

INTERNATIONAL LIVESTOCK CENTRE FOR AFRICA
AERIAL SURVEY UNIT

WET SEASON AERIAL SURVEYS OF CATTLE, HUMAN HABITATION AND CULTIVATION
IN SELECTED REGIONS OF THE NIGERIAN SUB-HUMID ZONE.

Report to:

ILCA Sub-humid Zone Programme, PMB 2248, Kaduna, Nigeria.

National Animal Production Research Institute, PMB 1096, Shika, Nigeria.

Federal Department of Pest Control Services,
Biological Control of Tsetse, PO Box 76, Vom, Nigeria.

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SUMMARY.

This report presents the results obtained from wet season aerial surveys over nine regions of the Nigerian Sub-humid Zone, carried out using the technique of low level systematic reconnaissance flights (SRF) and oblique photography.

Of the nine regions, seven are International Livestock Centre for Africa case study areas. Surveys of the two others regions were conducted at the request of the National Animal Production Research Institute, and the Federal Department of Pest Control Services project for Biological Control of Tsetse.

A total of some 21,175 square kilometers were surveyed during late September and early October 1984, at sampling intensities ranging 8 - 17%.

The distribution and abundance of cattle, cultivation, pastoral and arable habitation were assessed for each area. Results are presented in a series of computer drawn distribution maps, and comparative tables giving population estimates from this and previous aerial surveys.

Interrelations between regional cattle, cultivation and human habitation levels are assessed, and regional and similarities/differences emphasised.

Seasonal changes in cattle density are used to provide a basis for comparing and contrasting aerial survey regions, in terms of the degree to which one season's population exceeds that of the other.

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PREFACE AND ACKNOWLEDGEMENTS.

Following the tragic death of Dr. Kevin Milligan in May 1984, the International Livestock Centre for Africa (ILCA) and Resource Inventory and Management Limited (RIM) entered into a collaborative agreement in order to fulfill existing aerial survey commitments in Mali and Nigeria.

We are very grateful to many people who contributed, both directly and indirectly to the successful completion of the wet season aerial surveys in Nigeria. In particular, we would like to thank Rolph Busse, Mohamed Kallah, Neil MacDonald, Sam Madaie, and Willem Takken. We also wish to acknowledge the whole hearted support given by the ILCA Sub-humid Zone team, especially Alhadji Habibu Suliman and Ralph von Kaufmann.

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1 INTRODUCTION.

Soon after its establishment in Nigeria, the International Livestock Centre for Africa's Sub-Humid Zone Programme began an innovative series of low level aerial surveys using the technique of systematic reconnaissance flights. The objectives of these surveys were to assess the seasonal distribution and abundance of cattle; and to determine the patterns of land use and human settlement in selected regions of the sub-humid zone (Milligan, Bourn and Chachu, 1979). Some of these survey regions, subsequently become the subject of detailed ground investigation, as ILCA Case Study Areas.

Five years later in 1984, for comparative purposes, it was considered desirable to carry out repeat surveys over three of the original survey regions: Kurmin Biri, Abet and Mariga. At the same time it was also decided to carry out aerial surveys over four new areas of interest to ILCA: Pambegwa, Funa Funa, Ganawuni and Teginna-Minna, as well as a fifth region to the West of Zaria being studied by the National Livestock Production Research Institute (NAPRI). (See Map 1.) The preliminary results of the dry season surveys carried out in March/April were reported by Milligan et al. (1984). This report presents the results of the follow up wet season aerial surveys conducted during September and October 1984.

The results of an additional survey performed at the request of the Federal Department of Pest Control Service's project for the Biological Control of Tsetse (BICOT) are also included in this report. They compliment those of an earlier dry season survey of the BICOT project area, to the North-East of Lafia town in Plateau State, carried out in 1982 (Bourn and Milligan, 1982).

2 METHODS.

2.1 Flight and Sampling Procedure.

The aerial surveys were carried out from Kaduna and Haipang airports, using a high wing light aircraft with a crew of four. The same technique of low level systematic reconnaissance flights (SRF) and sampling procedure was adopted, as described by Milligan et al., (1984) for the the dry season aerial surveys. Further details of the methodology are given by Norton-Griffiths (1978) and Milligan and de Leeuw (1983).

Essentially each of the selected region was evenly covered by a regular series of parallel flight lines, 5 or 10 kilometers apart. Each flight line was divided into sectors 5 kilometers in length, to create a sampling grid, with 25 or 50 square kilometer cells.

With the aid of externally mounted viewing frames the two experienced back-seat observers recorded cattle and human habitation falling within sample ground strips on each side of the aircraft. Whenever possible a 35 mm colour slide photograph was taken of each herd, camp or settlement, containing more than 10 components, using a hand-held camera loaded with 200 ASA film and fitted with a 200 mm telephoto lens. Subsequently, accurate photo-count values were substituted for visual estimates, and used to determine levels of observer bias, in order to correct those estimates for which no adequate photographic coverage was available.

At the designated flying height of 800 feet above ground level the sample strip width on each side of the aircraft was set to be 400 meters. Periodically during the course of the surveys the aircraft altimeter was calibrated against ground of known altitude. Depending on grid cell size (5x5 km or 5x10) sample intensity varied from 8.6 - 17.2 %.

2.2 Information Collection.

The two back-seat observers were responsible for assessing the number of cattle within each grazing unit* and the form of human habitation, as well as the number of dwelling units within each settlement.

Arable and pastoral habitation was distinguished from the air by the presence of corrals with the latter. Three sub-categories of pastoral habitation were recognised:

Beehives: traditional FulBe style "rugga" dwellings, with associated corrals, perhaps typical of semi-permanent settlement:

Shelters: structures of an obviously temporary nature, associated with corrals, often made of cut branches stretched over with blue plastic sheeting; or formed from crop stalks laid in "wigwam" fashion:

Others: permanent structures of any form, associated with both corrals and cultivated fields:

* = management unit, to distinguish from owned herd which could be split into a number of grazing units

In addition to the information collected by the two back-seat observers, the navigating front-seat observer was responsible for assessing and recording general environmental conditions within each grid cell, including:

Cultivation: the proportion of cropped land:

Vegetation: the relative proportions of each of four vegetation types: Forest: Dense Savanna Woodland: Light Savanna Woodland: Scrub/Bush/Grassland:

Grass Cover: the proportion of ground covered by grass:

Greenness: the overall level of greenness of vegetation on a five point scale: 0 = No Indication of Greenery: 1 = Trace of Greenery: 2 = Patchy Green Flush: 3 = General Green Flush: 4 : Dense and Widespread Greenery.

Water: availability in terms of the visible presence or absence of surface water, standing pools, lakes, streams, or rivers.

2.3 Data Analysis and Presentation.

After photointerpretation, and correction for individual observer bias, the data collected by each observer was combined for each grid cell. This database was then subjected to a series of validity statistical tests and the necessary corrections made prior to more detailed analysis and population estimation on a VAX 11-750 computer. Three closely related, but distinct, software packages were used concurrently for handling data files and analysis:

A purpose built programme for population estimation using the Ratio Method of Jolly (1969) incorporating additional statistical facilities:

The Minitab (1982) software package for statistical summaries and tabulations:

The Mapics (1984) data handling and graphics system for data manipulation, selection and mapping facilities.

Distribution maps were produced using a proportional symbolism form of point mapping on a HP 7221 flat-bed plotter.

3 RESULTS.

The results of the 1984 wet season aerial surveys of selected regions of the Nigerian sub-humid zone are presented in the following sections. Each of the nine regions is considered separately, with the results being summarised in the form of four computer drawn maps representing the observed distribution patterns of cattle, cultivation, arable and pastoral habitation; and a table providing a comparison with previous aerial survey population estimates for each region. In order to facilitate interpretation of the computer drawn distribution maps transparent plastic overlays of roads, rivers and railway lines are provided for each region, which may be superimposed as required.

- | | |
|-------------------------------|------------------------|
| 3.1 Kurmin Biri: | Table 1 and Figure 2. |
| 3.2 Abet: | Table 2 and Figure 3. |
| 3.3 Mariqa: | Table 3 and Figure 4. |
| 3.4 Pambeqwa: | Table 4 and Figure 5. |
| 3.5 Funa Funa: | Table 5 and Figure 6. |
| 3.6 Ganawuri: | Table 6 and Figure 7. |
| 3.7 Tegina-Minna: | Table 7 and Figure 8. |
| 3.8 West Zaria (NAPRI): | Table 8 and Figure 9. |
| 3.9 North-East Lafia (BICOT): | Table 9 and Figure 10. |

Finally, a composite summary of 1984 wet season results for all nine survey regions within the Nigerian sub-humid zone is presented in table 10.

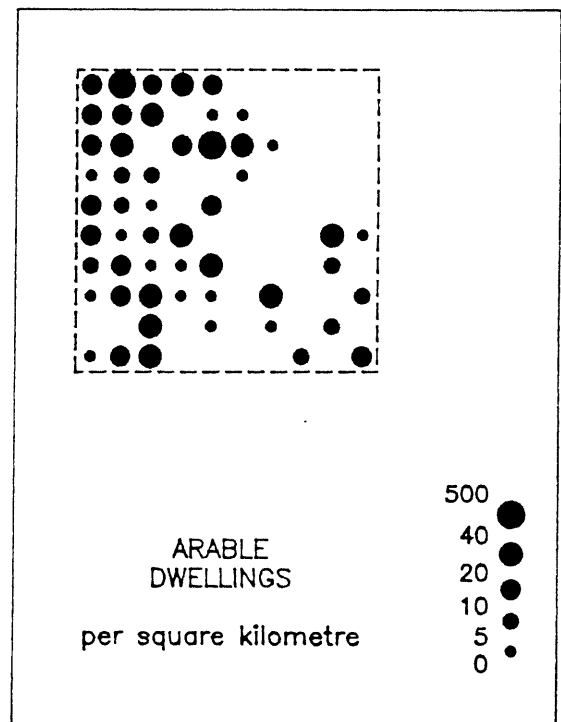
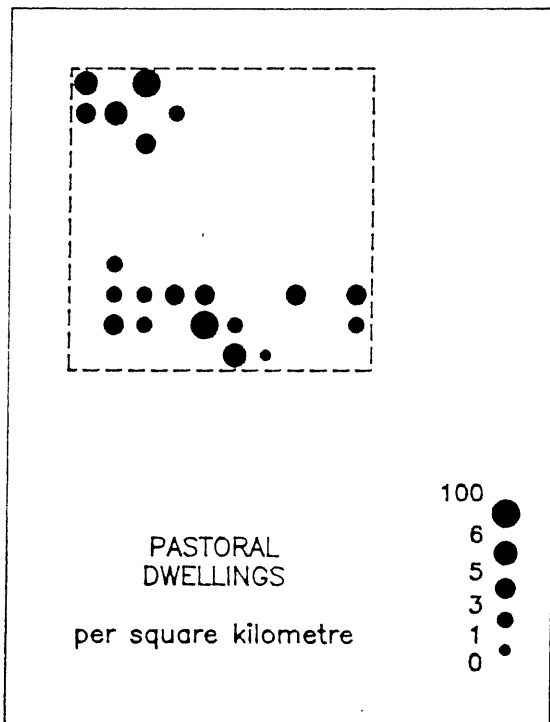
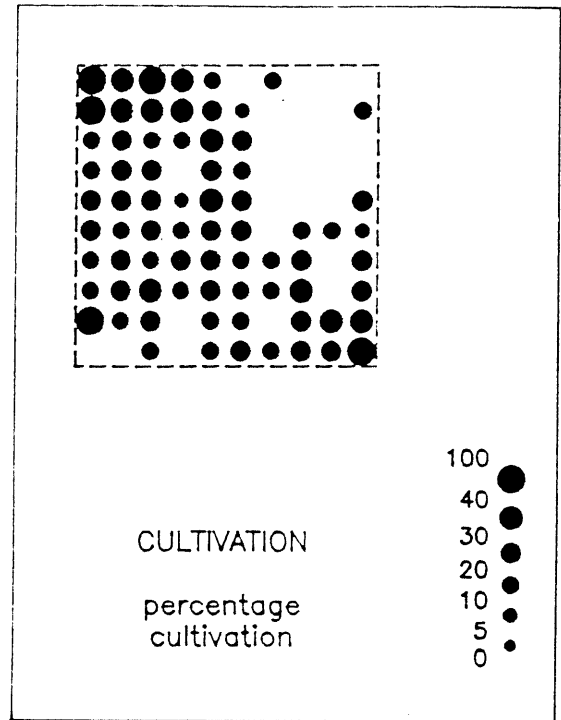
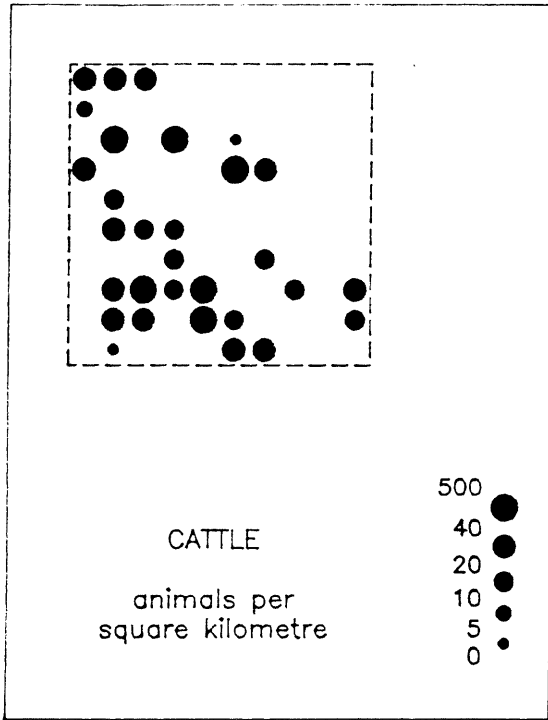
3.1 Kurmin Biri .

TABLE 1: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE KURMIN BIRI SRF AERIAL SURVEY REGION.

	1979 Dry	1979 Wet	1984 Dry	1984 Wet
<u>FLIGHT INFORMATION:</u>				
Area Surveyed - sq km	2,500	2,500	2,500	2,500
Date Flown	February	July	March	September
Flying Altitude - feet	1,000	1,000	1,000	800
Sample Intensity - %	20	20.0	14.7	17.2
<u>CATTLE:</u>				
Total Population (%SE)	43,180 (9)	10,410 (26)	19,800 (18)	24,669 (23)
Density - per sq km	17.3	4.2	7.9	9.9
Stocking Rate - ha/hd	5.8	24.0	12.6	10.1
Total Grazing Units	860 (8)	180 (19)	510	424 (26)
Mean G U Size (%SE)	51 (4)	58 (17)	37 (3)	58
<u>PASTORAL DWELLINGS:</u>				
Total dwellings	1,000		672	1,928 (35)
Density - per sq km	0.4		0.3	0.8
Beehives - % Total			64	100
Shelters - % Total			19	0
Others - % Total			17	0
<u>ARABLE HABITATION:</u>				
Total dwellings	(1,250 cpds*)			19,052 (24)
Density - per sq km				7.6
Tin roof %	1			10
<u>CULTIVATION:</u>				
Mean %	15		11	14

* cpds - Compounds containing a number of dwellings.

FIGURE 2 : CATTLE, HUMAN HABITATION AND CULTIVATION IN KURMIN BIRI.



3.2 Abet.

TABLE 2: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE ABET SRF AERIAL SURVEY REGION.

	1979 Dry	1979 Wet	1984 Dry	1984 Wet
<u>FLIGHT INFORMATION:</u>				
Area Surveyed - sq km	2,475	2,475	2,475	2,475
Date Flown	February	July	March	September
Flying Altitude - feet	1000	1000	1,000	800
Sample Intensity %:	20	20	14.7	17.2

<u>CATTLE:</u>				
Total Population (%SE)	92,440 (8)	56,275 (6)	81,200 (12)	78,625 (8)
Density - per sq km	37.4	22.7	32.8	31.8
Stocking Rate - ha/hd	2.7	4.4	3.1	3.1
Total Grazing Units	1,940 (6)	915 (7)	1,705	1,510 (11)
Mean G U Size (%SE)	48 (2)	61 (5)	48 (3)	561

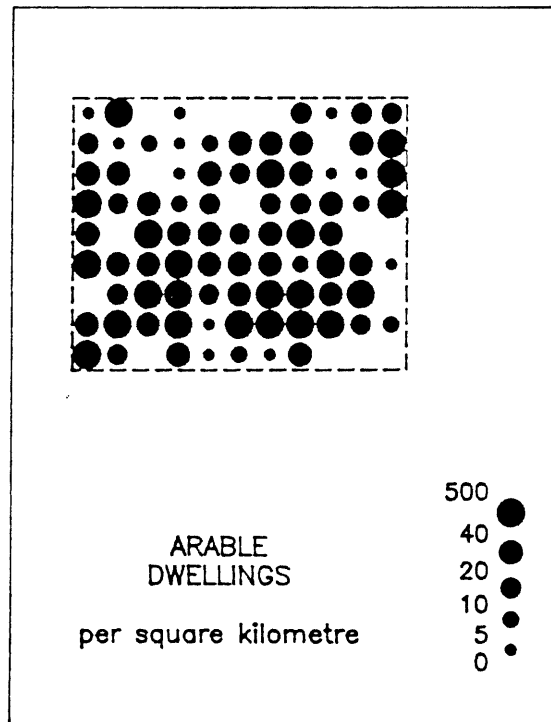
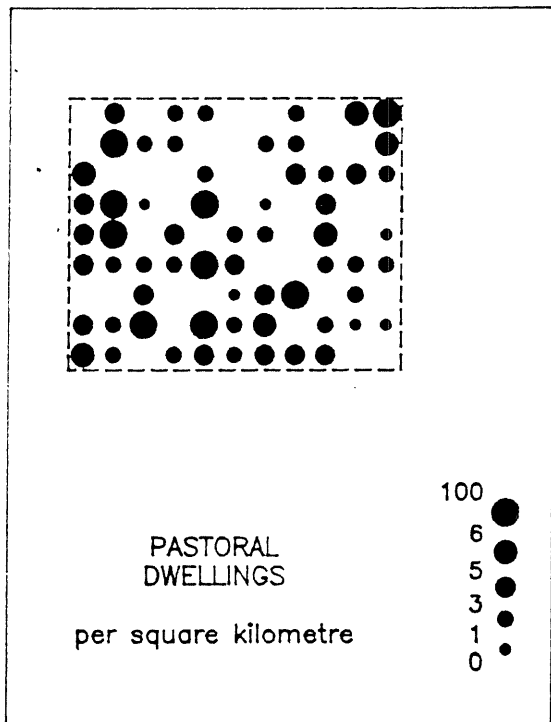
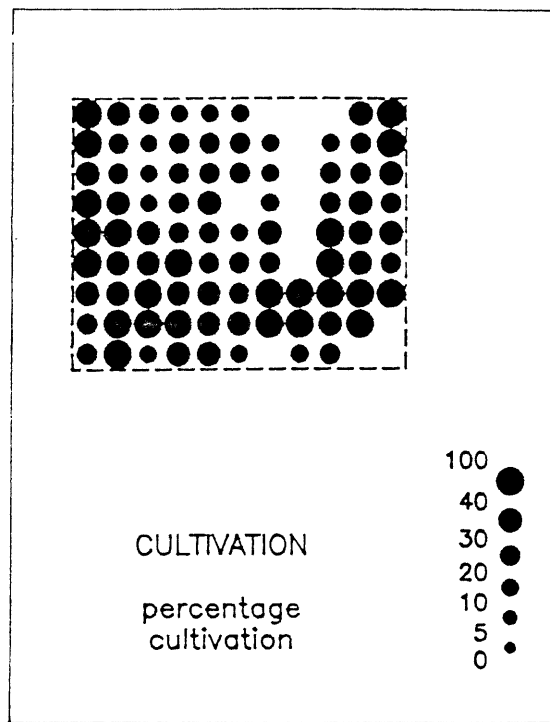
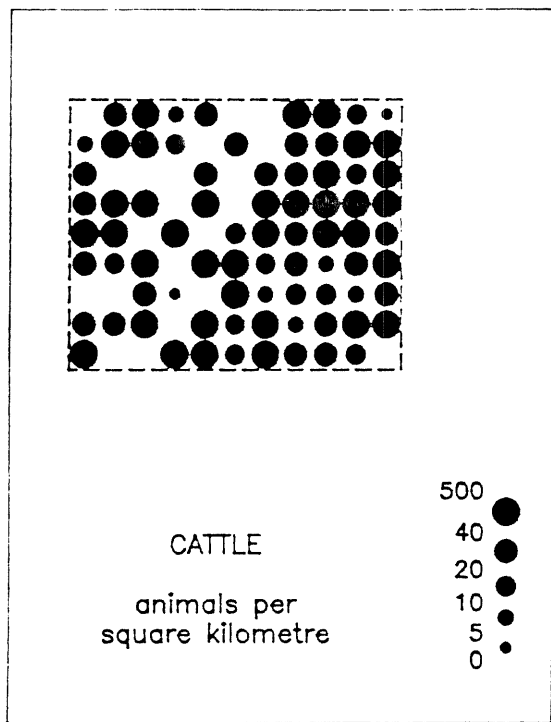
<u>PASTORAL DWELLINGS:</u>				
Total Dwellings	6,200		2,800	5,512 (12)
Density - per sq km	2.5		1.1	2.2
Beehives - % Total			82	97
Shelters - % Total			8	0
Shelters - % Total			10	3

<u>ARABLE HABITATION:</u>				
Total dwellings		(6,200 cpds*)		64,870 (6)
Density - per sq km				26.2
Tin roof %		13		27

<u>CULTIVATION:</u>				
Mean %	24		20	25

* cpds - Compounds containing a number of dwellings.

FIGURE 3: CATTLE, HUMAN HABITATION AND CULTIVATION IN ABET.



3.3 Mariga.

TABLE 3: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE MARIGA SRF AERIAL SURVEY REGION.

	1979 Dry	1979 Wet	1984 Dry	1984 Wet
<u>FLIGHT INFORMATION:</u>				
Area Surveyed - sq km	2,750	2,750	2,750	2,750
Date Flown:	February	July	March	October
Flying Altitude - feet	1,000	1,000	1,000	800
Sample Intensity - %	20	20	14.7	17.2

<u>CATTLE:</u>				
Total Population (%SE)	18,175 (16)	64,485	25,800 (17)	60,484 (7)
Density - per sq km	6.6	23.5	9.4	22.0
Stocking Rate - ha/hd	15.1	4.3	10.7	4.5
Total Grazing Units	740 (11)	1,235 (8)	940	1,313 (12)
Mean G U Size (%SE)	25 (9)	53 (5)	27 (3)	46

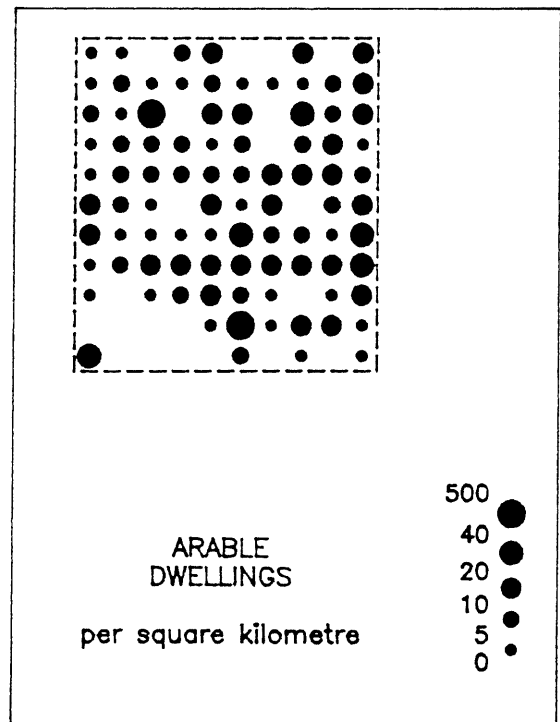
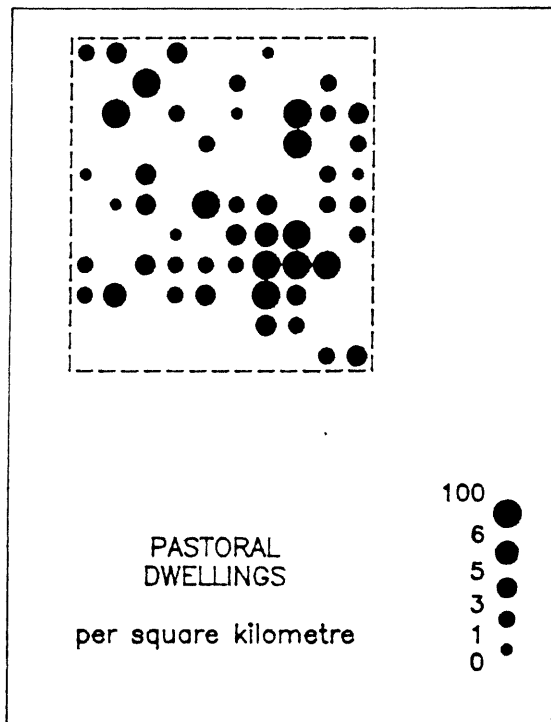
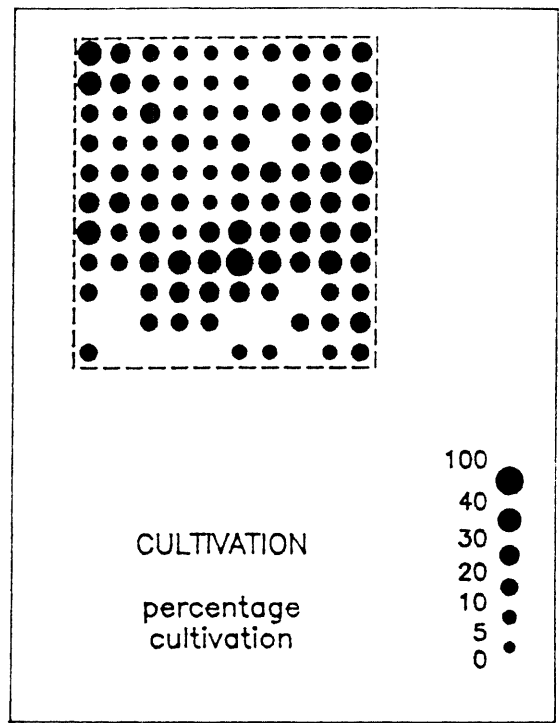
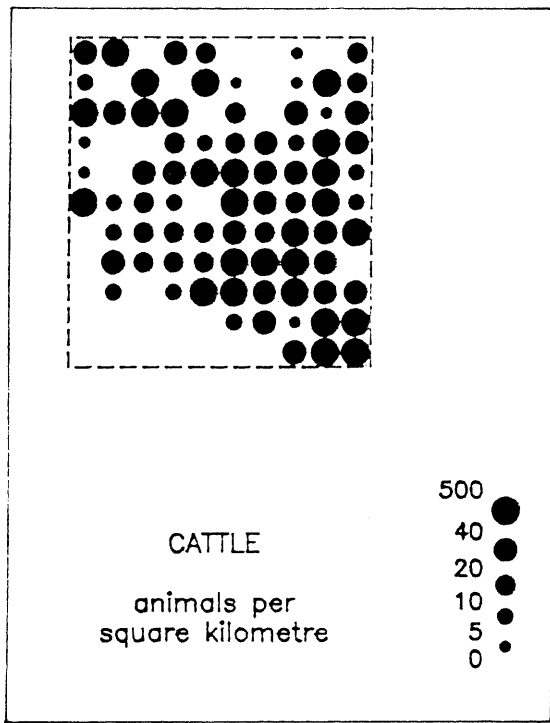
<u>PASTORAL DWELLINGS:</u>				
Total Dwellings	3,850		2,730	4,519 (18)
Density - per sq km	1.4		1.0	1.6
Beehives - % Total			59	76
Shelters - % Total			24	2
Others - % Total			17	22

<u>ARABLE HABITATION:</u>				
Total Dwellings	(2,475 cpds*)			23,878 (13)
Density - per sq km				8.7
Tin roof %	1			6

<u>CULTIVATION:</u>				
Mean %	13		10	12

* cpds - Compounds containing a number of dwellings.

FIGURE 4 : CATTLE, HUMAN HABITATION AND CULTIVATION IN MARIGA.



3.4 Pambe gwa.

TABLE 4: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE PAMBEGEWA SRF AERIAL SURVEY REGION.

	1984 Dry	1984 Wet	% Change (W-D)100/D
<u>FLIGHT INFORMATION:</u>			
Area Surveyed - sq km	3,000	3,000	
Date Flown	24 March	1 October	
Flying Altitude - feet	1,000	800	
Sample Intensity - %	7.4	8.6	

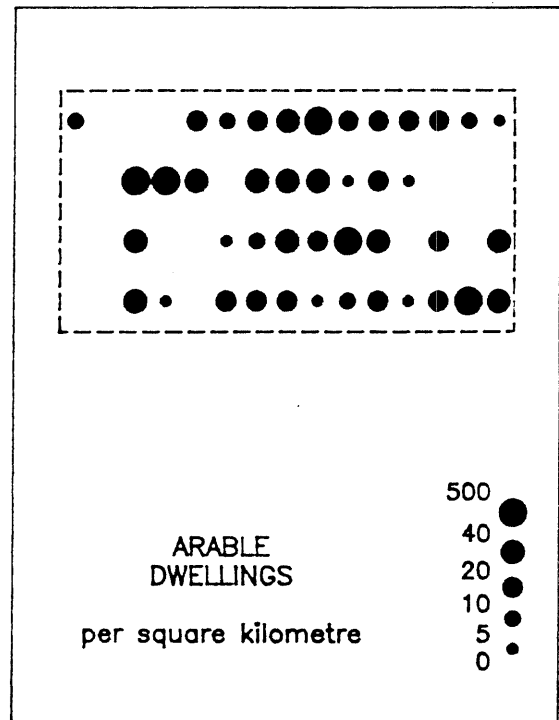
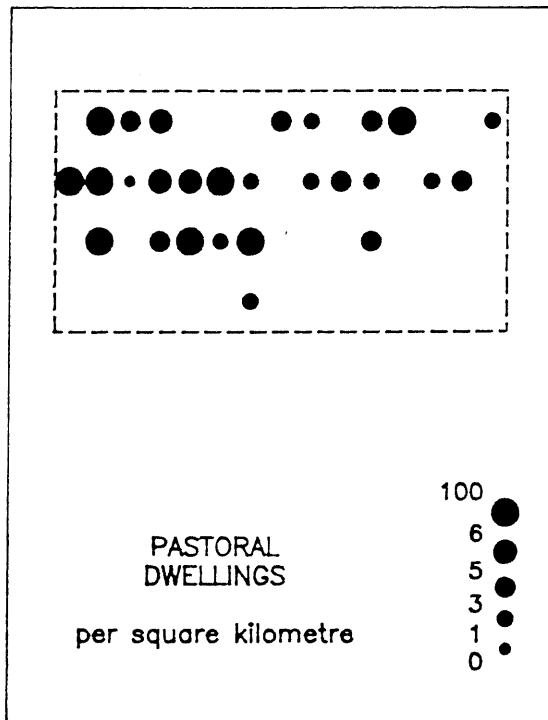
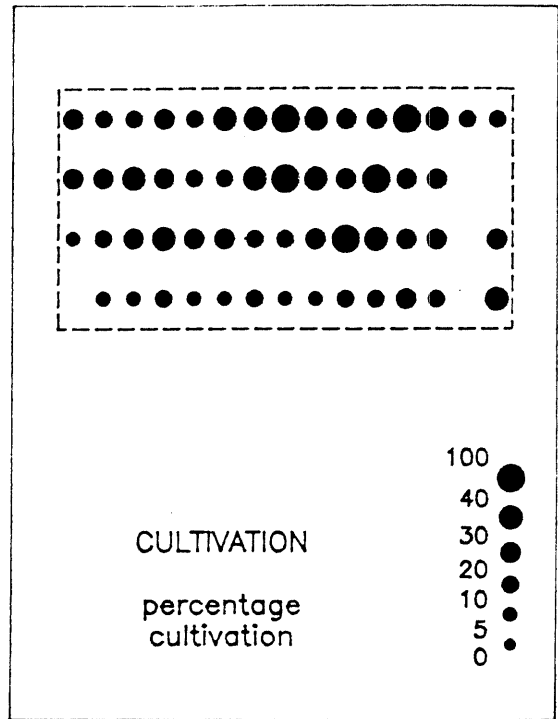
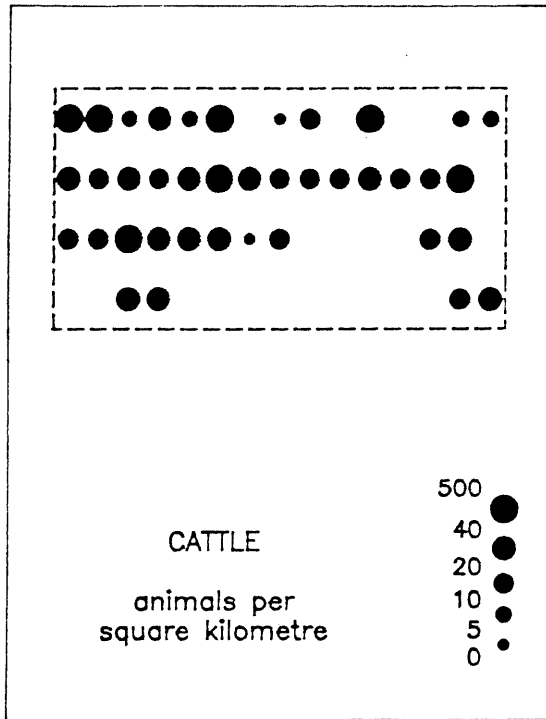
<u>CATTLE:</u>			
Total Population (XSE)	54,620 (37)	49,849 (25)	-9
Cattle - per sq km	18.2	16.6	
Stocking Rate - ha/hd	5.5	6.0	
Total Grazing Units	1,290	1,301 (23)	<1
Mean G U Size (XSE)	42 (4)	38	-10

<u>PASTORAL HABITATION:</u>			
Total Dwellings	5,200	6,668(32)	+28
Density - per sq km	1.7	2.2	
Beehives - % Total	52	100	
Shelters - % Total	48	0	
Others - % Total	0	0	

<u>ARABLE HABITATION:</u>			
Total Dwellings		42,716	
Density		14.2	
% Tin roofs		12	

<u>CULTIVATION:</u>			
Mean %	25	18	

FIGURE 5: CATTLE, HUMAN HABITATION AND CULTIVATION IN PAMPEGWA.



3.5 Funa Funa.

TABLE 5: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE FUNA FUNA SRF AERIAL SURVEY REGION.

	1984 Dry	1984 Wet	% Change (W-D)100/D
<u>FLIGHT INFORMATION:</u>			
Area Surveyed - sq km	750	750	
Date Flown	5 April	2 October	
Flying Altitude - feet	1,000	800	
Sample Intensity - %	14.7	17.2	

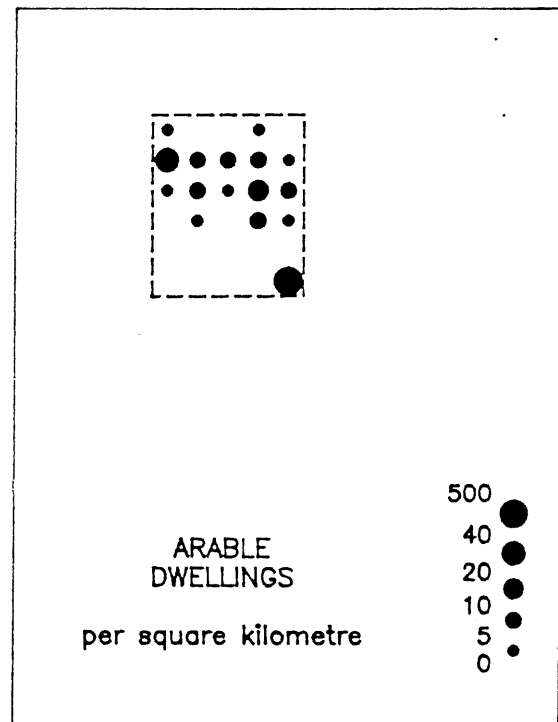
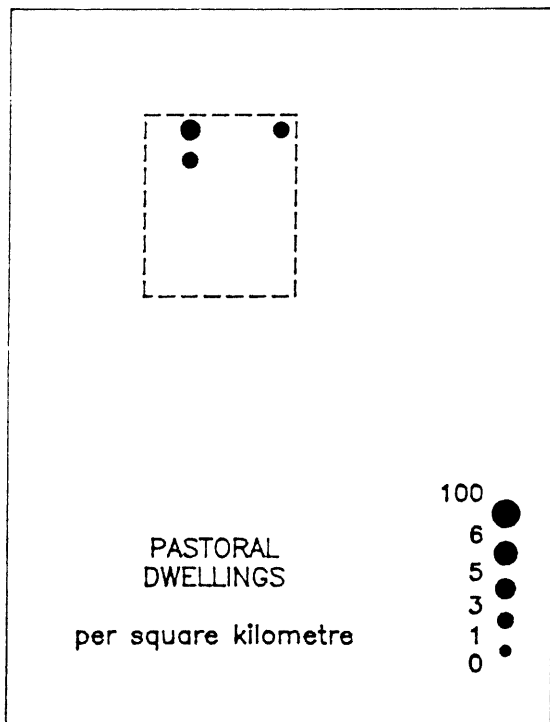
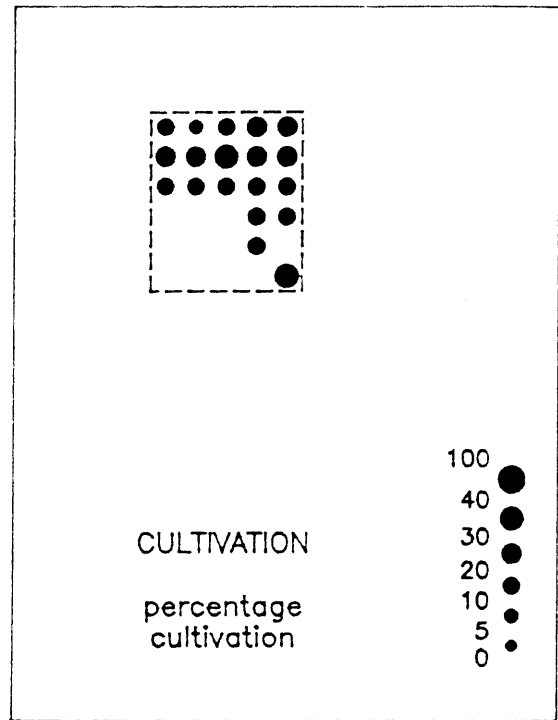
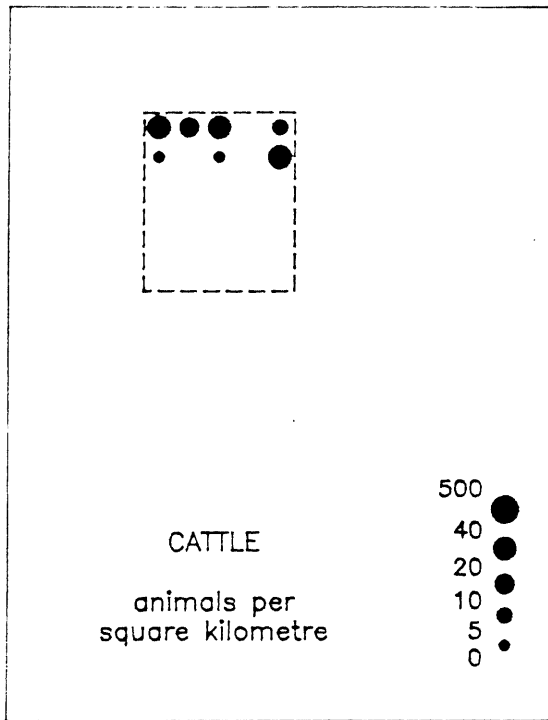
<u>CATTLE:</u>			
Total Population (%SE)	2,170 (37)	2,840 (64)	+31
Cattle - per sq km	2.9	3.8	
Stocking Rate - ha/hd	34.5	26.4	
Total Grazing Units	68	93 (60)	+37
Mean G U Size (%SE)	31 (9)	31	0

<u>PASTORAL HABITATION:</u>			
Total Dwellings	160	163 (63)	+2
Density - per sq km	0.2	0.2	
Beehives - % Total	29	100	
Shelters - % Total	71	0	
Others - % Total	0	0	

<u>ARABLE HABITATION:</u>			
Total Dwellings		7,179 (56)	
Density		9.6	
% Tin roofs		27	

<u>CULTIVATION:</u>			
Mean %	8	10	

FIGURE 6 : CATTLE, HUMAN HABITATION AND CULTIVATION IN FUNA FUNA.

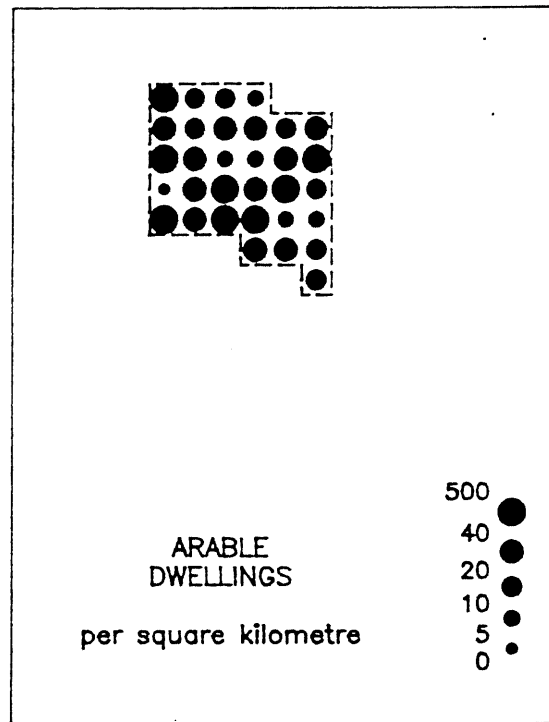
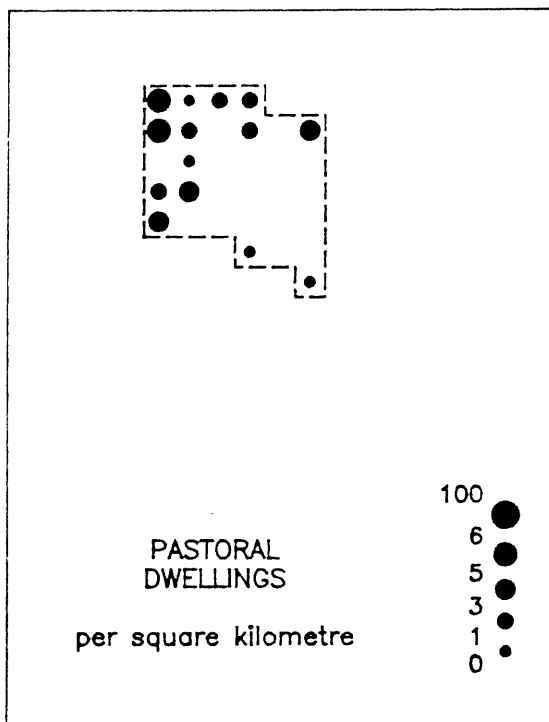
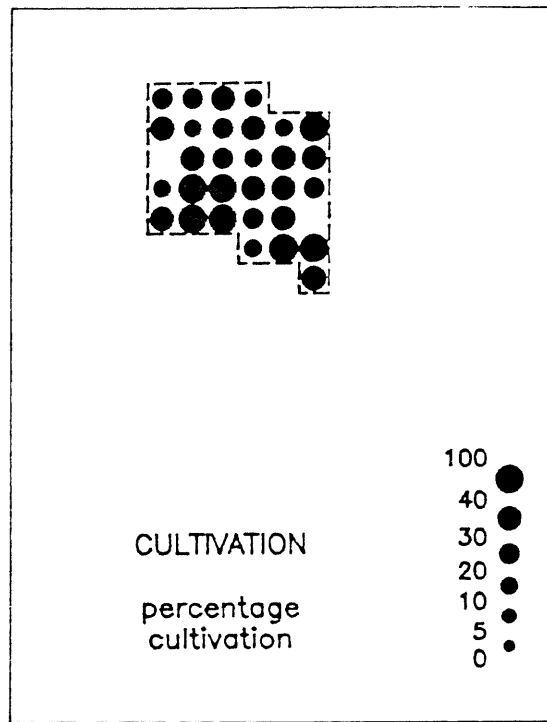
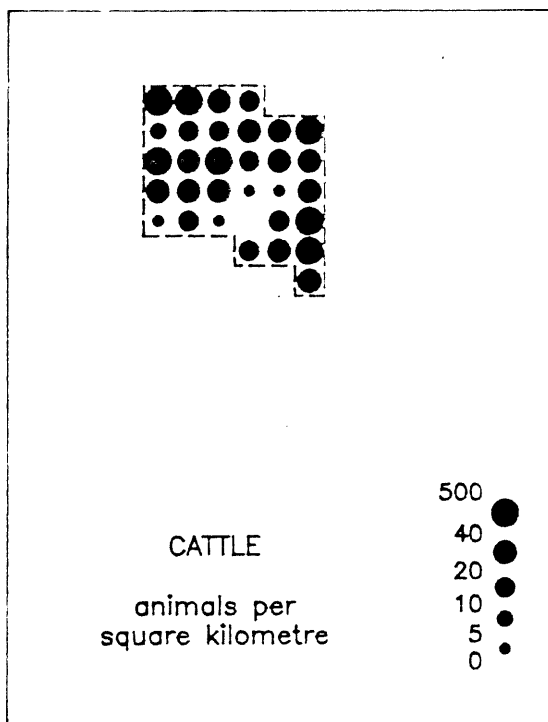


3.6 Ganawuri .

TABLE 6: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE GANAWURI SRF AERIAL SURVEY REGION.

	1984 Dry	1984 Wet	% Change (W-D)100/D
<u>FLIGHT INFORMATION:</u>			
Area Surveyed - sq km	800	800	
Date Flown	24 March	30 September	
Flying Altitude - feet	1,000	800	
Sample Intensity - %	14.7	17.2	
<hr/>			
<u>CATTLE:</u>			
Total Population (%SE)	19,450 (14)	23,315 (17)	+20
Cattle - per sq km	24.3	29.1	
Stocking Rate - ha/hd	4.1	3.4	
Total Grazing Units	570	650 (14)	+14
Mean G U Size (%SE)	34 (3)	36	+6
<hr/>			
<u>PASTORAL HABITATION:</u>			
Total Dwellings	1,340	813	-39
Density - per sq km	1.7	1.0	
Beehives - % Total	73	100	
Shelters - % Total	2	0	
Others - % Total	25	0	
<hr/>			
<u>ARABLE HABITATION:</u>			
Total Dwellings		25,639 (16)	
Density		24	
%Tin roofs		32	
<hr/>			
<u>CULTIVATION:</u>			
Mean %	33	26	

FIGURE 7: CATTLE, HUMAN HABITATION AND CULTIVATION IN GANAWURI.



3.7 Tagina-Minna.

TABLE 7: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE TEGINA-MINNA SRF AERIAL SURVEY REGION.

	1984 Dry	1984 Wet	% Change (W-D)100/D
<u>FLIGHT INFORMATION:</u>			
Area Surveyed - sq km	3,250	3,250	
Date Flown	5 April	1 October	
Flying Altitude - feet	700	800	
Sample Intensity - %	5.1	8.6	

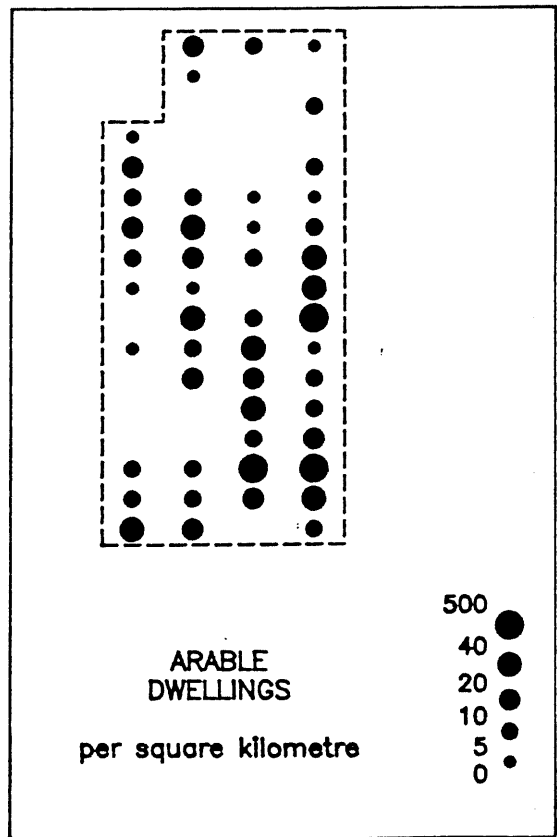
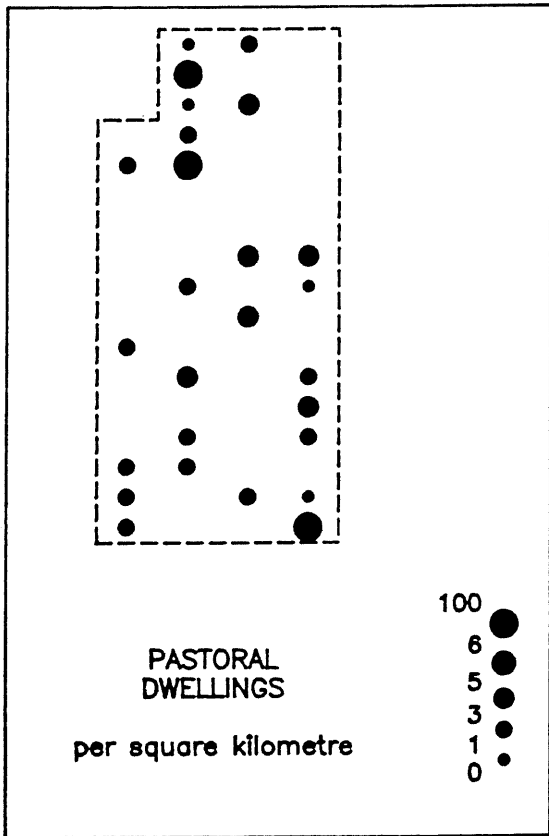
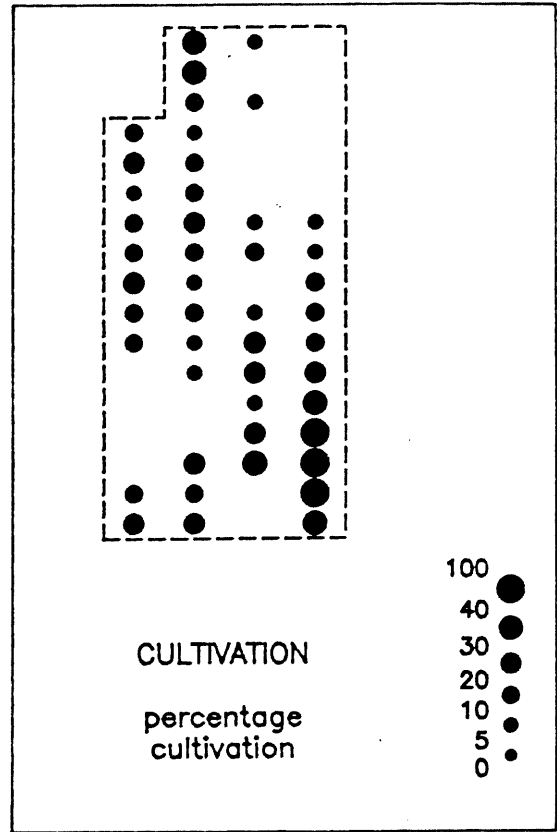
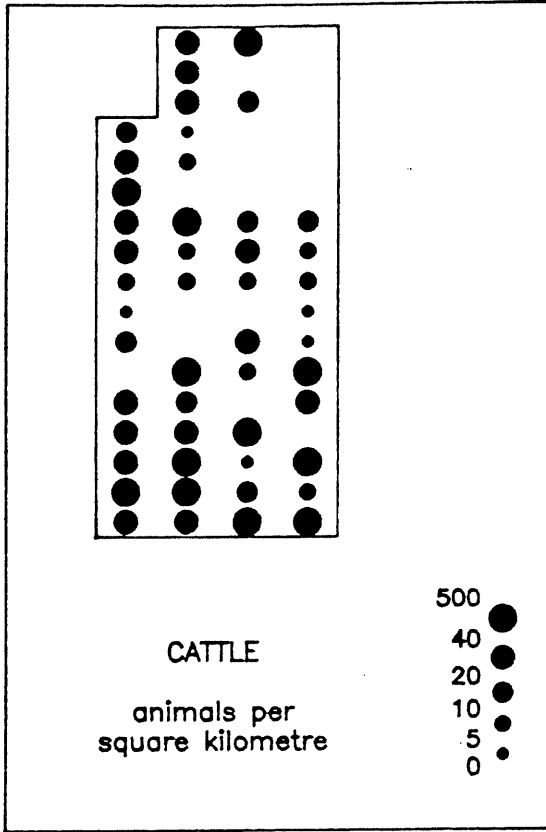
<u>CATTLE:</u>			
Total Population (%SE)	65,800 (16)	65,404 (17)	<1
Cattle - per sq km	19.4	20.0	
Stocking Rate - ha/hd	4.9	5.0	
Total Grazing Units	1,390	1,754 (13)	+26
Mean G U Size (%SE)	47 (7)	37	+21

<u>PASTORAL HABITATION:</u>			
Total Dwellings	7,720	3,404 (17)	-56
Density - per sq km	2.3	1.1	
Beehives - % Total	46	75	
Shelters - % Total	9	6	
Others - % Total	45	19	

<u>ARABLE HABITATION:</u>			
Total Dwellings		32,110 (17)	
Density		9.9	
% Tin roofs		8	

<u>CULTIVATION:</u>			
Mean %	8	11	

FIGURE 8: CATTLE, HUMAN HABITATION AND CULTIVATION IN TEGINA-MINNA.

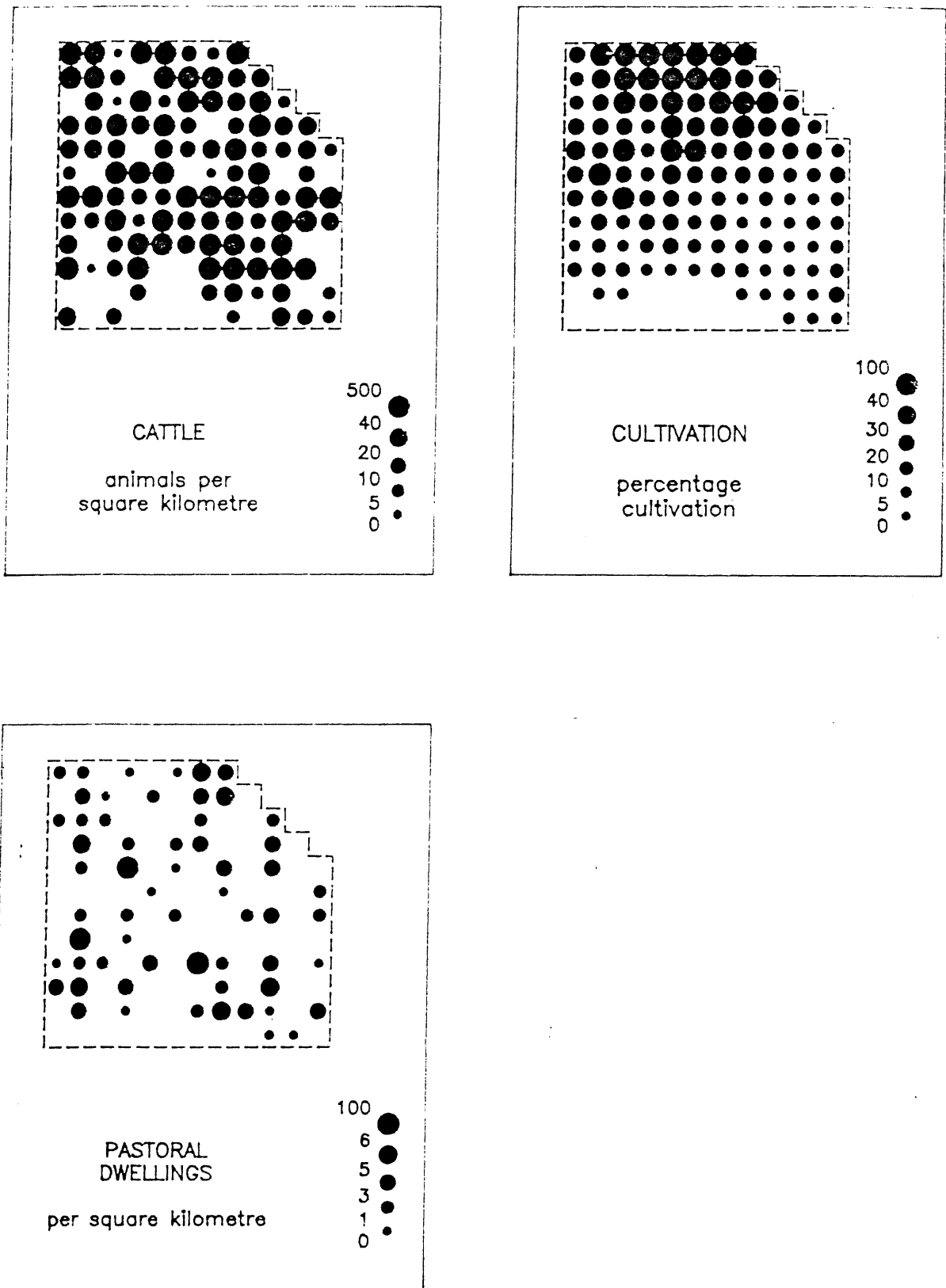


3.8 West Zaria (NAPRI).

TABLE 8: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE WEST ZARIA (NAPRI) SRF AERIAL SURVEY REGION.

	1984 Dry	1984 Wet	% Change (W-D)100/D
<u>FLIGHT INFORMATION:</u>			
Area Surveyed - sq km	3,350	3,350	
Date Flown	6 April	7 October	
Flying Altitude - feet	700	800	
Sample Intensity - %	10.3	17.2	
<hr/>			
<u>CATTLE:</u>			
Total Population (%SE)	81,610 (7)	105,257 (7)	+29
Cattle - per sq km	24.4	31.4	
Stocking Rate - ha/hd	4.1	3.2	
Total Grazing Units	2,560	2,091 (8)	-18
Mean G U Size (%SE)	32 (1)	50	+56
<hr/>			
<u>PASTORAL HABITATION:</u>			
Total Dwellings	3,960	4,298 (21)	+9
Density - per sq km	1.2	1.3	
Beehives - % Total	50	99	
Shelters - % Total	50	1	
Others - % Total	0	0	
<hr/>			
<u>CULTIVATION:</u>			
Mean %	23	20	

FIGURE 9: CATTLE, HUMAN HABITATION AND CULTIVATION IN WEST ZARIA (NAPRI).



3.9 North-East Lafia (BICOT).

TABLE 9: CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION ESTIMATES FOR THE SOUTH-EAST AND NORTH-EAST LAFIA (BICOT) SRF AERIAL SURVEY REGIONS.

	SOUTH-EAST LAFIA		NORTH-EAST LAFIA	
	1979	1979	1982	1984
	Dry	Wet	Dry	Wet
<u>FLIGHT INFORMATION:</u>				
Area Surveyed - sq Km	3,500	3,500	2,325	2,300
Date Flown	3 March	30 July	13 April	6 October
Flying Altitude - feet	1,000	1,000	800	800
Sample Intensity - %	20	20	16	17.3

<u>CATTLE:</u>				
Total Population (%SE)	44,420 (19)	131,845 (14)	38,138 (17)	52,567 (17)
Cattle - per sq Km	12.7	37.7	16.4	22.9
Stocking Rate - ha/hd	7.9	2.7	6.1	4.4
Total Grazing Units	750 (17)	1,525 (12)	506 (13)	755 (16)
Mean G U Size (%SE)	59	86	75	70

<u>PASTORAL HABITATION:</u>				
Total Dwellings	3,850		2,250 (18)	2,625 (14)
Density - per sq Km	1.1		1.0	1.1
Beehives - % Total				95
Shelters - % Total				2
Others - % Total				3

<u>ARABLE HABITATION:</u>				
Total Dwellings	(1,050 cpds*)		39,143 (25)	33,695 (26)
Density	0.3		16.8	14.7
% Tin roofs	2			29

<u>CULTIVATION:</u>				
Mean %	12		30	24

* Compounds containing a number of dwellings.

FIGURE 10: CATTLE, HUMAN HABITATION AND CULTIVATION IN NORTH-EAST LAFIA (BICOT).

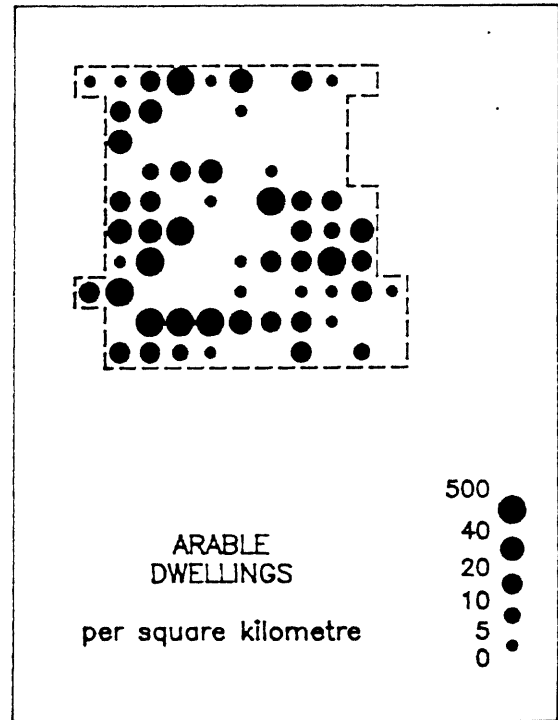
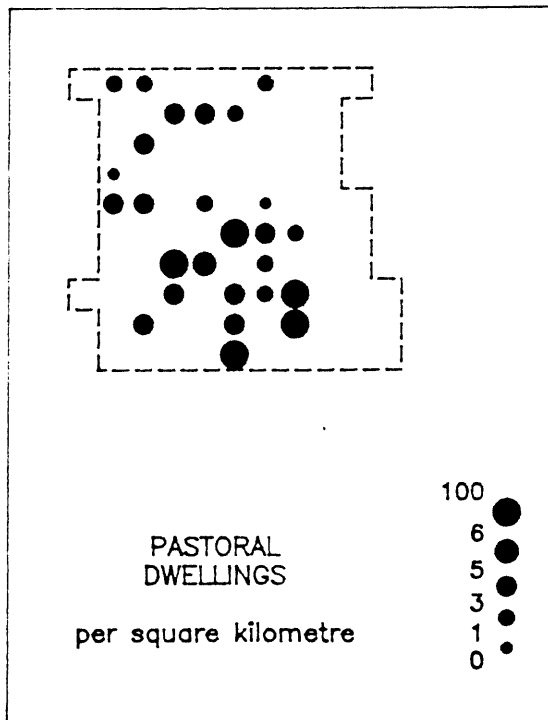
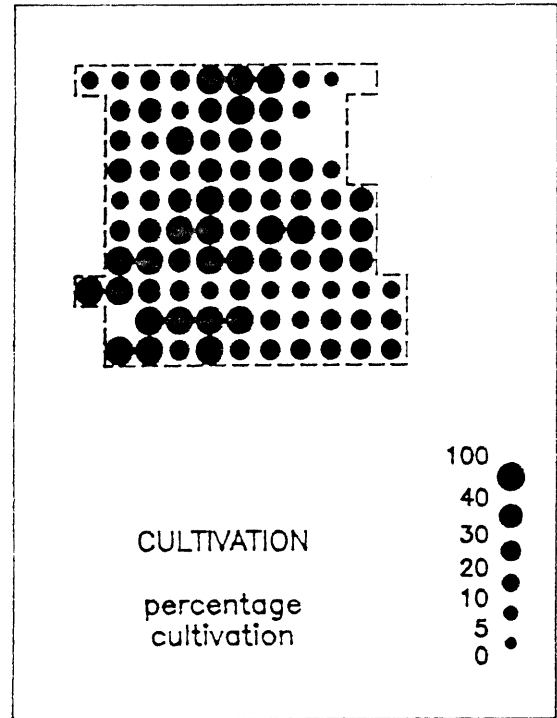
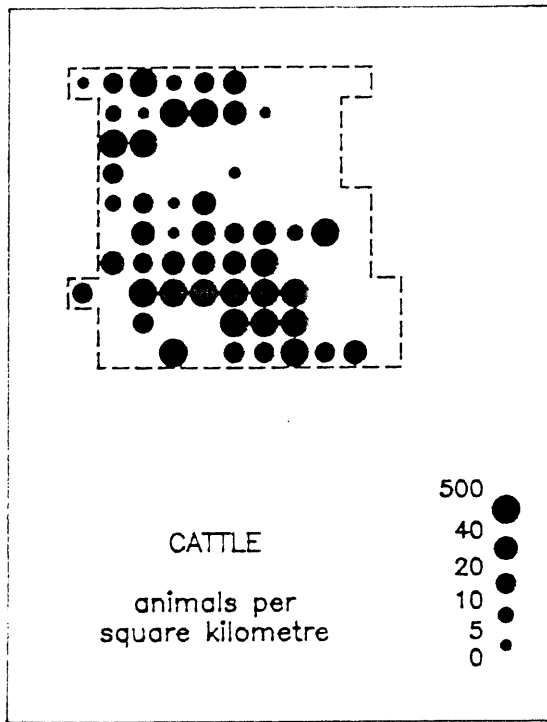


TABLE 10: COMPARISON OF WET SEASON AERIAL SURVEY RESULTS FOR SELECTED REGIONS OF THE NIGERIAN SUB-HUMID ZONE.

	K. BIRI	ABET	MARIGA	PAMBEGWA	FUNA FUNA	GANAURI	T. MINNA	W.ZARIA	NE.LAFIA
<u>FLIGHT INFORMATION:</u>									
Area Surveyed:	2,500	2,475	2,750	3,000	750	800	3,250	3,350	2,300
Date Flown:	29.9.84	30.9.84	2.10.84	1.10.84	2.10.84	30.9.84	1.10.84	7.10.84	6.10.84
Flying Altitude - feet:	800	800	800	800	800	800	800	800	800
Sample Intensity - %:	17.2	17.2	17.2	8.6	17.2	17.2	8.6	17.2	17.2
<u>CATTLE:</u>									
Total Population (%SE)	24,669(23)	78,625 (8)	60,484 (7)	49,849(25)	2,840(64)	23,315(17)	65,404(17)	105,257 (7)	52,567(17)
Density - per sq km	9.9	31.8	22.0	16.6	3.8	29.1	20.1	31.4	22.9
Stocking Rate - ha/hd	10.1	3.1	4.5	6.0	26.4	3.4	5.0	3.2	4.4
Total GUs	424(26)	1,510(11)	1,313(12)	1,301(23)	93(60)	650(14)	1,754(13)	2,091 (8)	755(16)
Mean G U Size (SE)	58.2	52.1	46.1	38.3	30.5	35.9	37.3	50.3	69.6
<u>SHEEP AND GOATS:</u>									
Total Population (%SE)	2,114(35)	6,837(11)	9,532(23)	11,025(15)	789(47)	4,020(2)	8,515(14)	9,305(14)	4,780(29)
Density - per sq km	0.9	2.8	3.5	3.7	0.9	5.0	2.6	2.8	2.1
Stocking Rate - ha/hd									
Total GUs	157(36)	383(11)	6,041(22)	511(20)	52(44)	186(13)	500(15)	627(13)	209(30)
Mean G U Size (SE)									
<u>PASTORAL HABITATION:</u>									
Total Dwellings	1,928(21)	5,512(12)	4,519(18)	6,668(32)	163(63)	813(43)	3,404(17)	4,298(21)	2,625(14)
Density - per sq. km.	0.8	2.2	1.6	2.2	0.2	1.0	1.1	1.3	1.1
Settled Fulani - % Total	100	97	76	100	100	100	75	99	95
Nomadic Fulani - % Total	0	0	2	0	0	0	6	1	2
Agro-pastoral - % Total	0	3	22	0	0	0	19	0	3
<u>ARABLE HABITATION:</u>									
Total Dwellings	19,052(24)	64,870 (6)	23,879(13)	42,716 (4)	7,179(56)	25,639(16)	32,110(17)	-	33,695(26)
Tin roof %	10	27	6	12	27	24	8	-	29
Density - per sq. km.	7.6	26.2	8.7	14.2	9.6	32.1	9.9	-	14.7
<u>CULTIVATION:</u>									
Mean %	14	25	12	18	10	26	11	20	24

4 DISCUSSION.

This report presents the results obtained from the 1984 wet season aerial surveys of selected regions in the Nigerian Sub-humid Zone carried out by low level systematic reconnaissance flights (SRF) and oblique photography. A more general review of the findings from both SRF aerial surveys and related ground studies in Nigeria, and for West Africa as a whole, is being prepared for the International Livestock Centre for Africa (Blench, Bourn and Wint, in prep.). Detailed assessment of the results presented here has therefore been restricted to an examination of the interactions between parameters recorded in the wet season; and observed seasonal changes in cattle density.

The relationships between cattle population, human habitation and cultivation levels for the various aerial survey regions are shown in Figure 11. Strong positive correlations are evident between the levels of:

Cattle and Arable Habitation (Figure 11B)

- Low - Funa Funa and Kurmin Biri;
- Medium - Lafia north-east, Pambeqwa, Tegna-Minna and Mariga;
- High - Abet and Ganawuri.

Cattle and Cultivation (Figure 11C)

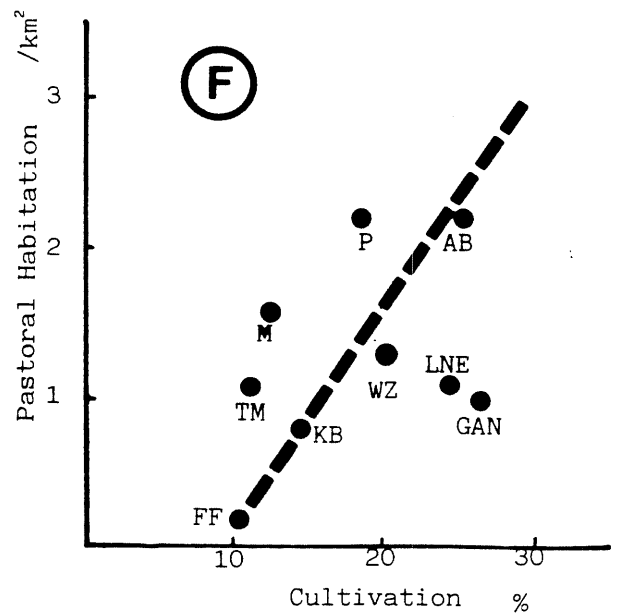
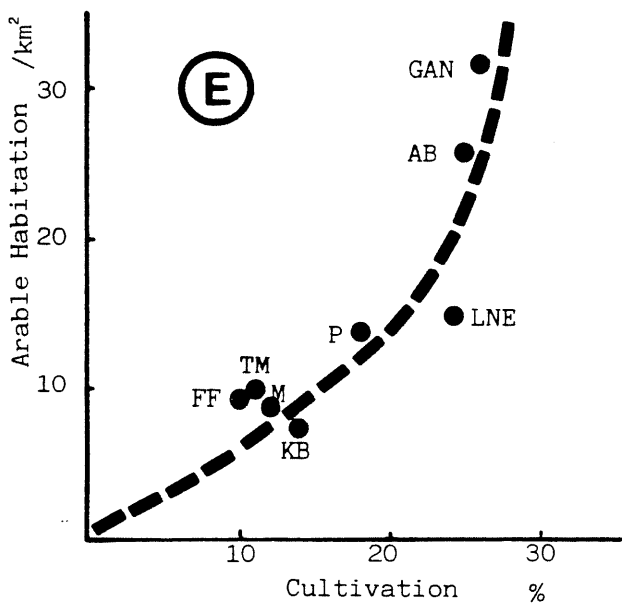
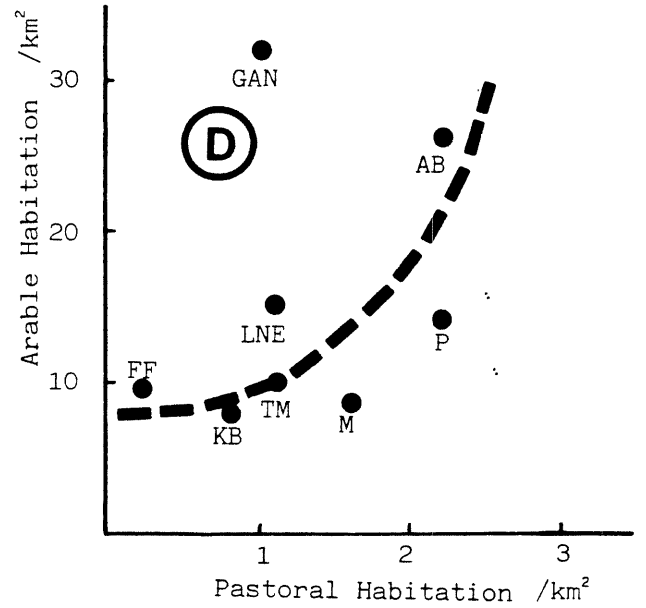
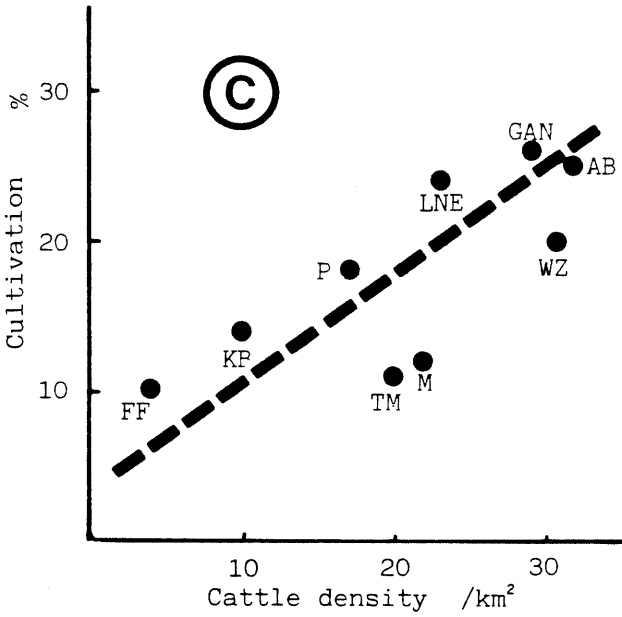
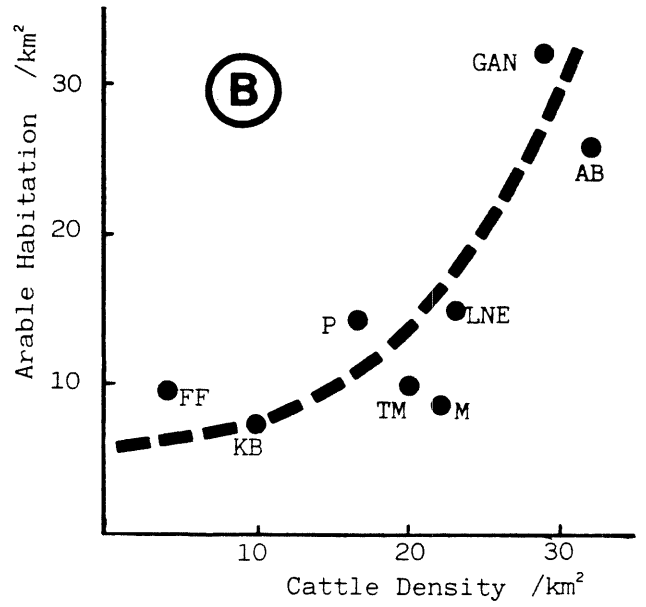
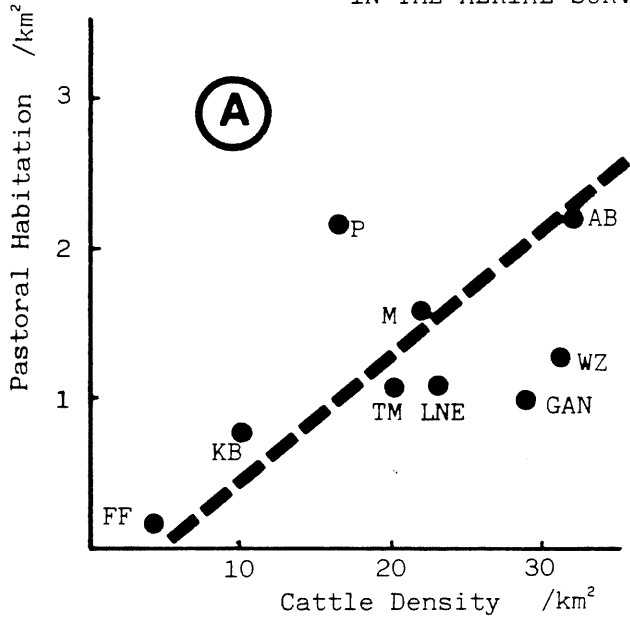
- Low - Funa Funa and Kurmin Biri;
- Medium - Lafia north-east, Pambeqwa, Tegna-Minna and Mariga;
- High - Abet, Ganawuri and West Zaria.

Cultivation and Arable Habitation (Figure 11E)

- Low - Funa Funa, Kurmin Biri, Mariga and Tegna-Minna;
- Medium - Lafia north-east and Pambeqwa;
- High - Abet and Ganawuri.

FIGURE 11: RELATIONSHIPS BETWEEN CATTLE POPULATION, HUMAN HABITATION AND CULTIVATION LEVELS

IN THE AERIAL SURVEY REGIONS DURING THE WET SEASON

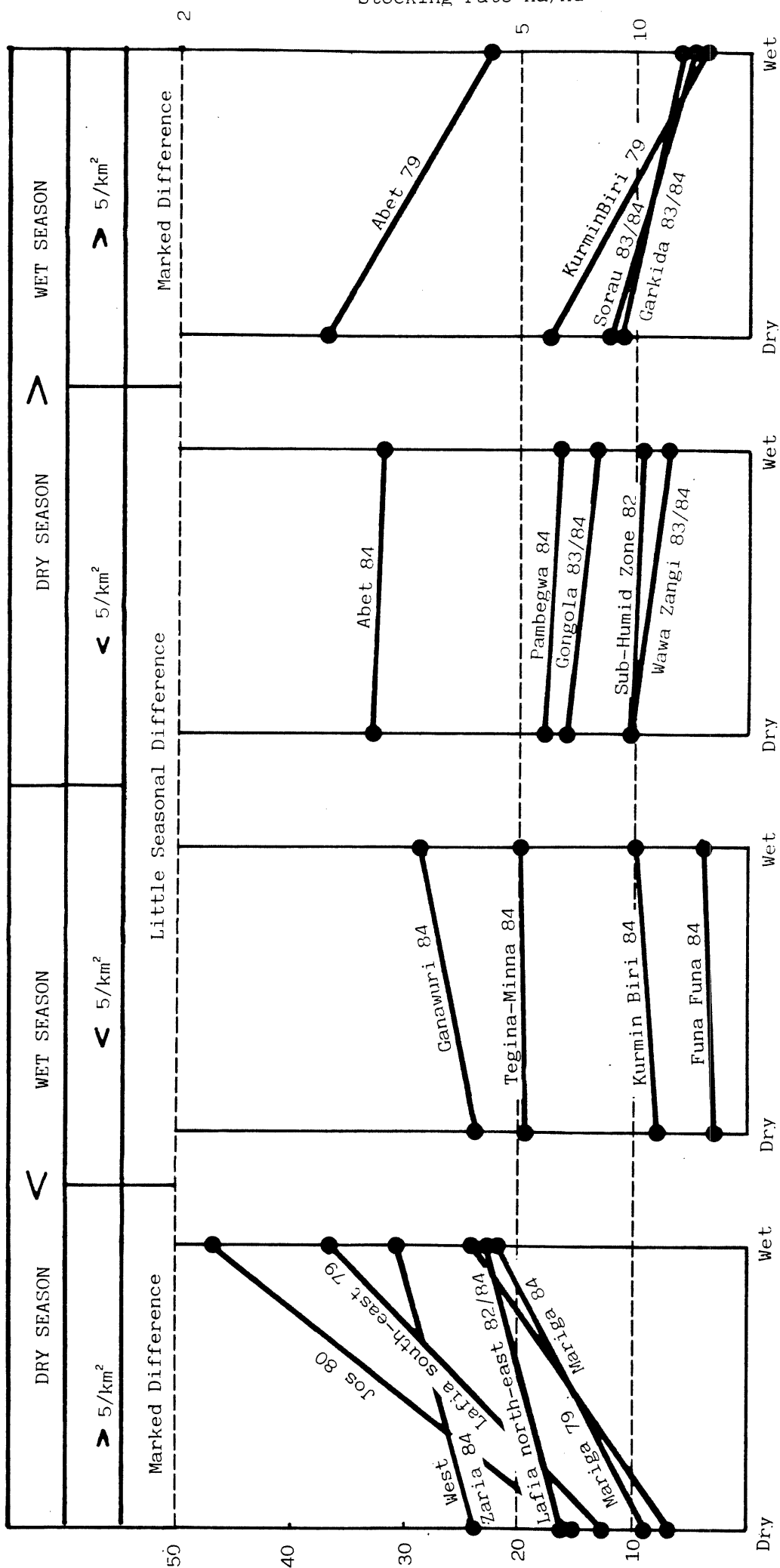


Relationships involving pastoral habitation and other variables were generally less clear than those mentioned above. This is perhaps not so surprising, given the temporary occupancy of some forms of pastoral habitation. Nevertheless, Figure 11A indicates the trend for cattle density to increase with that of pastoral habitation, as one would expect. Nevertheless Pambegwa would appear to have a particularly high density of pastoral dwellings for the levels of cattle found. Conversely, West Zaria (NAPRI) and Ganawuni would appear to have higher cattle densities than would be expected for the level of pastoral habitation encountered.

Figure 11D indicates that the density of pastoral habitation tends to increase with that of arable habitation. Again there is wide scatter of points, with Ganawuni appearing to have exceptionally high levels of arable habitation for the density of pastoral dwelling found. However, the Ganawuni region was selected as a case study area because of its high level of mixed farming (Bayer and Blench - Pers. comm.). Unfortunately in this area a distinction could not be easily made from the air, between arable and mixed farmer habitation. Thus, the recording category "arable habitation" is likely to have included a substantial number of mixed farmers.

A comparison between estimated wet and dry season cattle densities for each of the Nigerian aerial survey regions, both within and outside the sub-humid zone, is provided in Figure 12. The regions have been categorized on the basis of the degree to which wet season cattle density exceeded that of the wet season (to the left of Figure 12), and vice versa (to the right of Figure 12):

FIGURE 12: SEASONAL CHANGES IN CATTLE DENSITY



Wet Season Cattle Density Substantially Greater than Dry Season:

Jos Plateau, 1980 (ILCA, 1980); West Zaria, 1984; Lafia South-East, 1979; Lafia North-East, 1982/84; Mariqa 1979 and 1984.

Dry Season Cattle Density Substantially Greater than Wet Season:

Abet, 1979; Kurmin Biri, 1979; Sorau, 1983/84 and Garkida, 1983/84 (Wint, et al, 1985).

Little Difference Between Seasonal Cattle Densities:

Ganawuri, 1984; Tegina-Minna, 1984; Kurmin Biri, 1984; Funa Funa, 1984; Abet, 1984; Pambeqwa, 1984; Gongola, 83/84 (RIM, 1984); Sub-Humid Zone, 1982 (Bourn and Milligan, 1984); Wawa Zangi, 1983/84 (Wint, et al, 1985).

The low intensity SRF survey over the sub-humid zone (Bourn and Milligan, 1984) indicated that although there was a substantial redistribution of cattle within the sub-humid zone between seasons, overall population levels changed very little. For such a large area this is not altogether surprising, and is reflected in Figure 12 by the almost horizontal line at 10 head per square kilometer (10 hectares per head) for the Sub-humid Zone survey, which may be taken as a useful comparative baseline for all other surveys. Many of the much smaller areas show marked seasonal changes in one direction or the other, reflecting inward and outward migration depending on particular circumstances.

Exceptionally high cattle densities were found on the Jos Plateau and Lafia south-east region in the wet season, and Ganawuri and Abet in both seasons.

Exceptionally low cattle densities were encountered in Mariqa in the dry season, and Kurmin Biri, Funa Funa, Wawa Zangi, Garkida and Sorau in both wet and dry seasons. It is interesting to note that all of the last five mentioned aerial survey regions were selected on the grounds that they contained gazetted or proposed grazing reserves.

* * * * *

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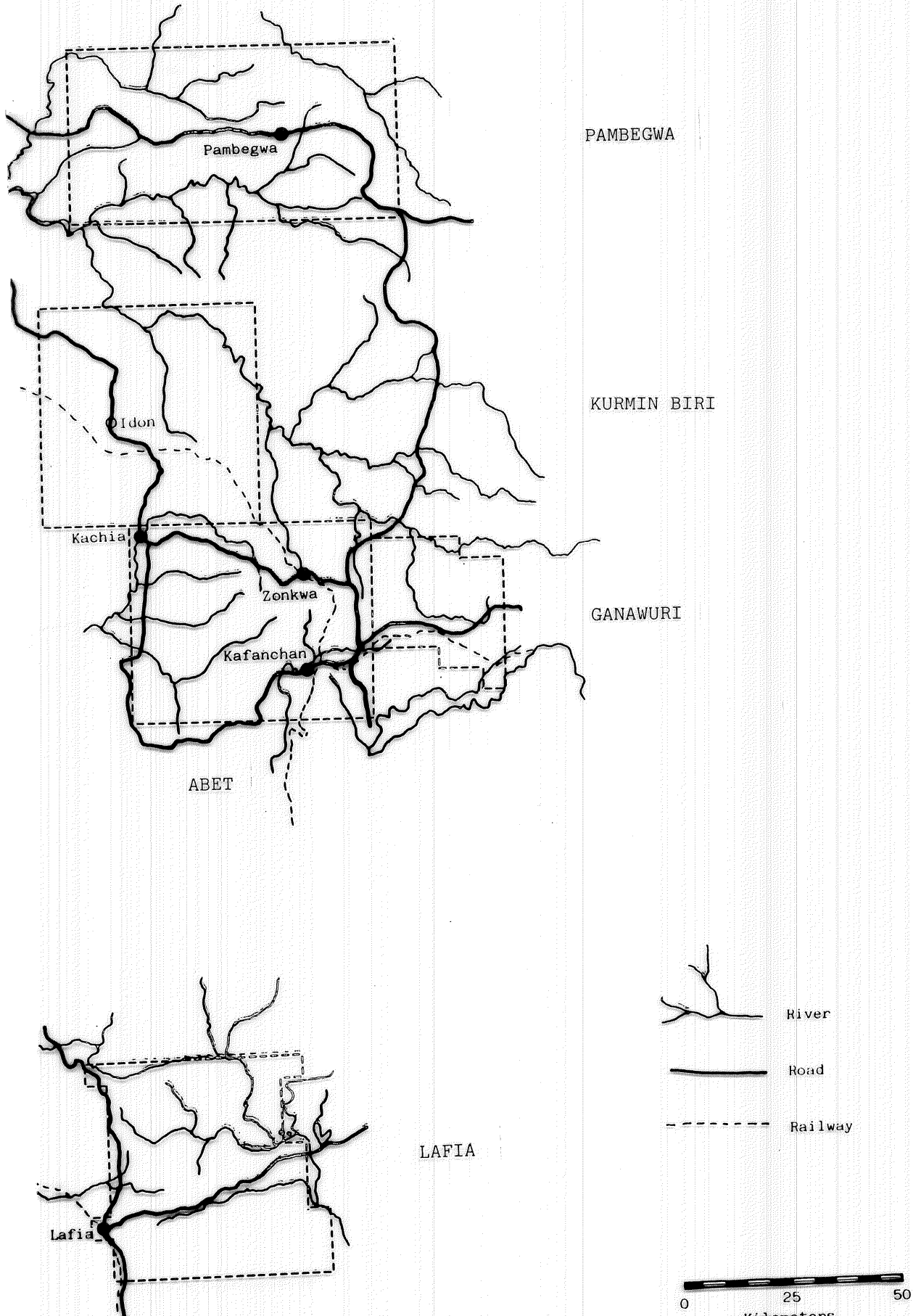
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ROAD, RIVER AND RAILWAY OVERLAYS FOR SUBHUMID ZONE AERIAL SURVEY REGIONS.



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