JESS *Juba Environmental and Socioeconomic Studies*

Daraasaadka Dooxada Jubba

A project of

Ministry of Juba Valley Development
U S Agency for International Development
Associates in Rural Development, Inc

PNABK-524

ACCESS GUIDE

for

GROUND VEGETATION MONITORING SITES

GOARIS. Then insert the appropriate data disk (labelled by survey and strata) and follow instructions on the screen For further information contact Resource Management and Research in London or Muqdisho.

I. VEGETATION MONITORING SITES DATABASES

These databases use "Reflex" software For each file name an example of the data entry form is reproduced Each "field" on that form is then explained. Formulae used to calculate some fields are not reproduced since these can be examined by "highlighting" the fields in question. No attempt is made to explain use of hardware or software. However, each data repository contains "Using Reflex", a book explaining how to manipulate the data using this program. The databases are not meant to be used in isolation Purposes of data collection and rationale of analysis is found in TEBS Report Field names are underlined in the following account.

A. Ground Monitoring Sites

Data are in six databases listed below

1 SITEDESC

This database is an outline description of each monitoring site Detailed descriptions appear in the accompanying volume TEBS Ground Monitoring Sites Figure 1 is an example of the reflex "form view" The following information is recorded

Site number These were assigned in sequence as sites were designated There are no site numbers 55-59.

Location. Latitude and longitude (degrees and minutes)

Floodplain "yes" and "no" refer to whether inside or outside Jubba floodplain, respectively

Type. For floodplain sites physiographic type is recorded as follows: undif = undifferentiated sediments; tog = seasonal stream bed or bank; H = heterogeneous alluvia, L = levee, D = dhesheeg; d/f = flat, free draining alluvia (see TEBS report for description of types). For non-floodplain sites number is "land system unit" as used in Southern Rangeland Survey (Watson & Nimmo 1985), additional qualifiers are added as appropriate, viz RCA = devastated area around refugee camps, waterpoint = major livestock watering point; old levee = old riverine alluvia, now never floods, sand dune = coastal dune

River Zone Equivalent to river sections I-VIII in TEBS Map 2 (TEBS report)

Description Vegetation description by three vertical strata as explained in TEBS report Appendix C

Figure 1 Example of Form View of SITEDESC Database

SITE NUMBER 35

Location 3 6N, 4E 34E

Floodplain no Type 4E River Zone E

Description thicket bushland
low shrub stratum sparse
herb stratum negligible

Soil texture rocky Soil color yellow

Calculated Woody Biomass

High 56 5 Medium 14 3 Low 10.4

Soil Texture: Derived from field examination of surface soil, categories simplified from USDA Soil Texture Triangle as follows (full classification given in TEBS Site Descriptions):

- USDA "rock" & "stone" combined as rocky,
- USDA "sand" & "loamy sand" combined as sandy;
- USDA "sandy loam" & "sandy clay loam" combined as sandy loams;
- USDA "loam" & "clay loam" combined as loamy,
- USDA "clay" and "silty clay" combined as clay,
- USDA "silty clay loam" and "silty loam" combined as silty

Soil Color: Derived from field examination of surface soil using Munsell Soil Color Charts, categories simplified as follows (full classification given in TEBS Site Descriptions):

- Munsell "gray, light brownish gray, very dark grayish brown, very dark gray, dark reddish gray" combined as gray,
- Munsell "brown, dark brown, very dark brown, strong brown, pale brown, very pale brown" combined as brown;
- Munsell "weak red, pale red, red, dusky red" combined as red,
- Munsell "light yellowish brown, yellowish brown, dark yellowish brown" combined as yellow brown;
- Munsell "dark reddish brown, reddish brown" combined as red brown,
- Munsell "reddish yellow, yellowish red" combined as red yellow,
- Munsell "yellow" is given as yellow.

Calculated Woody Biomass. "High", "Medium" and "Low" refer to regression equations in TEBS report, Appendix G, to predict tree and shrub wood biomass from crown diameter. Estimate given is for whole plot t ha^{-1}.

2. WOODYFP AND WOODYNFP

These two files have identical structure recording details of individual trees and shrubs at each site WOODYFP refers to the Jubba floodplain and WOODYNFP to the river-dependent zone (see TEBS report) Figure 2 is an example of the Reflex "form view". Note that sites without woody vegetation do not appear in this database.

Plot no (= site number), Floodplain (y = yes; n = no), Type, River Zone; Soil texture and Soil color are as in Section A for SITEDESC.

Figure 1 Example of Form View of WOODYFP Database

JESS WOODY VEGETATION

Plot no 60 | Date 7/05/87

Floodplain y | Type undit

River zone 1 | Area 100

Soil texture sandy loams | Soil color brown

Species Ac -anzib

Growth form s | No stems

Basal dia 13 4

Crown dia A 1 9 | Crown dia B 3 0
Crown begins 0 1

Height 1 8 | Height class 1

Basal area 195 59

Crown area 6 80 | Crown depth 1 70
Crown vol 11 61 | Mean crown dia 3 0

Comments

Area adjustment 1 00 | y cover 6 855

Date Date of enumeration of woody plants.

Area: Area of plot; 400 = 20 m x 20 m (except plots 40 and 50 which are 100 m x 4 m); 200 = 20 m x 10 m (plot 76), 100 = 10 m x 10 m See TEBS Site Descriptions and TEBS report, Appendix A for further information.

Species: Plant species names are given in full except for the following abbreviations Unidentified species are given either by [vernacular name]/u or unident. Some corrections to names are also included; where several species share the same genus and species names are given in full, only the generic abbreviation is given. For example, acacias other than A. zanzibarica are given as Ac reficiens, Ac nilotica, etc

Abut anglosom	Abutilon anglosomaliae
Acal fruticosa	Acalypha fruticosa
Ac	Acacia
Ac zanzib	Acacia zanazibarica
Aden aculeata	Adenia aculeatum
Aden rotund	Adenopodia rotundifolia
Al anthelmin	Albizia anthelimintica
An trisulcus	Anisotes trisulcus
Bos	Boscia
C sinensis	Cordia sinensis
Cad	Cadaba
Cae	Caesalpinia
Cal procera	Calotropis procera
Cel polystichia	Celosia polystachia
Ceph cordofanus	Cephalocroton cordofanus
Cof rhamnifolia	Coffea rhamnifolia
Comm	Commiphora
D	Dobera
Dalb commiph	Dalbergia commiphoroides
Dich cinerea	Dichrostachys cinerea
Dr natalensis	Drypetes natalensis
Eu	Euphorbia
Far robacciana	Farsetia robecchiana
Fic sycomorus	Ficus sycomorus
Gar fiorii	Gardenia fiorii
Garc livingstonei	Garcinia livingstonei
Gosy benad	Gossypium benadirense
Gr	Grewia
Ind	Indigofera
L inermis	Lawsonia inermis
Lec fraxinifolius	Lecaniodiscus fraxinifolius
Lep senegalense	Lepisanthes senegalensis
Mae	Maerua
Mon fornicata	Monanthotaxis fornicata
Orm kirkii	Ormocarpum kirkii
Pav spacrobotrys	Pavetta transjubensis
Ple pynantha	Pleiocarpa pycnantha

Pr resinosa	Premna resinosa
Ph somal	Phyllanthus somalensis
Sol	Solanum
Rin elliptica	Rinorea elliptica
S persica	Salvadora persica
Ser	Seriococomopsis
Sen incana	Senra incana
Ses busseanus	Sesamothamnus busseanus
Spir venenifera	Spirostachys venenifera
T	Terminalia
Th danis	Thespesia danis

Growth form t = tree, s = shrub; cl = climber

No stems number of stems; equals one by definition for trees, recorded for some shrubs (> 1) but discontinued later.

Basal dia: basal diameter (cm) of stem, or length of long axis of shrub stem cluster.

Crown dia A. and Crown dia B diameter of crown (m) in two horizontal perpendicular directions.

Crown begins: height (m) above ground that living crown begins (sometimes not determined when leafless, see Comments:).

Height: total height (m) of plant.

Height class: 1 = 0 - 1 m total height,
2 = 1 - 2 m,
3 = 2 - 5 m,
4 = 5 - 10 m,
5 = 10 - 20 m;
6 = 20+ m.

Basal area formula calculating basal area (cm^2) from Basal dia., assuming stem circular (note: overestimates for assymetric shrubs)

Crown area· formula calculating crown area (m^2) from Mean crown dia (see below) assuming crown circular

Crown volume. (m^3) assumes cylindrical crown calculated from Crown area and Crown depth

Mean crown dia: mean of Crown dia A and Crown dia B (m)

Crown depth: difference between total Height and Crown begins.

Comments any additional relevant information about a particular plant.

Area Adjustment formula for separating different plot areas, used to calculated % cover.

% cover formula calculating percentage of plot covered by each plant.

3 HERBVEG

This database records information about quantitative measurements of herbaceous vegetation made during different seasons. For details of point frame technique and meaning of "hits" see TEBS report, Appendix A. Sites without herbaceous vegetation do not appear in this database Figure 3 presents a REFLEX "form view."

Site number, Floodplain, Type and River zone are as in other databases, above.

Date precise date of site visits

Month: month of visit using Reflex conditions allowing sorting by months

Woody cover % woody canopy cover from SITEDESC database

Total vegetation hits: , Total ground hits· point frame data; see TEBS report, Appendix A

PERCENTAGES, grass green, forb green, dwsh (dwarf shrub) green, same names brown is % of total vegetation hits recorded in each category.

STANDING CROP DATA (kg ha^{-1}) gives Mean, Standard error of mean and number of samples (n) as determined by harvest samples (see TEBS report, Appendix A)

PREDICTED STANDING CROP is formulae for above categories calculated from % of each and Standing crop, assuming all categories are equivalent in mass to % cover ratio

DEGREE OF GRAZING is visual estimate of grazing pressure: 0 = no grazing, 1 = slight grazing; 2 = moderate grazing, 3 = heavy grazing.

COMMENTS any additional information relevant to herbaceous vegetation, such as flooding, fires, insufficient herbage to allow standing crop estimation (often recorded as > 100 kg/ha), etc.

Figure 3 Example of Form View of HERBVEG Database

JESS HERBACEOUS VEGETATION % SEASONAL CHANGES

Site number F0 Date 7/05/37
Floodplain y Month 7/01/87
Type n
River zone I Woody cover* bushed grassland

POINT FRAME DATA

Total vegetation hits 172 Total ground hits 86

PERCENTAGES

grass green	72	grass brown	24	soil	33	rock	
forb green		forb brown		litter	1	dung	
dwsh green	3	dwsh brown					

STANDING CROP DATA

Mean. 1217 Standard error 301 n 10

PREDICTED STANDING CROP

green grass	361	green forb	0	green dwsh	40
brown grass*	316	brown forb	0	brown dwsh	0

DEGREE OF GRAZING I

COMMENTS

Figure 4 Example of Form View of HERBSPP Database

JESS VEGETATION HERBACEOUS SPECIES COMPOSITION

Plot no 32 River Zone 6 Floodplain n
Type Woody Cover 42

Species Uro trichopus Growthform g

Density Rank 2 Height Rank 2 Composite abundance 5

Soil texture sandy Soil color brown

Notes

4 HERBSPP

Records information on herbaceous species composition of ground monitoring sites with one record for each species at each site Semi-quantitative estimated of abundance are from visual examination of sites and the immediate surrounding area Figure 4 shows an example of the Reflex "form view" Sites without herbaceous vegetation do not appear in this database.

Plot no, River Zone, Floodplain, Type, Soil texture and Soil color are the same as in previously described databases.

Woody cover: % woody cover for site from WOODYFP and WOODYNFP databases described above.

Species. Plant species names are given in full except for abbreviations for some genera given in the following list Plants which were not identified are given as "unident" or "[vernacular name]/u"

Abut	Abutilon
Ar	Aristida
Cench	Cenchrus
Chl	Chloris
Dactylo	Dactyloctenium
Dig	Digitaria
Ech	Echinochloa
Enic	Enicostemma
Ent	Enteropogon
Erag	Eragrostis
Erio	Eriochloa
Eu	Euphorbia
Helio	Heliotropium
Ind	Indigofera
Ip	Ipomoea
Rhyn	Rhynchosia
Schoen	Schoenfeldia
Sedd	Seddera
Sen	Senra
Set	Setaria
Sol	Solanum
Sor	Sorghum
Sp	Sporobolus
Teph	Tephrosia
Tet	Tetrapogon
Trib	Tribulus
Uro	Urochloa

Growthform. g = grass (or sedge, if footnoted); f = forb (or climber, or succulent if footnoted); ds = dwarf shrub

Density Rank: relative abundance visually estimated (see TEBS report Appendix A), 5 = abundant/dominant, 4 = common, 3 = frequent, 2 = occasional, 1 = rare.
Height Rank: total height of taller individuals of each species, visually estimated; > 100 cm = 4, 51 - 100 cm = 3, 21 - 50 cm = 2, 0 - 20 cm = 1

Composite Abundance formula giving sum of Density Rank and Height Rank.

Notes: any other information including some growthform categories mentioned above

5. PLANTAX

This database contains plant taxonomic and ethnobotanical information collected on or close to ground monitoring sites Figure 5 is an example of reflex "form view" for this database

Family, No, Species and Authority are standard botanical information (No = Family number which corresponds with Kuchar 1988 - reference in TEBS report).

Collection nos: JESS specimen numbers, collectors Hemming & Deshmukh and Deshmukh 1986/87/88. See TEBS report Appendix D

Growth form: indicates whether tree, tree/shrub, shrub, dwarf shrub, grass, sedge, forb, climber, succulent

FP, NFP found in floodplain or non-floodplain; y = yes, n = no

Sites: JESS ground monitoring sites at or near which species found

Distribution broad distribution in Somalia from Kuchar (1988)

Taxonomic notes sub-species, varieties, etc., plus other relevant information, such as "sterile" specimen sent for identification.

Vernacular name: (1 - 4) names given to species by local informants.

USES : categorization of reported uses (food is human food; fodder, livestock food).

Ethnobot notes: any other ehtnobotanical information

Figure 5 Example of Form View of PLANTAX Database

JESS PLANT TAXONOMY AND ETHNOBOTANY

Family Boraginaceae No 249 Species Cordia goetzei
Authority Guerke
Collection nos 34, 35, 36 Growth Form tree
FP y NFP. n
Sites 3, 15,
Distribution south
Taxonomic notes sterile
Vernacular name 1 geed cade Vernacular name 3 mareer dool
Vernacular name 2 geed madow Vernacular name 4

USES

Building poles and in-fill
Food fruit
Fodder
Medicinal roots crushed & boiled, liquid drunk for headaches
Utensils
Other

Ethnobot notes

B Photographic Monitoring Sites

{to be use with TEBS Product #4 Aerial Photographs of Monitoring Sites [prints]}

These (1: 1000) vertical aerial photographs are stored at REDSO, Nairobi. VEGPHOTO database records the TEBS analysis of these which is explained in TEBS report, Chapter VI and Appendix B Figure 6 is an example of a VEGPHOTO record in the Reflex "form view".

Photo no first number (1 - 4) is film number and number after " " is three digit frame number within that film, these numbers found on photo-edge

Floodplain indicates whether site is in Jubba floodplain; "y" = yes, "n" = no

Type: for floodplain, 1 = undifferentiated; 2 = tog; 3 = dhesheeg, 4 = flat, free-draining, 5 = levee, 6 = heterogeneous (see TEBS report). In river-dependent zone three digit number refers to "land system units" of Southern Rangeland Survey (see Watson & Nimmo 1985).

River Zone: Equivalent to river sections I-VIII in TEBS report, TEBS Map 1.

Distance from floodplain: distance of river-dependent zone sites from Jubba floodplain.

Side: whether west (W) or east (E) of Jubba floodplain (river-dependent zone sites only)

Woody to Nothing: records percent cover of photograph within dot grid frame used for analysis (see TEBS report, Appendix B); Road refers to car track, Track to footpath or livestock trail, Human other human created features including farmland; Other is discernible but unclassified; Nothing is uninterpretable section of photograph

Total is sum of all categories listed; must be 100 because of technique

Vegetation sum of potential vegetation cover categories (i e formula computing Total minus Water, Road, Track, Human, Other and Nothing).

Percent woody formula computing Woody as percent of Vegetation.

Cover class: subdivides Percent woody into following categories: 1 = 0 - 2% woody cover,
2 = 2 - 19%;
3 = 20 - 39%;

Figure 6 Example of Form View of VEGPHOTO Database

JESS VEGETATION PHOTOGRAPHY

Photo no 3 043 Floodplain y Type 2
Zone 5 Dist from fpl Side

Woody 64 Grassy 33 Bare 0 Water 0 Road 0
Track 0 Human 0 Fallen tree 0
Other 0 Nothing 3 Total 100 Vegetation 97

Percent woody 66 Cover class 5
Mean crown dia over 2m 7 5 Site description medium woodland

STAGE STRUCTURE ANALYSIS

No in sample 5 Total No 21
No in size class I 2 II 1 III IV 1
V VI 1 VII

Prop in size class I" 0 4 II" 0 2 III" 0 0 IV" 0 2
V" 0 0 VI" 0 2 VII" 0 0

NOTES

4 = 40 - 59%,
5 = 60 - 79%,
6 = 80+%.

Mean crown dia over 2m formula computing mean crown diameter for crown size classes > I (see SIZE STRUCTURE ANALYSIS below)

Site Description: uses classification described in TEBS report Appendix C, partly subjective from visual examination of photograph in conjunction with Cover class and Mean crown dia over 2m .

SIZE STRUCTURE ANALYSIS divides woody plants within the dot grid frame into size classes (see TEBS report, Appendix C).

No in sample number of individual woody plants in randomly selected sample using dot grid.

Total no total number of individual woody plants in dot grid frame.

I: to VII: number of sample in size classes (m) of woody plants based on crown diameter and 1 1000 scale

I =; > 2
II =, 2 - 4
III =, 4 - 6
IV =; 6 - 8
V =; 8 - 10
VI =, 10 - 15
VII = 15 +

Prop in size class, formula computing proportion of woody plants in each size category listed above.

NOTES: any other relevant information.

II. TEBS GROUND MONITORING SITES, PHOTOGRAPHIC SLIDES

At each ground monitoring site several photographs were taken as visual records for future comparison. These transparencies are in 4 boxes labelled "JESS/TEBS Vegetation Monitoring Sites"

At most sites four photographs were taken, two looking horizontally into the site from 5 or 10 paces outside and two looking vertically downward at the ground (see TEBS report Appendix A) The exact position from which these photographs were taken and variations on the standard pattern are recorded for each site in TEBS Ground Monitoring Sites

On the mount of each slide three items are recorded

for example, 23 III
July 87.

Arabic numerals are Site Numbers.
Roman numerals are number of photograph at that site.
Date Month and year when photograph was taken

III. AERIAL CENSUS DATA TABLES

Extensive aerial resource surveys yield a massive amount of data. JESS aerial censuses, performed by RMR, are summarized in Resource and Land Use Surveys of the Jubba Valley (Watson & Nimmo 1988) and used extensively in TEBS report (Deshmukh 1989) Watson & Nimmo (1988) also explain methods of data collection, analysis and organization These aspects are not covered in this guide

Following is a guide to six volumes of data produced by the aerial surveys.

Volume 1. Comparative Tables of Strata

Volume 2 Comparative Tables of Regions

Volume 3. Profiles of Strata

Volume 4 Profiles of Regions

Volume 5. Livestock Activities by Strata

Volume 6. Livestock Activities by Regions

A. Timing and Stratification of Censuses

Three censuses were conducted

- 1st Jilaal Survey; 26 January to 3 February 1987,
- 2nd Jilaal Survey; 28 March to 13 April 1987,
- Hagai (xagaa) Survey, 29 July to 26 August 1987

Subdivisions of the TEBS and Aerial Census study areas are shown in Figures 7 and 8. The primary ecological division is:

- the Jubba river and its floodplain,
- the river-dependent zone (or Jubba Valley Zone) which stretches 30 km either side (west and east) of the floodplain

The 1st Jilaal Survey covered only the floodplain, the other two surveys covered the whole study area. Floodplain surveys cover (approximately) 10% and river-dependent zone surveys (approximately) 3% of the respective areas Flight

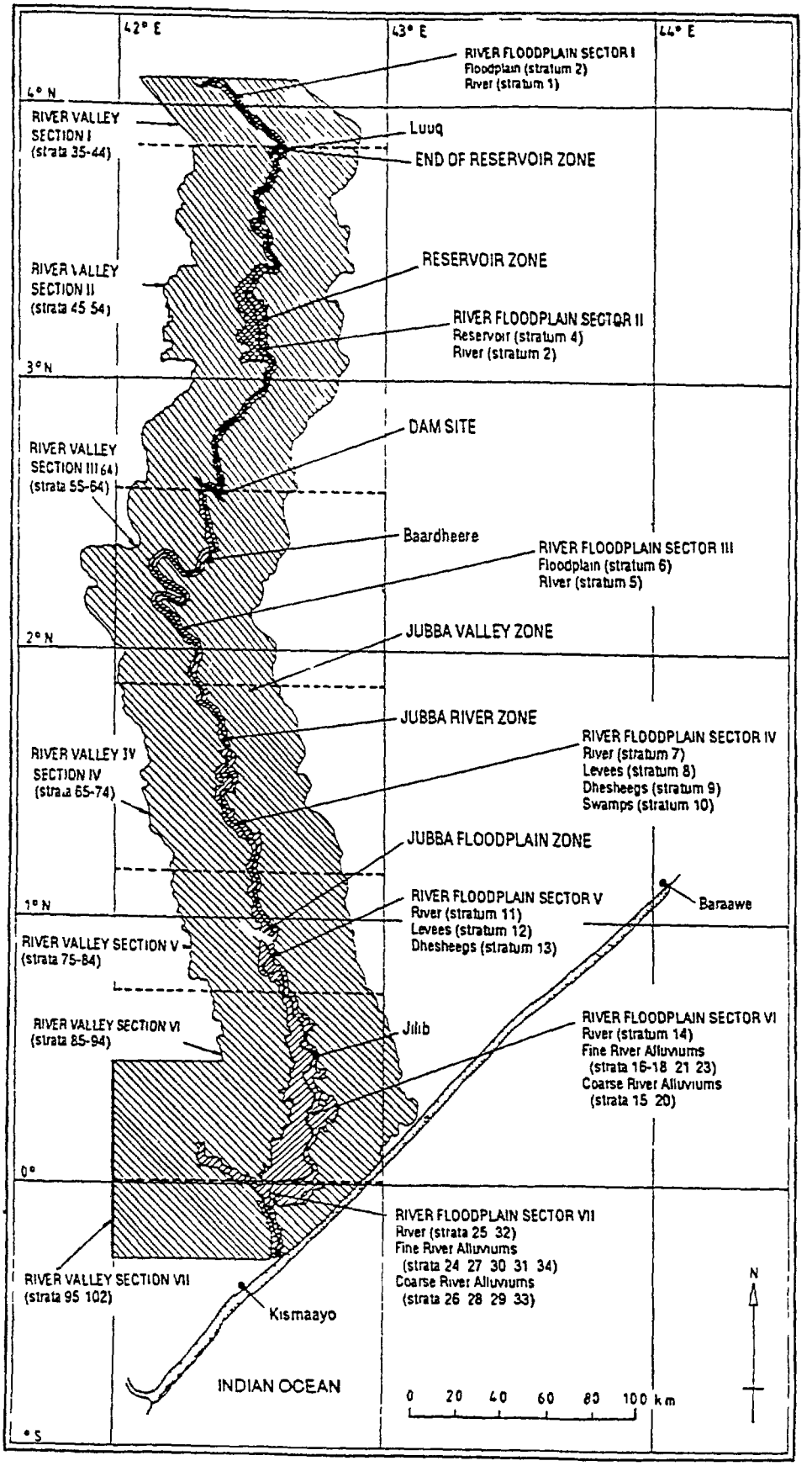

Figure 7 *River Valley Sections River Sectors and Survey Strata of the Impact Zones*

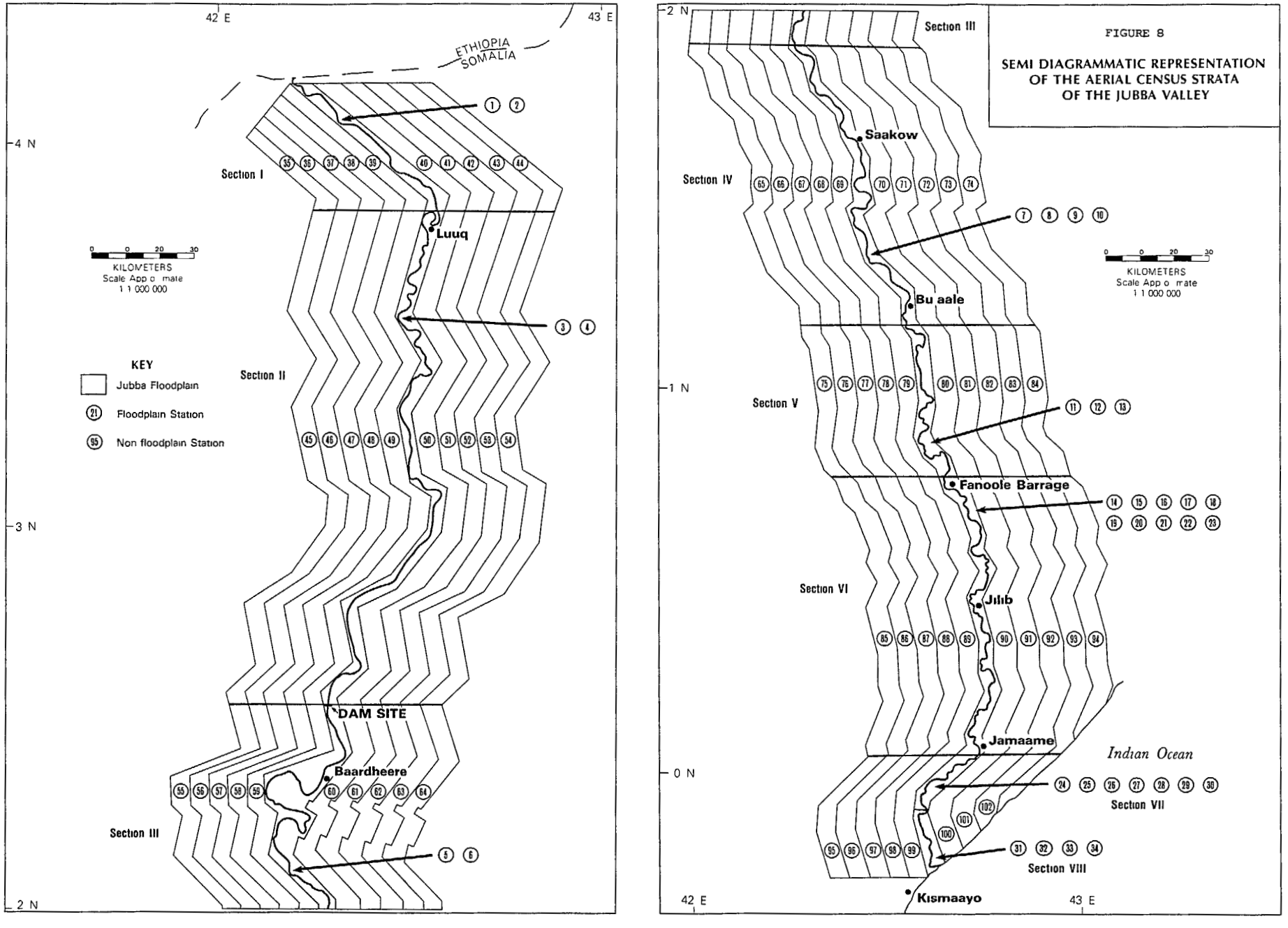

FIGURE 8

SEMI DIAGRAMMATIC REPRESENTATION OF THE AERIAL CENSUS STRATA OF THE JUBBA VALLEY

lines used in this strip census technique are shown in "Aerial Census Maps"

North to south the floodplain and river are divided into eight river sections (I to VIII) and the river-dependent zone into seven river sections (I to VII, VII is equivalent to sections VII and VIII in the floodplain). River Sections are shown in Figure 7.

The reservoir zone covers the river, floodplain and non-floodplain areas that will be inundated after closure of Baardheere Dam in river section II. In the south, the floodplain and river-dependent zone are extended westward to include Dhesheeg Waamo (see Figures 7 and 8).

B Strata

The floodplain and river-dependent zone are further subdivided into strata. These strata are combined in various ways to produce regions (see Section C) Data at the stratum level are presented in volumes 1, 3 and 5.

River-dependent zone (Jubba Valley zone) strata are arranged in the simple geographical fashion shown diagramatically in Figure 8. These strata are numbered 35 to 102 west to east by river section. Each is 6 km wide and the length of its river section Floodplain strata are more complex and relate to physiography and sediment type The classification is based on a series of land-use and vegetation photomaps produced by AHT (1984) This interpretation is updated in the JESS "Maps of Aerial Census Results". The strata are named

- undifferentiated floodplain in river sections I - III

In river sections IV to VIII possible categories are·

- levee (L),
- dhesheeg (D);
- fine flat alluvia (d);
- mixed alluvia (H);
- swamps;
- irrigated estates;
- villages

(Letters in parentheses refer to categories in AHT 1984). Where they occur in the same river section, dhesheegs, fine flat alluvia and irrigated estates are sometimes combined as fine river alluvia and levees and mixed alluvia as coarse river alluvia (see Figure 7)

Numbering of floodplain (and river) strata runs north to south by river section. Thus one physiographic type will have several stratum numbers. For example, levees in river section IV are stratum 8; levees in river section V are stratum 11, etc. (see Figure 7 and Table 1).

Table 1 Numbering System of Floodplain and River Strata
Flat = fine flat alluvia; mixed = mixed alluvia; irrig = irrigated estates.

RIVER SECTION	STRATA
I	1 = river; 2 = undifferentiated floodplain
II	3 = river, 4 = reservoir zone (includes floodplain and some non-floodplain areas)
III	5 = river; 6 = undifferentiated floodplain
IV	7 = river, 8 = levee; 9 = dhesheeg; 10 = swamp[1]
V	11 = river, 12 = levee; 13 = dhesheeg
VI	14 = river, 15 = levee, 16 = dhesheeg, 18 = flat, 19 = village[1]; 20 = mixed, 17, 21-23 = irrig[2]
VII	25 = river; 26 = levee, 27, 30[3] = dhesheeg; 28, 29[4] = mixed,
VIII	32 = river; 33 = levee; 34 = dhesheeg; 31 = flat

[1] swamps and villages occur sporadically throughout river sections, but are grouped for the whole floodplain under these stratum numbers
[2] 17 = Jubba Sugar; 21 = Fanoole rice; 23 = Mogambo rice/mixed, 24 = bananas.
[3] 30 = Dhesheeg Waamo
[4] 28 = Shabeelle mixed alluvia, 29 = Jubba mixed alluvia (see Maps of Aerial Census Results).

C. Regions

Regions are combinations of strata in some logical fashion They may be ecological combinations, such as all dhesheegs or geographically contiguous strata at various hierarchical levels. Eighty five of these stratum combinations are presented as regions in Volumes 2, 4 and 6 Regions are numbered in a continuous series regardless of hierarchical level or ecological or geographical stratum combinations.

The first regional classification is an ecological heirarchy of Ecological Zones, Ecological Regions and Ecological Provinces The basic unit in this scheme is termed Ecological Zones. This classification is intended to bring together areas which are environmentally similar, but widely spread geographically For this purpose the river-dependent zone is split into northern limestones and southern marine plains (see Figure 8 and TEBS report) West - east separation into 6 km bands is shown in Figure 8

Table 2 Regions Defined as Ecological Zones

REGION NUMBER	ECOLOGICAL ZONE	STRATA INCLUDED
1	Undifferentiated floodplain	2,4,6
2	River	1,3,5,7,11,14,25,32
3	Dhesheegs	9,13,16,27,30,34
4	Levees	8,12,15,26,33
5	Swamps	10
6	Irrigated estates	17,21,22,23
7	Fine flat alluvia	18,24,31
8	Villages	19
9	Mixed alluvia	20,28,29
10	0-6 km limestones	39,40,49,50,59,60
11	6-12 km limestones	38,41,48,51,58,61
12	12-18 km limestones	37,42,47,52,57,62
13	18-24 km limestones	36,43,46,53,56,63
14	24-30 km limestones	35,44,45,54,55,64
15	0-6 km marine plain	69,70,79,80,89,90, 99,100
16	6-12 km marine plain	68,71,78,81,88,91, 98,101
17	12-18 km marine plain	67,72,77,82,87,92, 97,102
18	18-24 km marine plain	66,73,76,83,86,93,96
19	24-30 km marine plain	65,74,75,84,85,94,95

Ecological Regions (Table 3) are combinations of ecological zones listed above. For example wetlands are combined as river and swamps, limestones and marine plains are grouped as close to the floodplain (0-18 km) and distant from the floodplain (18-30 km). The prefix "R" is used to distinguish region numbers from stratum numbers in the following tables where not specified by headings

Table 3 Ecological Regions Grouped from Ecological Zones

REGION NUMBER	ECOLOGICAL REGION	ECOLOGICAL ZONES INCLUDED
20	River and swamps	R2,R5
21	Undifferentiated floodplain	R1,R4,R9
22	Fine river alluviums	R3,R6,R7
23	Villages	R8
24	Close limestone	R10,R11,R12
25	Distant limestone	R13,R14
26	Close marine plain	R15,R16,R17
27	Distant marine plain	R18,R19

The next hierarchical step is to ecological provinces as broad combinations of ecological regions.

Table 4 Ecological Provinces Grouped from Ecological Regions

REGION NUMBER	ECOLOGICAL PROVINCE	ECOLOGICAL REGIONS INCLUDED
28	River and floodplain	R20,R21,R22,R23
29	River-dependent zone limestone	R24,R25
30	River-dependent zone marine plain	R26,R27

The second set of regions is geographical. In the first group, the basic units are River Sections, north to south with floodplain separated from river-dependent zone (Figure 7) These regions are in A column in Table 5 The second level is to combine floodplain and river-dependent zone for each river section (B column in Table 5 The third subdivision (column C in Table 5) is floodplain + river, by river section, but omitting the river-dependent zone

The study area (floodplain + river dependent zone) is also divided north to south into

region 71 upstream of the proposed reservoir (river section I),
region 72 the reservoir section (river section II),
region 73 downstream of the proposed dam (river sections III to VII),

Table 5 Geographical Hierarchy of Sub-division of Study Area into Regions

REGION NUMBERS			LOCATION	STRATUM NUMBERS INCLUDED
A	B	C		
			River Section I	
31		78	River	1
32	64		Floodplain	2
33			River-dependent zone, west	35-39
34			River-dependent zone, east	40-44
			River Section II	
35		79	River	3
36	65		Floodplain	4
37			River-dependent zone, west	45-49
38			River-dependent zone, east	50-54
			River Section III	
39		80	River	5
40	66		Floodplain	6
41			River-dependent zone, west	55-59
42			River-dependent zone, east	60-64
			River Section IV	
43		81	River	7
44			Dhesheegs	9
45	67		Levees	8
46			River-dependent zone, west	65-69
47			River-dependent zone, east	70-74
			River Section V	
48		82	River + Swamps	10,11
49			Dhesheegs	13
50	68		Levees	12
51			River-dependent zone, west	75-79
52			River-dependent zone, east	80-84
			River Section VI	
53			River	14
54		83	Dhesheegs + flat alluvia +	16-18, 21-23
	69		irrigated estates	
55			Levees + mixed alluvia	15,20
56			River-dependent zone, west	85-89
57			River-dependent zone, east	90-94

Table 5 continued

River Sections VII/VIII

58		River	25,32
59	[1]84+85	Dhesheegs + flat alluvia	24,27,30,31,34
60	70	Levees + mixed alluvia	26,28,29,33
61		River-dependent zone, west	95-99
62		River-dependent zone, east	100-102
63		Villages (in many River Sections)	19

[1] 84 is (floodplain + river) of river section VII;
85 is (floodplain + river) of river section VIII

Another geographical subdivision (Table 6) is West to East combining all river sections

Table 6. Subdivision of Study Area into Regions West to East

REGION NUMBER	LOCATION	STRATA INCLUDED
74	River-dependent zone West	35-39, 45-49, 55-59, 65-69, 75-79, 85-89, 95-99
75	Floodplain	2,4,6,8,9,12,13, 15-24, 26-31, 33,34
76	River	1,3,5,7,10,11,14,25,32
77	River-dependent zone East	40-44, 50-54, 60-64, 70-74, 80-84, 90-94 100-102

D. VOLUME 1 Comparative Tables of Strata

Tables comparing strata and census features are presented Numbering is such that Table 1 1, 1.2, etc., refer to 1st Jilaal Census; 2.1, 2 2, etc , refer to 2nd Jilaal Census and 3 1, 3 2 refer to Hagai Census Table numbers correspond across the censuses; thus Table 1 1 is equivalent to Table 2 1 and Table 3.1, etc. When comparing censuses it is important to recall that the First Jilaal Census covers only the river and floodplain and does not, therefore, have strata 35-102.

Looking at all tables the first column is stratum number and the second column (ommited from Hagai Census, but the same as Second Jilaal Census) is area of each stratum (km^2). For items that are counted (e g. livestock, water sources, agricultural features), DENS (density; number of features per km^2) and EST (estimate of total number in stratum) are given For items which are estimated as area covered (land-uses), %AGE (percentage of stratum) and HA (hectares) are given for each land-use category

At the foot of each table is a summary of data for all strata presented in that table DEN is overall density (features per km^2), EST is total of feature (all strata) and SE+/- is the standard error of the mean for that total

Tables presented for each census are as follows Table numbers are for 1st Jilaal Census, for 2nd Jilaal Census substitute prefix "2 ", for Hagai Census substitute prefix "3 " Tables 2.10 and 2.11 are included, although these features were not counted during the 1st Jilaal Census Where a table is too large for the page it is spilt into sections A, B, C. For precise meanings of any category Chapter 7 in Watson & Nimmo (1988) should be consulted

TABLE NUMBER	CONTENT
1.1	Livestock numbers by species (1 20)
1.2	Wildlife numbers by species (1 21)
1 3	Livestock and wildlife carcasses by species (1 22)
1 4	Livestock biomass by species (1.23)
1.5	Wildlife biomass by species (1 24)
1.6	Aggregate livestock, wildlife and herbivore biomass (herbivores = livestock + wildlife excluding crocodiles) (1 25)
1.7	Water sources (excluding river), see Watson & Nimmo (1985) for meaning of "Weighted Water Source Index" (1 26)
1 8	Rural structures by type (corrals, graves, houses) (1 27)
1 9	Agricultural features by type (shelters, crop stores, pole cutting, troughs, tractors, carts) (1 28)
2.10	Wood exploitation features (firewood, buiding poles, timber, charcoal features) (1.29)
2 11	Water-use features (installations, collecting points, troughs) (1 30)
1 12	Irrigation features (channels, bunds, pumps, abandoned) (1.31)
1.13	In-river features (boats, ferries, people, nets) (1 32)
1 14	Flood recession cropping (bank, dhesheeg) (1 33)
1.15	Rainfed cropland (including fallow, abandoned,

cleared, perennials) (1.34)

1 16 Irrigated cropland (including fallow, abandoned, cleared and some species) (1 35)

1 17 Miscellaneous land-use (refugee camps, swamp, enclosed, cut grass, burnt, forest nursery) (1.36)

1.18 Land-use summary (1 37)

1.19 Sample data (area sampled, percent of stratum sampled, number of samples) (1 38)

E. Volume 2 Comparative Tables of Regions

The layout of this volume is exactly the same as Volume 1 but regions are substituted for strata. Tables are arranged in the same sequence but numbered 1.20 to 1.38 for 1st Jilaal Census (2 20 to 2.38 for 2nd Jilaal Census, 3 20 to 3 28 for Hagai Census) The appropriate table numbers are in parenthesis at the end of stratum table descriptions listed above.

F Volume 3 Profiles of Strata

In this volume strata are viewed separately. Thus if an overview of all livestock, wildlife, land-use, etc is required for a particular stratum number (see Table 1 to locate appropriate stratum number). The heading to each profile indicates which census is referred to

G. Volume 4 Profiles of Regions

In this volume regions are viewed separately in the same way as for strata in Volume 3. Region numbers are given in Tables 2 to 6. Brief region "titles" are given as headings for each profile, Tables 2 to 6 should clarify the meanings of these titles.

H. Volume 5 Livestock Activities by Strata

This volume describes activities of livestock observed during each census (censuses are identified in the heading to each table) The categories, listed below, are self explanatory Species are recorded separately Estimates of the total number and percentage of animals engaged in each activity are given. For precise definitions of terminology,

see Watson & Nimmo (1988). For definitions of strata see Table 1 and Figures 1 and 2

A. Feeding on range
B Feeding on fallow rainfed cropping
C Feeding on abandoned rainfed fields
D. Feeding on enclosed (but otherwise unmanaged) land
E Feeding on fallow irrigated fields
F Feeding on abandoned irrigated fields
G Feeding on irrigated fields (and headlands, canal banks)
H Stall fed (in enclosure or at cut heap of crop residues)
I. Drinking from river bed or bank
J Drinking at well
K Feeding close to enclosure or dwelling
L. Feeding on land cleared for rainfed cropping
M. Drinking from war (dugout)
N Feeding on receding flood cropping, river bank
O Feeding on burned land
P. Feeding on irrigated banana plantation
Q. Trecking
R Carrying fodder or pulling fodder cart
S Feeding on mechanized rainfed fallow
T. Feeding on rainfed cropland
U Feeding on irrigated sugar plantations
V Draft animal
W Trecking to or from water
X. Drinking from spring
Y Feeding on flooded pasture
Z Drinking from pool

I Volume 6 Livestock Activities by Regions

This volume is organized in the same way as Volume 5, except data presented is for regions not strata. For definitions of region numbers see Section C and Tables 2 to 6.

VI. DISKETTES OF AERIAL CENSUS DATA

These disks contain raw data of items censused in each stratum along each flight line for each census This information can be used to pinpoint data geographically For example, it is possible to determine the number of cattle counted by the aerial surveyor as a particular flight line crosses a particular dhesheeg Locations of flight lines and subdivisions along them are marked on manuscript map sets c) and d) listed in the introductory section of this data guide. To access disks, insert the ARIS Master Disk and type