (S3)</td>
<td>CL, SL/LS (S2)</td>
<td>NIL (S1)</td>
<td>drainage</td>
<td>S3w</td>
</tr>
<tr>
<td>Bediesi – Sutawa</td>
<td>100+ (S1)</td>
<td>Well to Moderately well (S1)</td>
<td>SCL, CL (S1)</td>
<td>NIL (S1)</td>
<td>NIL</td>
<td>S1</td>
</tr>
<tr>
<td>Yaya - Pimpimso</td>
<td>10 – 30 S3 / N2</td>
<td>SL, LS (S3)</td>
<td>10 – 25% rock brash (S3)</td>
<td>Shallow depth; gravelly subsoil</td>
<td>S3/N2</td>
<td></td>
</tr>
</tbody>
</table>