COSCA

Working Paper No. 2

Collaborative Study of Cassava in Africa (COSCA): Site Selection Procedure

by

S. E. Carter and P. G. Jones

International Institute of Tropical Agriculture
Ibadan, Nigeria

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International Institute of Tropical Agriculture
PMB 5320
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Nigeria

1989

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Overseas Development Natural Resources Institute (ODNRI)
International Child Health Unit (ICHU)
National Agricultural Research Systems of Côte d'Ivoire, Ghana, Nigeria, Tanzania, Uganda and Zaire.

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ABBREVIATIONS

CBSC: Cassava Based Systems Working Group

CIAT: Centro Internacional Agricultura Tropicale

COSCA: Collaborative Study of Cassava in Africa

IARCS: International Agricultural Research Centres

ICHU: International Child Health Unit

IFPRI: International Food Policy Research Institute

IITA: International Institute of Tropical Agriculture

NARS: National Agricultural Research Systems

ODNRI: Overseas Development Natural Resources Institute, U. K.

RCMP: Resource and Crop Management Program, IITA.

TRIPP: Root Tuber and Plantain Improvement Program, IITA.

UNDP: United Nations Development Program.

PREFACE

Collaborative Study of Cassava in Africa (COSCA) is an inter-institutional effort to provide baseline information on cassava. Such information is needed to improve the relevance and impact of agricultural research on the crop in Africa in order to realize the potentials of cassava in raising food production and the incomes of poor people.

COSCA Working Paper Series is published by COSCA to quickly disseminate its intermediate outputs and does not represent official publications of IITA. Publications in the series include methodologies for, as well as preliminary results of their various components and phases of the COSCA surveys.

The series is aimed at scientists and researchers with National Agricultural Research Systems of Africa, the international research community, policy makers, donors and international development agencies that may be interested in cassava.

Individuals and institutions may receive copies free of charge by writing to:

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EXECUTIVE SUMMARY

This paper describes the methods of site selection used for a village-level survey which comprised the first phase of the Collaborative Study of Cassava in Africa (COSCA). Potential survey regions are defined using spatial data which describe ecological conditions, human population densities, accessibility, and the distribution of cassava production. Sixteen different types of regions are identified. Methods are described for selecting random samples of grid cells in each survey region, and for identification of 'villages' for surveys within each cell. The grid used for mapping climate, population, access and the crop's distribution is maintained as a frame throughout the survey site selection process. This will be useful during data analysis if raster techniques are employed to map the data generated.

INTRODUCTION

The COSCA Study

The Collaborative Study of Cassava in Africa (COSCA) is an inter- institutional effort to provide basic information about cassava in Africa, to increase the relevance and impact of research related to the crop, and to help increase incomes and food availability for the poor peoples in Africa. The study involves the collection of data which will be utilised to characterize:

i) The structure of cassava based cropping systems in Africa.

ii) The nature and distribution of various cassava processing techniques.

iii) The marketing system for cassava.

iv) Present and future demand for cassava in rural and urban areas, and

v) The relationships between cassava consumption and nutrition (Nweke 1988).

Data are to be collected at two levels. Generalised, mostly qualitative information will be gathered from group interviews, at what we will refer to as the village-level. Information which is specific to the household, farm or processing unit will be collected at the household-level. The village-level surveys comprise the first phase of the project, while the household-level surveys will be the second, and third phases. Details of these phases are given by Nweke, (1988).

FACTORS CONSIDERED IN THE DETERMINATION OF THE STUDY AREAS

It is inherent in the aims of the COSCA study to provide as much information as possible about cassava and those who grow and use it throughout Africa. The geographic areas covered by the project are large and have had to be reduced to a more manageable size. This has been done by selecting a restricted set of study areas representative of conditions which are known to affect cassava production in some significant ways. Originally, it was planned to conduct statistical comparison of the survey results, between and within these study areas, which restricted the number of survey regions to 3 per country. The project leadership rejected this, preferring to spread survey work over wider areas in each of the participating countries. Whilst this has enabled a slightly wider geographical coverage, it will hinder statistical comparisons between areas of different climatic, demographic and access conditions.

This paper describes the work undertaken prior to the training meeting in CIAT, to identify the potential survey areas following the procedures approved by the project leadership and steering committee. In addition, details are given of the methods used to apportion survey sites in all the areas which the project staff decided to survey.

Finally, some suggestions are made in the appendix about mapping of the survey data.

Factors considered

The most important factors for survey site selection identified at the third planning meeting for the project in September 1988 were as follows: the geographic distribution of the crop, ecology, human population densities, and infrastructural development, particularly accessibility. These have been used to construct a framework for selecting survey sites, and are now discussed in detail.

Each of the project countries will represent combinations of these different types of conditions. Six countries have been selected (Nweke 1988). They are Cote d'Ivoire, Ghana, Nigeria, Zaire, Uganda and Tanzania. They are amongst the largest producers of cassava in Africa. Willingness to participate in the study, ability to provide national staff with experience of research in cassava, political stability, easy accessibility and relatively moderate costs of living were other factors considered in their selection.

Geographic distribution of cassava

A map of the distribution of cassava in sub-saharan Africa was produced by Jamie Fairbairn of CIAT's Agroecological Studies Unit, using recent census statistics and other data (Figure 1). These data are summarized, by country, in Table 1. The map was also used to evaluate potential study areas on the basis of their importance for production.

Ecology

Climate has been selected as the most convenient determinant of ecological conditions. Climatic differences strongly influence the growth of the cassava plant, production techniques, biological pressures and processing methods.

The climatic classification devised in CIAT for cassava, has been used to subdivide the cassava producing areas of the selected countries (modified from that described in Carter 1987). This classification scheme is illustrated in Figure 2.

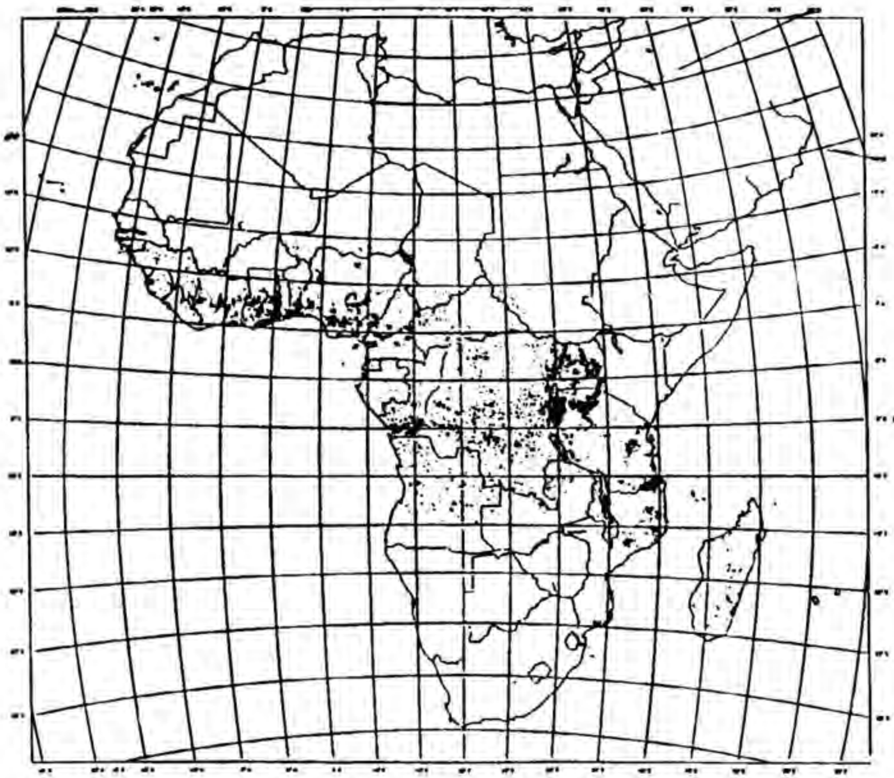


Figure 1. The distribution of cassava in sub-saharan Africa (each dot represents 1000 ha).

Table 1: Cassava production (hectareage), African countries

Country	Area (000 ha)	Percentage of Total Area
Angola	626	7.84
Benin	113	1.42
Burundi	302	3.79
Burkina Faso	1	0.01
Cameroon	383	4.80
C.A.R.	152	1.91
Chad	23	0.29
Comores	5	0.06
Congo	160	2.00
Cote d'Ivoire	230	2.88
Equatorial Guinea	25	0.31
Gabon	42	0.53
Gambia	2	0.03
Ghana	380	4.76
Guinea	79	0.99
Guinea-Bissau	6	0.08
Kenya	68	0.85
Liberia	43	0.54
Madagascar	240	3.01
Malawi	50	0.62
Mali	2	0.03
Mozambique	440	5.52
Niger	34	0.43
Nigeria	415	5.20
Rwanda	132	1.65
Senegal	11	0.14
Sierra Leone	30	0.38
Tanzania & Zanzibar	1306	16.37
Togo	49	0.61
Uganda	422	5.29
Zaire	2101	26.33
Zambia	161	2.02

Sources: Census statistics and reports, various years.

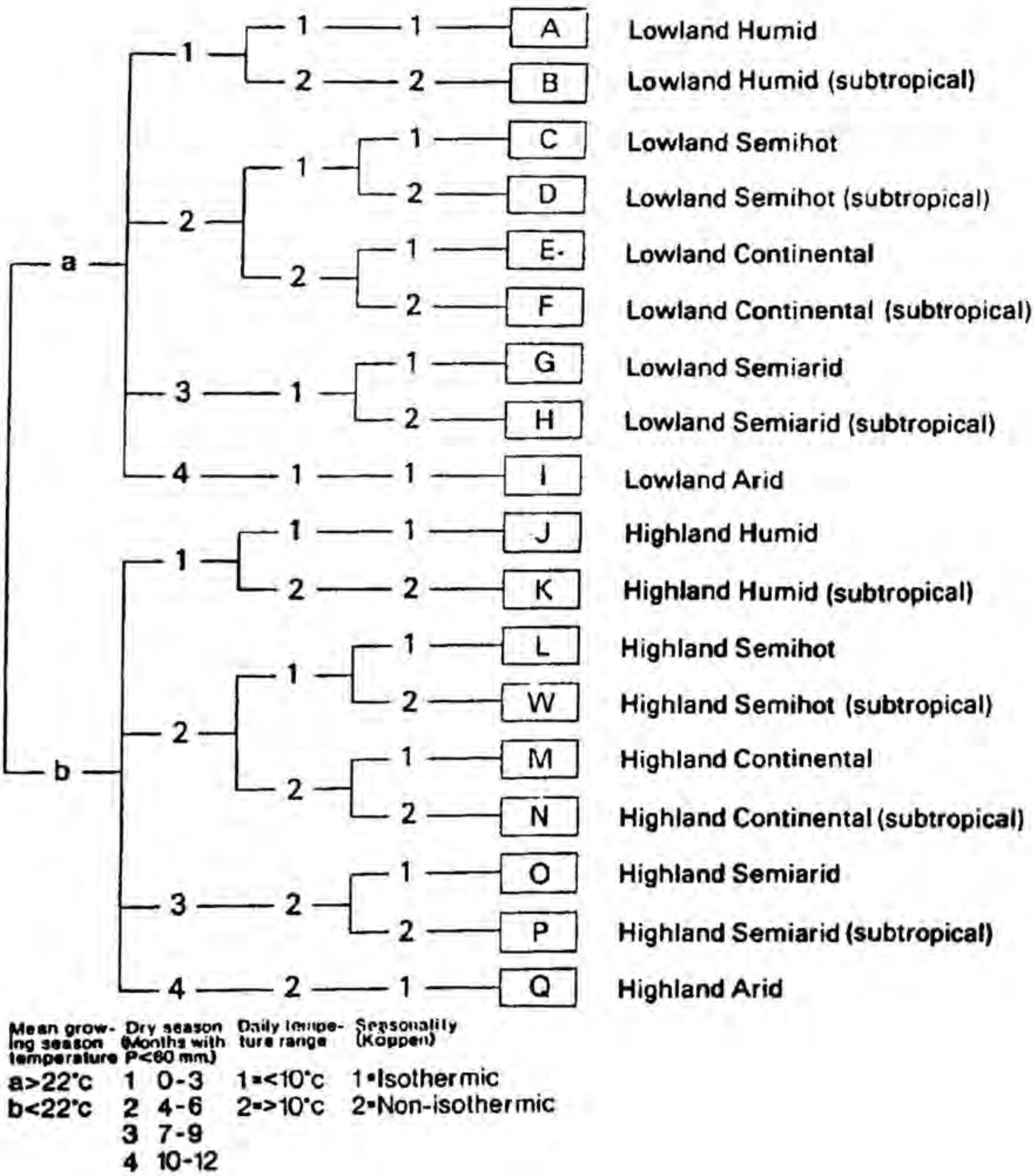


Figure 2. Climatic classification for cassava (adapted from Carter 1987).

It takes account of mean growing season temperatures, the length of the dry season, daily temperature ranges during the growing season and seasonality. The climatic classes in which most cassava is found in Africa are listed in Table 2.

All of these climates are represented in the 6 countries selected for the study. However, only a very limited area is covered by climate F, where very little cassava is found in Tanzania.

Table 2: Principal climatic classes for cassava in Africa, and proportion of the crop (hectareage) grown in each.

Class		Hectare-age %	Mean growing season tempera-ture	No. dry month (60mm rain)	Daily growing season tempera-ture range	Seasona-lity (Koppen)
A	Lowland Humid	33.26	> 22°C	< 4	< 10°C	Isothermic
C	Lowland Semi-Hot	16.62	> 22°C	4-6	< 10°C	Isothermic
D	Lowland Continental	9.45	> 22°C	4-6	10°C +	Isothermic
F	Lowland Continental (subtropical)	4.39	> 22°C	4 - 6	10°C+	Non-Isothermic
G	Lowland Semi-Arid	4.84	> 22°C	6 - 9	10°C+	Isothermic
J	Highland Humid	7.17	< 22°C	< 4	< 10°C	Isothermic
M	Highland Continental	7.15	< 22°C	4 - 6	10°C+	Isothermic

The density of human population

Density of human population strongly influences the intensity of land use, although it is not the primary controlling factor. Production and processing systems and the level of importance of cassava in the diet are all expected to be partly determined by population density.

Accessibility

Ease of accessibility will be an important determinant of the degree of commercialization of cassava production, as well as the importance of migration. A possible inverse relationships between the latter may be a measure of the integration of cassava producing areas into wider social, political and economic systems at the regional, national and global levels.

Other factors such as ethnic and edaphic conditions also exert a strong influence cassava cultivation. However, to consider more than the above to delineate the potential survey regions would have created an unmanageable number of sample sites.

DEFINITION OF POTENTIAL SURVEY REGIONS

A number of techniques were employed to identify potential survey regions for this study.

Firstly, the map of cassava distribution presented in Figure 1 was digitized to create a computer image.

CIAT's climatic databse for Africa (Jones1988) was used to map the distribution of the different climatic classification outlined in Figure 2. The African continent was divided into a grid of cells, each of 12' latitude by 12' of longitude. Mean growing season temperatures, length of dry season, daily temperature range and seasonality were calculated from the database for each cell. A computer image was then generated, showing each cell and the climatic class to which it was assigned.

All weather roads, railways and navigable rivers were digitized from the 1987 Michelin travel maps of Africa, using the Atlas graphic package, to create a third computer image.

Finally, secondary level administrative units for each of the 6 countries to be covered in the study were digitized and their respective areas calculated. Population data from the United States of America Bureau of the Census (unpublished data), projected forward to 1990, were used to calculate population densities for each of these administrative divisions.

A geographical analysis package, IDRISI (Eastman, 1988) was used to overlay these 4 maps on a microcomputer. Maps of cassava distribution, infrastructure and administrative units were rasterized to correspond exactly to the grid created for the climatic map. Each grid cell was thus assigned a hectareage of cassava, on one image, a population density, on another, and an accessibility factor, as Good or Poor according to whether a road, railway or navigable river crossed it, on a final image. For simplicity, population densities were reclassed into High and Low, the former comprising grid cells with 50 or more persons per square kilometer. IDRISI allows the user to overlay these images, to create new maps. A new image, describing areas with homogeneous climatic, demographic and access conditions, was thus created through this overlay process. By combining this with the image of cassava distribution, the hectareage within each combination of these conditions was then calculated.

Tables 3 to 8 show the combiantions of conditions which were found in 6 countries involved in the study, and the number of hectares of cassava (000's) in each combination. Table 9 summarises the total areas of cassava in the 6 countries on the basis of climate-accessibility-population combinations.

Table 3: Cote d'Ivoire: Area of cassava (000's ha) by combination.

CLIMATE	POPULATION DENSITY			
	Low		High	
	ACCESSIBILITY		ACCESSIBILITY	
	Poor	Good	Poor	Good
A	63	93	-	-
C	19	30	-	-
E	1	11	-	-

Table 4: Ghana: Area of cassava (000's ha) by combination.

CLIMATE	POPULATION DENSITY Low ACCESSIBILITY		High ACCESSIBILITY	
	Poor	Good	Poor	Good
A	24	40	52	136
C	20	7	5	52
E	-	-	-	2

Table 5: Nigeria: Area of cassava (000's ha) by combination.

CLIMATE	POPULATION DENSITY Low ACCESSIBILITY		High ACCESSIBILITY	
	Poor	Good	Poor	Good
A	-	-	17	152
C	-	-	77	150
E	-	-	5	5
G	-	-	3	12

Table 6: Tanzania: Area of cassava (000's ha) by combination.

CLIMATE	POPULATION DENSITY Low		High	
	ACCESSIBILITY		ACCESSIBILITY	
	Poor	Good	Poor	Good
A	-	-	17	17
C	131	38	-	120
E	120	68	27	7
F	-	-	-	1
G	200	75	-	-
J	-	-	13	4
M	80	-	12	6
Others+	53	24	19	47

+ Climatic types not amongst the seven most important for African cassava production.

Table 7: Uganda: Area of cassava (000's ha) by combination.

CLIMATE	POPULATION DENSITY Low		High	
	ACCESSIBILITY		ACCESSIBILITY	
	Poor	Good	Poor	Good
A	51	37	79	102
E	2	-	-	4
J	-	-	51	70
M	-	-	6	8
Others+	-	-	-	5

+ Climatic types not amongst the seven most important for African cassava production.

Table 8: Zaire: Area of cassava (000's ha) by combination.

CLIMATE	POPULATION DENSITY Low ACCESSIBILITY Poor	Good	High ACCESSIBILITY Poor	Good
A	836	240	-	-
C	131	89	11	15
E	218	79	-	3
F	1	-	-	-
J	293	12	1	-
M	43	17	-	-
Others+	19	29	-	-

+ Climatic types not amongst the seven most important for African cassava production.

Climate-access-population density combinations with less than 50,000 ha of cassava in total (all countries) were excluded from the analysis at this stage, because they were considered as unrepresentative of conditions in all the six countries. Within individual countries, combinations with less than 10,000 ha of cassava were also excluded. Since it was originally intended to make statistical comparisons of survey results between the different region types, unrepresentative areas were ignored.

The remaining areas formed the potential survey regions, which are shown in figures 3 to 8. These maps were produced on a larger scale and in colour, for the project leaders and national coordinators to select the final survey regions and survey sites. They were exported from IDRISI and mapped using a modified version of MAPROJ (Hutchinson 1981), with a CALCOMP 965 plotter on an IBM 4361.

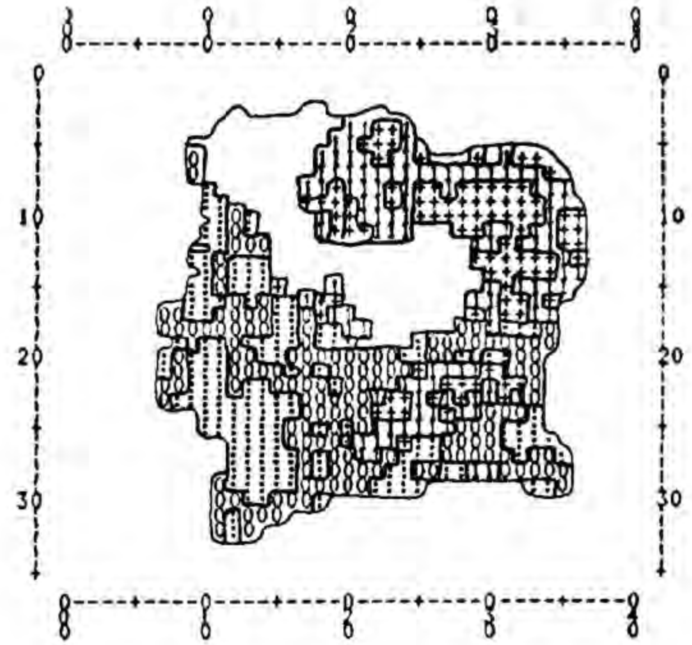
Table 9: Total area of cassava (000 ha) in 6 study countries, by climate- accessibility-population density combination.

CLIMATE	POPULATION DENSITY Low ACCESSIBILITY Poor	Low ACCESSIBILITY Good	High ACCESSIBILITY Poor	High ACCESSIBILITY Good
A	974	410	185	407
C	301	164	93	337
E	341	158	32	19
F	1	-	-	1
G	200	75	3	14
J	293	12	65	74
M	123	17	18	14
Others (combined)	72	53	19	52

Note: 'Other' Climates, and combinations with less than 50,000 ha. were excluded form further analyses.

Table 10. Combinations comparing potential sampling regions, with countries and cassava hectareages in brackets, which correspond to them.

CLIMATE	POPULATION DENSITY							
	Low				High			
	ACCESSIBILITY				ACCESSIBILITY			
	Poor		Good		Poor		Good	
A	Côte d'Ivoire	(63,000)	Côte d'Ivoire	(93,000)	Ghana	(52,000)	Ghana	(136,000)
	Ghana	(24,000)	Ghana	(40,000)	Nigeria	(17,000)	Nigeria	(152,000)
	Uganda	(51,000)	Uganda	(37,000)	Tanzania	(17,000)	Tanzania	(17,000)
	Zaire	(836,000)	Zaire	(240,000)	Uganda	(79,000)	Uganda	(102,000)
C	Côte d'Ivoire	(19,000)	Côte d'Ivoire	(30,000)	Nigeria	(77,000)	Ghana	(52,000)
	Ghana	(20,000)	Tanzania	(38,000)	Zaire	(11,000)	Nigeria	(150,000)
	Tanzania	(131,000)	Zaire	(89,000)			Tanzania	(120,000)
	Zaire	(131,000)					Zaire	(15,000)
E	Tanzania	(120,000)	Tanzania	(68,000)				
	Zaire	(218,000)	Zaire	(79,000)				
G	Tanzania	(200,000)	Tanzania	(75,000)				
J	Zaire	(293,000)			Tanzania	(13,000)	Uganda	(17,000)
					Uganda	(51,000)		
M	Tanzania	(80,000)						
	Zaire	(43,000)						



Key

```
::::  Climate A  -  Access Poor  -  Population density Low
++++  Climate C  -  Access Poor  -  Population density Low
0000  Climate A  -  Access Good  -  Population density Low
1111  Climate C  -  Access Good  -  Population density Low
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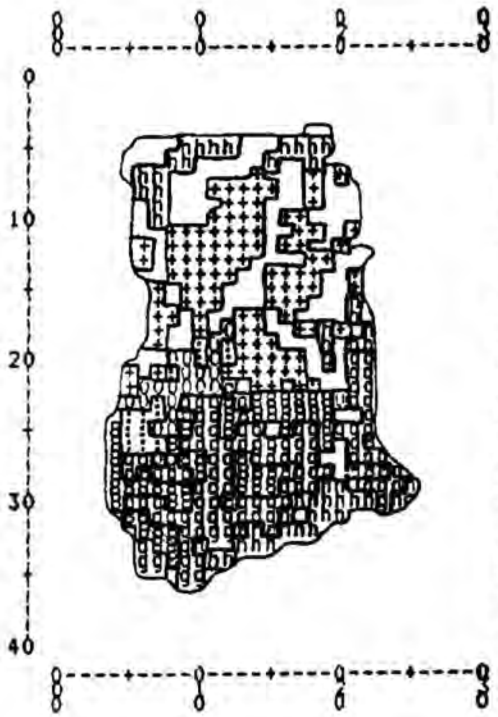
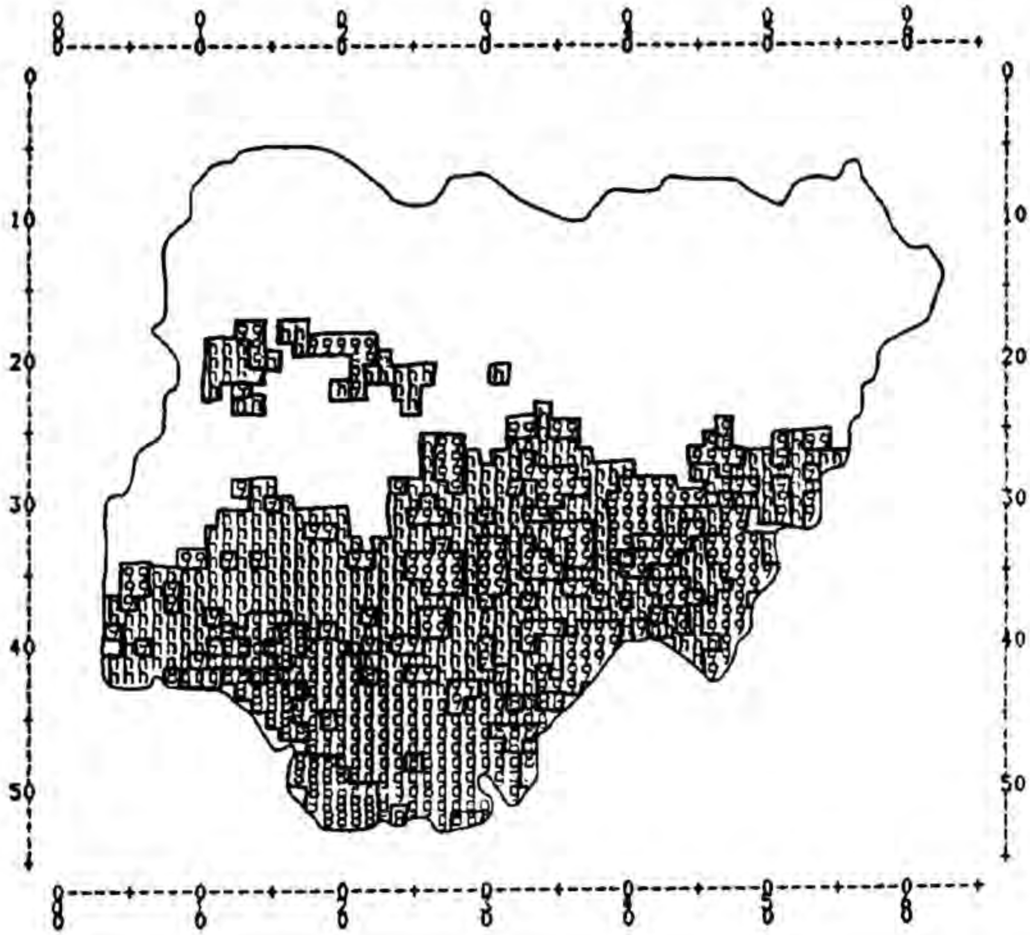
Figure 3. Cote d'Ivoire: Potential survey regions.



Key

::::	Climate A	- Access Poor	- Population density Low
++++	Climate C	- Access Poor	- Population density Low
0000	Climate A	- Access Good	- Population density Low
8888	Climate A	- Access Poor	- Population density High
gggg	Climate A	- Access Good	- Population density High
hhhh	Climate C	- Access Good	- Population density High

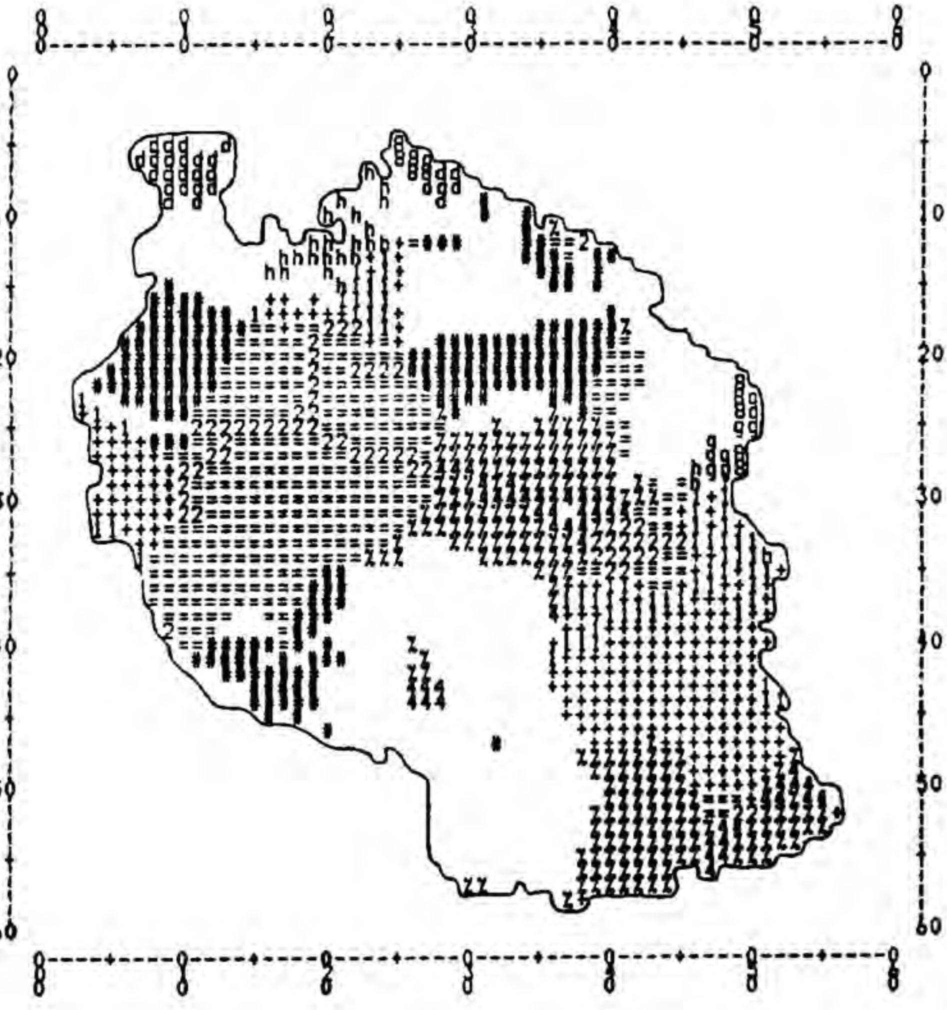
Figure 4. Ghana: Potential survey regions.



Key

8888 Climate A - Access Poor - Population density High
9999 Climate C - Access Poor - Population density High
gggg Climate A - Access Good - Population density High
hhhh Climate C - Access Good - Population density High

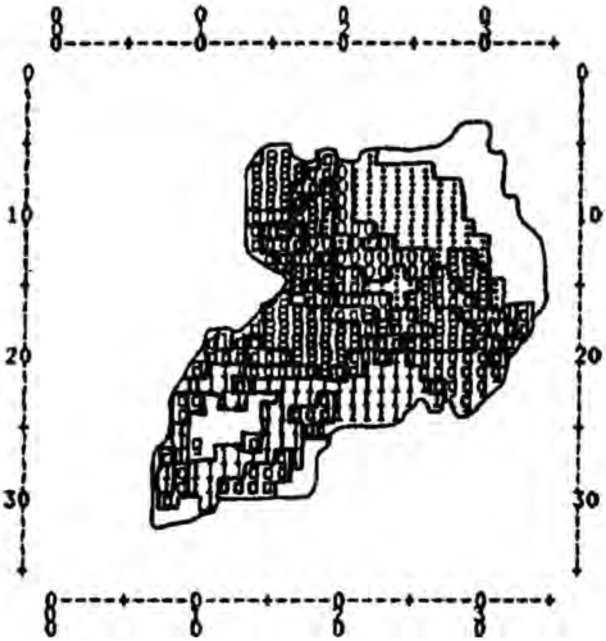
Figure 5. Nigeria: Potential survey regions.



Key

++++	Climate C	-	Access Poor	-	Population density Low
====	Climate E	-	Access Poor	-	Population density Low
ZZZZ	Climate G	-	Access Poor	-	Population density Low
####	Climate H	-	Access Poor	-	Population density Low
1111	Climate C	-	Access Good	-	Population density Low
2222	Climate E	-	Access Good	-	Population density Low
4444	Climate G	-	Access Good	-	Population density Low
8888	Climate A	-	Access Poor	-	Population density High
dddd	Climate J	-	Access Poor	-	Population density High
gggg	Climate A	-	Access Good	-	Population density High
hhhh	Climate C	-	Access Good	-	Population density High

Figure 6. Tanzania: Potential survey regions.



Key

:::: Climate A - Access Poor - Population density Low
0000 Climate A - Access Good - Population density Low
8888 Climate A - Access Poor - Population density High
dddd Climate J - Access Poor - Population density High
gggg Climate A - Access Good - Population density High
1111 Climate J - Access Good - Population density High

Figure 7. Uganda: Potential survey regions.

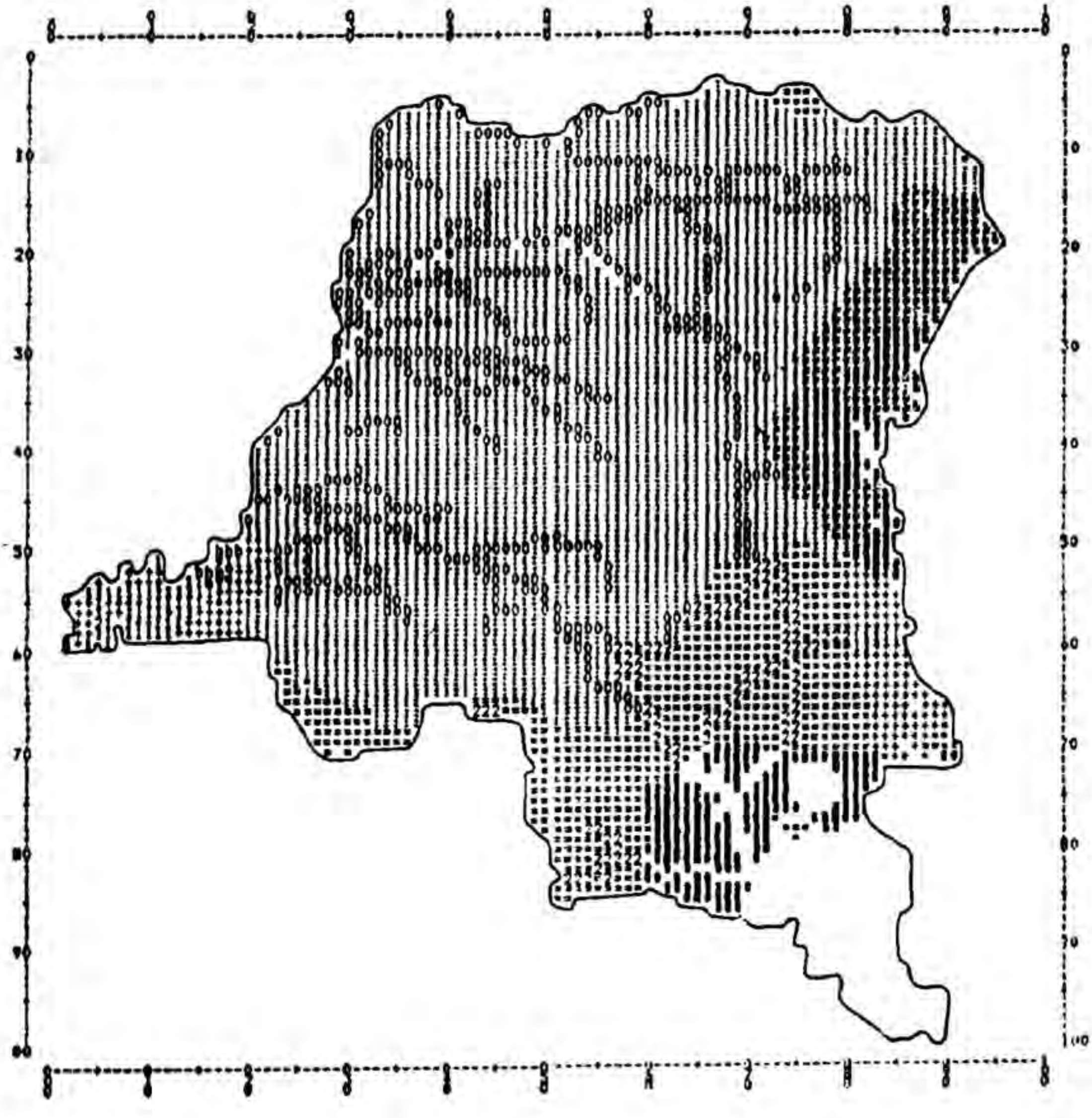


Figure 8. Zaire: Potential survey regions.

SURVEY SITE SELECTION

Survey regions

During the Phase I training meeting at IITA in April, 1989, the project leaders and national coordinators together identified the areas which they decided to survey and compared these with the potential survey areas described in the previous section of this paper. It was originally intended to limit the number of survey areas to 3 per country (6 in Zaire and Nigeria), and to complete 25 questionnaires per area. Instead, no limit was placed on the number of areas (climate - population - access homologues) to be surveyed, and other areas of specific interest to national coordinators were optionally included. Throughout the first week of the training meeting, while learning about site selection techniques, the national survey teams refined their estimates of the number of villages which they could survey in the time available which was approximately 5 months. These estimates, although crude, were based on budgeting and manpower limitations, seasonal weather conditions and the distances to be covered. The total number of questionnaires was then apportioned between the different types of survey regions identified, with unclassified areas grouped together as a single class for surveys.

The number of sites selected for each of the 6 countries were as follows:

Côte d'Ivoire	40
Ghana	30
Nigeria	65
Tanzania	42
Uganda	37
Zaire	37

For Zaire, this figure only covers the South-western part of the country, between the coast and Katanga. The Zairean team only had sufficient manpower and resources to cover this part of the country, even after excluding areas with difficult accessibility.

Site selection

The 12' x 12' grid used to construct the maps of potential survey areas provide a frame in which to select general locations at random for the questionnaires to be administered. Within each grid cell, a village (cluster or settlement) could then be selected, using the following techniques.

Grid cells were selected within each potential survey region as follows:

i) Areas with no agriculture, or cassava, such as game parks and uninhabited areas were excluded throughout the country.

ii) The map grid was extended, by hand, to areas chosen for survey which were unclassified on the maps produced in

CIAT. These were considered as a separate region type within each country.

iii) For each region type, grid squares were numbered consecutively, from 1 to 'n'.

iv) The total number of grid squares in all of the regions to be surveyed was calculated. This was then divided by the number of questionnaires which could be administered in each country, to give a sampling fraction.

v) A random 'start' number, between one and the sampling fraction, was then chosen, a different one for each region. Grid squares whose numbers corresponded to the start number were chosen, then the sampling fraction was repeatedly added to the start number, noting the grid squares selected from each summation, until the highest number in each region was reached or exceeded (Figure 9).

This method ensured an even spread of survey points across each region.

Identification of survey villages

The grid cells selected using the above methods then had to be transferred to larger scale maps of each country (1:100,000 or larger) by the national coordinators on return to their respective countries, where they could acquire the necessary maps. Information on these maps, such as latitude and longitude tick marks, and grid templates at the correct scale were used to draw the grid squares.

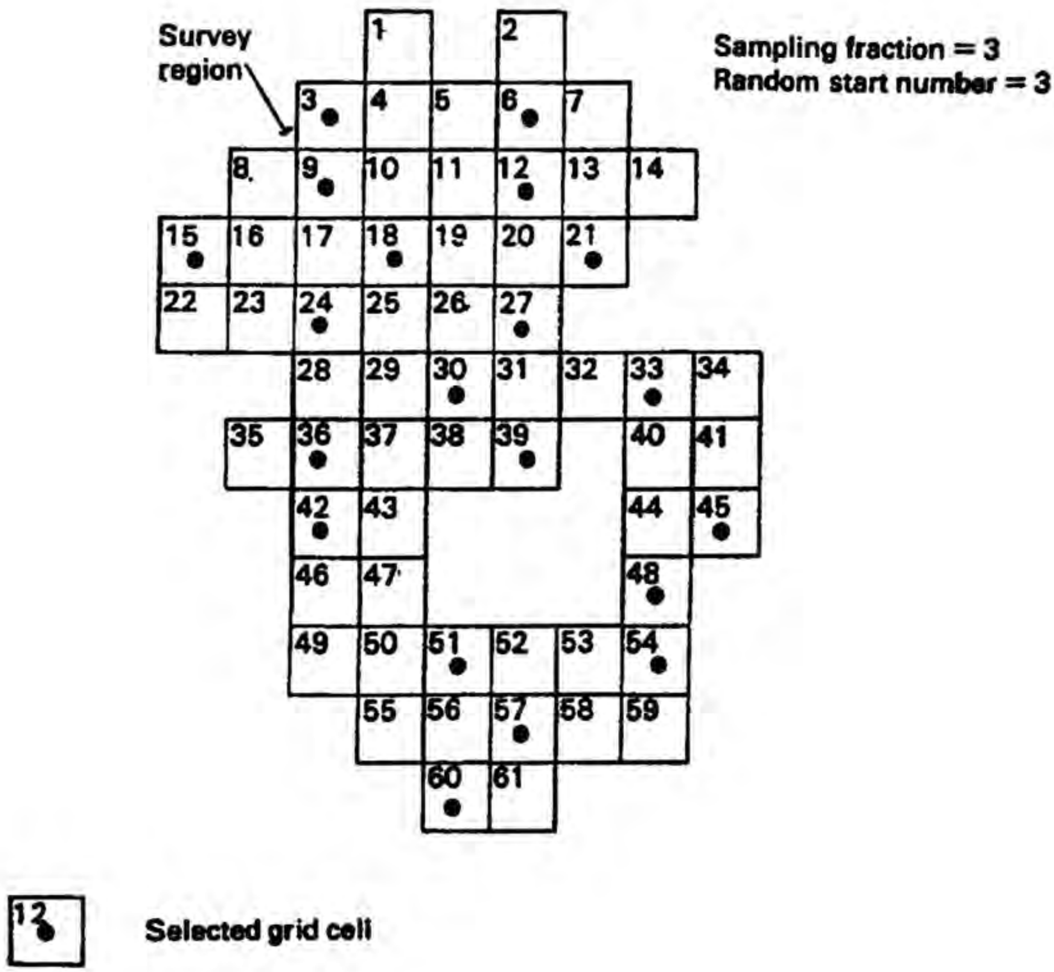


Figure 9: Grid cell selection method

It was emphasized that within each grid cell, the village surveyed must be selected at random in order to avoid bias.

To do this, enumerators were advised to elicit a list of all villages in the approximate area, using some known reference point within the grid square as a guide to its location. Available maps were unlikely to show all villages.

Practical Problems

The following points were emphasized in an attempt to overcome practical problems which might arise in the execution of the survey.

(i) Grid cells with no settlements, should be replaced by one of the same type (climate, population density and access) selected at random from the 8 cells surrounding the empty one.

(ii) Enumerators should allow for delays and try to return at a later date to temporarily inaccessible areas.

(iii) Sites which continue to be inaccessible should not be replaced.

(iv) Where available maps lack sufficient detail to allow enumerators to find a grid square by reference to places within it, enumerators should find its centre by calculating distances, and/or directions from a nearest known point such as a town. A list of villages should then be compiled once they arrive at the approximate location of the grid cell centre.

(v) In areas of very dense settlement, or in urban and peri-urban areas, settlements chosen should be divided into more manageable-sized units, such as neighbourhoods. Simple maps could be drawn to show the locations of these subdivisions. The questionnaire should then be administered in one randomly selected unit.

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APPENDIX

Procedure for Mapping Survey Data

An important part of the analytical stage of the Phase I survey will be the production of simple maps for some of the data collected. Maps are a very useful tool. They can be used to show how factors vary across the survey regions, and to help interpret these variations in the data. They lead logically to the generation of hypotheses which can be tested during later phases of the study, and can often directly answer important research questions.

The simplest way to map most of the data which the village level questionnaire will generate is to show categorised information for each village. Most of the survey data will be precoded, and these codes can be used directly to produce maps. Data with real values (cassava prices, for example) must be sorted into classes to map it.

(i) The first stage in mapping is to draw a base map which shows the entire area to be mapped. Convenient scales for the base map would be from 1:3,000,000 to 1:1,000,000, depending on the size of the subject. For reports, they will need to fit onto an A4 size page. The base map should have lines of latitude and longitude, important towns and cities of the region, major roads and rivers, and major contour lines (e.g. at 250 meter intervals). All of these features can be traced from maps used in the survey. Finally, each of the survey villages should be marked on the map.

Base maps should be drawn on good quality paper in ink so that they can be photocopied. Maps of the survey data can then be made on these photocopies.

(ii) The categories into which the data are classed can be represented by different symbols or coloured circles. For black and white reproduction in reports, symbols are more useful. A separate map is made for each variable to be represented and for each survey village, the symbol for the corresponding data category or class is marked on the map. Figure 10, taken from a similar study in Ecuador, South America, illustrates the use of such a map to show variations in space in the cultivation of different types of cassava varieties.

● Fast yielding cassava varieties
◉ Annual cassava varieties
● Varieties of minor importance
— Asphalt roads

Figure 10: An example of mapped survey data; cassava varietal use in Manabí, Ecuador.

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