THE ADOPTION OF SORGHUM AS A DROUGHT RESISTANT CROP BY PEASANT FARMERS IN MUKONCHI AREA, KABWE.

BY

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PROJECT TITLE: THE ADOPTION OF SORGHUM AS A DROUGHT RESISTANT CROP BY PEASANT FARMERS IN MUKONCHI AREA, KABWE.

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DEDICATION

To my father, without whom nothing would have been possible for me. May His Soul Rest in Peace. To my mother, sisters and brothers who have sacrificed a lot for my sake

I would most especially like to thank Mr. T. C. Chanda and the family who have encouraged and inspired me in life. It is through their care, love and guidance that has made me what I am and, what I may be.

To all of you I say thank you, and God bless you all.

DECLARATION

I **LINDA KASALU** hereby do declare that this research project report has not been submitted for an academic award before in any form or part thereof.

All maps were drawn by me, and all quotations used have duly. been acknowledged by references in the text and in the Bibliography at the end of the report.

Signature ..Kasalu..... Date ..1/10/96.....

ACKNOWLEDGEMENTS

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ABSTRACT

This study attempts to find out the adoption of sorghum as a drought resistant crop by peasant farmers in Mukonchi, Kabwe rural, Central Province, Zambia. The study seeks to assess the extent to which peasant farmers have adopted sorghum due to the frequent droughts being experienced in the area. The research also hopes to assess the extent to which the agricultural extension services have contributed to the adoption of sorghum. This is as a result of the frequent droughts being experienced and yet farmers continue to grow maize instead of drought resistant crops.

The methods used to collect data were by us of a questionnaire and review of secondary sources. The collection of primary data was through direct interviews of the questionnaire to a sample of farmers who were randomly selected. The secondary information was obtained from; researchers in Kabwe, Mutwe-wa-nsofu and Mukonchi research stations. Information on rainfall and temperature pattern of the area was provided, by Lusaka meteorological station while the initial information on the subject was collected from the University of Zambia main library and mount makulu.

Tables, charts and graphs are used to present the data collected. Analysis of data was done manually and it relies on percentages and the chi-square.

The research findings indicate that there is a good number of farmers who have adopted the growing of drought resistant crops and that most of them grow millet as opposed to sorghum. The findings also show that agricultural extension services have contributed to the adoption of sorghum as a drought resistant crop in Mukonchi area.

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CHAPTER ONE

1.0 INTRODUCTION

Sorghum was the indigenous staple food in much of Africa and Zambia in particular before maize was introduced by the portuguese in the 17th Century. However, sorghum nowadays does not remain the indigenous staple food, but the staple cereals of many African countries. Unlike in the past, sorghum is now grown on a small scale as compared to maize (productive farming magazine, 1991, 31).

Mukonchi area experienced one of the worst droughts in its recorded history in the 1991/92 farming season.The drought condition caused serious effects on crop production for instance, crop production of maize, sunflower and cotton in the area was reduced by 57 per cent in 1990/91 farming season.

Therefore, within such prevailing drought conditions in Mukonchi area, sorghum can become of importance. The government through the agricultural extension services are trying to encourage farmers to grow these drought resistant crops. For instance, in Zambia agricultural extension services in Misamfu regional research centre, Golden Valley, Chisamba and Mt. Makulu Research Station, Chilanga, just to mention a few, do encourage the adoption of sorghum. Another example is were the results of the farming systems research programme in Western and Eastern provinces showed that sorghum,especially local main crop sorghum featured more in the trial programme (ZGA, 1973:30). Such results of the programme forced extension workers to encourage farmers to grow sorghum.

1.1 STATEMENT OF THE PROBLEM

The people in Mukonchi area continue to grow maize which cannot do well during drought years, which are becoming more frequent in the area. As a result, the people of Mukonchi area like in other drought stricken areas of the country are generally faced with food insecurity due to poor harvests of maize when these droughts occur.

1.2 GENERAL OBJECTIVES

-The overall objective of this study is to find out if farmers have adopted the growing of sorghum as a drought resistant crop in Mukonchi area.

1.2.1 SPECIFIC OBJECTIVES

There are two specific objectives of this study;

- To assess the extent to which the agricultural extension services have contributed to the adoption of sorghum as a drought resistant crop in Mukonchi area.

- To assess the extent to which peasant farmers in Mukonchi area have adopted sorghum as a drought resistant crop due to the frequent droughts being experienced in the area.

1.3 SIGNIFICANCE OF STUDY

Mukonchi area like the rest of the country has experienced severe droughts in the agricultural seasons 1990/91 and 1991/92. As a result of these drought conditions there has been farming systems research programmes designed to encourage farmers grow drought resistant crops in the area.

It is thus against this background and through this research that the adoption of sorghum as a drought resistant crop needs to be assessed as to whether it has been or not been adopted by farmers in Mukonchi area from agricultural research workers or not. The findings of this study will be useful in designing extension messages and extension systems for enhancing the adoption of drought resistant crops, particularly sorghum by the local farmers in drought prone areas of the country. For instance, the extension system can help small-scales farmers to grow drought resistant crop so as to have a variety of crops for food security. This can be done at a large scale than they are doing now. Secondly, the agricultural policy can try to consider emphasising or recognisation and incorporating of the major indigenous practices of growing sorghum and other crops. Before Europeans came, Africans were practising agriculture, among which sorghum growing was advanced. These indigenous systems among other things did emphasise crop diversification, therefore local people grew a number of cereals in the fields.

1.4 ORGANISATION OF STUDY

This study has six chapters. Chapter one looks at the introduction, statement of the problem, study objectives and the importance of the study. Chapter two is based on literature review where the cultivation of sorghum in Zambia, the characteristics of sorghum farming and adoption in Zambia and the extension service evaluation are discussed.

Chapter three looks at the location and description of the study are. Under this chapter, soils, rainfall, temperature, geology and vegetation of the area are discussed. The farming system and the development of the area (i.e. feeder roads, health services etc) are also discussed under this chapter.

Chapter five reviews the research findings through data analysis and data presentation.

The last chapter gives a conclusion and outlines some recommendations made in the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 SORGHUM: A DROUGHT RESISTANT CROP

Sorghum is one of the most important cereal crops of the hotter and drier regions of the tropics and subtropics. In areas with uncertain and erratic rainfall, sorghum is a preferred crop. Its water requirements are 2/3 of that needed for maize. It out yields maize on poor soils and under low input conditions (Verma, 1987).

Sorghum grain is as nutritious as maize for food and feed. It is a superior grain for brewing because of its good malting capacity. Certain sorghum varieties remain green after harvest of the mature grain so the stover can be used for feeding cattle. Special storage sorghums are used for silage production and grazing (MAPP, 1992).

In Zambia, sorghum has few disease and insect pest problems. Birds are the main concern. Certain varieties of sorghum, if left unattended in the yield, can be attacked and substantially damaged at the soft-dough stage. However, as grain hardens it is not attacked by birds (MAFF, 1992).

Sorghum is largely a self-pollinated crop. Both pureline varieties and commercial highbrids are now available in Zambia. Hybrids give higher and more stable yields across seasons, locations and management levels, as they are capable of facing adverse growing conditions better than pure-line varieties (MAFF, 1992)).

Traditional varieties of sorghum require a long growing season, have low yield potential, and are tall and nonresponsive to improved management. Improved sorghums, however, are high yielding, input responsive, and far more resistant to drought (MAFF, 1992).

2.2 STATUS OF SORGHUM PRODUCTION

In view of the Government's increased realization of the importance of agriculture in recent years and in its efforts to diversifying Zambian agriculture, sorghum has once again assumed importance among cereal crops. In the past there were several factors which were working against these traditional crops. Heavy subsidy on maize, increased commercialization, unfavourable producer price and absence of a research and extension support were some of the factors which suppressed sorghum production and encouraged maize even in unfavourable agro-ecological zones of the country. However, people in less accessible areas continued to produce and use their traditional sorghum (Nath, 1986).
Very often sorghum is grown as a mixed crop, in small patches around anthills and in housing areas due to which statistics on production and areas are seldom reliable. However, according to the last available reports sorghum area, production and per hectare yield in Zambia in 1985 were 24, 811 ha, 20,226 metric tones and 810kg/ha, respectively. These figures showed an increase of 49.7 percent in area and 61.6 per cent in production over 1983. The largest hectarage of sorghum was in the southern province followed by copperbelt and Lusaka provinces (Nath, 1986).

Sorghum is an important cereal crop of Zambia, especially for small scale farming sector. The crop is largely grown for subsistence, but the potential for commercial market is great, especially in brewing; feed stock and in composite scope of sorghum for use in silage production and for feeding cattle on green and dry storage during the lean period of over six months (Nath Bhola, 1990).

In Zambia, as elsewhere in Africa, there is more emphasis on the production of cash crops for export than on food crops. The agricultural food production in Zambia show that traditional crops like cassava, sorghum and the millets are not promoted commercially and there is no supportive marketing, storage and other infrastructure. Thus the policies of the post-colonial state have a great bearing on the lack of diversity in what foods are grown, marketed and consumed, and such a state of affairs contributes to lack of food security and the food crisis as the country depends on one major cereal, maize and this hybrid cereal is more susceptible to drought (Kajoba, 1993:9).

There should therefore be the diversification of food crops to be grown in order to reduce the present dependency on maize cultivation which is undertaken at the expense of sorghum, the millers and the root crop cassava. For instance, it should be noted that in Zambia, the indigenous cultivation systems upon which sorghum is based, are largely rival and can also be a basis for modernisation and commercialisation of agricultural production into the peasant sector. In Zambia the planted area under sorghum is substantial as table A shows. However, the hectarage reduced from 1985-1986 to 1987-1989 season. Production

was also impressive and compares favourably with other crops like millet, although more sorghum was produced in the 1985-86 and 1988-89 seasons. However, sorghum production which registered a big increase of 122 per cent in the 1985-86 season declined substantially in the 1987-88 season, picking up again in the 1988-89 season (Kajoba, 1993:43).

According to the GRZ 1989 official crop estimates, 1984-1989, Table 1, showed that;

Table A:

SORGHUM: AREA PLANTED AND PRODUCTION IN ZAMBIA 1984-1989

YEAR	AREA(ha)	PRODUCTION(90kg bags)
1984/85	24,811	224,739
1985/86	59,550	499,950
1986/87	47,484	291,011
1987/88	47,448	253,041
1988/89	51,416	407,631

SOURCE: GRZ, 1989

Sorghum production for the 1988-89 season was quite substantial in all the provinces in Zambia with the exception of the Luapula and Northern provinces which are major millet producers.

Copperbelt was the leading producer of sorghum accounting for 32.9 per cent of national production. Although both the Southern and Eastern Provinces are major producers of maize, they

accounted for 15.7 per cent and 13.4 percent respectively of national production. The north western province produced the second highest amount of sorghum totaling 67,718 bags equivalent to 16.6 per cent of national production. Central province, although one of the least producer of sorghum accounted for 5.7 percent this scenario in central province could be as a result of lack of proper adoption process by extension workers and negative attitude of the farmers toward the adoption of sorghum.

From Table A, the area planted for sorghum has been increasing tremendously and so has been the production.

TABLE B:

SORGHUM PRODUCTION PER PROVINCE 1988/89

PROVINCE	PRODUCTION (90kg bags
Central	23,164
Copperbelt	134,160
Eastern	54,765
Luapula	7,635
Lusaka	17,717
Northern	3,498
N. Western	67,718
Southern	64,019
Western	34,955
Zambia	407,631

SOURCE: Kajoba, 1993.

It can therefore be said that the bulk of sorghum in Zambia is grown by resource poor small-scale farmers mainly for their subsistence. With the new developments in agriculture(i.e.

crops, technology etc) and the area of this traditional crop have declined in the past-decade mainly because of the lack of industrial utilization and technological developments. However, the crop production has increased in some areas of Zambia like the Copperbelt, Eastern and Western Provinces in recent years.

2.3 THE MARKET FOR SORGHUM IN ZAMBIA.

A very small percent of sorghum is marketed in the country. As a result large quantities of maize are used by chibuku breweries for brewing and by the millers as live stock feed. It is hoped that as the production of sorghum increases in the country, it will replace maize in brewing and in animal feed. Sorghum is more suitable for brewing than maize as it can produce a required malt which is presently being imported in the country.

TABLE C: SORGHUM SALES PER PROVINCE 1988/89

PROVINCE	SALES (90kg bags)	as % of National Sales
Central	5,182	4.0
Copperbelt	103,711	79.4
Eastern	589	0.5
Luapula	30	0.02
Lusaka	4,235	3.2
Northern	376	0.3
N. Western	131	0.1
Southern	14,476	11.0
Western	1,813	1.4
Zambia	130,543	

SOURCE: Kajoba, 1993.

Sales for sorghum have tended to be better than other cereal crops like millet probably due to the fact that the cereal is used for the partial commercial production of an opaque beer by the National Breweries popularly known as Chibuku and is substitute for maize required for the staple nshima in the country, and especially in the urban areas.

Copperbelt sold most of the sorghum which accounted for 77.3%. Poor sales were recorded for the Luapula (0.4%), Eastern (1.1%); and western (5.2%) provinces, suggesting that no adequate official marketing infrastructure exists for the cereal. However, provinces such as central, Lusaka and Southern had a considerable good sale which suggests a good market for the cereal.

According to prior et al (1982:44), he suggests that it could be offered as a useful suggestion that hammer meals for sorghum should be introduced as is the case with maize, in order to reduce the drudgery of women's labour required in pounding the grain. Such appropriate technology would enlarge expansion in production. In addition, the government and other organisations such as NGOs' should promote the milling of "breakfast packages" for while sorghum mealie meal for Nshima in order to create a bigger market for the cereal apart from the requirements for brewing chibuku beer and broaden the food base in addition to maize meal, to contribute to regional and national self-sufficiency and food security especially at the level of the household. Such a step would also contribute to improved nutrition since sorghum is richer in both proteins and calories than maize (Kajoba, 1993:46).

There is a substantial subsidy by the Government on maize, due to which maize works out to be cheaper for brewers and millers than sorghum which is supposed to replace maize for brewing and feed stock. As a result the industries are reluctant to buy sorghum from the cooperative unions which in turn do not want to buy from farmers despite the official price. The Government is, however, aware of this problem and it is hoped that this bottleneck may be over come in due course (Nath, 1986).

In order to promote sorghum for food as Nshima, the research have encouraged IDRC regional office at Nairobi to assist Zambia by providing dehulling technology on the lines similar to Botswana (Nath, 1986).

ICRISAT = International crops Research Institute for Semi-Arid topics

ASSP = Agriculture support sector programme

SIDA = Swedish International Development Agency

IDRC = International Development Research Center

EAAFRO = East African Agriculture and Forestry Organisation.

2.4 CLIMATIC AND SOIL REQUIREMENTS OF SORGHUM

2.4.1 AGRO-CLIMATIC REQUIREMENTS.

Sorghum is essentially a crop of the tropics but some new varieties can grow in temperate regions in the summer season provided temperatures are sufficiently high and the growing season is fairly long and free from forest. In the tropics it can be grown throughout the year but in temperate regions it can be grown only during summer season.

Sorghum perform best when average daily temperatures are from 24 to 26^{0}C. Although, this crop is capable of tolerating excessive heat better than maize, grain yield is often reduced if temperatures exceed 38^{0}C especially during the heading stage. The growth of sorghum plants is reduced appreciably when temperature is less than 16^{0}C. The optimum growth of plants is recorded when temperatures are 27-30^{0}C (FAO 1980).

Sorghum suits areas receiving an average annual rainfall of about 350-400mm. Balasubramanian (1959) while studying crop/weather relationships, analysed the effect of rainfall distribution on the yield of rained sorghum. His findings were:

i) about 25mm rain immediately after seeding helps in satisfactory germination.

ii) about 250mm rain during the growth period results in normal growth of the crop.

iii) rains should coincide with the critical stage of crop growth;

iv) heavy rainfall of 75 to 100mm in the flowering period is bad for the crop as it washes pollen or makes the stigma less receptive and intefers with the grain setting, and

v) about 25 to 50mm rainfall during maturation helps in better grain development.

Therefore, the rain requirements of sorghum is only about 375mm as compared to maize which has water requirement of about 480-800mm. In addition, the rainfall requirement of maize increases sharply if the temperature is higher than optimum for

crop growth.

Sorghum crop is able to grow in areas which are too dry and too hot for other crops especially maize. Therefore, it is sometimes called the 'camel' of the plant kingdom. Complete failure due to moisture scarcity are much less frequent in sorghum than other crops like maize. Arnon (1972) states that the drought resistance of sorghum is due to its extensive root system and profusion of rootless as well as to the morphological characteristics of its leaves and stalks which effectively reduce transpiration. The root system is about twice as active as that of maize in taking up water from the soil whereas the leaf area is considerably less (Martin, 1941).

Glover (1959) has opinioned that in contrast to plants like maize in which stomata do not recover after a severe drought, sorghum stomata resume their normal behaviour even after a severe drought lasting fourteen days. The recovery follows just after the restoration of turgidity to the leaves.

Furthermore, Slatyer (1955) reported that sorghum was not only able to absorb water more effectively than many other crops, but was also able to regulate water losses to the atmosphere better. With the onset of moisture stress, the crop shows the lowest rate of decrease in relative turgidity and the least divrnal depression as compared to other crops because it reduces its transpiration rate to a much greater extent than the other crops. On the contrary, the maize crop is specially sensitive to moisture stress during flowering when a short spell of stress can reduce the crop yield by 30-50 per cent. However, adequate moisture is needed for germination of maize, and after

germination the total rate of water use increases as the number of leaves increases. In most cases, it is essential to ensure a supply of 60-75mm of water per week during the active period of growth of maize.

On the other hand as compared to sorghum, maize in drier or drought regions increased intensity of radiation increases water-losses and thus yields tend to be negatively correlated with radiation (Pendleton et al, 1966).

2.4.2 SOIL REQUIREMENTS

Sorghum thrives well on different types of soils, but it performs best on deep, fertile sandy looms. Good yields are also possible on heavy but well drained soils. In fact, good fertility, drainage and optimum temperature are most important considerations in successful culture of sorghum. This crop can tolerate considerable quantities of alkali or salts. Under rained conditions it performs well in soils of high water retention capacity (FAO, 1980).

In comparison to sorghum, maize requires a deep loamy soil, high in organic matter and plant nutrients and with neutral pH is the best soils for maize. However, with proper management and fertilizer practices, can maize be grown successful on any soil from loamy sand to clay. The soil should also be free from salinity and water logging (FAO, 1980).

2.5 THE AGRICULTURAL EXTENSION SYSTEM

2.5.1 THE ROLE OF THE AGRICULTURAL WORKER

The role of an extension worker is to help farmers increase the productivity of their farms and improve their living standards. An extension worker has many roles, as an adviser, a technician and a middleman operating between agricultural research institutions and the farm families. He is a change agent helping farmers to identify their problems and find their own solutions. He works for the creation of community harmony essential for group projects. He is a manager, planning and organising his work and that of his assistants (M.F Admas, 1982).

Adams, further, states that the role of extension workers at village level or an area is that of an extension agent or contact man between the extension agency and the farmers, adviser and change agent.

Furthermore, Leonard (1977), state that the essential role of an agricultural extension field service is that of a linking mechanism. Its classic function has been to link agricultural research centres and farmers, transmitting new technologies to the farmers and current farming problems to the researchers.

2.5.2 THE AGRICULTURAL EXTENSION SYSTEM FOR SORGHUM IN ZAMBIA

According to the Department of Agriculture, (1996) the extension system in Zambia is educational and tries to reach farmers to change, that is a change in their attitude, knowledge and skills. For instance in many parts of the country, the farming systems Research have been and are still trying to

encourage farmers to grow drought resistant crops. Such a programme of trying to encourage farmers grow drought resistant crops (ie. sorghum, millet etc) has been initiated because of the prevailing droughts experienced in the country.

One way of carrying out their educational campaign, extension workers or farming systems Research programme have put up trial programmes in different areas. In one of the trial programmes in the Luangwa (Eastern Province) showed that sorghum, especially the local main crop sorghum, features prominently in the trial programme. One local brewing variety from western province, 'MASS I' proved very resistant not only to drought but also to bird attack in 1989 (ZGA, 1973:1).

Agronomic trials on local sorghum selections, which differ from commercial varieties such as WSV 189 in being planted in the early season as is local maize, have shown that early planting (mid-November), can give much higher yields than normal Yearly December) or late planting (ZGA, 1973:3).

2.5.3 THE EXTENSION PROGRAM EVALUATION

According to Vanzetti, extension evaluation is the assessment of the overall efforts of agricultural extension and research program on production levels and on the farmers' welfare to determine the degree to which their projects are reaching their economic, technical and social targets set for a given period of time (Vanzetti, 1973:13).

Such evaluations in Zambia have been done by the NGO's and the Ministry of Agriculture, food and fisheries.

RESEARCH ON SORGHUM

Research input on sorghum before the nighties was negligible. Some isolated and discontinued work on sorghum was done in the sixties by the cereal (maize) team-mainly in the form of introduction from neighbouring countries and EAAFRO. The red grain variety, Framida of south African origin was reported to perform well. However, the variety was not produced and marketed. Therefore, it was not widely grown (Anonymous, 1985).

From the late seventies ICRISAT started sending us sorghum trials to Zambia which was coordinated by Dr. K.N. Rao, the maize pathologist. The performance of this variety demonstrated potential of sorghum in Zambia. This coupled with the past few years of drought alarmed the government and farmers who realized the need to reduce their dependence on maize. As a result a research programme on sorghum was proposed by the government. This programme is a part as the Agriculture support sector programme (ASSP) funded by SIDA. The project has two SIDA sponsored staff (a Breeder and an Agronomist) who started the research programme in 1983/84 (Anonymous, 2985).

Prior to the beginning of the current programme, are white grain sorghum variety which was released in 1983 from the ICRISAT material rested in Zambia. Zambia seed company has been producing and marketing ZSV-1 and Framida varieties since 1982. With the announcement of official base price of sorghum, a few commercial farmers also started producing sorghum on a limited scale. The grain yield of ZSV-1 on commercial scale has been reported up to 5.0 tones/ha.

Agronomic management practices such as date of planting, optimum plant population, row spacing, and fertilizer doses have been worked out for the sorghum work is underway to find out the most appropriate method of planting and inter cropping systems for small scale farmers in cooperation with the Agronomist at Msekera and with ARPT agronomists. A closer work at possible solutions to the bird problem is also being attempted (Nath, 1986).

2.5.4 INNOVATIONS IN FARMING SYSTEMS

An innovation is an idea or object perceived as new by an individual. The innovation may not be new to people in general but, if it has not yet been accepted by an individual, to that person it is an innovation. It can therefore be said that growing drought resistant crops could be an innovation to some farmers as the idea has not yet been accepted. Sorghum innovations originate from agricultural research stations, others from the media or relatives or from other farmers.

Some innovations catch on faster than others, as it was with the case of growing maize. Those which are relatively simple and combative with previous experience are usually adopted more quickly than more complicated and unusual innovations. However, peoples' perceptions may affect adoption behaviour far more than the technical characteristics of innovation's (MF. Adms, 1982:40).

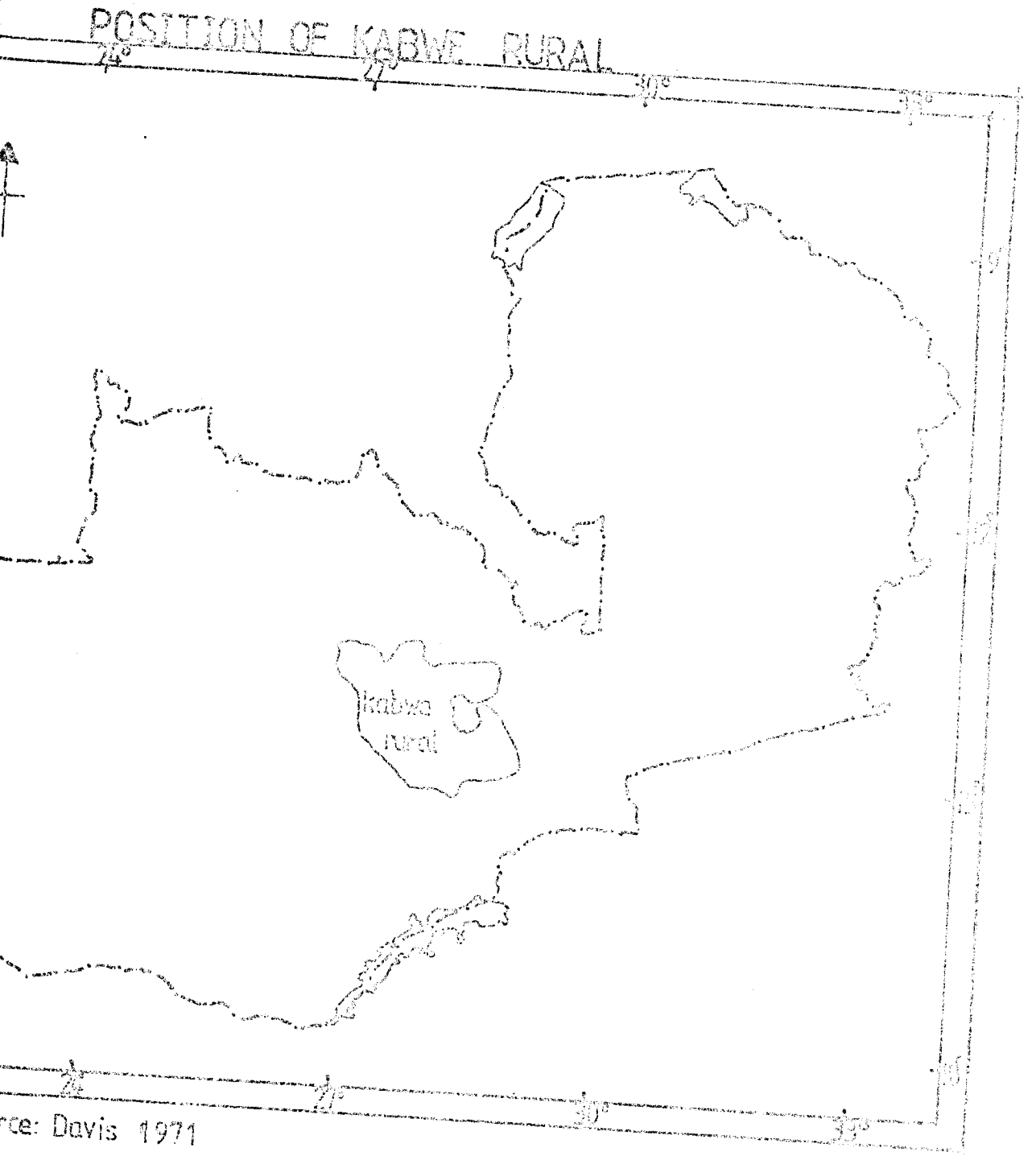
2.5.5 THE ADOPTION PROCESS

Adoption is not a sudden event, but a process. Farmers do not accept innovations immediately, they need time to think over before making a decision. It has however, been noted that the attitudes of people on sorghum adoption has not been good as compared to that of maize. This can be evident in the areas that sorghum is planted in different provinces and the total production of sorghum in these provinces. People have had a negative attitude towards the adoption of maize mainly because of lack of market.

There are several ways of explaining the adoption process, of which some may involve awareness, interest, evaluation, trial and adoption. The other may involve knowledge, persuasion, decision, confirmation. These stages means, knowledge as to when the individual learns of the extsistance of the innovation and gain's some understanding of its function. Persuasion as to when the individual forms a favourable or unfavourable opinion of the innovation. Decision as when the individual engages in activities which lead to a choice between adoption and rejection and confirmation as to when the individual makes a final decision to accept or abandon the innovation.

However, some people are more innovative (responsive to new ideas) than others. Adopters have been subdivided into categories on the basis of the relative time they take to adopt innovations: innovators, early adopters, early majority, late majority and laggard. Innovativeness generally can be related to other personal characteristics such as background, social status, affiliations, attitudes etc (M.E. Adams, 1982).

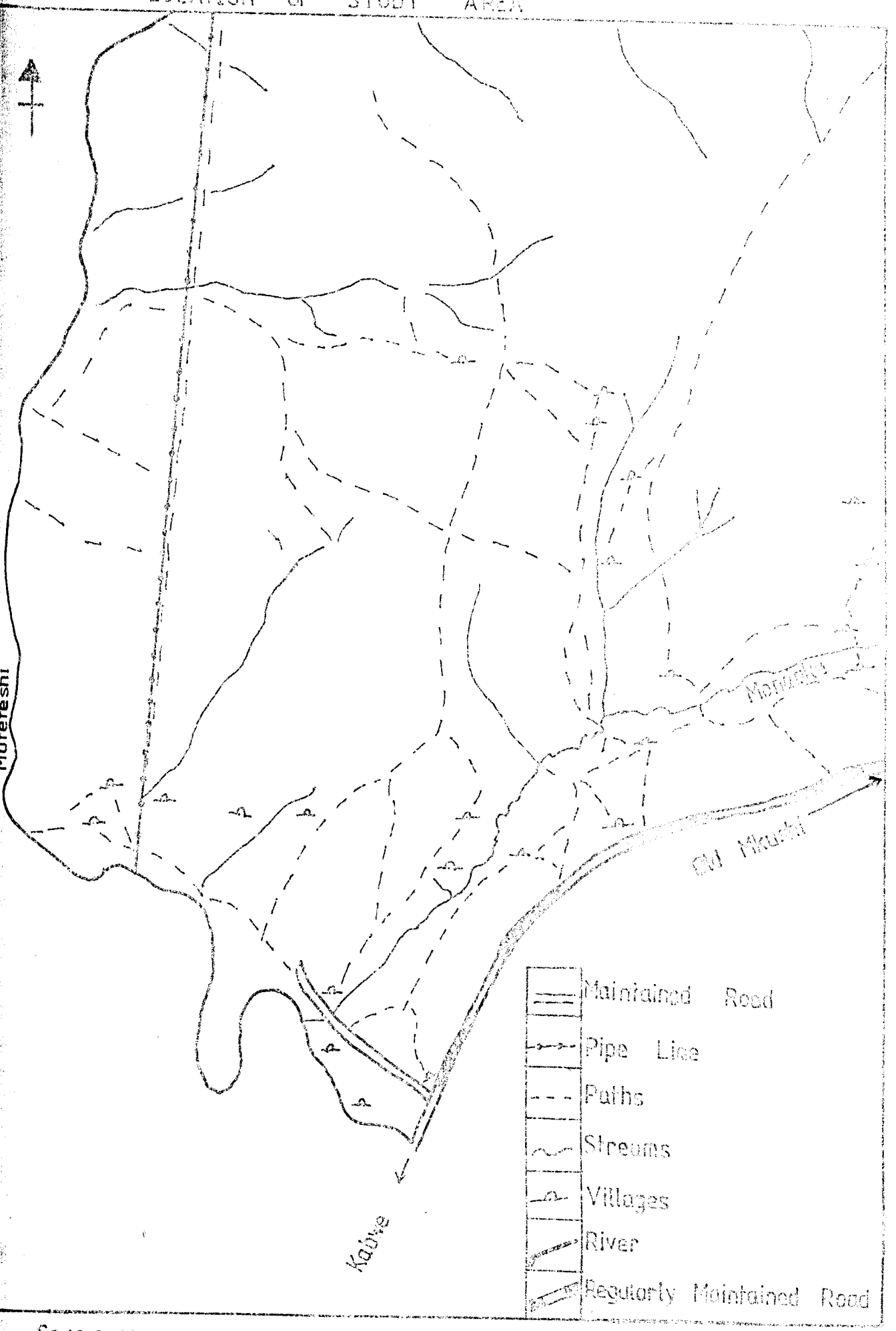
POSITION OF KABWE RURAL



rce: Davis 1971

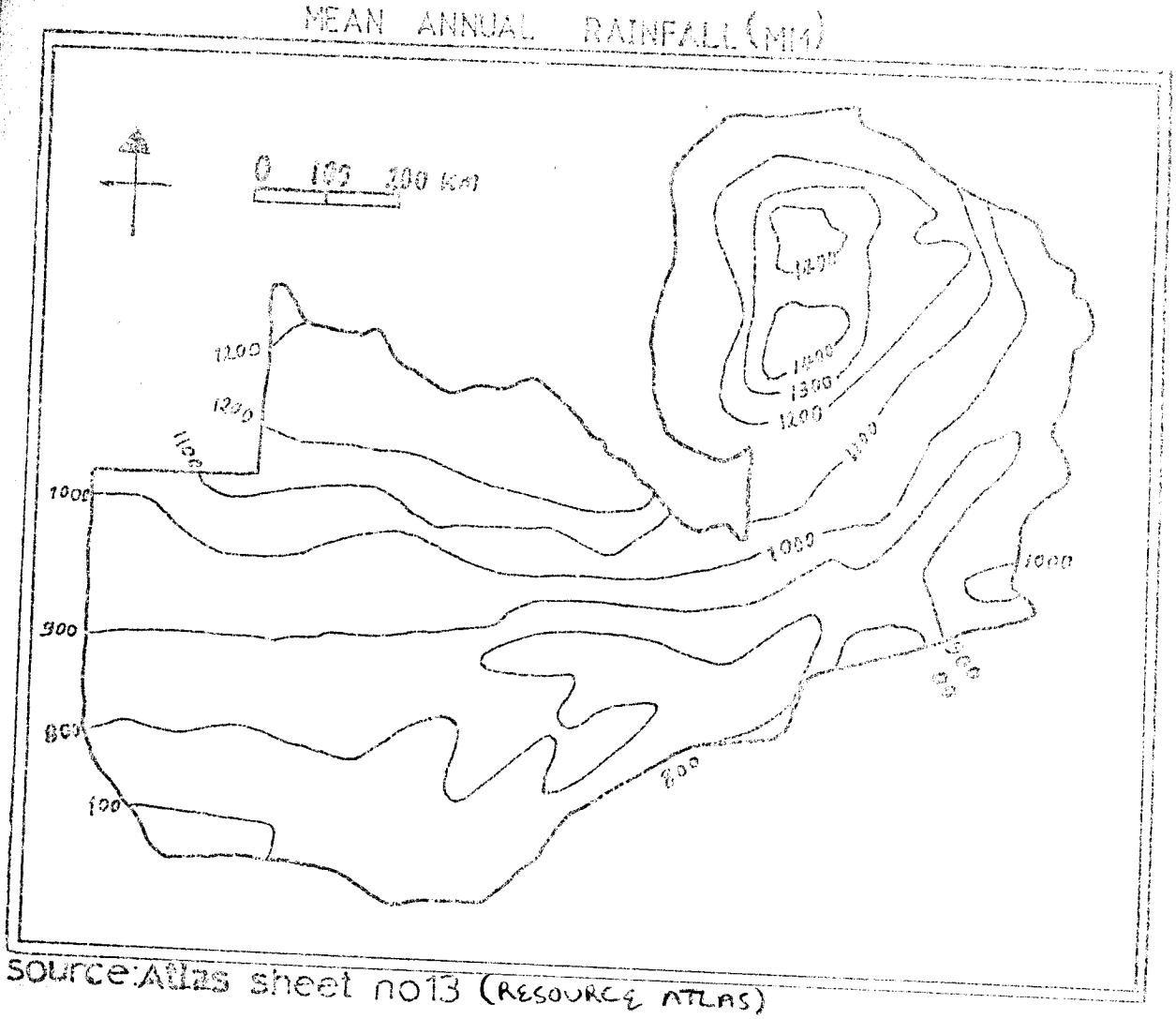
Fig. B

LOCATION OF STUDY AREA



Source: Map Sheet 1428B3

MEAN ANNUAL RAINFALL (MM)



Source: Atlas sheet no13 (RESOURCE ATLAS)

3.2.2 TEMPERATURE

Mukonchi area experiences the common Savannah temperature, where the maximum temperatures is in October and minimum temperatures in July (Meteorological station 1995).

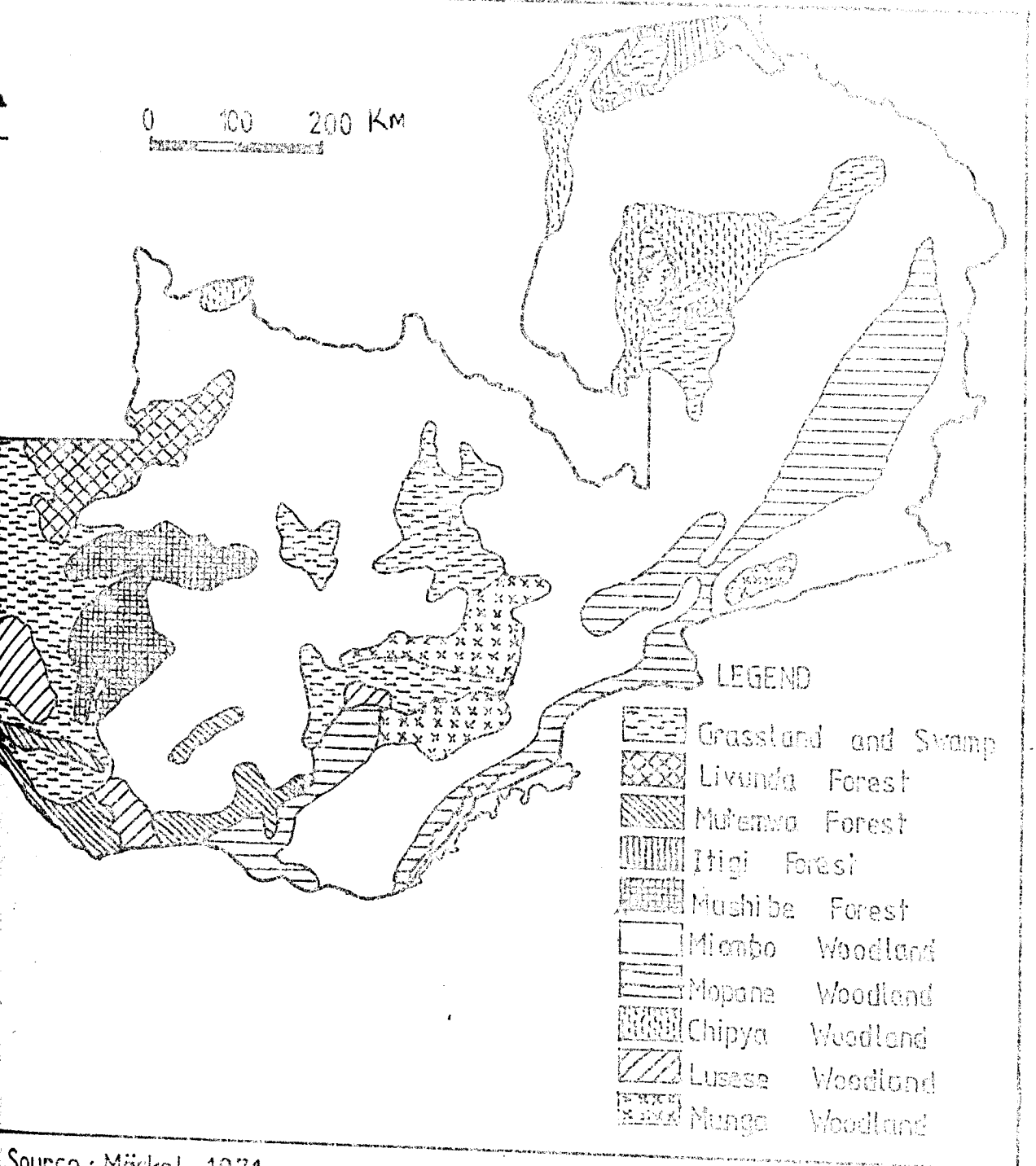
Mean daily temperatures during the growing season range from 23 degree Celsius to 25 degree Celsius. The mean maximum temperature may reach 32 degree Celsius in October with mean minimum temperatures below 10 degree Celsius in July (MAFF, 1995:21).

3.2.3 SOILS

The soils found in the region includes moderately leached reddish to brownish clay, changing to loam soils (ultisols-aljisols) with sandy to coarse loamy top soil derived from acid rocks. The area also has moderately leached red to reddish changing soils (aljisols) with fine loaming to clayey topsoil, derived from basic rocks, often in admixture with acid rocks (MAFF, 1995).

However, the main soils in the region have slight to severe chemical and physical limitations to crop production. These limitations include low water holding capacities, shallow rooting depth, low organic matter, low nutrient reserve and acidity, capping and coarse textured top soils which increase the erosion hazard (MAFF, 1995:22).

THE VEGETATION OF ZAMBIA



Source : Mäckel 1971

3.2.4 GEOLOGY

Geological, Mukonchi area is classified under the Katanga system. This system includes such types of rocks as Dolomite, Lirriestone and carbonaceous shales (MAFF, 1995).

3.2.5 VEGETATION

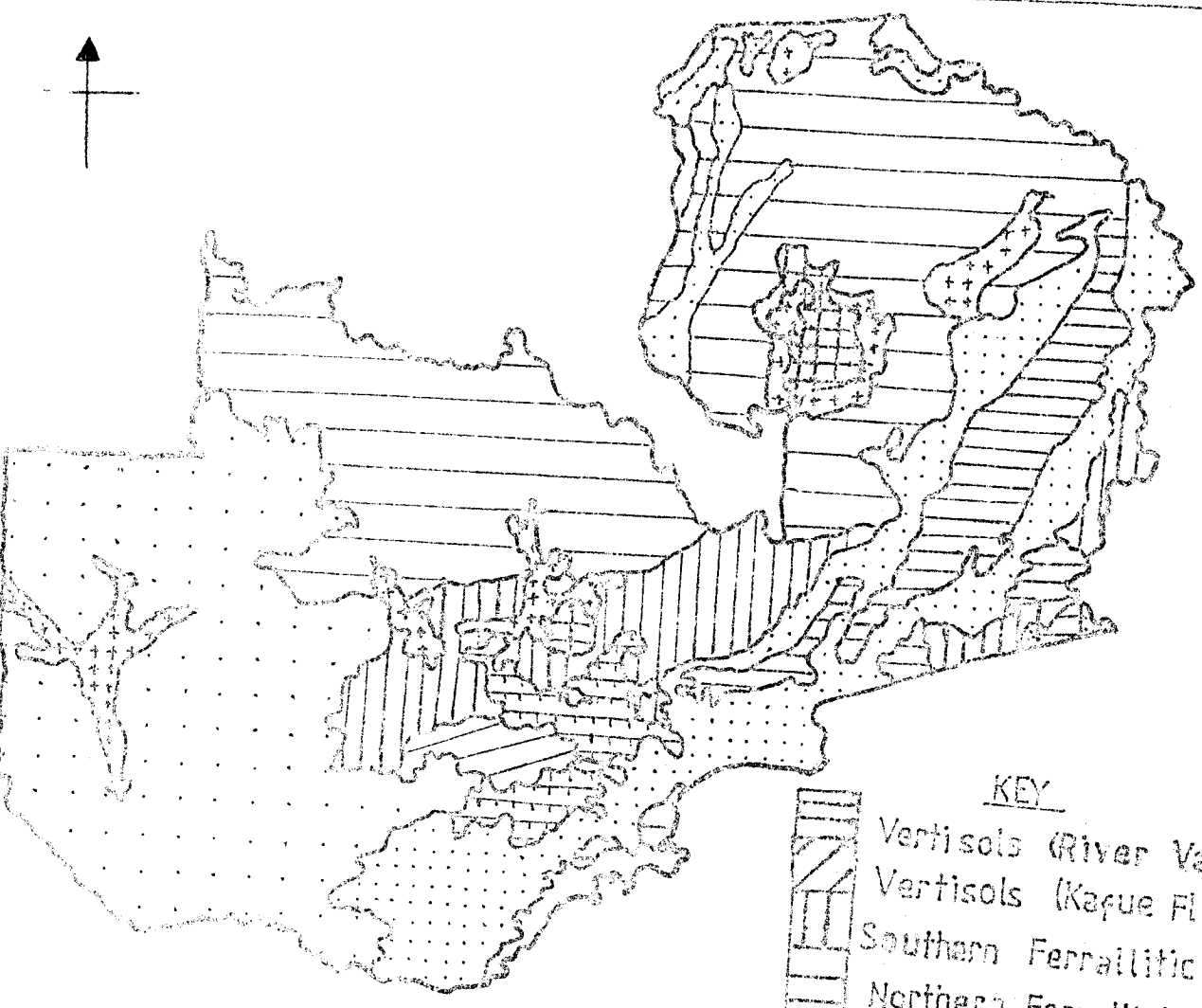
Mukonchi area in terms of vegetation is characterised under Miombo and Munga vegetation. This vegetation consists of Brachystegi and isoberlinia (MAFF, 1995).

3.2.6 FARMING SYSTEM

Mukonchi area has more commercial farmers than peasant farmers and has the following features:-

- The major draft power of the system is oxen. Most farmers use oxen extensively for both land preparation and planting.
- The major staple crops of the area are the local maize, beans, sweet potatoes and others.
- Hybrid maize production dominates the enterprise pattern, but cotton is also an important commercial crop for many farmers in the area.
- Hybrid maize, cotton, sunflower, and soya beans are all grown with deliberate intention to generate case income.
- Maize management suffers from labour on average in the area during the critical period from late October to early January (MAFF, 1995).

THE SOILS OF ZAMBIA



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RCE: DAVIES, (1971:27).

- Most of the farmers in Mukonchi area on average cultivate about 6-10 farm hectarage, a few below 5Ha and a very small number above 11 Ha.

- Lack of seeds to plant is the major reason why most farmers in the area do not use all the farm hectarage. This is followed by the problems of rain in the area which declined tremendously in the 1990/91 farming season. Other reasons for not using all the farm hectarage includes lack of labour and fallowing purposes.

3.3 CROPS GROWN.

Mukunchi area like any other region in Zambia has considerable good soils and rain fall (climate) to permit a number of crops to be grown. The crops cultivated in the area includes maize, millet, sorghum, groundnuts, cassava, soya beans, sunflower, cotton and a variety of other vegetables. These crops are grown for personal consumption and for sale in times of financial crisis.

3.4 SOCIAL FACILITIES AND SERVICES

Social facilities and services affect agricultural productivity of a population. Social facilities and services largely involves the existence of health, transport and market amenities.

There are no formal employment opportunities for people in Mukonchi area. The chief source of income is therefore agriculture, which is very low, considering that the people in the study area are peasant farmers.

Although the infrastructure in most rural areas in Zambia is not well developed, Mukonchi is probably above the bottom of the scale in as far as infrastructure is concerned. The road that runs from Kabwe to chibwe and to Mukonchi is not very poorly maintained although not tarred. The road is operational throughout the year.

It is from this graveled road that feeder rods branch off into different villages of Mukonchi. These feeder roads are poorly maintained, difficulties are therefore experienced in the supply of inputs as well as transportation of agricultural produce.

In terms of vehicular, public passenger transport, Mukonchi area has none. Thus, farmers from the interior of Mukonchi have to spend time hiking expensive private lifts to their respective feeder roads branching from the main road.

The area also lacks a localised centre for obtaining farm equipment. Farmers have to travel long distances to obtain equipment during the farming period, thus curtailing the total number of working hours each season. The reduction of working hours can have a big unrealised negative impact on the farm outputs.

In terms of health facilities, the area is in great need. The only clinic/hospital serving the area is St Pauls hospital which is a 6-8 hours walk. Coming to education, the area lacks a nearby school to cater for the children. However, there are primary schools in the main centres which are about 3-4 hours

walk i.e. Chibwe, Mukonchi and others. The area which includes Chibwe and Mukonchi are only served by two secondary schools, and St Pauls secondary school. The two schools do not adequately cater the area.

The area also lacks a localised centre for obtaining farm equipment. Farmers have to travel long distances to obtain equipment during the farming period.

CHAPTER FOUR

4.0 RESEARCH METHODOLOGY, PROBLEMS AND LIMITATIONS

The primary objective of this chapter is to look at methodology and problems encountered in the field during data collection. and limitation of the project.

4.1 METHODOLOGY

This includes both methods of data collection and analysis of data.

4.1.1 DATA COLLECTION

Collection of data for this study was done through the use of questionnaires and review of secondary sources.

4.1.1.1 QUESTIONNAIRE INTERVIEWS

Most of the primary data needed for this study was collected directly from the farmers using a questionnaire.

Although written questionnaires were planned to be administered to the responds within the setting of formal interviews, the questionnaire which was prepared could not be used by individual respondents because most of them were illiterate. To avoid the problem of illiteracy, the researcher had to fill in the necessary information. This meant that the researcher had to be involved in translating the questions from English into the local language (Bemba) and the local language into English.

The questionnaire was designed to interview the farmers and find out if and why they had or had not adopted the growing of

sorghum. The farmers were also asked for their opinion on the extension work to evaluate the extension system as a system of encouraging farmers to grow drought resistant crops.

The other primary data was collected from extension workers using a questionnaire. The questionnaire was designed to find out the spread and acceptance of sorghum growing by peasant farmers in Mukonchi area. Information on the farming system and the area in general was obtained from extension workers in Kabwe.

4.2.1 SECONDARY SOURCES

There was also additional data collected from secondary sources. Information on the farming system and the general crops grown in the area was obtained from the following sources:-

i) Researchers from Kabwe, Mutwe-wa-Nsofu and Mukonchi research stations. These provided the author with pamphlets and articles

ii) Lusaka Meteorological station provided information on the rainfall and temperature pattern of the area.

4.2.1.1. LIBRARY RESEARCH

Initial information on the subject under study which included the review of literature was collected from the University of Zambia main library, and the departmental library of Geography at the University of Zambia Great East Road Campus. Extra information was collected from the library at the department of Agriculture (UNZA), Meteorological station Lusaka, Mt. Makulu research station and Misamfu research station Kasama. These sources included books, tables, maps and reports such as a

brief guides to sorghum cultivation and others included under Bibliography.

4.3 SAMPLING PROCEDURE

The sampling method used in this study is simple random sampling. In this case, the sampling procedure gave an equal opportunity of selection for each farmer in Mukonchi area and personal biases were minimised.

Therefore, the technique of selection was based on the selection of farmers randomly on the complete list of farmers in Mukonchi. The farmers in the villages were each assigned a different number written on a piece of paper. The papers were then put in a small carton box and were mixed well. The numbers were then drawn out of the box and this constituted the sample. A sample of 40 farmers was taken.

4.4 DATA PROCESSING AND PRESENTATION

The data obtained from the field was processed using a code system. The forty farmers were given numbers 1-40 in a roll and the answers to the questions were then numbered in a column. Depending on the answer given by the respondent, the right box was ticked.

Presentation of data is done by use of tables, charts and graphs. These types of data presentations show the adoption of sorghum and the drought periods experienced in Mukonchi area. They also show the adoption of sorghum and the recommendations provided by the agricultural extension system research on the

drought resistant crop. The percentages of adopters and non-adopters are also shown.

4.5 DATA ANALYSIS

The analysis of data was done based on the tables, charts and graphs used to present the data. The data collected during field research is manually analysed so as to prepare summaries of the information obtained. Therefore, graphs, tables and charts are being used to present the findings of this research project. The percentages of responses and different characteristics were worked out and the data were presented in tabular form. The analysis employed both quantitative methods and non-quantitative. The statistical methods of chi-square was employed to further analyse the relationship between drought and sorghum adoption. It also showed whether there was a relationship between the availability of extension workers and the adoption of sorghum.

4.6 PROBLEMS ENCOUNTERED AND LIMITATIONS

Every research work has its own problems and like any other researcher, the author was faced with some limitations, some of which include the following:-

- Review of literature on the adoption of sorghum was a problem as little work has been written on the subject. Adoption of Sorghum as a drought resistant crop especially in relation to the Zambian situation was very limited.

- The research coincided with the time of the rain season which made it very difficult to collect data. It used to rain almost every day in the study area which made travelling difficult and caused a lot of delays in collecting data.

- The study was also conducted during the farming period. thus it was difficult to find the farmers or if you found them, they would be too busy to be interviewed. Therefore, this caused delays and problems as at times the author had to either follow the farmers to their fields or interview them the following day.

- Data collection on the part of the extension workers presented a problems as most of them were either out in the field or had gone to the headquarters in Kabwe. This meant that the author had to wait for them to return, which took days or was referred to Mutwe-wa-Nsofu to interview them there. The distance from Mutwe-was-Nsofu to Mukonchi is more than 60km.

CHAPTER FIVE

This section is dealing with the findings of the study.

Mukonchi area like any other part of the country has favourable climatic conditions for certain crops. Among the crops grown by farmers in the area includes drought resistant crops (see table 1).

TABLE 1: DROUGHT RESISTANT CROPS GROWN BY PEASANT FARMERS

CROPS GROWN	NO OF RESPONDENTS	PERCENTAGE
Sorghum	6	15.0
Cassava	3	7.5
Millet	12	30.0
Non-drought resistant	19	47.5
TOTAL	40	100.0

NOTE: Non-drought resistant = maize, groundnuts, sunflower, cotton, soya beans etc.

The table shows that there is a good number of farmers in mukonchi area who grow drought resistant crops. This can be seen from the fact that out of 40 farmers, 30.0% grow millet, 15.0% grow sorghum and 14.3% grow cassava. However, a considerably large number of farmers do not grow any of the drought resistant crops (47.5%).

The table reveals that most farmers grow millet in the study area. The crop is indigenous to most Zambian people and it is well adapted to Zambian conditions. It is widely grown as a subsistence crop where its grain has high nutritional value is

used as an important staple food and generally consumed as porridge made from blended sorghum mixed with cassava. The grain is also frequently used to make local beer. It is regarded as a strategic traditional food security crop on account of good storability. It has also fair potential both as a cash and industrial crop.

The table also shows that a considerable number of farmers grow sorghum (15.0%). Although sorghum is not grown on a large scale as compared to millet, it is the most important cereal after maize. the percentage of farmers who grow sorghum do so because sorghum in Mukonchi and Zambia as a whole use the grain for food. It is as nutritious as maize for food and feed. It is also a superior grain for brewing because of its good malting capacity.

The table also shows that a few farmers grow cassava (7.5%). This crop is not grown on a large scale in the area because it is not their staple food. Only a few farmers grow cassava so that they can use it for food (Nshima). It is mostly blended and the flour is mixed with the maize mealie meal. They also eat the roots when cooked as a snack.

It is important to note that innovations in any place can catch on faster than others or may not catch on at all. Table 2. below shows the percentages of farmers who have adopted the growing of sorghum and other drought resistant crops. It also shows the percentage of those who have not adopted.

TABLE 2: ADOPTION OF DROUGHT RESISTANT CROPS

CROPS	ADOPTERS %	NO-ADOPTERS %
Sorghum	15.0	85.0
Millet	30.0	70.0
Cassava	7.5	92.5

The table shows farmers who have adopted and those who have not adopted the growing of drought resistant crops in the area.

The research found out that about 15.0% farmers in the area had adopted sorghum growing. The adoption of such a crop was not only for drought reasons but it has been a traditional crop to them. Most farmers felt it was important to keep some of the traditional food even if it was on a smaller scale.

30.0% of the farmers interviewed had also adopted the growing of millet in the area. Reasons for adopting such a crop were mainly because of beer brewing so as to raise an income and labour. And only a small number of farmers grew cassava in the area (7.5%). This was mainly because cassava was not a traditional crop to them.

From observations, it appears that most farmers in Mukonchi area have not adopted the growing of sorghum as a drought resistant crop but millet. Reasons for not doing so varied from an individual farmer to another.

The reasons why farmers may adopt an innovation, as in this case drought resistant crops, will differ from one individual to another. Table 3, below shows some reasons why farmers in Mukonchi area have adopted the growing of drought resistant crops.

TABLE 3: REASONS FOR ADOPTING SORGHUM AND OTHER DROUGHT RESISTANT CROPS(ie. millet, cassava).

REASONS	NO. OF RESPONDENTS	PERCENTAGE
Persistent drought	5	23.8
Have a variety of crops	6	28.6
For beer brewing	4	19.0
Any other	6	28.6
TOTAL	21	100.0

NOTE: Any other = lack of cotton, maize etc seeds, lack of capital, lack of interest, lack of information etc.

Note that the total is not 6 of those who have only adopted sorghum growing but 21 to include all drought resistant crops grown in the area. Out of the 40 farmers interviewed, only 21 had adopted the growing of drought resistant crops, hence the total 21.

Out of the 21 farmers who have adopted the growing of drought resistant crops, when interviewed, 23.8% adopted these crops because of the persistent drought in the area. Central Province as already noted experienced one of the worst droughts in its recorded history in the agricultural season 1991/92. The drought was caused by failure of rains over much of the province during the most critical period of crop growth. The drought had serious effects on crop and livestock production. The crop production reduced tremendously in the stated period. The problem was compounded by late rains which were expected to cause cabot and fungus diseases to maize crop. This therefore caused

unpreceded food shortages in the affected area of Mukonchi. Therefore, in order for farmers to avoid food shortages they opted for the adoption of drought resistant crops which could withstand such harsh conditions.

The table also reveals that 28.6% of the farmers adopted drought resistant crops because they wanted to have a variety of crops. The main reason for this was that farmers could have food security in case other crops failed. In addition, income can be generated more from other crops unlike if one crop was grown.

Beer brewing which is one of the uses of sorghum and millet has made farmers adopt the growing of these crops. Farmers who grow these crops for this reason consist of 19.0%. As most farmers could not afford to hire labour, they could usually brew beer so that neighbouring families in the village could come and help with the cultivation. In the evening when they have finished weeding or ploughing or any other form of farm work, they would gather to drink the beer. While others brew beer so that they could raise some incomes. This is cheaper as compared to the use of maize in beer brewing which is expensive.

The research also showed that other farmers (28.6%) adopted the growing of drought resistant crops for other reasons. These may include lack of proper seeds like maize, cotton etc, lack of capital, lack of information on the crops and lack of interest and negative attitudes towards these crops.

The period a farmer may adopt an innovation will differ with another farmer depending on the reason for adoption. The table (4) below shows the periods farmers started growing drought resistant crops.

TABLE 4: PERIOD FARMERS STARTED GROWING DROUGHT RESISTANT CROPS.

PERIOD (in years)	No. of RESPONDENTS	PERCENTAGE
10	1	4.8
5	1	4.8
>2	3	14.3
Any other	16	76.2
TOTAL	21	100.1

NOTE: Any other = more than 10 years.

Most of the farmers interviewed on the adoption of drought resistant crops (adopters) started growing these crops more than 10 years ago. This is the period droughts were not severe. It thus means that most farmers started growing these crops merely as traditional crops. Table 4 thus shows that these farmers consist of 76.2% of the total 21 farmers who have been growing drought resistant crops.

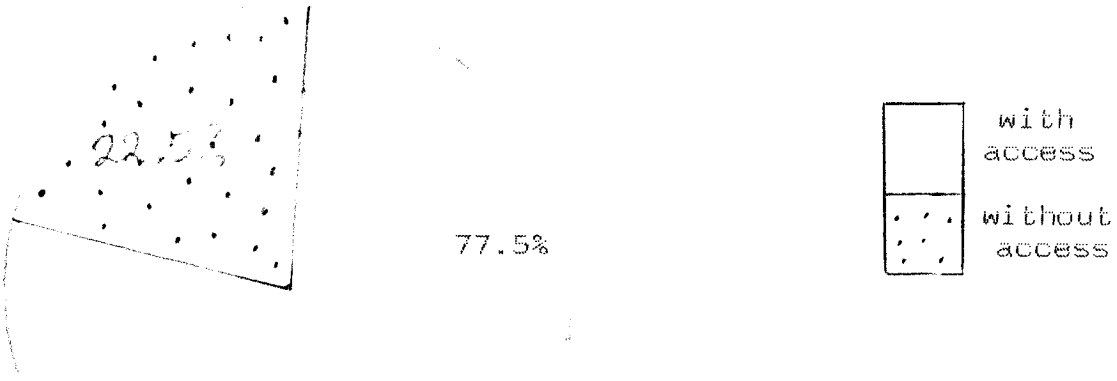
Table 4 further reveals that 14.3% farmers started growing drought resistant crops in less than two years ago. The main reason for adoption was food security as well s lack of capital to buy maize seeds and fertilizer.

Only a very small percentage of 4.8% of farmers started growing drought resistant crops in both about 10 years and 5 years ago.

Table 4 therefore, shows that most farmers in the area started growing drought resistant crops in the mid-80's. This is the period probably farmers still used to practice crop diversification and grew traditional crops. But recently, most

farmers have tended to adopt the western system of agriculture. The main crop grown now is maize which has seen the slow disappearance of traditional crops like millet, cassava and sorghum.

FIGURE 1: ACCESS TO EXTENSION WORKERS



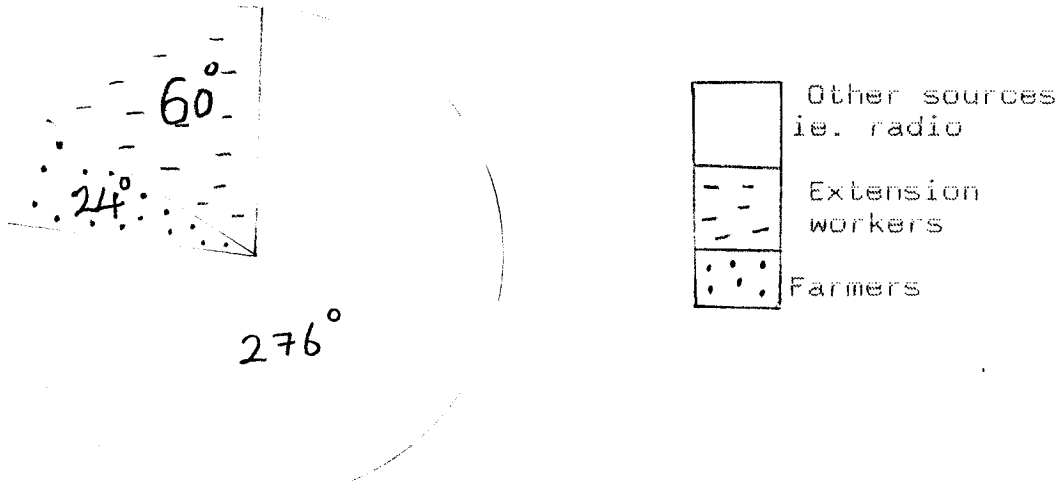
While loans and credits provision seems to be one of the main ways of encouraging small-scale farmers to achieve increased production; the role of the extension services is also important. The examination of the data in figure 1 indicates that a large proportion of farmers in the area have access to extension services (77.5%) and 22.5% claimed that agricultural extension services were not made available to them at all.

From figure 1, above, it appears that most farmers had access to extension services. Therefore, it can be said that those farmers that are regularly or have access to extension services, been taught or given the right message on drought resistant crops, have a higher chance of adopting sorghum than

those rarely unasked. The lack of communication on such important crops which are drought resistant and food security can be a hindrance to the adoption and agricultural production in general. There is a need therefore, for the extension workers not only to concentrate their efforts on the successful small-scale farmers but also on the less successful ones who require extension services very much.

For an innovation to be adopted, it has to be transmitted from a source. Figure 2, below shows the sources of information about sorghum growing as an innovation.

FIGURE 2: SOURCES OF INFORMATION ABOUT SORGHUM GROWING



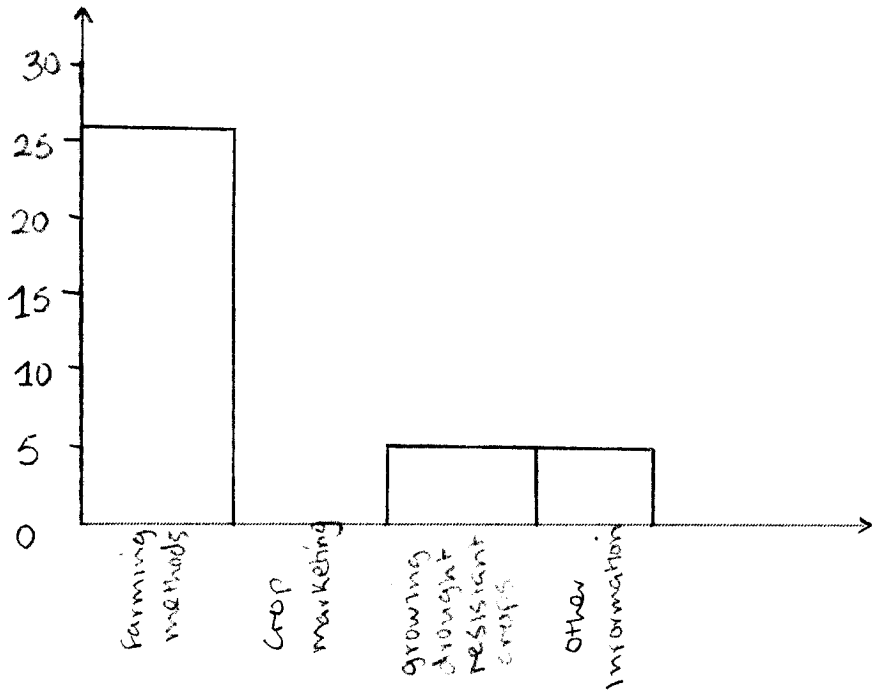
On the farmers' sources of information about sorghum growing, it was found out that most of the farmers interviewed knew about drought resistant crops. 16.7% heard about these crops from the extension workers or agricultural officers. Most of them mentioned that the information was disseminated to them on a person to person and others through contact village or groups. Thus, these had a chance to ask for clarification where

they did not understand. It is through such sources of information that farmers can adopt innovations as they are able to get more information on a particular crop.

6.7% of the farmers heard about drought resistant crops from their fellow farmers. The rest 76.7% heard about drought resistant crops from other sources which included mass media (radio), Lima adopters and many others.

Extension workers disseminate quite a number of messages to the farmers. This could be done either on person to person basis or through contact village or groups. In the figure (3) below, the general content of the messages from the extension workers are shown.

FIGURE 3: GENERAL CONTENT OF THE MESSAGES FROM THE EXTENSION STAFF



Messages from Extension workers

Most of the farmers interviewed have the view that the general content of the messages from the extension staff is on

agricultural methods of cultivation. These include messages on planting, weeding, fertilizer application, pesticide control and many more. This group of farmers consist of 73.0% and 13.5% received messages on drought resistant crops and other information on agricultural practices.

Figure 3 also reveals that no farmer in the area is taught about crop marketing. What happens to the crops after being harvested was left to be decided upon by the farmers themselves.

It is felt by most farmers that the extension services provided to them are not at all adequate. The extension workers do not only rarely visit the farmers but they also have little information to give them. The information mostly consists of what is already known to them and only needed to improve upon. Thus, this kind of situation hindered most farmers to have access to information on drought resistant crops.

Table 5 below shows whether peasant farmers of mukonchi area belong to a contact village/ group or not.

TABLE 5: SHOWING WHETHER PEASANT FARMERS BELONG TO A CONTACT VILLAGE/GROUP OR NOT.

	No. of Respondents	Percentage
Yes	33	82.5
No	7	17.5
TOTAL	40	100.0

The research revealed that most farmers in the area belong to a contact village or group in which they learned about

agricultural methods of cultivation. Out of the 40 farmers 82.5% belonged to such a contact village or group and about 17.5% farmers did not belong to any at all.

Such groups in the area in one way or another might have contributed to farmers having adopted such important crops as drought resistant crops. It is through the work and encouragement of the extension workers that farmers can adopt such innovations.

One way of introducing and encouraging the growing of drought resistant crops is through visits made by extension workers. Table 6 below shows how useful the visits made by extension workers are to the peasant farmers.

TABLE 6: USEFULNESS OF VISITS BY THE EXTENSION WORKERS TO PEASANT FARMERS

USEFULNESS OF VISITS TO FARMERS	NO. OF RESPONDENTS	PERCENTAGE
Very beneficial	0	0.0
Beneficial	28	90.3
Not beneficial at all	3	9.7
TOTAL	31	100.0

Table 6 above shows the differences in opinions among the farmers as to how beneficial or not beneficial the visits by extension workers are to them. The differences in opinion may be as a result of the content of the messages extension workers have and their rare visits to the farmers. It should be noted that the

source of information and the content or recommendations affects the adoption of an innovation.

From table 6, 90.3% of the farmers found the visits by extension workers to be beneficial in their agricultural practices, 9.7% found the visits not to be useful in any way and 0% or no respondents thought that the visits were very beneficial.

The research reveals that visits made by extension workers to farmers do benefit them and this depends largely on the frequency of these visits. It should be noted here that adoption is not a sudden event as noted in the Literature Review, but a process. Therefore, farmers cannot accept the adoption of drought resistant crops immediately but they need time to think over before they can make a find a decision. But this will also depend on how much farmers get encouraged by extension workers.

The adoption of sorghum as a drought resistant crop and other drought resistant crops will very much depend on the assistance given to peasant farmers on these crops by extension workers. Table 7, below shows the assistance given to peasant farmers by extension workers on such crops.

TABLE 7: ASSISTANCE GIVEN TO PEASANT FARMERS ON SORGHUM GROWING BY EXTENSION WORKERS

ASSISTANCE GIVEN	NO. OF RESPONDENTS	PERCENTAGE
More information on drought resistant crops	0	0.0
Recommendations on planting	9	40.9
Recommendations on weeding	9	18.2
Any other	4	18.2
TOTAL	22	100.0

NOTE: Any other = agricultural methods of farming.

As earlier noted in the Literature Review, an extension worker helps farmers to increase the productivity of their produce and also to improve their living standards. He is an adviser and change agent. He is a middleman operating between agricultural research institutions and the farmers. Therefore, an extension worker is an important person in transmitting new technologies to the farmers as well as current farming problems to the researchers. Thus, he can help farmers adopt new innovations' such as drought resistant crops.

When the extension workers were assessed as to what assistance they give farmers on sorghum growing, 40.9% responded that recommendations on planting and weeding are the main messages given. 18.2% were assisted on any help concerning agricultural methods of farming by extension workers.

However, no farmer was assisted on further or more information about drought resistant crops. This on its' own meant that extension workers mainly concentrate on trying to increase the farmers' productivity and advising on the already existing cultivation methods such as maize growing and other crops, weeding, planting and many more. It follows therefore, that no additional information as to those who heard the information on sorghum growing from extension workers was given to them.

Lack of such assistance can be further noted in Table 8 which is showing the fields of sorghum inspected and not inspected by extension workers. Out of the 21 farmers who grow drought resistant crops, only 29.0% of the farmers had their fields inspected. This means that 81.0% of the farmers had their fields not inspected by the extension workers.

Therefore, extension workers in the area are not giving much assistance to the farmers on drought resistant crops.

TABLE 8: INSPECTION OF DROUGHT RESISTANT CROP'S FIELDS BY EXTENSION WORKERS.

	NO. OF RESPONDENTS	PERCENTAGE
Fields inspected	4	19.0
Fields not inspected	17	81.0
TOTAL	21	100.0

Table 8 shows how many fields of drought resistance crops were inspected by extension workers. From the table, it can be

seen that a larger percentage of farmers 81.0% had their fields not inspected. It is from this that in Table 9. Farmers try to assess the contribution made by extension workers to the introduction and encouragement of sorghum growing.

TABLE 9: CONTRIBUTION OF EXTENSION WORKERS TO THE INTRODUCTION AND ENCOURAGEMENT OF SORGHUM GROWING.

CONTRIBUTION	NO. OF RESPONDENTS	PERCENTAGE
Very little	19	47.5
Little	7	17.5
Very much	6	15.0
Much	8	20.0
TOTAL	40	100.0

As a result of the content of messages given to farmers and the visits made by the extension workers, it was felt that extension workers contribute very little to the introduction and encouragement of sorghum growing and indeed other drought resistant crops. From Table 9: such farmers who felt this way consisted of 47.5%. About 17.5% felt that extension workers do contribute a little and only 15.0% thought they contribute very much. whilst 20.0% felt they contribute much to the introduction and encouragement of sorghum growing.

Although extension workers have contributed to the adoption of sorghum and other drought resistant crops, farmers felt that more has to be done. Table 10, below indicates the suggestions that farmers felt extension workers should further their contributions on drought resistant crop.

TABLE 10: SUGGESTIONS FOR FURTHER CONTRIBUTIONS ON DROUGHT RESISTANT CROPS BY EXTENSION WORKERS.

SUGGESTIONS	NO. OF RESPONDENTS	PERCENTAGE
Teach more on drought resistant crops	30	75.0
Give free seeds as incentives	2	5.0
Visit farmers often	8	20.0
TOTAL	40	100.0

Given the traditional view of agriculture in the study area about 75.0% of the farmers felt that the improvement on the information about drought resistant crops from the extension services is vital if farmers are to adopt such agricultural practices. The examination of the data in Table 9 indicates that extension workers in the area contribute very little to the introduction and encouragement on growing sorghum and other drought resistant crops. It is however, only through the improvement of such contributions can people adopt such crops.

20.0% of the farmers thought that extension workers could contribute more if they improved in the visits made to farmers and 5.0% thought that giving of free seeds as incentives on such crops could make more farmers adopt these crops.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

This chapter hopes to conclude the study by reflecting on the data analysis and then give recommendations on what should be done in the area to improve sorghum adoption.

6.1 CONCLUSIONS

6.1.1 ADOPTION OF SORGHUM AS A DROUGHT RESISTANT CROP

It was found that Adoption of sorghum, began only not because of the drought, but the crop has been a traditional cereal. Traditionally, the crop is used for beer brewing and in the preparation of Nshima.

Most of the farmers got information on sorghum growing the farmers through the radio, relatives and lima adopters. However, a few farmers heard about sorghum growing from the extension workers and their fellow farmers.

It was from this information that about 15% of the farmers adopted sorghum in the area.

6.1.2 REASONS FOR ADOPTING SORGHUM AS A DROUGHT RESISTANT CROP.

The project disclosed that the adopters of sorghum started growing this crop so that they could have a variety of crops. This is especially so to make farmers have a secure food base. In case one crop failed, farmers would not go hungry but use the sorghum grains for food. It was also discovered that some farmers could not adopt the growing of sorghum due to lack of inputs

(seeds and capital). They also had no information on crops such as sorghum, nor did they have interest in growing the crop.

There was lack of information on crops such as sorghum and the farmers lacked the interest in growing the crop.

6.1.3 EVALUATION OF THE EXTENSION SYSTEM

On evaluating the extension system, it was revealed in the research that the extension worker rarely visited most of the farmer in the area. Most of the sorghum yields were not inspected and little information was given to farmers on sorghum growing.

Most of the adopters felt the extension worker had done very little to the introduction and encouragement of sorghum growing in Mukonchi area. As a result of this, a bigger percentage of farmers felt that extension workers should teach more on drought resistant crops (ie sorghum) if farmers have to adopt such crops. Other farmers felt it was important to give seeds as incentives and visit farmers more often if farmers are to adopt drought resistant crops.

6.2 RECOMMENDATIONS

6.2.1 RESEARCH

i) The study revealed that poor sources of information about sorghum by some peasant farmers was the major barrier towards the acceptance of sorghum growing. I would therefore, suggest that further studies in the area be carried out. These should try to examine why extension workers do not introduce and encourage farmers to grow drought resistant crops especially after Zambia experienced droughts.

ii) An investigation in detail should be carried out to find out what measures the extension workers have put in place for the peasant farmers in case of drought.

6.2.2 MARKETING OF SORGHUM

i) The government should make subsides on sorghum so that sorghum can become cheaper for brewers and millers, if sorghum is to replace maize for brewing and feed stock. This will not make industries reluctant to buy sorghum from the cooperative unions which in turn will buy from farmers.

ii) Measures should be put in place to promote sorghum for direct food as Nshima as it is being done in other countries like Botswana. Therefore, the milling of sorghum should be promoted and correlated to the standard of maize. The packaging of sorghum mealie meal should also be attractive so as to attract people to buy the sorghum products(i.e breakfast sorghum, Roller mealie sorghum etc).

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APPENDIX A

UNIVERSITY OF ZAMBIA

DEPARTMENT OF GEOGRAPHY

ADOPTION OF SORGHUM AS A DROUGHT RESISTANT CROP BY PEASANT FARMERS AROUND MUKONCHI

QUESTIONNAIRE FOR PEASANT FARMERS

1) How big is your farm in hectares?

2) Do you use all the available land each farming season?

a) Yes [ ]
b) No [ ]

3) If no, how many hectares on average do you use per farming season?

a) half the farm hectares [ ]
b) less than half the farm hectares [ ]

4) Why don't you use all the hectares of your farm?

a) lack of seeds to plant [ ]
b) problems of rains (drought) [ ]
c) lack of labour [ ]
d) lack of market for crops [ ]
e) fallowing purposes [ ]

5) What crops do you grow?

.....

6) What was your average hectarage per crop last farming season?

.....

7) How much in kg per hectare did you harvest per crop last farming season.

CROPS	HACTARAGE PER CROP	YIELDS

8) Do you have access to extension service?

a) Yes [ ]
b) No [ ]

9) If yes, how far away is the extension worker stationed from your farm?

a) less than 1km [ ]
b) 2-5km
c) 6-10 km
d) more than 10km

10) Do you belong to a contact village or group?

a) Yes [ ]
b) No [ ]

11) How often are you visited by the extension officers?

a) Every fortnight [ ]
b) Monthly in a farming season [ ]
c) Once in 2 months in a farming season [ ]
d) Once in a farming season [ ]

12) What is the general content of the messages from the extension staff?

a) Recommendations on planting, weeding, fertilizer application, pesticide control etc. [ ]

b) Recommendations on makert crops of maize, sunflower, groundnuts etc. [ ]

c) Recommendations on what crops to grow such as drought resistant crops. [ ]

d) Others [ ]

13) How beneficial are the visits by the extension officers to you?

a) Very beneficial [ ]
b) Beneficial [ ]
c) Not Beneficial at all [ ]

14) What drought/mitigation measures have you learnt from the extension staff?

a) Early planting [ ]
b) Irrigation [ ]
c) Adequate weeding [ ]
d) Agroforestry [ ]
e) Crop Rotation [ ]
f) Growing drought resistant crops [ ]

15) Which of these have you adopted?

a) Early planting [ ]
b) Irrigation [ ]
c) Adequate weeding [ ]
d) Agroforestry [ ]
e) Crop Rotation [ ]
f) Growing drought resistant crops [ ]

16) If answer to question (15) is (f) when did you start growing drought resistant crops?

17. What kind of drought resistant crops do you grow in particular?

a) Sorghum [ ]
b) Cassava [ ]
c) Millet [ ]

18) If a and/or d to question (17)

Where did you get the information about sorghum and millet growing?

a) Extension workers [ ]
b) Farmers [ ]
c) Others [ ]

19) When did you get this information about sorghum and millet growing?

a) 10 years ago [ ]
b) 5 years ago [ ]
c) less than 2 years ago [ ]
d) any other period [ ]

20) What was your reason for adopting sorghum and millet?

a) Persistent drought [ ]
b) Have a variety of crops [ ]
c) For beer brewing [ ]
d) Any other [ ]

21) Did you forgo any crops to grow sorghum and millet?

a) Yes [ ]
b) No [ ]

22) If yes which ones

.....

23) Why did you forgo these crops?

a) Crop failure due to drought [ ]
b) No market [ ]
c) Lack of input and technical advice [ ]
d) Other [ ]

24) Did you buy any sorghum and millet seeds last year or the previous season?

a) Yes [ ]
b) No [ ]

25) If not, where did you get the seeds from?

a) Extension workers [ ]
b) Farmers [ ]
c) Any other [ ]

26) How has the yields for sorghum and millet been in the last drought year from 1990/91 season?

a) Good [ ]
b) Fair [ ]
c) Bad [ ]

27) Does the extension worker visit your sorghum and millet fields?

a) Yes [ ]
b) No [ ]

28) If yes, how many times in a farming season?

a) Twice [ ]
b) Once [ ]
c) Four times [ ]

29 How does he help you in your sorghum/millet growing?

a) Gives us information on the drought resistant crops. [ ]
b) Recommendation on planting [ ]
c) Recommendation on weeding [ ]
d) Any others [ ]

30) If you have not adopted the growing of sorghum and millet, what are your reasons for not doing so?

a) No market [ ]
b) Do not like sorghum and millet Nshima [ ]
c) Difficult to grow [ ]
d) Lack of inputs [ ]
e) Any other [ ]

31. How do you then hope to survive the drought years?

a) Government help [ ]
b) Donor help [ ]
c) Other farmers and relatives [ ]
d) Any other [ ]

31) (If the farmer has adopted), How much do you think the extension worker has helped in the introduction and encouragement of growing sorghum and millet.

a) Very little [ ]
b) Little [ ]
c) Very much [ ]
d) Much [ ]

33) What do you think the extension worker should do which he is not doing at the moment?

a) Teach more on drought resistant crops? [ ]
b) Give free seeds as incentives [ ]
c) Visit farmers often [ ]

34) In the last drought years (1990/91) - 1994/95) which crop was more affected by the drought?

a) Maize [ ]
b) Sunflower [ ]
c) Rice [ ]
d) Groundnuts [ ]
e) Sorghum, millet, cassava, cotton etc [ ]

35) What are your plans on growing sorghum and millet for the next growing season.

a) Grow more [ ]
b) Do not hope to improve [ ]
c) Grow less [ ]
d) Undecided [ ]

QUESTIONNAIRE FOR EXTENSION WORKERS

1) When did you start the agricultural farming system research in Mukonchi area?

a) 10 years ago [ ]
b) 5 years ago [ ]
c) Less than years ago [ ]
d) Any other year [ ]

2) What exactly do you teach farmers?

a) Early planting [ ]
b) Irrigation [ ]
c) Agricultural messages on maize growing [ ]
d) General messages on farming [ ]
e) Growing of drought resistant crops [ ]
f) Others [ ]

3) Do you teach farmers the need to adopt drought resistant crops of sorghum and millet?

a) Yes [ ]
b) No [ ]

4) If yes, when did you start teaching farmers on the need to grow drought resistant grow?

a) After experiencing the drought from 1990/91 season. [ ]
b) At the establishment of extension service in the area [ ]
c) Any other [ ]

5) Why did you start teaching farmers the need to grow drought resistant crops in the stated period above?

.....

.....

6) How do you carry out the teachings on adoption of drought resistant crops?

a) Send Booklets [ ]
b) Through contact villagers or farmer groups [ ]

7) How is the response from farmers on sorghum and millet in terms of adoption rates?

a) 100% [ ]
b) Above 75% [ ]
c) Between 50% and 75% [ ]
d) Below 50% [ ]

8) Where these crops grown as traditional crops before you introduced extension messages on the need for growing drought resistant crops?

a) Yes [ ]
b) No [ ]

9) Are the agroclimatic conditions favoured for sorghum and millet growing? Tick those that are favourable.

a) Rainfall [ ]
b) Soils [ ]
c) Temperature [ ]
d) Mechanization level and labour availability [ ]
e) Market availability [ ]

10) How is the supply of inputs for drought resistant crops?

a) Good [ ]
b) Fair [ ]
c) Bad [ ]

11) Is there market for drought resistant crops?

a) Yes [ ]
b) No [ ]

12) If the response from farmers on sorghum and millet adoption is poor, what do you think are the reasons for farmers not adopting sorghum and millet growing in the area?

a) Lack of seeds [ ]
b) No market [ ]
c) Labour constraints [ ]
d) Do not like sorghum and millet nshima. [ ]
e) Any other [ ]

13) How can this be facilitated?

a) Giving seeds to farmers [ ]
b) Providing market [ ]
c) Giving loans [ ]
d) Changing farmers' attitudes [ ]

14) Do you have the necessary logistics and support for carrying out your work effectively in the area?

a) Yes [ ]
b) No [ ]

15) To what extent does this impact on the adoption rates of sorghum and millet in the area?

a) Very much [ ]
b) Not much [ ]
c) Does not [ ]

16) If (a) or (b) to question (16), how can this be improved?

.....

.....

17) Any other comments on the subject

.....

.....

.....

APPENDIX B

H_1 = Peasant farmers in Mukonchi area have adopted the growing of drought resistant crops such as sorghum, millet and cassava.

H_0 = Peasant farmers in Mukonchi area have not adopted the growing of drought resistant crops such as sorghum, millet and cassava.

OBSERVED FREQUENCES

	Sorghum	Millet	Cassava	
SAMPLES: Adoptors	6	12	3	21
Non-adoptors	34	28	37	99
	40	40	40	120

EXPECTED FREQUENCIES

Adoptors	$\frac{40\times21}{120}$ 7	$\frac{40\times21}{120}$ 7	$\frac{40\times21}{120}$ 7	21
Non-adoptors	$\frac{40\times99}{120}$ 33	$\frac{40\times99}{120}$ 33	$\frac{40\times99}{120}$ 33	99
	40	40	40	120

$$x^2 = \frac{d^2}{e}$$

$$x^2 = \frac{(6-7)^2}{7} + \frac{(12-7)^2}{7} + \frac{(3-7)^2}{7} + \frac{(34-33)^2}{33} + \frac{(28-33)^2}{33} + \frac{(37-33)^2}{33}$$

$$x^2 = 0.143 + 3.571 + 2.286 + 0.030 + 0.7.758 + 0.485$$

$$x^2 = 7.273$$

Level of significance = 0.05

.. $(2-1) \times (3-1) = 2$
$= 5.99$

From the calculations the null hypothesis should be rejected because the calculated value fo x^2 is greater than the critical value at the 0.05 level.

Therefore, it can be concluded that most of the farmers in Mukonchi area have not adopted the growing of drought resistant crops, sorghum inclusive.

H_1 = There is a significant relationship between drought and the adoption of drought resistant crops.

H_0 = There is a significant relationship between drought and the adoption of drought resistant crops.

OBSERVED FREQUENCES

		Drought periods	normal rain season	
SAMPLES:	Adoptors	5	35	40
	Non-adoptors	16	5	21
		21	40	61

EXPECTED FREQUENCIES

Adoptors	(21x40) / 61 / 13.77	(40x40) / 61 / 26.23
Non-adoptors	(40x40) / 61 / 26.23	(40x21) / 61 / 13.77

$$x^2 = \frac{d^2}{e}$$

$$x^2 = \frac{(5-13.77)^2}{13.77} + \frac{(35-26.23)^2}{26.23} + \frac{(16-26.23)^2}{26.23} + \frac{(5-13.77)^2}{13.77}$$

$$x^2 = 5.586 + 2.932 + 3.990 + 5.586$$

$$x^2 = \underline{18.094}$$

Level of significance = 0.05

.. $(2-1) \times (2-1) = 1$

$= \underline{3.84}$

The calculations shows that the null hypothesis should be rejected because the calculated value of x^2 is greater than the critical value at 0.05 level.

This means that there is no significant relationship between drought and the adoption of drought resistant crops.

H_1 = There is a significance relationship between access to extension workers and the adoption of sorghum

H_0 = There is no significance relationship between access no extension workers and the adoption of sorghum.