UNIVERSITY OF EDINBURGH
AGRICULTURAL SURVEY, ZAMBIA, 1996

Kafinda Game Management Area, Serenje District,
24 July - 16 August, 1996

Jeff Anderson, Angela Fraser, Alison Mole & Lee Shields

University Of Edinburgh, 1997

PREFACE

This document forms the final report of *the University of Edinburgh Agricultural Survey, Zambia, 1996*, an expedition undertaken by four undergraduates during the summer vacation. The expedition was formerly known as *University of Edinburgh Kasanka Fire Impact Study, 1996*, which aimed to examine the impact of fire on the miombo woodland of Kasanka National Park. However, due to the discovery of research of a very similar nature previously conducted at Kasanka National Park (Martin, 1994), it was decided that the study would instead focus on the local agriculture in the Kafinda Game Management Area (KGMA) adjacent to the Park. The area of research follows on closely from that undertaken by the UoE Kasanka Land and Resource Use Survey 1995 (Frater et al 1996).

Correspondence regarding the expedition should be addressed to:

Jeff Anderson
108 Clerwood Park
Edinburgh
EH12 8PS
UK

SUMMARY

The traditional form of agriculture in the miombo woodland areas of Northern Zambia has been a form of shifting cultivation known as *chitemene*, in which finger millet is grown as the staple crop. Carrying capacities of *chitemene* systems are typically very low, and population growth has meant that they have been exceeded in many areas. The University of Edinburgh Agricultural Survey conducted an investigation into local agricultural practises and diet in the Kafinda Game Management Area, Serenje District. Here, population densites have greatly exceeded estimated carrying capacities of the *chitemene* system, and as a result, local agriculture has undergone significant changes. *Chitemene* is still practised to some extent, but finger millet is no longer the staple crop. Other crops such as sorghum, cassava and maize have assumed equal importance. These crops are grown using the *fundikila* cultivation system, which allows more permanent cropping of fields, thus requiring less area of land per person. Until recently, the cultivation of hybrid maize with purchased inorganic fertiliser had provided a high-yielding alternative to *chitemene* and *fundikila*, but changes in government policy have meant that it is no longer economic for small-scale farmers to cultivate hybrid maize. Therefore, the more traditional crops grown in the less intensive *chitemene* and *fundikila* sytems will continue to provide the majority of the local people's staple food requirements. However, the ability of these systems to sustain yields under decreasing fallow periods is uncertain, thus the pressure for new land to be cleared and brought under cultivation is likely to remain high.

INTRODUCTION

TRADITIONAL AGRICULTURE IN SERENJE DISTRICT

The soils of miombo woodland, the dominant vegetation in Zambia, are in general inherently infertile and not well suited to permanent cultivation (Chidumayo, 1996). Thus, traditional cultivation systems rely on natural fallow after a period of cultivation as a mechanism for regenerating soil fertility. The traditional form of agriculture in miombo areas of Northern Zambia (Luapula, Northern and northern parts of Central Province) is a form of shifting cultivation known as *chitemene*. In *chitemene* cultivation, the staple crop of finger millet is grown in an ash garden made from the burning of a pile of branches. The branches are obtained by the cutting of trees from an area several times larger than the ash garden.

The Lala people, the chief inhabitants of the Serenje plateau, have traditionally practised a form of *chitemene*, which Trapnell (1953) classified as the Southern, or small-circle *chitemene* system. Peters (1950), in his study of land use in the Serenje District, described the system as follows:

> "A large area of woodland ... is cut each year, the trees being cut at breast height though a few may be lopped. Branch-wood from the trees is stacked in circles ... these are burned to make a seed bed on which the millet seed is broadcast in December. No cultivation is necessary and the crop is harvested from April to June ... The *chitemene* areas are used for one year only and are then rested - in theory until the woodland is fully regenerated ... The diet is supplemented by a variety of crops grown in very small, but more varied and developed, subsidiary gardens which are hoe-cultivated."

PRESSURE ON TRADITIONAL AGRICULTURE

The carrying capacity of shifting cultivation systems is generally very low. Estimates ranging from 1.5 persons per square kilometre (Peters, 1950) to 5.6 persons per square km (Schultz, 1976) have been given for southern *chitemene* system. Due to population growth, the carrying capacity of *chitemene* has been exceeded in many areas. As early as 1953, Trapnell gave warning of the threat of deforestation on the Serenje plateau due to the high rate of woodland consumption brought about by the southern *chitemene* system (Trapnell, 1953). Peters (1950) attributed this to the general over population of the whole plateau area. Peters described the southern *chitemene* system as being "already in an advanced state of degradation" and to be "rapidly causing the deterioration of the natural resources of the land on which the system is based" due to the general shortening of woodland fallow periods.

METHODS

SELECTION OF STUDY HOUSEHOLDS

The field work was conducted over a period of three weeks from late July to mid August 1996. Due to the limitations of the short time period and lack of motorised transport, the study concentrated on eight family homesteads situated on or near the track linking Chantete NPWS scout camp with the Mansa Road. The homesteads were all relatively new, ranging from 2-7 years old, with an average age of about 5 years. Family sizes ranged from 5 to 15, with an average size of about 9.

TRANSLATION

One female interpreter was employed for the duration of the field-work, who was familiar with the local community and agricultural practices, and had experience of interpreting for research purposes, having acted as interpreter for the UoE Kasanka Land and Resource Use Survey (Frater et al, 1995).

HOUSEHOLD SEMI-STRUCTURED INTERVIEWS

These consisted of a list of pre-prepared questions to obtain general information on the family, crops grown, livestock kept, crops and livestock or animal products bought, sold or exchanged and diet at each household (see Appendix 1). The list of questions were not intended to be adhered to rigidly, but to be flexible to allow discussion on important issues that arose during the interviews. The interviews were generally held with the adult females of the household, as the men were frequently working elsewhere or attending a local beer-drink. It became apparent, however, that the women were more able to answer many of the questions, particularly those relating to food consumption and the buying and selling of crops and foodstuffs.

GUIDED WALKS AND FIELD MEASUREMENT

Guided walks through the fields were used to obtain information on the agricultural practices at each household. The areas of selected fields were calculated by measuring the length of each field edge and taking a compass bearing at each corner, and subsequently plotting the field on squared paper. This was a very time consuming process due to the often eccentrically-shaped fields, so only a limited number of fields could be measured, concentrating on sorghum, millet and maize fields. Where fields were not measured, the owner's estimate was used.

RESULTS AND DISCUSSION

CROPS GROWN

All the households visited grew cassava, sweet potato and sorghum and the majority grew finger millet and groundnuts. Other crops were maize (both hybrid and local), grown at six farms, pumpkins, grown at three farms, and sugar cane and beans which were grown at one farm. Apart from pumpkins, vegetables were not grown by any of the households. Lack of water and lack of seeds were the reasons cited for this. All households had mango trees, five had banana trees, four had orange and guava trees, and one had a pawpaw trees. Most of these, except the banana trees, were not old enough to bear fruit.

METHODS OF CULTIVATION

Typical crop rotations found in this study begin with the clearing of an area of woodland, and the piling and burning of the cleared wood in circles or strips. Finger millet, often intercropped with pumpkins, is grown in the ashes, while the remaining cleared area may either be left unplanted, as in the traditional *chitemene* system, or may be planted with other crops using the *fundikila* sytem. The latter case, in which *fundikila* is used for growing crops in the area not planted to finger millet, was found to be much more common than the traditional *chitemene* system, in which only finger millet is planted. The cleared area may be cultivated for a number of years using the *fundikila* system, with crops such as sorghum, maize, groundnuts or beans being grown on their own or intercropped with cassava, which takes three years to mature. After several years of cultivation, the fields are generally left for a short fallow period. The average period of cultivation (actual or intended future) was found to be about six years and the average period of fallow about two years.

YIELD RATES

Finger Millet

A yield rate of 40.5 x 90 kg bags ha^{-1} was found for the one traditional *chitemene* system encountered. In most cases, the combination of finger millet harvests from both *chitmene* and *fundikila* fields made it impossible to calculate a yield rate seperately for the two cultivation sytems. In the one case where a calculation could be made for *fundikila* finger millet, a yield rate of 15.5 x 90 kg bags ha^{-1} was found.

The Early Warning Unit (EWU) of the Zambian Ministry of Agriculture, Food and Fisheries produce figures at various times throughout the year for predicted yield of the main crops by district. The EWU Serenje District yield rate was 9 x 90 kg ha^{-1} with a

population increase in the district. Numbers of children in each household ranged from zero to nine, with an average of about four.

LENGTH OF STAY

Peters (1950) found that the average length of stay on one site was 5.5 years and the main reason for moving on was lack of regenerated trees for new *chitemene* cultivation (other reasons included water shortage, erosion and poor soil). In this study, the average length of stay at the present location was about five years to the present date and average length at the previous location was about eight years. Reasons for leaving the last location included poor soil fertility, change of job location, and leaving parents' farms to start their own. When questioned about their intended length of stay, 'forever' or 'indefinite' was the response given by all eight households.

HOUSEHOLD DIETS

It was established that, on average, three meals per day are consumed. Two of these meals invariably consist of *nshima* (a local staple composed of maize, millet, cassava or sorghum meal, which is boiled to a glutinous consistency) accompanied by a vegetable or meat relish. Breakfasts consisted of sweet potatoes, either alone or with groundnuts, sorghum porridge, or *sampo* (pounded and boiled maize) with groundnuts. The most commonly eaten lunch and evening meal relish was dried fish (usually Kapenta - *Limnothrissa & Stolothrissa*). Sweet potato leaves, cassava leaves, pumpkin leaves and chicken were also eaten relatively frequently.

The data on estimation of average consumption of fish, pork and chicken in a month are compared with those obtained by extrapolation of the week of diet observation (see table 1).

Table 1. Average consumption of fish, pork and chicken in a month

Food	No. times reported month^{-1}.	No. times predicted (from 1 week study) month^{-1}.
Fish	8	7
Chicken	3	4
Pork	3	2

It can be seen that these two sources show close agreement. The mean number of times fish is predicted to be consumed (extrapolating from one diet study week in eight villages) is 7. Overall, the villages suggested they ate fish eight times per month (mean of eight villages). Similarly villages reported consumption of chicken and pork three times per month and extrapolation of one week's diet suggested chicken was eaten four times per month and pork twice per month.

Measurements of quantities of staple foods (as well as groundnuts) eaten were used to establish an estimated mean weight eaten per person per day (see table 2). Consistent

Table 2. Estimated mean weight eaten (g person^{-1} day^{-1}).

	Food type				
	Finger millet meal	Sorghum meal	Cassava meal	Maize meal	Ground nuts
Mean weight (g person^{-1} day^{-1})	625	655	603	496	192

It can be seen that the lowest mean staple weight eaten per person per day was maize meal. The staple values are all close to the value predicted by Peters (1950), who suggested average daily consumption was about 1.4 lb. person $^{-1}$ day $^{-1}$.

Villagers were asked to comment on the availability of certain foods throughout the year. Most of the eight villages were able to eat maize, millet and cassava throughout the year (although two reported shortages between March and May). Consumption patterns of sorghum were seen to be concentrated between June/ July - October / December (although two villages said they were able to eat sorghum all year round). Groundnuts were eaten all year round at seven villages, while the eighth reported shortage between January and March.

A variety of fruit trees are grown at the study villages. All had mango trees but only in one village had they been established for long enough to bear fruit. Five villages had banana trees (all were of fruit bearing age) and guava were grown at four villages. Four villages had orange trees and on had papaw trees. None of the orange, guava or papaw trees were old enough to bear fruit. Within five years the trees can all be expected to start producing fruit which will provide further variation in the diet, as well as nutritional value.

The principle staples in Zambia are carbohydrate foods. Kaite (1990) found that "maize is the most widely grown staple crop (76-100% of all households) followed by millet (50-90%), cassava (19-67%) and sorghum (24-50%) in the area served by Chitambo Mission Hospital (close to the study area). This survey covered far fewer villages than Kaite but all eight were found to grow millet, sorghum and cassava while only six grew maize. These staples comprise a large part of the diet and thus their nutritional quality is of importance in maintaining health. Millet and maize do not contain enough high quality protein (both approx. 8%) to meet the needs of a young child or pregnant woman. Highly milled grains are less nutritious than lightly milled (FAO, 1966) due to removal of husks which contain most of the B vitamins, although all the households surveyed ate home pounded cereals. Sorghum can be used as the main source of protein without ill effect (FAO, 1966) due to its high level of quality protein (approx. 10%). Cassava meal is a poor source of protein (approx. 0.7%). The relish eaten with *nshima* can be an important source of nutrients, for example cassava leaves contain much iron and Vitamin B, dried Kapenta fish contain much calcium, protein and iron, and groundnuts can be an important source of protein of better quality than cereals, as well as minerals, B vitamins and fat (NFNC, 1987).

THE ROLE OF HYBRID MAIZE IN LOCAL AGRICULTURE

Maize and government policy

Since independence, government policy in Zambia has aimed at increasing national maize production in order to meet a growing demand urban demand for maize meal. Maize meal is the preferred ingredient for making *nshima*, the staple foodstuff for the majority of Zambians, both urban and rural. In Northern Zambia, maize production by small-scale farmers has been officially encouraged through the provision of subsidised high-yielding hybrid maize varieties and inorganic fertiliser. In addition, credit schemes for purchasing fertiliser have been implemented together with pricing systems which guaranteed maize prices, often above free-market levels. The result has been that maize has replaced other crops such as millet, sorghum and cassava as the staple food for small-scale farming families.

Since the beginning of the 1990s, however, Zambia's Structural Adjustment Programme (SAP) has aimed for the liberalisation of agricultural marketing and input supply. In line with the SAP, subsidies on seed and fertiliser were removed in 1990, and the maize price support system was ended. Agricultural credit schemes financed by the government continued to provide fertiliser through different types of institutions, such as co-operatives, parastatal organisations, non-governmental organisations (NGOs), and private firms. The history of agricultural credit schemes for small-scale farmers has been characterised by very poor loan recovery rates, typically less than 20%. This has amounted to 'free fertiliser' for those farmers who defaulted on loan repayments.

In 1996, the Inventory Credit Scheme was introduced, which allows farmers or traders to store their maize in a warehouse, and use this as collateral against a loan amounting to 70% of the value of the maize in store. The price increase of maize as the season progresses is supposed to allow the farmer to pay the interest on the loan, warehouse storage charges, and still allow a useful profit. Farmers who have defaulted in previous credit schemes will be prevented from participating in this and any future schemes.

Hybrid maize and small-scale farmers in Kafinda

In Kafinda, where the present study was located, finger millet, and to a lesser extent sorghum, cassava, and local varieties of maize have traditionally been the staple foods. Recent studies in Kafinda have found that hybrid maize has been replacing these crops as the staple food (Birchenough, 1993; Hinchcliffe, 1993; Frater et al, 1996). All eight of the households in this study had grown hybrid maize at least once in the previous two years. However, only two households planned to plant maize in the coming planting season, the others citing lack of fertiliser as the reason for not planting.

In previous years, agents from credit agencies such as Lima Bank and Credit Union and Savings Association (CUSA) had visited households in the study area, supplying fertiliser which would be paid for with maize in the following year. Many of the households in the study have defaulted on the repayments, blaming high interest rates and poor yields. As a result of the low loan-recovery rates throughout the country, the

all the crop may be kept for household consumption. Yield rates for finger millet of 9 bags ha^{-1} are suggested for the Serenje District by the EWU, although this includes the *chitemene* cultivation system, which is gives higher yields but requires more labour than the *fundikila* system, which has a similar labour requirement as maize production. Yield rates ranging from 2.4 bags ha^{-1} to 15.5 bags ha^{-1} of finger millet produced exclusively by the *fundikila* system were found by this study. Although it is difficult to estimate a typical *fundikila* finger millet yield rate from these values, they give an indication that finger millet production may well be more economical than maize production. The same appears to be true for sorghum, with a yield rate of 27 bags ha^{-1} suggested for Serenje District by the EWU, with this study finding rates ranging from 3.5 bags ha^{-1} to 12.7 x 90kg bags ha^{-1}. All sorghum found in this study was produced using the *fundikila* system. Other alternative crops such as cassava and local varieties of maize may also prove more economical when compared with hybrid maize.

Table 1. The economics of hybrid maize production for a small-scale farmer in Kafinda.

INPUTS PER HA	**UNIT**	**PRICE/UNIT**	**QUANTITY**	**TOTAL**
SEEDS	kg	1,460	17	24,812
FERTILISER				
Compound D	kg	480	200	96,004
Urea	kg	480	200	96,004
LABOUR	man-days	0	130	0
PACKING	bags	0	30	0
TRANSPORT				
In	bags	210	30	6,300
Out	bags	1,575	30	47,250
VARIABLE COSTS PER HA				270,369
TOTAL COST OF PRODUCTION PER HA INCLUDING 10% INTEREST				297,406
YIELD PER HA IN 90KG BAGS				30
PRICE PER 90KG BAG				10,886
OUTPUT PER HA				326,565
NET MARGIN PER HA				29,159

NOTES:
All prices in Zambian Kwacha; approx. exchange rate in July 1996: £1 = K1,900.
Based on figures supplied by ZNFU, with the following alterations:
1. Production level reduced from 40 to 30 x 90kg bags for hand-cultivation;
2. Price per bag reduced from K12,500 (Lusaka price) to 10,900 (Kabwe price);
3. Labour requirement increased from 70 to 130 man-days for hand cultivation;
4. No oxen or repairs and maintenence costs;
5. No deposit on implements;
6. Cost of seeds, fertiliser, and transport of bags increased by 5% for Serenje District;
7. Zero labour cost for labour supplied by household members.

REFERENCES

Birchenough, L. (1993) *The Impact of Natural Resource Utilisation on Miombo Woodland in Zambia.* MSc Diss. University College London, London, UK

Chidumayo, E.N. (1996). *Handbook of Miombo Ecology and Management.* Stockholm, Sweden.

FAO (1966). *Nutrition in Eastern Africa : A Manual for Teachers and Others.* Longmans, Nairobi.

Frater, J., Smith, J., Orsi, P., Rooley, R., Helyar, S. & Beedie, K. (1996). *Kasanka Land and Resource Use Survey.* University of Edinburgh, Edinburgh, UK.

Hinchcliffe, F. (1993). *The Park and The People : Community Based Conservation in the Absence of Large Mammals.* MSc Diss. University College London, UK

Kaite, C.D. (1990). *An Assessment of Some Social, Economic, Environmental and Agricultural Circumstances of Mothers of Malnourished Children Served By the Chitambo Nutrition Rehabilitation Centre*. National Food and Nutrition Commission, Lusaka.

Martin, S.C. (1994). *The Effect of Fire on the Natural Regeneration of Miombo Woodland, Kasanka National Park, Zambia.* MSc Diss. Manchester Metropolitan University, Manchester, UK.

Matthews, R.B., Holden, S.T., Volk, J. & Lunyu, S. (1992). The Potential of Alley Cropping in Improvement of Cultivation Systems in the High Rainfall Areas of Zambia 1- Chitemene and Fundikila. *Agroforestry Systems* 17 (3), 219-240.

NFNC (1987). *Food Composition Tables for Use in Zambia.* National Food and Nutrition Commission, Lusaka.

NFNC (1990). *Report on Minimum Monthly Food Requirements for an Average Zambian Family*. National Food and Nutrition Commission, Lusaka.

NFNC (1990). *The Nutritional Impact of Agricultural Change in the IRDP Serenje, Mpika and Chinsali Districts.* IRDP Occ. paper No.14. National Food and Nutrition Commission, Lusaka.

Peters, D.U. (1950). *Land Usage in Serenje District.* Rhodes-Livingstone Papers No. 19.

Reh, E. (1962). *Manual on Household Food Consumption Surveys*, FAO, Rome.

Schultz, J. (1976). *Land Usage in Zambia : Part 1 The Basically Traditional Land Use Systems and their Regions.* Welsforum Verlay.

Trapnell, C.G. (1953). *The Soils, Vegetation and Agriculture of North-Eastern Rhodesia.* Government Printer, Lusaka, Zambia.

20. Are there any other crops grown in the area that you know of, if so which ones?

21. Which crops would you like to grow other than those you grew this year?

22. Why don't you grow any of these crops?

23. What crops have you sold this year?

24. What quantity, where, when and at what price did you sell?

25. If you could sell more, which crops would you most like to sell more of?

26. Why would you like to sell more of these?

27. What crops have you bought this year?

28. What quantity, where, when and at what price did you buy these?

29. If you could buy more, which crops would you most like to buy more of?

30. Why would you like to buy more of these?

-Vegetables

31. Which vegetables did you grow this year?

32. Did you grow any other vegetables last year, if so which ones?

33. Have you ever grown any other vegetables in the past, if so which ones?

34. Are there any other vegetables grown in the area that you know of, if so which ones?

35. which vegetables would you like to grow other than those you grew this year?

36. Why don't you grow any of these?

37. Did you sell any vegetables this year?

38. Which vegetables have you bought in the last month?

39. If you could buy more vegetables which ones would you most like to buy more of?

40. Why would you like to buy more of these?

APPENDIX 2: DIARY

Date	Activity
11 July	Arrive Lusaka
15 July	Meet Mr Wixted, Kasanka Trust Ltd
18 July	Meet Prof. Chidumayo, Dept. of Biology, University of Zambia
19 July	Meet Mr Mwima, Chief Wildlife Research Officer, NPWS
20 July	Depart Lusaka; arrive Wasa, Kasanka National Park
24 July	Arrive Chantete
25 July	Meet Chief Citambo IV
26 July - 15 August	Fieldwork
16 August	Depart Chantete; arrive Wasa
19 August	Depart Wasa; arrive Lusaka
20 August - 24 August	Meet reperesentatives of TAZARA Corridor Agricultural Development Project, Zambian National Farmers Union, Ministry of Agricluture Food & Fisheries, University of Zambia
25 August - 29 August	Write-up of preliminary report
30 August - 9 September	Individual Travel
12 September	Depart Lusaka

APPENDIX 4: ACKNOWLEDGEMENTS

Above all, we are indebted to Tadg Wixtead of the Kasanka Trust Ltd, for providing transport to Kasanka, for the loan of a laptop computer and for generally bending over backwards to ensure our project was successful. Thanks also to Cliff Bishop for driving services and for being a wealth of information on the flora, fauna and many other aspects of Zambia.

At Kasanka, our stay at Wasa camp was made exceedingly pleasant by the incredible hospitality of David Lloyd. Thanks to Chief Chitambo IV for welcoming us to the Kafinda area and for his enthusiasm for our project. We are also grateful to Tim Ashworth for providing transport into Serenje. Special thanks to all the households near Chantete who gave their time, and sometimes their food, freely in order to help us with our study and make us feel welcome.

For the initial inspiration and encouragement to come to Kasanka we must thank all the members of UoE Kasanka Land and Resource Use Survey 1995.

Thanks must also be given to the following people for their general assistance-

-In UK :
Chris Minty, UoE Expeditions Society 'Exped'
Dr. Graham Russell, IERM, UoE
Dr. Colin Legg, IERM, UoE
Dr. Douglas Malcom, IERM, UoE.

-In Zambia :
Professor E.N. Chidumayo, Department of Biology, UNZA
Penroy Morris, TAZARA Corridor Agricultural Development Project
Andrew Fletcher, Agricultural Commodity Exchange
Alex Mwanakasele, Economist, ZNFU
Anthony Beluma, Economics Section, MAFF
Henry Mwima, Chief Wildlife Research Officer, NPWS
Mr. Fryers, British Council, Lusaka
Dr. Catherine Chatham, formerly of the British Council, Lusaka
Beauty, our translator
Stephen, our camp assistant

The study was made possible by financial support from the following bodies:

UoE Development Trust
UoE Weir Fund for field studies
UoE James Rennie Bequest
UoE Centenary Fund
Royal Geographical Society (Tate & Lyle Fund)
Albert Reckitt Memorial Trust