CONSERVATION AND UTILIZATION OF AGRO-BIODIVERSITY AT SMALL-SCALE HOUSEHOLD LEVEL IN MALAWI: A CASE STUDY OF BALAKA, NTCHEU AND MACHINGA DISTRICTS

MSC (BIOLOGY) THESIS

SIGFRIDO ROMEO

OCTOBER, 2005

The beginning of civilization depended on agriculture, so does its future…

CONSERVATION AND UTILIZATION OF AGRO-BIODIVERSITY AT SMALL-SCALE HOUSEHOLD LEVEL IN MALAWI: A CASE STUDY OF BALAKA, MACHINGA AND NTCHEU DISTRICTS

MASTER OF SCIENCE
(*BIOLOGY*)

by
SIGFRIDO ROMEO, B.Sc.

Submitted to the
Department of Biology, Faculty of Science, University of Malawi,
in fulfilment of the requirements for
Master of Science Degree in Biology

Chancellor College, Zomba
University of Malawi

October, 2005

The beginning of civilization depended on agriculture, so does its future…

La biodiversité est l'une des plus grandes richesses de la planète,
et pourtant la moins reconnue comme telle…

Edward O. Wilson, 1922, entomologist

American Forum on Biological Diversity
National Research Council (NRC), 1986

DECLARATION

I declare that the thesis is my own work and that it has not been submitted for a degree in any university. Acknowledgments have been made where work for other people has been used.

Signature…… Date…….

Sigfrido Romeo

We hereby declare that this thesis is the student's original work and where assistance has been sought this has been duly acknowledged. It is therefore submitted with our approval to the University of Malawi, as a fulfilment of the requirements for the degree of Master of Science in Biological Sciences.

Signature…… Date…….

Prof. Aggrey J. D. Ambali

Signature…… Date…….

Dr. Lawrence B. Malekano

Signature…… Date…….

Head of the Department of Biology

DEDICATION

First and foremost, to You, my Lord Jesus Christ, for the entire blessings which You have given to me from the beginning. Without You anything would be possible. Bless my parents, relatives, brothers, sisters, benefactors, benefactresses and all people of good will who have assisted me in this research. You always are in every step that I make.

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ACRONYMS and ABBREVIATIONS

ACP	African Caribbean Pacific
ADD	Agriculture Development Division
ADMARC	Agricultural Development and Marketing Corporation
AIDS	Acquired Immune Deficiency Syndrome
APIP	Agricultural Production Investment Program
CAMA	Consumers' Association of Malawi
CRS	Church Relief Service
CSB	Community Seed Bank
DAR	Department of Agricultural Research
DFID	Department for International Development
EPA	Extension Planning Area
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FSP	Food Security Programme
GDP	Gross Domestic Product
GMO	Genetically Modified Organisms
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
Ha	hectare
HIV	Human Immunodeficiency Virus
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICRAF	International Centre for Research in Agro forestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IPM	Integrated Pest Management
ISNAR	International Service for National Agricultural Research
MAFSP	Multi Annual Security Programme
MH	Malawi Hybrid
mm	Millimetre
MRFC	Malawi Rural Financial Company
NABW	National Association of Business Women
NFRA	National Food Reserve Agency
NGO	Non-Governmental Organisation
NRC	National Research Council

OPV	Open Pollinated Varieties
PRA	Participatory Rural Appraisal
PWP	Public Works Programme
RDP	Rural Development Project
SADC	Southern African Development Community
SGR	Strategic Grain Reserve
SC	Seed Company
SOLAGRAL	Solidarités Agricole et Alimentaires
SPE	Socio-Economic Profile
STI	Sexually Transmitted Infection
TIP	Targeted Input Program
TA	Traditional Authority
UNDP	United Nations Development Programme
US$	United State's Dollar
WB	World Bank

ABSTRACT

Poverty alleviation, especially among the rural people, is considered the overall aim of the Government of Malawi, while the acceleration of agricultural and rural development has been identified as the main strategy in order to fight against poverty. In this framework, food security has a crucial role.

Malawi has for the past decade been categorized as a food deficit country with an estimated 40% of the population being unable to satisfy its minimum daily energy needs of 2.200 kilocalories and 55% of the rural population suffering from chronic food insecurity. Likewise, under-nutrition has remained highly prevalent hence of major public health concern affecting development at all levels.

At the same time, the food security policy of the Government of Malawi underlines that, given the position of maize as the dominant staple, and the high cost of importing maize, national food security is very vulnerable to the periodic droughts that occur.

The number of traditional crop varieties (landraces) is diminishing, victimised by population growth, environmental change, and modern farming. Genetic diversity found in traditional farmer varieties – and in wild species – holds the key to conventional plant breeding, and to gene transfer projects in research laboratories. Without this diversity, science is unlikely to provide the technologies needed to ensure future food security and improve the lives of the rural and urban poor.

In this sectorial framework, where food security plays an important role in stability of the country, a field research was conducted in Balaka, Machinga and Ntcheu Districts to investigate the methods of conservation and utilisation of agro-biodiversity at small-scale household level.

Data were collected from two hundred (200) farmers and stakeholders in the three districts through individual household interviews using a structured questionnaire, unstructured questionnaire for focus group discussions and Participatory Rural Appraisal (PRA) methods.

Results show that farmers based their farming methods of conservation and utilization of agro-biodiversity at household level on traditional knowledge, previously adopted in their rural communities. Respondents selected seed from their own production, because the seed is kept safely and there is continuity of local breeds. Seed selection contributes to household food security

because the seeds sown are healthy and grow in good conditions, under a husbandry management and environmental factors, such as rain and fertility. In doing so, farmers are sure to preserve the biodiversity of the food crop varieties at household level. Other farmers preferred seed from the market, ADMARC or other companies, because farmers observe that the seed is well treated with chemicals and the susceptibility rate of this seed to weevils and pests is very low. Even the characteristics of flour are better in seed from market compared to seed from own production.

Farmers said that their household food security could improve if they have access to credit schemes, to buy seed, fertilizer and the possibility to learn new agronomic technologies for their farming production through training courses, and technical assistance by Government or other actors involved in agricultural activities.

On micro finance institutions, results show that farmers' access to credit schemes is very low, especially in Machinga District. This rate is higher in some villages in Balaka and Ntcheu Districts due to international organisations which have implemented rural development projects.

Results from Participatory Rural Appraisal method show that farmers plant maize (hybrid and local varieties), cassava (Mosaic Virus Free and local), groundnut, cow pea, pigeon pea, sweet potato, and vegetables. The results indicate that the conservation of agro-biodiversity at household level is maintained through the traditional knowledge of farming methods.

However, the utilization and conservation of agro-biodiversity at household level can be improved with financial inputs, such as certified seed, fertilizer, and technical assistance. In doing so, life standards can also be improved.

CHAPTER ONE

INTRODUCTION

1.1 PROBLEM STATEMENT

Malawi is a small landlocked country (118,480 sq km in area) in Southern Africa located between latitudes 9º to 18º S and longitudes 33º to 36º E, with approximately one third of its area covered by Lake Malawi (24,400 sq km). The population is about 11.6 million (World Bank, 2003).

A 2003 World Bank social indicator study ranks Malawi among the poorest countries in the world (as the sixth poorest globally, Human Development Index:0.387 [ranking 162nd out of 175 countries, 2003]), with an estimated 65.3% of the population below the poverty line of one US$ per person per day. The per capita income is around US$ 160 per year, which is the lowest in the Southern African Region.

In the absence of a variety of the other natural resources, agriculture is the predominant sector in the Malawian economy, relying on favourable climatic conditions and providing source of employment and income for the majority of the population which reside in rural areas (85%). Agriculture contributes about 35% of the country's Gross Domestic Product (GDP) and 90% of the foreign exchange earnings.

One of the objectives of the agricultural policy is to improve food self-sufficiency both at national and at household levels and to promote sustainable management of natural resources. However, evidence on the ground suggests that the performance of the agricultural sector in general and smallholder sub-sector in particular has faced a continuous and rapid decline over the years (Malawi Government, 1999).

Malawi Government (1999) reports that crop production is a key sub-sector in the national economy in terms of its contribution to food security. According to *Malawi National Land Policy, 2002*, the main staple food for the population is maize (*Zea mays L.*) with the exception of farmers along the northern lakeshore areas of Lake Malawi who grow cassava (*Manihot esculenta*) as the main food crop. Maize is grown on 80% of the arable land; it occupies about 70% of the cropped area. In Malawi food has become synonymous with maize without any regard to other important food crops such as cereals: rice (*Oryza sativa*), sorghum (*Sorghum bicolor*), finger millet (*Eleusine coracana*);

grain legumes or pulses, such as phaseolus bean (*Phaseolus vulgaris*), groundnut (*Arachis hypogaea*), soyabean (*Glycine max*), pigeon pea (*Cajanus cajan*), cow pea (*Vigna unguiculata*); root and tuber crops, such as cassava (*Manihot esculenta*), sweet potato (*Ipomea batatas* (see Table 1 for a typical hectarage allocation).

Table 1. Hectarage (ha) and production (Mt) of smallholder crops in Malawi (season 2001/2002)

Crop	Hectarage[1] (ha)	Production[2] (Mt)
Maize	1,504,760	1,899,185
Coffee	569,209	1,300
Pulses	512,381	310,537
Cassava	201,703	3,201,051
Sweet potatoes	190,947	2,534,896
Groundnuts	189,202	154,887
Tobacco	116,464	89,120
Cashew nuts	84,822	319
Sorghum	54,099	37,278
Rice	50,165	89,120
Cotton	48,481	40,637
Millet	34,169	19,926
Irish potatoes	21,163	285,850
Macadamia	17,966	142
Paprika	12,737	6,350
Sunflower	5,704	3,625
Chillies	4,974	2,350
Wheat	2,474	2,090
Sesame	940	381

(source: [1] Ministry of Agriculture, 2nd Round Crop Estimates; [2] Ministry of Agriculture, 3rd Round Crop Estimates (2001/2002))

All the food crops mentioned above represent an agro-biodiversity wealth, as well as heritage, which play an important role at household level and is critical in all farming systems. This agro-biodiversity is strongly linked to local communities, provides stability for the farming systems as well as helps in balancing yield variability within and among crops species.

Malawi Government (1999) further observes that despite the availability of technologies, like improved seed and chemical fertilizers, food crop production among smallholders farmers continue to decline. Leavy et al. (2000), report that a majority of smallholder farmers (65%) live below poverty line thus making them unable to afford the aforementioned technologies. As a result food crop productivity among smallholder farmers has been declining. Consequently, farmers fail to meet their annual food requirements.

In order to face the challenge of continued decline in food production, the Malawi Government in the past crop seasons introduced input distribution programs, such as Targeted Input Program (TIP), targeting the smallholder farmers with the aim of increasing food crop production. One of this input distribution programs was a Starter Pack Scheme, which was a free input distribution program for increasing food crop production. The scheme provided the smallholder farmers with high yielding varieties of maize seeds, legume seeds, chemical fertilizers and leaflets.

Several studies have been conducted on Starter Pack Scheme and evidence from such studies suggests that maize production increased in 1998/99 and 1999/00 as a result of the Scheme. For example, Tchale *et al.*, (2000) report that maize production was 2.86 million tons in 1998/99 season and approximately 2.3 million tons in 1999/2000 exceeding the required 1.6 million metric tons for Malawi. Other researchers reported that Starter Pack inputs contributed almost one quarter of the national maize production in 1999 and were expected to make a similar contribution in the year 2000.

Despite the above results, Starter Pack Scheme may not be sustainable because hybrid maize varieties and chemical fertilizers that were given to the farmers for free need to be bought yearly, yet the majority of smallholder farmers cannot afford to purchase the associated inputs. This could reduce maize production in future once the free packages are withdrawn as farmers fail to buy the technologies. Researchers have observed that hybrid varieties tend to use higher applications of chemical fertilizers, pesticides and insecticides than traditional or local varieties (Steven and Jabara, 1988). As such, the adoption of hybrid varieties tends to be slow because smallholder farmers have a weak financial base. Another important agronomical aspect is to have seed varieties that are well adapted to those areas where the seeds are to be used. In fact, a wrong choice of the area and the seed varieties can expose farmers to the risk of crop failure.

In harsh environments, with low soil fertility and productivity, lack of technical knowledge, and inputs, the need to increase crop yields is crucial if subsistence farmers are to survive, but so is yield stability. Resource-poor farmers must not be exposed to the risk of crop failure. In this framework, the conservation and utilization of agro-biodiversity, in terms of seeds and planting material, becomes very important, not only in terms of food security to eradicate hunger and ensure a daily food intake but, also in terms of heritage for the future of the next generations. Agro-biodiversity plays a crucial role in economic, social, and cultural life and development, not only in traditional societies but also in modern societies.

Conservation and utilization of agro-biodiversity are also strictly linked to the traditional knowledge especially in rural areas. Traditional knowledge is now widely recognised as having played and is still playing crucial roles in economic, social and cultural life in both traditional and modern societies. This recognition has heightened in recent years as a result of the increased awareness of the environmental crisis; the role of some modern technologies, production methods and products in contributing to this crisis; and a growing appreciation that local communities (especially those rural communities in developing countries) have a wide range of traditional knowledge, practices and technologies that are "environmentally sound and friendly" and that have been making use of the manifold and diverse biological and genetic resources for food, medicines and other uses (Khor, 2002).

In particular, the recent increased awareness of the value of genetic resources, in this case agro-biodiversity, and the need for its conservation and sustainable use, for present and future agriculture and provision of health care, has highlighted the role and critical importance of traditional knowledge. The knowledge of local communities, farmers and indigenous people on how to use the many forms and types of biological resources and for many functions, as well as on how to conserve these resources, is now recognised as being a precious resource that is critical to the future development or even survival of humankind (Khor, 2002).

This study focuses on conservation and utilization of agro-biodiversity at small-scale household level in Balaka, Machinga, and Ntcheu districts. Despite the importance of maize for improved household food security in the country, a particular attention was given to other food crops such as pulses, root and tubers and vegetables to understand how they are conserved and utilized by farmers.

1.2 OBJECTIVES OF THE STUDY

The main objective of the study was to investigate the extent to which farmers in Malawi have assumed and sustained the custodian and stewardship roles in the conservation and utilization of agro-biodiversity.

In view of the main objective, specific objectives of the study were to:

1) Document socio-economic characteristics of the farmers in the three districts.
2) Identify the agronomic characteristics of the farmers, in terms of food crops cultivated in the area and their technical knowledge of farming practices.
3) Document sources of seeds for the various crops grown and their knowledge of seed processing.
4) Document and assess conservation methods of seeds that farmers use.
5) Determine consequences of changes in environmental and socio-economic factors on agro-biodiversity conservation.

1.3 HYPOTHESIS

Agro-biodiversity and food security are strictly linked to each other.

The Malawi Government's objectives for improving food security level were to give inputs to farmers to improve soil productivity. Soil productivity is increased by increased soil fertility as a result of additional chemical fertilizers, nitrogen fixing leguminous crops and proper land management. It was envisaged that this would lead to long-term increased productivity whereby farmers will adopt their use, in terms of agro-biodiversity knowledge, and attain food security at household level.

1.4 JUSTIFICATION OF THE RESEARCH

Genetic resources are biological materials, plant and microbes that contain the hereditary information necessary for life and are responsible for their useful properties and ability to replicate. Agro-biodiversity can be defined as "*variety and variability of animal, plant and microbial organisms on earth that are important for food and agriculture*". It is an important sub-set of total genetic resources as it is the basis for food security and a fundamental feature of farming system

around the world. Also, genetic resources remain the basis for the improvement of agricultural crops (FAO, 1990).

Domesticated plants have been fundamentally altered from their wild relatives and they have been reshaped to meet human needs and wants. Crop genetic resources and agro-biodiversity are the result of thousands of years of evolutionary process. Two types of selection distinguish crop evolution, namely natural and artificial. These evolutionary processes must continue in order for agricultural systems to remain viable. Crop evolution has been altered by our enhanced ability to produce, locate and access genetic materials (ICARDA, 1996).

Both farmers and scientists have relied on genetic diversity present in crop plants that has been accumulated by hundreds of generations that have observed, selected, multiplied, stored and kept variants of crop plants. Many species, once plentiful, are now found in smaller number and some are considered to be threatened. Many species of medicinal and ornamental plants and timber have been over exploited. Some of the species are endangered. Genetic degradation occurs from more purposeful human action intended to increase food production.

Modern agriculture relies increasingly on a few improved varieties with a narrow genetic base displacing the traditional varieties. Thus traditional varieties are among categories of crop germplasm that have been under the threat of genetic erosion in the last 20-30 years. Transferring of indigenous knowledge from generation to generation in agriculture is being threatened because it is being replaced by modern scientific knowledge, influx of high yielding modern varieties and migration of people from villages to cities. The present generation, already accustomed to the modern technologies, is not prepared to carry the indigenous knowledge over the next generation (ww.fao.org/sd).

The importance of preserving the agro-biodiversity at household level is highlighted in some examples below in order to provide better understanding of the interactions among agriculture, rural communities, traditional knowledge, food security and other social and economic factors. Such interactions lead to improved household food security for rural communities.

Crop diversification is the growing of more than one crop by a farmer within the same season or year. In recent years crop failures and/or damage have been experienced because of drought, floods, pest and disease outbreaks, and other adverse weather conditions. As a result of these problems, it

has become necessary to grow more than one crop in order to reduce risks of crop failure. Where more than one crop is grown in the season, the farmer reduces the risk of total loss of food supply and cash return in the event of some of the crops failing, and also takes care of commodity price fluctuations.

Seed fairs are increasingly popular events for promoting agro-biodiversity. African interest in these was rekindled by exchange visits in the 1990s between Zimbabwe and Peru, where Seed Fairs are a traditional, spiritual and cultural mechanism for keeping seed diversity alive. Zimbabwean Seed Fairs are now annual events in many villages and the word spread to many countries throughout the continent. This has been achieved by informal information exchange, publications and through some formal NGO networks (www.fao.org/sd). In Tharaka, Kenya, for example, they are called Seed Shows and have been held annually since 1996, when they were initiated in an NGO project development area. In 1998, 29 women and 47 men as well as some community groups mounted displays. The total number of crop varieties displayed increased in 1998 to 149 from 134 in 1997. In 2001, 46 farmers displayed 206 varieties. Participants liked the seed show for many reasons: farmers can obtain rare crop varieties; they identify seed sources; it is a good forum for exchange of ideas on farming and exchange of seeds; farmers are exposed to national agricultural research work; the spirit of competition boosts farmer's morale and motivates farmers to diversify their crops indirectly enhancing food security; and it is a platform for interaction between farmers, students, researchers, extension staff and other development agents.

The Lake Zone and Arusha Region of Tanzania are among the areas that were affected by the 1999–2000 droughts. From mid-2000, Church Relief Services (CRS) Tanzania started receiving requests for food assistance (www.wfp.org) from dioceses around the world. However, it was already evident that free relief distribution is no longer the best option to help people recover from disasters. Therefore, CRS agreed with the affected households in communities to help them recover by providing them with seeds as a more sustainable way to produce not only their own food but also their own seeds for the coming seasons. The most vulnerable households were provided with vouchers to buy seeds at special seeds fairs that were organised within their respective villages. On one hand, local farmers and seed vendors were encouraged to bring whatever good seed they had for sale at the fair sites. On the other hand, beneficiaries of the vouchers were left free to buy seed of their choice, suitable for their farms and for the nutritional or economic needs of their families.

Although the project areas had severe droughts and crops failures, it was surprising to discover that certain community members had quantities of good seeds to sell at the fairs. The main lesson learnt is that the traditional seed system is very resilient and able to withstand even four years of drought. The seed fairs demonstrated that even though the seed coping mechanisms had collapsed for the more vulnerable in the community, there were still seeds available in the community to meet their needs.

The north-eastern region of Brazil is known for its dramatic periods of drought. At the state of Paraíba, the lack of water available to small farms represents a major constraint on the food security of the local community. In these systems, where family farm units are composed of home gardens, crop areas (corn, bean and cassava, mainly), pastures and orchards (especially banana and citrus) diversity is synonymous of food security. Farmer access to biodiversity, in terms of seeds, has been very difficult. The region's precipitation regime allows only one crop cycle per season and the reduced areas of the farms (most are under 5ha) does not provide enough seed production for feeding the family and keeping seeds for the next crop. Because of this, some local varieties have been lost. Two other factors contribute negatively to genetic erosion: farmers need to adopt crop varieties to meet market demands; government seed programmes where only a few commercial varieties are distributed.

In Malawi, limited studies on indigenous fruits have been conducted, especially by International Centre for Research in Agro-Forestry (ICRAF) and partners. These include ethnobotanical surveys, germplasm collections, seed germination and growth studies, propagation, quality and nutritional value and processing of selected species such as *Uapaca kirkiana, Sclerocrya birrea* and *Ziziphus mauritiana*. There is limited qualitative information on the conservation of germplasm, propagation, growth and yields of most indigenous fruit tree species. Currently, most indigenous fruits growing in farmers' fields were retained during land clearing and land preparation for agriculture or allowed to regenerate naturally. There is limited tradition of planting local species. Factors contributing to lack of planting of these tree include: poor understanding of their biology and genetic variation, the traditional concept that these fruits need not to be planted as they are a gift of nature, the perceived long period of waiting from planting to fruiting, lack of understanding for techniques to raise relevant planting stock from seed or vegetative parts, failure of seedling establishment due to lack of knowledge of management and the preference for exotic fruits (Horticulture in Malawi, 2001).

In this thesis, processes that smallholder farmers in Malawi have embarked on to preserve seed hence agro-biodiversity at household level were investigated and evaluated as important indigenous knowledge practices.

1.5 ORGANISATION OF THE THESIS

This thesis has been divided into five chapters as follows:

Chapter one provides background information to the study and it describes the problem, objectives, hypothesis, and justification of the research.

Chapter two presents the link between food security and agro-biodiversity in Malawi, the gender issues on food production, food security trends in various parts of the world, and the farmer's right.

Chapter three describes the methodology used in carrying out the research, sample size, sampling procedures, data collection and data analysis.

Chapter four presents results and discussion of the findings.

Chapter five outlines the conclusions, recommendations and suggested areas for future researchers.

CHAPTER TWO

LITERATURE REVIEW

2.1 AGRO-BIODIVERSITY

Biodiversity or biological diversity is a neologism from *bio* and *diversity*. It is the diversity of and in living nature. Diversity, at its heart, implies the number of different kinds of objects, such as species. The word biodiversity was first coined by the entomologist E.O. Wilson in 1986, in a report for the first American Forum on biological diversity organized by the National Research Council (NRC). The word *biodiversity* was suggested to him by the staff of NRC, to replace biological diversity, considered to be less effective in terms of communication.

The term *biological diversity* itself, was coined by Thomas Lovejoy in 1980. Since 1986 the term and the concept have achieved widespread use among biologists, environmentalists, political leaders, and concerned citizens world-wide. This use has coincided with the expansion of concern over extinction observed in the last decades of the 20th century.

There are three levels of biodiversity:

- Genetic diversity - diversity of genes within a species. There is a genetic variability among the populations and the individuals of the same species,

- Species diversity - diversity among species.

- Ecosystem diversity - diversity at a higher level of organization, the ecosystem (richness in the different processes to which the genes ultimately contribute).

The lattermost definition, which conforms to the traditional five organisation layers in biology, provides additional justification for multilevel approaches. If the gene is the fundamental unit of natural selection, thus of evolution, some, like E.O. Wilson, say that the real biodiversity is the genetic diversity. However, the species diversity is the easiest one to study.

Biodiversity has contributed in many ways to the development of human culture, and, in turn, human communities have played a major role in shaping the diversity of nature at the genetic, species, and ecological levels.

During the last decades, an erosion of biodiversity was observed. A majority of biologists believe that a mass extinction is under way. Although divided over the numbers, many scientists believe that the rate of loss is greater now than at any time in history. Some studies show that about one of eight known plant species is threatened with extinction. Every year, between 17,000 and 100,000 species vanish from our planet**.** Some people say that up to 1/5 of all living species could disappear within 30 years. Nearly all say that the losses are due to the human activities, in particular destruction of plant and animal habitats (ICARDA, 2000).

2.2 FOOD SECURITY AND AGRO-BIODIVERSITY IN MALAWI

Malawi, as one of the poorest countries in the world, receives substantial amounts of economic assistance from donors. The European Union (EU), with one of the largest allocation in any African Caribbean and Pacific (ACP) country, concentrates its development assistance on agriculture and natural resources in a framework of Rural Development Projects (RDPs).

The Food Security Programme (FSP), which started in 1995 as a pilot programme, was launched in 1997 with the aim of promoting national and household food security in the framework of market and economic liberalisation. Support to the people was given through several programmes, including safety nets such as the Public Works Programme (PWP), which provides employment opportunities in road rehabilitation, forestry and irrigation, and the Agricultural Production Investment Programme (APIP), which provides credit in kind for seeds and fertilizers to smallholders for food grain production. For instance, EU micro-projects on maize mill, also supported by the National Association of Business Women (NABW), were carried out in helping rural and urban community to improve their standards of living.

While the short-term results of the food security programme have been substantial, the long-term impact remains problematic, partly due to the fact the Malawi Government has not been able to develop a comprehensive food security policy. The EU has been the main donor supporting the government in replenishing and managing food reserves. The Multi Annual Security Programme (MAFSP) introduced a series of policy measures related to the Strategic Grain Reserve (SGR). A major step forward has been the establishment of the National Food Reserve Agency (NFRA),

which is now in charge of managing the SGR. The introduction of the NFRA is an important instrument in the Malawian food policy, and it represents a key for the future of food security. According to Malawi Government (1998a) by the year 2020, the country aspires to have adequate and safe food for all members of the households at all times of the year. The expectation is that this will be achieved through domestic production, conservation and utilization of seeds, and/or using cash to buy food from the local markets.

Agro-biodiversity conservation is a heritage at small-scale household level, which is also handed down through the traditional knowledge to the future generation. So it makes sense to use farmers' own varieties, also called landraces, which have characteristics of local adaptation. Agro-biodiversity is strictly linked to food security; moreover, food security depends on production, inputs, demands, incentives and trade as in all over parts of the world (Malawi Government, 1998). Furthermore, food security depends on availability, accessibility and utilization of the food. The Malawi government approach focuses on transferring resources such as inputs, to the poor to enable them to produce their own.

Despite the diversification of smallholder agriculture into cash crops and drought tolerant food staples, maize continue to dominate the smallholder cropping pattern, accounting for over 70% of the cropped area. However, maize productivity has stagnated over the past 15 years due to a decline in soil fertility and to increased incidences of drought. Assuring adequate maize production for the country is therefore a key component of national and small-scale household food security. But, increasing maize productivity depends critically on increased use of yield enhancing technologies, especially improved seed and fertilizer. Given that the majority of smallholders are poor, they cannot afford to purchase the improved seed and fertilizer, neither do they have any scope to increase the area planted to maize.

However, the adoption of improved and hybrid varieties is strongly recommended to smallholder farmers, alongside with other crop husbandry practices (crop rotation, agroforestry, soil conservation etc.) in order to increase food production through raising productivity (Guide to Agricultural Production, 2004). As stated previously, the adoption of hybrid varieties tends to be slow because smallholder farmers have a weak financial base, so that farmers are forced to rely back on their landraces. Consequently, studies concerning agro-biodiversity are functional to the achievement of the aim of food security at household level.

2.3 WOMEN AND AGRO-BIODIVERSITY

Giving due recognition

Chapter 24 of Agenda 21 (UNCED, 1992) recognises the importance of women to sustainable development and has as one of its key objectives the promotion of "the traditional methods and the knowledge of indigenous people and their communities, emphasising the particular role of women, relevant to the conservation of biological diversity and the sustainable use of biological resources" and the ensured "participation of those groups in the economic and commercial benefits derived from the use of such traditional methods and knowledge".

The Convention on Biological Diversity (UNEP, 1992) clearly recognises the "...vital role that women play in the conservation and sustainable use of biological diversity" and affirms "...the need for the full participation of women at all levels of policymaking and implementation for biological diversity conservation ".

FAO's Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (1996) acknowledges the role played by generations of men and women farmers and plant breeders, and by indigenous and local communities, in conserving and improving plant genetic resources. The Global Plan of Action promotes a more rational approach to in situ and ex situ conservation by focusing on developing links between conservation and utilization, and strengthening local capacities.

Gender Responsive Policies, Agreements and Support

Important international policies and legal agreements acknowledge the key role that women play, especially in the developing world, in the management and use of biological resources. Despite this increased recognition at international levels, little has yet been done to clarify the nature of the relationship between agro-biological diversity and the activities, responsibilities and rights of men and women. In fact, women's key roles, responsibilities and management practices for the conservation and improvement of animal and plant genetic resources and their intimate knowledge of plants and animals remain "invisible" to technicians working in the agriculture, forestry and environmental sectors as well as to planners and policy makers (FAO, 1998). The lack of recognition at technical and institutional levels means that women's interests and demands are given inadequate attention. Moreover, women's involvements in formalised efforts to conserve biodiversity remain low because of widespread cultural barriers to their participation in decision-making arenas at all levels.

Modern research and development and centralised plant breeding have ignored and undermined the capacities of local farming communities in modifying and improving plant varieties. With the introduction of modern technologies and agricultural practices, women have lost substantial influence and control over production and access to resources to men who benefit more from

extension services and have the ability to buy seeds, fertilizers and the required technologies (FAO, 1998).

Women as users and preservers of agro-biodiversity

As farmers, rural women are responsible for growing and collecting food and for deciding how to use diverse natural resources to fulfil daily household needs (crops and wild plants, tree products, wild and domesticated animals). To understand the importance of gender issues in plant and animal biodiversity we have to recognize that men and women have different roles within livelihood systems that comprise farms and gardens, common property resources, such as pastures and forested lands, as well as protected areas. In addition to staple food production in the fields, home gardens often provide a wide variety of vegetables, relishes and condiments. These home gardens are also experimental plots where women try out and adapt diverse wild plant and indigenous species. Research on 60 home gardens in Thailand revealed 230 different species, many of which had been rescued from a neighbouring forest before it was cleared (FAO, 1998).

Women are important contributors to Malawi's agricultural production. Approximately 75 per cent of all activities are conducted by women alone or with husbands. Almost 30 per cent of the households are headed by women. These women are household heads because of being widowed, divorced, abandoned, unmarried or in polygamy. In some households, men are engaged in off-farm activities. Many women whether single or married, are consequently, responsible for decisions and management of agricultural activities at household level.

Men and women hold different sets of knowledge

Through their different activities and resources management practices, men and women have developed different expertise and knowledge regarding the local environment, plant and animal species and their products and uses. These gender differentiated local knowledge systems play a decisive role in the in-situ conservation (in their natural habitat/ecosystem), management and improvement of genetic resources for food and agriculture because the decision of what to conserve depends on the know-how and perception of what is most useful to the household and local community.

Women's and men's specialised knowledge of the value and diverse use of domesticated crop species and varieties extends to wild plants that are used as food in times of need or as medicines and sources of income. This local knowledge is highly sophisticated and is traditionally shared and

handed down between generations. Through experience, innovation and experimentation, sustainable practices are developed to protect soil, water and natural vegetation, including biological diversity. This has important implications for the conservation of plant genetic resources.

Local knowledge and sustainability: some examples

A study of some Andean peasant communities in Peru showed that all family members harvest the crops but seed selection and reproduction for the next harvest and crop management and use (consumption, exchange or sale) are women's responsibilities. For centuries, peasant communities have organised seed fairs after the harvest to spread and exchange seeds. Women play a major role by identifying and presenting the best seeds and in this way nurturing the conservation and diversification of plant genetic resources. In the Encanada district of Cajamarca alone, up to 1600 accessions of 12 native Andean crops were presented in a 1993 seed fair. Although the Cajamarca Province is not the richest region in tuber diversity, local women recognise up to 56 potato varieties (FAO, 1998).

In parts of Zambia, cassava leaves are the main and sometimes the only dark leafy vegetable. Women are well acquainted with the local varieties and select them for their palatability, and their ease of harvest. Introduced varieties, promoted for their starch yield, are not as acceptable as leaf food and are too tall for women to harvest easily (FAO, 1998).

In Malaysia, among the Murut people, it is the women who are responsible for the management of planting materials, in making decisions on what planting materials to be used, time of planting, and in collection and storage of seeds. These women intentionally create pure lines. It is documented that among Karen women it is a common practice to exchange seeds with their relatives living in distant mountains. Some accounts reveal that women even walk for days after harvest season to visit their relatives and bring samples of the seeds that they have selected and developed. These seeds are then exchanged for seeds developed and selected by their relatives (FAO, 1998).

In smallholder agriculture, women farmers have been largely responsible for the selection, improvement and adaptation of plant varieties. The selection of certain varieties is a complex, multivariate process that depends on choosing certain desirable characteristics (for instance resistance to pest and diseases; soil and agroclimatic adaptability; nutritional, taste and cooking qualities; food processing and storage properties).

In Andra Pradesh state in India, individual women farmers and Sanghams, women's co-operatives, helped entomologists of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to carry out a successful pigeon pea (*Cajanus cajan*) programme to develop improved

pest resistant lines. Researchers examined women's traditional pea varieties and offered several lines that were resistant to the main enemy, the pod borer, and came closest to the farmers' seed preferences. The women assessed their performance not only in terms of yield but also on the basis of 10 different criteria including leaf production, pod borer damage, taste, wood biomass, quality market price and storability. Three of the four improved lines were rated by the women as being superior to their local varieties and were adopted to be grown alongside their own which they retain for superior taste.

Farmer's Rights

Through their daily activities, experience and knowledge women have a major stake in protecting biological diversity. However at national and local levels rural women today are still hampered by restricted rights to the resources they rely on to meet their needs. In general their rights of access and control over local resources and national policies do not match their increasing responsibilities for food production and management of natural resources.

Given that men and women farmers' knowledge, skills and practices contribute to the conservation, development, improvement, and management of plant genetic resources, their different contributions should be recognized and respected in terms of Farmers' Rights.

CHAPTER THREE

METHODS AND MATERIALS

3.1 LOCATION OF THE STUDY AREA

The research was carried out in the Southern Region of the Republic of Malawi, in the districts of Balaka, Machinga and Ntcheu. A total of 36 villages were studied in the three districts of which 16 were from Balaka, and 10 each from Machinga and Ntcheu (Fig. 1).

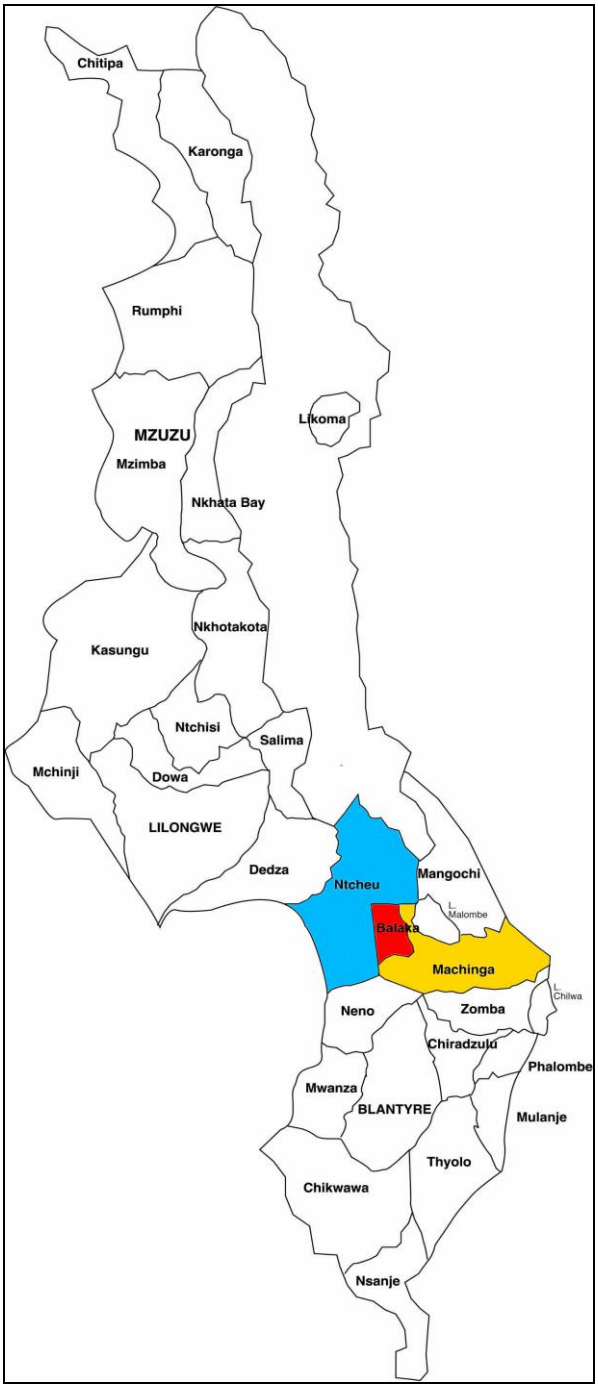

Fig. 1. Malawi and location of Balaka, Machinga and Ntcheu Districts

3.2 SAMPLE SIZE AND SAMPLING METHODS

The selection of farmers was randomly done in consultation with field assistants in the various Extension Planning Areas (EPAs) studied. A list of names households for each of the villages was provided by the Field Assistants. These were assigned numbers and randomly selected. Householders recruited for the study were randomly selected using the function =RANDBETWEEN(1,**y**) in the Excel programme, where **y** equal total number of households in the EPAs covered. In this case it was 300, 460 and 250 for Ntcheu, Balaka and Machinga, respectively (Table 2).

Table 2. Number of households provided for each of the districts

District and EPAs covered	Total number of households available for sampling	Number selected for the study
Ntcheu	300	60
Balaka	460	75
Machinga	250	65

The number of respondents selected for the study from each of the villages in the district is presented in Table 3.

Table 3. Distribution of the respondents among the selected villages in the three sampled districts

Balaka District	Number of Respondents
1. Chimpakati	7
2. Filini	8
3. Joshua	2
4. Kampeni	8
5. Kaniosa	4
6. Kaumphawi	2
7. Lile	2
8. Lupanga	4
9. Lupanga II	3
10. Matola	5
11. Matchereza	8
12. Mbera	8
13. Naweta	2
14. Phalula	5
15. Rosola	5
16. Utale II	2
Total	**75**
Machinga District	
1. Masapi	5
2. Mbarangwe	5
3. Milepa	12

4. Misoya	8
5. Mlelemba	5
6. Mpoya	8
7. Mwanadi	5
8. Namweta	5
9. Nkula	6
10. Nsanama	6
Total	**65**
Ntcheu District	
1. Bonongwe	5
2. Kadodwa	5
3. Kaloga	8
4. Kausinda	5
5. Kauvangoma	5
6. Makoswe	5
7. Matale	5
8. Mikoke	12
9. Njobvu	5
10. Saiwa	5
Total	**60**

3.3 DATA COLLECTION METHODS

Data were collected through individual households interviews, focus group discussions, key informants interviews, and governmental offices' reports and statistics.

Individual household interviews were used to collect quantitative data among 200 households using structured questionnaire. The household head was the respondent. The interviews were carried out in local languages, Chichewa and a few in English when the interviewees preferred so. Notes were taken during or immediately after discussions, interviews, remarks and observations. Field notes and recorded interviews were transcribed into English and were incorporated into the classified themes. In this research, in particular, some questions were implemented on whether household food security improved independent of socio-economic and agronomic factors or not; on whether decline in growing local food crops was independent of socio-economic and agronomic factors or not; and on whether traditional knowledge and farmers' willingness to continue using other inputs, would depend on socio-economic and agronomic factors or not.

Qualitative methods for data collection play an important role in impact evaluation by providing information useful to understand the processes behind observed results and assess changes in people's perceptions of their well-being. Furthermore qualitative methods can be used to improve the quality of survey-based quantitative evaluations by helping generate evaluation hypothesis; strengthening the design of survey questionnaires and expanding or clarifying quantitative

evaluation findings. In each village, two focus group discussions were conducted using unstructured questionnaire to collect qualitative data including methods used to select, process, store, share and replenish germplasm. These groups developed the general indicators of socio-economic and productive variations in the area to understand the methods of conservation and utilization of the agro-biodiversity, seeds and plant material, at household level.

Ten field assistants knowledgeable of lands and habits as well as seed, planting material and plant species identification, were selected as key informants from different communities. Key informants, and transect walk/observations were utilized as sources of planting material knowledge and cultivar identification. This approach provided a sufficient check for harmonizing the lands, food crop, local names and other.

The primary data were mainly collected from the structured and unstructured questionnaires that were presented to rural communities. Secondary data/information were collected from reports of all various government departments and outside the districts, non-governmental organizations (NGOs), parastatal working in the districts, business and rural communities. The cooperation of all these organizations was critical in the production of this research. A reconnaissance survey in Balaka, Machinga and Ntcheu districts was carried out through the governmental offices (Agriculture Development Division (ADD), District Administrations, and Departments) to obtain specific information on the areas investigated, in terms of socio-economic and productive profiles, especially on the agricultural sector.

3.4 DATA ANALYSIS

Data collected were in two forms: quantitative and qualitative. Quantitative data included demographic structures, income levels, education, types of crops, and production trends. Qualitative data on the other hand included methods used to select, process, store, share and replenish germplasm.

Data were subjected to descriptive statistical analysis where means, percentages, standard deviation and standard errot were calculated. Some data were presented in graphical form as pie-charts. The statistical Microsoft Excel software was used for data processing and analysis. Test for significance among means was done using $X \pm 2SE$ as 95% confidence interval.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the results of the research. Specifically, the survey analyses and discusses the socio-economic characteristic of the farmers, their agronomic characteristics, the source of seed and their knowledge of seed processing, their farming methods on conservation and utilization of seed for food crops production at household level in the selected villages of the three districts.

4.1 SOCIO-ECONOMIC CHARACTERISTICS OF THE FARMERS IN THE THREE DISTRICTS

Location and size

Balaka and Machinga Districts are located in the Southern Region of the Republic of Malawi, while Ntcheu District is one of the nine districts in the Central Region. Balaka District is bordered by Ntcheu to the North, Mangochi to the East and Machinga, Zomba and Mwanza to the South (Fig. 2); Machinga District is located between Lakes Chilwa, Chiuta and Malombe and shares a common boundary with Mangochi District in the North, Zomba District in the South, Balaka District in the West and the Republic of Mozambique in the east (Fig. 3); Ntcheu District borders Mozambique to the West, Dedza District to the North, Mwanza District to the South, Balaka District to the South-East and Mangochi District to the North-east (Fig. 4).

Balaka district covers an area of 2,193 square kilometres representing 2.4 percent of the total land area of Malawi. It is the 20th largest district in the country and the seventh largest in the Southern Region. The total land area of Ntcheu district is 3,424 square kilometres, representing 3.63 percent of the total land area of Malawi. Based on the 1998 Population and Housing Census, Machinga District has 369,614 inhabitants (Machinga District SEP, February 2001). With its total land estimated at 3,771 square kilometres, population density is placed at 98 persons per square kilometre, making the fourth least densely populated district in the Southern Region.

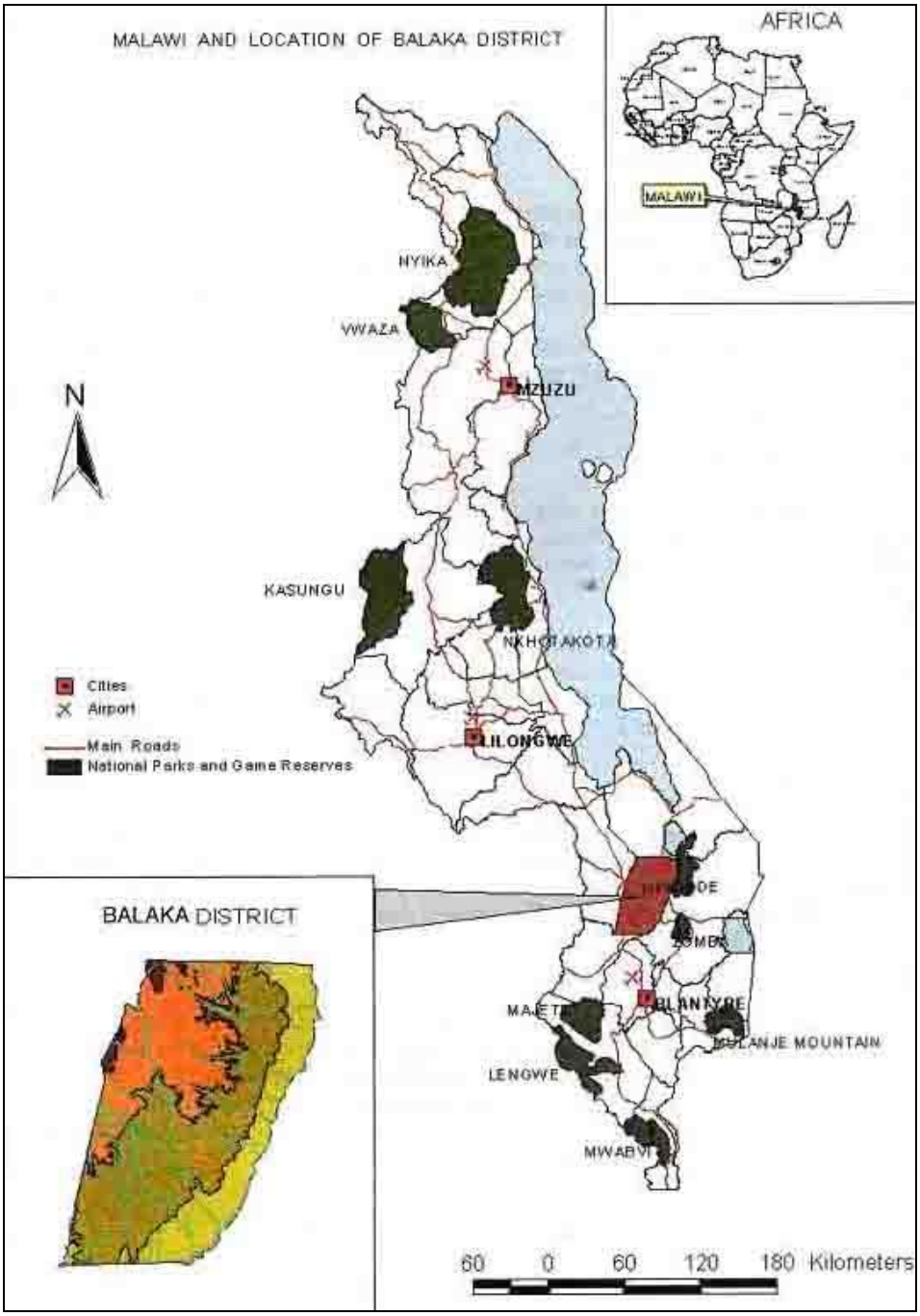

Fig. 2. Location of Balaka District
(source: Balaka District Socio-Economic Profile, August 2003)

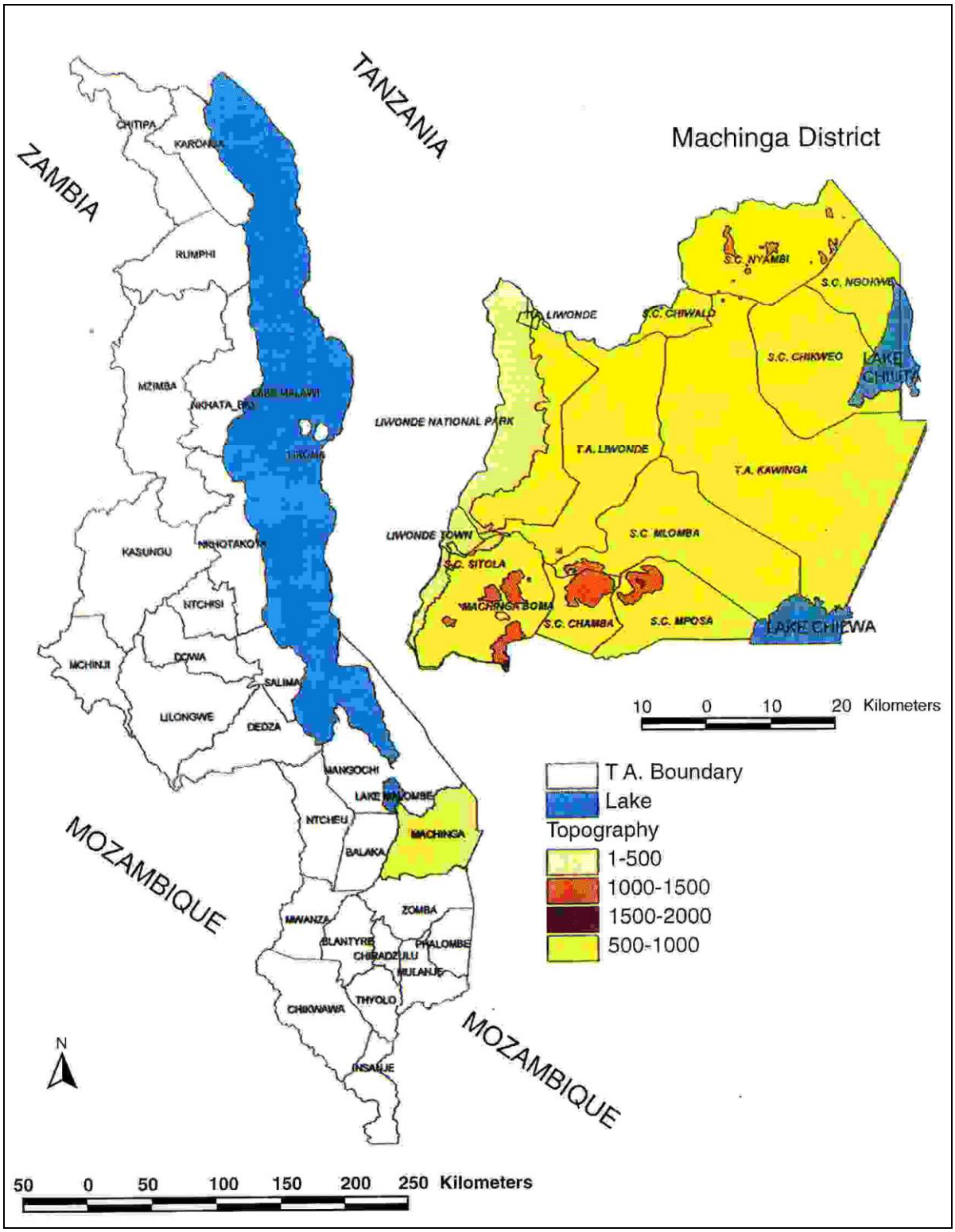

Fig. 3. Geographical location of Machinga District
(source: Machinga District Socio-Economic Profile, February 2001)

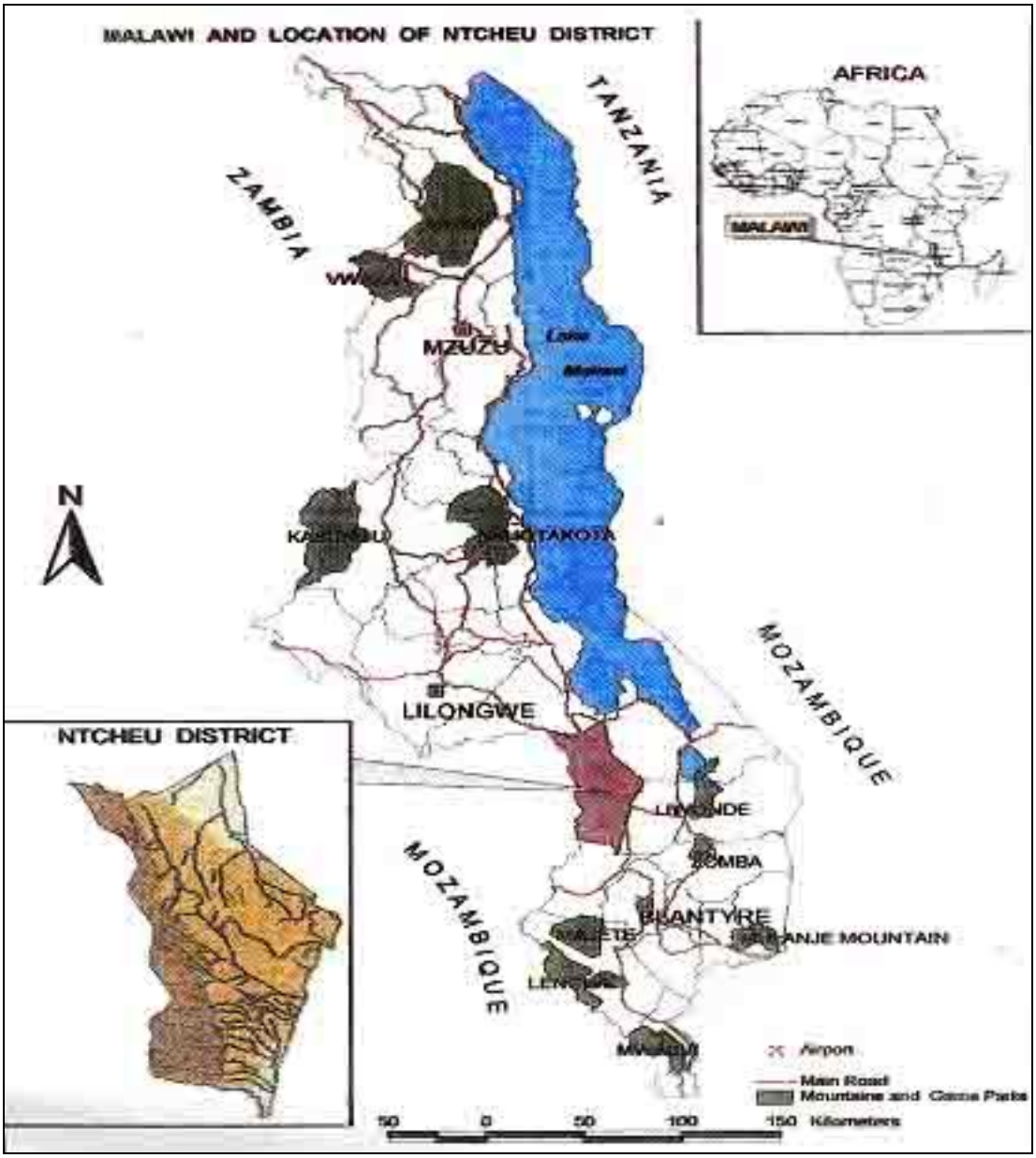

Fig. 4. Geographical location of Ntcheu District
(source: Ntcheu District Socio-Economic Profile, April 2001)

Tribes and Languages

The predominant tribe in Balaka District is Yao constituting 50% of the population while the remaining 50% consists of Ngoni, Lomwe, Man'anja, and Chewa. The Yaos are in majority also within the Machinga District, accounting for about 50 % of the population while the Lomwes comprise about 7 %. There are also minor tribes of Nyanjas and Ngonis accounting for about 6 and 4 % of the district's residents, respectively. Ncheu District has a rich culture as a result of the coexistence of 3 ethnic groups, namely, Yao, Chewa and Ngoni. Of the said ethnic groups, most people predominantly come from the Ngoni tribe.

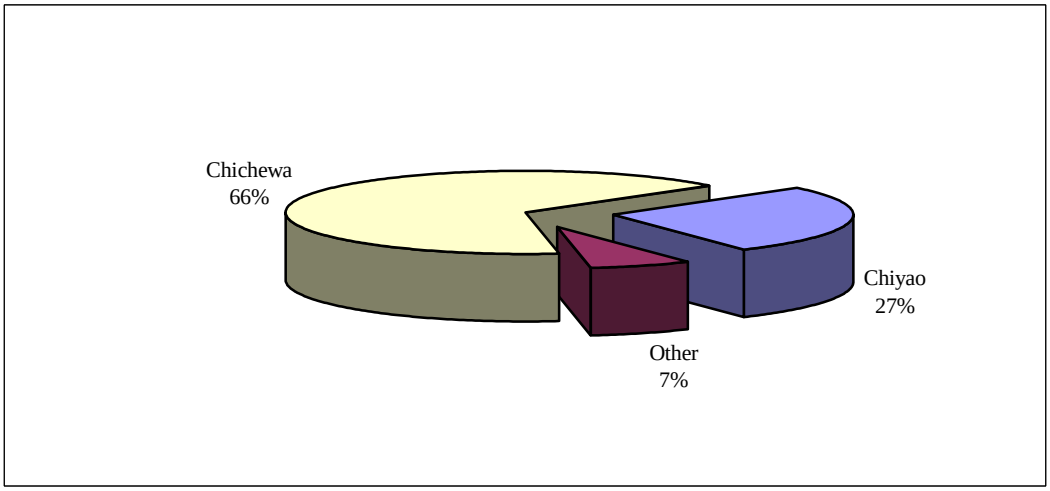

Fig. 5. Proportion of population by used language (Balaka District)
(source: Balaka District Socio-Economic Profile, August 2003)

As the Fig. 5 suggests, the main language spoken in Balaka District is Chichewa/Chinyanja with 66% of the people while Chiyao is spoken by 27% of the population. Other languages include Chingoni, (4%,) and Chilomwe (3%). The major language in use in Machinga District is Chiyao; despite the prevalence of the Ngoni tribe, Chichewa is the most common language in Ncheu District. (Table 4).

Table 4. Major used languages in the three Districts

Languages	Balaka (%)	Machinga (%)	Ntcheu (%)
Chichewa/ Chinjaya	66	36	68
Chiyao	27	55	15
Chilomwe	3	7	2
Chinoni	4	2	15
Total	**100**	**100**	**100**

(sources: Balaka District Socio-Economic Profile, August 2003, Machinga District Socio-Economic Profile, February 2001, Ntcheu District Socio-Economic Profile, April 2001,)

Characteristics of the households

Specifically, in the research carried out in the 36 selected villages, of the sampled 200 households, 30% of the respondents were male and 70% were female. 81% of their families are male-headed household (MHH), while 19% are female-headed household (FHH) as shown in Tables 5 and 6.

Table 5. Percentage of head of family per district

Head of Family	Balaka (%)	Machinga (%)	Ntcheu (%)	Total (%)
Female (38)	17	18	34	19
Male (162)	83	82	66	81
Total (200)	**100**	**100**	**100**	**100**

Table 6. Sex of the head of family per district

Head of Family	Balaka	Machinga	Ntcheu	Total	Percentage (%)
Female	13 (17%)	13 (20%)	12 (20%)	38	19
Male	62 (83%)	52 (80%)	48 (80%)	162	81
Total	**75**	**65**	**60**	**200**	**100**

The study found out that the average household size is six people per family (Table 6), which is higher than the national average of 4 people and the average number of people per household in agriculture sector which is 5 (Malawi Government, 2000).

As shown in Table 7, the average household size was not significantly different among the three districts:

Table 7. Average household size in the three districts

Balaka	Machinga	Ntcheu
5,9 ± 0,30	5,5 ± 0,27	5,5 ±0,29

A majority of the respondents (80%), that get their income from the farm, earn an average income of less than MK 5,000 per annum (Table 8). Yet this is less than the country's per capita income of US$ 160 that is approximately MK 17,000 (World Bank, 2002; Economist Intelligent Unit, 2003). This result suggests that generally speaking, these households are low-income families. These farmer groups with low-income levels need continual supply of safety nets.

Table 8. Average income levels in the three districts

Balaka	Machinga	Ntcheu
3.250 ± 140,15	3.165 ± 121,7	4.580 ± 42,3

Data collected show that at least 70% of the respondents were married (85.3 in Balaka, 78.4 in Machinga and 70.0 in Ntcheu). 78% of the householders had no education, with 22% having primary school education and only 10% had secondary school education. Kydd (1989) reports that people with high education level tend to adopt new technology more than those with low education or those with no education at all. Kydd further observes that education has been used as a tool for adopting new technologies or innovations faster. With this high rate of illiteracy in the investigated districts the new technologies or innovations are not expected to be adopted fast enough. At the same time the simple distribution of leaflets, concerning innovation in agricultural activities, among such farmers and without non-specific training courses does not give the expected results.

The several social-economic surveys carried out in Malawi evidence the link between the high rate of illiteracy and large household size: the same result could be observed in the area. This might explain why very often the food produced by the previous growing season finishes before the next harvesting season. Farmers need more food to be produced or brought to meet the needs of the large household.

Table 9. Food security in the 36 selected villages, Balaka, Ntcheu and Machinga Districts, 2004

District	Food secure months in 1 year (%)
Balaka	71,2%
Machinga	77,6%
Ntcheu	51,5%

As Table 9 shows, respondent farmers in the three districts report to experience at least four months of food insecurity through an average season; the most affected district being Ntcheu, with six months insecure out of twelve.

4.2 AGRONOMIC CHARACTERISTICS OF THE THREE DISTRICTS

Topography and Drainage

Balaka District is on the eastern edge of the Great Valley, hence has a varied topography ranging from an elevation of about 350 to 800 meters above sea level. The district has 3 main types of topographical features comprising plateaus, ridges and natural drainage system.

The most conspicuous and dominant physical feature of the district are the plateaus with isolated hills found around the district. Major rivers in the district are: Shire, Rivirivi, Livulezi. Most of the other rivers/streams are seasonal. These natural drainage channels are narrow with steep slopes (Fig. 6).

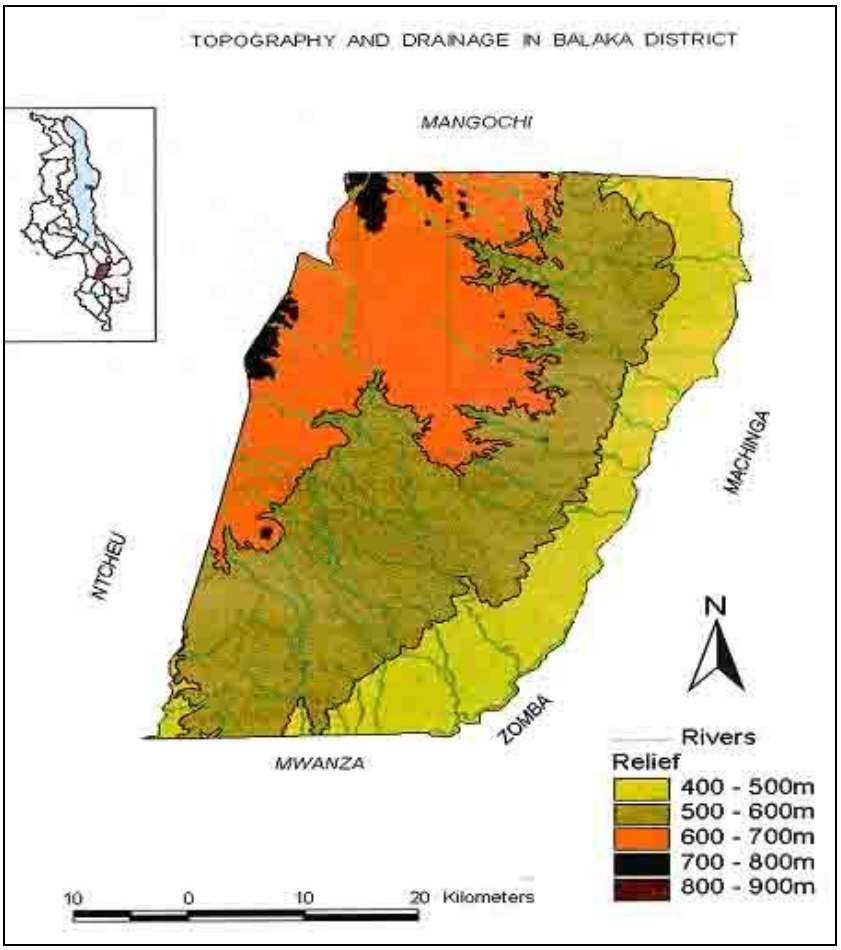

Fig. 6. Topography and Drainage in Balaka District
(source: Balaka District Socio-Economic Profile, August 2003)

Machinga District can be divided into five major topographical characteristics, which vary at altitudes of 400 to 1,100 metres above sea level (Fig. 7). The first of these characteristic features is the Shire River that forms part of the Great Rift Valley traversing from the North to the South of Malawi. The Shire River is also common boundary between Machinga District and Balaka District. The second topographical characteristic is Liwonde National Park spreading over 596 sq. km. East of the Shire River and South of Lake Malombe. The area occupies generally a flat terrain in the rift valley floor. Machinga's third characteristic feature is the mountainous and hilly zones of Malosa-Chikala-Chinduzi-Liwonde Forest Reserve, Ntaja Escarpment and Lungwe hills in Nyambi area. Much of these areas contain mountainous terrain with gradients of more that 12 percent and flat-bottom valleys with slopes of less than two percent. The fourth major topographical characteristic is the Kawinga Plains, which has a gradient of less than two percent. The plain is drained by Mpiri, Mikoko, Lifune and Sankhwi Rivers, which flow into the Lake Chiuta and Lake Chilwa Marshes. The two lakes form the district's fifth major topographical characteristic. With the exception of the natural mound running East to West, dividing the marshes and providing a transportation corridor

through to Nayuchi, the area is flat and featureless. Bordering the Chilwa and Chiuta Marshes are strips of seasonal Marshes.

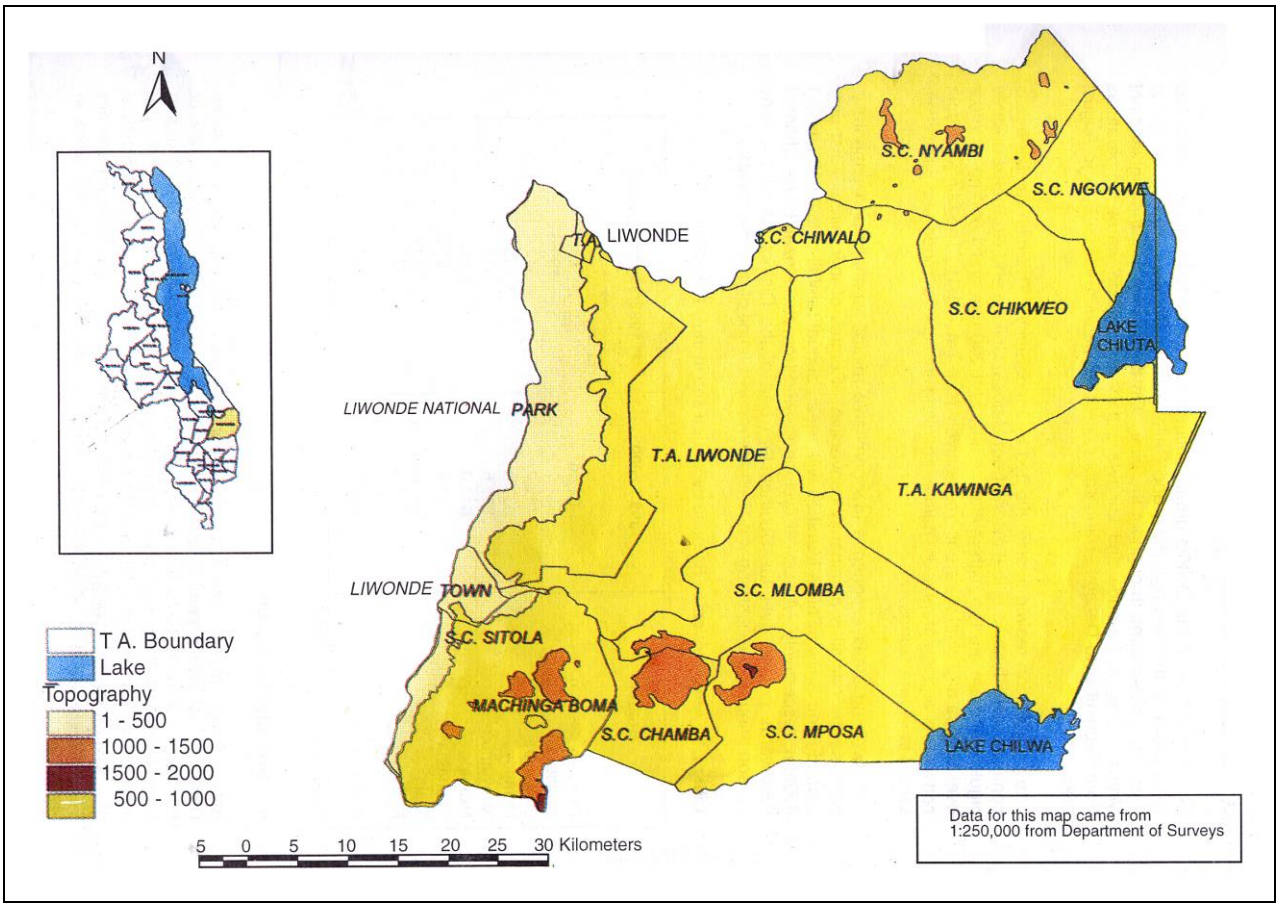

Fig. 7. Topography map of Machinga District
*(source: Machinga District Socio-Economic Profile, February 200*1)

There are two distinct terrain patterns in Ntcheu District. The first is the Bwanje Valley that is located in the eastern part of the district. The valley has alluvial soils very suitable for agricultural production. The second is the Kirk Range. This is an upland area that lies along Malawi and Mozambique border. The Kirk Range extends from Tsangano to Lizulu (Fig. 8).

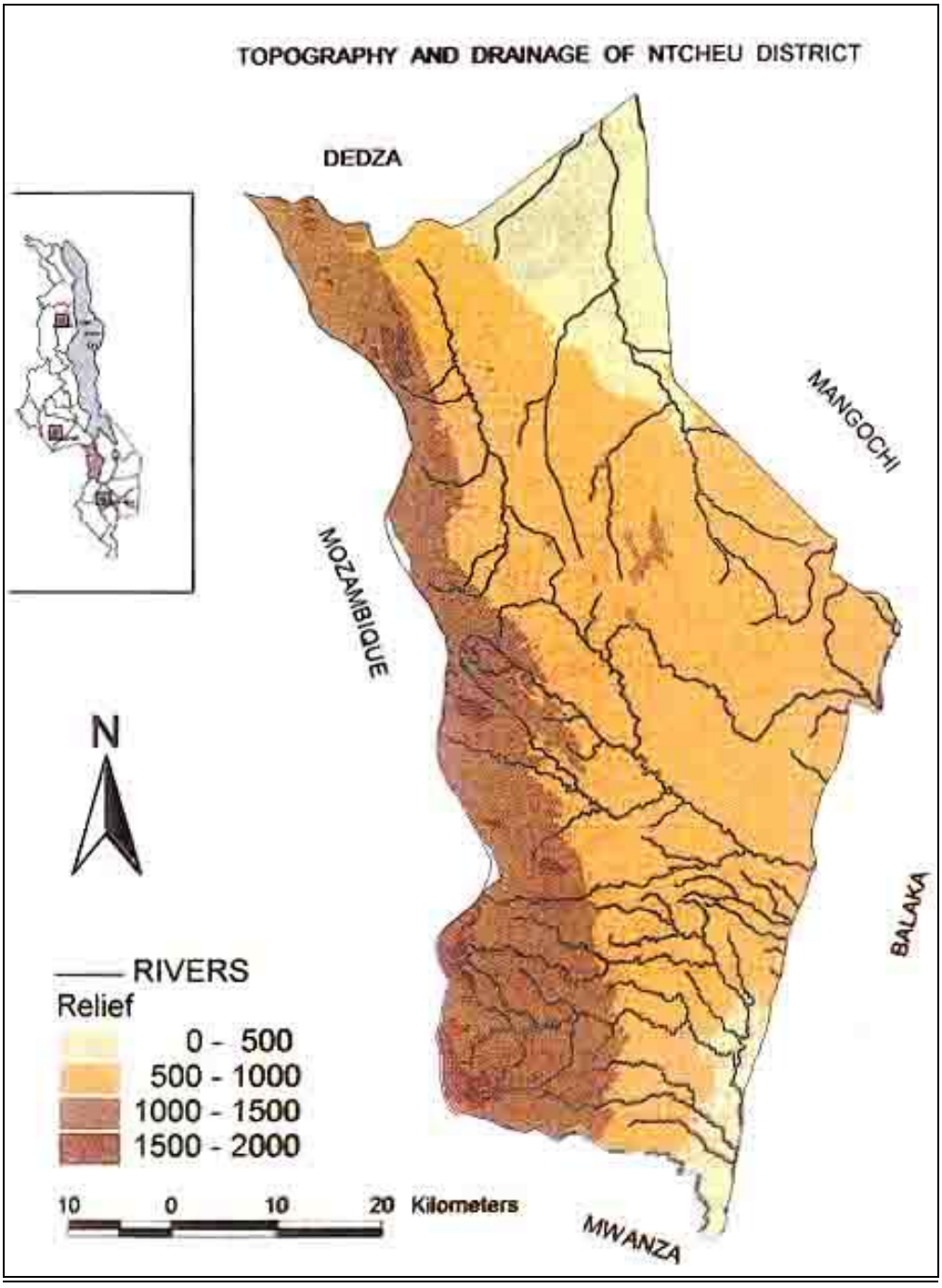

Fig. 8. Topography and Drainage map of Ntcheu District
(source: Ntcheu District Socio-Economic Profile, April 2001)

Climate

The three Districts experience two distinct seasons. There is a cool dry season (*masika*) that runs from June to August and a rainy season (*dzinja*) from October to April. May and September are transitional months. Most of the rains fall between December and March. The earliest dates for the start of planting rains fall in the last 15 days of November to the first 15 days of December (Fig. 9). The best time for rain-fed agricultural production is between December and March when soils are moist.

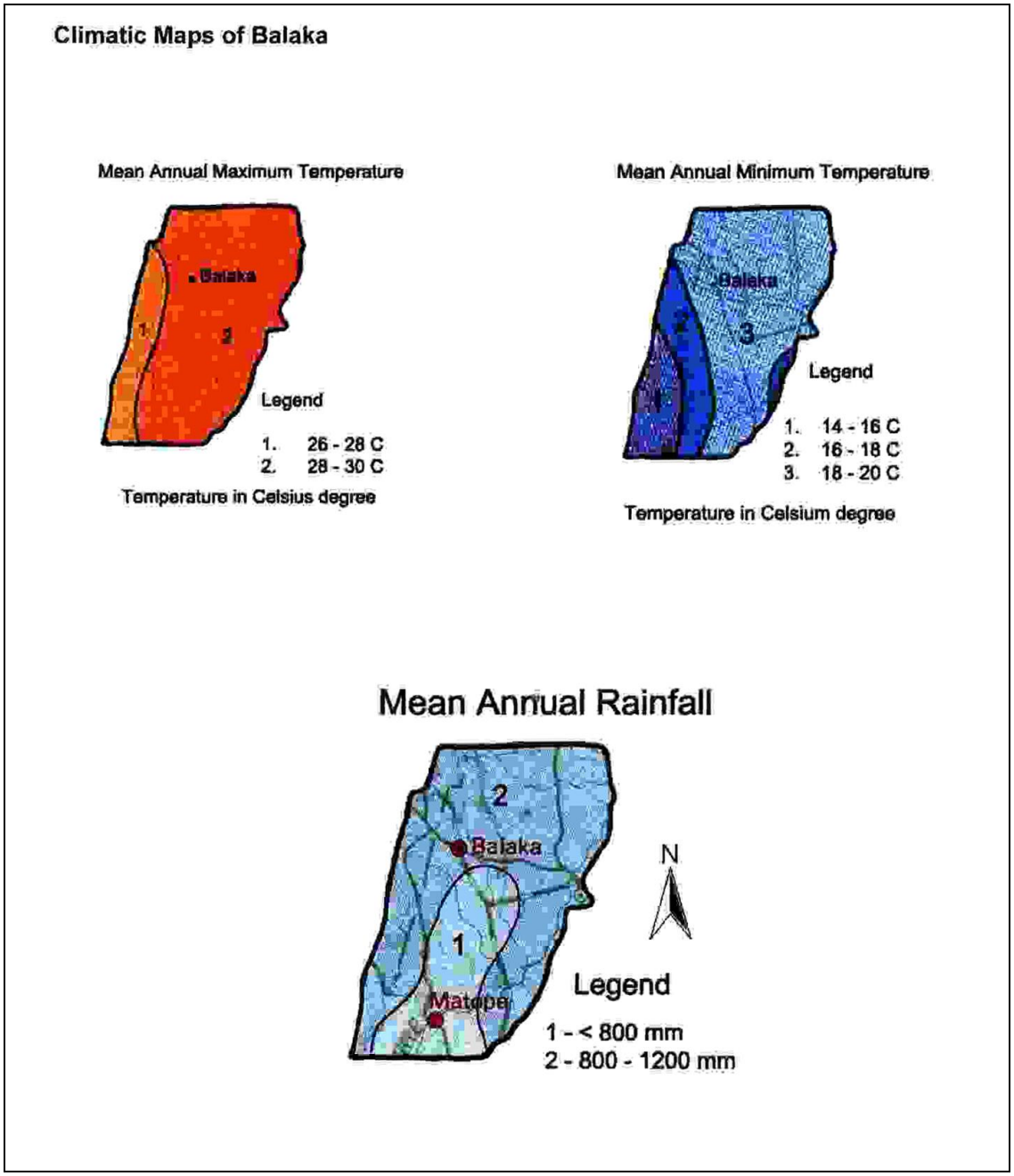

Fig. 9. Climatic maps of Balaka District
(source: Balaka District Socio-Economic Profile, August 2003)

The average annual rainfall for the Ntcheu district is 900 mm, while for Balaka area the average annual rainfall is approximately about 450 – 600 mm/year. Rainfall data recorded in the 2003/04 season show a quantity of rain of about 551 mm (raingauge located at Andiamo Youth Cooperative by Chimanga Project). During the previous agricultural season, the quantity of recorded rains was about 805 mm. The Balaka district generally experiences hot to warm climate with mean annual temperature of 27 °C. Highest temperatures are experienced in areas close to Shire River between Balaka and Machinga districts. The lowest temperatures in the district are normally experienced in

June and July while blowing a cool dry wind from Mozambique called Chiperoni Wind. The highest temperatures are registered in October and November.

The topography of the Machinga District greatly influences its thermal regime. Thus low lying areas of the Kawinga Plain and Chilwa/Chiuta Marshes experience hot to very hot temperatures throughout the year. On the other hand, the highlands of Malosa, Chikala, Liwonde and Lungwe experience mild to warm temperatures from September to December and cool to cold temperatures from May to August. The precipitation regime is also affected by topography. The high rainfall belt is confined to the highlands that extend from Malosa, Chikala and Northeast towards Ngokwe. There are two high rainfall centres of 1,200 mm and 1,000 mm or more over Malosa and Ngokwe areas, respectively (Table 10). The rainfall is both convective and orographic in nature, resulting in light to moderate intensities, except in severe storms. The low-lying areas experience low unreliable rainfall, spatially and temporally, because the rainfall is dominantly convective. Centres of low rainfall exist over Liwonde and Chilwa/Chiuta Marshes with mean annual rainfall below 750 mm and 800 mm, respectively. A tropical cyclone moving from the Mozambique Channel Westwards passes over the South-eastern part of the District during the rainy season bringing with it strong winds and torrential rainfall of high intensities.

Table 10. Annual average rainfall, by station and in mm; 1998-2000 (Machinga)

Station	1999 / 2000	1998 / 1999
Chikweo	1,047.8	1,175
Kwilasya	651.7	589.3
Lambulira	789.1	845.2
Nampeya	632.1	746.8
Nanyumbu	835.5	833.6
Nkapa	842.2	1,152.4
Nsanama	747.4	901.2
Ntaja	1,076.2	899.2
Ntubwi	777.4	987.6
Mean	**822.1**	**903.4**

(source: Kawinga RDP, 2000. Machinga SEP, 2001

Because of the varying topography, Ntcheu District also experiences varying temperatures. Temperatures along the Kirk Range are generally warm, with mean annual temperatures of 15 to 20 °C. The temperature at Ntcheu Boma is within the range of 18 to 23 °C. Temperatures within the Tsangano area are generally very cold, sometimes even reaching freezing point during the winter season (May-July). Temperatures in Bwanje Valley are generally above 30 °C and considered to be highest in the district. In general, May and July are the coldest periods for Ntcheu District while

September and November are the warmest. As in most districts in Malawi, the rainfall season for Ntcheu District runs from December to April. The annual rainfall ranges from 600 mm to 1200 mm. However, the rainfall pattern varies significantly depending on altitude. The valley has a mean rainfall of 600 mm while the plateau area has relatively higher rainfall.

Soils and Geomorphology

The soil is important natural resource that together with climate, form resource basis for the agriculture on which much of the wealth of the country depends. According to different types of information recorded on sediments and rocks a wide variety of soils have developed in Balaka, Machinga and Ntcheu District that vary from area to area (Figure 10b). By walking among the villages, recording specific information from the Balaka, Machinga, and Ntcheu District Socio-Economic Profiles (SEP, August 2003 and February 2001 editions) and cross-checked with the National Atlas of Malawi, (1983 edition), the main soil types in the three districts are represented by:

- Mopanosols: is a local name given to soils covered by the tree *Colophospermum mopane*. They are compact, alkaline, dark grey sandy clays, with free calcium carbonate, have low permeability and a coarse sand fraction.
- Ferruginous soils: they are red, with a sandy clay loam topsoil over a sandy clay or clay subsoil, weakly to moderately acid.
- Alluvial soils: they are grey to brown, neutral to weakly alkaline, and often have horizon of free calcium carbonate at depth. The texture is variable as a result of deposition and they frequently occur in association with gleys on low-lying sites.
- Weathered Ferralitic soils: also known as “plateau” or “sandveld soils”, they are yellowish red to yellow or brown, sandy in texture and weakly to moderately acid. They have a low neutral fertility and became rapidly exhausted, but can be farmed with either fertiliser inputs or fallow periods.

Ferruginous and Alluvial soils (Fig 10a) with a prevalence of Ferruginous soils are found in the Eastern part of the Balaka district and Alluvial soils in the Central and Western part.

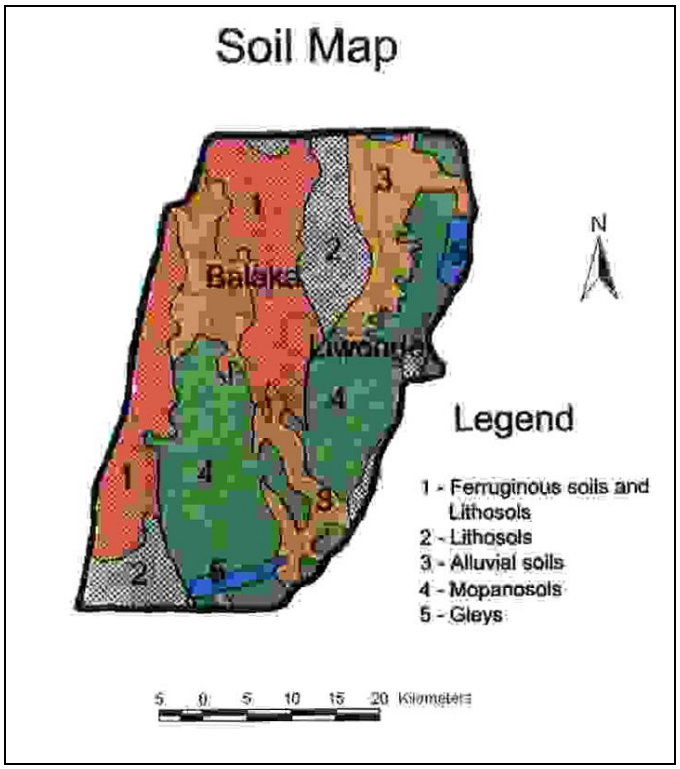

Fig. 10a. Soil map of Balaka District
(source: Balaka District Socio-Economic Profile, August 2003)

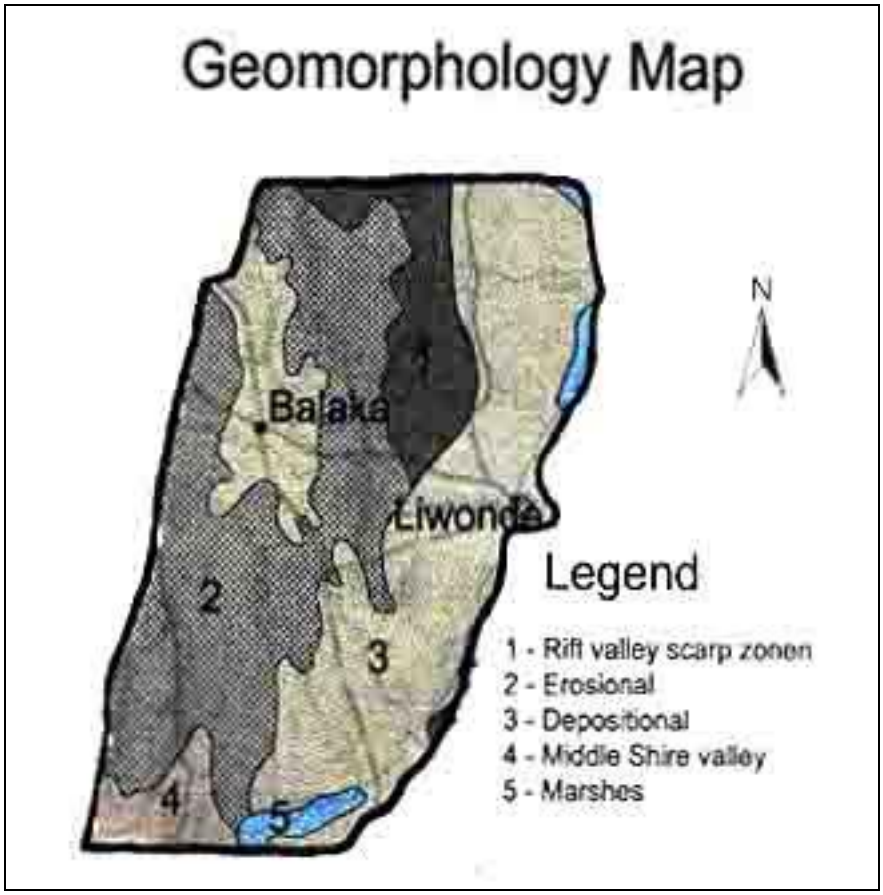

Fig. 10b. Geomorphology map of Balaka District
(source: Balaka District Socio-Economic Profile, August 2003)

The main soil types in the Machinga District and around the selected villages are represented by Mopanosols, Alluvial soil, Lithosols and Weathered Ferralitic soils.

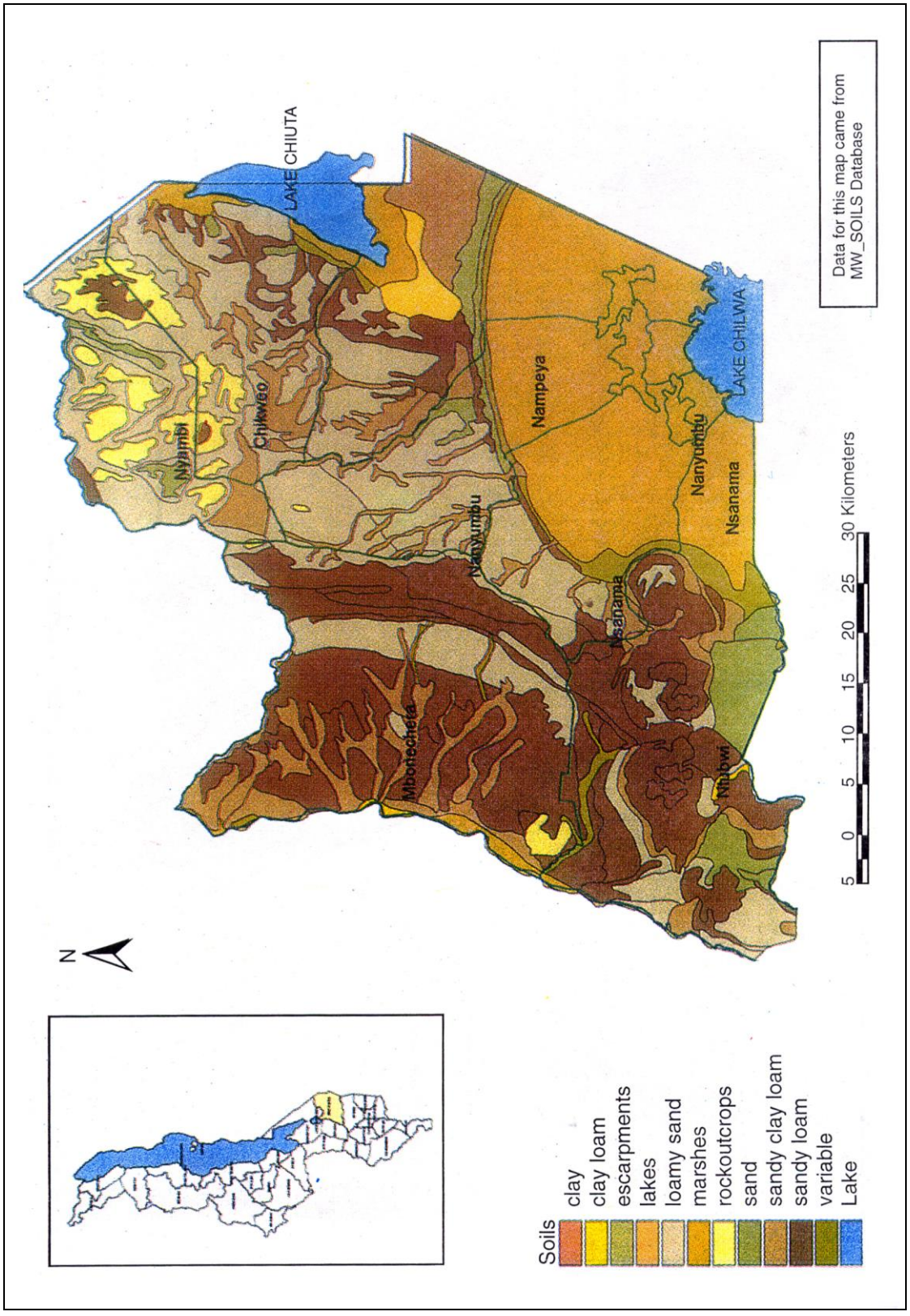

Fig. 11. Soil types in Machinga District
(source: Machinga District Socio-Economic Profile, February 2001)

Ntcheu District has soils that vary with altitude. The plateaus have either Ferruginous soils with Lithosols or Ferallitic soils with moderate structure and acidity. The escarpment, on the other hand, has either sandy soils with Lithosols or stony Ferruginous soils (Fig. 12).

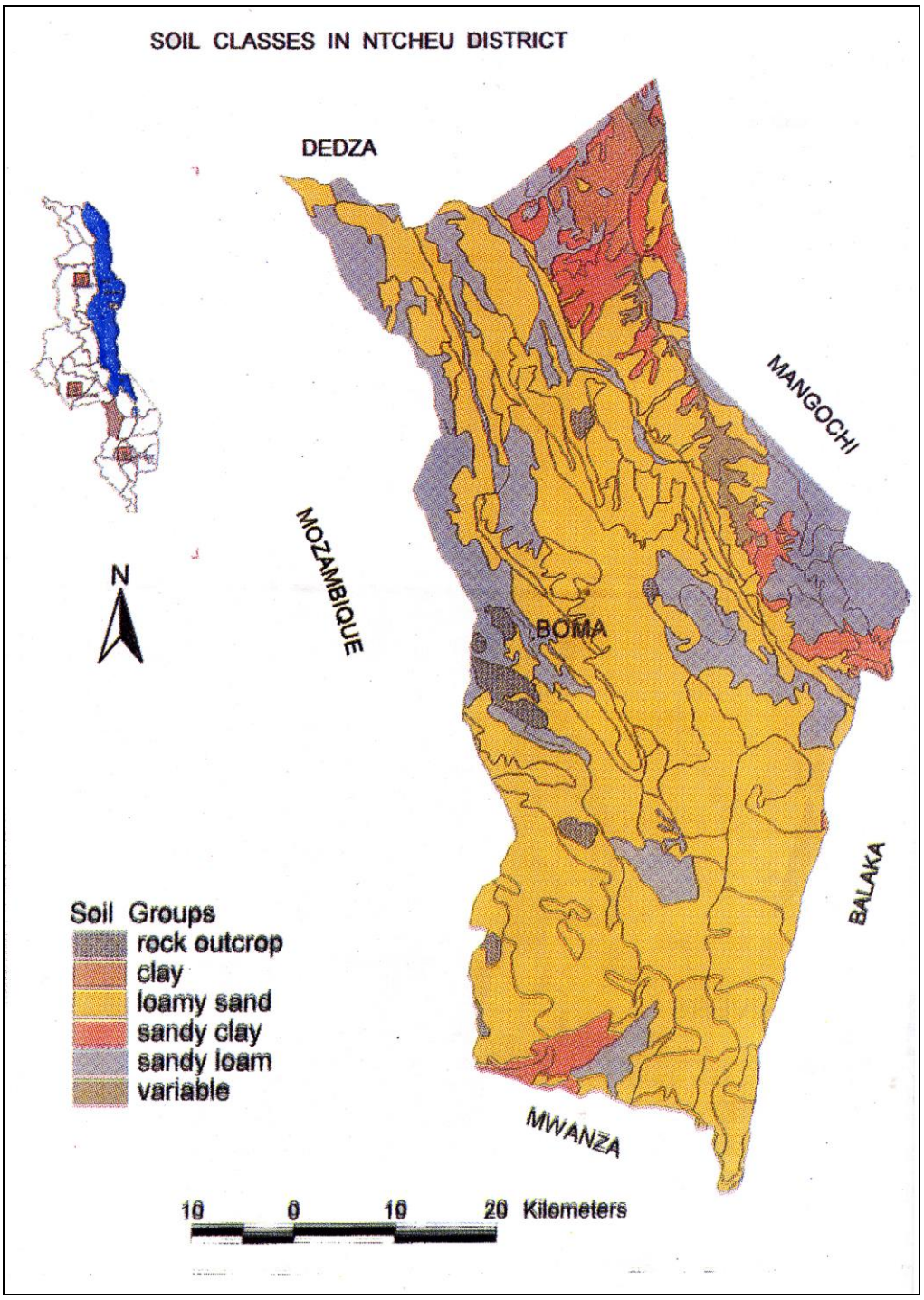

Fig. 12. Soil classes in Ntcheu District
(source: Ntcheu District Socio-Economic Profile, April 2001)

Land use and agriculture

Balaka District covers a total land area of 2,193 square kilometres (sq km) or 219,300 hectares (ha). Of the total land area, 96,5573 ha are under crop production while the remaining hectares (122,743 ha) are either under forest/woodland, human settlement or other uses (Fig 13). There are also small portions of land unsuitable for agriculture or livestock, but very important as forest reserves or nature reserves that should be protected and developed for other uses.

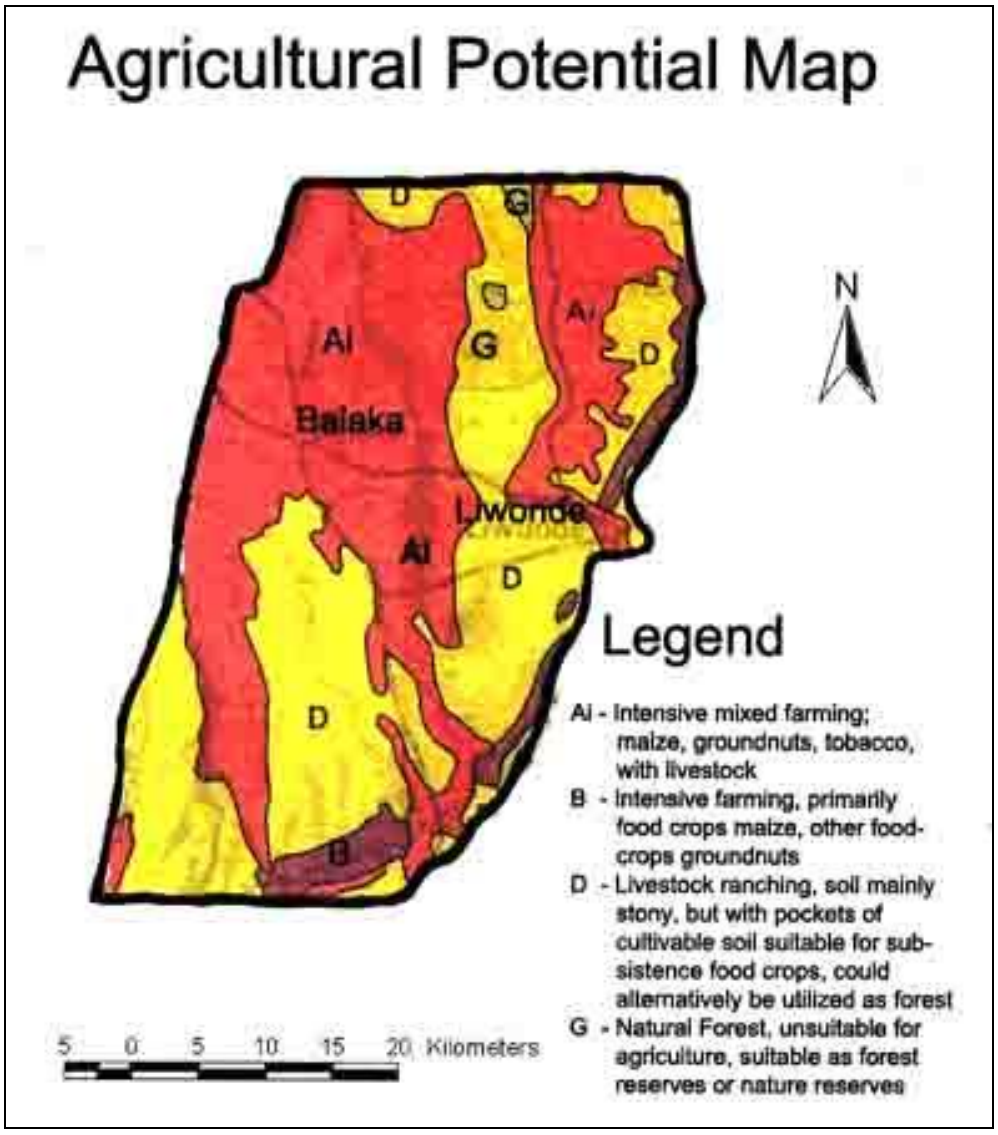

Fig. 13. Agricultural Potential map of Balaka District
(source: Balaka District Socio-Economic Profile, August 2003)

Areas of high, medium and low agricultural potential have been identified in the Machinga District. Total arable land in Machinga amounts to 3,012 square kilometres or 80% of the district's total land mass. Of this, only 1,340 square kilometres (44%) is of high agricultural potential, 207 square kilometres (7%) of medium agricultural potential, and 84 square kilometres (3%) of low agricultural

potential. Marginal lands consist of 1,381 square kilometres (46%) and are considered unsuitable for agriculture. There are 40,169 hectares, representing 11 percent of the total land area in the Machinga District, classified as forest reserves and protected areas. Another 27,322 hectares, comprising 57 percent of the land mass, are slated for various agricultural activities. The remainder of the land is for settlement and woodlands with 0.3 percent of the total land occupied by Lakes Chiuta, Chilwa and Malombe (Fig 14).

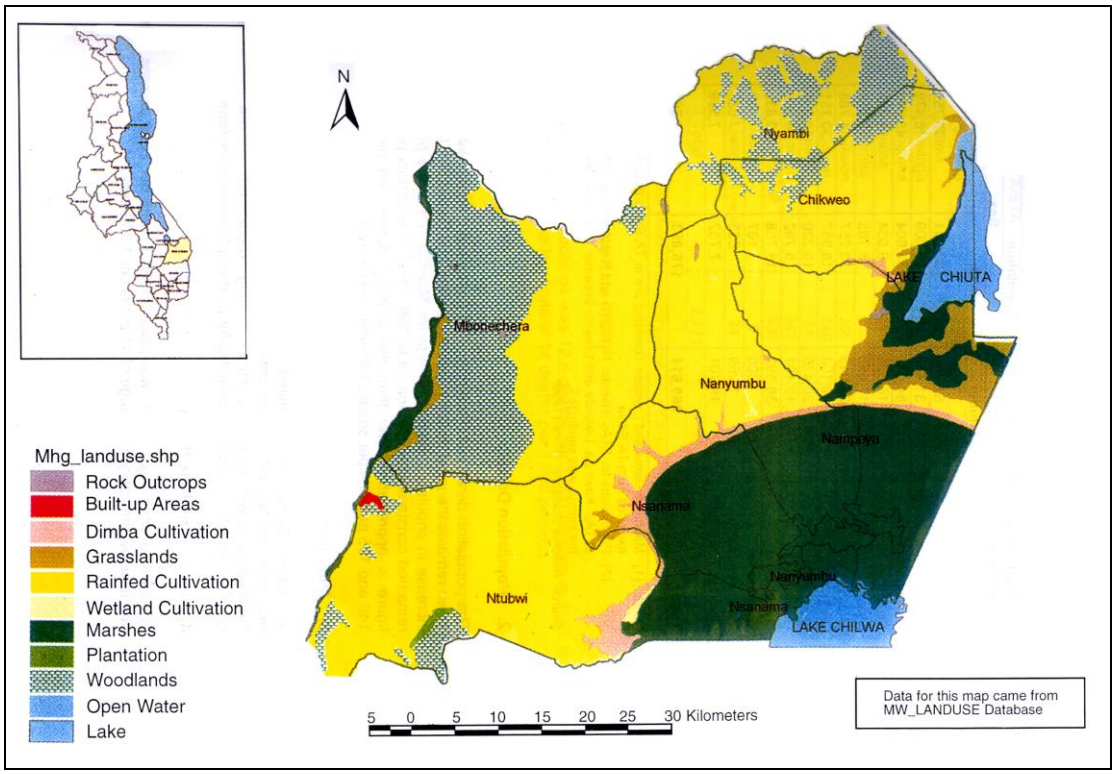

Fig. 14. Land Use in Machinga District
(source: Machinga District Socio-Economic Profile, February 2001)

Nthceu District land is used mainly for agriculture, forestry and water conservation. Fig. 15 shows the land use pattern and vegetation in the district. In general, the soils have varying fertility levels with Bwanje being the only area suitable for agricultural production. However, the potential of this valley is constrained by the inadequacy of rainfall.

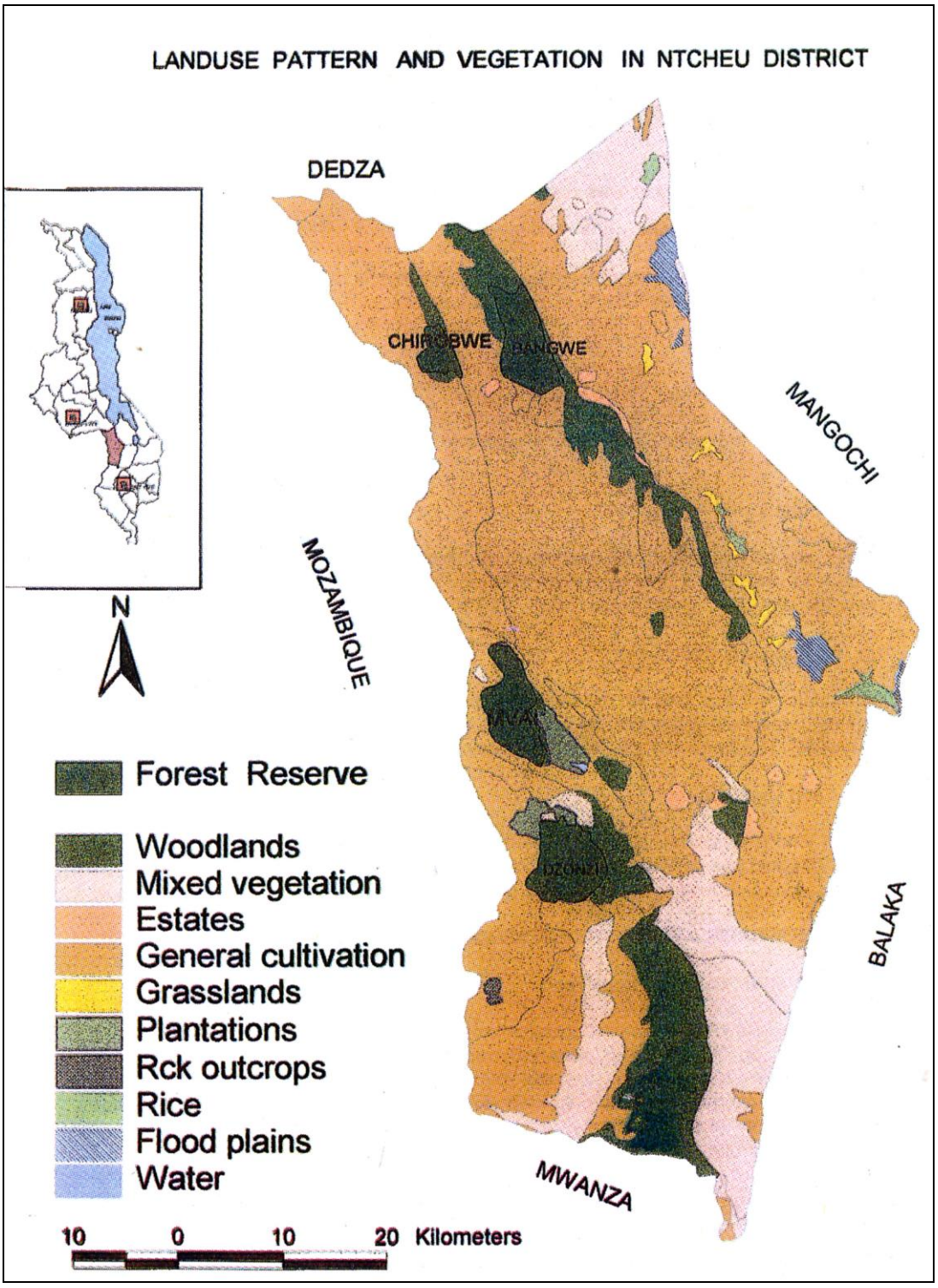

Fig. 15. Land Use Pattern and Vegetation in Ntcheu District
(source: Ntcheu District Socio-Economic Profile, April 2001)

Smallholder farmers constitute the majority of the farming community in the three Districts. In Balaka, the average land holding is 4.5 acres (1.8 ha), while the average land owned is 3.7 acres (1.5 ha). In Machinga, smallholder farming covers about 80,000 hectares with average landholding

size per family placed at 0.5 hectare. In Ntcheu District, the average land holding size is 0.8 ha. (Table 11).

Table 11. Land cultivated and average land holding in the three districts

	Balaka	**Machinga**	**Ntcheu**
Land cultivated (%)	44	44	38
Average holding size (ha)	1,8	0,5	0,8

Smallholder farmers in the three disctricts mainly grow food crops, especially maize, rice, sorghum, cassava, sweet potatoes and pulses. According to the information collected at the Districts' RDPs, the crop yield and production level would have been higher but continuing land degradation caused by run off water due to the destruction of natural vegetation and bad farming practices has greatly affected soil fertility. This is aggravated by the destruction of agricultural crops caused by occurrence of pests and diseases, frequency of long dry spells, flooding and the inadequate number of agricultural extension workers. These data have been confirmed by farmers and stakeholders during focus group discussion. Table 12 shows the land allocation for major crop in each surveyed area.

Table 12. Land allocation for major crop in the three districts

	Balaka	**Machinga**	**Ntcheu**
Maize	80	78	78
Rice	3	5	0
Groundnuts	3	6	5
Sorghum	2	2	0
Cassava	1	1	4
Sweet potatoes	2	3	7
Pulse and others	9	5	6

In the three Districts, maize occupies a huge chunk of the total area planted, being the staple food of the people. Table 13 shows the food crop cultivated in the Balaka District.

Table 13. Food crops cultivated, 2003 (Balaka District)

Crop	**Average Yield per ha (kg/ha)**
Local Maize	279
Composite Maize	693
Hybrid Maize	1,252
Pulse	398
Sweet Potato	7,824
Cassava	7,322
Sorghum	470
Groundnut	486
Rice	934

(source: Balaka RDP, 2001/2003)

As shown in the Fig. 13, the intensive mixed farming include food crops especially where the land is suitable for such products. Other food crops grown in the district are sorghum and pulses such as pigeon pea and cow pea (Table 13). Farmers in district also grow cash crops that include tobacco, cotton, sweet potato, cassava, and groundnuts, fruits and vegetables, root and tuber crops, paprika and chillies.

In the 16 selected villages, smallholder farmers mainly grow food crops especially maize (80%). The Figure 16 below, shows the main crops cultivated and their percentages in the 16 selected villages of Balaka District.

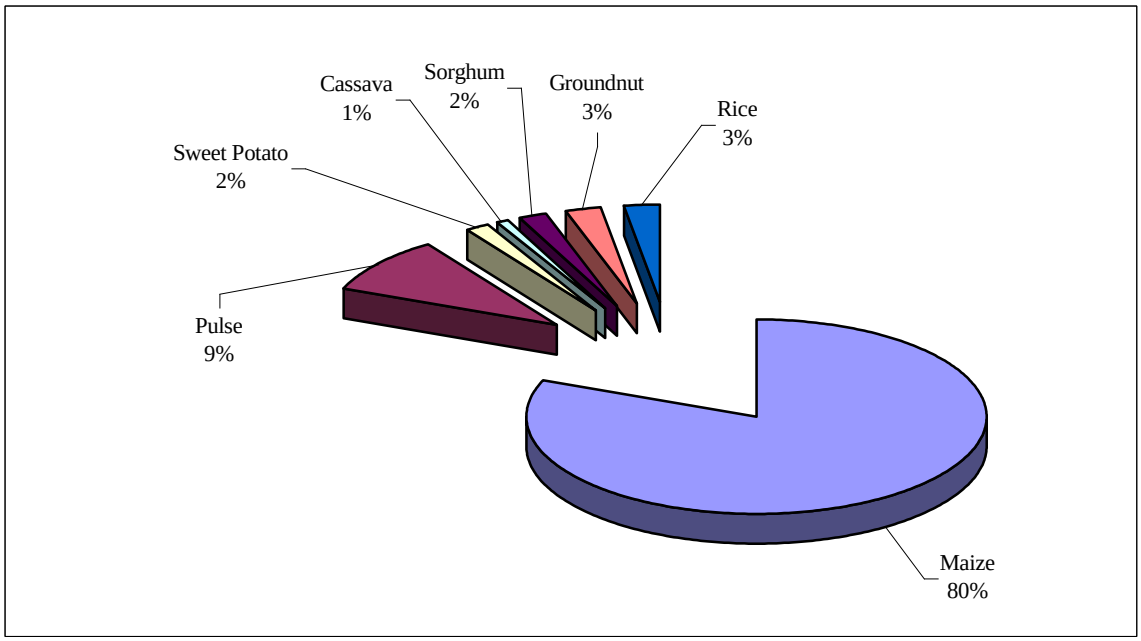

Fig. 16. Percentages and cultivated food crops in the 16 selected village, 2004 (Balaka District)

There are 137,853 farm families in the Machinga district growing a variety of crops intended for consumption and income. Maize, rice, sorghum, groundnut, cowpea, pigeon pea, cassava and tobacco are the major crops for Machinga District. Except for tobacco, these crops are grown both for food and sale. The minor crops for the district include horticultural crops, chillies, sunflower, sesame, cotton, beans and millet. The table 13 below shows crop production in the smallholder sub-sector in Sitola Rural Development Project (RDP).

Table 14. Smallholder crop production, by type, hectarage, yield and production (Machinga)

Crop	Hectarage	Yield (kg/ha)	Production (Mt)
Major Crops			
Local Maize	20,636	818	16,873
Hybrid Maize	13,934	2,652	36,958
Composite Maize	590	1,493	881
Rice (Faya)	8,981	1,733	15,563
Rice (Pusa)	60	2,417	147
Groundnut (Chalimbana)	9,868	540	5,327
Groundnut (CG 7)	55	600	33
Sorghum	6,603	716	4,728
Cowpea	4,711	456	2,149
Tobacco (Burley)	2,091	1,107	2,315
Cassava	5,949	6,820	40,574
Sweet potato	3,834	9,485	36,366
Minor Crops			
Chilli	240	463	111
Sunflower	2	500	1
Sesame	42	429	18
Cotton	411	718	295
Finger millet	69	435	30
Bean	80	413	33
Horticultural Crops			
Orange (trees)	12,393	65	806
Tangerine (trees)	364	60	22
Mango	82,866	171	14,170
Banana	899	27,189	24,443
Cabbage	2	16,500	33
Tomato	55	22,000	1,210
Onion	2	20,000	40

(source: Machinga SEP, 2001)

Table 15 shows the kind of crops, yield, and level of production for smallholder farming in the 10 selected villages. Cassava has the highest tonnage in terms of production followed closely by hybrid maize and sweet potato. In terms of yield, banana produced the highest yield 27,189 kilograms per hectare. The lowest yield was produced by tangerine which yields 60 kg per hectare.

Table 15. Hectarage and percentages of crops in the 10 selected villages, 2004 (Machinga)

Crop	Hectarage (ha)	Percentage (%)
Major Crops		
Maize	35	26
Rice	7	5
Groundnut (CG7)	25	18
Sorghum	11	8
Cowpea	20	15
Tobacco (Burley)	5	4

Cassava	21	15
Sweet potato	12	9
Total	**136**	**100**
Minor Crops		
Chilli	2	5
Sunflower	5	14
Sesame	2	5
Cotton	18	51
Finger millet	5	14
Bean	4	11
Total	**36**	**100**
Horticultural Crops		
Orange (trees)	3	6
Tangerine (trees)	3	6
Mango	5	10
Banana	8	15
Cabbage	13	25
Tomato	11	21
Onion	9	17
Total	**52**	**100**

In Ntcheu District, fruits are predominantly produced in Bwanje RDP while vegetables are grown in Ntcheu RDP (Table 16). Among fruits and vegetables, bananas and tomatoes (Table 17) produce the highest yield.

Table 16. Smallholder crop production, by type of crop, area and hectarage (Ntcheu)

Crop	Area (ha) and Percentage (%) of total area Ntcheu RDP	Area (ha) and Percentage (%) of total area Bwanje RDP
Maize	45.474 – (60)	16.447 – (21)
Beans	10.457 – (12)	116 – (0.2)
Groundnut	3.574 – (4)	1.797 – (2.3)
Potato	3.196 – (3.5)	(not available)
Sweet potato	2.926 – (3.1)	1.091 – (1.4)
Burley Tobacco	1.977 – (2.7)	887 – (1)
Soya bean	1.876 – (2.6)	138 – (0.2)
Cow pea	155 – (0.2)	1.132 – (1.5)
Pigeon pea	104 – (0.15)	816 – (1)
Cassava	1.156 – (1.6)	494 – (0.6)
Cotton	541 – (0.7)	2.642 – (3.4)
Cabbage / Onion	1.936 – (2.7)	(not available)
Sorghum	308 – (0.4)	(not available)
Millet	5.038 – (5.67)	1.213 – (1.6)
Chilli	16 – (0.072)	115 – (0.2)
Paprika	45 – (0.008)	9 – (0.01)
Wheat	428 – (0.6)	(not available)
Total	**1674.79 – (100)**	**2599.32 – (34.41)**

(source: Ntcheu SEP, 2001)

Table 17. Fruit and vegetable production in Bwanje RDP

Crop	Estimated Scale of Production	Estimated Yield	Estimated Annual Production (Mt)
Orange	810	60	47
Tangerine	65	35	3
Mango	7,220	110	810
Banana	31	15,000	465
Tomato	225	13,000	2,900
Total	8.351	28.205	4.225

Note: 1) Scale of production refers to number of fruit trees and number of hectares for vegetables. 2) Yield- kg /tree for fruits and kg/ha for vegetables. (*source: Ntcheu SEP, 2001)*

Major farming systems in the Ntcheu district include mixed cropping: inter planting of maize with other crops and dimba cultivation. There are also some positive progresses towards soil improvement programmes. Among farmers there is also significant cash cropping. Popular cash crops are tobacco, groundnut, fruit and vegetable, cotton, root and tuber crops, paprika, and chilli.

There is a bee keeping activities found in Manjawira EPA where 9 Farm Families, 2 Village Natural Resource Committees and 2 Women Groups are actively involved in honey production.

Table 18. Percentages and hercentages of crops grown in the 10 selected villages, 2004 (Ntcheu)

Crop	Hectarage (ha)	Percentage (%)
Maize	49	27
Groundnut	18	10
Sorghum	2	1
Cowpea	10	5.5
Tobacco (Burley)	5	3
Cassava	10	5.5
Sweet potato	12	4
Chilli	2	1
Cotton	6	3
Millet	7	3.8
Beans	9	4.9
Orange	3	1.6
Tangerine	3	1.6
Mango	5	3
Banana	8	4.4
Cabbage	13	8.7
Tomato	11	7
Onion	9	4.9
Total	**182**	**100**

At household level, farmers in the three Districts mainly grow maize (hybrid, local and composite varieties) with, at least, one harvest per year (Table 19).

Table 19. Maize varieties cultivated in the 36 selected villages, 2004

Maize Varieties	Percentage Cultivated		
	Balaka	**Machinga**	**Ntcheu**
Composite (Masika, ZM621, Sundwe)	19%	2%	4%
Hybrid (MH 18, PAN 67)	32%	38%	36%
Local (Makolo)	49%	60%	60%

In all the Districts, among the major maize varieties cultivated, the principal is local maize (49 to 60%), followed by hybrid (32 to 38%) and composite (2 to 19%).

Interviewed farmers (9%) in Balaka District cultivate legumes. Farmers recognised that grain legumes are an important source of vegetable proteins at household level for their own consumption (to improve their nutritional status) and for cash. Those farmers whose land holdings are small, interplant grain legumes mainly with maize, cassava and sorghum for the right purpose of harvesting two crops per season and improving the nutrients status of the soil. In fact, pulses have the possibility to improve nitrogen-fixing capability by more sympiotically efficient combinations of host cultivars and *Rhizobium* strains. Pulses commonly grown in the selected villages are groundnut, pigeon pea and cow pea. A few farmers cultivate phaseolus bean and soyabean.

Also in Machinga, beside maize, farmers cultivate principally pulses (groundnuts and cow pea) and cassava. Pulses have been grown in almost all types of free draining soils in intercropping with maize and cassava. Cow pea improves soil fertility through leaf litter and nitrogen fixation. Farmers grow cow peas either as annual or perennial crop. Cassava is grown as security crop by most farmers of the district, that cultivate local varieties (Mwaya and Kaunjia), because of their wide adaptation in the land.

In Ntcheu, farmers grow vegetables in the rainy season and in dimba gardens during the dry season. The farmers who have been involved in vegetable production have the gardens near a permanent water supply. Some of them apply compost or khola manure. Nurseries are re-located on new land every two years so as to reduce the build-up of diseases, nematods and insect pests. Due to the lack of financial inputs they do not apply pesticides (very expensive to purchase), preferring burning maize stocks or wood heaped close to the fields.

Livestock

According to the 2002 Livestock Census for Balaka District (SEP, August 2003), and the 1998 Livestock Census for Ntcheu and Bwanje RDPs, the livestock raised in the three District includes cattle, sheep, goats, pigs, rabbits and poultry (chickens). The livestock are raised for human consumption and source of income. Table 20 gives the livestock population in the district and the Table 21 gives the livestock population in the 16 selected villages.

Table 20. Livestock population in the three Districts

Type of Livestock	Balaka	Machinga	Ntcheu
Cattle	7,081	8,953	25,589
Goats	16,418	32,797	37,366
Pigs	833	2,034	11,278
Sheep	4,516	11,413	433
Rabbit	8,955	10,254	7,377
Poultry	118,640	299,130	200,467

(sources: Balaka SEP, 2003, Machinga SEP, 2001, Ntcheu SEP, 2001)

Table 21. Livestock population in the 36 selected villages, 2004

Type of Livestock	Balaka	Machinga	Ntcheu
Cattle	75	10	28
Goats	220	110	789
Pigs	19	22	19
Sheep	57	15	15
Rabbit	65	49	56
Poultry	310	330	821

Most farming families keep chickens rather than any other type of livestock although these are local breeds that are of low productivity. On the other hand, cattle population is decreasing slowly in the districts due to inadequate grazing land and the high demand for meat. Farmers complained the lack of extension services, especially concerning technical advices on animal health. This operational problem has led to a loss of production.

Livestock are affected by certain types of diseases. Ruminants are very vulnerable to liver and conical flukes (also identified as Fascioliasis (*Fasciola hepatica*)); Stomach flukes (also called Ruminal flukes (*Paraphistomum evansi*)) especially when they graze in wetlands. While gastrointestinal worms are more prevalent and acute in young animals during the wet season. These particular diseases are caused by microorganisms called endo-parasites.

According to the Livestock Services, ticks (nkhupa) are a serious problem in livestock production. Bont ticks (*Hyalomma sp.*), Blue ticks (*Boophilus decoloratus*) and Brown Ear ticks (*Otobius megnini*) occur in the districts sometimes causing direct damage to the skin of animals and transmitting other diseases. Babesiosis (cattle tick fever or red water), Anaplasmosis (Gall sickness) and Cow Driosis, also called Heart Water tick (*Amblyomma hebraeum Kock*), are important tick borne diseases occurring in the districts.

For those farmers who keep goats, was reported that worms and respiratory diseases are very common in their corrals. The possibility of a good veterinary service should improve their herds. The establishment of a reproductive center for livestock should give to these farmers the possibility to have another source of food. The availability of meat and milk should improve the food diversification at village level improving the daily diet nutritional intakes of proteins and fats, and so helping in the prevention of malnutrition diseases especially among children.

According to the farmers in Mikoke, livestock production is very important in Ntcheu District. There is the possibility of grazing with green pastures and fodder production, especially along the Rivirivi river. Fields were planted with maize for several years and then returned to pasture for cattle. These households, as everywhere in the selected villages, are mainly relating on agriculture as primary source of income. The possibility to increase and improve the number of herds should contribute to their source of both food and income beside agriculture, representing a valid alternative in cases of famine and food shortage.

Livestock in Ntcheu is mainly raised for meat production. Total volume of meat (beef, goat meat, mutton, pork, poultry meat, and broiler meat) produced for the year totalled 1,177, 844 kg. Dairy production is about 2,278,200 lts. Other livestock products include skins and hides.

Micro-credit

Access to agricultural credit is very limited because of prohibitive conditions imposed by credit lending institutions such as high interest rates and collateral security. Two types of loans are available: seasonal and medium-term. Seasonal loans are usually in form of fertilisers, seeds, chemicals, tobacco bailing paper, plastic sheets for barn construction and medium loans are for ploughs, riggers, ox-cart, and tobacco-bailing machines.

Some micro credit agricultural institutions lending available in all the districts include:

- Malawi Rural Finance Company (MRFC),
- Agricultural Development and Marketing Corporation (ADMARC),
- Agricultural Production Investment Project (APIP),
- Tobacco Association of Malawi (TAMA)

Farmers World and Farmers Finance Company (FFC) are available in Balaka, the Chimanga Project (Ricerca e Cooperazione) is operating in Balaka and Ntcheu, Savings and Credit Cooperative (SACCO), National Association of Business Women (NABW), Liwonde Business Association (LIBA), Malawi Council for the Handicapped (MACOHA), Action Aid are active in Machinga, Concern Universal is found in Ntcheu.

MRFC, SACCO and APIP offer credit facilities on top of their regular banking services, however, as before mentioned, access to credit is very difficult due to the high interests rates and unfavourable credit conditions.

Some of these lending institutions operate throughout the district targeting all eligible individuals while others focus on specific areas and/or specific targets depending on the nature of the organization (Tables 22, 23, 24). In almost all cases, except where there is a special facility for females only, males dominate access to credit facilities.

Table 22. Micro-credit institutions present in the 16 selected villages and involved beneficiaries (Balaka District)

Name of the Credit Scheme	Selected Villages	Number of Beneficiaries
Malawi Rural Finance Company (MRFC)	Chimpakati, Filipi, Lile, Lupanga, Lupanga II, Utale II	6
Agricultural productivity Investment Programme (APIP)	Filipi, Joshua, Mbera, Phalula, Sosola	5
Agricultural Development and Marketing Corporation (ADMARC)	Chimpakati, Kampeni, Lile, Lupanga, Matchereza, Matola, Mbera, Phalula	8
Farmers World	Naweta, Phalula, Utale II	3
Farmers Finance Company (FFC)	Phalula	1
Tobacco Association of Malawi (TAMA)	Chimpakati, Joshua, Kaniosa, Lupanga, Matola, Matchereza, Phalula, Sosola, Utale II	9
Chimanga Project (Ricerca e Cooperazione)	Chimpakati, Filipi, Kampeni, Matchereza, Matola, Mbera, Phalula, Sosola	23

Table 23. Micro-credit institutions present in the 10 selected villages and involved beneficiaries (Machinga District)

Name of the Credit Scheme	Selected Villages	Beneficiaries	Type of Credit
Malawi Rural Finance Company (MRFC)	Masapi, Milepa	2	Small-scale business loans
Agricultural productivity Investment Programme (APIP)	Masapi, Milepa, Nsanama	3	Small-scale business loans
Agricultural Development and Marketing Corporation (ADMARC)	Masapi, Mbarangwe, Milepa, Nkula, Nsanama	5	Small-scale business loans
Savings and Credit Cooperative (SACCO)	Misoya, Nkula	2	Small-scale business loans to women only
Tobacco Association of Malawi (TAMA)	Masapi, Milepa, Mwanadi, Namweta	5	Small-scale business loans
Liwonde Business Association (LIBA)	Nsanama	2	Special business loans for LIBA members only
Action AID	Masapi, Milepa, Nkula	4	Agricultural inputs e.g. Maize, Pulses, Vegetables, etc.
Malawi Council for the Handicapped (MACOHA)	Masapi, Milepa, Misoya, Mwanadi, Nsanama	6	Small loans for various businesses for people with disabilities e.g. Livestock production, Bakery, etc.

Table 24. Micro-credit institutions present in the 10 selected villages and beneficiaries (Ntcheu)

Name of the Credit Scheme	Selected Villages	Beneficiaries	Type of Credit
Malawi Rural Finance Company (MRFC)	Matale, Mikoke, Njobvu	3	Small-scale business loan
Agricultural productivity Investment Programme (APIP)	Matale, Mikoke, Njobvu	3	Small-scale business loan
Agricultural Development and Marketing Corporation (ADMARC)	Bonongwe, Kakodwa, Mikoke, Njobvu	4	Small-scale agricultural loan
Chimanga Project (Ricerca e Cooperazione)	Mikoke	12	Small-scale agricultural loan
Tobacco Association of Malawi (TAMA)	Matale, Mikoke, Njobvu, Saiwa	5	Small-scale agricultural loan
Concern Universal	Bonongwe, Kakodwa, Kausinda, Mikoke, Njobvu	5	Small-scale business loan

Marketing

Effective marketing of agricultural produce is critical to household food security and income as a majority of people in the district rely on markets for food and sale produce.

Traditionally, farmers and stakeholders in the three District and then in the villages selected, depend on ADMARC markets for food, inputs such as seeds and fertilizers, and produce marketing. In addition to ADMARC markets, there are private traders' markets and farmers' market associations. It has been reported that ADMARC in the quest for commercialisation has closed down most of its

bush markets, especially those that were not making profits. Consequently, markets became few and sparsely located (Table 25, 26, 27).

Table 25. Markets available for the 16 selected villages (Balaka District)

Village	Markets available
Chimpakati	Phalula
Filipi	Phalula
Joshua	Balaka
Kampeni	Balaka / Liwonde
Kaniosa	Balaka
Kaumphawi	Balaka
Lile	Balaka
Lupanga	Balaka
Lupanga II	Balaka
Matchereza	Phalula
Matola	Balaka
Mbera	Balaka
Naweta	Balaka
Phalula	Phalula / Balaka
Sosola	Balaka
Utale II	Phalula / Balaka

Table 26. Markets available for the 10 selected villages (Machinga District)

Selected Villages	Markets available and grade
Masapi	Masapi (E) / Liwonde (B)
Mbarangwe	Liwonde
Milepa	Milepa (D) / Liwonde
Misoya	Liwonde
Mlelemba	Mlelemba (D) / Liwonde
Mpoya	Liwonde
Mwanadi	Liwonde
Namweta	Namweta (D) / Liwonde
Nkula	Nkula (D) / Liwonde
Nsanama	Nsanama (C) / Liwonde

Table 27. Markets available for the 10 selected villages (Ntcheu Distrcit)

Selected Villages	Markets available and grade
Bonongwe	Matale (E) / Manjawira (E)
Kadodwa	Matale / Manjawira
Kaloga	Kaloga (D) / Njobvu (D) / Manjawira
Kausinda	Matale / Manjawira
Kauvangoma	Matale / Manjawira
Makoswe	Matale / Manjawira
Matale	Matale / Manjawira
Mikoke	Senzani (D) / Manjawira
Njobvu	Njobvu / Manjawira
Saiwa	Matale / Manjawira

Although agricultural markets are found in each Traditional Authority, the number is still inadequate as farmers continue to travel long distances to sell their produce. Furthermore, several trading centres have no level and quality standards of services and facilities. Of the three Districts, Machinga has 23 trading centres with grades ranging from B to E. Liwonde Trading Centre achieved the highest classification in the district as gauged by the level and quality of services and facilities that it provides. On the other hand, smallholder farmers in the Ntcheu District are making progress in trying to organise themselves. So far, market associations have emerged in the district and farmers are using these associations to access markets outside their borders.

4.3 SOURCES OF SEEDS AND KNOWLEDGE OF SEED PROCESSING

In the selected villages farmers, both men and women, but especially women, have learnt how to conserve their own seed, at household level, from traditional knowledge through their parents or relatives. The majority of farmers and stakeholders in the three Districts use own seed from the previous harvest (recycling). Very few of them are able to purchase seeds and planting material from ADMARC, markets and other companies (Table 28). Another important aspect is that farmers get seed and planting materials from parents sharing experiences on farming methods and new technologies learnt (Table 29).

Tables 28 and 29. Source of seed for the crops

	n.	Retail outlers	Local markets	Friends	Own
Balaka	75	31 (41,3%)	26 (34,6%)	52 (69,3%)	69 (92%)
Machinga	65	26 (40%)	32 (49,2%)	57 (87,7%)	60 (92,3%)
Ntcheu	60	25 (41,7%)	30 (50%)	40 (66,7%)	57 (95%)

	Reatail outlers	Local seed supply
Balaka	41,3	58,7
Machinga	40	60
Ntcheu	41,7	58,3

The provision of good quality seed for improved crop varieties to smallholder farmers is essential for increased crop production. Some farmers buy seed from Agricultural Development and Marketing Corporation (ADMARC), market or other companies because the seed are properly certified, processed, stored and well treated with chemicals. This is a guarantee for farmers for having good planting material to get high yields. Farmers agree that the good quality of improved

varieties is essential for increased crop production. In this view, ADMARC is recognized to supply certified seed that guarantees high yields.

Tables 30, 31 and 32 show the principal sources of seed and planting material at household level per district.

Table 30. Principal sources at household level of seed and planting material (Balaka District)

Selected Villages	Respondents	ADMARC	Companies	Markets	Parents	Recycling
Chimpakati	7	1	0	1	5	7
Filipi	8	2	2	2	5	6
Joshua	2	1	0	2	1	2
Kampeni	8	1	0	2	5	7
Kaniosa	4	2	0	1	3	4
Kaumphawi	2	1	0	1	2	2
Lile	2	2	0	1	1	2
Lupanga	4	1	0	1	2	3
Lupanga II	3	1	0	2	2	2
Matola	5	2	1	5	5	5
Matchereza	8	1	1	3	6	8
Mbera	8	3	1	2	6	7
Naweta	2	1	0	1	2	2
Phalula	5	2	1	1	2	5
Sosola	5	2	1	1	3	4
Utale II	2	1	0	0	2	3
Total	**75**	**24**	**7**	**26**	**52**	**69**

Table 31. Principal sources at household level of seed and planting material (Machinga District)

Selected Villages	Respondents	ADMARC	Companies	Markets	Parents	Recycling
Masapi	5	1	0	3	5	5
Mbarangwe	5	2	2	3	5	5
Milepa	12	6	2	7	12	12
Misoya	8	1	1	3	7	7
Mlelemba	5	2	0	1	4	4
Mpoya	8	1	0	4	6	7
Mwanadi	5	2	0	1	4	5
Namweta	5	1	0	3	4	5
Nkula	6	1	1	2	5	5
Nsanama	6	2	1	2	5	5
Total	**65**	**19**	**7**	**32**	**57**	**60**

Table 32. Principal sources at household level of seed and planting material (Ntcheu District)

Selected Villages	Respondents	ADMARC	Companies	Markets	Parents	Recycling
Bonongwe	5	1	0	3	5	5
Kadodwa	5	2	2	3	5	5
Kaloga	8	6	2	7	6	8
Kausinda	5	1	0	2	2	5
Kauvangoma	5	0	1	2	3	5
Makoswe	5	1	0	2	2	5
Matale	5	1	0	1	2	5
Mikoke	12	4	1	5	7	10
Njobvu	5	2	0	1	4	4
Saiwa	5	1	0	4	4	5
Total	**60**	**19**	**6**	**30**	**40**	**57**

All farmers recognise the importance of the traditional knowledge on farming methods. The traditional knowledge, on agricultural technologies and farming methods is handed down from one farmer to another within the family or village. This is an important aspect to safeguard the agro-biodiversity at household level and preserving the landraces, but it is imperative to improve this traditional knowledge through the technical assistance and other inputs, in order to meet the needs of food security at household level. At the same time, safeguarding agro-biodiversity at household level means preserving their own landraces.

4.4 SEED CONSERVATION METHODS

At household level, farmers store shelled maize, typically hybrid varieties, in sacks applying chemicals, such as "Actellic Dust". For unshelled maize, such as local and composite varieties, farmers prefer to store their production in granaries (also called *nkhokwe*) in the compound near house. For other crops, farmers store their seeds and foodstuffs in sacks and big pots preferably at home. Farmers store their roots and tubers (sweet potato and cassava) in pits by applying ashes (Table 33).

Table 33. Storage methods in the 36 selected villages (Balaka, Machinga, Ntcheu Districts)

Product	Storage Method	Place	Reason	Respondents
Hybrid Maize	Sacks with Actellic Super Dust	House	Well kept, insects and pests free	200
Local and Composite Maize	Granary (nkhokwe)	Compound / Store	Resistant to insects and pests	200
Pulses	Pots or Sacks	House	Safe place	200
Rice	Sacks	House	Safe place	15
Tubers and Roots	Pits with ashes	House	Safe place	190
Sunflower	Sacks	House / Store	Safe place	12
Finger millet	Sacks	House / Store	Safe place	30
Cotton	Sacks	Store	Safe place	100
Vegetables	Baskets	House	Safe place	170
Fruits	Baskets	House / Store	Safe place	76

During field visits and meetings with farmers it was reported that the susceptibility to weevils remains the most negative effect of the hybrid maize varieties kept by farmers in their stores. According to a large number of interviewees, maize weevils, *Sitophilus spp.* (*nankafumbwe*) (Photo 1) easily and quickly attacked the granaries and stores where hybrid, local and composite maize varieties were stored together.

Photo 1. Maize weevils on maize cob

Grain moths belonging to Angoumois fam., *Sitotroga cerealella* (Photo 2) were also observed flying from the same granaries at harvesting time. According to the author's professional experience, severe weevil infestations fastly lead to storage losses, as well as insect pests and diseases can reduce yields and quality of produce if not treated in time. By adopting sound ecological and biological principles, as cultural methods (crop rotation, intercropping, crop sanitation, soil amendments), also referred as Integrated Pest Management (IPM), the incidence of pests and diseases can be heavily reduced.

Photo 2. Angoumois Grain moth on maize cob

At household level, the local maize seeds, instead, is obtained from previous harvest (recycling); in this case the farmers save money by recycling and at the same time they continue to safe-guard the agro-biodiversity. Recycling own seeds because farmers are sure to keep safety their seeds and there is continuity of local breeds (landraces).

In over 90% of the villages visited, a majority of the respondents said that they adopt the primitive ways of conservation handed down by the ancestors through the traditional knowledge. Farmers store their local maize unshelled in cribs traditionally known as *nkhokwe*, which are made from poles, reeds and bamboos, and apply ash to protect maize against insects.

A farmer's decision in the choice of crop varieties that are grown and maintained is based on yield, storability, drought resistance, taste, marketability and early maturing. They are interested in growing a diversity of crops and varieties for food security reasons. Food security is indeed important because for households to be more food secure, crop diversification is important. Local varieties are grown mainly for yield and storability.

The concept of on-farm conservation may be relatively new but the process has a long history. Farmers have been involved in the maintenance and development of crop germplasm over many generations and a great deal of knowledge and practices for the maintenance and utilization of the local crop diversity has been generated. Major threats to the process are modern methods of farming and introduction of new varieties. Several activities are used to conserve genetic diversity at household level including variety selection, seed selection, seed storage. Variety selection is an important process especially in crops like sorghum. Farmers have with continuous drought episodes tended to select varieties that are early maturing and discarded late maturing varieties. This has in most cases resulted in farmers in a given agro-ecological zone growing the same variety of sorghum. Seed selection is an important seed maintenance process and varies from crop to crop depending on social-economic, agronomic and other variables like storage and taste. A typical example is in crops propagated through seed like maize. Farmers tend to select seed from their harvest based on healthy looking grain, large in size. This is normally identified while the maize is in storage in a *nkhokwe* where women do the actual selection of seed for the next harvest. The small cobs with small size grain are not selected. This is mostly done of local maize varieties for which the seed supply is largely farmer-dependent while the hybrid varieties are usually bought from the retail shops and commodity markets like ADMARC. Selection of varieties by farmers is done between harvest and threshing because that is the best time to select good seed and keep it safe from

weevils and other pests; and it provides opportunity not to eat up everything during famine. Selection is also done at planting time because apart from being big in size, the seed must also demonstrate to be able to survive pests and disease attack.

Apart from the modern methods of storing crops, farmers also practiced several indigenous methods which included use of 'good hands', ash dust, smoke, *Neem* (*Azadirachta indica*) and ultra sun drying. Use of 'good hands' has no scientific basis and can therefore not be explained scientifically. It was believed that certain people of either sex and of any age have good hands. Once they have been involved in seed processing, like harvesting, threshing and storage, there is less pest attack on the seed. The other traditional methods of seed storage include smoking by hanging over a cooking fire place, keeping seed in a calabash with ash treatment.

Vegetatively propagated crops do not require special methods of selection. Farmers collect planting materials from existing standing crop for instance banana and cassava. In the case of potatoes farmers collect planting materials obtained from volunteer crop in a previous season field. No special selection of cultivars is carried out in most cases. The outcome of this is that cultivars are mixed in a given field of these vegetatively-propagated crops. Farmers have maintained these crops for a long period without much government intervention because there is currently limited crop improvement research on vegetatively propagated crops with the exception of cassava and bananas.

Traditional methods of conservation offer several advantages in these small scale farming communities some of which include ability to mix different varieties in the same field; ability to grow several farmers' varieties on a small piece of land and in the process agrobiodiversity is maintained. The negative impacts of the indigenous system of agro-biodiversity conservations are that some varieties are disappearing as farmers continue to select for early maturing varieties. As farmers select early maturing varieties with the recurrent drought period, late maturing varieties are being lost hence the gene pool is being reduced. Some farmers select seed at planting time, a practice that has had negative impact on genetic diversity of crop species because most households that are food insecure run out of food before the next rainy season hence they have no stock to select from and end up planting inferior seed and lose crop varieties completely.

4.4 CHANGES IN ENVIRONMENTAL AND SOCIO-ECONOMIC FACTORS ON AGRO-BIODIVERSITY CONSERVATION

As observed and mentioned before, agro-biodiversity and food security are strictly linked to each other as well as biodiversity is a key to food security. In the past centuries, farmers have experienced severe changes in environmental conditions making some decisions on their farming production in order to obtain food security at household level. The strict link between bio-diversity and food security has led them to consider the huge importance of looking to those changes for facing their daily needs in order to obtain a better life.

Notwithstanding the fact that an increased production is strongly dependent on the adoption of hybrid varieties, between 92 and 95% of the farmers interviewed stated that they rely on recycling as source of their seeds (Tables 28 and 29). This figure means that farmers are not disposed to change their traditional methods for getting seeds.

The main factors affecting changes in the sources of food crops in the areas where the research has been carried out are: environmental factors, such as rainfall and altitude, and socio-economic factors, such as financial inputs and marketing.

New varieties of cereals, pulses and vegetables have been developed to be suitable according to the different agro-ecological zones of the country. It is important to remember that Malawi can generally be divided into three areas depending on altitude and amount of rainfall received. These areas are as follows:

- ¶ High altitude areas which receive high rainfall and have generally cool temperatures. Different food and cash crops are grown, such as tea, rubber, Irish potato, wheat, coffee, bananas which do well in these areas (Ntcheu).
- ¶ Medium altitude areas which receive moderate rainfall and have moderate temperatures. Crops like maize, sweet potato, tobacco, groundnut, cassava and beans can produce well in these agro-ecological areas (Machinga).
- ¶ Low altitude areas which experience low rainfall (and record hot temperatures). Crops like cotton, sorghum and millet do well in these zones (Balaka).

Consequently, these new technologies are potentially available to the farmers; however, their implementation is not satisfying, due to the pressure of the socio - economic factors.

Concerning maize, the reasons for recycling local and composite varieties are:

- high price of hybrid seeds;
- high requirements of fertilizers and pesticides by improved varieties, both during cultivation and storage;
- more efforts required in terms of labour and management

As far as cassava and legumes are concerned, the main factors envisaged for the failed choice of improved varieties are:

- high prices of improved varieties
- low availability of these high production-virus free seeds through the normal dealers (these inputs are mostly found in the governmental research stations)

Moreover, in the areas where the research was carried out, several farmers have reported that erratic rains were the cause of changing from hybrid maize varieties to composite varieties or local varieties which are more resistant to water-stress. This depends on the characteristics of the seed and agro-ecological zones.

Farming is a business aiming at making a profit and, like any entrepreneur, farmers and stakeholders need money to run in their business. They need financial inputs to grow food and cash crops or keep livestock not only for food security at household but also for a profit. Farming as a business issue requires good planning.

The choice of food and cash crops to be grown for sale will depend on market demand. Farmers grow mainly crops which are in great demand and those that get high prices on the market.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Malawi is a land of farms. There are three reasons why the farms are so important. First, the farmers both women and men, produce nearly all the food needed by the people. Secondly, some of the crops are sold to other countries, and in exchange manufactured goods are bought. Thirdly, the products of agriculture are the basis of many industries in Malawi, for example, sugar-refining and the manufacture of cigarettes. Therefore, the economy of Malawi, and then its food security, depends on its agriculture, so does its future for the next generations.

Agriculture is based on the natural resources of land, climate, soil, water, bio-diversity and technical knowledge. Every landrace grows best in a particular climate, and on a particular type of soil; that is why different landraces are grown in different parts of the country. The climate is important in choosing which crops to grow. The soil type is also important in choosing which land to use for pasture and which to use for cultivation. The knowledge is important to manage properly the land. Good farming makes the best use of the natural resources. One of the most important aims of farming is to obtain high yields. Women play an important role in the conservation of agro-biodiversity.

Although research and development have tended to ignore and undermine the role of indigenous knowledge in modifying and improving plant varieties, methods of conservation and utilization of agro-biodiversity in developing countries are commonly based on traditional knowledge.

Results obtained and elaborated show that farming methods of conservation and utilization of agro-biodiversity are commonly based on traditional knowledge. Variety selection, seed selection and seed storage are three key factors that contribute to the process of on-farm agro-biodiversity conservation. However, environmental and socio-economic factors, such as drought, husbandry management, credit facilities, can also contribute to improve or the decline of this knowledge affecting the agro-biodiversity, and consequently, the food security at household level.

Household food security improves in accordance with socio-economic and agronomic factors due to the availability of financial and technical inputs as well as the decline or improvement of local crop varieties (landraces) is in accordance with the availability of inputs to allow farmers to cultivate their landraces.

In summary the research found out that farming methods on conservation and utilization of agro-biodiversity are handed down through the traditional knowledge from one generation to another, as farmers to farmers within the family of the same clan, and positevely contributed to the household food security. Socio-economic and agronomic factors can decline or improve this level of food security at household level and consequently the quality of life.

Moreover, the implementation of rural development projects aimed to improve both traditional knowledge and new agricultural technologies could help these rural communites to obtain higher household food security level.

A long-term strategy for the conservation, utilization, improvement and management of genetic resources diversity for food and agriculture requires the recognizing of the value of men and women's knowledge, skills and practices and their right to benefit from the fruit of their labour.

5.1 SUGGESTED AREAS FOR FUTURE RESEARCHERS

The research suggests that significant influence that has been shown between traditional knowledge on conservation of agro-biodiversity and other factors affecting the household food security. Some variables contributing positively to the improvement of agro-biodiversity at household level could be investigated in a countrywide study to look at factors affecting household agro-biodiversity than this research did.

A systematic study, for example, on crop husbandry practices, and agro-forestry technologies as well, can be conducted to determine and compare results in yields among food crop varieties, fertilizer application, measuring loss of food crops due to pests among others.

Important and usefull activities that can also be developed for a better understanding of agro-biodiversity conservation; among other it has been suggested:

- ¶ Make a collection of food crops, cash crops, fruit and seed cases, leaves and flowers; display these during focus group discussions among farmers and agricultural extension officers and discuss their differences, their method of cultivation and how they interact with the background.
- ¶ Name all the crops (food and cash) and trees around your environment and make a nature trial for other people to follow.

- ¶ Talk to older people about the traditional names and methods of conservation and utilization of agro-biodiversity in terms of food crops, trees and uses of this important resources at household level.
- ¶ Visit different sorts of lands and gardens for comparing the differences between: natural woodlands, plantations and agricultural land. What food or crops or trees grow? What is the reason for this? Why we conserve natural resources?
- ¶ Plant one or more native crops or trees (from seeds or from cutting) observing their life-cycle.
- ¶ Find out whether people are planting trees in their home area. What type of trees are they planting and what are they going to be used for? How long will the people have to wait before they can use the trees? Have they planted enough trees? What sort of problems do people meet when starting to grow trees in a village forestry plot?

5.3 RECOMMENDATIONS

Despite much progress and opportunities from new technologies, population growth, climate change, and diseases still threaten the country. The challenges faced by the Malawi Government to reduce hunger, poverty and improve the life standards of the rural and urban poor, are enormous and progress in arresting the current trend of degradation requires concerted effort by the Government with the assistance of both Traditional Authorities (TA) as well as other local and international organizations.

As observed and mentioned before, many farmers have not access to credit facilities, get very small profits and inputs purchase is very expensive. This research, therefore, recommends that proper and sustainable agricultural technologies and strategies for preserving the bio-diversity and consequently the improvement on household food security, should be addressed to reduce the need of purchase expensive inputs and the reliance on foreign donors.

Sustainable agricultural policies and strategies should be viable and constant in the long run, in order to maintain the food security at household level. Such policies and strategies at national level, should aim to empower the farmers to benefit from the sustainable technologies.

From this viewpoint and for a sustainable utilization and conservation of agro-biodiversity at small-scale household level, the study recommends therefore that:

- Farmers should prepare their gardens soon after harvesting in order to give possibility to the incorporated crop residues to decompose and consequently improving soil fertility. Farmers should also continue at growing local crop species (landraces) and improving traditional technologies. Financial inputs, training courses and technical assistance should be granted in every district. Extension officers should give advice to farmers on the appropriate time for planting each crop based on long term experience and reliable meteorological and research data obtained from within the various agro-ecological zones.
- The establishment of individual plant nurseries of medicinal and important timber species are important sources of income generation and permit to maintain bio-diversity at small-scale household level.
- Agro-forestry, and its related technologies, have to be implemented, if considered as a proper and sustainable strategy to achieve household food security on long and short-term. Inputs, training courses, technical assistance and micro-credit schemes should be provided to the farmers.
- Recruitment and training of farmers to document their traditional knowledge on farming practices must be encouraged; otherwise the store of local knowledge will be lost to future generations.
- To achieve biodiversity conservation, *in sensu latu*, a progressive land use planning, vegetation and landscape development of the districts must be initiated with the involvement of all stakeholders.
- Extensive systems of livestock production on smallholdings are not sustainable. Farmers should therefore be advised to use intensive systems of livestock production to ensure increased availability of animal protein, income and organic fertilizer (manure). As regards intensive systems of production, disease control is an important aspect to be observed in order to realise the full benefits of the systems.
- To recognize that there are gender-based differences in farming communities, and to acknowledge the value of women's knowledge, skills and practices and their right to benefit from their labour would ensure the long term perpetration of traditional knowledge in agrobiodiversity conservation.
- Appropriate legislation should be implemented to protect the "threatened" genetic resources for food and agriculture, ensuring their continued and sustainable use by local communities, indigenous people and ensuring the fair and equitable sharing of benefits.

5.4 LIMITATION OF THE STUDY

The main aim of the research is concentrated to the knowledge of the farming methods of conservation and utilization of agro-biodiversity at smallscale household level in Balaka, Machinga and Ntcheu Districts, in order to understand how biodiversity plays an important role like a key to food security. Consequently, technicians and experts may be able to come out with sustainable interventions for food crops production and processing technologies for a continuous improvement at household food security level in these rural areas of the country.

A specific assessment of food security at household level, needs to consider several factors that were not specifically investigated in this research. Such abiotic factors, as meterological, hydro-geological factors and biotic factors, as insect, pests and diseases were not properly investigated.

Due to time limitations, practical experiments in the field were not carried out, especially on food crop planting varieties to observe their yields, and other related features. Comparative scientifically results with other local or new technologies to determine their effects on food security, were not carried out. In general, crop management practices such as land preparation, planting, fertilizer application, weeding, harvesting, storage moisture content, measuring loss of food crops due to pests, rodents and insects among others were not carried out. Some time, there were difficulties to find out complete up-to-date pictures especially on agricultural production, livestock and other related fields.

However, this research provides a first starting point for other feasible studies on potential effects of farming methods on conservation and utilization of seeds for crops production at household level in terms of food security.

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APPENDICES

APPENDIX A: STRUCTURED QUESTIONNAIRE

UNIVERSITY OF MALAWI

CHANCELLOR COLLAGE

(DEPARTMENT OF BIOLOGY)

Conservation and utilization of agro-biodiversity at small-scale household level in Malawi: a case study of Balaka, Ntcheu and Machinga Districts

INDIVIDUAL INTERVIEWS

Opening statement:

My name is…….and I am carrying out this research on behalf of Prof. Aggrey J. D. Ambali and Dr. Lawrence B. Malekano of Biology Department of Chancellor Collage, Zomba. I am interested to learn about your farming methods on conservation and utilization of seeds for food crops production at household level. Be assured that all answers you will give remain confidential. There are no right or wrong answers.

Questionnaire number……. **District of……..…...**

SOCIO-ECONOMIC CHARACTERISTICS

1) Name of the household: _____

2) Name of the village: _____

3) Traditional Authority: _____

4) Family size (number of occupants) _____
Parents _____
Children 0 – 5 _____
6 – 10 _____
11 – 15 _____
> 15 _____

5) Head of the family: MHH _____ FHH _____

6) Total land area owned by the farmer: _____ acres
7) Total land area cultivated by the farmer: acres owned _____
acres borrowed _____

8) Literacy:

	Literate	Illiterate
Adults	_____	_____
Children (School going)	_____	_____

9) Adult Education:
Standard attained 1-5 6-8 Form 1-2 Form 3-4

10) Children Education:
Primary Number of children _____
Secondary Number of Children _____

11) Housing: Type of housing:
Brick wall Mud wall Grass roofed Iron roofed Floor Cement Mud
12). Kitchen arrangement:
Good Poor Fair Bad

13) Socio-economic status of the household:
Rich

(If the household has five (5) of the following: 1. Orchard garden. 2. Livestock. 3. Poultry. 4. Decent house i.e. corrugated, cemented and burnt brick. 5. Have/has relative who are at work. 6. Have more than five (5) acres of land. 7. Have/has various household properties such as clothing, kitchen ware, oxcarts, bicycles, radios and others that respondents will specify.

Medium (if the household has 2 – 4 of the above items).
Poor (if the household has 1 – 0 of the above items).

14) List the food crops that you have been growing in this area:

Local maize (specify the variety_____)
  Yes, average yield per acre _____ bags/50 Kg
  No

Hybrid maize (specify the variety_____)
  Yes, average yield per acre _____ bags/50 Kg
  No

Composite maize (specify the variety_____)
  Yes, average yield per acre _____ bags/50 Kg
  No

Local cassava (specify the variety_____)
  Yes, average yield per acre _____ bags/50 Kg
  No

Cassava Mosaic Virus Free (Hybrid Cassava) (specify the variety_____)
  Yes, average yield per acre _____ bags/50 Kg
  No

15) How were you getting food crop seeds for your farming?
  Own seeds From neighbours From the market From the credit clubs Others (specify)

16) Explain why?
_____
_____
_____
_____

17) Where do you prefer to get your seeds from?
_____
_____

18) Explain why?
_____
_____
_____
_____

19) Have you ever changed your farming practices due to environmental or other changes? (new crops, drought, floods).
  Yes

No

20) Explain why?

_____
_____
_____

21) What is your main cropping system in this area?
Monocropping Intercropping Both

22) Explain why and specify the crops cultivated?

_____
_____
_____
_____

23) Which kind of seeds and where do they come from?

_____
_____
_____
_____

24) Is there any relationship between seed types and yield?
Yes
No

25) Explain with specific examples.

_____
_____
_____
_____

26) Where have you learnt the agronomic techniques? (Traditional knowledge, Technical assistance, other).

_____
_____
_____
_____

27) Do you have nurseries to produce roots and tubers seed and planting material?
Yes, specify below:
Area dedicated to the nursery ___ sqm
Kind of roots and tubers seed and planting material 1_____ 2_____ 3_____
Roots and tubers seed and planting material productivity 1_____ 2_____ 3_____ / acre
No

28) Where else do you get seeds (roots and tubers) and planting material?

_____
_____
_____
_____

29) Do you have any *Dimba Garden?*
Yes, specify the total area _____ sqm
Based on: bore holes , tank , and pipeline from the river
No

30) Grain legumes:
Yes (specify which kind of legumes) _____ average yield per acre _____ Kg
Yes (specify which kind of legumes) _____ average yield per acre _____ Kg
Yes (specify which kind of legumes) _____ average yield per acre _____ Kg
Yes (specify which kind of legumes) _____ average yield per acre _____ Kg

No

31) Where and why do you get the seeds from?
_____
_____
_____
_____

32) Main vegetables cultivated:
Cabbages: average yield per acre _____ Kg
Tomatoes: average yield per acre _____ Kg
Onions: average yield per acre _____ Kg
Carrots: average yield per acre _____ Kg

33) Where and why do you get the seeds from?
_____
_____
_____
_____
_____

34) Others crops cultivated by the farmer (e.g. sweet potato, sunflowers, etc.):
Yes (specify which kind of crops) _____ average yield per acre _____ Kg
Yes (specify which kind of crops) _____ average yield per acre _____ Kg
Yes (specify which kind of crops) _____ average yield per acre _____ Kg
Yes (specify which kind of crops) _____ average yield per acre _____ Kg
No

35) Where and why do you get the seeds from?
_____
_____
_____
_____

36) What are the main fertilizers used?
UREA quantity per acre _____ bags / 50 Kg
DAP quantity per acre _____ bags / 50 Kg
23 21 0 4S quantity per acre _____ bags / 50 Kg
Manure (organic matter) quantity per acre _____ bags / 50 Kg
Others (specify)_____ quantity per acre _____ bags / 50 Kg
None

37) How were you getting fertilizers?
From the market From credit clubs From relatives Other sources (specify).

38) Explain why?
_____
_____
_____
_____

39) Is there any relationship between your seed types and the fertilizers applied?
Yes
No

40) Explain why?
_____
_____
_____
_____

41) Are the newly introduced food crops (seed varieties) cultivated in this area compatible with the food crops that people previously cultivated in the area?

Yes
No

42) Explain why?

_____
_____
_____
_____

43) How and where do you store your seeds and food crops?

_____
_____
_____
_____

44) Explain your preferences for the storage methods specified above.

_____
_____
_____
_____

45) What are the types of livestock kept?
(a)_____ (b) _____ (c) _____ (d) _____ (e)

46) Explain why?

_____
_____
_____
_____

Thank you very much for you help.

APPENDIX B: UNSTRUCTURED QUESTIONNARIE USED FOR FOCUS GROUP DISCUSSIONS

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QUESTIONS FOR FOCUS GROUP DISCUSSION

Opening statement:

My name is…….and I am carrying out this research on behalf of Prof. Aggrey J. D. Ambali and Dr. Lawrence B. Malekano of Biology Department of Chancellor Collage, Zomba. I am interested to learn about your farming methods on conservation and utilization of seeds at household level. Be assured that all answers you will give remain confidential. There are no right or wrong answers.

What food crop have you been growing in this area?

Do you know the farming history of the village (drought, floods, other)?

How were you getting food and cash crop seeds in this area?

Do you have other sources of finding food and cash crop seeds, organic and inorganic fertilizers?

Where do you prefer to get your seeds from and why?

What are the implications of the seeds selection methods identified above on agricultural production in this area?

Do you have a proper knowledge on agronomic techniques?

How do you maintain food security at your household level?

List the credit schemes found in this area and their benefits for seeds provision.

List three major constraints to increasing your farming productivity in this area.

How can you reduce the effects of these constraints?

What opportunities exist in this area regarding increased food security?

How does seed selection contribute to household food security?

Where do you store your locally selected seed and why?

Resources mapping for the village.

Thank you very much for your help.