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Bay Region Agricultural Development Project

Volume 2
Technical Appendices

August 1982

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Bay Region Agricultural Development Project

Volume 2
Technical Appendices

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A.1 INTRODUCTION

The interpretation of aerial photographs or satellite imagery proves extremely beneficial in the appreciation of broad distributions of existing land resources. With the availability of computer analysis techniques which make use of the Computer Compatible Tapes (CCT's) much more sophisticated analyses can be performed. These analyses can be used to produce enhanced and enlarged precision photographic products that have considerable value for natural resource mapping.

A.2 LANDSAT SYSTEM AND PRODUCTS

The first of a series of three LANDSAT satellites so far launched by the National Aeronautics and Space Administration (NASA) of the United States began to acquire imagery in 1972. Each satellite was established in an orbit that was intended to provide repeated coverage of each point on the Earth's surface every 18 days. However, the occurence of thick cloud banks and haze often prevents the LANDSAT sensors from obtaining images. Also relatively minor technical faults have occasionally developed and these have caused NASA to shut down the satellites temporarily. As a result, 18-day repeated coverage is rarely available for any given area. Within the Bay Region only a few scenes are of acceptable quality for analysis and the most recent of these was acquired in 1976.

Each satellite is equipped with two sensors. These are the Multi-Spectral Scanner and Return Beam Vidicon camera.

The LANDSAT Multi-Spectral Scanner (MSS) records the intensity of reflected light (brightness value) in each of four spectral bands for an array of adjacent areas known as ground resolution cells. Each of these cells is equivalent to the instantaneous field of view of the sensor and measures 80 metres x 80 metres. The brightness value for each cell is an average reflectance for all the features of that cell and so the resolution of LANDSAT MSS is 80 metres x 80 metres. Features smaller than the resolution cell only appear on the image if their reflectance is sufficiently different from the surrounding area to influence the brightness value of the whole cell. In certain circumstances, therefore, a narrow road or canal can be seen on the imagery.

These resolution cells overlap and so the effective area covered by each cell is 57 metres x 79 metres, about half of one hectare. Each complete LANDSAT scene is composed of 3 240 of these cells (known as pixels) along each of 2 340 scan lines and so covers an area of approximately 185 km x 185 km.

The four spectral bands have the following characteristics:

Band	Wavelength (μm)	Reflected Colour	Colour used for projection/display
4	0.5 to 0.6	Green	Blue
5	0.6 to 0.7	Red	Green
6	0.7 to 0.8	Photo Infra-red	Red
7	0.8 to 0.11	Photo Infra-red	Red

The brightness values for three of the spectral bands (Bands 4, 5 and 6) are recorded in 128 levels and those for Band 7 are recorded in 64 levels. Usually the Band 7 values are multiplied by two, before the data are distributed to users, to give a consistent brightness scale in all four bands. By combining images from three of these bands a coloured image can be produced.

The Return Beam Vidicon Camera records the intensity of reflected light in one band; it is essentially a TV camera. This sensor has a ground resolution cell of 40 m x 40 m and so is able to record a greater amount of detail than the MSS sensor. As there is one band it can only be viewed as a black and white image unless some type of density slicing technique is used to produce a colour image.

These sensors produce imagery that is available either in the form of precision photographic products or as digital data on Computer Compatible Tapes (CCT's). These products can be purchased from the Eros Data Centre (EDC) in the USA or from other establishments in Europe and elsewhere that have been appointed as official LANDSAT receiving stations.

In the early years of the LANDSAT programme information from the sensors was recorded on the satellite and transmitted down to receiving stations in the USA when the satellite was within range of the ground based receiving aerials. More recently, the failure of these on board recorders has meant that receiving stations in other parts of the world have been essential for providing up-to-date imagery of areas outside the range of the US based stations. The failure of recorders explains why there are several years for which no LANDSAT cover is available.

Photographic products in the form of 70 mm 'chips' at approx. 1:3.3 million scale can be analysed on a colour additive viewer. Such a machine is used to illuminate chips from three of the MSS bands with red, green and blue light to produce a false colour composite image at 1:500 000 scale on a ground-glass screen. Hunting Technical Services Limited have a 1^2S Mini-Adcol viewer and have made considerable use of 1:500 000 scale colour composites for reconnaissance mapping.

Other photographic products commonly available are 1:1 million scale positive transparencies. These can be photographically enlarged as either black and white single band images or false-colour composite images. The effective limit of photographic enlargement from these products is 1:250 000 scale.

The disadvantage of these photographic products is that the film is not as sensitive as the LANDSAT sensors and so the data are degraded when recorded on film. Using a computer-based digital image processing system allows the full range of recorded LANDSAT data to be analysed.

The data recorded on a LANDSAT Computer Compatible Tape (CCT) are brightness values for each of the bands for each resolution cell. These data can be displayed as an image on the TV monitor screen of an interactive image processor such as the Hunting Image Processor and Analysis System (HIPAS) described in Section A.3.

Images displayed on HIPAS can be enhanced and successfully enlarged up to 1:50 000 scale. Photographic images enlarged to this scale loose most of their interpretable information.

A.3 THE HUNTING IMAGE PROCESSOR AND ANALYSIS SYSTEM

A.3.1 Description of the system

The Hunting Image Processor and Analysis System (HIPAS) has been fully operational since May 1980. HIPAS is based upon the Stanford Technology Corporation/International Imaging System (1^2S) System 101 Interactive Image Processor. It consists of an 1^2S Model 70 image processor, with six channels of refresh memory, which is driven by a Hewlett-Packard HP 3000 host computer. The digital image data are transferred from Computer Compatible Tapes (CCT's) to the bulk image store, from which they can be displayed as an image on a high-grade colour TV monitor. The interpreter operates the system by typing commands on a standard computer terminal and there is an additional control box for carrying out interactive (i.e. operator controlled) enhancement of the image.

The HIPAS TV monitor is capable of displaying up to 256 brightness levels in each band for each pixel and so LANDSAT CCT data are usually multiplied by two by the image processor before display in order to make full use of this capacity.

The various image processing programs available on HIPAS perform calculations using the brightness values for individual pixels. Any type of remotely sensed imagery that has the same format as LANDSAT, i.e. composed from recorded brightness levels for discrete pixels, can be displayed on the TV monitor and manipulated using the programs available on HIPAS.

With the addition of a TV camera it is possible to scan photographic imagery (e.g. standard aerial photographs) and topographic maps and display these on the HIPAS monitor. This is particularly useful for comparing information from different dates, so that, for example, progressive erosion, logging in forests and agricultural development can be monitored.

A.3.2 Image Enhancement

Once a CCT has been read into the HIPAS bulk image store there are two principal routes by which the data can be analysed. The first route is image enhancement. The standard LANDSAT photographic products, which have been used for natural resource mapping for several years, do not display all the information that was originally collected by the sensors because photographic film is not as sensitive as the information-gathering instrument. Thus the 128 brightness values in each band of the LANDSAT data have not previously been used to their full potential. When the CCT data are displayed on the TV monitor screen the image is composed from a complete range of brightness values, whereas on a photographic film only about 20 levels can be recorded. In addition the HIPAS image does not have any of the blurring of photographic images, which is associated with the grain size of the film used. This permits successful enlargement to 1:50 000 scale.

By assigning the data from MSS Bands 7, 5 and 4 respectively to the red, green and blue guns of the colour TV monitor, a standard false colour composite image is displayed on the screen. This image can then be enhanced on the monitor screen using programs from the System 101 software. For example, if there are any irregularities in the data, such as a faulty scan line, these can be filtered out. The scene can be magnified or the tonal contrasts between different units stretched. The effect of using these display functions is to highlight features so that the interpreter is able to identify patterns on the image that may not have been visible prior to enhancement.

The image can also be enhanced by processing the digital data in the Central Processor Unit (CPU) of the host computer. A number of statistical transformations can be applied to all the available data (i.e. four MSS bands) so that the differentiation of features can be further improved. Also the data can be corrected to fit a given map projection. This is achieved by creating new pixels of a specified size through re-allocation of the data from neighbouring pixels. These more complex operations require considerable processing time on the host computer and are usually only carried out if a precision hard copy product is required to be matched to existing topographic map sheets.

To produce precision hard copy (photographic) products a magnetic tape of the enhanced image is produced. This CCT is then reproduced as a hard copy using a precision film-writer such as the Optronics Colorwrite or Linoscan 204D. These products are accurate to a specified scale and closely reproduce the enhancements that have been made using HIPAS.

A.3.3 Information Extraction

The second principal analysis route is information extraction . In this route the digital data from the CCT are anlysed using the host computer. The primary interest is not the visual appearance of the image but the statistical information content of the tape.

The supervised spectral classification is an example of information extraction. To carry out such a classification the interpreter first chooses a training area by outlining pixels of interest on the HIPAS monitor screen. One of several HIPAS classification programs is then used to record the pixel values (for each band) in that area. These data then form a training set which is compared with the rest of the image and all the pixels that are statistically similar to the training set are identified as one class or level. A number of different training sets each corresponding with, for example, a particular land use type or geomorphological class, can be selected and used for classifying a LANDSAT scene into several levels. These classes can then be displayed together on the TV monitor each with a different colour. The host computer also produces a print-out of the area of each class in a spectral classification.

A classified image can be used, together with the original image to produce a thematic map of the area being investigated. Usually some time must be spent in ground checking such LANDSAT interpretations; seldom is a spectral classification on its own sufficient basis for completion of an accurate map. Anomalous spectral signatures of some land cover types may only be explained after field checking.

A.4 ANALYSIS OF THE BAY REGION LANDSAT MSS DATA

A.4.1 Outline of the study

The analysis of LANDSAT MSS data using HIPAS had two objectives. Firstly the data were to be enhanced and geometrically corrected so as to produce mosaics at 1:250 000 scale for use as an image base for thematic mapping.

The second objective was to examine, in detail, imagery covering a number of study areas and to carry out spectral classifications in particular areas of interest. The results of these studies were displayed on the HIPAS TV monitor and photographed. Several examples of this more detailed work are illustrated in this Appendix.

Both the mosaics and the photographs of detailed areas were supplied to the field teams so that ground verification of the results of image analysis could be carried out.

A.4.2 Imagery Used.

The LANDSAT Multi-spectral Scanner data from four scenes was required for complete coverage of the region. The latest available Computer Compatible Tapes of MSS imagery are as follows:

(a) North west quadrant:- Path 177 Row 058, acquired 14th February 1973.

(b) North east quadrant:- Path 176 Row 058, acquired 26th January 1973.

(c) South west quadrant:- Path 177 Row 059, acquired 21st January 1976.

(d) South east quadrant:- Path 176 Row 059, acquired 7th February 1976.

A.4.3 Construction of 1:250 000 Mosaics of the Bay Region

The 1:250 000 scale mosaics produced for the Bay Region Project were produced from LANDSAT MSS data that had been enhanced and corrected using several HIPAS processing options. On many LANDSAT images, and most particularly on Band 7, the average pixel intensity value of every sixth line is different from its neighbours; this feature is independent of ground conditions and is caused by a fault in the sensing device. The DESTRIPE program smooths these regular tonal peaks so that they fit uniformly into the pattern of surrounding brightness values. The destriping of a full LANDSAT scene takes approximately 10 hours of computing on HIPAS and is usually run overnight.

The program called EDIT has been used to replace rogue scan lines or individual pixels, which can appear as randomly scattered and very brightly coloured spots on the image, with new pixel values that are calculated from the mean intensity of a surrounding window of normal pixels from the image. The replacement pixels, being mean values, can usually be picked out on the corrected image after careful scrutiny as they have rather bland tones; but the visual effects of the faulty data have been suppressed.

In order to fit the images to the existing 1:250 000 scale maps drawn on the UTM map projection is is necessary to use the WARP program. The first stage of this process is to select points of detail on both the LANDSAT image and the map. The coordinates of each point are then recorded; the image coordinates are in terms of samples and lines from the top left hand corner and the map coordinates are based on the UTM grid.

The pixel size of the warped LANDSAT image is then specified; in this case an 80 m x 80 m pixel was chosen because the final mosaiced image would be quite large and this size offered the best compromise between image quality and computing time.

In this WARP program the original LANDSAT image is geometrically altered to fit the map coordinates and rotated to be aligned to true north.

The brightness value for each pixel, in each band lies somewhere between levels 0 and 255 on the HIPAS monitor. On most scenes the values are concentrated towards the darker end of the range and there is usually a sharp peak of values indicating most pixel brightness values occur over quite a small range. A contrast enhancement technique alters the distribution of the brightness values so that the visual appearance of the image is improved.

In producing the Bay Region mosaics the brightness values of each MSS band were stretched independently. Within each band the brightness was enhanced by the operator to show the maximum amount of detail in both the darkest and brightest areas of the original image. At the same time the differences between brightness values that occur at the peak of the original distribution were increased.

Once the data had been corrected and enhanced the images could be digitally mosaiced using HIPAS. As a result of the different acquisition dates of the four images, and the corresponding tonal differences between images, it was not possible to produce a single mosaic of the four scenes that had an acceptable colour balance suitable for interpretation. The mosaics were therefore constructed from pairs of images: the north west and north east quadrants (1973 imagery) formed one mosaic and the south west and south east quadrants (1976 imagery) formed the other. There is a small area in the central eastern part of the area under study that is not covered by any of the available imagery.

The completed mosaics were recorded on to new magnetic tapes. These enhanced image tapes were then processed using a precision film-writing instrument to convert the digital tape data into a photographic image. A separate piece of film was exposed for each of the LANDSAT MSS bands. These were subsequently combined into a colour negative. From this negative the final mosaics were photographically reproduced as standard false colour composite images at 1:250 000 scale. The sections of imagery extending beyond the Bay Region were excluded from the final mosaics.

A.4.4 Detailed analysis of specific study areas

Once the LANDSAT MSS data had been enhanced and corrected detailed analysis could be carried out in selected areas. By displaying an image that contains 512 samples in each of 512 lines on the HIPAS TV monitor, a scene equivalent to 41 km x 41 km on the ground can be viewed. At this stage it is possible to apply a specific local contrast stretch to a sample area which may reveal important features that are obscure when the whole image is viewed. This locally enhanced imagery can also be used as the basis for spectral classification.

Imagery enhanced in this way can be successfully enlarged to 1:50 000 scale either by making a precision photographic image, adopting the same procedure as used to produce the 1:250 000 scale mosaics, or by photographing the monitor screen and making photographic prints of the results. This second method is less accurate but the results are usually of sufficient quality for interpretation. The photographs included as Plates 1-7 in this Appendix were reproduced from monitor screen photographs but for convenience of presentation they have been printed at scales smaller than 1:50 000.

Using the enhanced imagery spectal classifications in the main areas of interest could be carried out. In a composite 3-band LANDSAT image the resultant tones are produced from the combination of the brightness values of the pixels in each hand. The composite tone is called the spectral response of the feature on the ground. Information extraction using HIPAS involves the classification of spectral responses into a few broad units which can then be displayed, in colour, on the TV monitor.

The classification procedure requires the following stages:

(a) Definition of training areas:
Using a cursor on the TV monitor screen, the interpreter draws a line around a small region with a particular spectral response. The procedure is repeated until 2 or 3 regions have been defined for each of the principal spectral responses. These regions are class training areas for use in Stage (b).

(b) Calculation of statistics:
A set of reference statistics for each training area are then calculated. These statistics are based on the brightness values found in the training area (for each band separately).

(c) Classification process:
One of several classification programs available on HIPAS can then be used to assign individual pixels to classes. The pixels are assigned to a class where their brightness values are the same or similar to one set of reference statistics. This assignment to classes is dependent upon probabilities; the acceptable limits of probability can be specified by the interpreter. Pixels that are outside the range of probabilities for the reference statistics of each training set are excluded from the classification.

(d) Display of results:
The results of a classification appear as a grey tone image on the TV monitor screen. One grey tone value represents one class level. Thus a 7-level classification would have seven different grey tones. These classes can also be displayed in colours specified by the interpreter. Individual classes can also be superimposed in colour on the original scene. The unclassified pixels appear as black when the classification is displayed.

(e) Calculation of areas:
Several different classifications, based on different training set data can be tested on each image. Once the interpreter is satisfied that the most appropriate spectral classification has been worked out the ground area covered by each of the classes is calculated.

The results of spectral classification should, in most cases, be treated as an aid to interpretation rather than a definitive land use map. A particular spectral response may sometimes represent several land cover types that appear the same on the imagery but have very different forms on the ground. Spectral classifications must be checked against alternative sources of information in the form of existing maps or through ground checking. In the case of the Bay Region Study it was possible to carry out field work to check the LANDSAT analysis, so that some idea of the accuracy of classification was obtained.

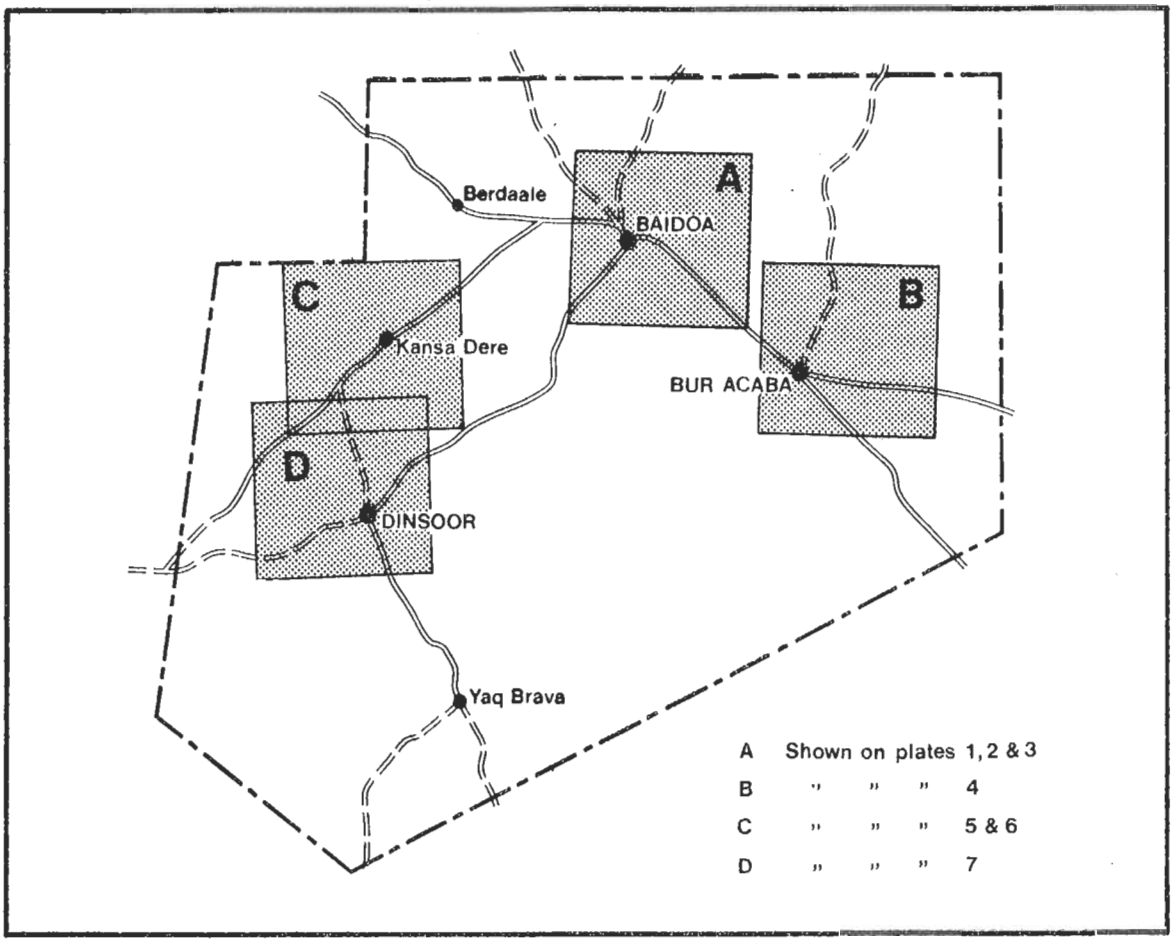
A.5 RESULTS OF DETAILED ANALYSES

Four sample areas were examined during the detailed analyses. The results of enhancement and spectral classification are discussed and illustrated in this section. The locations of the four detailed study areas are given in Figure A.1.

A.5.1 Baidoa Area

A photograph of a 41 x 41 km image centred on Baidoa is shown in Plate 1. The contrast stretch employed on this sub-scene enabled maximisation of the differences between tonal units in the Baidoa area. If this stretch had been applied to the whole LANDSAT scene it would not necessarily have improved interpretability or revealed significant differences. Applying a contrast stretch within a well defined local area is often more successful for interpretation purposes.

A.1 HIPAS Landsat analysis: Location of detailed study areas



In this particular example the objectives were to discriminate between cultivated and non-cultivated land within the predominantly cultivable Baidoa soils north and south of the escarpment in the proposed irrigation area.

Given the limitations of the scale of the imagery as presented in Plate 1, local contrast enhancement has made possible the separation of several small land units within the area north and northwest of the escarpment. The bedding of the Baidoa suite karstic limestone along the escarpment shows up very clearly.

South and southeast of the escarpment, the most pronounced feature on the 1:250 000 mosaics is the strong red response characterising all the main streams which drain the foot of the escarpment. These red responses are not so clear on the locally enhanced image in Plate 1; this illustrates how enhancement can have a significant effect on the appearance of the image and how contrast stretching can both highlight and obscure certain features. Areas of limestone rocks capping the low ridges south and southeast of Baidoa have a clearly defined brownish signature. The clay soils in the convex or depressional plains have a characteristic even textured appearance on the imagery. Highly degraded soils with sparse vegetation cover, either on limestone or on basement complex rocks, have a clearly distinguishable white appearance.

Separate enlargements and classifications have been carried out on imagery covering the Togga Shiikh Asharow Valley where detailed soil investigations were conducted. The

16 times enlargement of the irrigated area south of Baidoa shown in Plate 2 covers part of the area shown in Plate 1. A simple classification of this enlargement was carried out in an attempt to discriminate between spectral responses within the irrigation areas. Some areas have been colour coded brown on Plate 2. On the original 1:250 000 scale mosaic these areas had the brightest shades of red, due to strong reflection in the near infra red waveband. These areas are healthy growing vegetation. Non-irrigated areas are coded dark blue, light blue and white on Plate 2 with unclassified pixels shown in black. The area of degraded vegetation immediately south of the town of Baidoa shows up clearly and has been coded dark blue in this photograph. Areas of less disturbed ground cover have been displayed in light blue. Fallow land located within the irrigated area was displayed in green on the HIPAS TV monitor. Unfortunately colour reproduction on this photograph has obscured the difference between light blue and green, but the difference is clear on Slide H2 which is presented in Volume 3 of this Report. The yellow class corresponds with the non-irrigated and often water short areas that are potentially irrigable.

Plate 3 shows a 4 times enlargement and classification of a section from Plate 1, covering the Asharow valley. The classification has successfully picked out the ridges of shallower soils in the east of the valley. However, this classification has a much stronger correlation with vegetation than with soils. The classification shows clearly the areas of sparse and degraded vegetation used extensively for fuelwood extraction; this area includes the deeper Uiamo soils in the north. The alluvial soils in the valley bottom (Asharow series) have been colour coded in shades of blue and green. This has not been entirely successful as there are areas of shallow soils over basement complex, in the west of the image, with the same colour codes.

A.5.2 Bur Heybo Area

Field observations around the Bur Heybo region indicated that although a large area had been identified in the Lockwood Survey as Bur Acaba soils, and included in the aerial census as Stratum 10, a number of significant separations could be made within this unit. These included: the grey clay soils found in the northern part of the region; the soils east of Mood Mooda with a very high stone content at the surface; and, between Bur Acaba and Bur Dhijis, the extensive ridges of brown clay soils of shallow depth with frequent quartz pegmatite outcrops. These ridges occur most extensively in the area north of Wafdhey Weyn.

On the image shown in Plate 4 the boundary between the basement complex strata and the clay plains is sharp and well defined. The deeper clay soils have a strong red signature. The irregular texture on the imagery covering the area to the east of Togga Urugey reflects the irregular topography of the area of shallower clay soils. Areas of sparse vegetation and erosion have a very white appearance on Plate 4. The Togga Urugey has a broad very sandy bed with little vegetation cover; in contrast the two drainage lines to the east of it have a much redder signature, especially the Togga Gurgurta, showing the occurrence of denser vegetation cover.

A.5.3 Kansa Dere area

This full resolution image (Plate 5) has been enhanced in order to discriminate more effectively between the clay soils of the less resistant Jurassic rocks and the intervening pavement areas. In this particular region the clays occur in a number of separate, but linked, areas. These areas have very sharply defined boundaries with the surrounding pavements; often separated by low cuestas.

Areas of shallow bouldery clay soils can be detected north of the village of Kansa Dere. Very dark signatures correspond closely with limestone pavements associated with a thick surface cover of ironstone pebbles. The escarpment at Malmalka above the Dalmelly valley is very well defined because of its sparse vegetation cover and the corresponding low near infra red responses.

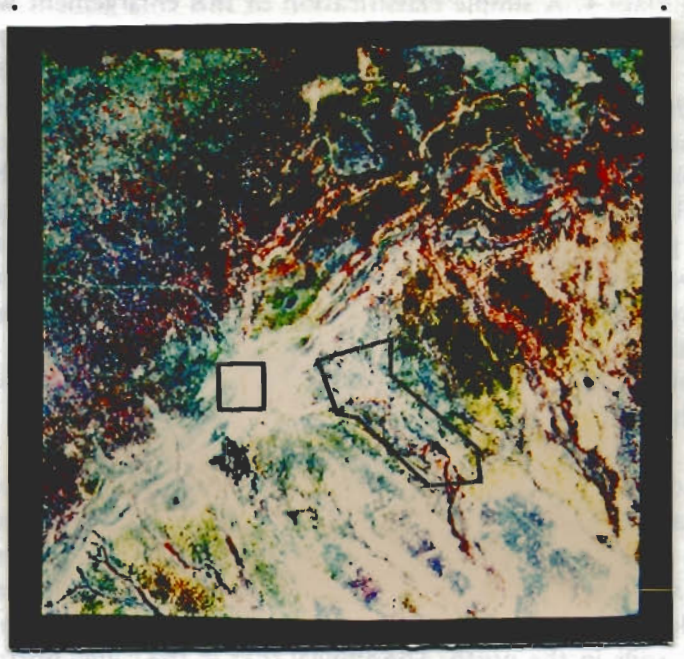


PLATE 1 Baidoa area: a 41 km x 41 km section of LANDSAT imagery displayed with local contrast enhancement.

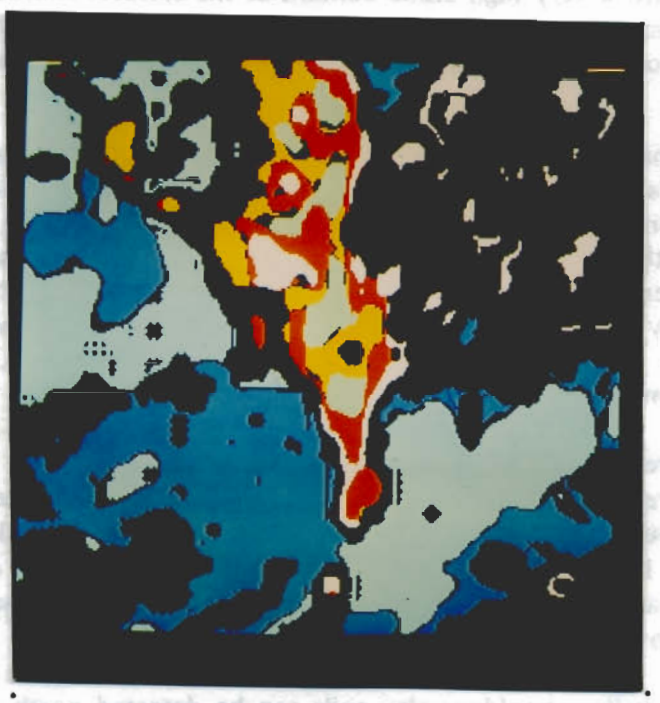


PLATE 2 Baidoa area: classification of the irrigated area south of Baidoa (area of image is approximately 2.6 x 2.6 km).

Plate 3 Baidoa area: classified image of the Asharow valley area.

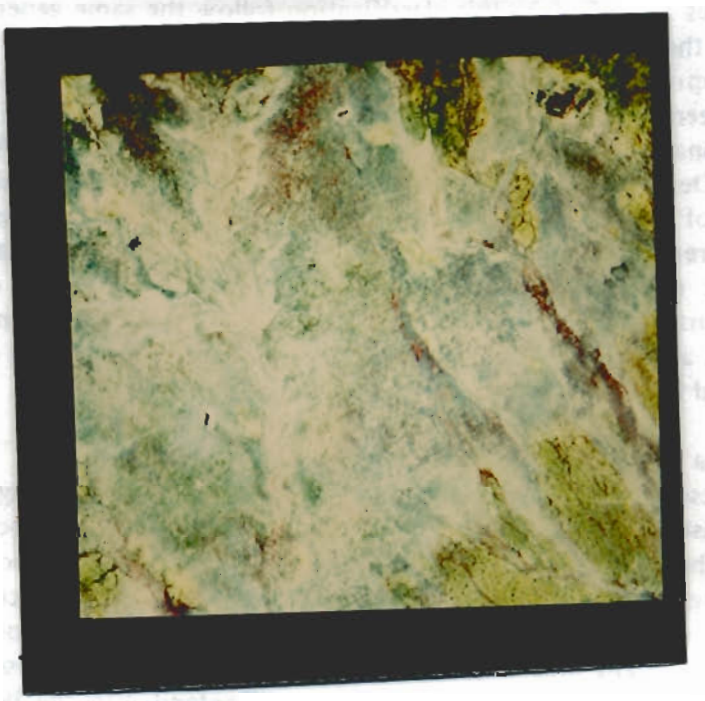


Plate 4 BurHeybo area: a 41 km x 41 km section of LANDSAT imagery displayed with local contrast enhancement.

The image shown in Plate 5 was classified using the method described in Section A 4.4. In this classification, illustrated in Plate 6, 12 levels of spectral response were identified. These are outlined in Table A.1. The class names used were taken from the reconnaissance and semi-detailed soil survey carried out in this area.

TABLE A.1 COVERAGE BY CLASS TYPE IN KANSA DERE AREA

Class Number	Hectares	Cover Per Cent	Class Name	Colour on Plate 6
0	1969	1.2	Reject Class	Black
1	26351	15.7	Amin 1	Green
2	15315	9.1	Amin 2	Green
3	6931	4.1	Uiamo 1	Blue
4	20704	12.3	Uiamo 1	Orange
5	23691	14.1	Baidoa	Brown
6	2180	1.3	Concretions 1	White
7	13251	7.9	Concretions 2	Yellow
8	21425	12.8	Regosol 1	Khaki
9	22206	13.2	Regosol 2	Purple
10	685	.4	Regosol 3	Purple
11	12917	7.7	Regosol 4	Purple
12	237	1	Vegetation	Beige

Total area of sub scene 512 samples by 512 lines, where each pixel is equivalent to 80 m x 80 m is 167 772 hectares.

The features identified in this classification follow the same general pattern to that discriminated on the original 1:250 000 scale imagery but the definition of the Amin clay soils has been improved, particularly in the southern part of the image. There is a strong correlation between the classes coloured yellow and white on Plate 6 and the areas of shallow concretionary soils. There is significantly more variation in the Amin classes to the north of Kansa Dere. It is likely that this is due to the variations in signature produced from clay soils of different depths and degrees of stoniness. This classification has also successfully differentiated the Uiamo clay soils in the southeast of the image. Unfortunately the photographic reproduction on Plate 6 has obscurred some of the colour differences that were apparent when colours were assigned to classes on the TV monitor screen. In particular orange and khaki, and white and beige cannot be separated on this print. The slide H6 presented in Volume 4 gives a definitive colour representation.

A.5.4 Dinsor Area

This full resolution image of Dinsor has, like the Kansa Dere image, been subject to both local contrast enhancement and spectral classification using the procedure described in Section A.4.4. The particular contrast stretch used has strongly enhanced the appearance of the underlying geological structures, which have a strong influence on the soils and topography, north of Dinsor. On Plate 7 there is a clearly defined boundary to the clay soils on the less resistant limestone strata to the north of Dinsor. Also the wadis which drain the basement complex can be clearly seen to extend into the limestone area. This pattern was observed in the field as a series of hollows containing impermeable fine textured soils. The northwest corner of the image shows bands of darker coloured land which correspond with clay soils.

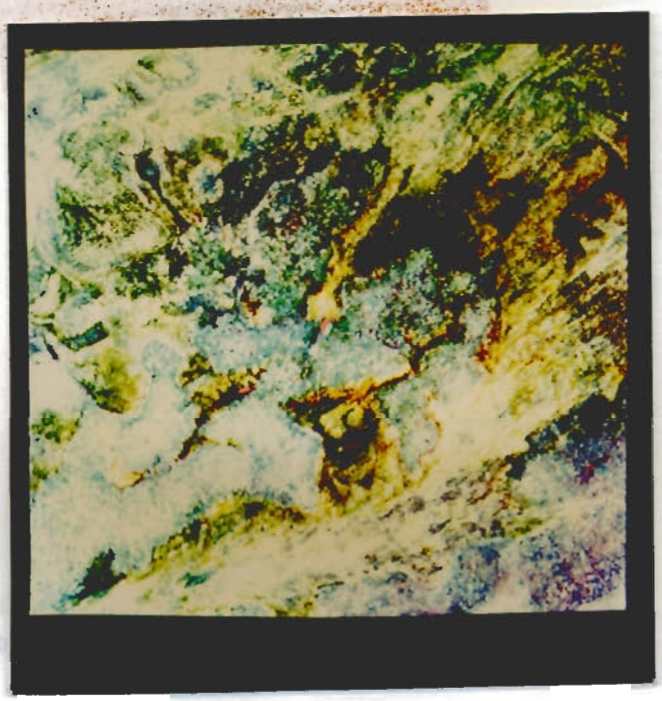


Plate 5 Kansa Dere area: a 41 km x 41 km section of LANDSAT imagery displayed with local contrast enhancement.

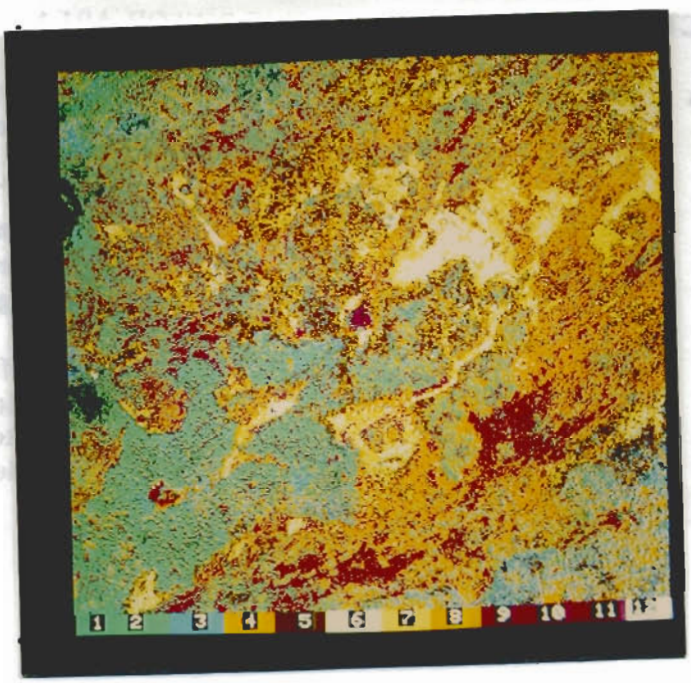


Plate 6 Kansa Dere area: spectral classification of the area shown in Plate 5. For legend see Table A.1.

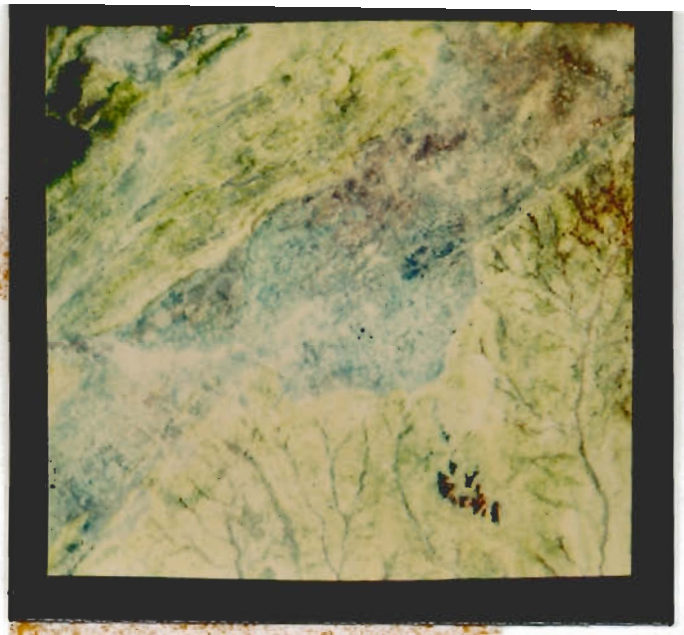


Plate 7 Dinsor area: a 41 km x 41 km section of LANDSAT imagery displayed with local contrast enhancement.

The areas on either side of the escarpment have broadly the same colours on the 1:250 000 scale mosaics. However detailed colour differences such as those associated with riverine vegetation, highlight sufficient differences in geological structure and drainage patterns for the two areas to be mapped as separateunits. A spectral classification was carried out on this image and a summary of the results is presented in Table A.2.

TABLE A.2 SPECTRAL CLASSIFICATION IN THE DINSOR AREA

Unit	Hectares	Cover per cent	Appearance on original 1:250-000 Mosaic	Identification by Field Observation
A	35 716	21.3	grey/pale blue	Clay plain
B	55 409	33.0	green/yellow	Shallow rangeland soils
C	49 398	29.4	pale red	Sparse vegetation (includes ratoon sorghum)
D	1 092	0.7	dark blue/black	Clay soils
E	2 829	1.7	white	Not identified
F	2 894	1.7	bright red (on hills)	Granodiorite burs
G	18 540	11.1	red/brown	Valley bottoms in Dinsor soils and depressions in limestone
Reject	1 894	1.1		
	167 772	100.0		

There appears to be some broad correlation between the areas of classes shown in Table A.2 and the soil types mapped after the soil survey measurements. On the final soil map the area equivalent to that shown in Plate 7 is divided between Uiamo soils (34 per cent), Dinsor soils (40 per cent), Amin soils (3 per cent) and regosols/concretions (23 per cent).

Vegetation, according to the LANDSAT spectral classification, covers approximately 31 per cent of the land area. If one assumes that some vegetation occurs in all the main mapping units, although the density will be locally variable, then the remaining area is divided between clay soils (22 per cent) and shallow and rocky soils (45 per cent) in the ratio 2:1. This is roughly the same ratio as that of Uiamo clay soils and all the other rangeland and very poor soils shown on the map. However it was not possible to separate Dinsor range soils from the regosols/concretions on the basis of spectral signature alone.

APPENDIX B

LABORATORY METHODS

B.1 SOIL PROFILE DESCRIPTIONS AND LABORATORY DATA

B.1.1 Methods of Laboratory Analysis

Analyses of soil samples were performed at Resource International Laboratories Limited in the United Kingdom. The methods of analysis used are descibed briefly in this appendix; these derive from the USDA Handbook 60 (USDA, 1954) and the FAO Soils Bulletin 10 (FAO, 1970).

B.1.2 Sample Preparation

Each soil sample was air-dried and sieved to pass a 2 mm screen before being despatched to the laboratory. This fine earth fraction was used in subsequent analysis. No particles coarser than 2 mm were recorded. A sub-sample of the fine earth fraction of each surface horizon was ground in a mechanical mortar to pass on 80 mesh sieve for use in determinations of carbon, nitrogen and phosphorus.

B.1.3 Particle Size Analysis

A sample of 40 g of soil was dispersed by shaking overnight with sodium hexametaphosphate and water. The suspension was then transferred to a 1.1 cylinder, made up to volume and stirred. A Bouyoucos hydrometer, calibrated in g of soil/1 was used to take readings of the density of the soil suspension at the following settling times:

(a) 46 s to give coarse silt + clay content.

(b) 4 min 48 s to give silt + clay content.

(c) 6.5 h to give clay content.

The density readings were corrected for temperature variations and dispersing agent content. The soil suspension was then washed through an 80 mesh (0.2 mm) sieve and the coarse sand weighed after drying.

B.1.4 Electrical Conductivity of Saturation Extract

Distilled water was added to the soil until the saturation point was reached. The saturated soil paste was then extracted using suction, to obtain a saturation extract. The electical conductivity of this extract was then measured and the results expressed in mmhos/cm as the electrical conductivity of the saturation extract (EC_e).

B.1.5 pH Determination

A glass electrode was used for the determination of the pH of a 1:2.5 soil-water suspension.

2 ml of one-eigth molar calcium chloride was added to the suspension to bring the effective concentration to M/100.

The suspension was restirred, equilibrated for 1h and the pH read again.

B.1.6 Cation Exchange Capacity - Bascombe's Method

Two grams of soil were shaken twice with triethanolamine-buffered barium chloride solution (pH 8.2), in order to replace all exchangeable cations with barium. Excess barium was removed by shaking with water. The sample was then shaken with a solution of magnesium sulphate of known concentration. This replaced the exchangeable barium by magnesium, at the same time removing barium from solution by precipitating barium sulphate. Magnesium remaining in solution was determined by titration. The cation exchange capacity is derived from the difference between the amount of magnesium added and the amount remaining in solution.

B.1.7 Exchangeable Bases

Four grams were extracted by shaking with 20 ml of N-ammonium acetate solution, buffered at pH 7.0. Calcium and magnesium were determined by atomic absorption spectroscopy using strontium chloride as a releasing agent to overcome interference by aluminium or phosphate. Sodium and potassium were also determined using atomic absorption methods, utilising strontium chloride as an ionization buffer. The exchangeable cation values were corrected to allow for soluble salts.

B.1.8 Soluble Cations in Saturation Extract

Soluble calcium, magnesium, sodium and potassium were measured in the saturation extract utilising atomic absorption techniques in the presence of strontium chloride.

B.1.9 Soluble Anions in Saturation Extract

(a) Carbonate and Bicarbonate

A portion was titrated against dilute hydrochloric acid using phenophthalein as indicator. When the pink colour had been discharged the amount of acid was measured, methyl orange indicator added and the titration continued to the end point.

(b) Chloride

Chloride was measured using an EEL chloride meter, which automatically titrates the chloride against silver ions.

(c) Sulphate

The sulphate was precipitated as barium sulphate in the presence of a stabilised gel. The opaque suspension was then measured using a nephelometer.

B.1.10 Gypsum

Calcium was determined in saturation extract and also in a 1:5 soil/water extract. Knowing the saturation percentage of the soil, the increased solubility of calcium in the 1:5 extract was used to calculate gypsum content.

B.1.11 Cation Exchange Capacity

Calculated by summation of values for all exchangeable cations.

B.1.12 Total Carbonate

A weighed sub-sample of soil is mixed with dilute hydrochloric acid and the volume of gas evolved in the reaction is measured by calcimeter. The per cent total carbonate is obtained by calculation.

B.1.13 Moisture Retention Characteristics

Undisturbed soil cores 50 mm in diameter were collected in the field using a special sampling device. The dry weight of the undisturbed soil in the core was determined and the bulk density calculated. The cores were saturated with water and their moisture content measured. They were then placed on the porous plate apparatus and subjected to a suction of 7.6 cm of mercury (0.1 bar). When the moist sample reached equilibrium with the suction and water ceased to flow from the chamber, the sample was removed and weighed to determine the moisture content. The determination was repeated at suctions of 25.4 cm of mercury (0.3 bar) and 76 cm of mercury (1.0 bar). The samples were then transferred to the high pressure chamber (pressure plate) and the soil moisture content determined when in equilibrium with a suction of 15 bar.

B.1.14 Bulk Density

The weight of dry soil in the core was determined and the bulk density calculated.

B.2 SOIL PROFILE PITS AND ANALYSIS

A total of 19 pits were sampled by natural horizons for physical and chemical analyses.

Ten of these pits were sited in the areas investigated for irrigation development, classified as follows:

Profile No.	Classification
T119	Asharow
T197	Asharow
T199	Asharow
T253	Asharow
T254	Modu Mode
T101	Bur Acaba
T255	Bur Acaba
T136	Uiamo
T196	Uiamo
T198	Uiamo

A further 9 pits were examined in the P.A.D.U sample areas as follows:

S117	Uiamo
DS01	Uiamo
DS27	Uiamo
T283	Baidoa
QS24	Berdaale
T233	Berdaale
FS34	Valley Bottom
FS35	Issur
QS10	Amin

Profile No. T119	**Series Asharow**
Location	1.5 km south east Baidoa in Asharow Valley NA 38-28 522419
Geomorphic Unit	Valley bottom
Parent Material	Alluvium
Topography	Nearly flat valley floor
Microrelief	Smooth even
Vegetation	Abandoned irrigation area
Drainage	Well
Remarks	A well drained brown sandy clay loam soil over calcareous alluvial gravels

Depth (cm)	**Profile Description**
0-26	Dark brown to brown (7.5YR 4/4) sandy clay loam, moderate medium to fine subangular blocky structure breaking to fine crumb; dry slightly hard; common fine tubular pores; few large interstitial pores; abundant fine, few medium roots; few whitish carbonates; few large faunal chambers. Gradual smooth boundary to:
26-54	dark brown to brown (7.5YR 4/4) sandy clay loam; strong fine prismatic breaking to fine subangular blocky structure; dry slightly hard; abundant fine pores; abundant fine, few medium roots; few faunal chambers; common fine white powdery carbonates along old cracks or faunal chambers; few quartz grits and shell fragments. Gradual smooth boundary to:
54-95	dark brown to brown (7.5YR 4/4) sandy clay loam; strong medium prismatic structure; dry slightly hard; common fine tubular pores, few large, many fine, few medium roots; abundant fine 1-5 mm soft powdery carbonates; few fragments of platy limestone; some large (termitaria ?) chambers. Gradual smooth boundary to:
95-170	dark brown to brown (7.5YR 4/4) clay loam; weak medium subangular blocky structure; dry slightly hard to slightly moist extremely firm; common fine tubular pores, few medium pores; few fine, few medium roots; abundant fine powdery and occasionally hard 1-5 mm carbonate nodules; few dessicated shell fragments.

PROFILE No. T119 Class As

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-26	17	10	35	38		49,3	0
2	26-54	13	9	30	48		47.5	0.3
3	54-95	14	8	28	50		57.8	0.3
4	95-170	12	8	30	50		55.8	0.2

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.95			0.88	11.22	2.70	0.16	1.57	20.3	1
7.85			1.32	12.00	3.87	0.18	1.30	19.2	1
7.70			2.17	10.80	3.88	0.53	0.90	19.9	3
7.70			2.55	10.60	4.58	0.54	0.75	20.8	3

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
4.00	1.00	1.39	0.58	1.20	1.20	0	3.85	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.T197	Series Asharow
Location	8 km south east of Baidoa just off main road, Sheet 38 - 28, 580449
Geomorphic Unit	Tributary valley of Asharow
Parent Material	Limestone/colluvium
Topography	Flat valley floor
Microrelief	Smooth even, few large termite hills and old channels
Vegetation	Fallow/grazing
Drainage	Well
Remarks	A yellowish brown silty, clay loam soil with well structured surface horizons over more massive subsoil horizons.

Depth (cm)	Profile Description
0 - 16	Dark yellowish brown to yellowish brown (10YR 4/4) to 5/4) silty clay loam; strong fine subangular blocky breaking to fine crumb structure; dry slightly hard; few infilled cracks; many fine pores; abundant fine, few medium roots. Clear smooth boundary to:
16 - 48	yellowish brown (10YR 5/4) silty clay loam; weak to moderate medium prismatic to strong medium subangular blocky structure; dry very hard; few fine vertical cracks; common fine, few large pores; few medium, common fine, few very fine roots; common very fine carbonate nodules; occasional mica sand flakes. Gradual smooth boundary to:
48 - 85	dark yellowish brown (10YR 4/4) heavy silty clay loam; weak to moderate medium angular blocky structure; dry extremely hard; common fine tubular pores; few fine, few medium roots; abundant very fine carbonate nodules; some faunal activity. Gradual smooth boundary to:
85 - 120	yellowish brown (10YR 5/4) heavy clay loam; massive structureless; many medium, abundant fine pores; few fine roots; common fine shells and shell fragments; few large faunal chambers. Gradual smooth boundary to:
120 - 170	yellowish brown (10YR 5/4) heavy clay loam; massive structureless abundant fine, common medium pores; very few fine roots; abundant fine 1 - 2 mm powdery carbonate and few black nodules.

PROFILE No. T197 Class As

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-10	4	13	60	23		43.8	0.2
2	10-48	4	11	42	43		46.3	0
3	48-85	8	19	30	43		41.3	0.2
4	85-120	11	21	33	35		53.7	0.2
5	120+	8	19	33	40		55.8	0.5

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.98			0.61	12.38	3.06	0.09	1.25	22.0	0
7.97			1.30	13 18	3.16	0.06	0.74	19.0	0
8.00			0.57	13.35	3.03	0.07	0.39	17.5	0
7.95			0.50	11.88	3.10	0.13	0.30	27.2	0
8.01			0.53	11.58	3.75	0.16	0.30	28.3	1

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.T199	Series Asharow
Location	Approx. 1.5 km north west of Gonownog Sheet 38 - 28, 630390
Geomorphic Unit	Old flood plain of river Asharow
Parent Material	Basement schists/limestone drift
Topography	Flat plain
Microrelief	Smooth even
Vegetation	Cooperative farm - maize stova
Drainage	Well
Remarks	Deep well drained dark yellowish brown clay loam well structured profile.

Depth (cm)	Profile Description
0 - 17	Dark yellowish brown (10YR 4/4) clay loam; strong fine to medium subangular blocky structure; dry slightly hard; common fine infilled cracks; abundant fine and few medium tubular pores; common fine roots; few mica sand flakes; few fine hard carbonate nodules less than 1 mm and many hard black nodules; Occasional fine shell fragments. Clear smooth boundary to:
17 - 38	dark yellowish brown (10YR 4/4) clay loam; strong medium to coarse prismatic breaking to fine medium angular blocky structure; dry hard; common 1 - 5 mm vertical cracks; many fine to medium pores; few fine roots; common fine shell fragments; common fine dark nodules and carbonate grits, occasional red felspars. Gradual smooth boundary to:
38 - 82	dark brown (10YR 4/3) heavy clay loam moderate medium angular blocky to moderate fine wedge structure; dry very hard common 1 - 5 mm vertical cracks. common fine to medium pores; common mica sand flakes; abundant fine black nodules; many fine shell fragments; few very fine milky white quartz grits. Gradual wavy boundary to:
82 - 140	brown (10YR 4/3) heavy clay loam; moderate fine wedge structure dry very hard; common fine, few medium pores; common mica sand flakes; common very fine less than 1 mm quartz grits; occasional shell fragments; few weak shear faces. Gradual wavy boundary to:
140 - 160	yellowish brown (10YR 5/4) heavy clay loam; massive poorly structured; slightly moist friable; many fine pores; common mica sand flakes; common fine black nodules; few less than 1 mm quartz grits; few shell fragments.

PROFILE No. T199 Class As

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-17	6	16	30	48		26.9	0.5
2	17-38	6	16	25	53		22.7	0.6
3	38-82	11	16	20	53		31.0	1.0

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.93			0.37	24.91	7.73	0.28	1.24	35.3	1
8.01			0.45	29.34	8.96	0.23	1.24	41.3	1
8.00			0.40	14.73	6.47	0.21	0.60	24.2	1

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No T253	Series Asharrow
Location	12 km south east of Baidoa south west of Gasarta village Sheet 38 - 28 581421
Geomorphic Unit	Valley bottom
Parent Material	Alluvium
Topography	Flat valley floor
Microrelief	Uneven distributary channel
Vegetation	Grassland
Drainage	Well
Remarks	A strongly micaceous alluvial profile moderately well structured and very freely draining.

Depth (cm)	Profile Description
0 - 25	Dark brown (7.5YR 4/4) very fine sandy clay loam; moderate to strong fine to medium subangular blocky structure; dry slightly hard to hard; common fine 1 - 5 mm vertical cracks; common fine to medium pores; abundant fine, few medium roots. Abundant mica sand flakes, surface cracks up to 2 cm wide infilled at surface. Clear smooth boundary to:
25 - 65	dark yellowish brown (10YR 4/4) silt clay loam to clay loam; moderate medium prismatic to fine subangular blocky structure; dry slightly hard; many to abundant fine and medium pores; common fine roots; abundant coarse mica sand flakes. Abrupt smooth boundary to:
65 - 75	dark yellowish brown (10YR 4/4) gravelly clay loam; structureless; dry slightly hard; abundant fine pores; abundant 1 - 10 mm rounded iron silicate nodules, carbonaceous nodules and rounded to subangular quartz grits. Abrupt smooth boundary to:
75 - 135	dark brown to brown (10YR 3/3 to 4/3) clay loam; moderate medium wedge to angular blocky structure; dry hard; common fine pores; few fine roots; abundant fine to medium sand flakes; shell fragments and large shells, occasional shell and carbonate patches. Abrupt smooth boundary to:
135 - 145	as 65 - 75 with abundant fine well rounded gravel fragments and 1 - 3 mm quartzites; white calc silicates; sandy clay loam; dry slightly hard.
145 - 165	as 75 to 135.

PROFILE No. T253 Class As

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-25	2	8	47	43		32.2	0.6
2	25-65	2	18	40	40		33.9	1.2
3	65-75	11	19	25	45		28.9	0.7

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.94			0.53	17.68	5.84	0.37	1.24	27.7	1
7.95			0.42	16.45	5.00	0.52	0.71	24.6	2
7.94			0.54	20.52	7.66	0.55	0.76	25.9	2

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.T254	**Series** Mode Mode
Location	one km south east of Daynuuany village, Sheet 38 - 28, 681359
Geomorphic Unit	Flat clay plain
Parent Material	Basement granites/gneisses
Topography	Flat level
Microrelief	Smooth even occasional slight gully erosion
Vegetation	fallow
Drainage	Well
Remarks	A dark grey sandy clay soil with well structured surface horizons and considerable carbonates at depth.

Depth (cm)	**Profile Description**
0 - 20	dark grey (5Y 4/1) sandy clay; strong fine subangular blocky breaking to fine crumb structure; dry slightly hard; many fine infilled cracks; many fine to medium pores; adundant 1 - 5 mm angular calc-silicate fragments and quartz grits. Abrupt smooth boundary to:
20 - 55	dark grey (5Y 4/1) sandy clay; moderate, medium prismatic breaking to strong fine wedge structure; dry hard; many 1 - 2 cm vertical cracks; common fine pores; common fine roots; few weak shear faces; common fine to medium well rounded to subrounded quartz grits; few fine sand inclusions. Gradual wavy boundary to:
55 - 122	dark grey (5Y 4/1) sandy clay; strong fine wedge structure; dry hard; horizontal cracks near top of horizon; common fine to medium pores; few fine roots; common fine gyptum crystals; few fine to medium sand inclusions and sand coatings to ped faces; common fine carbonates near base and carbonate infillings to shells and fragments. Gradual wavy boundary to:
122 - 130	carbonate and calc-silicate materials; duricrusted.

PROFILE No. T254 Class Mo

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-20	26	16	10	48		2.9	1.1
2	20-55	24	21	10	45		5.0	1.7
3	55-112	12	20	15	53		8.3	1.7

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
8.01			0.33	30.44	9.22	1.45	0.38	40.5	4
8.02			0.42	27.0	10.74	4.41	0.32	41.6	11
8.00			6.50	30.44	12.43	5.80	0.29	47.3	12

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
0.95	0.04	1.82	0.03	1.62	0.20	0	0.09	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No. T101	Series Bur Acaba
Location	6 km east of Daynuunay Village. Sheet 38 - 28, 720398
Geomorphic Unit	Tributary valley bottom
Parent Material	Alluvium basement/limestone
Topography	Smooth even depression
Microrelief	Smooth even
Vegetation	*Acacia nilotica* open thicket
Drainage	Well
Remarks	A moderately deep well structured heavy textured brown clay loam soil.

Depth (cm)	Profile Description
0 - 20	Brown (10YR 4/3) sandy clay loam moderate medium crumb structure; dry slightly hard; abundant fine tubular pores; abundant fine, few to common medium and few large roots; abundant fine quartz grits to 5 mm common medium to fine black nodules. Gradual wavy boundary to:
20 - 55	dark greyish brown (10YR 4/2) heavy sandy clay loam; moderate medium prismatic breaking to moderate medium angular blocky structure; dry hard; few fine vertical cracks; few fine pores; few very fine quartz grits, few fine black nodules. Gradual smooth boundary to:
55 - 97	brown to olive brown (10YR 4/3 to 2.5Y 4/4) heavy sandy clay loam; moderate medium angular blocky structure; few fine pores few fine roots; few medium sand inclusions; few fine black nodules few very fine quartz grits. Gradual smooth boundary to:
097 - 120	olive brown (2.5Y 4/4) heavy sandy clay loam; slightly moist extremely firm; weak medium angular blocky structure; few fine pores; few fine roots; few very fine quartz grits; common fine patches of gypsum, few small carbonates.

PROFILE No. T101 Class Br

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-20	30	0	32	38		6.2	2.0
2	20-55	27	20	9	44		9.1	1.5
3	55-97	28	13	10	49		10.3	2.3
4	97-120	21	14	10	55		9.1	2.2

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
8.01			0.86	15.50	4.21	0.06	0.96	23.6	0
7.99			0.78	14.50	8.91	1.37	0.59	25.9	0
8.02			7.50	9.80	12.20	4.05	0.57	25.9	16
8.00			9.50	27.00	17.33	14.00	0.85	19.7	71

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
6.00	1.66	1.05	0.43	0.98	1.82	Nil	6.10	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.T255	**Series** Bur Acaba
Location	Sheet 38-28. 780521, 20 km north east of Daynuunay
Geomorphic Unit	Toeslope of limestone escarpment
Parent Material	Limestone drift over basement pink granite
Topography	Gently sloping plain
Microrelief	Uneven, moderate gully erosion
Vegetation	*Acacia mellifera* scrub woodland
Drainage	Well
Remarks	A well structured brown clay vertisol overlying basement complex granites

Depth (cm)	Profile Description
0 - 25	A dark brown (10YR 3/3) clay loam; strong fine subangular blocky structure; dry slightly hard; many fine tubular pores; abundant fine , many medium and few large roots; slightly layered surface; many fine rounded black nodules. Gradual wavy boundary to:
25 - 51	brown (10YR 4/3) clay loam to silt clay loam; strong medium prismatic breaking to moderate fine angular blocky structure; dry slightly hard; common fine, many medium vertical cracks; many fine tubular pores; many fine and common medium roots; few sand inclusions down and along cracks; many fine quartz grits many fine, less than 1 mm black nodules; Gradual smooth boundary to:
51 - 90	dark brown to brown (10YR 3/3 to 4/3) heavy clay loam; moderate medium angular blocky structure; dry slightly hard; few fine vertical cracks; common fine tubular pores; common fine, few medium roots; common fine 1 - 2 mm quartz grits; common fine 1 - 2 mm black nodules. Gradual smooth boundary to:
90 - 150	dark greyish brown (2.5Y 4/2) heavy clay loam; strong coarse wedge breaking to strong fine wedge structure; slightly moist extremely firm; common fine horizontal and diagonal cracks; many fine tubular pores; abundant fine, few medium roots; massive well developed slickensides and diagonal cracks; common fine powdery gypsum and carbonates. Clear wavy boundary to:
150 - 200	dark brown to brown (7.5YR 4/2) to 4/4) with common medium distinct red brown (2.5YR 4/4) mottles, heavy clay loam; slightly moist extremely firm; moderate medium sub-angular blocky structure; few fine tubular pores; many fine roots; many 1 - 2 mm powdery carbonate patches, and common fine gypsum crystals.

PROFILE No. T255 Class Br

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-25	15	20	17	48		13.2	0.8
2	25-51	14	16	15	55		13.2	1.4
3	51-90	14	17	14	55		12.4	2.2
4	90-150	7	5	23	65		12.4	3.0
5	150+	12	8	17	63		18.6	3.2

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
8.00			0.35	28.4	9.45	0.65	0.36	41.5	2
8.01			1.60	24.65	11.02	4.23	0.30	42.2	10
7.99			2.80	20.61	11.54	6.60	0.31	42.1	16
8.02			6.00	23.38	15.31	11.33	0.35	47.4	24
8.00			6.50	15.43	14.91	12.30	0.31	39.4	31

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
1.5	0.16	1.39	0.03	1.40	0.41	0	1.30	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL. P PPM	B PPM	% GRAVEL

Profile No. T136	**Series** Uiamo
Location	7 km east of Baidoa. Sheet 38 - 28, 561458
Geomorphic Unit	Upper toe slope of limestone escarpment
Parent Material	Limestone drift/colluvium
Topography	Nearly flat slight depression
Microrelief	Smooth even
Vegetation	Cleared grazing land
Drainage	Well
Remarks	A grey brown medium textured deep profile developed in limestone colluvium

Depth (cm)	Profile Description
0 - 20	Dark greyish brown (10YR 4/2) light clay loam; moderate medium subangular blocky to fine subangular blocky structure; dry very hard; few fine vertical cracks; abundant fine tubular and few medium pores; common fine and medium roots; some vertical cracks infilled with surface soil; common dark nodules; common rounded angular 1 mm quartz grits. Gradual smooth boundary to:
20 - 45	dark greyish brown (10YR 4/2) heavy clay loam; weak medium prismatic breaking to medium subangular blocky structure; slightly moist extremely firm; few fine vertical 5 mm cracks; few medium interstitial pores; common fine, few medium roots; few faunal chambers; common fine shells and shell fragments; few fine 2 - 5 mm angular quartz grits; few 1 mm carbonate nodules. Gradual smooth boundary to:
45 - 130	dark greyish brown (10YR 4/2 to 2.5Y 4/2) clay loam to clay; weak coarse subangular blocky structure to massive; slightly moist extremely firm; few fine pores; common fine roots; few salt encrustations; some clay movement on pore faces; common fine quartz grits few shells/shell fragments; and fine carbonate nodules; few old closed vertical cracks. Gradual smooth boundary to:
130 - 150	dark greyish brown (2.5Y 4/2) with common, fine, faint yellow brown (10YR 5/4) mottles; heavy clay loam; moderate fine subangular blocky structure; slightly moist to moist friable; few fine tubular pores; common fine roots; common fine powdery carbonates; weak clay skins on ped faces; few very fine quartz grits.

PROFILE No. T136 Class Ua

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-20	5	15	30	50		48.7	0.9
2	20-45	5	9	28	58		51.6	1.4
3	45-130	3	12	25	60		55.8	2.8

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.95			0.36	20.54	7.68	0.26	0.30	31.8	1
7.95			0.46	15.75	10.49	1.20	0.18	30.0	4
8.00			2.45	8.04	14.80	5.36	0.17	36.7	15

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
1.72	0.34	0.95	0.05	0.80	0.41	0	1.60	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.T196	**Series** Uiamo
Location	6 km east of Baidoa. Sheet 38 - 28, 558451
Geomorphic Unit	Footslope terrace on limestone escarpment
Parent Material	Limestone
Topography	Very weakly sloping south
Microrelief	Smooth even
Vegetation	Fallow cropland
Drainage	Well
Remarks	A greyish brown moderately deep porous sandy clay loam to clay loam soil over a poorly structured subsoil.

Depth (cm)	**Profile Description**
0 - 17	Brown (10YR 4/3) sandy clay loam; moderate medium to fine subangular blocky structure; dry slightly hard; abundant fine tubular and common medium pores; abundant fine, few medium roots; many infilled; fine vertical cracks; common fine shells and shell fragments; few fine gritty carbonates. Gradual smooth boundary to:
17 - 42	greyish brown (10YR 5/2) clay loam; weak to moderate, fine subangular blocky structure; dry slightly hard to dry hard; few fine vertical cracks; common fine tubular and few large pores; abundant fine, few medium roots; few fine carbonate nodules; few fine weathered limestone fragments. Gradual smooth boundary to:
42 - 105	greyish brown (10YR 5/2) clay loam; massive to weak fine crumb structure; dry extremely hard; few medium common fine pores; many fine, few medium and few dead roots; few large patches carbonates;some termite activity; few large shell fragments; many fine powdery carbonates. Gradual smooth boundary to:
105 - 150	olive brown (2.5Y 4/4) with common fine faint yellow brown (10YR 5/4) mottles; silty clay loam; structureless to weak fine crumb structure; dry slightly hard; common fine tubular pores; common fine roots; abundant very fine and fine powdery carbonates passes into weathered DPM.

PROFILE No. T 196 Class Ua

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-11	18	13	31	38		45.4	0.2
2	11-42	11	14	30	45		45.4	0.2
3	42-105	9	11	31	49		49.6	0.4
4	105+	7	18	30	45		57.0	0.2

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.98			0.50	14.93	3.15	0.16	1.11	25.4	1
7.90			0.36	15.63	4.23	0.11	0.15	24.4	0
8.00			0.56	14.50	6.14	0.38	0.13	27.5	1
7.93			7.20	11.88	7.82	0.32	0.15	21.6	1

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.T198	Series Uiamo
Location	10 km south east of Baidoa. Sheet 38 - 28, 570430
Geomorphic Unit	Foot of limestone escarpment toeslope
Parent Material	Limestone
Topography	Nearly flat
Microrelief	Smooth even
Vegetation	*Acacia* sp open canopy
Drainage	Well
Remarks	A pale coloured medium textured highly calcareous soil.

Depth (cm)	Profile Description
0 - 27	greyish brown (10YR 5/2) sandy clay loam; moderate fine subangular blocky breaking to fine crumb structure; dry slightly hard; common fine, few medium pores; abundant fine, few medium roots; slightly capped surface; few very fine powdery carbonate granules; few fine shells and fragments. Clear smooth boundary to:
27 - 57	greyish brown (10YR 5/2) sandy clay loam to clay loam; weak to moderate fine subangular blocky breaking to fine crumb structure; dry slightly hard; common fine, few large roots; common fine, few medium roots; common fine powdery carbonates and fine shell fragments. Gradual smooth boundary to:
57 - 108	greyish brown (10YR 5/2) silt clay loam; weak fine subangular to angular blocky structure; dry slightly hard; many large and fine pores; few fine and medium roots; occasional 1 - 20 mm weathered limestone fragments; abundant 1 - 5 mm fine powdery carbonates; gradual smooth boundary to:
108 - 175	light brownish grey (10YR 6/2) sandy clay loam; compact massive structureless; common medium pores; rare fine roots; with layer of carbonate nodules and weathered limestones 1 - 20 mm sized between 130 and 141 cm. Abundant fine powdery carbonates and 1 - 5 mm limestone fragments; slightly stratified at base of horizon.
175+	duri crusted limestone.

PROFILE No. T198 Class Ua

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-27	15	12	33	40		43.4	0
2	27-51	15	12	25	48		47.5	0.4
3	51-108	10	10	15	55		53.7	0.2

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.93			0.85	10.68	1.91	0.06	1.98	16.8	0
7.98			0.68	10.78	2.38	0.06	0.34	21.1	0
7.99			0.40	10.93	2.64	0.04	0.26	21.5	0

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.S117	Series Uiamo
Location	7 km northeast of Buulo Guduud, 38 - 62 481408
Geomorphic Unit	Low hill crest
Parent Material	Limestone
Topography	
Microrelief	(Smooth even) plateau area
Vegetation	Secondary *Ac. bussei*
Drainage	Moderate
Remarks	A dark greyish brown slightly silty clay loam with coarse sub surface structures, vertisolic features, and carbonates at depth.

Depth (cm)	Profile Description
0 - 12	dark greyish brown (2.5Y 4/2) (silt) clay loam; strong medium subangular blocky to strong medium platy structure; dry hard; many fine to medium pores; many fine to medium roots; common infilled vertical cracks; common small black nodules; few small shell fragments; common 1 - 4 mm rounded quartz gravels. Clear smooth boundary to:
12 - 62	dark greyish brown (2.5Y 4/2) clay loam; massive weak coarse angular blocky structures; dry hard; common less than 5 cm vertical cracks; common fine to medium pores; common fine to medium roots; few small black nodules; and shell fragments; few, less than 5 mm, limestone grits. Gradual wavy boundary to:
62 - 88	dark greyish brown (2.5Y 4/2) clay loam; weak coarse angular blocky to medium wedge structure; slightly moist extremely firm; few diagonal cracks to 1 cm, few fine to medium pores; few fine to medium roots; common weak slickensides; few fine up to 15 mm; inclusions; few small less than 5 mm black nodules and limestone grits. Clear smooth boundary to;
88 - 116	dark greyish brown (2.5Y 4/2) heavy clay loam; weak medium angular blocky structure; slightly moist extremely firm; few diagonal, less than 2 mm cracks; few pores; few fine roots common fine less than 10 mm patches of sand inclusions; few black less than 5 mm nodules and limestone grits; common 10 mm diameter gypsum crystals. Abrupt smooth boundary to:
116+	Grey karsitic limestone.

PROFILE No.S 117 Class Ua

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-12	5	15	30	50		8.3	1.2
2	12-62	4	11	20	65		10.3	2.4
3	62-88	4	11	15	70		8.3	2.9
4	88-116	2	10	19	69		8.3	2.2

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
8.03			0.49	43.06	11.84	2.22	0.85	53.4	4
8.00			0.93	41.20	14.47	8.07	0.52	54.5	15
8.02			4.40	39.08	16.72	11.63	0.49	56.3	21
7.92			7.00	43.94	15.85	8.75	0.30	57.2	15

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
1.5	0.16	2.29	0.05	2.10	1.15	0	0.50	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No DS01	Series Uiamo
Location	12 km northeast of Buulo Guduud Sheet 38 - 62 520445
Geomorphic Unit	Limestone plateau
Parent Material	Limestone drift
Topography	Flat crest
Microrelief	Smooth even
Vegetation	*Ac. bussei* secondary bush
Drainage	Moderate
Remarks	A dark grey clay loam to clay soil, well structured with many fine salts in the subsoil.

Depth (cm)	Profile Description
0 - 10	A dark grey (5Y 4/1) heavy clay loam; strong fine subangular blocky structure; dry hard; many 5 mm vertical cracks; many fine pores; many fine and medium roots; common rounded quartz grits; common small black iron nodules. Clear wavy boundary to:
10 - 48	A dark grey (5Y 4/1) heavy clay loam; moderate coarse prismatic breaking to subangular blocky structure; dry hard; common 2 mm vertical cracks; many fine pores; common fine to medium roots; common small black nodules; few 5 mm sand inclusions. Clear wavy boundary to:
48 - 78	A dark grey (5Y 4/1) clay; moderate medium angular blocky structure; slightly moist very firm; very few horizontal cracks; few fine pores; few fine to medium roots; many fine gypsum and carbonates; common small black iron nodules; few 5 mm sand inclusions. Gradual smooth boundary to:
78 - 165	A dark grey (5Y 4/1) clay; strong coarse subangular blocky and medium wedge structures with well developed slickensides; moist firm; very few fine pores; few large horizontal roots; many gypsum patches up to 2 cm; few small black nodules, many up to 2 cm patches of carbonates.

PROFILE No. DS 01 Class Ua

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-10	41	6	13	40		1.7	0.6
2	10-42	35	7	10	48		3.3	1.6
3	42-78	25	7	15	53		1.7	2.6

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.82			0.43	18.33	6.20	0.37	1.08	30.3	1
8.12			0.58	14.16	9.50	4.30	0.65	28.8	15
8.10			3.78	15.37	11.76	5.90	0.82	28.8	20

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.DS27	**Series** Uiamo
Location	1 km north of Buulo Guduud, 38 - 62 408384
Geomorphic Unit	Clay plain
Parent Material	Limestone
Topography	Nearly flat plateau,slight slope to south west
Microrelief	Smooth even
Vegetation	Cropland adjacent to secondary thickets with *Dobera glabra*
Drainage	Moderate
Remarks	A dark greyish brown well structured clay loam soil with many fine black nodules at the surface and fine carbonates and gypsum salts in the subsoil

Depth (cm)	**Profile Description**
0 - 12	Dark greyish brown (10 YR to 2.5Y 4/2) clay loam; strong medium subangular blocky breaking to fine medium subangular blocky structure; dry hard; many fine to medium infilled vertical cracks; many fine to medium pores; many fine to medium roots; common small black nodules; few shell fragments. Clear wavy boundry to:
12 - 36	dark greyish brown (10YR to 2.5Y 4/2) clay loam, coarse strong prismatic to moderate medium subangular blocky structure; dry hard; common 2 cm vertical cracks many fine to medium pores;common fine to coarse roots; common small black nodules few very fine pale grits. Gradual smooth boundary to:
36 - 66	dark greyish brown (2.5Y 4/2) heavy clay loam; weak coarse prismatic to moderate medium angular blocky structure; slightly moist firm; few vertical up to 1 cm cracks; few iron coated gravels up to 5 mm;Clear wavy boundary to:
66-106	dark greyish brown (2.5Y 4/2) clay; weak moderate wedge structure; moist very firm; few fine pores; few fine roots; few 2 mm carbonate patches; common 2 mm gypsum patches. Abrupt smooth boundary to:
106-	parent material, grey karsitic limestone.

PROFILE No. DS27 Class Ua

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-12	7	18	25	50		13.2	3.2
2	12-36	7	13	22	58		16.5	1.6
3	36-66	3	17	15	65		17.5	2.6
4	66-106	4	10	18	68		14.5	1.6

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.89			0.82	42.81	10.16	0.53	0.59	54.3	1
8.05			0.71	36.55	9.05	2.71	0.36	52.9	5
8.02			0.77	32.30	11.55	7.88	0.49	57.3	14
7.73			8.00	47.75	9.68	5.38	0.47	47.5	11

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
6.26	0.66	1.33	0.08	1.13	1.80	0	5.02	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.T283	Series Baidoa
Location	5 km west of Hartinganle, Sheet 38 - 28 485623
Geomorphic Unit	clay plain
Parent Material	limestone
Topography	level plateau
Microrelief	smooth even
Vegetation	Cropland
Drainage	well
Remarks	A brown clay soil with considerable migration of salts during drying out

Depth (cm)	Profile Description
0 - 20	A dark brown (10Y 3/3) clay loam to clay; moderate medium subangular blocky structure; dry slightly hard; abundant fine tubular pores; abundant fine, very few medium roots; few clay coatings to ped faces; common less than 2 mm black (haematite) nodules; common very fine carbonates below 10 cm; Gradual smooth boundary to:
20 - 52	dark brown to dark yellowish brown (10YR 3/3 - 3/4) clay loam to clay; strong fine angular blocky structure breaking to strong fine wedge; slightly moist extremely firm; abundant fine tubular pores; many fine, few medium roots; common fine white carbonates; few small ant channels; many white secondary carbonates coating ped faces; common less than 0.5 mm rounded black nodules. Gradual smooth boundary to:
52 - 97	dark yellowish brown (10YR 3/4) clay; strong fine wedge structure; slightly moist extremely firm; common fine pores; many fine few medium roots; common less than 1 mm, very fine black haematite and carbonate nodules, few fine gypsum crystals towards base of horizon; well developed fine diagonal slickensides; some white salt coatings to ped faces. Diffuse smooth boundary to:
97 - 140	dark brown to brown (10YR 3/3 - 4/3) clay; strong fine to medium wedge structure; slight moist extremely firm; many fine, common medium pores; common fine and medium roots; many fine 1 - 3 mm platy gypsum crystals; common fine white powdery carbonates; common fine black nodules; well polished shear faces.

PROFILE No. T 283 Class Ba

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1a	0-10	4	16	32	48		2.5	0.6
1b	10-20	3	9	30	58		2.9	0
2	20-52	3	9	30	58		2.1	0.2
3	52-97	2	18	25	55		2.5	1.4
4	97-140	3	17	25	55		2.5	1.6

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.64			2.13	34.20	9.10	0.43	4.05	48.8	1
7.53			4.90	41.30	12.70	1.47	2.38	47.9	3
7.50			7.75	47.46	14.10	2.00	1.49	46.8	4
7.58			6.93	31.69	16.50	2.96	0.92	45.3	7
7.62			8.57	48.26	16.60	8.12	0.71	49.0	17

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
8.62	3.64	8.55	0.28	20.28	1.48	0	0.50	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No. QS24 Series Berdaale

Location	5 km northeast of Kansa Dere 38 - 39 820218
Geomorphic Unit	Limestone Plateau
Parent Material	Limestone
Topography	Slight slope to north west on plateau
Microrelief	Smooth even
Vegetation	Mature *Acacia/Delonix* shrubland with 7-8 m emergents
Drainage	Well

Depth (cm)	Profile Description
0 - 78	dark red (2.5YR 3/6) light clay loam; massive to structureless; dry slightly hard; many fine pores; many fine to medium roots; many rounded iron manganese coated calcareous gravels up to 1 cm across. Abrup wavy boundary to :
78+	bedrock limestone

PROFILE No. QS 24 Class Bd

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-78	10	10	42	38		3.3	0.2

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.33			0.22	7.70	1.67	0.79	1.88	12.4	6

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No. T223	**Series** Berdaale
Location	approximately 1 km north east of Saydeelo, Sheet 38 - 16 521719
Geomorphic Unit	limestone plateau
Parent Material	Limestone
Topography	Flat to gently sloping plateau
Microrelief	Smooth even
Vegetation	Mixed *Acacia-Combretum* Woodland
Drainage	Well
Remarks	A moderately shallow probably eroded profile in very resistant limestone strata.

Depth (cm)	**Profile Description**
0 - 28	Dark red (2.5YR 3/6) gritty clay loam; strong fine crumb structure; dry slightly hard; common fine tubular pores; abundant fine, few medium roots; abundant fine black and yellow weathered limestone nodules towards base of horizon. Clear wavy boundary to:
28 - 40	mainly nodular weathered pale grey and yellow limestone becoming more indurated below 40 cm.

PROFILE No. T 223 Class Bd

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-18	9	12	24	55		35.1	1.7

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.95			0.62	13.12	9.32	1.5	0.56	26.5	6

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No.FS34	Series Valley bottom
Location	10 km north of Buulo Fulaay, 38 - 52 345422
Geomorphic Unit	Valley bottom
Parent Material	Peneplaned granites
Topography	Very gentle south east slope
Microrelief	Weakly undulating less than 25 cm
Vegetation	Open thorn shrubland up to 3 metres
Drainage	Moderate
Remarks	A dark grey residual soil with sandy clay loam over clay textures containing much detrital material derived from weathering of basement complex and granite strata.

Depth (cm)	Profile Description
0 - 10	dark grey (10YR 4/1) sandy clay loam; strong medium subangular blocky structure; dry hard; common infilled vertical cracks; many coarse medium and fine pores; common fine to medium roots, abundant pale rounded quartz grits. Clear wavy boundary to:
10 - 31	dark grey (10YR 4/1) heavy sandy clay loam; strong coarse prismatic to weak medium subangular blocky structure; common, up to 2mm, vertical cracks; common medium to fine pores; common fine to medium roots; abundant pale rounded quartz grits; common fine 1 cm sand patches; Clear wavy boundary to:
31 - 80	dark grey (10YR 4/1) sandy clay; massive; slightly moist extremely firm; many fine pores; few fine roots; common quartz grits; abundant medium sized sand and grit inclusions along cracks up to 7 cm square; Gradual smooth boundary to:
80 - 160	dark grey (N4) clay with common medium pale brown (10YR 6/3) mottles; massive; slightly moist firm; many fine pores; few fine roots; common quartz sands; common up to 1 cm, soft concretions of carbonates; Gradual smooth boundary to:
160 - 180	grey (10YR 5/1) clay with common medium pale yellow/grey (2.5Y 7/4 and N5) mottles; massive; moist soft; many fine pores; few soft concretions of carbonates.

PROFILE No. FS 34 Class Valley Bottom

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0-10	42	8	5	45		2.9	0.8
2	10-31	40	7	8	45		1.7	1.6
3	31-80	45	6	6	43		2.5	2.5
4	80-160	36	9	7	48		3.3	2.9
5	160-180	38	8	6	48		0.8	2.9

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
8.00			0.43	16.38	7.48	1.04	0.71	27.9	4
8.15			0.46	14.14	8.80	3.24	0.50	28.4	11
8.30			3.42	10.40	10.50	7.65	0.53	29.5	26
8.07			10.00	12.60	11.16	7.40	0.51	28.5	26
8.07			7.26	13.00	11.51	10.18	0.45	19.0	54

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
1.35	0.34	2.64	0.15	2.40	0.01	0	1.52	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No. FS35	Series Issur
Location	12 km north of Buulo Fulaay, 38 - 62 361442
Geomorphic Unit	Peneplain
Parent Material	Basement complex
Topography	Slightly sloping to south east
Microrelief	Smooth even
Vegetation	Open mature mixed shrubland
Drainage	Moderate
Remarks	A coarse textured dark reddish brown weakly structured freely draining soil passing into laterised parent material within one metre of the surface.

Depth (cm)	Profile Description
2 - 0	surface wash of pale quartz grits and red brown (5YR 4/3) silts.
0 - 18	dark reddish brown (5YR 3/3) coarse sandy clay loam; moderate coarse prismatic to weak medium angular blocky structure; dry very hard; common up to 5 mm vertical cracks; many fine pores; many fine roots; abundant pale pink slightly rounded quartz grits. Clear wavy boundary to:
18 - 50	dark reddish brown (5YR 3/3) coarse sandy clay loam; massive to weak coarse angular blocky structure; slightly moist extremely firm; few up to 2 mm vertical cracks; common fine pores; few medium roots; abundant pale pink,, slightly rounded quartz grits.
	Abrupt smooth boundary to:
50+	gravelly, deeply weathered, parent material with nodular gravels up to 1.5 cm and quartz pebbles up to 5 cm.

PROFILE No. FS 35 Class : ls

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0 - 18	49	10	5	36		1.2	0.6
2	18 - 50	51	11	3	35		0	0.6

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.23			0.73	11.70	6.10	0.74	1.12	22.2	3
7.45			0.41	12.70	6.30	1.40	0.34	29.2	5

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

Profile No. QS10 Series Amin

Location	4 km north of Kansa Dere 38 - 38 767219
Geomorphic Unit	Plateau
Parent Material	Limestone
Topography	Clay plain, gently sloping north west
Microrelief	Very slight gilgai
Vegetation	Cropland
Drainage	Moderate
Remarks	A dark brown strongly structured grumosol with clay loam to clay textures and a high moisture holding capacity

Depth (cm)	Profile Description
0 - 19	dark brown (7.5YR 4/4) clay loam; strong coarse subangular blocky to weak medium subangular blocky structure; dry slightly hard; common up to 5 mm vertical cracks; many fine to medium pores; common fine roots; abundant small black iron nodules. Gradual wavy boundary to:
19 - 64	dark brown (7.5YR 4/4) clay loam; weak coarse subangular blocky to medium angular blocky structure; slightly moist firm to friable; common fine to medium pores; few fine roots; common small fine black nodules; Clear wavy boundary to:
64 - 164	dark reddish brown (5YR 3/4) clay; massive to weak medium wedge structure with few weak slickensides; slightly moist firm; common fine pores; few medium roots; common gypsum flakes; few small black nodules.

PROFILE No. QS 10 Class: Am

Sample No.	DEPTH cm	SOIL PARTICLES %				ACTIVE CARBONATE %	TOTAL CARBONATE %	GYPSUM meq/100g
		COARSE SAND	FINE SAND	SILT	CLAY			
1	0 - 19	5	12	25	58		8.3	0.6
2	19 - 64	4	8	18	70		8.3	1.4
3	64 - 104	4	6	30	60		7.3	1.0

pH PASTE	pH SUSP	EC mmhos/cm 1:5	EC mmhos/cm S.E.	EXCHANGEABLE CATIONS me/100g				CEC me %	ESP
				Ca	Mg	Na	K		
7.91			0.38	33.0	8.00	0.95	1.25	43.1	2
7.94			2.52	32.22	10.30	2.96	1.00	39.0	8
7.82			6.22	53.10	13.60	8.75	1.10	42.4	21

SOLUBLE CATIONS me/l				SOLUBLE ANIONS me/l				ESP
Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	
1.4	0.28	1.58	0.11	1.20	0.01	0	1.8	

TOTAL P mg %	TOTAL N %	ORGANIC CARBON %	C/N RATIO	AVAIL P PPM	B PPM	% GRAVEL

B.3 ROUTINE SAMPLE ANALYSIS

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	Soil Class
1442	T002/1	0-25	4.30	29.9	14	4.0	Br
1443	T002/2	-75	5.84	23.4	25	9.5	
1444	T002/3	-125	4.13	13.6	30	12.9	
1445	T005/1	0-25	3.21	27.3	12	14.7	Br
1446	T005/2	-75	4.99	29.8	17	13.4	
1447	T005/3	-125	3.33	21.0	16	10.8	
1448	T010/1	0-25	0.25	24.4	1	0.7	Br
1449	T010/2	-75	0.24	15.9	1	0.8	
1450	T010/3	-125	0.21	12.0	1	0.7	
1451	T013/1	0-25	1.23	40.2	3	0.7	Br
1452	T013/2	-75	3.07	34.3	8	0.9	
1453	T013/3	75+	3.25	35.3	9	7.0	
1454	T016/1	0-25	1.81	39.9	4	7.5	Br
1455	T016/2	-75	2.04	36.2	5	7.2	
1456	T016/3	75+	5.45	33.9	16	9.0	
1457	T025/1	0-25	0.07	27.2	0	0.5	Br
1458	T025/2	-75	0.38	17.4	2	0.6	
1459	T025/3	75+	0.47	17.9	3	1.2	
1460	T028/1	0-25	0.37	20.7	2	0.6	Br/As
1461	T028/2	-75	1.25	18.9	7	1.0	
1462	T028/3	75+	3.68	19.6	19	3.7	
1463	T035/1	0-25	0.07	13.2	0	0.9	Bd
1464	T035/2	-75	0.11	13.7	0	1.2	
1465	T035/3	75+					
1466	T037/1	0-25	0.67	29.3	2	0.7	Br
1467	T037/2	-75	4.52	24.3	19	3.1	
1468	T037/3	75+	6.78	20.3	33	4.3	
1469	T044/1	0-25	0.14	17.3	0	0.8	Br
1470	T044/2	-75	4.73	22.8	21	5.2	
1471	T044/3	75+	1.13	13.8	8	1.3	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1472	T047/1	0-25	0.77	36.3	2	7.5	Br
1473	T047/2	-75	3.40	36.3	9	8.0	
1474	T047/3	75+	3.33	36.1	9	8.5	
1475	T049/1	0-25	0.68	43.4	2	1.2	Br
1476	T049/2	-75	4.99	40.2	12	2.9	
1477	T049/3	75+	4.70	31.8	15	7.5	
1478	T052/1	0-25	1.02	35.3	3	0.7	Br
1479	T052/2	-75	4.57	21.5	21	1.3	
1480	T052/3	75+	17.92	34.8	51	6.0	
1481	T055/1	0-25	0.11	16.3	0	0.4	As
1482	T055/2	-75	0.02	8.3	0	0.4	
1483	T055/3	75+	0.02	8.2	0	0.4	
1484	T059/1	0-25	1.13	18.0	6	8.0	As
1485	T059/2	-75	2.28	17.9	13	4.4	
1486	T-59/3	75+	1.85	13.0	14	14.9	
1487	T062/1	0-25	0.21	28.1	1	1.4	Br
1488	T062/2	-75	0.71	18.7	4	0.7	
1489	T062/3	75+	1.24	23.1	5	2.1	
1490	T065/1	0-25	0.23	23.5	1	0.8	Br
1491	T065/2	-75	2.81	21.7	13	3.6	
1492	T065/3	75+	3.10	32.8	9	9.0	
1493	T069/1	0-25	0.84	35.3	0	0.5	Br
1494	T069/2	-75	6.94	35.4	20	1.0	
1495	T069/3	75+	2.59	35.0	7	5.4	
1496	T072/1	0-25	0.45	29.2	2	3.2	Br
1497	T072/2	-75	1.31	24.6	5	8.5	
1498	T072/3	75+	4.88	19.6	25	9.0	
1499	T075/1	0-25	2.48	40.5	6	1.3	Br
1500	T075/2	-75	5.45	29.6	18	7.0	
1501	T075/3	75+	5.43	22.0	25	8.5	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1502	T092/1	0-25	0.39	14.0	3	0.4	Br
1503	T092/2	-75	0.25	21.9	1	0.7	
1504	T092/3	75+	0.06	16.4	0	1.4	
1505	T096/1	0-25	2.62	23.8	11	2.0	Br/Mo
1506	T096/2	-75	10.13	27.2	31	8.1	
1507	T096/3	75+	11.30	22.3	51	10.8	
1508	T103/1	0-25	0.24	14.1	2	0.6	Br
1509	T103/2	-75	0.16	15.2	1	0.7	
1510	T103/3	75+	0.11	15.3	1	0.9	
1511	T109/1	0-25	0.52	42.7	1	0.6	Br/Mo
1512	T109/2	-75	5.40	49.2	11	1.0	
1513	T109/3	75+	10.69	46.7	23	3.1	
1514	T112/1	0-25	0.25	16.0	2	0.7	Lst/Bd
1515	T112/2	25-75	0.11	19.0	0	1.3	
1516	T115/1	0-25	0.11	26.1	0	0.3	Lst/Bd
1517	T115/2	-75	0.47	30.4	2	0.4	
1518	T115/3	75+	0.95	19.3	5	0.4	
1519	T118/1	0-25	0.18	33.3	1	1.2	Br/Mo
1520	T118/2	-75	1.60	37.3	4	1.3	
1521	T118/3	75+	3.23	35.3	9	4.8	
1522	T120/1	0-25	0.13	18.0	1	0.8	Lst/Bd
1523	T120/2	-75	0.04	20.5	0	0.7	
1524	T120/3	75+	0.06	19.1	0	0.4	
1525	T123/1	0-25	0.06	14.8	0	1.3	Di/Bd
1526	T123/2	-75	0.11	15.8	1	0.5	
1527	T123/3	75+	0.06	16.3	0	0.4	
1528	T126/1	0-25	0.11	16.7	1	0.5	Di
1529	T126/2	25+	0.08	16.6	0	0.4	
1530	T129/1	0-25	0.04	18.4	0	0.6	Bd
1531	T129/2	-75	0.15	19.5	1	1.1	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1532	T130/1	0-25	0.11	35.0	0	0.5	Br
1533	T130/2	-75	2.62	20.7	13	0.7	
1534	T130/3	75+	6.06	30.7	20	3.9	
1535	T133/1	0-25	0.11	13.1	1	0.4	Bd
1536	T133/2	-75	0.14	14.1	1	1.4	
1537	T133/3	75+	0.18	14.0	1	2.3	
1538	T169/1	0-25	0.18	22.0	1	0.9	As
1539	T169/2	-75	0.20	19.7	1	0.5	
1540	T169/3	75+	0.22	19.1	1	0.8	
1541	T171/1	0-25	0.06	16.2	0	0.6	As
1542	T171/2	-75	0.51	13.8	4	3.7	
1543	T171/3	75+	0.73	17.9	4	14.3	
1544	T175/1	0-25	0.09	18.0	0	1.0	Ua
1545	T175/2	25+	0.11	20.0	1	0.9	
1546	T177/1	0-25	0.16	27.3	1	0.7	As
1547	T177/2	-75	0.11	20.3	1	0.3	
1548	T177/3	75+	0.11	18.5	1	0.6	
1549	T180/1	0-25	0.18	20.0	1	0.4	As
1550	T180/2	-75	0.18	20.5	1	0.4	
1551	T180/3	75+	0.26	25.3	1	0.7	
1552	T183/1	0-25	0.16	22.0	1	0.6	As
1553	T183/2	-75	0.19	19.2	1	0.7	
1554	T183/3	75+	0.19	15.6	1	1.0	
1555	T185/1	0-25	0.08	22.0	0	0.3	Bd
1556	T185/2	-75	0.13	22.2	1	0.3	
1557	T185/3	75+	0.13	20.8	1	0.4	
1558	T188/1	0-25	0.38	27.9	1	0.3	Br
1559	T188/2	-75	0.21	19.0	1	0.8	
1560	T188/3	75+	0.18	21.9	1	0.8	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1561	T191/1	0-25	1.34	36.4	4	0.4	Br
1562	T191/2	-75	7.03	38.9	18	3.3	
1563	T191/3	75+	5.69	39.1	15	6.0	
1564	T194/1	0-25	0.31	24.8	1	0.6	Br
1565	T194/2	-75	2.89	17.4	17	3.8	
1566	T194/3	75+	6.53	18.0	36	8.0	
1567	T206/1	0-25	3.38	45.3	7	0.4	Ba
1568	T206/2	-75	1.80	45.6	4	0.3	
1569	T206/3	75+	1.89	47.2	4	0.9	
1570	T209/1	0-25	2.47	50.0	5	0.3	Ba
1571	T209/2	-75	3.04	46.3	7	0.4	
1572	T209/3	75+	10.53	50.6	21	1.1	
1573	T224/1	0-25	2.33	49.2	5	0.4	Ba
1574	T224/2	-75	6.64	48.3	14	2.7	
1575	T224/3	75+	9.29	48.6	19	5.4	
1576	T227/1	0-25	1.38	49.0	3	0.4	Ba
1577	T227/2	-75	8.13	48.4	17	1.5	
1578	T227/3	75+	8.73	47.6	18	4.5	
1579	T230/1	0-25	1.73	50.8	3	0.4	Ba
1580	T230/2	-75	8.13	47.2	17	1.06	
1581	T230/3	75+	12.3	46.2	27	5.8	
1582	T233/1	0-25	1.39	44.2	3	0.3	Ba
1583	T233/2	-75	6.60	31.7	21	0.9	
1584	T233/3	75+	2.63	21.9	12	6.4	
1585	T236/1	0-25	1.64	34.5	5	0.4	Ba
1586	T236/2	-75	5.59	26.5	21	1.8	
1587	T236/3	75+	8.70	28.8	30	4.2	
1588	T239/1	0-25	5.92	40.9	14	2.4	Ba
1589	T239/2	-75	8.73	28.7	30	7.5	
1590	T239/3	75+	10.13	39.3	26	7.0	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1591	T242/1	0-25	1.66	23.9	7	0.4	Ba
1592	T242/2	-75	6.48	26.4	25	1.5	
1593	T242/3	75+	4.25	14.8	29	6.4	
1594	T245/1	0-25	1.00	34.7	3	0.4	Ba
1595	T245/2	-75	6.27	22.6	28	3.0	
1596	T245/3	75+	4.63	22.5	21	6.7	
1597	T248/1	0-25	0.97	23.0	4	0.4	Ba
1598	T248/2	-75	2.64	12.3	21	0.6	
1599	T248/1	75+	5.35	14.0	38	0.7	
1678	T260/1	0-25	0.15	39.0	0	2.3	Br/Mo
1679	T260/2	25-75	3.32	36.4	9	6.7	
2680	T260/3	75+	5.43	39.7	14	6.7	
2681	T273/1	0-25	1.78	57.4	3	0.4	Ba
2682	T273/2	25-75	7.37	55.4	13	1.1	
2683	T273/3	75+	9.96	55.4	18	3.5	
2684	T276/1	0-25	2.50	56.3	4	0.5	Ba
2685	T276/2	25-75	6.60	52.4	13	0.7	
2686	T276/3	75+	8.85	54.4	16	3.9	
2687	T279/1	0-25	0.54	51.5	1	0.8	Ba
2688	T279/2	25-75	2.44	48.5	5	2.1	
2689	T279/3	75+	1.78	34.3	5	4.8	
2690	T287/1	0-25	0.60	36.7	2	2.1	As
2691	T287/2	25-75	0.52	25.7	2	0.8	
2692	T288/1	0-30	0.15	29.2	1	0.8	As
2693	T289/1	0-25	0.04	20.1	0	0.7	As
2694	T289/2	25-75	0.08	19.7	0	0.9	
2695	T289/3	75+	0.20	19.6	1	0.6	
2696	T290/1	0-25	0.04	10.6	0	0.7	As
2697	T290/2	25-75	0.13	9.7	1	1.9	
2698	T290/3	75+	0.21	11.7	2	0.4	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1600	S118/1	0-25	2.33	49.6	5	0.6	Un
1601	S118/2	-75	5.77	48.8	12	0.4	
1602	S118/3	75+	7.69	47.7	16	4.0	
1603	S120/1	0-25	0.46	29.8	2	1.1	Ua/vB
1604	S120/2	-75	1.41	29.2	5	1.0	
1605	S120/3	75+	3.15	28.9	11	0.8	
1606	S122/1	0-25	1.78	40.9	4	0.8	Ua
1607	S122/2	-75	4.70	36.9	13	6.2	
1608	S122/3	75+	3.85	40.5	10	4.2	
1609	S124/1	0-25	0.09	14.1	0	0.4	Ba/vB
1610	S124/2	-75	0.24	16.7	1	0.4	
1611	S124/3	75+	2.45	16.7	15	1.8	
1612	S126/1	0-25	0.28	39.3	1	2.4	Ua
1613	S126/2	-75	2.00	29.4	7	5.0	
1614	S126/3	75+	5.50	20.5	27	8.6	
1615	S128/1	0-25	1.00	38.7	3	0.7	Ua
1616	S127/2	-75	2.80	38.9	7	5.0	
1617	S128/3	75+	4.83	20.5	24	7.6	
1618	S130/1	0-25	2.20	43.3	5	0.6	Am
1619	S130/2	-75	6.77	27.6	25	3.2	
1620	S130/3	75+	6.13	29.1	21	9.6	
1621	S132/1	0-25	0.41	42.4	1	1.2	Am
1622	S132/2	-75	0.42	19.6	2	2.8	
1623	S132/3	75+	2.08	24.9	8	5.7	
1624	S134/1	0-25	1.73	40.5	4	0.6	Am
1625	S134/2	-75	4.05	37.8	11	1.0	
1626	S134/3	75+	3.33	19.2	17	0.6	
1627	S135/1	0-25	0.54	38.8	1	1.0	Am
1628	S135/2	25+	0.31	31.5	1	1.3	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1629	S136/1	0-25	0.73	41.2	2	0.5	Am
1630	S136/2	-75	1.95	12.8	15	4.9	
1631	S136/3	75+	4.13	8.3	50	7.3	
1632	S137/1	0-25	2.78	36.0	8	7.2	Am
1633	S137/2	-75	6.88	15.7	44	11.5	
1634	S137/3	75+	4.13	13.6	30	10.8	
1635	S139/1	0-25	1.68	25.0	7	0.5	Am
1636	S139/2	-75	6.43	36.0	18	1.7	
1637	S139/3	75+	5.50	16.8	33	6.5	
1638	S140/1	0-25	1.08	44.5	2	0.8	Am
1639	S140/2	-75	1.84	40.7	5	4.0	
1640	S140/3	75+	7.50	34.5	22	6.0	
1641	S141/1	0-25	2.50	46.0	5	0.7	Am
1642	S141/2	-75	4.41	40.5	11	5.0	
1643	S141/3	75+	5.38	34.0	16	7.1	
1644	S143/1	0-25	2.47	40.3	6	0.6	Ua
1645	S143/2	-75	11.16	40.4	28	5.0	
1646	S143/3	75+	8.95	42.2	21	8.6	
1647	S144/1	0-25	1.56	45.2	3	0.5	Ua
1648	S144/2	-75	6.40	43.2	15	1.6	
1649	S144/3	75+	9.25	40.0	23	9.7	
1650	S145/1	0-25	0.79	43.7	2	0.4	Ua
1651	S145/2	-75	2.98	40.5	7	4.2	
1653	S145/3	75+	9.13	39.8	23	7.1	
1654	S146/1	0-25	0.33	42.7	1	2.2	Ua
1655	S146/2	-75	2.04	33.5	6	3.5	
1656	S146/3	75+	4.83	31.0	16	7.6	
1657	S147/1	0-25	1.19	45.5	3	0.8	Ua
1658	S147/2	-75	5.56	43.9	13	1.2	
1659	S147/3	75+	3.95	42.9	9	4.9	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1660	S154/1	0-25	2.19	28.5	8	0.7	Ua
1661	S154/2	-75	9.60	26.9	36	3.8	
1662	S154/3	75+	8.25	31.7	26	6.5	
1663	S155/1	0-25	2.88	38.9	7	0.8	Ua
1664	S155/2	-75	10.30	39.2	26	3.6	
1665	S155/3	75+	16.00	41.4	39	6.1	
1666	S156/1	0-25	2.63	43.7	6	0.6	Ua
1667	S156/2	-75	9.85	42.9	23	3.8	
1668	S156/3	75+	8.13	40.8	20	6.8	
1669	S157/1	0-25	1.20	36.4	3	0.6	Ua
1670	S157/2	-75	6.44	38.4	17	3.3	
1671	S157/3	75+	9.70	39.5	25	7.6	
1711	S158/1	0-25	4.11	48.4	8.0	0.6	Ua
1712	S158/2	25-75	8.13	50.3	16	5.9	
1713	S158/3	75+	9.50	48.9	19	8.9	
1714	S159/1	0-25	2.43	26.4	9.0	1.0	Ua
1715	S159/2	25-75	3.85	26.7	14	6.0	
1716	S159/3	75+	4.13	27.9	15	7.4	
1717	S162/1	0-25	1.38	55.2	3.0	0.4	Ba
1718	S162/2	25-75	5.87	60.8	10	0.6	
1719	S162/3	75+	9.90	64.3	15	1.2	
1720	S165/1	0-25	1.33	49.6	3.0	0.4	Ba
1721	S165/2	25-75	7.60	45.3	17	1.5	
1722	S165/3	75+	10.30	49.2	21	4.2	
1723	S168/1	0-25	1.20	52.4	2.0	0.7	Ba
1724	S168/2	25-75	9.60	52.4	18	2.1	
1725	S168/3	75+	7.60	39.5	19	0.7	
1726	S171/1	0-25	3.44	52.7	7	0.6	Ba
1727	S171/2	25-75	7.27	52.6	14	1.2	
1728	S171/3	75+	6.00	48.8	12	5.2	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1729	S174/1	0-25	2.41	51.6	5	0.5	Ba
1730	S174/2	25-75	8.02	52.5	15	1.2	
1731	S174/3	75+	6.75	49.4	14	5.2	
1732	S177/1	0-25	2.25	53.1	4	0.5	Ba
1733	S177/2	25-75	2.75	42.8	6	3.3	
1734	S177/3	75+	6.87	39.5	17	5.9	
2666	S180/1	0-25	1.05	57.4	2	0.4	Ba
2667	S180/2	25-75	3.18	57.4	6	0.5	
2668	S180/3	75+	4.39	57.4	8	0.5	
2669	S183/1	0-25	2.38	60.3	4	0.3	Ba
2670	S183/2	25-75	7.20	60.8	12	0.7	
2671	S183/3	75+	9.00	61.7	15	1.7	
2672	S186/1	0-25	2.36	55.8	4	0.6	Ba
2673	S186/2	25-75	7.00	54.4	13	2.0	
2674	S186/3	75+	3.95	46.9	8	6.1	
2675	S189/1	0-25	3.82	51.7	7	0.5	Ba
2676	S189/2	25-75	7.10	51.6	14	1.4	
2677	S189/3	75+	4.00	47.1	8	5.3	
2735	DS02/1	0-25	0.79	52.7	1	1.5	Ua
2736	DS02/2	25-75	2.26	52.5	4	3.8	
2737	DS02/3	75+	7.70	51.9	15	0.6	
2738	DS03/1	0-25	4.99	55.4	9	0.6	Ua
2739	DS03/2	25-75	8.41	54.4	15	4.0	
1740	DS03/3	75+	6.20	56.0	11	6.6	
1741	DS06/1	0-25	3.71	56.7	7	0.6	Ua
1742	DS06/2	25-75	2.88	49.5	6	4.9	
1743	DS06/3	75+	4.80	45.2	11	7.1	
1744	DS08/1	0-25	13.67	46.8	29	1.4	Ua
1745	DS08/2	25-75	0.44	47.8	1	4.2	
1746	DS08/3	75+	6.75	48.6	14	6.9	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
1747	DS10/1	0-25	3.24	56.9	6	0.5	Ua
1748	DS10/2	25-75	6.18	55.5	11	0.7	
1749	DS10/3	75+	3.73	53.8	7	4.6	
1750	DS13/1	0-25	1.56	48.6	3	0.6	Ua
1751	DS13/2	25-75	6.55	49.5	13	3.1	
1752	DS13/3						
1753	DS25/1	0-25	3.85	56.4	7	0.6	Ua
1754	DS25/2	25-75	7.43	57.5	13	1.9	
1755	DS25/3	75+	4.88	55.0	9	6.3	
1756	DS29/1	0-25	1.45	55.9	3	0.5	Ua
1757	DS29/2	25-75	3.59	54.5	7	2.6	
1758	DS29/3	75+	6.88	44.8	15	6.3	
2699	FS14/1	0-25	1.12	17.9	6	1.0	VB
2700	FS14/2	25-75	4.80	16.3	29	2.6	
2701	FS14/3	75+	5.40	15.9	34	7.6	
2702	FS18/1	0-25	1.00	18.5	5	0.4	VB
2703	FS18/2	25-75	6.00	21.0	29	2.9	
2704	FS18/3	75+	4.80	24.6	20	2.3	
2705	FS22/1	0-25	0.42	31.0	1	0.6	VB
2706	FS22/2	25-75	2.90	27.1	11	0.9	
2707	FS22/3	75+	5.40	27.8	19	6.5	
2708	FS25/1	0-25	0.65	25.0	3	0.5	VB
2709	FS25/2	25-75	6.40	25.1	25	2.9	
2710	FS25/3	75+	9.90	27.7	36	6.4	
2712	FS28/1	0-25	0.45	28.0	2	0.8	VB
2713	FS28/2	25-75	3.15	32.8	10	1.7	
2714	FS28/3	75+	6.20	42.6	15	7.5	
2715	QS03/1	0-25	0.42	29.5	1	0.8	Am
2716	QS03/2	25-75	1.24	28.6	4	3.5	
2717	QS03/3	75+	3.30	40.4	8	5.6	

LAB No.	SAMPLE No.	DEPTH cm	EXCH Na me/100g	CEC me/100g	ESP	EC_e mmhos/cm	SOIL CLASS
2718	QS06/1	0-25	1.25	39.6	3	0.4	Am
2719	QS06/2	25-75	4.50	31.4	14	3.4	
2720	QS06/3	75+	4.80	40.2	12	6.2	
2721	QS09/1	0-25	1.39	32.0	4	0.5	Am
2722	QS09/2	25-75	1.27	31.7	4	3.4	
2723	QS09/3	75+	2.92	46.0	6	4.6	
2724	QS13/1	0-25	0.64	36.0	2	0.5	Am
2725	QS13/2	25-75	1.43	34.5	4	3.5	
2726	QS13/3	75+	4.70	24.7	19	5.4	

B.4 SURFACE INFILTRATION

Surface infiltration tests were carried out at two sites within the possible irrigation development area.

At each site triplicate infiltration rings were installed to a depth of 150 mm and an approximate constant head of water was maintained in each of the rings.

Half hourly infiltration rates were measured over a period of seven hours. The results of the tests are summarised in Table B.1. The data have not been corrected for evaporation during the test period. However, observations from Class A pans at Bonkay Research Station indicated that 24 hour evaporation rates ranged from 7 to 8 mm/hr. In the tables t (hrs and mins) and Σi (mm) are mean values of observations recorded from the three tests at each site.

TABLE B.1 INFILTRATION DATA FOR IRRIGATION AREAS

T119			T136		
t		Σi	t		Σi
hr	min	mm	hr	min	mm
00	30	92	00	30	72
01	00	171	01	00	121
01	30	250	01	30	163
02	00	332	02	00	202
02	30	417	02	30	239
03	00	511	03	00	275
03	30	589	03	30	310
04	00	684	04	00	343
04	30	760	04	30	377
05	00	881	05	00	407
05	30	977	05	30	437
06	00	1088	06	00	468
06	30	1185	06	30	498
			07	00	528

APPENDIX C

THE AERIAL CENSUS SURVEY

C.1 INTRODUCTION

This appendix includes the tabulated census data from the aerial census carried out for the BRADP by Resource Management and Research Limited (RMR) in February and March 1982.

The data has been tabulated by the 29 geomorphological strata that were identified, and these are shown in Figure C.1.

If there is a need to present data according to any other land classification (for example there are strong arguments to show results by an easily perceived District classification) a pro-rata redistribution and partitioning procedure can be employed based on areas.

For example if District A comprises strata 1, 2, 3, and 4 in their entirety, and 33 per cent of stratum 5 and 28 per cent of stratum 6 by area, then the population of any feature in District A is the sum of that feature in strata 1 to 4, plus 33 per cent of the feature in stratum 5 and 28 per cent of the feature in stratum 6.

The density of that feature in District A then becomes the population estimated as above, divided by the area of District A.

C.2 METHODOLOGY

The system can be broken down into three stages as follows:

- soil and vegetation stratification
- sampling
- interpretation of sampling and estimation of population numbers.

C.2.1 Stratification

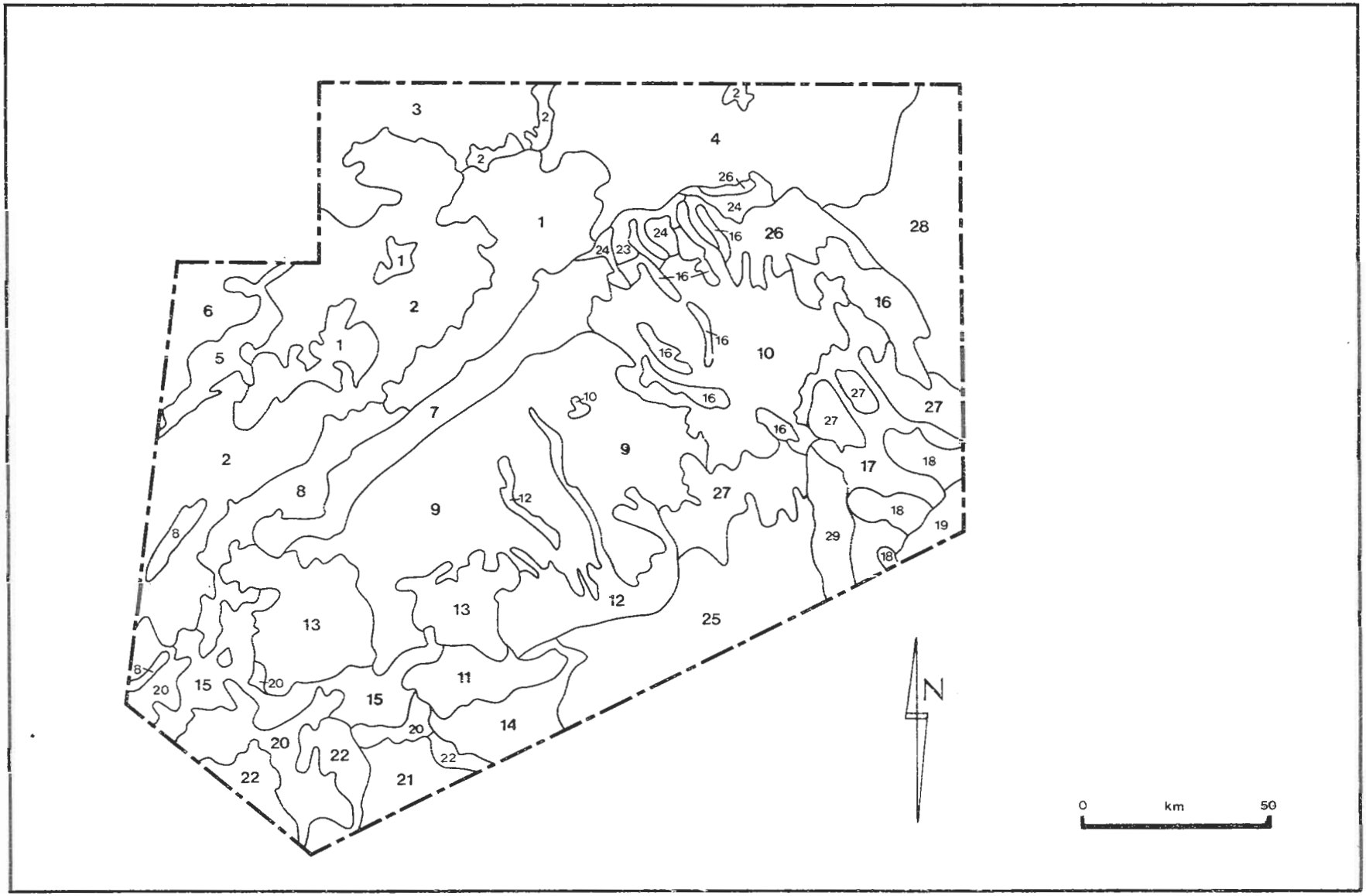
The purpose at this stage is to break up the heterogeneous survey area into units of relative homogenity in order to improve the efficiency of the sampling and to provide units of land of a convenient size for the actual flying programme. It also provides a better understanding of the relationship between livestock numbers and distribution, and the range resources available.

In the current study the stratification was established by examination of map, photographic, LANDSAT imagery and reconnaissance flying over the area.

The following features are included in the evaluation:

- Topography
- Drainage pattern
- Soils
- Water source distribution
- Vegetation
- Human use (mostly cultivation).

C.1 Aerial census strata



LEGEND FOR FIGURE C.1.

GEOMORPHOLOGICAL CLASS	NUMBER	STRATUM DESCRIPTION
Clay plains on Limestone	1	Baidoa-Talissa and Kansadere Plain
	5	Malmaalka Plain
	8	Korow and Shongolou Plains
	20	Banada, Qurdhuuba and Juwaarey Plains
Clay Plains on Basement Complex	10	Bur Acaba Plain
	12	Ramudle Plain and Valleys
	17	Guuriyo Plain
	21	Togga Bohol Dheelo Plain
Clay Plains on Coastal Deposits	19	Saraar Goobo Plain
	29	Togga Uruugey Fan
Mixed Limestone and Basement Valleys	24	Baidoa Escarpment/valleys
Limestone Plateau	2	Berdaale Plateau
	3	Adegow Plateau
	4	Northern Plateau
	6	Togga Juba Escarpment
	15	Togga Juwarrey Plateau
	28	North Eastern Plateau
Basement Peneplain	9	Marreerd peneplain
	13	Buur Muun and Buur Dabeeley Eroding Peneplain
	16	Northern Peneplain Remnants
	27	Eastern Peneplain Remnants
Basement - Limestone interface	7	Dinsoor/Baidoa Escarpment and Footslope
	23	Baidoa Eastern Escarpment and Footslope
	26	Beer Shabool Escarpment.
Coastal Deposits	11	Yak Brawe Coastal Deposits
	14	Heylin Coastal Sand Plain
	18	South Eastern Plain
	22	South Western Coastal Plain
	25	Southern Coastal Plain

A reconnaissance at between one and five thousand feet above the ground over the whole Region was made to determine the criteria and approximate position of the geomorphic units. These were draft plotted on colour copies of the 1:100 000 survey department maps.

Aids in this work were the Lockwoods soil map boundaries transferred by eye to the 1: 100 000 maps, and the data of the 1:100 000 maps themselves. (The latter are much more informative and accurate.)

The draft boundaries were checked and re-drawn by further boundary investigation flying which took place at levels of 1 000 to 4 000 feet above the ground.

The high resolution LANDSAT imagery was also used to refine the final boundaries, and adjustments of boundaries were made during the census flying.

Descriptions of land system units were made during the mapping flying and these were modified and augmented during the census flying.

C.2.2 Sampling

Samples take the form of transects flown in a straight line across the stratum. The number of samples selected for each stratum will vary according to size and density of population but rarely fell below six and generally averaged between eleven and twelve. Where unexpectedly high densities occurred extra samples were flown. Samples selection is random with probability proportional to size. Orientation of samples is demonstrated in Figure C.2, where orientation is at right angles to the ecological axis of the stratum. Sampling strategy is geared to allow for migration and other movements in the unavoidable physical time scale necessary to cover the area. Figures C.3 and C.4 demonstrate the practices applied.

Samples are demarcated by an optical method using an observation framework attached to the wing struts of the aircraft, which is designed to give the pilot an easily observed and defined area for counting. This system allows for predetermination of the sample area at given altitudes, banked flight, angle of terrain and nature of the stratum, using trigonometrical principles.

Strip samples were flown across each land system unit at a height of 360 feet above the ground, at a speed of 100 km/hour, making observations of a strip 234 m wide.

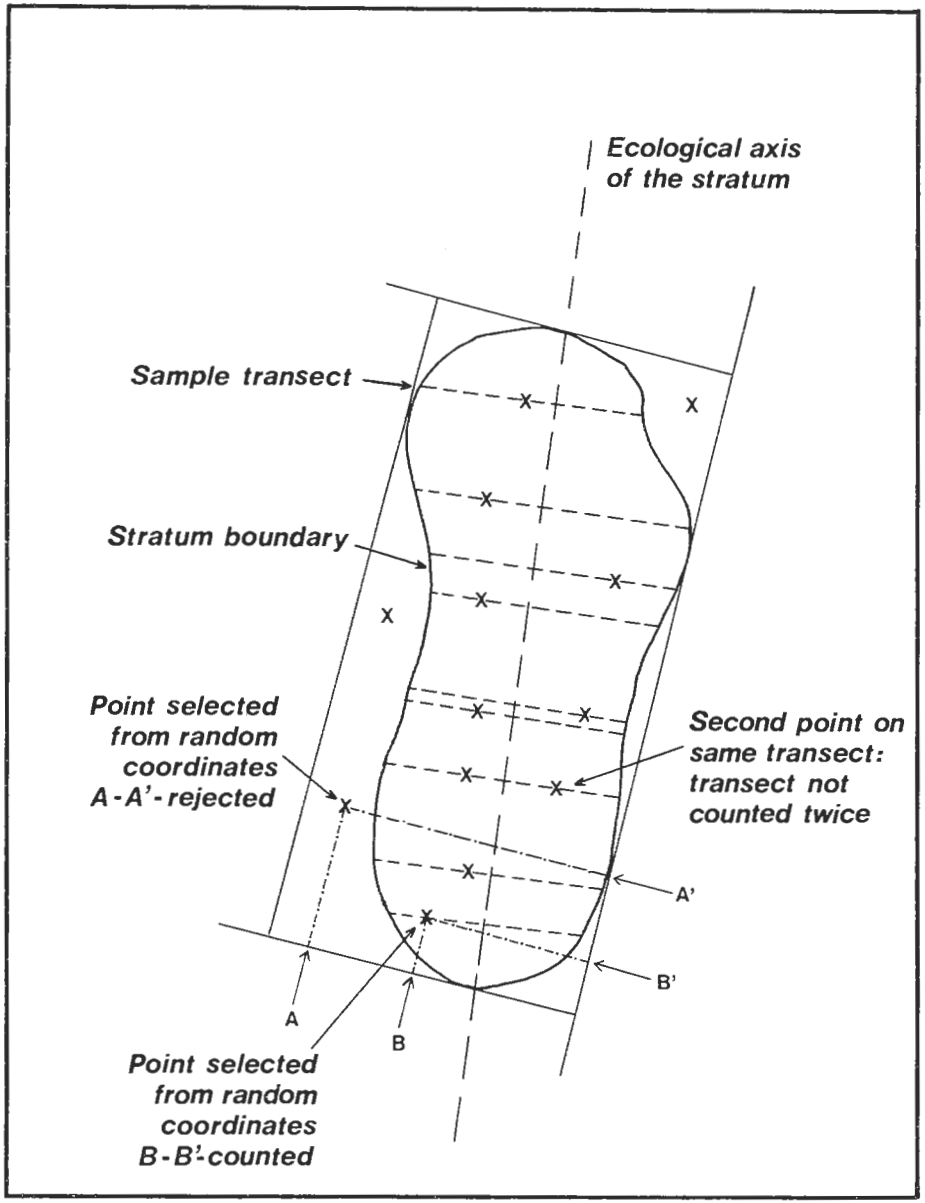
The percentage of the Bay Region enumerated was 4.17 per cent.

All counting was recorded on tape as the sampling progressed and where relatively dense groups of phenomenon, particularly smaller animals, were seen the transect was temporarily broken for photography and later counting.

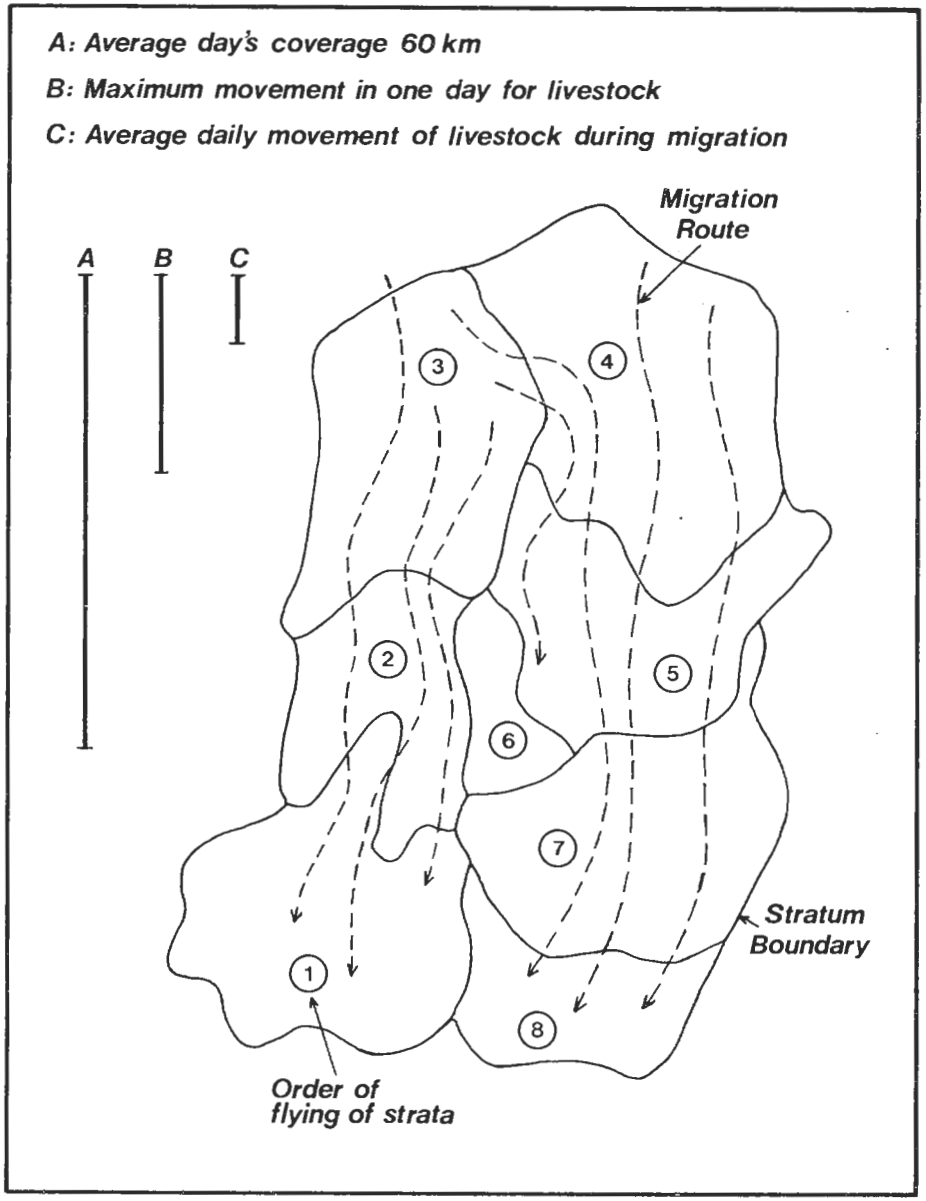
C.2.3 Sampling Errors

Correction factors, using the Watson-Jolly bias estimation method were based upon extensive calibrations carried out in the Central and Northern Rangelands of Somalia, (Resource Management and Research 1979) and additional observations in the Bay Region.

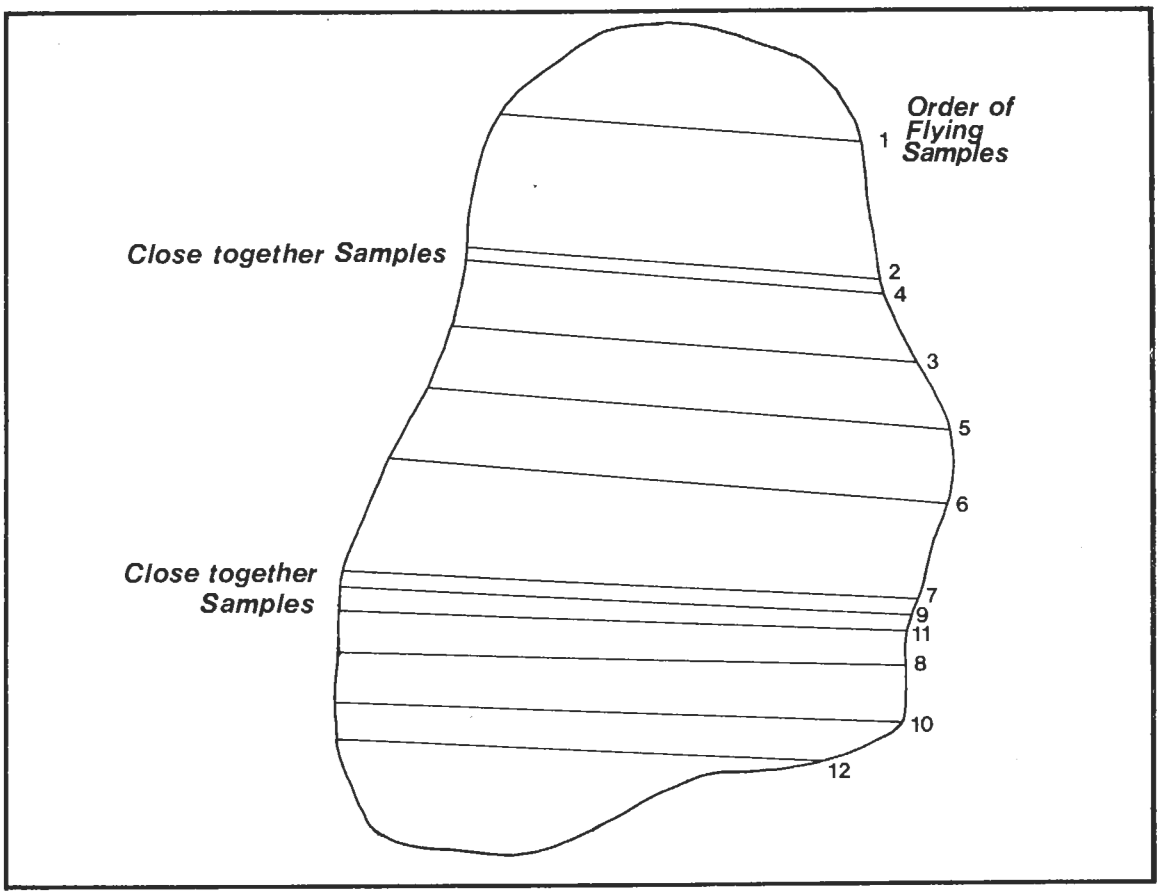
C.2 Orientation of samples



C.3 Sampling strategy



C.4 Treatment of Close Together Samples



The factors were:

	Cattle	Goats Sheep	Camels Donkeys	Wildlife
Strata 1, 10, and 8 ("open" category of cover following the terminology and criteria of the Central and Northern Rangelands studies)	1.050	1.078	1.091	1.312
All other strata ("dense" to "very dense" category of cover)	1.264	1.320	1.275	2.280

C.2.4 Sample Data

The features photographed for counting, or counted directly were:

Livestock

Cattle - classified as free ranging or drinking or being fed on sorghum stover

Camels - classified as free ranging or drinking or being fed on sorghum stover or being used for draught

Goats

Sheep

Horses

Donkeys

In addition groups of livestock judged to be migrating between grazing areas (this could be determined from the carriage of aqallo by camels) were noted separately.

Wildlife

Gerenuk
Lesser Kudu
Elephant tracks
Elephant carcass
Giraffe
Porcupine
Oryx
Baboon
Quaelia
Duiker
Warthog

Houses and Structures

Conical grass roofed house ('Mudul')
Tin roofed houses (ridged)
Grass roofed houses (ridged) ('Carish')
Domed houses on light frame using skins, mats, etc. ('Aqal')
(NB The latter have been separately classified depending upon their inferred degree of permanence, aquallo not in villages have been separated and assumed to be truly migratory).
Cubical grass/branch houses with no walls or insubstantial walls Agricultural shelters - conical grass roofed houses without walls or with walls or large logs.

Shelter made of poles
Grain stores with conical grass roof and mud walls
Shelter made from living tree
Underground grain stores, usually enclosed by thorns
Grain stored on the surface in piles, usually enclosed by thorns
Stores of sorghum stover
Occupied livestock enclosures
Abandoned livestock enclosures

Charcoal Production Features

Sites of old charcoal kilns
Functioning charcoal kilns
Charcoal makers' camps (these have a very characteristic type of house with a flat grass roof, upon which red earth is piled to a depth of 1 m)
Piles of timber cut and prepared awaiting carbonisation
Piles of charcoal awaiting collection.

Water Sources

Small stock ponds in clay or other heavy soils (war, waro, warta)
(NB These have been classified as "with water"
"dry"
"under construction"
"abandoned")
Wells (ceel, ceelal)
(NB These have been classified as : "riverine" "fossil sand dune"
"other")
Natural depressions seasonally collecting water (balli, balliyo)
(NB these have been classified as "dry"
"with water")

Riverine pool
Rainwater pans - small ephemeral pools
Flowing rivers/streams
Springs (il, isha)

Land Use

Land use, on the other hand has been estimated by the following approach:

The inner transect demarcator is considered to pass over the land as a line intersect sampling line. two stop-watches are operated to provide estimates of the time taken to pass over different land use categories. The distinguishable categories are:

Cropped - land with evidence of the last season's crop. In the Bay Region this land is easily recognisable, because almost the only crop is sorghum, which leaves distinct and easily identifiable stalks (stover). It appears that even when stover is cut and removed for livestock some stalks remain on the field surface.

Ploughed - land which has been ploughed since the last season's cropping, and which may or may not have been cropped then. There is a sub category MECHANICALLY PLOUGHED.

*Fallow - previously cropped land which was not cropped last season, but upon which the regeneration of vegetation has not yet produced woody species beyond the "dwarf shrub" height.

*Abandoned - previously cropped land which was not cropped last season, and upon which the regeneration of vegetation has produced woody species taller than dwarf shrubs.

Irrigated - Irrigated land. This is confined to one of the valleys of stratum 24, making use of water pumped from the Togga Shiikh Asharrow, or from shallow wells close to the stream.

Range - land which has never been cultivated.

*This term implies no status in the cropping system. It is used purely as a descriptive label for the degree of regeneration observed.

The total time for flying any line transect is also recorded, and thus the percentages of land under each category for each sample, and, by normal computation, for each stratum, are estimated.

This method was applied for all strata except 1 and 8. In these the data on the 1:100 000 survey maps was found to be sufficiently good to allow a modification of the approach:

The line intersect of the flight path can be judged in flight very precisely in relation to the 1:100 000 surveys maps. Therefore the segments of flight path over cropped, fallow or recently abandoned land, according to these maps (white and bounded by dotted line) have been recorded separately from segments over uncultivated or long term abandoned land (green).

In the segments of flight path over white parts of the map, all categories of land except cropped, as defined above, have been timed, and cropped land found by subtraction. In segments over green parts of the map all categories of land except range, as defined above, were timed, and range land was found by subtraction. Measurements were then made of the survey department maps to partition the time recorded for the total transect into "white" and "green" segments.

This modification allows a more precise examination of cropping trends since the 1973 aerial photography, on which the survey department maps are based.

C.3 COMPARISONS WITH 1973 SURVEY DEPARTMENT DATA

The 1:100 000 scale Survey Department Maps provide detailed information on water sources, houses and land use based on the 1973 air photographs. A number of comparisons between this information and the census data are drawn in the following paragraphs.

C.3.1 Land Use

- at a general reconnaissance level the 1:100 000 maps used during the flying have been annotated where conspicuous changes of land use have been observed. These changes have been, for the most part, an expansion of rain fed farming, an abandonment of rain fed farming, and the production of charcoal. It is interesting to speculate on the absence of any features on the 1:100 000 maps indicating charcoal tracks, kilns or camps of charcoal producers. Possibly this activity has developed since 1973; the features in question would certainly be visible on 1:40 000 photographs.

- at a more quantitative level, the results of line intersect sampling undertaken during this census have been compared with a line intersect sampling performed on the maps, along the flight lines of the aerial census. In order to make this comparison it has been assumed that the areas marked as cropland (white surrounded by a dotted line) cover the categories: cropped, fallow and abandoned fields, but it is recognised that later stages of regeneration of low bushland on abandoned fields will render them indistinguishable from unmanaged rangelend. Obviously observations made on 1:40 000 aerial photographs, and the direct observation from 350 feet are unlikely to be in agreement on this issue, and it is probable that the methods of this survey will have enabled fields to be still recognised substantially later in the bush-land regeneration process.

C.3.2 Water Sources

- new water sources have been added to the 1:100 000 maps where they have been observed, but this has not been systematically carried out, and indeed such an up-dating of the 1973 map data would be a major task

- all waro, bore holes and wells marked on the 1:100 000 maps have been listed for the land system units of the census, and these estimates have been compared with the results of the aerial census.

C.3.3 Houses

- new villages have been marked on the 1:100 000 maps where they have been observed, and in most cases the houses in the villages have been counted. This work has not been systematically performed, and many new villages have remained unmapped.

- the houses in a selection of villages marked on the 1:100 000 maps have been carefully counted from the air, and the houses categorised as permanent (i.e. all types except aquallo) and temporary (i.e. aqallo). Since most villages mapped from the 1973 photographs were enumerated in the same way, these data can provide an indication of trends in the population over the period 1973 to 1982.

- "houses" as denoted on the 1:100 000 survey maps fall into three categories:

    - village houses - permanent (the first number under the village name

    - village houses - temporary (the second number under the village name

    - non village aqallo - marked by the symbol " " and sometimes denoted as qual, indicating one house, and sometimes as aqallo, indicating more than one.

These have been counted for each land system unit, and the estimates compared wth those from the aerial census. The comparison is hampered by the fact that large villages have no accompanying house estimates on the survey maps, and by the absence of notation beside most of the aquallo symbols as to whether a single house or group of houses is indicated. In general it is assumed to represent a cluster of aqallo.

C.4 RESULTS OF THE AERIAL CENSUS

The results of the census are set out in Tables C.1 to C.11.

Data for the whole Bay Region has been derived together with a standard error or sampling error. A confidence interval may be derived in the normal way, assuming normality of distributions of error and a "large" number of sampling units (more than 30). For example 95 per cent confidence limits, under this assumption, are 1.96 times the sampling error.

The per cent sample cover shown in Table C.1 applies throughout the tables for the various strata.

TABLE C.1 LIVESTOCK IN THE BAY REGION

	%	Cattle		Cattle	Goats		Sheep		Camels		Camels	Camels	Donkeys		Horses		
	Sample Cover	Dens /km^2	Est No	"Stall Fed" %	Dens /km^2	Est No.	Dens /km^2	Est No.	Dens /km^2	Est No.	"Stall Fed" %	Draught %	Dens /km^2	Est No.	Dens /km^2	Est No.	Area km^2
1	5.09	27.182	70 130	3.90	37.856	97 668	1.380	3 560	12.276	31 672	11.59	1.39	0.078	201	0.008	21	2 580
2	3.27	6.326	29 783	-	13.824	65 083	1.678	7 900	11.305	53 224	5.89	0.09	0.007	33	-	-	4 708
3	3.49	2.133	2 833	-	12.502	16 603	0.172	228	11.899	15 802	-	-	-	-	-	-	1 328
4	2.99	0.778	2 353	-	1.072	3 242	0.341	1 031	5.443	16 460	-	-	-	-	-	-	3 024
5	4.80	1.777	626	-	-	-	-	-	1.721	606	-	-	-	-	-	-	352
6	6.49	7.915	5 857	-	15.923	11 783	4.022	2 976	9.695	7 174	-	-	-	-	-	-	740
7	3.54	8.077	10 726	-	18.112	24 053	0.444	590	11.393	15 130	-	-	-	-	-	-	1 328
8	5.68	15.375	17 220	-	15.918	17 828	2.454	2 748	9.654	10 812	2.49	-	-	-	-	-	1 120
9	4.00	6.128	32 724	-	6.791	36 264	0.765	4 085	10.369	55 370	-	-	-	-	-	-	5 340
10	4.13	19.296	51 173	-	14.416	38 231	2.515	6 670	9.975	26 454	-	-	0.094	249	-	-	2 652
11	8.68	16.911	11 432	-	3.159	2 135	0.844	571	0.741	501	-	-	-	-	0.024	16	676
12	4.82	40.794	40 631	-	10.261	10 220	0.456	454	27.225	27 116	-	-	-	-	-	-	996
13	3.18	8.684	14 589	-	1.239	2 082	0.518	870	3.545	5 956	-	-	-	-	-	-	1 680
14	3.40	5.398	3 951	-	1.644	1 203	-	-	3.180	2 328	-	-	-	-	-	-	732
15	4.62	9.185	12 381	-	2.144	2 890	0.416	561	8.099	10 917	-	-	-	-	-	-	1 348
16	4.00	8.697	10 228	-	6.485	7 626	1.524	1 792	9.318	10 958	-	-	-	-	-	-	1 176
17	6.23	4.386	4 105	-	1.301	1.218	-	-	3.153	2 951	-	-	-	-	-	-	936
18	5.09	2.643	1 607	-	-	-	-	-	3.930	2 389	-	-	-	-	-	-	608
19	6.11	9.310	1 974	-	1.132	240	1.660	352	2.187	464	-	-	-	-	-	-	212
20	6.05	21.093	21 220	-	4.076	4 100	0.040	40	4.716	4 744	-	-	-	-	0.047	47	1 006
21	5.22	5.008	2 264	-	2.027	916	0.271	122	9.343	4 223	-	-	-	-	-	-	452
22	3.15	3.712	4 573	-	0.376	463	0.050	62	1.190	1 466	-	-	-	-	-	-	1 232
23	7.19	4.443	586	-	3.909	516	0.793	105	27.083	3 575	-	-	0.091	12	-	-	132
24	7.58	2.103	513	-	14.736	3 596	2.699	659	5.720	1 396	-	-	-	-	-	-	244
25	2.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 360
26	4.13	6.164	3 698	-	0.954	572	0.061	37	2.898	1 739	-	-	-	-	-	-	600
27	3.91	6.127	6 152	-	1.749	1 756	-	-	1.744	1 751	-	-	-	-	-	-	1 004
28	4.75	0.154	245	-	1.240	1 969	0.491	780	3.058	4 856	-	-	-	-	-	-	1 588
29	4.47	8.875	4 491	-	1.811	9.16	-	-	3.336	1 688	-	-	-	-	-	-	506
All Strata	-	9.05	368 065	-	8.68	353 173	0.89	36 193	7.91	321 722	-	-	0.01	495	0.002	84	40 672
Sampling error	-		+/-6 690	-		+/-6 937		+/-2 801		+/-7 482	-	-		+/-422		+/-146	

TABLE C.2 - WILDLIFE IN THE BAY REGION

Stratum	Gerenuk		Duiker		Lesser Kudu		Warthog		Giraffe		Oryx		Porcupine	
	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	0.006	28	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	0.979	1300	-	-	-	-
4	0.065	197	-	-	-	-	-	-	-	-	-	-	-	-
5	0.059	21	-	-	-	-	-	-	-	-	-	-	-	-
6	0.276	204	-	-	-	-	0.073	54	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	0.129	689	-	-	-	-	0.008	43	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	0.120	81	-	-	0.063	43	-	-	-	-	-	-	-	-
12	0.048	48	-	-	0.024	24	-	-	-	-	-	-	-	-
13	0.127	213	-	-	-	-	-	-	-	-	-	-	-	-
14	0.075	55	-	-	-	-	0.075	55	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	0.126	148	-	-	0.038	45	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	0.111	112	0.258	260	-	-	-	-	-	-	-	-
21	0.635	287	0.121	55	0.278	126	-	-	-	-	-	-	0.121	54
22	0.211	260	-	-	0.14	128	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	0.072	170	0.528	1246	-	-	-	-	0.030	71	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	0.223	354	-	-	0.069	110	-	-	0.034	54	-	-	-	-
29	-	-	-	-	0.195	99	-	-	-	-	-	-	-	-
All Strata Sampling Error	0.063	2585 +/-1053	0.008	337 +/-576	0.051	2081 +/-1304	0.004	152 +/-300	0.033	1354 +/-1063	0.002	71 +/-352	0.001	54 +/-135

TABLE C.2 Continued

Stratum	Elephant Tracks		Elephant Carcass		Baboon		Quelea Flock	
	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-
6	-	-	-	-	0.226	167	-	-
7	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-
9	-	-	0.011	59	-	-	0.031	166
10	-	-	-	-	0.007	8	0.042	47
11	-	-	-	-	0.024	16	-	-
12	-	-	-	-	-	-	-	-
13	0.083	139	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-
20	0.134	135	-	-	-	-	-	-
21	0.098	44	-	-	-	-	-	-
22	0.143	176	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-
27	-	-	0.050	50	-	-	-	-
28	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-
All Strata	0.012	494	0.003	109	0.005	191	0.005	213
Sampling Error		+/-253		+/−308		+/-241		+/-509

TABLE C.3 - NON NOMADIC HOUSES

Stratum	Conical Grass Roofed		Tin Roofed		Ridged Roofed		Domed Roof		Square Grass House		Abandoned Con Grass Roofed		Compound		Abandoned Compound	
	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No
1	3.944	10176	0.040	103	0.004 [1]	10	3.478	8973	0.023	59	0.309	797	3.170	8179	0.475	1226
2	1.323	6229	0.009	42	0.011 [1]	28	0.597	2811	0.016	75	0.229	1078	0.945	4449	0.137	645
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	0.861	1143	-	-	-	-	0.722	959	-	-	-	-	0.983	1305	-	-
8	0.556	623	0.073	82	-	-	0.470	526	-	-	-	-	0.488	547	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	3.012	7988	0.004	11	-	-	0.664	1761	-	-	0.089	236	2.055	5450	0.059	156
11	0.028	19	-	-	-	-	0.019	13	-	-	-	-	0.037	25	-	-
12	0.478	476	-	-	-	-	0.221	220	-	-	-	-	0.335	334	-	-
13	0.016	27	-	-	-	-	-	-	-	-	-	-	0.016	27	-	-
14	0.033	24	0.033	24	-	-	-	-	-	-	-	-	0.033	24	-	-
15	0.187	252	-	-	-	-	0.024	32	-	-	0.142	191	0.144	194	0.059	80
16	0.448	527	-	-	-	-	0.053	62	-	-	-	-	0.313	368	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	0.058	58	-	-	-	-	0.009	9	-	-	-	-	0.041	41	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	0.852	112	-	-	-	-	0.474	63	-	-	-	-	0.568	75	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	3.711	2227	-	-	-	-	0.318	191	-	-	-	-	2.439	1463	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
All Strata	0.735	29881	0.006	262	0.0002	10	0.384	15620	0.003	134	0.056	2302	0.553	22481	0.052	2107
Sampling Error		+/-2342		+/-258		+/-69		+/-1599		+/-228		+/-889		+/-1954		+/-720

Note: [1] *Abandoned ridged roofed 28 0.0007 +/-120*

TABLE C.4 - COMPARISON OF AERIAL CENSUS DATA (1982) AND INFORMATION FROM THE 1:100 000 MAPS (1973) ON NON NOMADIC HOUSES

	Permanent				Impermanent			
	Census		Maps		Census		Maps	
Stratum	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No
1	3.988	10289	2.498	6445	3.478	8973	1.223	3155
2	1.332	6271	0.346	1629	0.597	2811	0.040	188
3	-	-	0.083	110	-	-	-	-
4	-	-	0.088	266	-	-	0.023	70
5	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-
7	0.861	1143	0.252	335	0.722	959	0.248	329
8	0.629	705	0.224	251	0.470	526	0.207	232
9	-	-	0.025	134	-	-	0.071	379
10	3.016	7998	5.078	13467	0.664	1761	2.201	5837
11	0.028	19	-	-	0.019	13	-	-
12	0.478	476	0.061	61	0.221	220	0.136	135
13	0.016	27	0.014	24	-	-	0.016	27
14	0.066	48	-	-	-	-	-	-
15	0.187	252	0.059	80	0.024	32	0.011	15
16	0.448	527	1.167	1372	0.053	62	0.878	1033
17	-	-	0.219	205	-	-	0.045	42
18	-	-	0.013	8	-	-	0.007	4
19	-	-	-	-	-	-	0.042	9
20	0.058	58	0.589	593	0.009	9	0.153	154
21	-	-	-	-	-	-	-	-
22	-	-	0.005	6	-	-	0.003	4
23	0.852	112	0.447	59	0.474	63	0.568	75
24	-	-	1.164	284	-	-	1.029	251
25	-	-	-	-	-	-	-	-
26	3.711	227	-	-	0.318	191	0.010	6
27	-	-	0.024	24	-	-	0.045	45
28	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-
All Strata	**0.741**	**30143**	**0.623**	**25353**	**0.384**	**15620**	**0.295**	**11990**

TABLE C.5 - AGRICULTURAL FEATURES

Stratum	Stover Stack		Hay Store in Tree		Underground Grain Store		Surface Grain Store		Grain Store		Agricultural Shelter		Stable		Cart	
	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No
1	2.835	7314	0.096	248	2.028	5232	-	-	0.198	511	0.155	400	0.114	294	0.015	39
2	1.049	4939	-	-	0.156	734	-	-	0.073	344	0.062	292	0.121	570	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	0.088	266	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	0.160	56	-	-	-	-	-	-	0.087	31	0.123	43	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	0.254	337	-	-	0.028	37	-	-	-	-	0.031	41	-	-	-	-
8	1.331	1491	0.098	110	2.223	2490	0.489	548	0.154	172	0.462	517	0.137	153	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	0.683	1881	-	-	0.532	1411	-	-	-	-	0.128	339	0.041	109	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	0.056	38	-	-
12	0.059	59	-	-	0.298	298	0.020	20	-	-	0.190	189	-	-	-	-
13	0.127	213	-	-	0.032	54	-	-	-	-	-	-	0.127	213	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	0.191	225	-	-	0.024	28	-	-	-	-	-	-	0.024	28	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	0.566	569	-	-	0.466	469	-	-	-	-	0.375	372	0.037	37	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.071	9
24	-	-	0.075	18	0.075	18	-	-	-	-	0.075	17	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	0.023	14	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strata	**0.410**	**16679**	**0.10**	**390**	**0.248**	**10099**	**0.014**	**568**	**0.026**	**1058**	**0.054**	**2216**	**0.035**	**1442**	**0.001**	**48**
Sampling Error		+/-1631		+/-266		+/-1076		+/-293		+/-490		+/-639		+/-652		+/-118

TABLE C.6 - LIVESTOCK ENCLOSURES, NOMADIC HOUSES AND GRAVES

Stratum	Occupied Livestock Enclosure		Abandoned Livestock Enclosure		Tree Shelter		Grave		Occupied Aqal		Nos. of Aqal Shown on Survey Dept. Maps	
	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No	Dens/ Km^2	Est No
1	1.966	5072	1.228	3169	-	-	1.178	3039	4.134	10666	1.458	3761
2	1.119	5268	3.191	15023	0.014	66	0.589	2773	2.102	9896	0.203	956
3	0.146	194	2.337	3104	-	-	0.053	70	0.297	394	0.039	52
4	0.087	263	1.464	4427	-	-	0.048	145	0.233	705	0.039	118
5	0.114	40	1.676	590	0.152	54	0.125	44	0.265	93	0.045	16
6	0.338	250	3.587	2610	0.036	27	0.063	47	0.792	587	0.001	1
7	0.724	961	3.915	5199	-	-	0.063	84	1.661	2206	0.090	120
8	1.387	1553	1.513	1695	-	-	0.213	239	3.165	3545	0.284	318
9	0.256	1367	2.985	15940	-	-	0.107	571	0.698	3727	0.019	101
10	0.515	1366	1.982	5256	-	-	0.366	971	1.431	3795	0.957	2538
11	0.079	53	2.210	1494	-	-	0.038	26	0.497	336	0.003	2
12	0.848	845	1.901	1893	-	-	0.142	141	3.188	3175	0.076	76
13	0.701	1178	2.528	4247	-	-	0.144	242	1.530	2570	0.009	15
14	0.066	48	2.061	1509	-	-	0.033	24	0.131	96	0.008	6
15	0.188	253	1.640	2211	-	-	0.179	241	0.316	426	0.020	27
16	0.421	495	2.406	2829	-	-	0.261	307	1.818	2138	0.212	249
17	0.042	39	2.826	2645	-	-	0.047	44	0.079	74	0.028	26
18	0.019	12	4.963	3018	-	-	0.111	67	0.056	34	0.007	4
19	0.400	85	3.866	820	-	-	-	-	0.400	85	0.061	13
20	0.168	169	1.879	1890	-	-	0.058	58	0.375	377	0.265	267
21	0.043	19	2.229	1008	-	-	-	-	0.086	39	-	-
22	0.145	179	2.801	3451	-	-	0.372	458	0.377	465	0.023	28
23	0.671	89	2.764	497	-	-	0.819	108	2.652	350	0.129	17
24	0.161	39	1.751	427	-	-	-	-	0.316	77	0.410	100
25	-	-	1.009	2381	-	-	-	-	-	-	0.001	2
26	0.061	37	1.863	1118	-	-	0.038	23	0.122	73	0.007	4
27	0.028	28	2.463	2473	-	-	-	-	0.128	129	0.017	17
28	0.020	32	1.823	2895	-	-	0.014	22	0.132	210	-	-
29	0.095	48	3.560	1801	-	-	0.230	116	0.284	144	-	-
All Strata	0.491	19952	2.351	95619	0.004	147	0.242	9860	1.004	48986	0.217	8834
Sampling Error		+/-736		+/-1394		+/-758		+/-758		+/-1203		

TABLE C.7 - WATER SOURCES

	Wet Balli		Dry Balli		Flowing River		Rainwater Pool		Riverine Pool		Spring	
	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.
1	-	-	-	-	-	-	0.030	77	0.048	124	-	-
2	-	-	-	-	-	-	-	-	0.004	19	0.006	26
3	0.009	12	-	-	-	-	0.067	89	0.057	76	-	-
4	-	-	-	-	0.009	27	0.019	57	-	-	0.019	57
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	0.12	9	-	-	0.133	98	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	0.012	64	0.008	43	-	-	0.076	406	0.040	214	-	-
10	-	-	0.004	11	-	-	-	-	-	-	-	-
11	-	-	0.009	6	-	-	-	-	-	-	-	-
12	-	-	0.019	20	-	-	0.173	172	0.154	153	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	0.172	126	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	0.016	22
16	0.036	42	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	0.135	29	-	-	-	-	-	-	-	-
20	-	-	0.036	36	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	0.215	265	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	0.061	15
25	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	0.098	98	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-
All Strata	**0.004**	**180**	**0.016**	**634**	**0.0009**	**36**	**0.020**	**801**	**0.017**	**684**	**0.003**	**120**
Sampling Error		+/-169		+/-435		+/-169		+/-652		+/-574		+/-224

TABLE C.7 CONTINUED

Stratum	Wet War		Dry War		War Under Const.		War Abandoned		Well		Riverine Well		Sand Dune Well	
	Dens Km^2	Est. No.	Dens Km^2	Est. No.	Dens Km^2	Est. No.	Dens Km^2	Est. No.	Dens Km^2	Est. No.	Dens Km^2	Est. No.	Dens Km^2	Est. No.
1	0.350	903	0.611	1576	0.072	186	0.036	93	0.030	77	-	-	-	-
2	0.011	52	0.090	424	0.008	38	0.005	26	0.074	349	-	-	-	-
3	-	-	-	-	-	-	-	-	0.009	12	-	-	-	-
4	-	-	-	-	-	-	-	-	0.009	27	-	-	-	-
5	-	-	0.078	27	0.152	54	-	-	-	-	-	-	-	-
6	-	-	0.029	21	-	-	-	-	-	-	0.055	41	-	-
7	0.112	149	0.098	130	0.140	186	0.028	37	1.004	1333	-	-	-	-
8	0.108	121	0.220	246	0.064	72	-	-	0.087	97	-	-	-	-
9	-	-	0.029	155	-	-	-	-	0.357	1906	0.074	395	-	-
10	0.494	1310	0.246	652	0.065	172	0.004	11	0.132	350	0.031	82	-	-
11	0.009	6	0.061	41	0.045	30	-	-	0.144	97	0.014[1]	9	-	-
12	0.406	404	0.374	373	0.248	247	-	-	0.117	117	-	-	-	-
13	-	-	0.105	176	0.016	27	-	-	0.340	571	-	-	0.169	284
14	-	-	-	-	-	-	-	-	0.111	81	-	-	0.295	216
15	-	-	0.016	22	-	-	-	-	0.047	63	0.501	675	0.019[2]	26
16	0.166	195	0.141	166	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	0.026	16	-	-	-	-	-	-	-	-	-	-
19	-	-	0.348	74	0.054	11	0.054	11	1.474	312	-	-	-	-
20	0.033	33	0.099	100	0.112	113	-	-	-	-	0.191	192	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	1.838	2264	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	0.150	37	-	-	0.049	12	0.226	55	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	0.076	46	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	0.041	41	-	-	-	-
28	-	-	-	-	-	-	-	-	0.038	60	-	-	-	-
29	-	-	0.063	32	-	-	-	-	-	-	-	-	-	-
All Strata	0.078	3173	0.106	4314	0.028	1137	0.005	190	0.193	7838	0.034	1385	0.012	500
Sampling Error		+/-943		+/-812		+/-479		+/-260		+/-1458		+/-893		+/-346

Note [1] *Well Field 0.0002 9 +/-53*

[2] *Well under construction 0.0006 26 +/-118*

TABLE C.8 COMPARISON OF WATER SOURCE DATA FROM THE AERIAL CENSUS (1982) AND THE 1:100,000 SURVEY DEPARTMENT MAPS (1973)

Stratum	Year	Waro		Wells		Balliyo		Bore Holes		Springs	
		Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.
1	73	0.398	1027	0.001	2	-	-	0.002	4	0.0004	1
	82	1.069	2758	0.030	77	-	-	-	-	-	-
2	73	0.032	151	0.016	75	0.0002	1	0.0004	2	0.0002	1
	82	0.115	539	0.074	349	-	-	-	-	0.006	26
3	73	0.006	8	0.004	5	-	-	0.003	3	-	-
	82	-	-	0.009	13	0.009	12	-	-	-	-
4	73	-	-	0.003	9	0.0003	1	-	-	0.002	6
	82	-	-	0.009	27	-	-	-	-	0.019	57
5	73	0.071	25	-	-	-	-	-	-	-	-
	82	0.23	81	-	-	-	-	-	-	-	-
6	73	0.004	3	-	-	-	-	-	-	0.003	2
	82	0.029	21	0.055	41	-	-	-	-	-	-
7	73	0.018	24	0.020	27	0.002	3	-	-	0.002	3
	82	0.378	502	1.004	1333	-	-	-	-	-	-
8	73	0.204	228	0.028	31	-	-	0.0009	1	-	-
	82	0.392	439	0.087	97	-	-	-	-	-	-
9	73	0.004	21	0.033	176	0.011	59	-	-	-	-
	82	0.029	155	0.431	2302	0.020	107	-	-	-	-
10	73	0.162	430	0.039	103	0.001	3	-	-	-	-
	82	0.809	2145	0.163	432	0.004	11	-	-	-	-
11	73	0.003	2	-	-	0.027	18	-	-	-	-
	82	0.115	78	0.144	97	0.009	6	-	-	-	-
12	73	0.037	37	0.157	156	0.014	14	-	-	-	-
	82	1.028	1024	0.117	117	0.019	20	-	-	-	-
13	73	0.004	7	0.004	7	0.006	10	-	-	-	-
	82	0.121	203	0.509	855	-	-	-	-	-	-
14	73	-	-	-	-	0.038	28	-	-	-	-
	82	-	-	0.406	297	0.172	126	-	-	-	-
15	73	0.004	5	-	-	0.002	3	-	-	-	-
	82	0.160	22	0.567	764	-	-	-	-	0.016	22
16	73	0.065	76	0.020	24	0.005	6	0.0009	1	-	-
	82	0.307	361	-	-	0.036	42	-	-	-	-

TABLE C.8 CONTINUED

Stratum	Year	Waro		Wells		Balliyo		Bore Holes		Springs	
		Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.
17	73	0.031	29	-	-	-	-	-	-	-	-
	82	-	-	-	-	-	-	-	-	-	-
18	73	0.010	6	-	-	-	-	-	-	-	-
	82	0.026	16	-	-	-	-	-	-	-	-
19	73	0.066	14	-	-	0.019	4	-	-	-	-
	82	0.456	97	1.474	312	0.135	29	-	-	-	-
20	73	0.030	30	-	-	0.028	28	-	-	-	-
	82	0.244	245	0.191	192	0.036	36	-	-	-	-
21	73	-	-	-	-	0.070	32	-	-	-	-
	82	-	-	-	-	-	-	-	-	-	-
22	73	0.013	16	-	-	0.174	214	-	-	-	-
	82	-	-	1.838	2264	0.215	265	-	-	-	-
23	73	0.008	1	0.015	2	-	-	-	-	-	-
	82	-	-	-	-	-	-	-	-	-	-
24	73	0.025	6	0.037	9	-	-	-	-	0.012	3
	82	0.199	49	0.226	55	-	-	-	-	0.061	15
25	73	-	-	-	-	0.002	5	-	-	-	-
	82	-	-	-	-	-	-	-	-	-	-
26	73	0.007	4	-	-	-	-	-	-	0.002	15
	82	0.076	46	-	-	-	-	-	-	-	-
27	73	0.003	46	-	-	0.008	8	0.001	1	0.001	1
	82	-	-	0.041	41	0.098	98	-	-	-	-
28	73	-	-	-	-	0.001	2	-	-	0.002	3
	82	-	-	0.038	60	-	-	-	-	-	-
29	73	-	-	-	-	-	-	-	-	-	-
	82	0.063	32	-	-	-	-	-	-	-	-
All	**73**	**0.054**	**2185**	**0.015**	**626**	**0.011**	**439**	**0.0003**	**12**	**0.0005**	**21**
Strata	**82**	**0.216**	**8814**	**0.240**	**9749**	**0.018**	**752**		-	**0.003**	**120**

TABLE C.9 LAND USE IN THE BAY REGION

Stratum	Cropped		Ploughed		Fallow		Abandoned		Cleared		Enclosed		Burnt	
	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha
1	67.85	175053	(0.09	232	2.07	5341	1.67	4309	0.66	1703	-	-	-	-
2	5.24	24670	(0.02[1]	39	1.44	6780	0.90	4237	0.13	612	0.08	377	0.34	1601
3	-	-	-	-	-	-	-	-	-	-	-	-	0.08	106
4	0.07	203	-	-	0.06	181	0.04	121	-	-	-	-	0.22	665
5	4.02	1415	-	-	3.19	1123	0.81	285	0.39	137	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	1.91	2536	-	-	0.99	1315	0.31	412	0.12	159	-	-	0.04	58
8	37.65	42168	0.18	202	3.37	3774	1.00	1120	0.93	1042	-	-	0.03	34
9	0.03	160	-	-	0.01	64	-	-	-	-	-	-	0.03	176
10	39.05	103561	0.42	1114	6.30	16708	6.59	17472	0.64	1697	-	-	-	-
11	0.47	311	-	-	0.13	88	0.06	41	0.22	149	-	-	0.42	284
12	7.60	7570	-	-	1.49	1484	0.57	568	0.68	677	0.03	25	0.11	110
13	0.49	823	-	-	0.11	192	-	-	0.03	52	-	-	0.07	111
14	-	-	-	-	-	-	-	-	-	-	-	-	0.46	337
15	-	-	-	-	0.05	73	0.13	175	-	-	-	-	0.57	768
16	0.87	1023	-	-	0.37	435	0.13	153	-	-	-	-	-	-
17	-	-	-	-	0.10	92	0.06	60	-	-	-	-	0.55	514
18	0.14	85	-	-	0.16	97	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	0.26	55
20	11.23	11297	0.01	10	2.14	2153	0.35	352	0.48	483	-	-	1.19	1197
21	-	-	-	-	-	-	-	-	-	-	-	-	4.09	1849
22	-	-	-	-	-	-	-	-	-	-	-	-	0.12	148
23	-	-	-	-	0.07	9	0.52	69	0.08	11	-	-	-	-
24	7.20	1757	0.03	7	5.00	1220	1.57	383	1.48	361	0.44[2]	107	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	0.99	2336
26	0.04	24	-	-	-	-	0.11	66	-	-	-	-	1.03	618
27	-	-	-	-	-	-	-	-	0.06	64	-	-	-	-
28	-	-	-	-	-	-	0.17	270	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	0.56	283
All Strata	**9.16**	**372656**	**0.04**	**1565**	**1.01**	**41129**	**0.74**	**30093**	**0.18**	**7147**	**0.01**	**509**	**0.28**	**11250**
Sampling Error		**+/-4699**		**+/-611**		**+/-2111**		**+/-2227**		**+/-1056**		**+/-478**		**+/-4849**

Notes: [1] *Mechanically Ploughed 0.001 39 +/-141*

[2] *Irrigated 0.003 107 +/-76*

TABLE C.10 COMPARISON OF LAND USE INFORMATION FROM THE AERIAL CENSUS (1982) AND FROM THE 1:100,000 SURVEY DEPARTMENT MAPS (1973)

Stratum	Cropland (Census)		Cropland (Maps)	
	%	ha	%	ha
1	71.70	184973	69.94	180445
2	7.58	35687	8.18	38511
3	-	-	-	-
4	0.17	505	-	-
5	8.02	2823	5.54	1950
6	-	-	-	-
7	3.21	4263	approx. 2.00% (data not obtained from maps)	
8	42.20	47264	32.42	36310
9	0.04	224	-	-
10	52.36	138859	47.43	125784
11	0.65	439	-	-
12	9.66	9621	9.28	9243
13	0.60	1015	-	-
14	-	-	-	-
15	0.18	248	-	-
16	1.37	1611	-	-
17	0.16	150	-	-
18	0.30	182	-	-
19	-	-	-	-
20	13.73	13812	(data not obtained from maps)	
21	-	-	-	-
22	-	-	-	-
23	0.59	78	-	-
24	13.80	3367	14.96	3650
25	-	-	-	-
26	0.15	90	-	-
27	-	-	-	-
28	0.17	270	-	-
29	-	-	-	-
All Strata	**10.95**	**445481**	**9.73**	**395893**
Sampling Error		**+/-4849**		**+/-5105**

Note *Totals for map information are excluding strata 7 and 20.*

TABLE C.11 CHARCOAL PRODUCTION FEATURES

Stratum	Abandoned Kiln Site		Functioning Kiln		Timber Prepared For Kiln		Charcoal Waiting For Collection		Charcoal Makers' Camp		Abandoned Charcoal Makers' Camp			
	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.	Dens/Km^2	Est. No.		
1	-	-	-	-	-	-	-	-	-	-	-	-		
2	1.224	5763	0.002	9	0.074	348	0.009	42	0.012	56	0.006	28		
3	1.179	1566	0.010	13	0.020	27	-	-	0.010	13	0.010	13		
4	1.444	4355	0.051	154	0.016	48	0.069	209	0.039	118	0.008*	24*	Timber Truck*	
5	-	-	-	-	-	-	-	-	-	-	-	-		
6	-	-	-	-	-	-	-	-	-	-	-	-		
7	0.340	452	-	-	-	-	-	-	-	-	-	-		
8	-	-	-	-	-	-	-	-	-	-	-	-		
9	0.061	326	-	-	0.017	91	0.004	21	-	-	-	-		
10	-	-	-	-	-	-	-	-	-	-	-	-		
11	-	-	-	-	-	-	-	-	-	-	-	-		
12	0.053	53	-	-	-	-	-	-	-	-	-	-		
13	-	-	-	-	-	-	-	-	-	-	-	-		
14	-	-	-	-	-	-	-	-	-	-	-	-		
15	-	-	-	-	-	-	-	-	-	-	-	-		
16	-	-	-	-	-	-	-	-	-	-	-	-		
17	0.139	130	-	-	-	-	-	-	-	-	-	-		
18	0.181	110	-	-	0.023	14	-	-	-	-	-	-		
19	0.172	36	-	-	-	-	-	-	-	-	-	-		
20	-	-	-	-	-	-	-	-	-	-	-	-		
21	-	-	-	-	-	-	-	-	-	-	-	-		
22	-	-	-	-	-	-	-	-	-	-	-	-		
23	-	-	-	-	-	-	-	-	-	-	-	-		
24	-	-	-	-	-	-	-	-	-	-	-	-		
25	-	-	-	-	-	-	-	-	-	-	-	-		
26	0.114	68	-	-	-	-	-	-	-	-	-	-		
27	0.790	793	-	-	0.060	60	0.050	50	-	-	-	-		
28	-	-	-	-	-	-	-	-	-	-	-	-		
29	0.167	85	-	-	-	-	-	-	-	-	-	-		
													Timber Truck	
All Strata	**0.338**	13737	**0.004**	176	**0.014**	588	**0.008**	322	**0.005**	187	**0.002**	65	24	**0.0006**
Sampling Error		+/-981		+/-165		+/-271		+/-250		+/-162		+/-78	+/-71	

APPENDIX D

RANGE RESOURCES

D.1 CHECK LIST OF PLANTS FROM THE BAY REGION, SOMALIA

This list is by no means meant to be exhaustive. It includes only those plants seen or collected during the period of field work. Annuals and grasses are particularly poorly represented because field work was undertaken during the dry season. Of the woody species the *Commiphora* species are probably the most under represented and also the least understood.

Specimens have been deposited at the National Range Agency Herbarium, Mogadi shu, the East African Herbarium, Nairobi, and at the Kew Herbarium, London.

The Bay Region, and Somalia as a whole, is poorly known botanically. There has been no systematic collecting from within the Bay Region itself but a number of collectors have passed through the Region, mainly in the first half of this century. The dates and locations of these collections are as follows:

Luca Riva (1894) Florence
Stefanini and Paoli (1913) Florence
Stephanini and Puccioni (1924) Florence
G. Popov (Dersert Locust Control Organisation). E. Africa, Kew, British Mus.
G. Reynolds and P.R.O. Bally (1953) E. Africa, Kew, Pretoria.
P.R.O. Bally and R. Melville (1973) E. Africa and Kew.

The following publications deal specifically with the above mentioned collections. Most can be found in the National Range Agency, Mogadishu.

Chiovenda, E. (1916) Le collezioni botaniche della Stenfanini and Paoli nella Somalia Italiana. R. Istituto di Studi Superiori, Firenze.
Chiovenda, E. (1929) Flora Somala I, Roma.
Chiovenda, E. (1932) Flora Somala II, Forli.
Chiovenda, E. (1936) Flora Somala III, Atti dell' Istituto Botanico dell' Universita di Pavia (Serie IV) 7: 117 - 160.
Cufodontis, G. (1952-1972). Enumeratio Plantarum Aethiopiae Spermatophyta. Bulletin du Jardin Botanique de L'Etat, Bruxelles.
Reynolds, G.W. (1966). The Aloes of Tropical Africa and Madagascar. The Trustees, The Aloe Book Fund, Box 234, Mbane, Swaziland.

PTERIDOPHYTA

Actiniopteris radiata (Sw.) Link

DICOTYLEDONS

ACENTHACEAE

Anisotes involucratus Fiori
A. parvifolium Oliv.
Barleria sp. sect. *prionitis* (B1794)
B. sp. sect. *somalia* (B1524, B1665)
B. stelligera Lindau
Dicliptera verticillata (Forsk.) Christens
Ecbolium anisacanthus (Schweinf.) C.B.Cl.
Lepidagonthis scariosa Nees
Peristrophe bicalyculata (Retz.) Nees
Ruellia patula Jacq.
Ruspolia hypocrateriformis (Vatke) M.-Rh.
Satanocrater sp. nov. (B1591, B1767)

AIZOACEAE

Glinus setiflorus Forsk.
Limeum praetermissum C. Jeff.

AMARANTHACEAE

Aerva javanica (Burm.f.) Schult.
A. lanata (L.) Schult.
Celosia polystachia (Forsk.) Townsend
Digera muricata (L.) Mart. var. *macroptera* Townsend
Pupalia lappacea (L.) A. Juss.
Sericocomopsis pallida (S.Moore) Schinz

ANACARDIACEAE

Lannea rivae (Chiov.) Sacleux
L. triphylla (A. Rich.) Engl.

ANNONACEAE

Uvaria denhardtiana Engl. and Diels
U. sp. aff. *U. leptocladon* Oliv. (B 1521)

APOCYNACEAE

Adenium obesum (Forsk.) Roem. and Schult
Strophanthus mirabilis Gilg
Wrightia demartiniana Ghiov.

ASCLEPIADACEAE

Calotropis procera (Ait.) ait.f.
Caralluma priogonium K. Schum.
C. sp. (B 1572)
?Cryptolepis sp. (B1610)
Gomphocarpus fruticosus (L.) Ait. f.
Pergularia daemia (Forsk.) Chiov.
Sarcostemma andongense Hiern
S. viminale R. Br.
Socotora visciformis (Vatke) K. Schum.

BALANITACEAE

Balanites aegyptiaca (L.) Del.

BIGNONIACEAE

Kigelia africana (Lam.) Benth.
Markhamia zanzibarica (DC.) Engl.

BOMBACEAE

Adansonia digitata L.

BORAGINACEAE

Cordia ovalis DC.
C. sinensis Lam.
C. sp. (B 1562, 1779)
Ehretia sp. nov. aff. *E. buxifolia* Roxb. in KTS (B1525, 1598)
E. sp. (B1781)
Heliotropium cinerascens DC.
H. ovalifolium Forsk.
H. supinum L.

BURSERACEAE

Boswellia hildebrandtii Engl.
Commiphora africana (A. Rich.) Engl.
C. boiviniana Engl.
C. sp. near *erlangerana* Engl.
C. rostrata Engl.
C. schimperi (Berg) Engl.
C. sp. C in EAH (B1526, 1630) *sennii* Chiov?
C. sp. sect. *glaucidulae (B1703)*
C. cassan Chiov.
C. sp. sect. *opobalsamum* (1724) probably *C. cassan* Chiov.
C. lughensis Chiov. edesor. (B 1800)

CAESALPINIACEAE

Afzelia quanzensis Welw.
Bauhinia ellenbeckii Harms
Caesalpinia erianthera Chiov.
C. trothae Harms ssp. *erlangeri* (Harms) Brenan
Cassia abbreviata Oliv. ssp. *beareana* (Holmes) Brenan
C. humifusa Brenan
C. longiracemosa Vatke
C. senna L. var. *obtusata* Brenan
Delonix baccal (Chiov.) Bak. f.
D. elata (L.) Gamble
Parkinsonia aculeata L. (alien)
Tamarindus indica L.
Tylosema argentea (Chiov.) Brenan

CAPPARACEAE

Boscia coriacea Pax
B. minimifolia Chiov.
B. mossambicensis Klotzsch
B. tomentella Chiov.
Cadaba farinosa Forsk. ssp. *farinosa*
C. glandulosa Forsk.
C. mirabilis Gilg
Capparis sepiaria L. var. *subglabra* (Oliv.) DeWolf
Maerua angolensis DC.
M. crassifolia Forsk.
M. denhardtiorum Gilg
M. glauca Chiov.
M. macrantha Gilg.
M. oblongifolia (Forsk.) A. Rich.
M. sessiliflora Gilg
M. sp. (B1741)
M. subcordata (Gilg) DeWolf

CARYOPHYLLACEAE

Polycarpaea grahamii Turrill

CELASTRACEAE

Elaeodendron squifolium (Fiori) Chiov.
Hippocratea crenata (Klotz.) K. Schum. and Loes.
Maytenus undatus (Thunb.) Blakelock

COMBRETACEAE

Combretum contractum Engl. and Diels
C. hereroense Schinz ssp. *volkensii* (Engl.) Wickens var. *volkensii*
C. molle G. Don.
C. sp. (B1580)

C. sp. (B1597)
C. sp. (B1616), 1713)
Terminalia brownii Fres.
T. orbicularis Engl. and Diels
T. parvula Pampan.
T. polycarpa Engl. and Diels
T. prunioides Laws
T. sp. nov. (B1708)
T. spinosa Engl.

COMPOSITAE

Aspilla mossambicensis (Oliv.) Wild
Blepharispermum fruticosum Klatt and Schinz
Flaveria australosica Hook.
Launea cornuta (Oliv. and Hiern) C. Jeffr.
Psiadia incana Oliv. and Hiern
Pluchea ovalis (Pers.) DC.
Pulicaria sp. (B1423, 1736)
Sphaeranthus sp. (B1452, 1479)
Tridax procumbens L.
Vernonia cinerascens Sch. Bip.

CONVOLVULACEAE

Hildebrandtia sepalosa Rendle
H. somalensis Peter
Ipomoea cicatricosa Bak.
I. garckeana Vatke
I. sp. (B1589)
Merremia pinnata (Choisy) Hall. f.

CUCURBITACEAE

Coccinia grandis (L.) Voigt
Cucumis sp. (B1810)
Momordica sp. (B1651)
M. spinosa (Gilg) Chiov.

EBENACEAE

Diospyros cornii Chiov.

ERYTHROXYLACEAE

Nectaropetalum kaessneri Engl. var. *parvifolius* Verdc.

EUPHORBIACEAE

Acalypha fruticosa Forsk. var. *eglandulosa* A.R.-Sm.
Cephalocroton cordofanus Hochst.
Chrozophora plicata (Vahl) Juss.
Croton megalocarpus Hutch.
C. menyhartii Pax
Euphorbia cuneata Vahl

E. erlangeri Pax
E. geniculata Orteg
E. glochidata Pax
E. grandicormis Goebel
E. hirta L.
E. robecchii Pax
E. tirucalli L.
Jatropha fissispina Pax
J. stuhlmanni Pax
Phyllanthus somalensis Hutch.
Ricinus communis L.
Suregada procera (Prain) Croizat
Tragia hildebrandtii Muell. -Arg.
Genus unknown (B1646)

LABIATAE

Basilicum polystachymum (L.) Moench
Becium obovatum (E. Mey.) N.E.Br.
Endostemon tenuiflorus (Benth.) Ashby
Leucas abyssinica Briq. var. *argyrophylla* (Vatke) Sebald
L. glabrata (L.) R. Br.
Ocimum tomentosum Oliv.
?Ocimum sp. (B1639, 1696)
Orthosiphon sp. nov. aff. O. *ctenoneurus* R. Harley
Tinnea aethiopica Kotschy ex Hook. f.

LORANTHACEAE

Emelianthe panganensis (Engl.) Danser

LYTHRACEAE

Lawsonia inermis L.
Nesaea radicans Guill. and Perr. var. *floribunda*

MALPIGHIAGEAE

Acridocarpus glaucescens Engl. var. *ferrugineus* (Engl.) Launert
Caucanthus albidus (Nied.) Nied.

MALVACEAE

Abutlon figarianum Webb.
A. fruticosum Guill. and Perr.
Hibiscus aponeurus Sprague and Hutch.
H. dictyocarpus Webb
H. meyeri Harv.
H. micranthus L.f.
? *H.* sp. (B 1722)
Pavonia pirottae (A. Terr.) Chiov.
Sida alba L.
Thespesia danis Oliv.

MELIACEAE

Turraea parvifolia Deflers

MIMOSACEAE

Acacia brevispica Harms ssp. *brevispica*
A. bricchettiana Chiov.
A. bussei
A. etbaica Schweinf ssp. *uncinata* Brenan
A. hamulosa Benth.
A. horrida (L.) Wild. ssp. *benadirensis* (Chiov.) Hillcoat and Brenan
A. mellifera (Vahl) Benth. ssp. *mellifera*
A. nilotica (L.) Del.
A. nubica Benth.
A. ogadensis Chiov.
A. oliveri Vatke
A. paolii Chiov.
A. reficiens Wawra ssp. *misera* (Vatke) Brenan
A. senegal (L.) Willd. var. *?kerensis* Schweinf. (B1752)
A. senegal (L.) Willd. var. *leiorhachis* Brenan
A. sieberiana DC. var. *sieberiana*
A. stuhlmanii Taub.
A. tortilis (Forsk.) Hayne ssp. *spirocarpa* (A. Rich.) Brenan
A. zanzibarica (S. Moore) Taub. var. *microphylla*
A. zanzibarica (S. Moore) Taub. var. *zanzibarica*
Albizia anthelmintica Brongn.
A. harveyi Fourn.
A. sp. aff. *A. petersiana* (Bolle) *Oliv. (B.1448, 1699, 1757)*
Dichrostachys cinerea (L.) Wight and Arn. var. *obtusata* Brenan
Entada leptostachya Harms.

MORACEAE

Dorstenia crispa Engl.
Ficus populifolia Vahl
F. sycomorus L.
F. vasta Forsk.
F. zambesica Hutch.

MORINGACEAE

Moringa longituba Engl.

OCHNACEAE

Ochna inermis (Forsk.) Schweinf.
O. sp. (B1657)

OPILIACEAE

Opilia campestris Engl.

PAPILIONACEAE

Abrus precatorius L. ssp. *africanus* Verdc.
Aeschynomene indica L.
Cadia purpurea (Pico.) Ait.
Crotalaria scassellatii Chiov.
Dalbergia eremicola Polh.
D. microphylla Chiov.
Dicraeopetalum stipulare Harms
Erythrina melanacantha Harms probably ssp. *somala* (Chiov.) Gillett
Indigofera sp.
I. sp. sect. *dissitiflorae* (B1531)
I. spinosa Forsk
I. vohemarensis Baill.
Mundulęa sericea (Willd.) A. Chev.
Ormocarpum keniense Gillett
O. muricatum Chiov.
Platycelyphium voense (Eng.) Wild
Sesbania sericea (Willd.) Link
Stylosanthes fruticosa (Retz) Alston
Tephrosia polyphylla (Chiov.) Gillett
T. villosa (L.) Pers. ssp. *ehrenbergiana* (Schweinf.) Brummitt.
? Vigna sp. (B1604)
Zornia glochidiata DC.

PASSIFLORACEAE

Adenia venenata Forsk.

PEDALIACEAE

Josephinia africana Vatke
Sesamothamnus busseanus Engl.

PORTULACACEAE

Portulaca oleracea L.
P; sp. (B1617), 1641)

RHAMNACEAE

Berchemia discolor (Klotzsch) Hemsl.
Ziziphus hamur Engl.
Z. mucronata Willd.
Z. spina-christi (L.) Desf. var. *microphylla* A. Rich.

RESEDACEAE

Ochradenus somalensis Bak.f.

RUBIACEAE

Canthium sp. possibly *C. granticola* (Chiov.) Senni (B1512A, 1692)
Coffea paolli Brids.
Gardenia fiorii Chiov.
G. volkensii K. Schum.
Meyna tetraphylla (Hiern) Robyns ssp. *tetraphylla*
Oldenandia fastigiata Bremek. var. *fastigiata*
Paederia popsischilii K. Schum.
Pavetta subcana Hiern var. *longiflora*
Spermacoce sanensis (Klotzsch) Hiern

RUTACEAE

Vepris eugeniifolia (Engl.) Verdoorn

SALVADORACEAE

Dobera loranthifolia (Warb.) Harms
Salvadora persica L.

SAPINDACEAE

Bottogea insignis Chiov.

SAPOTACEAE

Manilkara sulcata (Engl.) Dubard
Mimusops kummel A.DC.
M. mochisia (Bak.) Dubard
M. sp. perhaps *M. somalensis* Chiov. (B1726)

SCROPHULARIACEAE

Stenodiopsis rivae Engl.

SIMAROUBACEAE

Kirkia tenuifolia Engl.

SOLANACEAE

Solanum jubae Bitter

STERCULIACEAE

Sterculia rhynchocarpa K. Schum.
Waltheria indica L.

TILIACEAE

Grewia bicolor Juss.
G. penicillata Chiov.
G. sp. (B1608)
G. sp (B1449, 1457, 1728)
G. sp. aff. *G. bicolor* Juss. (B1520, 1783)
G. tenax (Forsk.) Fiori
G. tembensis Fres.
G. villosa willd.
Triumfetta actinocarpa S. Moore

THYMELACEAE

Gnidia latifolia (Oliv.) Gilg

UMBELLIFERAE

Steganotaenia araliaceae Hochst.

VERBENACEAE

Cylocheilon eriantherum (Vatke) Engl.
Premna resinosa Schauer
Vitex mombassae Vatke

VITACEAE

Cissus aphylla Chiov.
C. cactiformis Gilg.
C. furcifera Chiov.
C. quinquangularis Chiov.

ZYGOPHYLLACEAE

Tribulus terrestris L.

MONOCOTYLEDONS

AGAVACEAE

Sansevieria abyssinica N.E. Br.
S. powellii N.E. Br.
S, robusta N.E. Br.
S. sp. (B1450/A)

AMARYLLIDACEAE

Crinum sp. (B1546/B)
Scadoxus multiflorus (Martyn) Ref.

ARACEAE

Stylochiton sp. (B1624)

COMMELINACEAE

Commelina diffusa Burm.f.

CYPERACEAE

Bulbostylis sp. (B1535
Cyperus pygmaeus Rottb.
C. sp. (B1483, 1734)
C. sp. (B1484)
C. sp. (B1450/B)
Kyllinga comosipes (Matt.f.) Kukenth and Napper
K. flava C.B.Cl.

GRAMINEAE

Andropogon gayanus Kunth
A. kelleri Hack.
Aristida adscensionis L.
Brachiaria eruciformis (J.E.Sm.)Griseb.
Cenchrus ciliaris L.
Chrysopogon plumosus Hochst.
Cynodon dactylon (L.) Pers.
Dactyloctenium geminatum Hack.
D. scindicum Boiss.
Dichanthium annulatum (Forsk.) Stapf var. *annulatum*
D. foveolatum (Del.) Roberty
Digitaria argyrotricha (Anders.) Chiov.
Echinochloa colona (L.) Link
E. haploclada (Stapf) Stapf
Enneapogon schimperanus (A. Rich.) Renv.
Eragrostis abrumpens Kabuye
E. cilianensis (All.) Lut.
E. ciliaris (L.) R. Br.
E. perbella K.Schum.
E. sp. (B1818)
Ischaemum afrum (J.F. Gmel.) Dandy
Leptocholoa obtusiflora Hochst.
Leptothrium senegalensis (Kunth) W.D. Clayton
Lintonia nutans Stapf.
Loudetia arundinacea (A. Rich) Steud.
Panicum coloratum L.
P. deustum Thunb.
P. hippothrix K. Schum.
Paspalidium desertorum (A. Rish.) Stapf.
Perotis hildebrandtii Mez.
Rottboellia exaltata L.f.
Schoenfeldia transiens (Pilg) Chiov.
Sporobolus helvolus (Trin.) Dur. and Schinz.
Tetrapogon cenchriformis (A. Rich.) W.D. Clayton.
T. tenellus (Roxb.) Chiov.
Trichoneura mollis (Kunth) Ekman.

LILIACEAE

Aloe microdonta Chiov.
A. ruspoliana Bak.
Asparagus africana Lam.
A. somalensis Chiov.
Scilla somaliensis Bak.
Urginea altissima (L.f.) Bak.

PALMAE

Hyphaene sp., ? *H. reptans* Beccari (B1790).

D.2 VERNACULAR LIST OF PLANT NAMES FROM THE BAY REGION, SOMALIA

Abbreviations used under growth form

An	=	Annual species
H	=	Herb
G	=	Grass
S	=	Shrub
B	=	Bush
T	=	Tree
C	=	Climber
Ag W	=	Agricultural weed
L	=	Liliaceae
Suc	=	Succulent
Par	=	Parasite

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Abal	Abaal	B/T	*Afzelia quanzensis*
Adgo		B/T	*Terminalia brownii*
Adad	Cadaad	B	*Acacia* spp. in the *senegal* group
Adad guri		B/T	*Acacia senegal* var. *leiorhachis*
Adad jerni		B/T	*Acacia senegal* var. *leiorhachis*
Adei		B/T	*Salvadora persica*
Adurr	Cadur	S	*Croton menyhartii*
Af gub	Af gub	S	*Opilia campestris*
Alan	Cilaan	S/B/T	*Lawsonia inermis*
Amerey garas	Amaroy gaare	B	*Pavetta subcana* var. *longiflora*
Ando fia wi		H	*Leucas abyssinica*
Anna ni	Canaaniye	S	*Tragia hildebrandtii*
Aramo		C	*Cissus quinquangularis*
Armo	Armoo	C	*Cissus aphylla*
Baccal	Bokol	T	*Acacia sieberana* var. *sieberana*
		T	*Delonix baccal*
Baga adei	Baag caade	S	*Croton menyhartii*
		An	Twining *convolvulus* sp.
Balambal	Balanbaal	Ag W	*Abutilon figarianum*
		Ag W	*Chrozophora plicata*
		Ag W	*Gomphocarpus fruticosus*
			General name for unpalatable plants
Baldangerad	Baldagaraan	G	*Andropogon gayanus*
Bangi		Ag W	*Datura stramonium*
Banyo	Baanyo	S	*Blepharispermum fruticosum*
Banyo bered			Unidentified 2 m shrub
Banyo barar	Baanyo baraar		Unidentified 1.5 m shrub
Bar	Baar	L	*Scadoxus multiflorus*
			Scilla somaliensis
			General name for members of the Liliaceae with underground bulbs
Bararorth	Bacaroor	B	*Commiphora erlangerana*
Barherjis	Baraajis	An	*Ipomoea* sp. (Beckett 1589)
Barrahre	Baraare	C/H	*Asparagus africana*
Be bei	Bii bii Ba beey	S	*Boswellia neglecta*
Berde	Barde	T	*Ficus vasta*
		T	*Ficus zambesica*
			General name for *Ficus* spp.
		T	*Kigelia africana*
Billil	Bilcil	B	*Acacia mellifera* ssp. *mellifera*
		S	*Bauhinia allenbeckii*
Bissik	Bisik, Bisiq	S	*Terminalia orbicularis*
Bo oh	Booco	S/B	*Calotropis procera*
Borah		B	*Commiphora boiviniana*
Bungi	Bunjii	S	*Datura stramonium*
Bunshugar	Bun shugaar	B	*Launea cornuta*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Bur gudi	Bur gudey	An	*Tylosema argentea*
Buro	Buro	B	*Erythrina melanacantha*
Chiler orio	Jiliya oryo	S	*Acalypha fruticosa* var. *eglandulosa*
Cabish	Kabish	S	*Grewia villosa*
Daar	Daar	Suc	*Aloe microdonta*
		Suc	*Aloe ruspoliana*
			General name for *Aloe* spp.
Daar warabi		Suc	*Urginea altissima*
Daba dube		G	*Dichanthium annulatum* var. *annulatum*
Dabal	Dhanbal	T	*Acacia sieberiana* var. *sieberiana*
		B/T	*Afzelia quanzensis*
Dab berek	Dabirig	B	*Commiphora boiviniana*
Dabi	Dhabi	S	*Grewia bicolor*
Dabo	Dabo	S	*Euphorbia glochidata*
Daga lo	Dag loo	Suc	*Sansevieria abyssinica*
Daga loh	Dhega loxei	S	*Solanum* sp.
Dagdako	Deeg daro	H	*Pupalia* sp.
		G	*Dactyloctenium scindicum*
			General name for plants whose fruits are easily detached and stick to clothing
Dai dai	Dhay dhay	B	*Dalbergia eremicola*
Dalad	Dolad	S	*Euphorbia cuneata*
Dallol		H	*Plectranthus* sp.
Damaq	Dhamaag	S	*Grewia tembensis*
Dambil	Danbal	S	*Solanum jubae*
Damero gomis	Dameero qumis	S	*Solanum jubae*
Damero umis	Damier qumis		Unidentified 3 m shrub
Danno	Dano	B/T	*Euphorbia tirucalli*
Danrabo	Daan raaboow	B	*Sterculia rhynchocarpa*
Danrub	Dhanrab, Dho rab	B	*Sterculia rhynchocarpa*
Daremo	Dareemo	G	*Chrysopogon plumosus*
		G	*Leptothrium senegalensis*
Darfurur	Darfuruur	S	*Grewia tenax*
Dar ga		H	*Indigofera schimperi* var. *schimperi*
Darkain	Dharkeen	T	*Euphorbia robecchii*
Darkain gab	Dharkeen gaab	S	*Euphorbia glochidata*
Dawei	Dawey	S	*Grewia* sp. (Beckett 1449)
De	Dho	S	*Canthium* sp. (Beckett 1692)
Debi yo danan	Dhibiyo dhanaan	S	*Grewia* sp. (Beckett 1475)
Degan	Degaan	T	*Mimusops* sp. (Beckett 1926)
Deg darran	Deeg daran	S/C	*Cissus furcifera*
Dego yar	Dhego yare	S/B/T	*Boscia coriaceae*
Ded darran	Dag daran	S/C	*Cissus furcifera*
Dega dega	Dhega dhego	H	*Pupalia* sp.
Den	Dheen	T	*Berchemia discolor*
Dhug		S	*Cadaba glandulosa*
Diktar	Dhiig daar	S	*Dichrostachys cinerea*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Dibir	Dabir	S/B	*Strophanthus mirabilis*
Dirindir	Dhirin dhir	S	*Euphorbia cuneata*
Dirka		S	*Indigofera* sp.
		C	*Cissus cactiformis*
Do donle	Do doonle	C	*Cissus quinquangularis*
	Dood anle	Suc	*Caralluma priogonium*
	Don doonle	Suc	*Caralluma* sp. (Beckett 1572)
Dofar	Doofar	G	*Chrysopogon plumosus*
		G	*Dactyloctenium scindicum*
		G	*Paspalidium desertorum*
		G	*Echinochola haploclada*
Do fara god	Don faar qod		Unidentified Leguminous shrub
		S	*Phyllanthus somalensis*
Doma dhere	Doma dhere	B/T	*Cassia abbreviata* spp. *bearana*
Dorar	Doraar	G	*Paspalidium desertorum*
		G	*Echinochloa haploclada*
Dowi	Dhawii	S	*Grewia bicolor*
		S	*Grewia* sp. (Beckett 1728)
Doyo	Dooyo	G	*Dactyloctenium scindicum*
Du	Dho, Dhoo	S	*Canthium* sp. (Beckett 1692)
Du eh	Dhuyax	S	*Dalbergia microphylla*
Dufun	Dufun	S	*Satanocrater* sp. (Beckett 1591)
Dugar	Dugaar	S	*Acacia* sp.
Dugta horio	Dudta xirow	S	*Gnidia latifolia*
		S	*Mundulea sericea*
Duk		S	*Cadaba glandulosa*
Duka fis	Dug kufis	G	*Sporobolus helvolus*
Dumbel	Dubeel	Polin	*Hyphaene* sp. ? *H. reptans* (Beckett 1790)
Dumbul		S	*Cadia purpurea*
Dumi	Dhumay	S/B	*Turraea parvifolia*
Dumot	Dhuumood	T	*Cassia abbreviata* spp. *beareana*
Duncal	Dhunkaal	B	*Commiphora* sp. near *erlangeriana*
Dun duk	Dhun dhuug	S	*Anisotes involucratus*
		S	*Anisotes parvifolius*
Durka		S	*Indigofera* sp.
Durrur	Dhuruur	Suc	*Sansevieria abyssinica*
Ed gud	Ceda good	S	*Caesalpinia trothae* spp. *erlangeri*
	Cidi good		
Edi gudud	Ceedi gudug	S	*Caesalpinia trothae* ssp. *erlangeri*
		S	*Combretum* sp. (Beckett 1580)
Edi shabell	Ceedi shabeel	C	*Cissus furcifera*
	Ciidi shabeel	S	*Meyna tetraphylla* ssp. *tetraphylla*
		S/B/T	*Euphorbia* sp. section *tirucalli*
		C	*Asparagus africana*
		C	*Asparagus somalensis*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Fagirta	Faniita	B	*Adenium obesum*
Faleray	Falaari	G	*Andropogon gayanus*
Fardahn	Fardaan	B/T	*Terminalia brownii*
Far dar		Ag W	*Aspilla mossambicensis*
Fidi fido	Fiido fiido	B/T	*Acacia ogadensis*
Fiid		S	*Coffea paolii*
Filared	Filaareed	S/T	*Boscia coriacea*
		T	*Maerua* sp. (Beckett 1741)
Fiyoro	Fiyorow	Ag W	*Cassia longiracemosa*
Fulai	Fulaay	S/B	*Acacia zanzibarica* var. *microphylla*
		S/B	*A. zanzibarica* var. *zanzibarica*
Fulo	Fule		Evergreen climber with *lanceolate* leaves
Gabal	Qabaal	S	*Croton menyhartii*
Gab yer	Gaabo yar yar	S	*Euphorbia glochidiata*
			General name for small spiny *Euphorbia* sp.
Gadei	Qade(y)	Pr	*Emelianthe panganensis*
			General name for parasitic *Loranthaceae*
Gahir	Gahiye	An/H	*Blepharis ciliaris*
		H	*Blepharis* spp.
Galaliyo	Qalaaliyo(w)	S	*Euphorbia glochidata*
		B/T	*Euphorbia grandicormis*
		Suc	*Euphorbia triaculeata*
			General name for spiny *Euphorbia* spp.
Galangal	Qalaanqal	S	*Cadaba glandulosa*
		S	*Cadaba mirabilis*
		S	*Maerua glauca*
		S	*Maerua sessiliflora*
			General name for members of the *Capparaceae*
Gallol	Galool	B	*Acacia bussei*
Gamir ka ma		S	*Psiadia incana*
Ganararho	Qararo	S/B	*Sterculia rhynchocarpa*
Gan boli	Gabuuli	B	*Gardenia volkensii*
Gansa	Qansax	B	*Acacia reficiens* ssp. *misera*
Garan gara	Garan gaare	S/B	*Premna resinosa*
Garan garo	Qaran qaaro		Unidentified *Labiate*
			General name for aromatic shrubs and herbs
Garas	Garas	T	*Dobera glabra*
		T	*Dobera loranthifolia*
Ga shun (ad)		S	*Croton menyhartii*
Ged ad	Geed cadd		General name for white leaved plants
Ged bahal	Geed bahal	S	*Aerva javanica*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Ged biyod	Geed biyood		See below
Ged biyha	Geed biye		General name for plants growing in wet or seasonally wet areas and includes:
		S	*Acalypha fruticosa* var. *eglandulosa*
		H	*Aeschyromene indica*
		An	*Glinus setiflorus*
		H	*Heliotropium supinum*
		S	*Phyllanthus somalensis*
		H	*Sesbania sericea*
Ged bun	Geed bun	S	*Cephalocroton cordofanus*
		S	*Solanum jubae*
Ged bured	Geed buureed		General name for plants growing on hills and rocky places (inselbergs) and includes:
		S/B/T	*Acridocarpus glaucescens* var. *ferrugineus*
		B/T	*Afzelia quanzensis*
		G	*Andropogon gaynanus*
		S/B	*Hippocratea crenata*
		G	*Loudetia arundidaceae*
		B	*Manilkara sulcata*
		B	*Nectaropetalum kaessneri* var. *parvifolius*
		S	*Ochna* sp.
		B	*Vepris eugeniifolia*
Ged chini	Geed jini		See Ged jini
Ged dhuk	Geed dug	S	*Maerua subcordatum*
Gede	Gedo	S/B	*Ehretia* sp. (Beckett 1781)
Ged gomi	Geed qumi	S	*Ormocarpum keniense*
		S	*Ormocarpum muricatum*
Ged gurberi		S	*Strophanthus mirabilis*
Geidir	Geyde		See Geydir
Ged jini	Geed jini	Ag W/S	*Cassia longiracemosa*
Ged limo			See Limo
Ged maggot		S/B	*Elaeodendron aquifolium*
Ged ma sakeen	Geed masaakiin		Unidentified evergreen climber with lanceolate leaves
Ged meged	Geed meged	S	*Strophanthus mirabilis*
Ged rahma			General name for small shrubs and includes *Endostemon* and *Crotalaria* spp.
Ged ramud	Geed raamod	T	*Markhamia zanzibarica*
	Geed ramood	S	*Strophanthus mirabilis*
Gesaji	Gosaaji	S	General name for shrubs and trees ? *Hibiscus* sp. (Beckett 1722)
Ged sagar	Geed sagoor	H	*Barleria stelligera*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Ged sar	Geed saar		General name for climbers and twiners and includes members of the *Asclepiadaceae, Cucurbitaceae, Malpighiaceae* and *Vitaceae*
Gedudis madone	Goodudis madone	T	*Markamia zanzibarica*
Gesareeb	Gisareeb	T	*Albizia harveyii*
		T	*Albizia* sp. (Beckett 1488, 1699, 1757)
		B	*Terminalia parvula*
Ged yetin	Geed yatiin		Unidentified evergreen climber with lanceolate leaves
Geyde	Geyde, Geydho	Suc	*Agave* sp. (Sisal plant, agricultural escape)
		Suc	*Sansevieria robusta*
		Suc	*Sansevieria powellii*
		Suc	*Sansevieria* sp. (Beckett 1450 A)
Gid wey			See Jid wey
Gora		B	*Commiphora* sp.
Gora	Qora	B/T	*Acacia tortilis* ssp. *spirocarpa*
Gora adei	Gure cade	B/T	*Bottogea inermis*
Gor gon	Qo qoorn, Qoo qoon	S/T	*Combretum hereroense* ssp. *volkensii* var. *volkensii*
Gor gor	Gor gor	B	*Acacia brevispica* ssp. *brevispica*
		S	*Caesalpinia trothae* ssp. *erlangeri*
Guba harig	Goob hareeg	B	*Commiphora* sp.
Guda	Qudha	B	*Commiphora* sp.
Gududis madone	Goodudis modone	T	? *Markhamia zanzibarica*
Gul	Quul	G	*Andropogon kelleri*
Gummar		S/B	*Acacia nubica*
Gummar jeri		S	*Acacia bricchettiana*
		S	*Acacia edgeworthii*
		S/B	*Acacia nubica*
		S	*Acacia paolii*
		S	*Acacia stuhlmanii*
Gumme		S	*Cadaba farinosa* ssp. *farinosa*
Gummur		S/B	*Elaeodendron aquifolium*
Gunbe	Qunbe	Polin	*Coccus* sp. (Coconut palm)
Gundi	Gundi	S/B	*Caesalpinia erianthera*
Gunrei adei	Gunri cadey	B	*Commiphora* sp.
Gunre madobe	Guniri modiibe	B	*Commiphora* sp.
Haba kubis	Haba kubis	G	*Sporobolus helvolus*
Haba sebe	Xumba siib	G	*Schoenfeldia transiens*
Habla haris	Habla xaariis	S	*Gnidia latifolia*
Habla subke	Habla subke	B	*Commiphora* sp.
Hagar	Xagar	B	*Canthium* sp. (Beckett 1692)
Haggar jere	Xagar jariir	B	*Commiphora* sp. (Beckett 1703)
			General name for unarmed *Commiphora* spp., section *glaucidulae*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Halfo	Halfo	G	*Eragrostis perbella*
Hall	Hool	S	? *Hildebrandtia* sp.
Hamer	Xamer	S/B	*Ehretia* sp. nov. aff. *buxifolia* (Beckett 1525)
Hamr	Xamer	S	*Ziziphus hamur*
		S/B	*Ziziphus mucronata* ssp. *mucronata*
Hansa		B	*Acacia reficiens* ssp. *misera*
Hanshille	Hanshile	S	*Grewia tenax*
Hanya	Xanya	B/T	*Wrightia demartiniana*
Hara	Hara(r)	B/T	*Terminalia spinosa*
Hara boga	Harar buga	B/T	*Terminalia spinosa*
Harare	Hareeri	B/T	*Terminalia polycarpa*
		B/T	*Terminalia* sp. (Beckett 1597, 1713)
Hareri			See Harare
Harrow		An	*Merremia pinnata*
Haskul	Xuskul	Suc	*Sensevieria robusta*
		Suc	*Sansevieria powellii*
Haskul yer yer	Xuskul yar yar	Suc	*Sansevieria* sp. (Beckett 1450 A)
Hia hadia	Xanye xidid		? *Wrightia* sp.
Himir	Himir	S/B	*Ehretia* sp. nov. aff. *buxifolia* (Beckett 1525)
Hirim	Hiirin	S	? *Hildebrandtia* sp.
Hirim adei	Hiirme cade	S	? *Hildebrandtia* sp.
Hobisho	Hoobisho	S	*Grewia penicillata*
Hodei	Xodley	B	*Commiphora* sp. (Beckett 1523, 1630)
Ho hob	Ohob	S	*Grewia penicillata*
Hra rei		T	*Albizia* sp. Beckett 1448, 1699, 1757)
Hrihri		S	*Croton manyhartii*
Hubiri		B/T	*Ziziphus spina-christi* var. *microphylla*
Humbawei	Hunbawe	B	*Commiphora* sp. (Beckett 1523, 1630)
Hundreis		Suc	*Caralluma priogonium*
		Suc	*Caralluma* spp.
Hungeyer		C	*Sarcostemma viminale*
Idan	Idaan	S	*Croton menyhartii*
I id	Idic	H	*Ocimum tomentosum*
Ja bi	Jabe	C	*Cissus cactiformis*
Ja ib	Jaiib	S/B	*Combretum* sp.
Jebin	Jeebin	G	*Tetrapogon cenchriformis*
Jenno	Jenaw	B	*Commiphora rostrata*
Jid	Jid	Fern	*Actiniopteris radiata*
Jid way	Jiidi waa	S/B	*Lannea triphylla*
	Jida waahey	S/B	*Lannae rivae*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Lowie	Lowie	H	*Sesbania sericea*
		H	*Aeschynomene indica*
Lowie		T	? *Delonix* sp.
Luf	Luf	T	*Markhamia zanzabarica*
		S	? *Mundulea sericea*
		S	*Ochna inermis*
Luo galal		B/T	*Cassia abbreviata* ssp. *beareana*
Madena	Madiina	H	*Barleria* sp. (Beckett 1665)
Madmadal	Madmadaal	S/B	*Gardenia fiorii*
Ma duliso	Madhuliso	C/H	*Cissus aphylla*
Ma eratili	Mici ratili	S	*Indigofera spinosa*
Magallo	Magaalo	B/T	*Maytenus undatus*
Mag deye	Mag deeye	B	*Commiphora* sp.
	Mug doye	S/B	*Elaeodendron aquifolium*
	Mug daaye		
		T	*Maerua* sp. (Beckett 1741)
Ma jib	Majab(e)	B	*Combretum contractum*
		S	*Phyllanthus somalensis*
Ma jibe	Ma giab		Unidentified 8 m tree
Mama dool	Mara dool	B	*Gardenia fiorii*
	Mara lool		
Maradu	Maradaf	H	? *Seddera* sp.
Marere	Mareer	S/B	*Cordia sinensis*
		B	*Cordia* sp. (Beckett 1562, 1779)
Marer deylib	Mareer daylib	S	*Cordia ovalis*
Marer doye	Mareer doye	B	*Uvaria denhardtiana*
Mar marod	Mar maroog	B	*Caucanthus albidus*
Marerh or gabo	Merer oor gaabo	S	*Coffea paolii*
Marode makeran		S	*Ormocarpum muricatum*
		B/T	*Bottogea insignis* (immature)
Matito		H	*Ocimum* sp. (Beckett 1639, 1696)
Megag		S/B/T	*Boscia minimifolia*
Merer deylib	Marer daylib	S	*Cordia ovalis*
Merigis	Marajas	S	*Anisotes involucratus*
		S	*Anisotes parvifolius*
Mesar jibis	Mesar jibis	B	*Acacia hamulosa*
		B	*Acacia seneral* var. *kerensis*
		B	*Acacia* sp. (single hooked thorn)
Majab			See Majibe
Mirifur	Mirifir		Unidentified 2 m shrub
Mohwi	Mawe	S	*Moringa longituba*
Mokway	Mokore	G	? *Dignathia* sp.
Mor mor	Muur muur		*Acridocarpus glaucescens* var. *ferrugineus*
Moulon	Mulaam	S	*Cadaba mirabilis*
Mud weina	Mud weine	H	*Ecbolium anisacanthus*
Mug deye	Mug daaye	S/B	*Elaeodendron aquifolium*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Kabero	Khabeero	C	*Euphorbia erlangeri*
Kabgal	Kabgal	H	*Hibiscus meyeri*
		H	*Hibiscus micranthus*
Kabhan	Kabham	S	*Thespesia danis*
Kabish	Kabish	S	*Grewia villosa*
Kabo gor	Kabo gor	C	*Entada leptostachys*
Kadi	Qade(y)	Par	*Emelianthe panganensis*
			General name for parasitic *Loranthaceae*
Kadi gududis	Kaadi guduudis		*Acridocarpus glaucescens* var. *ferrugineus*
Kahare	Kahar	Ag W/H	*Tribulus terrestris*
Kakio	Kokiyo	S	*Solanum jubae*
Kasan	Kasaan	B	*Commiphora* sp.
Kish	Kish	S	*Cadaba glandulosa*
		S	*Cadaba mirabilis*
Kok sar	Kok saar	G	*Dichanthium foveolatum*
Kowara		G	*Sorghum* sp. (cultivated)
Ku ka	Ku ka	B	*Commiphora* sp. (Beckett 1800)
Kulan	Kulan	B/T	*Balanites aegyptiaca*
Kulmis	Kulmis	S	*Maerua subcordata*
Kurare	Kuraariyey	S	*Solanum* sp. (spiny)
Kurare	Kuraariy	C	*Coccinia grandis*
Ku rehre		C	*Cucumis* sp. (Beckett 1810)
Kurun dey	Kurun doy	S/B	*Ochna* sp. (Beckett 1657)
Kurun doye	Koron dooye	S/B	*Gardenia volkensii*
Kus gabe	Kuus gabe		*Acalypha fruticosa* var. *eglandulosa*
Labeynud	Labeenaad	H	*Indigofera* sp.
Laf du jit		S	*Ochna inermis*
Lafo	Lafo	S	*Ehretia* sp. (Beckett 1781)
Laga yer	Dhego yare	S	*Boscia coriaceae*
Lama loshe	Laama loxshe	T	*Maerua angolensis*
Lambur dir	Lambo deer	C	*Maerua macrantha*
Lan burad	Laan buraad	S	*Jatropha fissispina*
Langid	Laan jiid	S	*Ipomoea cicatricosa*
		B	*Sesamothamnus busseanus*
Lebi	Lebi	T	*Delonix elata*
Lebi wandid	Lebi wandiid	S	*Mundulea sericea*
		S	*Ochna inermis*
Lebi yer		S	*Sesbania* sp.
Leylo	Liiloowi	H	*Celosia polystachia*
Limo	Limo	C	*Capparis sepiaria*
		B/T	*Maytenus undatus*
		B/	General name for evergreen shrubs
Lohe lohe	Loxe loxei	S	*Solanum* sp (spiney)
Loomot	Dhuumood	T	*Cassia abbreviata* ssp. *beareana*
Loos			Groundnuts (cultivated)

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Muqi	Mukaay	T	*Ficus populifolia*
		T	*Ficus sycomorus*
Murode masiwi	Maroode masiibe	S	*Ormocarpum muricatum*
Murug	Muroog		Unidentified 2 m shrub
Neerga fijis	Nigo figiis	S	*Mundulea sericea*
		S	*Cassia longiracemosa*
Odatole	Odax tool	H	*Barleria* spp. (spiney herbs)
Ogir	Ojir	B	*Commiphora* sp. (Beckett 1632)
Olol	Olol	Polin	*Hyphaene* sp.
Oor dugal	Ur dhugaal	S	*Satanocrater* sp. (Beckett 1591, 1767)
Or barbar		S	*Indigofera spinosa*
Oruk	Oroog	B	*Kirkia tenuifolia*
Osma doye	Osma doy	S/B	*Uvaria denhardtiana*
Ouse	Caawes		Grass
Ouse koksar			See Koksar
Rabia		B/T	*Cassia abbreviata* ssp. *beareana*
Ragay	Ragay	T	*Tamarindus indica*
Rarmo	Rormo	G	*Andropogon kelleri*
		G	*Sporobolus helvolus*
Rhedo		T	*Albizia* sp. (Beckett 1448, 1699, 1757)
Rheidab	Reydab	T	*Albizia anthelmintica*
Rihan	Riixaan	H	*Endostemon tenuiflorus*
		H	*Ocimum* sp. (Beckett 1639)
			Orthosiphon sp. nov. aff.
			O. ctenoneurus (Beckett 1639)
			General name for aromatic
			Composites and Labiataes
Rihan gedud	Riixaan gaduud	H	? *Pulicaria* sp. (Beckett 1423)
Sar sar	Saar saar		See Ged sar
Saboon du led	Saabuu dheeleed		Fruit of *Momordica spinosa*
Saby saydi	Saby saydho	T	*Platycelyphium voense*
	Saby seedho		
Salelma	Saleel mace	B	*Sesamothamnus busseanus*
Salma selmi	Salma salmi	T	*Cassia abbreviata* ssp. *beareana*
		H	*Cassia humifusa*
		T	*Dicraeopetalum stipulare*
Salmuko	Salma koo	S	*Cassia senna* var. *obtusata*
	Salmuko		
Sareedo	Sareedo	S/B	*Ochna inermis*
Sarin	Saren	H	*Barleria* sp. (Beckett 1524)
Sarman	Sarmaan	S	*Acacia horrida* ssp. *benadirensis*
		S	*Acacia stuhlmanii*
Sennet day		Suc	*Urginea altissima*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Sharefod	Shan farood Shan faryood	S/B	*Steganotaenia araliaceae*
Shallole	Shaloolei	B	*Uvaria* sp. aff. *U. leptocladon* (Beckett 1521)
Shalloria		S	*Croton menyhartii*
Sheffer		S	*Maerua subcordata*
Shinsa	Shinsha	H	*Barleria* spp.
		H	*Blepharis ciliaris*
Shinshi			See Shinsha
Shishi	Shiishe	H	*Lepidaganthis scariosa*
Shubta naba	Shurbato nabo	S	*Cassia senna* var. *obtusata*
Shufi			Tree Lichens
Shugdi		Suc	*Sansevieria robusta*
Shuge	Shugey	Suc	*Sansevieria* sp. (Beckett 1450 A)
Sigareb	Siigareb	H	*Waltheria indica*
Sufe sufe	Suufi suufi	S	*Triumfetta actinocarpa*
Suf gini	Sufi jini	Ag W	*Gomphocarpus fruticosus*
Suf yerere		Ag W	*Gomphocarpus fruticosus*
Sug sug	Sog sog	S	*Acacia oliveri*
Sun fur	San fur	H	*Orthosiphon* sp. nov. aff. *O. ctenoreurus* (Beckett 1565)
		H	*Socotora visciformis*
Sun gorug	Soohin kiroog	Suc	*Caralluma* sp.
Ti e	Tiyes	B/T	*Terminalia prunioides*
Ti eg	Tiyeeg	B/T	*Terminalia polycarpa*
Towse	Towsi	T	*Albizia* sp. (Beckett 1448, 1699, 1757)
		T	*Boscia tomentella*
		T	*Dobera loranthifolia*
Tugare	Turaar	B/T	*Acacia nilotica*
Tu ru	Tuurow	Ag W/H	*Sphaeranthus* sp. (Beckett 1452)
Turub habahre	Turin barbaar	Suc	*Caralluma* sp. (Beckett 1572)
Ul deeg	Ul dhiig	S	*Caucanthus albidus*
		S	*Vernonia cinerascens*
Ul dig			See Ul deeg
Ul gudug	Ul guduud	S	*Ochna inermis*
Umba	Oonba	S	*Adenia venenata*
Umba	Oombo	S	*Adenium obesum*
		S	*Ipomoea cicatricosa*
Umba bered		Suc	*Urginea altissima*
Umba weilied		S	*Jatropha fissispina*
Umbe	Qunbe	Polin	*Coccus* sp. (Coconut palm, cultivated)
Umbey		H	*Rhynchosia* sp.
Urhe e	Oohiye	S/T	*Maerua denhardtiorum*
Ur jir	Uur jir	B	*Commiphora* spp. (Beckett 1632, 1724)
U sur	Yusur	T	*Cassia abbreviata* ssp. *beareana*

Somali name	Somali (spelling)	Growth form	Botanical name (or collectors number)
Waanri	Waan re	B	*Commiphora* sp.
Wa chired	Waa jireed	S/B/T	*Acridocarpus glaucescens* var. *ferrugineus*
Wadiduk	Wadiidig	B/T	*Euphorbia* sp., section *tirucalli*
Wahri	Ware	B	*Lannea rivae*
Walan wali	Wan waanay	C	*Sarcostemma andongense*
Wani wani		Suc	*Dorstenia crispa*
Wanei	Waney	B/T	*Afzelia quanzensis*
		S	*Manilkara sulcata*
		T	*Mimusops kummel*
		T	*Mimusops mochisia*
		S	*Suregada procera*
			General name applied to evergreen trees and shrubs
Wa rabared	Waraaba reeb	B	*Commiphora africana*
		B	*Commiphora* spp. (usually armed)
Warawareb			See Wa rabared
Wa shager	Waa shagar	SG	*Launea cornuta*
Web		B/T	*Terminalia brownii*
Weydiduk	Wadiidiq	C	*Cissus quinquangularis*
Wisil	Wisil	C	*Kleinia* sp.
Yal ais sagar	Yacey sagaar	H	*Waltheria indica*
Yag	Yaag	T	*Adansonia digitata*
Yagar	Yagaa	H	*Glinus setiflorus*
	Yagar	H	*Hibiscus micranthus*
		H	*Tricax procumbens*
Ya ie	Yace	S	*Croton menyhartii*
		H	*Erythrochlamys* sp.
		S/B	*Sericocomopsis pallida*
Ya ie madobe	Yacay madoobe	S	*Triumfetta actinocarpa*
Yamarug	Yamaarug	H	*Blepharis* spp.
Yei		S/B	*Sericocomopsis pallida*
			General name for white leaved shrubs

ADDENDA

Dabal		B/T	*Afzelia quanzensis*
Dego yar	Dhego yare	S/B/T	*Boscia coriaceae*
Ged biyod	Geed biyood	H	*Aeschynomene indica*
		H	*Sesbania sericea*
Ged bured	Geed buureed	S	*Ochna* sp. (Beckett 1657)
Luf		T	*Markhamia zanzibarica*
Rihan	Riixaan	H	*Ocimum* sp. (Beckett 1639)
		H	*Orthosiphon* sp. nov. aff. *O. ctenoreurus* (Beckett 1639)
Salmi selmi		H	*Cassia humifusa*
		G	*Tetrapogon tenellus*

D.3 SAMPLE SITES

A total of 46 sites were described in detail during the course of the field surveys, in addition observations were made of the vegetation at all soil survey bore and pit sites. The location of new sites is shown on map sheets 1 and 3 respectively.

This section includes representative site from each of the mapping units. The cover abundance scale used in the descriptions is as follows:

COVER ABUNDANCE SCALE

D	=	Dominant
A	=	Abundant
F	=	Frequent
O	=	Occasional
R	=	Rare
V	=	Very
L	=	Locally

Unit: Medium Mixed Shrubbed Bushland **Date:** 19.2.82

Location: West Dinsor **Site No:** V17

	Cover Abundance Scale
Grewia tenax	O
Commiphora sp.	F
Adenium sp.	O
Acacia bussei	O
Dalbergia microphylla	F
Acacia tortilis	F
Gardenia fiorii	F
Cordia ovalis	O - F
Sesamothamnus busseanus	O - R
Boscia coriacea	O - R
Abutilon fruticosa	O
Pavonia sp.	F
Tetrapogon tenellus	F - A
Basilicum polystachyum	F
Baleria sp.	F
Pupalia sp.	O
Delonix elata	O
Grewia penecillata	O
Hildebrantia sp.	O
Sericocomopsis pallida	O
Boswellia neglecta	O

Remarks:
Well grazed site with common tracks. Some evidence of misuse, with increasing herb layer of less palatable species. *T. tenellus* confined to the cover of woody vegetation.

Topography:
Flat level

Soils:
5 YR sands

Erosion:
None visible

Penetrability:
Good

Unit: Open Mixed Shrubbed Bushland **Date:**4.4.82

Location: Ceel Bisiq Caddey **Site No:** 46

	Cover Abundance Scale
Acacia tortilis	O
Cordia ovalis	O
Cadaba glandulosa	O
Grewia tenax	O
Gardenia fiorii	O
Anisotes sp.	O
Commiphora africana	O/R
Mundulea sericea	O
Delonix elata	R
Hildebrandtia sp.	F
Dalbergia microphylla	F
Baleria sp.	O
Basilicum polystachyum	O
Tetrapogon tenellys	F
Indigofera sp.	F

Remarks:
Very open site, with evidence of overgrazing and erosion features. Poor cover especially herb and grass species. Very poor site.

Topography:
3% North

Soils:
Dinsor group 5YR sands and occasional laterite nodules

Erosion:
Rilling and gullying esp. along edges of tracks

Penetrability:
Very good for all stock, many tracks

Unit: Dense Mixed Shrubbed Bushland (localised) **Date:** 27.2.82

Location: Bur Qalan (Bur Acaba District) **Site No:** V34

	Cover Abundance Scale
Acacia senegal	F
A. tortilis	F
Commiphora boiviniana	O/F
C. africana	O/R
Dalbergia microphylla	F
Lawsonia inermis	F
Cordia ovalis	O/F
Gardenia fiorii	O/F
Croton menyhartii	F
Acalypha fruticosa	F
Albizia harveyi	O/F
Grewia villosa	O/F
Terminalia sp.	O
Sesamothamnus busseanus	F
Kigelia africana	R
Crotalaria scassellatii	F
Ruellia patula	R
Leucas glabrata	F

Remarks:
Good browse species but poor grass cover. Much evidence of camels, few sheep or cattle. Wells at base of Bur. Few medium tracks.

Topography:
3% slope

Soils:
10YR/7.5YR Sands

Erosion:
Some small rills

Surface features:
Occasional basement outcrop

Pentrability:
Good

Unit: Open Mixed Bushed Grassland **Date:** 3.3.82

Location: Geel Geel Gaab **Site No:** V 41

	Cover Abundance Scale
Salvadoria persica	O
Boscia coriacea	O
Albizia anthelmintica	O/R
Gardenia fiorii	F
Lawsonia inermis	O
Cordia ovalis	F
Ormacarpum sp.	O
Dobera loranthifolia	O
Terminalia sp.	O
Cadaba glandulosa	O
Acacia bussei	O
A.mellifera	F
A. senegal	O
A. tortilis	O
Baleria sp.	F
Basilicum polystachyum	F
Ipomoea garckeana	O
Sporobolus helvolus	F
Echinochloa colona	O

Remarks:
Even, wellgrazed site. Common small and medium tracks.

Topography:
Concave

Soils:
Variable, clays in depression
Sand away from depression

Erosion:
None visible

Penetrability:
Good

Unit: Open Mixed *Acacia* Shrubbed Bushland **Date:** 13.2.82

Location: N. Berdaale **Site No:** V.4

	Cover Abundance Scale
Acacia senegal	O
A. tortilis	O
A. bussei	O
Grewia villosa	O
Gardenia fiorii	F
Cordia ovalis	O
Premna resinosa	O-F
Solanum jubae	F
Hilderbrandtia sp.	O
Kleinia sp.	O
Commiphora sp.	L F
Boscia tomentella	O
Leucas abyssinica	F
Dactyloctenium scindicum	F
Tetrapogon tenellus	F

Remarks:
Reasonably good grass cover, despite the presence of many tracks and paths.

Topography:
Flat, Even

Soils:
7.5 YR Sands and clays

Erosion:
None visible

Penetrability:
Good for all types of stock

Unit: Dense Mixed Bushed Woodland **Date:** 13.3.82

Location: Escarpment East of Baidoa; Surweyn **Site No:** V42

	Cover Abundance Scale
Acacia sieberiana	F
A. senegal	O (L A)
Berchemia discolor	O
Phyllanthus somalensis	O
Albizia sp.	O
Tamerindus indica	F
Mimusops kummel	O
Ziziphus mucronata	F
Ficus vasta	O
Bauhinia ellenbeckii	O
Ormocarpum muricatum	F
Bottogea insignis	O
Terminalia polycarpa	O
Meyna tetraphylla	R
Grewia bicolor	F
Acacia brevispica	O/R
Combretum hereroense	F
Ochradenus somalensis	O
Mimusops mochisia	O
Pavetta subcana	F
Indigofera spinosa	F
Eragrostis abrumpens	F
Cenchrus ciliaris	F
Dactyloctenium geminatum	F

Remarks:
Site predominantly dense, a few open areas. Few tracks. Dense herb layer, little used by stock.

Topography:
Escarpment edge

Soils:
10YR sands and clays over Limestone (some Outcropping)

Erosion:
A few rills along track edges. Potential hazard if misused.

Penetrability:
Poor

Unit: Medium Mixed *Acacia* Shrubbed Bushland **Date:** 13.2.82

Location: Buur Gal Waay Berdaale **Site No:** V.3

	Cover Abundance Scale
Acacia bussei	F
A. mellifera	O
A. tortilis	O
Grewia tenax	F
G. villosa	O
Gardenia fiorii	F
Dalbergia microphylla	F
Premna resinosa	F
Commiphora sp.	O
Indigofera sp.	F
Boscia coriacea	O
A. zanzibarica	O-R
Neuracanthus sp.	F-A
Aristida adscensionis	F
A. kelleri	F

Remarks:
Well developed herb and shrub layer. Poor grass species. Very few paths and tracks.

Topography:
Even Level

Soils:
10YR clays and limestone

Erosion:
None visible

Penetrability:
Fair, restrictions for cattle.

Unit: Medium *Acacia* Grassed Bushland **Date:** 21.2.82

Location: South of Idad Geeray (Dinsor District) **Site No:** V.25

	Cover Abundance Scale
Acacia mellifera	F
A. reficiens	F
A. brussei	F
Croton menyhartii	F
Acalypha fruticosa	O
Dalbergia microphylla	F
Gardenia fiorii	O
Combretum hereroense	O/R
Euporbia erlangeri	R
Cadaba glandulosa	O
Dobera loranthifolia	O/R
Anisotes involucratus	O
Platycelyphium sp.	O
Commiphora sp.	O/R
Endostemon tenuiflorus	F
Baleria sp.	O
Tetrapogon tenellus	A
Echinochloa haploclada	O/R

Remarks:
Good grass cover, a few small tracks but little evidence of recent grazing

Topography:
Level-even

Soil:
10 YR clays over limestone

Erosion:
None visible

Surface features:
10% fossiliferous limestone at surface

Penetrability limitations:
Good - camels and goats
Fair - cattle and sheep

Unit: Dense Mixed Acacia Shrubbed Bushland **Date:** 2.3.82

Location: Buur Gal Waay **Site No:** V37

	Cover Abundance Scale
Acacia bussei	O
A. senegal	O
A. tortilis	O
A. mellifera	O
A. reficiens	O
Anisotes sp.	F
Cordia ovalis	F
Cissus quadrangularis	O
Gardenia fiorii	F
Platycelphium voense	O - F
Solanum jubae	O - F
Boscia coriacea	O
Grewia villosa	F
Combretum sp.	O
Maerua sp.	O
Euphorbia glochidata	O
Baleria sp.	F - A
Sporobolus helvolus	O
Tetrapogon tenellus	F
Indigofera spinosa	F

Remarks:
Dense and difficult to penetrate, all layers well developed.

Topography:
Even

Soils:
10YR clays occasional limestone

Erosion:
None Visible

Penetrability:
Poor for all types of stock.

Unit: *Acacia* thicket **Date:** 20.2.82

Location: S. W. Dinsor **Site No:** V.22

	Cover Abundance Scale
Acacia nilotica	F/O
A. horrida	F/O
A. mellifera	F
A. tortilis	O
A. zanzibarica	O (LA)
A. stulmanii	F (LD)
Cordia ovalis	O
Cadaba glandulosa	O
Grewia tenax	O
Albizia anthelmintica	O
Dobera loranthifolia	O
Dichrostachys cinerea	O (LF)
Tetrapogon tenellus	F/A
Sporobolus helvolus	F
Schoenfeldia transiens	O

Remarks:
Good grass cover, very tall, due to protection from grazing offered by the spiny woody species. Site cleared at one stage for arable use.

Topography:
Flat, even

Soils:
10 YR clays and occasional limestone

Erosion:
None visible

Penetrability:
Poor

APPENDIX E

LIVESTOCK

E.1 TOTAL BIOMASS AND PERCENTAGE CONTRIBUTION BY SPECIES

Stratum No.	Biomass (kg/km²)	Camels %	Cattle %	Goats %	Sheep %	Equines %
1	11400	40.7	51.6	7.3	0.3	0.1
2	5990	71.4	22.9	5.0	0.6	0.2
3	5245	85.9	8.8	5.2	0.1	-
4	2260	91.2	7.5	1.0	0.3	-
5	1035	62.9	37.1	-	-	-
6	5820	63.1	29.4	6.0	1.5	-
7	6465	66.7	27.0	6.1	0.1	-
8	7385	49.5	45.1	4.7	0.7	-
9	5415	72.5	24.5	2.7	0.3	-
10	8335	45.3	50.1	3.8	0.7	0.1
11	4035	6.9	90.7	1.7	0.5	0.2
12	19370	53.2	45.6	1.2	0.1	-
13	3260	41.2	57.6	0.8	0.4	-
14	2410	50.0	48.5	1.5	-	-
15	5110	60.0	38.9	0.9	0.2	-
16	5585	63.2	33.7	2.5	0.6	-
17	2170	55.0	43.7	1.3	-	-
18	2060	72.2	27.8	-	-	-
19	2905	28.5	69.4	0.8	1.3	-
20	6455	27.7	70.7	1.4	-	0.2
21	4671	75.7	23.2	0.9	0.1	-
22	1265	35.7	63.6	0.6	0.1	-
23	11315	90.6	8.5	0.8	0.2	-
24	3015	71.8	15.1	10.7	2.0	0.4
25	nil	-	-	-	-	-
26	2455	44.7	54.4	0.8	0.1	-
27	2025	32.6	65.5	1.9	-	-
28	1230	94.2	2.7	2.2	0.9	-
29	3225	39.2	59.6	1.2	-	-
Regional mean	5165	58.0	37.9	3.7	0.4	0.04

E.2 PRODUCER PRICES FOR LIVESTOCK AT LOCAL MARKETS (FEBRUARY 1982)

Camels		S.Sh
Male	- Slaughter 12 years	4000 - 4500
Male	- 2 - 4 years	1500 - 2000
Male	- ⩽ 2 years	800 - 1200
Female	- Breeding/pregnant	8000 - 9000
Female	- Breeding 4 - 5 years	6000 - 7000
Female	- < 2 years	1200 - 1500
Female	- Slaughter cull	3300 - 3600

Cattle		
Male	- Breeding bull 6 years	3000 - 3500
Male	- > 4 years	2000 - 3000
Male	- 2 - 4 years	1500 - 1700
Male	- 1 - 2 years	1000 - 1500
Cow	- + calf at foot	3800 - 4500
Cow	- pregnant	3500 - 4200
Heifer	- Breeding	3000 - 3500
Heifer	- 1 - 2 years	1500 - 2000
Female	- Slaughter cull	1800 - 2500

Sheep and Goats		Sheep (S.Sh)	Goats(S.Sh)
Mature Ram		800 - 1200	600 - 700
Young Ram < 2 years		400 - 550	400 - 500
Female	- Breeding/pregnant	800 - 1000	500 - 700
Female	- gimmer	450 - 500	450 - 600
Female	- Slaughter cull	350 - 500	350 - 500

Camel Milk: S.Sh per Combo (± 1 litre)

Baidoa	Dry season	8 - 12	Rainy season	6 - 8
Bur Acaba		7 - 8		2 - 3
Dinsor		9 - 10		6
Kansa Dere		12 - 17		6 - 8

Ghee: S.Sh per Karsho (± 1 litre)

Baidoa	Dry season	55 - 60	Rainy season	45 - 50
Bur Acaba		55 - 60		40 - 50
Dinsor		45 - 50		40 - 45
Kansa Dere		55 - 60		45

Eggs: Cents each

Baidoa	Dry season	80 - 100	Rainy season	100 - 150
Bur Acaba		70		120
Dinsor		50		100
Kansa Dere		100		150

APPENDIX F

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