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Major professor

Dr. F. R. Whims

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PRACTICE OF SELECTED AGROFORESTRY TECHNOLOGIES: FARMER PERCEPTIONS OF INFLUENTIAL FACTORS

By

Charles MacPhery Masangano

A DISSERTATION

Submitted to
Michigan State University
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ABSTRACT

PRACTICE OF SELECTED AGROFORESTRY TECHNOLOGIES: FARMER PERCEPTIONS OF INFLUENTIAL FACTORS

by

Charles MacPhery Masangano

This study was designed to determine the factors that influenced the farmer in the decision to practice selected agroforestry technologies in Malawi. The influence of the Malawi Agroforestry Extension Project, food productivity, control of soil erosion, fuelwood productivity and profitability were investigated. The influence of demographic variables which included: gender; age; income; education; landholding size and land and tree tenure system was also investigated.

The study was conducted in Njolomole Extension Planning Area of Ntcheu RDP in Malawi. A sample of 449 respondents was drawn from the study population of 9236 farm households. Data collection was by interviews which were conducted by five male and four female interviewers. A total of 399 questionnaires were used for data analysis.

Exposure to the Malawi Agroforestry Extension Project and control of soil erosion significantly influenced the practice of contour hedgerows. Food productivity significantly influenced the practices of planting and caring for trees in garden boundaries and planting and caring for trees in croplands. Profitability significantly influenced the practice of planting and caring for trees at homesteads. Gender was significantly related to the practices of planting and caring for trees in garden boundaries and planting and caring for trees in croplands. Male farmers practiced planting and caring for trees in garden

boundaries and croplands. Farmers' income was significantly related to the practices of woodlots and planting and caring for trees in garden boundaries. Land tenure system significantly influenced the practice of contour hedgerows.

Dedication

For the encouragement and support they gave me as a young child and throughout my school years, this work is dedicated to my father, MacPhery Masangano, mother, Ivy Masangano and brother, Synod Mpaya. Without their words of encouragement and physical support I would not have gone to this level. To my wife, Jane and children, MacPhery, Joshua, Caleb and James, I say thank you for your patience and endurance during my studies here at Michigan State University.

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ACRONYMS

ADD	Agricultural Development Division
AC	Alley cropping
CH	Contour hedgerows
EPA	Extension Planning Area
FA	*Faidherbia albida*
FB	Fodder banks
IF	Improved fallows
LF	Living fences
MAFE	The Malawi Agroforestry Extension Project
RC	Relay cropping
RDP	Rural Development Project
TC	Planting and caring for trees in croplands
TGB	Planting and caring for trees in garden boundaries
TH	Planting and caring for trees at homesteads
WL	Woodlots

Chapter I

INTRODUCTION

Background

Hunger, environmental degradation and high population growth rate are growing problems the world is facing today. Experts predict an additional four billion people on earth with 95 percent of them living in developing countries by the year 2025. Food demand will triple with the increased population (Anonymous, 1995). An obvious question is "where will this increased food be produced?" Land for agricultural production is very limited and poverty so rampant. Increasing numbers of small producers are failing to produce enough for their basic needs. Already 1.3 billion people, most of whom being women and children are living in poverty.

The green revolution of the 1960s and 1970s saved millions from starvation. The efforts of donor organizations like USAID, World Bank, Ford and Rockfeller Foundations played a key role in establishing international research organizations and training scientists from developing nations. These efforts helped to strengthen national policies as well as research and extension organizations resulting in adoption of technologies by small farmers. Population pressure has however caught up with the gains made in the green revolution. Low agricultural production combined with rampant environmental degradation raise Malthusian concerns of wide spread poverty and hunger (Anonymous, 1995).

Introduction to Malawi

Malawi is a small narrow country occupying the southern part of the East African Rift Valley, within 9 to 17 degrees south latitude and 33 to 36 degrees east longitude. It is divided into the Northern, Central and Southern Regions, with 25 administrative districts. The country covers a total area of 11.9 million hectares with 9.4 million hectares of land and the rest under lakes. The total available agricultural land is 5.3 million hectares (Bunderson et al, 1993; Malawi Government, 1987). The per capita GNP in 1992 was USD 200.00 with a national debt service ratio of 23 percent. Forty eight percent of the people do not have access to safe drinking water. Just like other developing countries Malawi is faced with major challenges of how to increase smallholder agriculture production and maintain food self sufficiency at household level in the face of increasing population and limited land resources. Malawi has an average population density of 89 people per square kilometer, with a population growth rate of 3.7 percent. Eighty eight percent of her people live in rural areas and are basically engaged in agriculture. This rapidly increasing population is putting a lot of pressure on the limited and un-expanding land resources. Landholding sizes continue to decrease as farmers sub-divide their land in order to share it among their children. Estimated land holdings are very small, averaging 0.5 hectares in the Southern Region, 0.7 hectares in the Central Region and 1.1 hectares in the Northern Region (Bunderson et al, 1993). Other estimates of landholding size in the country are even more conservative than these (Jones et al, 1993). Farmers practice continuous cropping with maize, the main staple as the dominant crop. Crop rotation is almost nonexistent. Low incomes and high fertilizer prices on the other hand result in low usage of inorganic fertilizers. Only 13 percent of those cultivating one hectare or less use inorganic fertilizers (Malawi Government, 1987). Declining soil fertility is a major land degradation problem as evidenced by the declining crop yields (Banda et al, 1994; Smale, 1991). As observed elsewhere (Guggenheim and Spears, 1991), one strategy farmers use in order to deal with the problem of land pressure is expanding their farm lands by opening marginal areas. Most of these marginal areas were originally natural forests with steep slopes. Soils on these steep slopes are usually very shallow and susceptible to erosion (Park, 1992). Cultivation of these marginal lands is therefore causing major problems of soil erosion and depletion of natural forests. Once the tree cover has been opened for cultivation, the land quickly gets degraded and its productivity reduced.

Banda et al (1994) conducting a study on crop productivity and soil erosion on a 44 percent slope, reported maize yields as low as 300 kg/ha. They also observed that soil loss due to erosion was as high as 80 tons per hectare per year. At such high rates of soil loss, the top soil gets washed away within a few years of opening the land.

The total national forest cover, estimated to be 38 percent of the total land in 1987, is being depleted at the estimated rate of 3.5 percent per year in Malawi. Land clearing for agricultural production is the major cause of deforestation (Dewees, 1995). Agricultural land is also estimated to be expanding at the rate of 3.5 percent per year. Other causes of deforestation include: fuelwood consumption for domestic energy needs; tobacco curing and other industrial uses like brick making and sale of fuelwood and charcoal to urban centers.

To maintain food self sufficiency, while protecting the precious natural resources of land and forests, Malawi needs immediate intervention of existing farming practices by the majority of its smallholder farmers. Technologies which are capable of maintaining and or improving soil fertility at low cost and reducing the rate of environmental degradation while increasing food production are required. Agroforestry when used as a complementary approach to conventional technologies has potential to increase food production while improving soil fertility and reducing environmental degradation.

Research in Malawi has generated a number of agroforestry technologies promising to provide solutions to the problems of low food production and soil and environmental degradation. Farmer practice of these technologies has however been very low. Efforts to increase the number of farmers practicing these technologies led to the introduction of a pilot project called the Malawi Agroforestry Extension (MAFE) Project in 1992. This was a five year project, implemented in partnership between Malawi Government and Washington State University using funds provided by the USAID. It was piloted in five of the 175 extension planning areas (EPA) of the country. One of the EPAs where the project was piloted was Njolomole EPA of Ntcheu Rural Development Project (RDP). Despite all these efforts by the Malawi Government and all its partners, low farmer adoption of agroforestry technologies is still a major problem and studies to identify reasons for this situation have not been conducted. This study was therefore aimed at identifying some of the farmer perceptions of the factors influencing adoption of the technologies.

Problem statement

The main problem in this study was the lack of farmer practice of selected agroforestry technologies in the face of low crop yields, high rates of soil and land degradation and depletion of natural forests. The study was therefore an attempt to investigate the reasons for the low farmer practice.

Objective of the study

The purpose of this study was to identify farmer perceptions of the factors influencing farmer decision to practice agroforestry technologies in Njolomole EPA of Ntcheu RDP in Malawi. Two specific objectives of the study were:

1. To investigate the influence of five selected factors: farmer exposure to the MAFE project; food productivity; soil erosion control; fuelwood productivity and profitability on farmers' decision to practice agroforestry technologies in Njolomole EPA of Ntcheu RDP.
2. To investigate the influence of six demographic factors: gender; age; education; income; landholding size and land and tree tenure system on farmer decision to practice agroforestry technologies in Njolomole EPA of Ntcheu RDP.

Comparisons were made between farmers who were exposed to the MAFE project and those who were not. Similar comparisons were made between male and female farmers.

Specific research hypotheses

The specific research hypotheses were:

1. Farmer exposure to the MAFE project influenced their decisions to practice selected agroforestry technologies in Njolomole EPA of Ntcheu RDP.

2. Farmer perceptions regarding the effect of selected agroforestry technologies on food crop yields influenced their decisions to practice those agroforestry technologies.

3. Farmer perceptions regarding the effect of selected agroforestry technologies on the control of soil erosion influenced their decisions to practice those agroforestry technologies.

4. Farmer perceptions regarding the effect of selected agroforestry technologies on the availability of fuelwood influenced their decisions to practice those agroforestry technologies.

5. Farmer perceptions of the effect of selected agroforestry technologies on profitability influenced their decisions to practice those technologies.

6. The following demographic factors: gender; age; highest level of formal schooling attained; the amount of income farmer received in 1996; landholding size; land and tree tenure system; influenced their decision to practice the selected agroforestry technologies.

As the conceptual model in figures 1 shows, independent variables were: the effect of Malawi Agroforestry Extension Project; food productivity; soil erosion; fuelwood production and profitability. Demographic variables investigated are shown in Figure 2 and they included: gender; age; education; landholding size; income and land and tree tenure system. Farmers' decision to practice the specific agroforestry technology was the dependent variable. There were eleven agroforestry technologies studied.

CONCEPTUAL MODEL

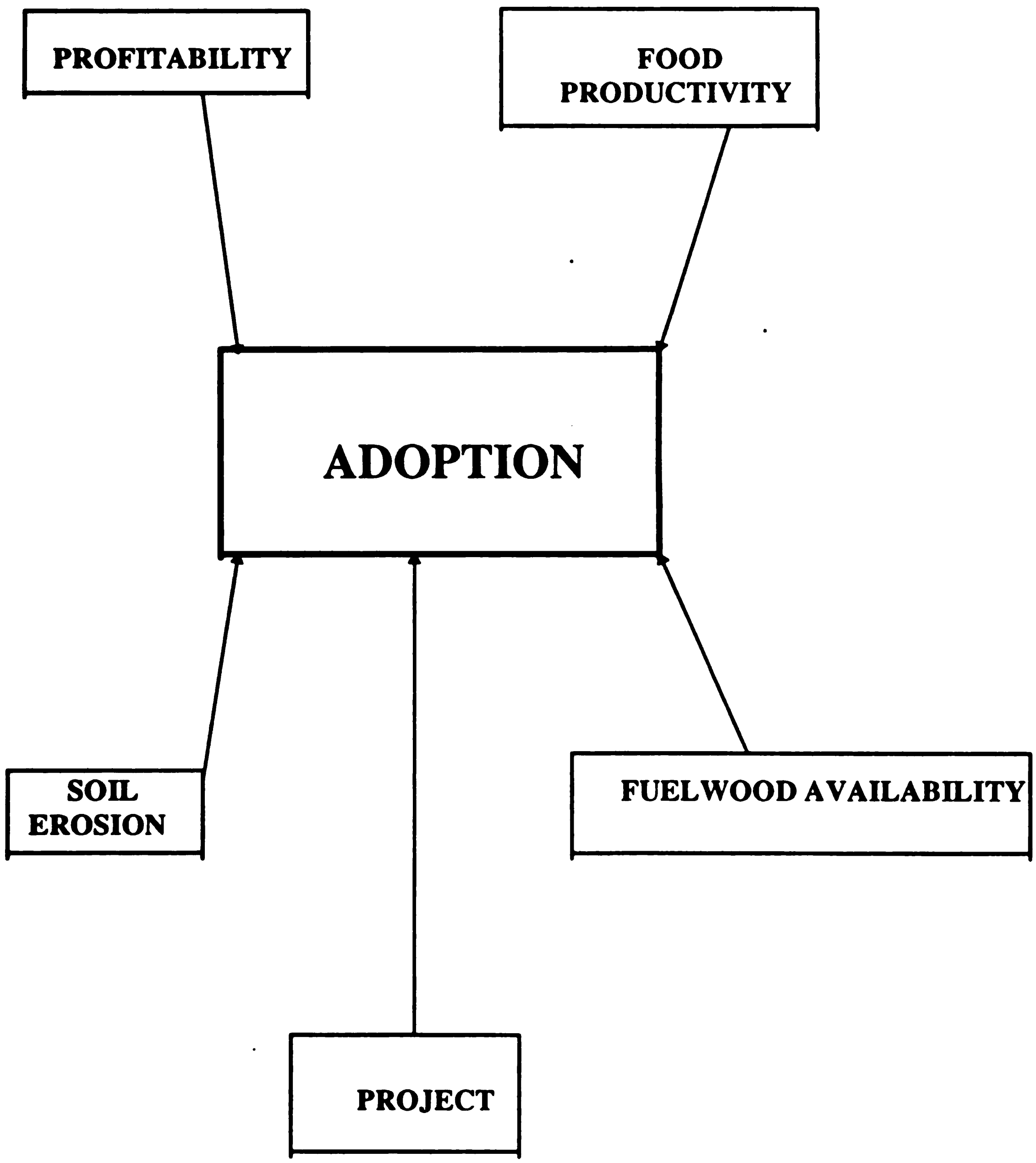

Figure 1: Conceptual model with adoption as the dependent variable.

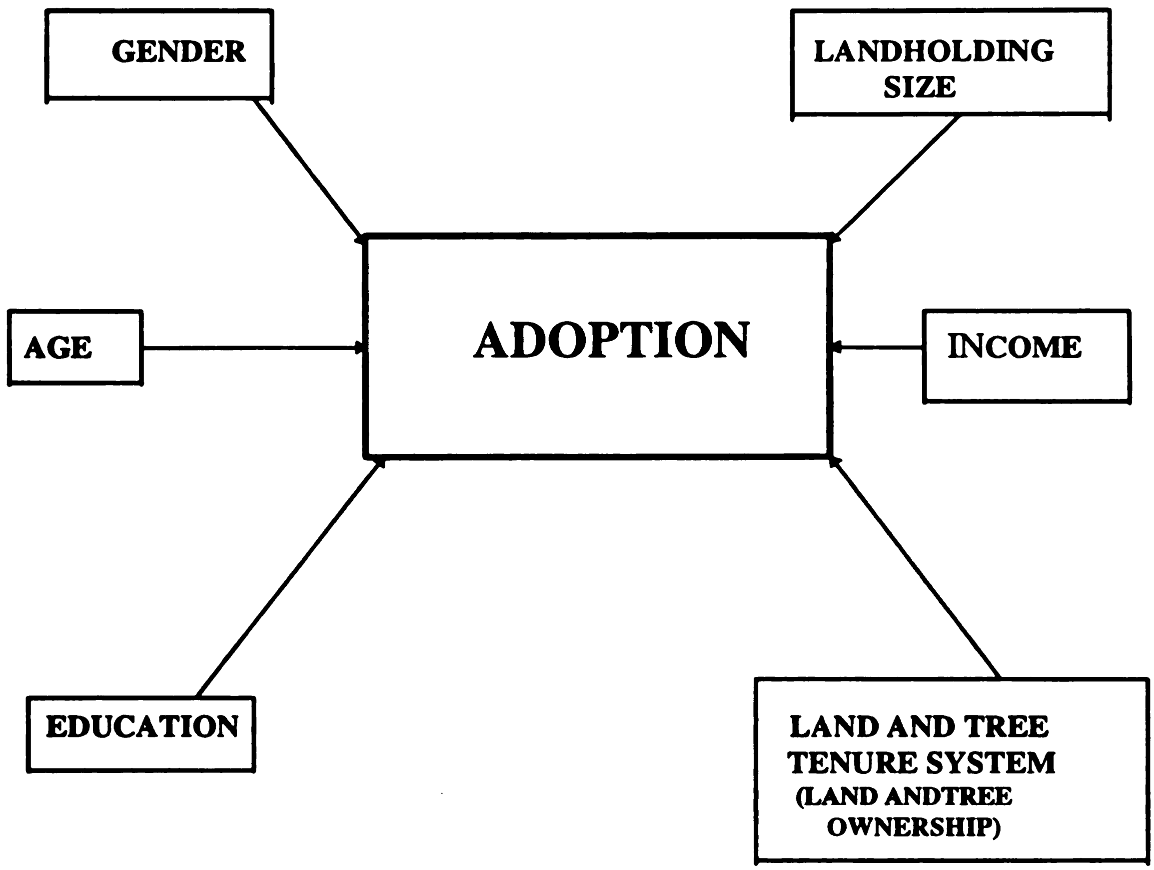

Figure2: Demographic factors influencing adoption of agroforestry technologies

Significance of the study

The study represents the first major effort to identify the factors that influence farmer decisions to practice selected agroforestry technologies in Malawi. Malawi has made a lot of efforts to come up with agroforestry technologies that seem to have promising impact on the productivity of smallholder farmers while also preserving the precious natural resources of the country. The benefits of these efforts can never be felt unless the technologies are practiced by farmers. The findings of this study provide an understanding of the factors influencing the decision to practice the technologies and are instrumental in designing a strategy for increasing the rate of adoption of the technologies. The findings and recommendations made in this study will be made available to both the Ministry of Agriculture and Livestock Development and the Ministry of Forestry and Natural Resources for them to be able to redesign their research and extension efforts for increasing the adoption of the selected agroforestry technologies.

Definition of terms

Adoption: The word adoption in this study was defined in terms of farmer perceptions of practicing the selected technologies. A farmer was considered an adopter of a particular agroforestry technology if he/she said that he/she practices the technology.

Agroforesty: The International Center for Agroforestry (ICRAF) has defined the term agroforestry as "a collective name for land-use systems and practices where woody perennials are deliberately integrated with agricultural crops or animals on the same land management unit either in spacial mixture or in temporal sequence" (ICRAF annual report, 1992). The integration must result in significant ecological and economic interactions between the woody and non woody components.

Alley cropping: This is an agroforestry system in which agronomic crops are grown in alleys formed by hedgerows of woody shrubs or trees. The hedgerows are usually cut back at planting and kept pruned during cropping season to reduce shedding and competition with the crops (Kang et al, 1981). The prunings are normally applied to the agronomic crop as green manure to provide the crop with nutrients after decomposition.

Contour hedgerows: This refers to the practice whereby hedgerows of woody shrubs or trees are grown on contour. Agricultural crops are normally grown between the hedgerows. The main purpose for contour hedgerows is soil and water conservation. The hedgerows serve as runoff checks and therefore reduce soil erosion (ICRAF annual report, 1992). The hedgerows can also be used in the same manner as in alley cropping, where the agronomic crop benefits from leaf application and/or nitrogen fixation in the case of leguminous and other nitrogen fixing woody shrubs or trees. These hedgerows were most often reinforced by strips of grass planted just above the hedgerow. When this was done, they were referred to as contour buffer strips. In some cases only the grass strips were used without the hedgerows and this was referred to as contour vegetation strips (Bunderson et al, 1995).

Faidherbia albida: This is a widely distributed tree in croplands of the semi-arid zone of Western Africa, in the unimodal upland plateau of Southern Africa and in Eastern Africa (ICRAF annual report, 1992). Increased crop yields have been observed for some crops when grown under this tree. The positive effect of *F. albida* on crop production is attributed to improved soil fertility, improved soil physical conditions brought about by better water retention, microbial populations and micro-environmental conditions produced by the trees (ICRAF annual report, 1992). The tree is unique in that it sheds off its leaves in the rainy season and hence competes little for light and water with the crops growing beneath it.

Fodder banks: This term refers to an agroforestry technology where by protein rich woody shrubs and trees like *Leucaena leucocephala* and *Gliricidia sepium* are planted to provide abundant high quality feed to livestock.

Living fences: Living fences are normally established on the boundaries of homesteads, crop fields or as enclosures for livestock dwelling places. They are most often established in order to maintain privacy or to keep out domestic and wild animals. "Their main function is to eliminate the need to construct and replace dead fences every year, or the cost of purchasing and maintaining wire fences" (Bunderson et al, 1995). If multipurpose trees are used, living fences can provide fruits, fodder, manure, wood for fuel, poles and handles for farm tools.

Profitability: The term profits was defined in financial terms as the surplus income a farmer realized after all production costs had been accounted for. Accordingly the term profitability was defined in relative terms as the degree to which one technology gave more financial profits than another technology. This definition was limited to financial benefits. All other benefits which were not financially quantifiable at farm level like those relating to environmental protection were not included in this definition. Secondly, profitability in this study was measured in terms of farmer perceptions only.

Project: The term project referred to the Malawi Agroforestry Extension (MAFE) project.

Smallholder farmers: Agricultural producers in Malawi are generally broken down into two groups of small holders and estate producers (Malawi Government, 1987). Smallholder farmers generally refer to "all the households associated with customary land tenure system" (Mkandawire, 1992), and "are involved in farming primarily for subsistence needs" (Masangano, 1989). Malawi Government segments these smallholder farmers into three groups of those with less than 0.7 hectares, those with between 0.7 and 1.5 hectares and those with more than 1.5 hectares of land.

Limitations

The data collection was done by interviews using a team of five male and four female interviewers. Limitations associated with this type of instrument such as interviewer bias, response bias were acknowledged as weaknesses of this study.

The selected agroforestry technologies considered in this study included, systematic interplanting with *F. albida,* alley cropping, relay cropping, improved fallows, contour hedgerows, woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands, planting and caring for trees at homesteads, fodder banks and living fences. The choice of these technologies were made because the technologies were currently recommended by Malawi Government to farmers in the study area. Findings of this study are therefore only generalizable to these technologies only.

Although this study compared the perceptions of farmers who were exposed and those who were not exposed to the MAFE project, caution must be exercised when interpreting the results. The MAFE project was piloted in the same EPA from which farmers who were not exposed to the MAFE project were sampled. There was no barrier to control those farmers who were not exposed to the project from observing what was happening to those farmers who were exposed to the MAFE project. Distance could have been one barrier imposed on the farmers not exposed to the project, however the ecological conditions of the EPA, notably the degree of soil erosion problems, rendered it more suitable for studying both categories of farmers.

Chapter 2

REVIEW OF RELATED LITERATURE AND RESEARCH

Introduction

Malawi like most developing countries is facing a critical problem of how to increase smallholder agricultural production and maintain food self-sufficiency at household level with the high rate of population growth and limited land resources. Malawi has a total population approaching twelve million (Malawi Government, 1993) with one of the world's highest population growth rates of 3.7 percent (Bunderson et al, 1993) The country's fertility rate is estimated at 7.6 (Malawi Government, 1993) with a life expectancy of 44 years and infant mortality rate of 149 per 1000 (Bean Cowpea Collaborative Research Support Program Report, 1996).

Food production in Malawi

Malawi's economy is basically agricultural based involving 88 percent of the labor force and producing 40 to 50 percent of the GNP as well as contributing 85 to 90 percent of the foreign exchange earnings (Malawi Government, 1987). Malawi has had a record of food self-sufficiency until the early 1980s. This situation has however, been changing lately. The country is now failing to keep pace the rising food demands due to limited land resources and low production levels. The current food position of Malawi is poor as demonstrated by the high incidence of child malnutrition among the 55 percent of rural households who have land holdings of less than one hectare (Kydd, undated; Sahn and Arulpragasam, 1991; Quinn et al, 1988).

Landholding sizes are getting smaller and more fragmented while demand for food continues to rise. By 1987, thirty five percent of the small holders had 0.7 hectares of land or less, and forty percent had between 0.7 and 1.5 hectares of land (Malawi Government, 1987). A more recent estimate by Jones et al (1993) indicate an average landholding size of only 0.48 hectares. These land holdings are too small to support an average household of five. Consequently farmers do not practice crop rotations on their farms. Continuous cropping with food crops is common practice. Maize being the main staple tends to dominate the cropping pattern. Intercropping of maize with other food crops like beans, groundnuts, cassava and others is a common phenomenon. This is leading to declining soil fertility and low productivity. The situation is worsened by the low usage of inorganic fertilizers by most smallholder farmers. Kydd (undated) reported the average inorganic fertilizer application rate by smallholder farmers as 11 kg/ha and that this was largely skewed towards the large landholding farmers. A large majority of the smallholder farmers can not afford fertilizers due to very high prices. The cost of inorganic fertilizer in Malawi is much higher than other countries in the region. Lele (1988) observed that the 1987 fertilizer maize price ratio in Malawi was three times that of Kenya, making the use of inorganic fertilizer in Malawi largely unattractive for most smallholder farmers. Low currency rates, lack of subsidies and high transportation costs are largely to blame for the high cost of inorganic fertilizers.

Low production levels are a common feature among smallholder farmers, especially those with less than one hectare of land (Lele, 1988; Mkandawire, 1988). Smale (1991) working with farmers in Malawi reported maize yields as low as 0.8 metric tones per hectare from unimproved maize varieties that were not fertilized, increasing to

1.4 tons with fertilization. Hybrid maize with fertilizer on the other hand gave yields of 2.5 tons. Despite the large relative increases in yields resulting from fertilizers and improved varieties, only twenty four percent of the maize area was grown to improved varieties. Ninety six percent of the improved maize growers fertilized their crop as compared to only fifty seven percent of the unimproved maize growers. High cost of seeds for improved varieties as well as their associated inputs like fertilizers, were the major constraints to farmer's ability to adopt improved agricultural technologies. Carr (1988) stated that;

> "past initiatives in a number of agricultural programs have sought to overcome the constraint of land through the intensification of maize production with a consequent release of resources for other cash crops. Intensification has been fostered through the expanded use of fertilizers and improved maize seed, supported by a growing credit and extension service. These efforts have resulted in the use of fertilizers by more than 25% of the farming population with about 16% receiving credit. Improved maize seed has not proved widely popular to date and its use has stagnated at less than 10% of the maize area. The programs have assisted farmers with above average land resources, but have so far had little impact on the majority of the resource poor households which face the most serious problem of falling soil fertility and seasonal undernutrition."

Conventional technologies available in the country are very expensive and obviously not suitable for the smallholder farmers. The productivity of these farmers is therefore getting poorer. Previous studies have demonstrated that a large majority of these farmers are not able to feed themselves from one end of the cropping season to the other. In a study conducted in Salima Agricultural Development Division, Mkandawire (1988) showed that as high as eighty six percent of the farm families run out of food in the months just before the next harvest, see Table 2.1 below.

Table 2.1: Months in Which Family Food Stores were Exhausted in the 1987/88 Season in Salima ADD

Month	Cumulative number of families who had run out of food	Percent of total
May 87	21	5
June 87	27	7
July 87	41	11
August 87	67	17
September 87	90	23
October 87	147	38
November 87	164	43
December 87	216	56
January 88	233	61
February 88	312	81
March 88	330	86

Source: Mkandawire, 1988
Note: Crop growing season in Malawi starts from November to April.

These farmers need technologies which can increase their food production and reduce environmental degradation at low cost. Agroforestry technologies have been heralded as capable of helping to increase crop yields and maintain or even improve the environment at low cost.

Advantages of agroforestry technologies.

Agroforestry technologies have several characteristics which can help mitigate some of the problems discussed above. The following are some of the commonly documented advantages of agroforestry technologies.

Provision of nutrients and organic matter

Some agroforestry practices supply essential organic matter (Beer, 1988; Sharma et al, 1994) and other nutrients such as magnesium, potash, calcium and sulfur which can become limiting under continuous cultivation without inputs of these elements. The supply of plant nutrients is achieved through the process of nutrient recycling from deep to upper soil layers. The woody tree species, especially those that are deep rooted absorb nutrients from deep soil layers, where the rooting system of the agronomic crops can not reach. These nutrients are translocated to above ground parts including leaves. Litter fall and decomposition completes the process of nutrient recycling from deep to upper soil layers while also adding organic matter (MacDicken and Vergara, 1990). Application of prunings gives the same effect as leaf fall. Kang et al (1984) observed that "six years of alley cropping *Leucaena* with maize and cowpeas on low fertility entisol had given very encouraging results. Periodic addition of *Leucaena* prunings helped to maintain high levels of soil nutrients and organic matter". These authors observed that plots which were receiving prunings contained twice the amount of soil organic matter as compared to the plots where prunings were removed. Similar observations have been documented by other authors (Beer, 1988; Campbell et al, 1994; Sharma et al, 1994).

Nitrogen fixation

Some tree species especially those with nitrogen fixing characteristics seem to provide nitrogen to the agronomic crops. When grown under suitable conditions, some nitrogen fixing woody species like *Leucaena leucocephala* and *Gliricidia sepium* have been observed to provide as much as 110 kg N/ha in one year (Kang et al, 1986).

Effect on agronomic crop yields

Some agroforestry technologies seem to have a positive influence on yields of the agronomic crops. Studies show that yields of agronomic crops tend to be higher when grown under *F. albeda* (Randwanski and Wickens, 1967; Saka et al, 1994). Banda et al (1994) observed increases in yield of maize grown in strips between hedgerows of *Leucaena species*. As Table 2.2 shows, maize grown between hedgerows of *Leucaena species* gave yields of 1369kg per hectare and higher over a number of years while the highest yield obtained from a maize monocrop was only 815 kg per hectare.

Table 2.2: Yields of Maize from Closely Spaced Hedgerows of *Leucaena* Varieties and the Control at Nkhande in Malawi.

Treatment	Maize yield KG/ha				
	1986	1987	1989	1990	1991
Peru	2479	3818	4106	2143	2295
Hawaian Giant	2033	1530	3652	1571	1369
Cunningham	1639	1936	2136	1558	1832
Control	815	455	318	309	152

Source: Banda et al, 1994

Effect on soil erosion

Some agroforestry technologies such as contour strips with woody hedgerows significantly reduce soil erosion and runoff on steep slopes. Banda et al (1994) observed that cultivation of steep land (slope of 44 percent) resulted in erosion of 266 tons of soil per hectare in six years. However, hedgerows of *Leucaena leucocephala* reduced the amount of soil loss to 15 tons and in some cases less 10 tons per hectare on the same slope in the same period of time. Similar observations have been reported elsewhere (Lal, 1989; Dharmasena, 1994). Reduction of the rainfall erosivity by the multi storied canopy of the agroforestry systems (MacDicken and Vergara, 1990) and reduction of runoff velocity by stems and surface roots are the main factors that contribute to the reduction of soil erosion.

Effect on fuelwood availability

The woody biomass obtained from agroforestry trees can be a major source of fuelwood for both domestic household needs as well as a source of cash. Bunderson et al (1991) reported woody biomass yields from *Leucaena leucocephala* as high as 2.5 tones per hectare in one year. Such levels of woody biomass can supply a substantial amount of fuelwood.

Fuelwood is a major source of energy in Malawi, providing 90 percent of the fuel requirements (Malawi Government, 1987). Fuelwood consumption has been estimated at the rate of 1.1 cubic meters (0.66 tons) per capita per year in the rural areas. Almost all the preparation of meals which require cooking or roasting is done using firewood. Alternative sources of energy are either too expensive or not available to the majority of the people. Electricity for example, is only available in the urban areas and even there, most of the people can not afford it. The cost of petroleum products like kerosene is beyond the reach of the low income population. Firewood is considered the cheaper alternative (Dewees, 1995).

The task of food preparation is mostly done by women and as a result they are the ones who normally go out to fetch firewood. With the high rate of deforestation (3.5 percent per annum) the forest area is diminishing and the distances that women travel to fetch firewood are becoming longer. This has direct impact on their labor demands as is evidenced by seasonal differences in their collection and usage of fuelwood behavior. Coote et al (1993) observed a remarkable reduction in the amount of firewood that women collected in the rainy season when they are busy with field activities as compare to the dry season. These authors observed that women collected and used 6 to 9 head loads of firewood per month in the rainy season as compared to 10 to 15 head loads in the dry season. This has important implications on the number and types of meals prepared. Women cook less often and family members eat fewer warm meals when firewood is scarce (Agarwal, 1986; Molnar and Screiber, 1989;). Women switch to foodstuffs and ingredients which require less cooking. Fuelwood-dependent food processing and preservation activities like smoking meats and fish or parboiling cereals and pulses decrease. Consequently the problem of fuelwood shortage may have serious impacts on the nutritional status of people.

Shortage of fuelwood also tends to affect soil fertility as women start using dung and other farm residues for cooking instead of applying them in the field as manure.

Other benefits

Other benefits include provision of forest products like timber and poles for both domestic purposes and cash. Usage of fruit trees in agroforestry provides the advantage of provision of fruits (Bunderson et al, 1994). Similarly usage of certain tree species, especially the leguminous ones like *Leucaena leucocephala* and *Gliricidia sepium* provide abundant high quality feed to livestock (ICRAF annual report, 1992; Bunderson et al., 1994).

Overall, aggregate production from agroforestry systems has been greater than systems of monoculture with forest or agronomic crops alone (Harwood, 1979; Wilson and Kang, 1981). MacDicken and Vergara (1990) discussed perceived economic and social benefits of agroforestry technologies as:

1. Crop diversity and reduced risk; diversification of the production base reduces risks of complete crop failure as well as economic impacts of price fluctuations of any single crop.
2. Increased income opportunities resulting from the intensification of agroforestry practices. Distribution of labor demand as well as income also tends to be more extended than the seasonal monoculture systems.
3. Increased variety of products may also have potential for improved human nutrition.

Disadvantages of agroforestry technologies.

This section provides a brief discussion of a number of disadvantages of agroforestry technologies:

Competition

Although not well understood the major weakness of agroforestry technologies cited in the literature is competitive interaction between the woody species and the agronomic crops. The woody species and the agronomic crops interact for light, water and nutrients. This interaction can be complementary or competitive. Some evidence shows that the competitive effect tends to have more impact on agronomic crop yields in some agroforestry technologies. Alley cropping is the most criticized in this respect.

A review conducted by Sanchez (1995) showed that out of eight alley cropping studies conducted in widely differing ecological zones of the world, only three had a positive interaction (net complementarity) when yields of the agronomic crops were the only economic benefit considered. The other five studies showed a negative effect on crop yields. In one of the studies, the negative effect was as much as -58 percent. In other words, there was 58 percent crop yield reduction in alley cropping as compared to the sole crop. The competitive effect seems to be more serious where soil moisture seems to be most limiting.

It should however be pointed that, the equation used for calculating these interaction effects only considered yields of agronomic crops as the only economic benefit of the alley cropping. Other benefits like production of fuelwood, poles, timber and fruits were not considered. Nevertheless, the data provide very strong evidence about the negative effects of alley cropping.

Time taken to see returns

Agroforestry technologies have the disadvantage of not providing or only providing limited early returns. Farmers are usually required to wait for a minimum of three years before they start reaping the benefits of agroforestry (Carter, 1996; Sanchez, 1995). This disadvantage is worsened by the fact that agroforestry technologies tend be associated with the risk of reduction of food crop yields as discussed above. Most of the farmers are operating at a bare survival level, what they produce is usually just enough for consumption from one harvest to the next. They are not able to produce surpluses for use in later years. They therefore can not afford the risk of having a reduction in their food production in any particular year while waiting for benefits which are supposedly to come much later.

Complexity

Another problem associated with agroforestry technologies is that of complexity. Rogers (1983) defined the concept of complexity as the degree to which an innovation is perceived as difficult to understand and use.

Sanchez (1995) described complexity as one of the four major issues associated with agroforestry. Agroforestry is a multi-disciplinary area combining several disciplines including forestry and agriculture. The interactions which occur between the woody species and the agronomic crops are complex and difficult to understand. Farmers engaging in agroforestry need to have a deep understanding of these interactions and their consequences to farm productivity. All these factors make practicing of agroforestry technologies complex. This complexity may be influencing farmer adoption of agroforestry technologies. Innovations which are more complicated tend to be adopted more slowly than those which are more readily understood by most members of the social system (Rogers, 1983).

Labor demanding

Some agroforestry tasks tend to demand labor during periods when the labor is also needed in other production activities. A good example of such tasks is pruning. The woody species or trees in alley cropping or contour hedgerows need frequent pruning in order to reduce competition for light in the crop growing season (Bunderson et al, 1991; Kang and Wilson, 1981; Wendt et al, 1993). This pruning can sometimes be as frequent

as every three weeks. The times these prunings are supposed to be done is also the time when agronomic crops are in the field, demanding labor for other tasks like weeding. Farmers may therefore perceive shortage of labor at such times as a constraint to their adoption of recommended agroforestry technologies.

Agroforestry technologies recommended in Malawi

Research in Malawi has identified and recommended a number of agroforestry technologies to smallholder farmers. These technologies are discussed in this section.

Cultivation under *F. albida.*

Cultivation of food crops under *F. albida* trees is one of the agroforestry technologies recommended in Malawi. *F. albida* is a large leguminous tree which is commonly found in most parts of Malawi. It is a unique tree in that it sheds off its leaves in the main growing season and this reduces competition with the food crop for light and water. The shedding of the leaves also enriches the top soil with nutrients and organic matter as well as influencing the micro-environment in terms of improved rainfall infiltration (Saka et al, 1994). Observations made in Malawi in 1993, showed that up to 125 kgN/ha was mineralized in alluvial soils under *F. albida* over a period of four months (ICRAF, 1993). Other studies have shown that yields of food crops like maize, sorghum and pearl millet can increase by 50 to 250 percent when grown under *F albida* (Randwanski and Wickens, 1967; Saka et al, 1994). *F. albida* is also a good source of fuelwood.

Contour hedgerows and/or grass strips

Contour hedgerows and/or contour grass strips is another agroforestry technology recommended in Malawi. This technology is designed to control soil erosion. Forty five percent of the total land in Malawi is on slopes of at least 12 percent (Shaxon et al, 1977). Soil erosion is a major problem on these sloping lands. Erosive rains, poor crop management and inadequate crop cover all result in increased soil erosion. On the other hand, the high population growth rate that Malawi has been experiencing has increased the problem of land pressure. Landholding sizes for most of the smallholder farmers are too small to support their family food requirements. As a result of this, most of the farmers expand their farming areas by opening land which is on steep slopes originally deemed unsuitable for cultivation. Some farmers cultivate land as steep as 45 percent slope. Problems of soil erosion and consequently, land degradation are so serious in these types of land that if left unchecked, a major crisis will occur.

Adoption of conventional soil conservation measures has on the other hand been very poor because they are expensive, labor intensive, and do not show short term benefits (ICRAF annual report, 1992). Studies in Malawi as well as in other countries have shown that contour hedgerow intercropping is very effective in controlling erosion (Banda et al, 1994; Bunderson et al, 1994) and at a much lower cost (ICRAF annual report, 1992). The contour hedgerows check runoff coming from above. When farmers use fruit trees on the contour ridges, they also benefit from the fruit while usage of leguminous woody species provide added advantages of:

a) Provision of biologically fixed nitrogen to the companion crop.

b) Provision of green manure or mulch to the companion crops, hence recycling plant nutrients from deeper soil layers.

c) Provision of favorable conditions for soil macro- and micro-organisms.

d) Provision of woody biomass which can be used for fuelwood, poles and timber.

e) Provision of prunings for browse.

Fodder banks

Fodder banks of protein-rich woody legumes provide a lot of high quality feed to livestock as well as a ready supply of fuelwood and even building materials (Bunderson et al, 1994). Studies conducted in Kenya showed that the economic advantages of using *Leucaena* leaf as livestock feed for dairy animals was three and a half times better than using it as mulching for fertilizer for food crops (ICRAF annual report, 1992).

Alley cropping

The major advantages associated with alley cropping include:

1. Provision of biologically fixed nitrogen to the companion crop especially when leguminous woody species have been used (Kang et al, 1986).

2. Provision of green manure or mulch to the companion crop (Beer, 1988; Kang et al, 1986; Sharma et al, 1994).

3. Recycling of nutrients from deeper soil layers where the roots of agronomic crops can not reach. Agronomic crops benefit from these nutrients through litter fall from the woody species (Beer, 1988; Kang et al, 1986; Sharma et al, 1994).

4. Provision of fuelwood and other materials like poles, staking sticks and browse. Bunderson et al (1991) reported woody biomass yields from *Leucaena leucocephala* from

an alley cropping trial as high as 2.5 tones per hectare.

Alley cropping has however been criticized as a technology which can sometimes be more harmful than beneficial to farmers. The criticism stems from the issue of competition between the woody species and the agronomic crops. Competition for light, water and nutrients has most often been observed to result in reduction of yields of the agronomic crops.

Homestead, boundary and woodlot planting.

Fruit and other multipurpose tree(MPT) species may be planted along farm boundaries, roads and homesteads. Trees may also be planted in small woodlots or orchards, depending on the availability of land. These trees can be important sources of food, fuelwood, poles, timber and fodder for both domestic use as well as sale for cash. Some of the tree species may even have important medicinal or pesticide value (Bunderson et al 1995).

Living fences

Living fences are planted mainly to eliminate the need to construct and replace dead fences every year or the cost of purchasing and maintaining wire fences. They are planted for a number of reasons including; keeping out domestic and wild animals, enclosing domestic animals and demarcating farm or garden boundaries and homesteads. Depending on species, living fences do also provide other uses like; fodder, green manure, fruits, fuelwood as well as privacy (Bunderson et al, 1995).

Problems of low farmer practice of agroforestry technologies in Malawi

Despite all the efforts made in Malawi and the advantages that the agroforestry technologies have, their adoption has remained very poor. Furthermore studies to identify the reasons for this poor response have not been done. Adoption of a particular innovation can be influenced by a number of factors including the specific characteristics of the innovation, the diffusion process and the characteristics of the social system. This section will briefly discuss each of these factors, as they relate to the adoption of selected agroforestry technologies in Malawi.

Rogers (1983) discussed five innovation specific characteristics including; relative advantage, compatibility, complexity, triability and observability. These characteristics have profound influence on the clients decision to adopt the particular technology (Ryan and Gross, 1943). Rogers (1983) defined the concept of relative advantage as the degree to which an innovation is perceived as better than the idea it supersedes. The degree of relative advantage may be measured in economic terms like increased profitability and productivity. It can also be measured using other factors like socio-prestige, convenience and satisfaction. Perceived relative advantage tends to weigh more than the physical advantage in the decision to adopt the innovation. This study investigated whether farmers perceived agroforestry technologies as having some relative advantage over their current practices. Specifically the study investigated whether farmers thought that agroforestry technologies were better than their previous or current practices in terms of: profitability; crop productivity; production of fuelwood and control of soil erosion.

Profitability

One reason for low adoption suggested in the literature is that farmers do not perceive agroforestry technologies as more profitable than the monocultures of agronomic crops. Several authors have suggested that farmer adoption of new and improved technologies depends on their perception of the profitability of the technologies (Atta-Krah and Francis, 1986; Monu and Omole, 1991; Moris, 1991; Osuji 1991; Wendt et al, 1994). Roling (1993) working with Kenyan farmers, observed that small farmers can innovate incredibly fast if they perceive the program or technology to be profitable. When the farmers were provided with the right type of seeds packaged in appropriate bags, fertilizers being widely available and prices of their produce were attractive, adopted the technology very fast. This suggests that scientists need to evaluate their technologies more carefully before recommending them to farmers. The few economic studies on agroforestry technologies have generated mixed results. Akyeampong and Hitimana (1996) conducted an economic appraisal of alley cropping with *Leucaena diversifolia* in Burundi. They observed that alley cropping on maize gave negative net present values. Even when they conducted a sensitivity analysis with the price of maize increased by 50 percent, the net present values were still negative. In another study, where bananas, beans were intercropped with nine different species of trees, some treatments showed positive net present values while others showed negative net present values (Akyeampong et al, 1995).

A cost benefit analysis of agroforestry in Indonesia showed that maize grown under agroforestry systems was not economically beneficial to farmers (Silver, 1991). With this kind of mixed results, two questions of interest would include; what are the perceptions of farmers relating to the profitability of agroforestry technologies? Secondly, how do the perceptions of farmers relating to the profitability of agroforestry technologies influence their decision to adopt those agroforestry technologies?

An important variable to be considered when one talks about profitability is the availability of good markets for the products from the technologies (Sanchez, 1995). Successful marketing of the agroforestry products is a necessity if farmers are to benefit from the technologies. The problem is that most of the non timber products of the agroforestry technologies do not have well developed markets. As a result, most of the financial appraisals tend to show that agroforestry technologies are not profitable (Peters et al, 1989). However, evidence from other literature show that marketing of non timber products can make agroforestry more profitable (Clay, 1992; Hosier, 1989; Guggenheim and Spears, 1991; Mercer and Soussan, 1992; Peters et al, 1989).

In Malawi, the market for some of the agroforestry products has been so much controlled to the extent that farmers may not perceive the profitability of the technologies. Dewees (1995) discussing issues of forestry policy in Malawi indicated that there exists a large market for firewood and charcoal in the main urban centers. Urbanization rate in Malawi is estimated at 2,000 people per week. One problem of this high rate of urbanization concerns energy supply.

Firewood and charcoal are the major sources of energy in the urban sector. This is due to the unavailability and high costs of other sources of energy. The urban population depends heavily on the market for the supply of firewood and charcoal. The retail value of the urban annual consumption of firewood and charcoal in 1993 was estimated at MK370.5[1] million and MK16.4 million respectively (Ng'ong'ola, 1992). Although the rural areas may not seem to have a market for these products, the urban market is likely to spread deeper into those areas of the country as supply becomes scarce in the areas close to the urban centers.

However, the problem seems to do with the wood energy policy of the country. The government has been encouraging farmers to plant trees to meet the woodfuel market demand. Tree planting has been subsidized and in some cases lucrative bonuses have been paid to farmers in order to make tree planting financially attractive compared to crops.

Secondly the government has committed itself to undertake monitoring and control of woodfuel trafficking where it is being done on a commercial scale (Malawi Government, 1987). As a result of this, woodfuel markets have been controlled through confiscation on road blocks and on routes to main urban centers (Dewees, 1995).

The third aspect of the policy is that while woodfuel prices are not controlled, prices for woodfuels from government plantations are at a level below prices for woodfuels from customary and private land (Malawi Government, 1987). This is done in order to discourage farmers from selling fuelwood from natural forests. The policy is however affecting prices for fuelwood from planted forests making tree planting for fuelwood production unprofitable. These policies present two major contradictions:

a) Government is encouraging investment in tree planting while keeping prices from its

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[1] MK370.5 million was equivalent to US $97.5 million while MK16.4 million was equivalent to US $4.3 million at the exchange rate of 1993.

plantations low. There is no way farmers can expect to get higher prices for their woodfuel products. Government plantations account for 89,300 hectares while farmers' plantations account for less than 10,000 hectares. The supply from government plantations completely suppresses the prices paid to farmers. This situation could be a major constraint to implementing effective tree growing programs especially if the major objective is to produce fuelwood (Mercer and Soussan, 1992).

b) The other contradiction lies in the fact that government controls the movement of fuelwood products to the market while on the other hand encouraging farmers to invest in tree planting. Although the main objective is to protect indigenous natural forests, farmers may be interpreting this as a government way of discouraging any markets for fuelwood and therefore not be willing to invest in agroforestry technologies.

Food productivity

With the problems of small landholdings, most of the smallholder farmers engage in farming for subsistence. Their main concern is to produce enough food to feed their families from one harvest to the next. Sometimes these farmers fail to achieve this objective and are forced to engage in other activities like doing piece work in order to generate the food they need to cover up for the deficit (Mkandawire, 1988; Masangano, 1989). For these farmers, a beneficial technology would have to be one which helps them to get enough food for the whole year.

In some studies, agroforestry technologies have been reported to maintain and or increase crop yields of their companion crops by maintaining or even improving soil fertility and soil micro-environment (Banda et al, 1994; Saka et al, 1994). Such observations are however confounded by the fact that other study findings tend not to support these findings (Gosh et al, 1989). One problem with agroforestry is that the woody species use up part of the land which could be used for the food crop. If yields of such food crops do not increase sufficiently to compensate for the yields lost from the area planted to the trees, then the farmer risks a reduction in his/her total food production. Secondly is the problem of competition between the agronomic and tree crops for growth factors like light, water and nutrients. As discussed in the section on disadvantages of agroforestry technologies above, this competition has sometimes resulted in reduction of food crop yields. The risk of reduction of food production may be too costly for the farmer to accept and the technology is therefore, unlikely to be accepted.

Soil erosion

The problem of land pressure is forcing most smallholder farmers to open marginal land for cultivation. Such land is most often on very steep slope with very easily erodible soils. As a result of this, soil erosion is a major problem in Malawi. A large amount of soil is lost every year with the fertile top soil lost within the first few years of cultivation (Banda et al, 1994). This problem is causing serious land degradation and continuous decline in crop yields. It is however not known whether farmers perceive soil erosion as a major problem on their farms. If they do, the next question is whether they perceive the selected agroforestry technologies as a solution to this problem.

Fuelwood production

Shortage of fuelwood is becoming a crisis in many developing countries. Fuelwood is the main source of energy in the developing world. FAO estimates show that more than seventy five percent of the energy consumption in most developing countries is from woodfuel (Agarwal, 1986). However, with the increasing problem of deforestation, fuelwood is becoming more scarce. People are becoming more desperate for energy in most developing countries. Journeys to gather fuelwood which used to take an hour or less in the past, now take as much as a full day (Eckholm, 1975). The consequences of these fuelwood shortages are many. Molnar and Screiber (1989) listed some of them as follows;

1. Women who are the main fuelwood collectors spend more time collecting fuelwood and hence spend their time less productively.
2. Children spend more time helping with fuelwood collection and less time in school.
3. Women cook less often and family members eat less meals.
4. Women use dung and crop residues for cooking and therefore having less farm yard manure to apply in their fields.
5. Fuelwood-dependent food processing and preservation decrease.
6. Wood based income generating activities decrease or become less profitable.

Agroforestry technologies can help mitigate the problem of fuelwood shortage. It is however not known whether farmers think that the recommended agroforestry technologies can help them reduce their fuelwood shortage problems.

Diffusion process

The diffusion process can briefly be defined as the process by which an innovation is communicated through certain channels over time among members of a social system (Rogers, 1983). As the definition implies, the process takes time to occur. Most often, focused efforts have to be made to speed up the process. National agricultural extension programs are examples of such efforts. Several approaches have been used in the agricultural extension programs. Pickering (1989) described five extension approaches used in Africa. These include what he called the commodity-based approach, community development-cum-extension approach, innovation centered approach, group based approach and farmer focussed approach. The farmer focussed approach also been referred to as the training and visit system (Benor and Baxter, 1984; Benoer et al, 1984). A sixth extension approach was described by Collinson (1981) as the farming systems research and extension approach.

Agricultural extension in Malawi

Agricultural extension in Malawi is implemented by the Ministry of Agriculture and Livestock Development through eight Agricultural Development Division (ADDs). These ADDs are sub-divided into 30 Rural Development Projects (RDPs) which are further divided into 173 Extension Planning Areas (EPAs).

The extension approach followed is called the block extension method which is basically a modified training and visit system. The approach requires that an extension worker divide the working area, which is normally called a section, into eight sub-sections. These sub-sections are called blocks. The extension worker is to work with all the farmers in each block as a group and is encouraged to visit each block at least once every two weeks. Each block should to have a demonstration garden where farmers are provided with agricultural advice in a practical way. The main delivery method for the agricultural advice is through demonstrations, meetings, short courses, lectures, radio and printed materials like posters and newsletters for the few who can read them.

The main advantages of the block extension approach approach include: a wider cross-section of the farmers are contacted simultaneously; sharing of ideas is enhanced through farmer interaction; and, extension workers are more easily supervised. Although, the block extension approach has been effective for some endeavors, it has not been effective in promoting farmer practice of selected agroforestry technologies. It was therefore decided to introduce a new extension approach for the promotion of farmer practice of selected agroforestry technologies. The approach was introduced as a pilot project called the Malawi Agroforestry Extension Project.

The Malawi Agroforestry Extension Project

In an effort to increase the adoption of recommended agroforestry technologies, the Malawi Government with cooperation from Washington State University and financing from USAID introduced a pilot agroforestry extension project called the Malawi Agroforestry Extension Project (MAFE). It was a five year project extending from August, 1992 to September 1996. The project was implimented by several organisations including Ministry of Agriculture and Livestock Development, Ministry of Forestry and Natural Resources, Washington State University and the USAID. It was piloted in parts of certain EPAs of five of the twenty five districts of the country. The districts involved were Mzimba in the Northern Region, Dowa and Ntcheu in the Central Region and Mangochi and Chikwawa in the Southern Region. The goal and objectives of the project were;

Project goal: Enhance the economic well-being of smallholder farmers by improving food production efficiency and sustainability with reduced degradation of natural resources.

Project objectives:

1. Develop and refine an agroforestry delivery system for implementation nationwide.
2. Adapt agroforestry technologies to farmer problems in order to facilitate adoption, impact and long term viability.
3. Train staff and farmers on agroforestry technologies and practices.
4. Develop and strengthen linkages between appropriate governmental and non-governmental organization.

The extension approach used in the project was more of the farming systems research and extension approach as described by Collinson (1989). In this approach, technologies developed by research are tried and managed under farmer condition. Researchers, extension workers as well as farmers work together when trying the technologies at the farm. The main objective being to test and adapt the technologies to farm situations

The basic concept of the project was to empower and motivate farmers to help themselves in a manner that was ecologically sound and economically attractive (Bunderson et al, 1992). This in essence meant that the farmers were the center of project activities. In other words, while the technologies may have been already available for practice, the project emphasized on the process rather than the product. Farmer involvement or participation in the planning, decision making and implementation of the project was central. Their needs, objectives and priorities were emphasized. Their indigenous and traditional knowledge was also recognized. Farmers were considered as partners in the implementation process, rather than imposing the knowledge gained from research. Where necessary the technologies as designed by research were adapted to suit farmers' needs, objectives, priorities and constrains. There are several advantages to this approach including:

1. When farmers are involved in the planning and decision making process, they are likely to be deeply committed to the project. Knowles (1980) said that "human beings tend to be committed to a decision to the extent that they have participated in making it. In other words farmers in the project were more likely to remain committed to practicing the technologies to the extent that they were involved in planning and deciding how to implement them. Involving the farmers in the planning and decision making process would have made them feel empowered that they were determining their own destiny and that feeling is very rewarding in itself (Adams, 1975; Dewey, 1966; Freire, 1970).

2. If farmers were involved in identifying their own needs, then the technologies they decided to practice would have been those that directly addressed those needs. The technologies and the learning experiences they gained would be more appropriate to them (Dewey, 1966). Knowles (1980) indicated that people tend to be more deeply motivated to learn those things they see the need to learn.

3. Emphasis on indigenous and traditional knowledge would have made possible

adaptation of the technologies to local needs and conditions (Brokensha et al, 1980). Also adults have a background which is rich with experience. They define themselves in terms of the experience which they have accumulated. When they find themselves in situations which their experience is not being used, or its worth is minimized, they feel rejected as persons (Knowles, 1980). By tapping on the farmer's knowledge and experience, they would have felt more accepted in the project and therefore be more willing to practice the technologies.

Demographic factors

Evidence from the literature shows that some demographic factors do influence farmer adoption of recommended agricultural technologies. Such demographic factors include: gender; age; level of education; level of income; landholding size and land tenure system (land ownership). This part of the literature review will isolate some of the current knowledge about the relationship of these demographic factors and adoption of recommended technologies.

Gender

Gender differences in developing countries have been observed to have fundamental influences on agroforestry technologies and other tree planting programs. Some of the differences between men and women relate to issues of responsibilities for food and crop production, household food preparation, child care and land and tree tenure issues.

Men and women have three distinct domains of responsibility for food and cash cropping in most developing country situations. The level of differentiation may vary from society to society, but generally women tend be more concerned and responsible for household food provision and other household chores like child care (Chavangi et al, 1988). On the other hand, men tend to be more interested in cash generation (Molnar and Screiber, 1989). With the kind of responsibilities that women have to fulfill, their interests and knowledge about trees is very different from that of men. Women tend to be more interested in trees products like fruit, herbal medicines and firewood, while men tend to be interested in planting trees for cash generating products like poles and timber (Agarwal, 1986; Chavangi et al, 1988; Rocheleau, 1992; Scherr, 1994). Tree production programs whose primary focus is cash generation have tended not to be supported by women. Similarly tree production programs whose primary focus is production of food and fuelwood have tended not to be supported by men. Indigenous knowledge on trees and tree products between men and women also differs a lot (den Biggelaar, 1994a; Rocheleau, 1991; Rocheleau, 1992). The differences are mostly due to the same differences in responsibilities.

These gender differences have significant influences on the successful implementation of agroforestry technologies. Women are the main source of labor for crucial activities like watering tree nurseries. However, these women have been observed to be unwilling to provide such labor where the main purpose for such labor was cash generation (Rocheleau, 1991).

The other major difference between men and women relates to land and tree tenure. In some societies in developing countries, land tends to be under the control of men (Chavangi et al, 1988; Footmann and Nabane, 1992; Jacobson, 1992) while in other societies, land is supposed to be controlled by women (Rocheleau, 1987; Rocheleau 1988). Tree rights also tend to vary from society to society. In some cases the person who has rights to the land, also has exclusive rights to trees growing on it. In other cases, a person may have exclusive rights to the land but having no rights or only part of the rights to the trees growing on his land. These differences have fundamental influences on the adoption of agroforestry technologies. Fortmann and Nabane (1992) observed that women in Mhondoro District in Zimbabwe were not willing to plant trees because they did not have rights of tenure to the land. In the event of divorce, a woman lost all the rights of usage of trees which she planted on her husband's land even if she was living in the same locality. On the other hand, men of the Luhya tribe in Kenya did not allow their women to plant trees on their land for fear of losing their rights to the land (Chavangi et al, 1988).

Malawi has two distinct customary systems of land tenure. Most societies of the Southern and Central Regions practice matrilineal system of marriage, where the husband joins the wife. By definition, women control the land in these societies. Land is transferred from the mother to the daughters and not to the sons. People of the Northern Region practice patrilineal system of marriage, where the wife joins the husband. By definition, land is controlled by men in this system. Land is transferred from the father to the sons and not to daughters. These differences may have significant influences on the adoption of recommended agroforestry technologies.

Age

There is mixed evidence about the relationship between age and farmers' willingness to innovate. Some studies show that there is a significant negative relationship between farmer's age and their willingness to adopt new innovations (Akinola, 1987; Akinola and Young, 1985; Polson and Spencer, 1991). This means that the younger the farmers, the higher the rate of adoption of new innovation. Bongunjoko (1991) on the hand, observed a positive relationship between farmers' age and the adoption rate of new technologies. This particular observation meant that the older the farmer, the higher the adoption rate. Other studies found no relationship between the farmers' age and adoption rate (Onyenwaku and Mbuba, 1991; Opare, 1977).

Education

Wharton (1963) discussed the importance of education on farmer's ability to adopt new technologies. He argued that a literate person is much easier to train as compared to an illiterate person. Education, apart from helping farmers to acquire simple skills like writing, reading and simple calculations which facilitate communication, it increases farmer's inquisitiveness which results in self discovery of knowledge concerning farming. It widens the scope of decision making, stimulates motivation and induces frustration which usually leads to heightened personal and political activity with some important political consequences.

Education enables the farmer to engage in the general process of improved rationality or thinking through problems and not merely accepting them as unchangeable givens. With education, farmers are able to question their value systems and cultural weaknesses. Educated people have a good attitude to change and are most often willing to seek and try new information. Noor (1980) indicated that if education is relevant to the needs of the people, it leads to more production. Despite these assertions, studies which have tried to investigate relationships between education and farmer adoption have produced mixed results. A positive relationship between farmer's level of education and rate adoption of innovations was observed in some cases (Akinola, 1987; Atala, 1984; Marsh and Coleman, 1955; Napier et al, 1984; Osunji, 1981). In other cases there was no relationship between farmers' level of education and rate of adoption of innovations (Ashby, 1982; Bongunjoko, 1981; Fett, 1971; Onyenwaku and Mbuba, 1991).

Income

Some innovations require capital in order to be implemented and are therefore not suitable for resource poor farmers. A good example is that of improved maize varieties. For a farmer to grow an improved maize variety, he/she needs to have sufficient amount of capital for purchasing seed and other inputs like fertilizers. Most of the resource poor farmers would not have the capital required for the implementation of such technologies (Carr, 1988; Mkandawire, 1988; Mkandawire and Chipande, 1988).

Landholding size

Shortage of land is a major constraint under which smallholder farmers in Malawi operate. Average landholding sizes are very small (Bunderson et al, 1993; Jones et al, 1993; Malawi Government, 1987) so that it is very difficult for farmers to produce enough food to feed their families (Masangano, 1989; Mkandawire, 1988). Shortage of land has sometimes been a hindrance to farmers' ability to adopt new technologies (Carr, 1988;

Mkandawire and Chipande, 1988). Studies in various places have shown a positive relationship between landholding size and willingness to adopt new innovations (Akinola, 1987; Onyenwaku and Mbuba, 1991; Opare, 1977; Polson and Spencer, 1991). Mkandawire (1988) observed that farmers with very small landholding sizes failed to utilize credit packages[2] provided by the Ministry of Agriculture. The packages were too large for their landholding sizes.

Adoption of agroforestry technologies could be influenced by the problem of small landholding sizes in Malawi. One way that adoption would be influenced by this problem would be the mere fact that the woody species use up some of the land. This implies a reduction of the land area left for crop production and consequently a reduction in crop production.

Land and tree tenure system

There are three land tenure systems in Malawi including: customary land, leasehold land and freehold land. The customary land is regulated by customary law. Essentially land belongs to the community under the custodianship of the local chiefs who allocate it to their subjects. Once allocated, the occupants have rights to utilize the piece of land indefinitely and also have rights of gratuitous transfer and inheritance. (Mkandawire, 1983) provided a good description of customary land in Malawi. Land under this category is regarded as not having a market value, except the value from its capacity to produce a crop. Otherwise the occupants can not sell the land nor dispose it off to an

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[2] A credit package consists of a collection of inputs like fertilizers, seeds and chemicals recommended for a particular crop on a specific hectarage. Such a package is issued to farmers on loan.

outsider (non member of the community). By custom the occupants do not own the land which they cultivate, but have rights of control over it. Its possession transcends an individual's lifetime as it is held to belong to the living, the dead and the unborn. Occupants deemed to be behaving in a manner contrary to the community's norms can have their land forfeited by the village headman.

Leasehold land is held on lease for 21 years, with a number of specified standard covenants relating to such matters as agricultural use, soil conservation and tree planting. The lease is reviewed every seven years (Malawi Government, 1987).

Most of the leasehold land belongs to large estate owners, most of which being foreigners who obtained it in the pre-colonial and colonial periods. Very little land has been converted to freehold system in the post-colonial era. One district, Lilongwe, has a special extended family freehold system. This was introduced in 1972 on a pilot basis and only had limited success (Mkandawire, 1983).

The bulk of the land (59,281 out of the 71,475 square kilometers) is under customary land tenure. This is the land on which smallholder farmers occupy and cultivate. Perceived weaknesses of this land tenure system include a lack of security of tenure and lack of concern among the farmers on long term matters such as deforestation and soil erosion (Malawi Government, 1987). One implication of this would therefore be that since farmers don't perceive secure rights of land tenure, they may not be interested to invest in long term technologies like those of agroforestry.

Associated with the land tenure issue is tree tenure system. Being that the customary land belongs to the whole community, each member of the community has equal access to any natural trees growing on it. This is especially manifested in virgin land where members of the community just go in and out to cut trees or harvest any of the tree products like fruits and medicinal plants. Only in those few cases where the village headman regulates the usage of the natural forests is the situation different. In most cases, such regulations do not exist. This may have posed problem to the adoption of agroforestry technologies. Farmers may have thought that they may not have security to the trees which they plant and therefore not be willing to adopt the agroforestry technologies.

Summary of chapter

In summary, this chapter has provided a review of the literature on: food situation in Malawi; advantages and disadvantages of agroforestry technologies; agroforestry technologies recommended and problems of low farmer practice of selected agroforestry technologies in Malawi. The country is facing problems of shortage of land for cultivation, land degradation and low food productivity. One consequence of these problems is failure to meet the national food requirements. To address these problems, Malawi is advocating the practice of agroforestry technologies. However, farmer practice of those agroforestry technologies is very low and factors which could be likely reasons for this situation have been discussed.

Chapter III

DESIGN AND METHODOLOGY

Introduction

The methodology of this study was designed to obtain farmer perceptions of factors influencing farmer decision to practice selected agroforestry technologies. Data was collected from two groups of farmers including farmers who were exposed to the Malawi Agroforestry Extension (MAFE) and from farmers who were not exposed to the MAFE project in Njolomole EPA of Ntcheu RDP. Perceptions of the two groups of farmers regarding the influence of the selected factors on farmer decision to practice the selected agroforestry technologies were compared. Male and female farmer perceptions were also compared. Interviews were the primary data collection technique.

This chapter provides a detailed description of the methodology of the study. It is divided into the following sections: design; population; sampling procedures; instrumentation and data collection methods; model specification and data analysis.

Design

The dependent variable in the study was farmer practice of selected agroforestry technologies with farmer exposure to the MAFE project, farmer perceptions regarding the effect of selected agroforestry technologies on food crop yields, farmer perceptions regarding the effect of selected agroforestry technologies on the control of soil erosion, farmer perception regarding the effect of selected agroforestry technologies on availability of fuelwood and farmer perceptions regarding the effect of the selected agroforestry technologies on profitability as the independent variables. The influence of some demographic variables on farmer decision to practice the selected agroforestry technologies were also investigated. The demographic variables included were, gender, farmer's age, highest level of formal schooling attained, total income received in the previous year (1996), landholding size, land and tree tenure system.

Population

Malawi is divided into eight agricultural development divisions (ADDs). These divisions are further divided into 30 rural development projects (RDPs) which are further divided into 173 extension planning areas (EPAs). This study was conducted in Njolomole EPA of Ntcheu RDP in Lilongwe ADD. This EPA was chosen for several reasons. It is one of the EPAs where the MAFE project was piloted. It is also an EPA which lies on the Kirk Range where most of the land is on steep slopes and erosion hazard is major problem. It is also one of the highly populated EPAs such that most of the farmers are cultivating land which is not suitable for agriculture. The need for agroforestry technologies is very high in this EPA. It was therefore chosen as an ideal place for this study.

The EPA has 9,236 farm households with eight village extension workers, one soil conservation assistant, one women's programs assistant and two supervisors. The crops which were grown in the EPA included maize, beans, groundnuts, soya beans, potatoes and cassava (Project crop estimate report, 1997). The EPA experiences high rainfall with annual precipitation ranging from 1000 mm to 1800 mm. Seasonal food shortages is a major problem in the EPA. Thirty percent of the farm households had run out of their food stocks by January 1997.

The population of the study included all 9,236 farm households. This population was divided into two groups including 64 farm households who were exposed to the Malawi Agroforestry Extension Project and 9,172 households who were not exposed to the MAFE project.

Sampling procedures

The village extension workers with the help of the enumerators used in this study compiled a list of all the farm households in the EPA. This effort produced a list of 7,748 farm households. The samples used in this study were therefore drawn from this list of 7,748 farm households. The first sample to be drawn was respondents not exposed to the MAFE project. A total of 385 farm households were sampled using random numbers. This sample size was determined using tables provided by the Educational and Psychological Measurement (1970). The other sample constituted all the 64 farm households who were exposed to the MAFE project. These two samples were split into halves using systematic sampling procedure. One male member of each household was interviewed from half of the samples and one female member of each household was interviewed from the other half of the samples.

Instrumentation and data collection methods

An interview questionnaire was used to measure respondent's perceptions the influence of the selected agroforestry technologies on food crop yields, the control of soil erosion, fuelwood availability and exposure to the MAFE project (see appendix F). The instrument was pilot tested in Bembeke EPA of Dedza Hills RDP. This EPA has similar geographical and climatical features to Njolomole EPA. The purpose of pilot testing the instrument was to test the suitability and reliability of the instrument. A test-retest reliability r of 0.79 was obtained. The instrument was also reviewed by one agroforestry researcher and one extension specialist and with minor changes made they both agreed that it measured what was intended to be measured. Data collection was by interviews. A team of five male and four female interviewers was recruited by the researcher in February 1997. These interviewers were trained by the researcher with assistance of two extension staff in the first week of March 1997. The main objectives of the training were to acquaint the interviewers with the objectives of the questionnaire, the selected agroforestry technologies and interview techniques. Each item on the questionnaire was thoroughly discussed and mock interviews were conducted. Issues of general ethics including confidentiality of the information, obtaining respondent's consent and building rapport were also discussed.

Actual interviews were conducted from the second week of March to the second week of April 1997. The male interviewers interviewed male respondents while the female interviewers interviewed the female respondents. Interviewers had to make prior arrangements with the respondents making sure that the interviews were conducted at convenient times for the respondents. Respondents were interviewed in the absence of members of the family of the opposite sex to avoid responses which were influenced by their presence. This was done where necessary by politely asking such other members of the family to leave as the interviews were being conducted.

A total of 402 out of the targeted 449 respondents participated in the interviews. This consisted of 64 respondents (100%) exposed and 338 respondents (87.8%) not exposed to the MAFE project. Three questionnaires were rejected because they were not properly completed. Reasons for non-respondents were refusals and untraceable cases.

Out of the 399 respondents whose responses were finally used in the analysis, 203 were male and 196 were female.

Model specification and data analysis

a) Analytical framework

The choice of an appropriate model for this study was mainly dictated by the fact that farmer practice of a particular agroforestry technology was a binary dependant variable. It only took two forms of either practicing or not practicing. The appropriate models used in such cases are multiple discriminant analysis or linear probability models (Hair et al, 1995). These models specify a linear relationship between the probability of a particular event and the various predictors.

The independent variables took two different forms of measurement. Landholding size, education and age were measured as continuous variables, while total income received in 1996, respondent exposure to the MAFE project, respondent perceptions regarding the influence of selected agroforestry technologies on food crop yields, control of soil erosion, fuelwood availability, respondent perceptions of soil erosion problems and shortage of fuelwood were all measured either as dichotomous or categorical. The assumptions which the discriminant analysis model requires are essentially violated by this kind of combination of independent variables, (Hair et al, 1995; Norusis, 1994). Most specifically the requirement of multivariate normality can not be logically assumed with this combination of variables. Linear probability models were therefore preferred for the study. Logistic regression model was therefore chosen for the study.

Conceptually, the following was the behavioral model used to examine factors influencing farmer decision to practice of a particular agroforestry technology:

$Y_1 = 1/1 - e^z$ (1)

where Y_1 is probability of practice of agroforestry technology,

z is the linear combination

$z = B_0 + B_1X_1 + B_2X_2 + \ldots\ldots. B_pX_p$

where B is the likelihood estimate (coefficient) and e is base of the natural logarithm, approximately 2.718.

The probability of not practicing the particular agroforestry technology was estimated by;

$Y_0 = 1 - Y_1$

b) Model specification

The main objective for the statistical analyses was to test the following hypotheses;

1. Respondents' exposure to the MAFE project did not influence their decision to practice selected agroforestry technologies.

2. Respondents' perceptions regarding theeffect of selected agroforestry technologies on food crop yields did not influence their decision to practice those agroforestry technologies.

3. Respondents' perceptions regarding the effect of selected agroforestry technologies on the control of soil erosion did not influence their decision to practice those agroforestry technologies.

4. Respondents' perceptions regarding the effect of selected agroforestry technologies on

their fuelwood availability did not influence their decision to practice those agroforestry technologies.

5. Respondents' perceptions regarding the effect of selected agroforestry technologies on profitability did not influence their decision to practice those agroforestry technologies.

6. The following demographic factors: gender, respondent's age, respondent's highest level of formal schooling attained, the amount of income the respondent received in 1996, landholding size, land tenure system and tree tenure system did not influence to their decision to practice selected agroforestry technologies.

The model was specified as follows;

$Y_1 = e^z/1+e^z$

where Y_1=practice of a specific agroforestry technology.

where

$z=B_0+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+B_7X_7+B_8X_8+B_9X_9+B_{10}X_{10}+B_{11}X_{11}+B_{12}X_{12}$
$+B_{13}X_{13}+B_{14}X_{14}+B_{15}X_{15}+B_{16}X_{16}$

X_1=exposure to the MAFE project,

X_2=respondent perception of the influence of the practice of the selected agroforestry technology on food crop yields,

X_3=respondent perceptions as to whether they experienced soil erosion problems on their farm

X_4=whether respondents practiced the selected agroforestry technology in order to control soil erosion,

X_5=respondent perceptions as to whether the practice of the selected agroforestry reduced soil erosion,

X_6=respondent perceptions as to whether they experienced problems of shortage of fuelwood,

X_7=whether respondents practiced the selected agroforestry technology in order to increase fuelwood,

X_8=respondent perceptions as to whether the practice of the selected agroforestry technology increased fuelwood,

X_9=respondent perceptions as to whether the practice of the selected agroforestry technology was more or less profitable than their previous practices,

X_{10}=gender

X_{11}=respondent's highest level of formal education attained,

X_{12}=respondent's age,

X_{13}=total income received in 1996

X_{14}=landholding size,

X_{15}=land tenure system and

X_{16}=tree tenure system.

c) Data analysis

The data were analyzed using Statistical Package for the Social Sciences, advanced statistics version 6.1. The forward likelihood-ratio method was used in order to identify and remove the variables which were not important in the prediction of farmer practice of the technology. "The forward likelihood-ratio method involves estimating the model with each variable eliminated in turn and looking at the change in the log likelihood when each variable is deleted. The likelihood-ratio test for the null hypothesis that the coefficients of the terms removed are 0 is obtained by dividing the likelihood of the reduced model by the likelihood of the full model" (Norusis, 1994).

The analysis for each practice was run several times, each time excluding all those variables which were removed by the preceding analysis. This was done in order to come up with better fitting and stronger predictive models. The alpha level was set at p=.05. Respondent's highest level of formal schooling was constantly discarded in the five models due to problems of missing data.

Chapter IV

ANALYSIS AND RESULTS

Introduction

The main purpose of this study was to identify the factors influencing farmer's decision to practice selected agroforestry technologies in Njolomole EPA of Ntcheu RDP. Two specific objectives of the study were:

1. To investigate the influence of five selected factors: farmer exposure to the MAFE project; food productivity; soil erosion control; fuelwood productivity; and, profitability, on farmers' decisions to practice selected agroforestry technologies in Njolomole EPA of Ntcheu RDP.
2. To investigate the influence of six demographic factors: gender; age; education; income; landholding size and land and tree tenure system, on farmer decision to practice agroforestry technologies in Njolomole EPA of Ntcheu RDP. These objectives were further broken down to a set of six hypotheses.

This chapter presents the data and results of the study starting with demographic information about the sample, descriptive statistics and finally the chapter discusses predictive models using logistic regressions. The chapter is divided into the following sections;

1. Introduction
2. Demographic information about the sample
3. Distribution of respondents practicing selected agroforestry technologies.
4. A comparison of respondents who were and those who were not exposed to the MAFE

Project regarding their practice of selected agroforestry technologies.

5. A comparison of male and female respondents practicing selected agroforestry technologies.

6. Respondent perceptions regarding the effect of selected agroforestry technologies on food crop yields.

7. Respondent perceptions regarding the effect of selected agroforestry technologies on the control of soil erosion.

8. Respondent perceptions regarding the effect of selected agroforestry technologies on fuelwood availability.

9. Respondent perceptions regarding the effect of selected agroforestry technologies on profitability.

10. Hypotheses testing using logistic regression models.

Comparisons of respondent perceptions of the effect of selected agroforestry technologies on food crop yields, soil erosion, fuelwood availability and profitability were made between respondents who were and those who were not exposed to the MAFE project. Similar comparisons were made between male and female respondents.

The agroforestry technologies were grouped according to the basic purposes for which they were designed and implemented. The practices of systematic interplanting with *F. albida,* alley cropping, relay cropping and improved fallows were grouped together as technologies designed for soil improvement. The practice of contour hedgerows was discussed separately as a technology designed for the control of soil erosion. The practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and planting and caring for trees at homesteads were grouped together as technologies designed for the production of fruit, fuelwood and other wood related products. Although fodder banks and living fences were technologies designed for two different purposes, they were grouped together for convenience. Fodder banks were basically designed for production of livestock feed while living fences were designed for the provision of protection and privacy. Most of these agroforestry technologies fulfill more than one purpose and could have fitted in several of these groups. However they were restricted to these four groups mostly for purposes of convenience in reporting the results.

Demographic information about the sample.

A total of 402 out of the targeted 449 respondents participated in the study. This consisted of 64 respondents who were exposed and 338 respondents who were not exposed to the MAFE project. Three questionnaires were rejected because they were not properly completed. Reasons for non-respondents included, 20 refusals and 27 untraceable cases.

The age of the respondents ranged from 18 to 94 years with a mean age of 43.6 years. The number of years that the respondents spent in formal schooling ranged from zero to 14 with a mean of 3.97 years. They had very small land holdings with an average landholding size of 1.22 hectares ranging from a minimum of 0.1 to a maximum of 8 hectares. Based on recall information, seventy percent of the respondents received an income which was less than 2,000.00 Malawi Kwacha[3] from various sources in 1996.

A DISTRIBUTION OF RESPONDENTS PRACTICING SELECTED AGROFORESTRY TECHNOLOGIES.

There were relatively higher proportions of respondents who practiced technologies designed for the control of soil erosion and the production of fruit, fuelwood and other products in the EPA (Table 4.1). Contour hedgerows were practiced by 39.6% of the respondents, woodlots by 41.6% planting and caring for trees in croplands by 49.9% and planting and caring for trees at homesteads by 56.9% of the respondents. The rest of the technologies were practiced by less than forty percent of the respondents. Respondents cited lack of exposure to information and demonstrations by extension staff as the major reasons for not practicing the selected agroforestry technologies. Appendix A Table A1 provides a distribution of respondents who were provided with information and or saw demonstrations on the selected agroforestry technologies as mounted by the extension staff. Thirty nine percent of the respondents cited lack of input as the reason for not practicing the agroforestry technologies. The most commonly cited input in short supply was *F. albida* seedlings, which resulted directly into a low proportion of respondents who practiced systematic interplanting with *F. albida*. Other factors cited less frequently as reasons for failure to practice selected agroforestry technologies were shortage of land, livestock and termite damage and some farmers believed that trees grew too slowly for their needs.

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[3] One United States Dollar was equivalent to 15.29 Malawi Kwacha at the time of the field data collection. (Published exchange rates by the Reserve Bank of Malawi, Nation Newspaper, April 23, 1997).

Table 4.1: A Distribution of Respondents Practicing Selected Agroforestry Technologies in Njolomole EPA of Ntcheu RDP.

Agroforestry technology	Number practicing	Percent practicing	Number not practicing	Percent not practicing
FA	15.5		337	84.5
AC	35	8.8	364	91.2
RC[4]	52	13.0	347	87.0
IF[5]	88	22.1	311	77.9
CH	158	39.6	241	60.4
WL	166	41.6	233	54.8
TGB	111	27.8	288	72.2
TC	199	49.9	200	50.1
TH	227	56.9	172	43.1
FB	30	7.5	369	92.5
LF	79	19.8	320	80.2

Note: FA is *F. Albida,* AC is alley cropping, RC is relay cropping, IF is improved fallows, CH is contour hedgerows, WL is woodlots, TGB is planting and caring for trees in garden boundaries, TC is planting and caring for trees in croplands, TH is planting and caring for trees at homesteads, FB is fodder banks and LF is living fences.

[4] Most respondents did not seem to understand this technology and efforts to explain it were limited to verbal description due to lack of posters and pictures. This problem seems to have resulted in over-reporting of the number of respondents practicing relay cropping in this study. Some agroforestry experts in Malawi think that the proportion of farmers practicing this technology is much less than reported here (Itimu 1997 in press). The other technologies did not suffer this problem since each interviewer had a copy of the field manual for the agroforestry practices in Malawi which has colorful pictures of the technologies.

[5] Some respondents practiced woodlots on pieces of land they were not currently using for crop production as a way of preserving it until the time they need it for cultivation. Most of those respondents considered such a practice both as woodlots and improved fallows. This may have resulted in repeat reporting in this study and hence over-reporting the number of improved fallows in the EPA. The literature shows that there were very few respondents practicing improved fallows in the EPA (Bunderson et al, undated).

In order to provide a general picture of the extent to which the technologies were practiced, the respondents were asked to indicate the plot sizes on which they practiced the agroforestry technologies. On the other hand, five percent of respondents had their plots paced by the interviewers in order to come up with interviewer estimates of plot sizes. The interviewer estimates were compared with the respondents' estimates and these two estimates had an error margin of fifteen percent. Generally the respondents tended to under estimate their plot sizes. Table 4.2 below provides information about respondents estimates of plot sizes on which the selected agroforestry technologies were practiced.

Table 4.2: Estimated Plot Sizes Where the Selected Agroforestry Technologies were Practiced in Njolomole EPA of Ntcheu RDP.

Agroforestry technology	Minimum (hectares)	Maximum (hectares)	Mean plot size (hectares)
FA	0.02	1.60	0.56
AC	0.01	1.40	0.66
RC	0.08	1.60	0.48
IF	0.04	6.00	0.63
CH	0.08	3.00	0.73
WL	0.01	2.40	0.39
TGB	0.04	4.00	0.60
TC	0.04	2.40	0.74
TH	0.04	1.60	0.21
FB	0.08	3.00	0.77
LF	0.10	1.60	0.21

Note: FA is *F. albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows, Ch is contour hedgerows, WL is woodlots, TGB is trees in garden boundaries, TC is trees in croplands, TH is trees at homesteads, FB is fodder banks and LF is living fences.

The technologies were generally practiced in very small plots with mean plot sizes of less than one hectare. The smallest plot sizes being for the practices of planting and caring for trees at homesteads and living fences. These two technologies were mostly practiced around farmers dwelling compounds. Such compounds usually occupy small pieces of land.

A COMPARISON OF RESPONDENTS WHO WERE AND THOSE WHO WERE NOT EXPOSED TO THE MAFE PROJECT REGARDING THEIR PRACTICE OF SELECTED AGROFORESTRY TECHNOLOGIES.

This section presents findings on the influence of exposure to the MAFE project on respondent's decisions to practice the selected agroforestry technologies. Comparisons are made between respondents who were exposed to the MAFE project and those who were not regarding their practice of the selected agroforestry technologies. The discussion is divided into four sections according to the purposes for which the technologies were designed.

There were generally higher percentages of respondents exposed to the MAFE project who perceived that they were exposed to information (Appendix A Table A2) and seen demonstrations provided by extension staff (Appendix A Table A3) than those of respondents not exposed to the project.

a) Comparison of farmers exposed to the Malawi Agroforestry Extension Project and those not regarding their practice of selected agroforestry technologies designed for soil improvement.

There were significantly higher percenteges of respondents who were exposed to MAFE project and practiced the selected agroforestry technologies designed for soil improvement as compared to the percentages of respondents who were not exposed to MAFE project ($p=<.05$), see Table 4.3 below. Systematic interplanting with *F. albida* was practiced by 60.9% of the respondents exposed to the MAFE project as compared to 6.9% of the respondents not exposed. Alley cropping was practiced by 29.7% of those exposed as compared to 4.8% of those not exposed. Relay cropping was practiced by 32.9% of those exposed as compared to 8.7% of those not exposed and improved fallows were practiced by 32.8% of those exposed as compared to 20.0% of those not exposed. An evaluation study conducted in all five areas where the MAFE project was piloted showed that systematic interplanting with *F. albida* was practiced by fifty eight percent, alley cropping was practiced by seventy two percent and improved fallows was practiced by nine percent of the respondents exposed to the MAFE project (Bunderson et al, undated).

Table 4.3: A Comparison of Farmers Exposed to the Malawi Agroforestry Extension Project and those not Regarding their Practice of Selected Agroforestry Technologies Designed for Soil Improvement in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	Exposed to MAFE project (n=64)		Not exposed to MAFE project (n=335)	
	number practicing	number not practicing	number practicing	number not practicing
FA**	39 (60.9)	25 (39.1)	23 (6.9)	312 (93.1)
AC**	19 (29.7)	45 (70.3)	16 (4.8)	319 (95.6)
RC**	23 (32.9)	41 (64.1)	29 (8.7)	306 (91.3)
IF*	21 (32.8)	43 (67.2)	67 (20.0)	268 (80.0)

df=1 for all technologies. ** significant at p=.01, * significant at p=.05
Note: Numbers in the brackets are percentages. F. A. is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

b) Comparison of respondents exposed and those not exposed to the Malawi Agroforestry Extension Project regarding their practice of contour hedgerows.

The percentage of respondents exposed to the MAFE project practicing contour hedgerows was significantly higher than that of respondents who were not exposed to the MAFE project (p=<.01) Table 4.4. The technology was practiced by 85.9% of the respondents exposed to MAFE project as compared to only 30.7% of those not exposed. The evaluation study conducted in all the five areas where the MAFE project was piloted revealed that fifty six percent of the farmers exposed to the project practiced contour hedgerows (Bunderson et al, undated). The percentage of respondents exposed to the MAFE project practicing contour hedgerows was much higher in Njolomole EPA as compared to the other areas where the MAFE project was piloted. Conversely the percentage of respondents exposed to the MAFE project and practicing alley cropping in Njolomole EPA was much lower than that of respondents from other piloted areas. This can be explained by the fact that being in the Kirk Range, farmers were more likely to practice contour hedgerows for the sake of controlling soil erosion rather than alley cropping which is more suitable in flat lands.

Table 4.4: A Comparison of Respondents Exposed and those not Exposed to the Malawi Agroforestry Extension Project Regarding their Practice of Contour Hedgerows in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Exposed (n=64)		Not exposed (n=335)	
	number practicing	number not practicing	number practicing	number not practicing
CH**	55 (85.9)	9 (14.1)	103 (30.7)	232 (69.3)

df=1 ** significant at p=.01, * significant at p=.05
Note: Numbers in brackets are percentages. CH is contour hedgerows

c) Comparison of respondents exposed and those not exposed to the Malawi Agroforestry Extension Project regarding their practice of selected agroforestry technologies designed for the production of fruit, fuelwood and other products.

The percentages of respondents exposed to the MAFE project who practiced woodlots, trees in garden boundaries and trees in croplands were significantly higher than the percentages of respondents not exposed to the MAFE project (p=<.05) see Table 4.5. Trees at homesteads was the only agroforestry technology which was widely practiced by both the respondents exposed to the MAFE project (64.1%) and those who were not exposed to the project (55.5%).

Table 4.5: A Comparison of Respondents Exposed and those not Exposed to the Malawi Agroforestry Extension Project Regarding their Practice of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and other Products in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit and other products	Exposed (n=64)		Not exposed (n=335)	
	number practicing	number not practicing	number practicing	number not practicing
WL**	39 (60.9)	25 (39.1)	127 (37.9)	208 (62.1)
TGB*	25 (39.1)	39 (60.9)	86 (25.7)	249 (74.3)
TC**	57 (89.1)	7 (10.9)	142 (42.4)	193 (57.6)
TH	41 (64.1)	23 (35.9)	186 (55.5)	149 (44.5)

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. WL is woodlots, TGB is planting and caring for trees in garden boundaries, TC is planting and caring for trees in croplands and TH is planting and caring for trees at homesteads.

d) Comparison of respondents exposed and those not exposed to the Malawi Agroforestry Extension Project regarding their practice of selected agroforestry technologies designed for production of livestock feed and protection.

The percentages of the respondents exposed to the MAFE project who were practicing both fodder banks and living fences were significantly higher than the percentages of respondents not exposed to the MAFE project (p=<.01) see Table 4.6.

Table 4.6: A Comparison of Respondents Exposed and those not Exposed to the Malawi Agroforestry Extension Project Regarding their Practice of Selected Agroforestry Technologies Designed for Production of Livestock Feed and Protection in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-livestock feed and protection	Exposed (n=64)		Not exposed (n=335)	
	number practicing	number not practicing	number practicing	number not practicing
FB**	28 (43.8)	36 (56.6)	2 (0.6)	333 (99.4)
LF**	30 (46.9)	34 (53.1)	49 (14.6)	286 (85.4)

** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. FB is fodder banks and LF is living fences.

A COMPARISON OF MALE AND FEMALE RESPONDENTS PRACTICING SELECTED AGROFORESTRY TECHNOLOGIES.

This section presents findings on the influence of gender on the practice of selected agroforestry technologies in Njolomole EPA. Comparisons are made between male and female respondents regarding their practice of selected agroforestry technologies. Discussions are divided into the four groups according to the purposes for which the agroforestry technologies were designed.

a) Comparison of male and female respondents regarding their practice of selected agroforestry technologies designed for soil improvement.

The percentage of male respondents practicing relay cropping and improved fallows were significantly higher than those of female respondents practicing these two technologies (p=<.01) see Table 4.7. No differences were observed between male and female respondents regarding their practice of systematic interplanting with *F. albida* and alley cropping.

Table 4.7: A Comparison of Male and Female Respondents Regarding their Practice of Selected Agroforestry Technologies Designed for Soil Improvement in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- soil improvement	Male (n=203)		Female (n=196)	
	number practicing	number not practicing	number practicing	number not practicing
FA	30 (14.8)	173 (85.2)	32 (16.3)	121 (83.7)
AC	23 (11.3)	180 (88.7)	12 (6.1)	184 (93.9)
RC**	36 (17.7)	167 (82.3)	16 (8.2)	180 (91.8)
IF**	57 (28.1)	146 (71.9)	31 (15.8)	165 (84.2)

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

b) Comparison of male and female respondents regarding their practice of contour hedgerows.

The percentage of male respondents practicing contour hedgerows was significantly higher than that of female respondents (p=<.05) see Table 4.8.

Table 4.8: A Comparison of Male and Female Respondents Regarding their Practice of Contour Hedgerows in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Male (n=203)		Female (n=196)	
	number practicing	number not practicing	number practicing	number not practicing
CH*	92 (45.3)	111 (54.7)	66 (33.7)	130 (66.3)

df=1, ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. CH is contour hedgerows.

c) Comparison of Male and Female Farmers Practicing Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and other Products.

The percentages of male respondents practicing agroforestry technologies designed for the production of fruit, fuelwood and other products were significantly higher than those of female respondents (p=<.01) Table 4.9. Woodlots were practiced by 57.1% of the men and 25.5% of the women. Planting and caring for trees in garden boundaries were practiced by 33.5% of the male and 21.9% of the female respondents. Planting and caring for trees in croplands were practiced by 65.0% of the male and 34.2% of the female respondents while planting and caring for trees at homesteads were practiced by 68.5% of the male and 44.9% percent of the female respondents.

Table 4.9: A Comparison of Male and Female Farmers Practicing Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and other Products in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit & other products	Male (n=203)		Female (n=196)	
	number practicing	number not practicing	number practicing	number not practicing
WL**	116 (57.1)	87 (42.9)	50 (25.5)	146 (74.5)
TGB **	68 (33.5)	135 (66.5)	43 (21.9)	153 (78.1)
TC**	132 (65.0)	71 (35.0)	67 (34.2)	80 (65.8)
TH**	139 (68.5)	64 (31.5)	88 (44.9)	108 (55.1)

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. WL is woodlots, TGB is planting and caring for trees in garden boundaries, TC is planting and caring for trees in croplands and TH is planting and caring for trees at homesteads.

d). Comparison of male and female respondents practicing selected agroforestry technologies designed for the production of livestock feed and protection.

The percentage of male respondents practicing living fences was significantly higher than that of female respondents in the EPA (p=<.01), see Table 4.10. There was no significant difference between the percentages of male and female respondents practicing fodder banks.

Table 4.10: A Comparison of Male and Female Respondents Practicing Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-livestock feed & protection	Male (n=203)		Female (n=196)	
	number practicing	number not practicing	number practicing	number not practicing
FB	20 (9.9)	183 (90.1)	10 (5.1)	186 (93.9)
LF**	57 (28.1)	146 (71.9)	31 (15.8)	165 (84.2)

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. FB is fodder banks and LF is living fences.

RESPONDENT PERCEPTIONS REGARDING THE EFFECT OF SELECTED AGROFORESTRY TECHNOLOGIES ON FOOD CROP YIELDS

This section discusses respondents' perceptions regarding the effect of selected agroforestry technologies on yields of their food crops. Distributions of respondent perceptions regarding the effect of the selected agroforestry technologies on food crop yields are discussed. Comparisons are made between those respondents exposed to the MAFE project and those not exposed. Similarly, comparisons were made between male and female respondents. There was a high percentage of respondents who were either not sure or declined to respond to items on the effect of selected agroforestry technologies on food crop yields. Two possible reasons for this were that either the respondents were not currently practicing the technologies or they had not practiced the technologies long enough to make informed judgements on them. The discussions are divided into four subsections according to the purposes for which the agroforestry technologies were designed.

a) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for soil improvement on food crop yields

Table 4.11 below provides a distribution of respondents' perceptions of the effect of selected agroforestry technologies designed for soil improvement on food crop yields. There were generally higher percentages of respondents who perceived the practices of selected agroforestry technologies designed for soil improvement as having resulted in increased food crop yield as compared to the respondents who perceived the selected agroforestry technologies as having resulted in reduction of their food crop yields.

Table 4.11: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- soil improvement	Increased yield	Decreased yield	Not sure/no response
FA	42 (10.5)	24 (6.0)	333 (83.5)
AC	24 (6.0)	1 (0.3)	374 (93.7)
RC	37 (9.3)	8 (2.0)	354 (88.7)
IF	71 (17.8)	4 (1.0)	324 (81.2)

Note: Numbers in brackets are percentages. FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

Table 4.12 shows the percentages of respondents exposed to the MAFE project who perceived the practices of systematic interplanting with *F. albida* and relay cropping as increasing their food crop yields were significantly higher than those of respondents who were not exposed to the MAFE project (p=<.01).

Table 4.12: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project Regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	Exposed (n=64)			Not exposed (n=335)		
	more yield	less yield	NR	more yield	less yield	NR
FA**	27 (42.2)	3 (4.7)	34	15 (4.5)	21 (6.3)	299
AC	18 (28.1)	0	46	6 (1.8)	1 (0.3)	328
RC**	19 (29.7)	0	45	18 (5.4)	8 (2.4)	309
IF	15 (23.4)	0	49	56 (16.7)	4 (1.2)	275

df=1 for all the technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

Table 4.13 shows that the percentage of male respondents who perceived the practice of systematic interplanting with *F. albida* as decreasing their food crop yields was significantly lower than that of female respondents who perceived the practice of systematic interplanting with *F. albida* as decreasing their food crop yields (p=<.01).

Table 4.13: A Comparison of Male and Female Respondent Perceptions regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	Male (203)			Female (196)		
	more yield	less yield	NR	more yield	less yield	NR
FA**	27 (13.3)	2 (1.0)	174	15 (7.7)	22 (11.2)	159
AC	19 (9.4)	1 (.5)	183	5 (2.6)	0.00	191
RC	27 (13.3)	6 (3.0)	170	10 (5.1)	2 (1.0)	184
IF	49 (24.1)	3 (1.5)	151	22 (11.2)	1 (0.5)	173

df= 1 for all technologies. ** significant at p=.01, * significant at p=.05
Note: Numbers in brackets are percentages. NR is non respondents, FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows

b) Distribution of respondent perceptions regarding the effect of contour hedgerows on food crop yields.

Table 4.14 shows, the percentage of respondents who perceived the practice of contour hedgerows as helping to increase food crop yields was higher (27.3%) than the percentage of respondents who perceived the practice as causing a reduction in food crop yields (2.5%).

Table 4.14: A Distribution of Respondent Perceptions Regarding the Effect of Contour Hedgerows on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Increased yield	Decreased yield	Not sure/no response
CH	109 (27.3)	10 (2.5)	280 (70.2)

Note: Numbers in brackets are percentages. CH is contour hedgerows

There was no significant difference in the percentages of respondents who perceived the practice of contour hedgerows as helping to increase food crop yields between those respondents exposed and those not exposed to the MAFE project (see Table 4.15).

Table 4.15: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, regarding the Effect of Contour Hedgerows on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Exposed (n=64)			Not exposed (n=335)		
	more yield	less yield	NR	more yield	less yield	NR
CH	39 (60.9)	3 (4.7)	22	70 (20.9)	7 (2.1)	258

df=1, ** significant at p=.01, * significant at p=.05
Note: Numbers in brackets are percentages. NR is non respondents CH represents contour hedgerows.

Similarly, there was no significant difference in the percentage of male and female respondents who perceived the practice of contour hedgerows as helping to increase food crop yields (see Table 4.16).

Table 4.16: A Comparison of Male and Female Respondent Perceptions regarding the Effect of Contour Hedgerows on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Male (n=203)			Female (n=196)		
	more yield	less yield	NR	more yield	less yield	NR
CH	76 (37.4)	5 (2.5)	122	33 (16.8)	5 (2.6)	158

df=1, ** significant at p=.01, * significant at p=.05

Note: Numbers in brackets are percentages. NR is non respondents and CH is contour hedgerows.

c) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for the production of fruit, fuelwood and other products on food crop yields.

The percentage of respondents who perceived the practice of agroforestry technologies designed for the production of fruit, fuelwood and other products as helping to increase food crop yields were higher than those of respondents who perceived the technologies as reducing food crop yields (Table 4.17). The percentage of respondents who perceived the practice of woodlots as helping to increase food crop yields was 29.3% while that of those who perceived it as reducing food crop yields was 4.5 percent. The percentage of respondents who perceived the practice of planting and caring for trees in garden boundaries as helping to increase food crop yields was 18.8% while that of respondents who perceived the practice as reducing food crop yields was 4.5 percent. For planting and caring for trees in croplands 24.3% perceived it as helping to increase food crop yields as compared to 11.3% who perceived it as reducing food crop yields. Similarly, 42.6% of the respondents perceived the practice of planting and caring for trees at homesteads as helping to increase food crop yields as compared to 2.8% who perceived the practice as reducing food crop yields.

Table 4.17: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and Other Products on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- fruit, fuelwood & other products	Increased yields	Decreased yield	Not sure/no response
WL	117 (29.3)	18 (4.5)	264 (66.2)
TGB	75 (18.8)	18 (4.5)	306 (76.7)
TC	97 (24.3)	45 (11.3)	257 (64.4)
TH	170 (42.6)	11 (2.8)	218 (54.6)

Note: Numbers in brackets are percentages. WL is woodlots, TGB is planting and caring for trees in garden boundaries, TC is planting and caring for trees in croplands and TH is planting and caring for trees at homesteads.

The percentage of respondents exposed to the MAFE project who perceived the practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands as helping to increase food crop yields were significantly higher than the percentages of respondents who were not exposed to the MAFE project (p=<.05) see

Table 4.18. While there were generally high percentages of respondents who perceived the practice of trees at homesteads as helping to increase food crop yields, there was no significant difference in the percentages between respondents who were and those who were not exposed to the MAFE project.

Table 4.18: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, regarding the Effect of Selected Agroforestry Technologies Designed for Production of Fruit, Fuelwood and other Products on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit & other products	Exposed (n=64)			Not (n=335)		
	more yields	less yields	NR	more yields	less yields	NR
WL*	30 (46.9)	0	34	87 (26.0)	18 (5.4)	230
TGB*	19 (29.7)	0	45	56 (16.7)	18 (5.4)	261
TC**	38 (59.4)	4 (6.3)	22	59 (17.6)	41 (12.2)	235
TH	33 (51.6)	0	31	137 (40.9)	11 (3.3)	187

df=1 for all technologies. ** significant at p=.01, * significant at p=.05
Note: Numbers in brackets are percentages. NR is non respondents, WL is woodlots, TGB is trees on garden boundaries, TC is trees in croplands and TH is tree at homesteads.

There were no differences in the percentages of male and female respondents who perceived the practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and plating and caring for trees at homesteads as helping to increase food crop yields (Table 4:19).

Table 4.19: A Comparison of Male and Female Respondent Perceptions regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and other Products on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit, fuelwood & other products	Male (n=203)			Female (n=196)		
	more yield	less yields	NR	more yields	less yields	NR
WL	84 (41.4)	13 (6.4)	106	33 (16.8)	5 (2.6)	158
TGB	44 (21.7)	31 (15.3)	144	31 (15.8)	3 (1.5)	162
TC	73 (36.0)	37 (18.2)	93	24 (12.2)	8 (4.1)	164
TH	119 (58.6)	7 (3.4)	77	51 (26.0)	4 (2.0)	141

df=1 for all technologies. ** significant at p=.01, * significant at p=.05
Note: Numbers in brackets are percentages. NR is non respondents, WL is woodlot, TGB is trees on garden boundaries, TC is trees in croplands and TH is trees at homesteads.

d) Distribution of Respondent Perceptions Regarding the effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection on Food Crop Yields.

As Table 4.20 shows, there was a higher percentage of respondents who perceived the practice of living fences (15.8%) as helping to increase food crop yields as compared to the percentage of those who perceived the practice as resulting in reduction of food crop yields (1.0).

Table 4.20: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- livestock feed & protection	increased yield	Decreased yield	Not sure/no response
FB	24 (6.0)	0	375 (94.0)
LF	63 (15.8)	4 (1.0)	332 (83.2)

Note: Numbers in brackets are percentages. FB is fodder banks and LF is living fences.

The percentage of respondents exposed to the MAFE project who perceived the practice of living fences as helping to increase food crop yield was significantly higher (43.8%) than the percentage of respondents not exposed to the MAFE project (10.4%) see Table 4.21.

Table 4.21: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, regarding the Effect of Selected Agroforestry Technologies Designed for Production of Livestock Feed and Protection on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- livestock feed and protection	Exposed (n=64)			Not exposed (n=335)		
	more yields	less yields	NR	more yields	less yields	NR
FB	22 (34.4)	0	42	2 (0.6)	0	333
LF	28 (43.8)	0	36	35 (10.4)	4 (1.2)	296

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FB is fodder banks and LF is living fences.

There were no differences in the proportions of male and female respondents who perceived the practices of fodder banks and living fences as helping to increase food crop yields in Njolomole EPA (see Table 4.22).

Table 4.22: A Comparison of Male and Female Respondent Perceptions regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection on Food Crop Yields in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-livestock feed & protection	male (n=203)			female (n=196)		
	more yields	less yields	NR	more yields	less yields	NR
FB	20 (9.9)	0.00	183	4 (2.0)	0.00	192
LF	54 (26.6)	4 (2.0)	145	9 (4.6)	0.00	187

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FB represents fodder banks and LF represents living fences.

RESPONDENT PERCEPTIONS REGARDING THE EFFECT OF SELECTED AGROFORESTRY TECHNOLOGIES ON SOIL EROSION.

This section of the chapter discusses the perceptions of respondents regarding the effect of selected agroforestry technologies on the control of soil erosion. Distributions of respondents' perceptions regarding the effect of the selected agroforestry technologies on the control of soil erosion are discussed. Comparisons of respondent perceptions are made between respondents exposed to the MAFE project and those not exposed as well as those of male and female respondents.

There were high proportions of respondents who were either not sure or declined to respond to items on the influence of selected agroforestry technologies in reducing soil erosion. Two reasons for this were either the respondents were not currently practicing the technologies or they had not practiced them long enough to be able to make informed judgements on them. The discussions are divided into four sections according to the purposes for which the technologies were designed.

a) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for soil improvement in the control of soil erosion.

The percentage of respondents who perceived the practice of relay cropping as having controlled soil erosion was higher (11.0%) than that of respondents who perceived the practice of this technology as not having reduced soil erosion (2.3%) see Table 4.23.

Table 4.23: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement in the Control of Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- soil improvement	Controlled erosion	Did not control erosion	Not sure/no response
FA	39 (9.8)	25 (6.3)	335 (84.0)
AC	20 (5.0)	8 (2.0)	371 (93.0)
RC	44 (11.0)	9 (2.3)	346 (86.7)
IF	28 (7.0)	11 (2.8)	360 (90.2)

Note: Numbers in brackets are percentages. FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

The percentages of respondents exposed to the MAFE project who perceived the practices of alley cropping and improved fallows as helping to reduce soil erosion were significantly higher than the percentages of respondents not exposed to the MAFE project (p=<.01) see Table 4.24.

Table 4.24: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement in Reducing Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	Exposed (n=64)			Not exposed (n=335)		
	reduced erosion	did not reduce erosion	NR	reduced erosion	did not reduce erosion	NR
FA	23 (35.9)	10 (15.6)	31	16 (4.8)	15 (4.5)	304
AC**	17 (26.6)	1 (1.6)	46	3 (0.9)	7 (2.1)	325
RC	20 (31.3)	1 (1.6)	43	24 (7.2)	8 (2.4)	303
IF**	16 (25.0)	1 (1.6)	47	12 (3.6)	10 (3.0)	313

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FA is *Faidherbia. albida,* AC is alley cropping, RC is relay cropping and IF is improved fallows.

There were no significant differences between male and female respondents who perceived the practices of systematic interplanting with *F. albida,* alley cropping, relay cropping and improved fallows as helping to reduce soil erosion (Table 4.25).

Table 4.25: A Comparison of Male and Female Respondent Perceptions regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement in Reducing Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	Male (n=203)			Female (n=196)		
	reduced erosion	did not reduce erosion	NR	reduced erosion	did not reduce erosion	NR
FA	19 (9.4)	11 (5.4)	173	20 (10.2)	14 (7.1)	162
AC	15 (7.4)	4 (2.0)	184	5 (2.6)	4 (2.0)	187
RC	31 (13.3)	6 (3.0)	166	13 (6.6)	3 (1.5)	180
IF	22 (10.8)	6 (3.0)	175	6 (3.1)	5 (2.6)	185

** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

b) Distribution of respondent perceptions regarding the effect of contour hedgerows in the control of soil erosion.

The percentage of respondents who perceived the practice of contour hedgerows as having helped to reduce soil erosion was higher (30.3%) than that of respondents who perceived it as not having reduced soil erosion (14.0%) see Table 4.26.

Table 4.26: A Distribution of Respondent Perceptions Regarding the Effect of Contour Hedgerows in the Control of Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Controlled erosion	Did not control erosion	Not sure/no response
CH	121 (30.3)	56 (14.0)	222 (55.6)

Note: Numbers in brackets are percentages. CH is contour hedgerows

The percentage of respondents exposed to the MAFE project who perceived the practice of contour hedgerows as having controlled soil erosion was significantly higher than that of respondents who were not exposed to the MAFE project (p=<.01) see Table 4.27.

Table 4.27: A Comparison of Respondents Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, regarding the Effect of Contour Hedgerows in Reducing Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- soil erosion control	Exposed (n=64)			Not exposed (n=335)		
	reduced erosion	did not reduce erosion	NR	reduced erosion	did not reduce erosion	NR
CH**	51 (79.7)	3 (4.7)	10	70 (20.9)	53 (15.8)	212

df=1, ** significant at p=.01, * significant at p=.05

Note: Numbers in brackets are Percentages. NR is non respondents, CH is contour hedgerows.

There was no significant difference in the percentages of male and female respondents who perceived the practice of contour hedgerows as controlling soil erosion (Table 4.28).

Table 4.28: A Comparison of Male and Female Respondent Perceptions regarding the Effect of Contour Hedgerows in Reducing Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Male (n=203)			Female (n=196)		
	reduced erosion	did not reduce erosion	NR	reduced erosion	did not reduce erosion	NR
CH	69 (34.0)	31 (15.3)	103	52 (26.5)	25 (12.8)	119

df=1, ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents and CH is contour hedgerows.

c) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for the production of fruit, fuelwood and other products in the control of soil erosion.

The percentages of respondents who perceived the practice of selected agroforestry technologies designed for the production of fruit, fuelwood and other products as helping to control soil erosion were higher than the percentages of respondents who perceived the practices as not having helped to control soil erosion: woodlots 17.0% compared to 4.3%; trees in garden boundaries 13.0% compared to 6.0%; trees in croplands 18.8% compared to 8.5%; and, trees at homesteads 19.0% compared to 5.5%, see Table 4.29.

Table 4.29: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the production of Fruit, Fuelwood and Other Products in the Control of Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- fruit, fuelwood & other products	Controlled erosion	Did not control erosion	Not sure/no response
WL	68 (17.0)	17 (4.3)	314 (78.7)
TGB	52 (13.0)	24 (6.0)	323 (81.0)
TC	75 (18.8)	34 (8.5)	290 (72.7)
TH	76 (19.0)	22 (5.5)	301 (75.4)

Note: Numbers in brackets are percentages. WL is woodlots, TGB is planting and caring for trees in garden boundaries, TC is planting and caring for trees in croplands and TH is planting and caring for trees at homesteads.

The percentages of respondents exposed to the MAFE project who perceived the practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and planting and caring for trees at homesteads as having controlled soil erosion were significantly higher than those of respondents not exposed to the MAFE project ($p=<.01$) see Table 4.30.

Table 4.30: A Comparison of Respondent Perceptions between Respondent who were and those who were not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and other Products in Reducing Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit & other products	Exposed (n=64)			Not exposed (n=335)		
	reduced erosion	did not reduce erosion	NR	reduced erosion	did not reduce erosion	NR
WL**	28 (43.8)	1 (1.6)	35	40 (11.9)	16 (4.8)	279
TGB**	21 (32.8)	1 (1.6)	42	31 (9.3)	23 (6.9)	281
TC**	40 (62.5)	4 (6.3)	20	35 (10.4)	30 (9.0)	270
TH**	32 (50.0)	3 (4.7)	29	44 (13.1)	19 (5.7)	272

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, WL is woodlots, TGB is trees on garden boundaries, TC is trees in croplands and TH is trees at homesteads.

There were no significant differences in the percentages of male and female respondents who perceived the practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and planting and caring for trees at homesteads as having helped to control soil erosion (Table 4.31).

Table 4.31: A Comparison of Male and Female Respondent Perceptions regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and other products in Reducing Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- fruit & other products	Male (n=203)			Female (n=196)		
	reduced erosion	did not reduce erosion	NR	reduced erosion	did not reduce erosion	NR
WL	55 (27.1)	12 (5.2)	136	13 (6.6)	5 (2.6)	178
TGB	38 (18.7)	11 (5.4)	154	14 (7.1)	13 (6.6)	169
TC	53 (26.1)	29 (14.3)	121	22 (11.2)	5 (2.5)	169
TH	61 (30.0)	13 (6.4)	129	15 (7.7)	9 (4.6)	172

df=1 for all technologies. ** significant at p=.01, * significant at p=.05
Note: Numbers in brackets are percentages. NR is non respondents WL is woodlots, TGB is trees on garden boundaries, TC is trees in croplands and TH is trees at homestead.

d) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for the production of livestock feed and protection in the control of soil erosion.

The percentage of respondents who perceived the practice of living fences as having controlled soil erosion was higher (14.3%) than that of respondents who perceived this practice as not having helped to control soil erosion (3.8%) see Table 4.32.

Table 4.32: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the production of Livestock Feed and Protection in the Control of Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- livestock feed & protection	Controlled erosion	Did not control erosion	Not sure/no response
FB	24 (6.0)	6 (1.5)	369 (92.5)
LF	57 (14.3)	15 (3.8)	327 (82.0)

Note: Numbers in brackets are percentages. FB is fodder banks and LF is living fences.

The percentages of respondents exposed to the MAFE project who perceived the practices of fodder banks and living fences as having helped to control soil erosion were higher than those of respondents not exposed to the project (p=<.01) see Table 4.33.

Table 4.33 A Comparison of Farmer Perceptions between Farmers who were and those who were not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection in Reducing Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- livestock feed & protection	Exposed (n=64)			Not exposed (n=335)		
	reduced erosion	did not reduce erosion	NR	reduced erosion	did not reduce erosion	NR
FB**	23 (35.9)	0	41	1 (0.3)	6 (1.8)	328
LF**	29 (45.3)	1 (1.6)	34	28 (8.4)	14 (4.2)	293

** significant at p=.01, * significant at p=.05. Note: Numbers in brackets are percentages. NR is non respondents, FB is fodder banks and LF is living fences.

There were no significant differences between the percentages of male and female respondents who perceived the practices of fodder banks and living fences as having helped to control soil erosion (Table 4.34).

Table 4.34: A Comparison of Male and Female Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection in Reducing Soil Erosion in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-livestock feed & protection	Male (n=203)			Female (n=196)		
	reduced erosion	did not reduce erosion	NR	reduced erosion	did not reduce erosion	NR
FB	18 (8.9)	3 (1.5)	182	6 (3.1)	3 (1.5)	187
LF	49 (24.1)	11 (5.4)	143	8 (4.1)	4 (2.0)	184

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FB is fodder banks and LF is living fences.

RESPONDENT PERCEPTIONS REGARDING THE EFFECT OF SELECTED AGROFORESTRY TECHNOLOGIES ON FUELWOOD AVAILABILITY.

This section of the chapter discusses respondent's perceptions regarding the effect of selected agroforestry technologies on the availability of fuelwood in Njolomole EPA. Distributions of respondent perceptions are discussed, followed by comparisons between perceptions of respondents who were and those who were not exposed to the MAFE project. Similar comparisons are also made between the perceptions of male and female respondents.

There were very high proportions of respondents who were either not sure or declined to respond to items on the effect of selected agroforestry technologies on fuelwood availability. Two reasons for this were either the respondents were not currently practicing the technologies or they had not practiced them long enough to be able to make informed judgements on them. The discussions are divided into four sections according to the purposes for which the technologies were designed.

a) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for soil improvement on fuelwood availability.

The percentages of respondents who perceived the practices of systematic interplanting with *F. albida,* alley cropping, relay cropping and improved fallows as having helped to increase fuelwood availability were not different from the percentages of those who perceived the practices as not having helped to increase fuelwood availability (Table 4.35).

Table 4.35: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement on Fuelwood Availability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- soil improvement	Increased fuelwood	Did not increase fuelwood	Not sure/no response
FA	33 (8.3)	48 (12.0)	318 (79.7)
AC	17 (4.3)	27 (6.8)	355 (89.0)
RC	39 (9.8)	29 (7.3)	331 (83.0)
IF	39 (9.8)	58 (14.5)	302 (75.7)

Note: Numbers in brackets are percentages. FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

The percentages of respondents exposed to the MAFE project who perceived the practices of selected agroforestry technologies designed for soil improvement as having helped to increase fuelwood availability were significantly higher than those of respondents who were not exposed to the MAFE project ($p=<.05$) see Table 4.36.

Table 4.36: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement on Fuelwood Availability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	Exposed (n=64)			Not exposed (n=335)		
	more fuel-wood	less fuel-wood	NR	more fuel-wood	less fuel-wood	NR
FA*	18 (28.1)	14 (21.9)	32	15 (4.5)	34 (16.1)	286
AC**	13 (20.3)	4 (6.3)	47	4 (1.2)	23 (6.9)	308
RC**	20 (31.3)	1 (1.6)	43	19 (5.7)	28 (8.4)	288
IF**	17 (26.6)	1 (1.6)	46	22 (6.6)	57 (17.0)	256

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

The percentages of female respondents who perceived the practices of selected agroforestry technologies designed for soil improvement as not having increased fuelwood were significantly higher than those of male respondents (p=<.05) Table 4.37.

Table 4.37: A Comparison of Male and Female Respondent Perceptions Regarding the Effect Selected Agroforestry Technologies Designed for Soil Improvement on Availability of Fuelwood in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	Male (n=203)			Female (n=196)		
	more fuel-wood	less fuel-wood	NR	more fuel-wood	less fuel-wood	NR
FA*	18 (8.9)	13 (6.4)	172	15 (7.7)	35 (17.9)	146
AC**	14 (6.9)	7 (3.4)	182	3 (1.5)	20 (10.2)	173
RC**	31 (15.3)	5 (2.5)	167	8 (4.1)	24 (12.2)	164
IF**	32 (15.8)	20 (9.9)	155	7 (3.6)	38 (19.4)	155

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

b) Distribution of respondent perceptions regarding the effect of contour hedgerows on fuelwood availability.

The percentage of respondents who perceived the practice of contour hedgerows as having increased fuelwood was not different from that of respondents who perceived the practice as not having increased fuelwood (Table 4.38).

Table 4.38: A Distribution of Respondent Perceptions Regarding the Effect of Contour Hedgerows on Fuelwood Availability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- soil erosion control	Increased fuelwood	Did not increase fuelwood	Not sure/no response
CH	43 (10.8)	43 (10.3)	313 (78.4)

Note: Numbers in brackets are percentages. CH is contour hedgerows.

The percentage of respondents exposed to the MAFE project who perceived the practice of contour hedgerows as having increased fuelwood was significantly higher than that of respondents not exposed to the MAFE project (p=<.01) see Table 4.39.

Table 4.39: A Comparison of Respondent Perceptions between Respondents who were and those not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Contour Hedgerows on the Availability of Fuelwood in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Exposed (n=64)			Not exposed (n=335)		
	more fuel-wood	less fuel-wood	NR	more fuel-wood	less fuel-wood	NR
CH**	28 (43.8)	10 (15.6)	26	15 (4.5)	57 (17.0)	287

df=1, ** significant at p=.01, * significant at p=.05.
Note: Numbers ib brackets are. percentages. NR is non respondents and CH is contour hedgerows.

As Table 4.40 shows, the percentage of male respondents who perceived the practice of contour hedgerows as having increased fuelwood was higher than that of female respondents (p=<.01).

Table 4.40: A Comparison of Male and Female respondent Perceptions Regarding the Effect of Contour Hedgerows on the Availability of Fuelwood in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion	Male (n=203)			Female (n=196)		
	more fuel-wood	less fuel-wood	NR	more fuel-wood	less fuel-wood	NR
CH**	33 (16.3)	17 (8.4)	153	10 (5.1)	26 (13.3)	160

df=1, ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents and CH is contour hedgerows.

c) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for the production of fruit, fuelwood and other products on fuelwood availability.

The percentages of respondents who perceived the practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and planting and caring for trees at homesteads as having increased fuelwood were not different from those of respondents who perceived these technologies as not having increased fuelwood (Table 4.41).

Table 4.41: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and Other Products on Fuelwood Availability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- fruit, fuelwood & other products	Increased fuelwood	Did not increase fuelwood	Not sure/no response
WL	91 (22.8)	73 (18.3)	235 (58.9)
TGB	50 (12.5)	64 (16.0)	285 (71.4)
TC	80 (20.1)	76 (19.0)	243 (60.9)
TH	98 (24.6)	102 (25.6)	199 (49.9)

Note: Numbers in brackets are percentages. WL is woodlots, TGB is planting and caring for trees in garden boundaries, TC is planting and caring for trees in croplands and TH is planting and caring for trees at homesteads.

The percentages of respondents exposed to the MAFE project who perceived the practice of selected agroforestry technologies designed for the production of fruit, fuelwood and other products as having increased fuelwood were significantly higher than those of respondents not exposed to the project (p=<.01) see Table 4.42.

Table 4.42: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and other Products on Fuelwood Availability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit, fuelwood & other products	Exposed (n=64)			Not exposed (n=335)		
	more fuel-wood	less fuel-wood	NR	more fuel-wood	less fuel-wood	NR
WL**	32 (50.0)	1 (1.6)	31	59 (17.6)	72 (21.5)	204
TGB**	22 (34.4)	2 (3.1)	40	28 (8.4)	62 (18.5)	245
TC**	38 (59.4)	2 (3.1)	24	42 (12.5)	74 (22.1)	219
TH**	35 (54.7)	1 (1.6)	28	63 (18.8)	101 (30.1)	177

df =1 for all technologies. ** significant at p=.01, * significant at p=.05.

Note: Numbers in brackets are percentages. NR is non respondents, WL is woodlots, TGB is trees in garden boundaries, TC is trees in croplands and TH is trees at homesteads.

The percentages of male respondents who perceived the practices of selected agroforestry technologies designed for the production of fruit, fuelwood and other products as having increased fuelwood were significantly higher than those of female respondents (p=<.01) see Table 4.43.

Table 4.43: A Comparison of Male and Female Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and Other Products on the Availability of Fuelwood in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit, fuelwood & other products	Male (n=203)			Female (n=196)		
	more fuel-wood	less fuel-wood	NR	more fuel-wood	less fuel-wood	NR
WL**	73 (36.0)	35 (17.2)	95	18 (9.2)	38 (19.4)	140
TGB**	36 (17.7)	21 (10.3)	146	14 (7.1)	43 (21.9)	139
TC**	64 (31.5)	47 (23.2)	92	16 (8.2)	29 (14.8)	151
TH**	75 (36.9)	53 (26.1)	75	23 (11.7)	49 (25.0)	124

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, WL is woodlots, TGB is trees in garden boundaries, TC is trees in croplands and TH is trees at homesteads.

d) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for the production of livestock feed and protection on fuelwood availability.

The was a smaller percentage of respondents (3.8%) who perceived the practice of fodder banks as having increased fuelwood as compared to the percentage of those who perceived the practice as not having increased fuelwood (7.3%). On the other hand the percentage of respondents who perceived the practice of living fences as having increased fuelwood availability was higher (14.5%) than that of respondents (8.5%) who perceived it as not having increased fuelwood see Table 4.44.

Table 4.44: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection on Fuelwood Availability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- livestock feed and protection	Increased fuelwood	Did not increase fuelwood	Not sure/no response
FB	15 (3.8)	29 (7.3)	355 (89.0)
LF	58 (14.5)	34 (8.5)	307 (76.9)

Note: Numbers in brackets are percentages. FB is fodder banks and LF is living fences.

The percentages of respondents who were exposed to the MAFE project who perceived the practices of fodder banks and living fences as having increased fuelwood availability were significantly higher than those of respondents not exposed to the project (p=<.01) see Table 4.45.

Table 4.45: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- livestock feed & protection	Exposed (n=64)			Not Exposed (n=335)		
	more fuel-wood	less fuel-wood	NR	more fuel-wood	less fuel-wood	NR
FB**	15 (23.4)	8 (12.5)	41	0	21 (6.3)	314
LF**	29 (45.3)	1 (1.6)	34	29 (8.7)	33 (9.9)	273

df= 1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FB is fodder banks and LF is living fences.

The percentage of male respondents who perceived the practices of fodder banks and living fences as having increased fuelwood were higher than the percentages of female respondents (p=<.01) see Table 4.46.

Table 4.46: A Comparison of Male and Female Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection on the Availability of Fuelwood in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-livestock feed & protection	Male (n=203)			Female (n=196)		
	more fuel-wood	less fuel-wood	NR	more fuel-wood	less fuel-wood	NR
FB**	13 (6.4)	8 (3.9)	182	2 (1.0)	21 (10.7)	173
LF**	50 (24.6)	12 (5.9)	141	8 (4.1)	22 (11.2)	166

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FB is fodder banks and LF is living fences.

RESPONDENT PERCEPTIONS REGARDING THE EFFECT OF SELECTED AGROFORESTRY TECHNOLOGIES ON PROFITABILITY.

This section discusses respondent perceptions regarding the profitability of selected agroforestry technologies in Njolomole EPA of Ntcheu RDP. Distributions of respondent who perceived the selected agroforestry technologies as more profitable than their previous practices are compared to those of respondents who perceived that the agroforestry technologies were less profitable than their previous practices. Comparisons are made between perceptions of respondents who were and those who were not exposed to the MAFE project. Similar comparisons are made between male and female respondents.

A large proportion of the respondents were either not sure or did not respond to the items on profitability. The reasons for these were either the respondents did not practice the technologies or did not practice them long enough to be able to make informed judgements on their profitability. The discussions are divided into four sub-sections according to the purposes for which the technologies were designed.

a) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for soil improvement on profitability.

The percentage of respondents who perceived the practice of improved fallows as more profitable than their previous practices was higher (16.5%) than the percentage of those who perceived it as less profitable than their previous practices (1.8%) see Table 4.47.

Table 4.47: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	More profits		Less profits		Not sure/no response	
	number	%	number	%	number	%
FA	32	8.0	23	5.8	344	86.2
AC	20	5.0	3	0.8	375	94.2
RC	38	9.5	13	3.3	348	87.2
IF	66	16.5	7	1.8	326	82.2

Note: Numbers in brackets are percentages. FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

The percentages of respondents exposed to the MAFE project who perceived the practices of systematic interplanting with *F. albida*, alley cropping, and relay cropping as more profitable than their previous practices were significantly higher than those of respondents who were not exposed to the MAFE project (p=<.01) see Table 4.48.

Table 4.48: A Comparison of the Perceptions of Respondents Exposed and those not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil improvement	Exposed (n=64)			Not exposed (n=335)		
	more profits	less profits	NR	more profits	less profits	NR
FA**	24 (37.5)	4 (6.3)	36	8 (2.3)	19 (5.7)	308
AC**	15 (23.4)	0	49	5 (1.5)	3 (0.9)	327
RC**	19 (29.7)	1 (1.5)	44	19 (5.7)	12 (3.6)	304
IF	14 (21.9)	1 (1.6)	49	52 (15.5)	6 (1.8)	277

df =1 for all technologies. ** significant at p=.01, * significant at p=.05
Note: Numbers in brackets are percentages. NR is non respondents. FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

The percentages of male respondents who perceived the practice of systematic interplanting with *F. albida* as more profitable than their previous practices was significantly higher than that of female respondents (p=.01) see Table 4.49.

Table 4.49: A Comparison of Male and Female Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for Soil Improvement on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-Soil improvement	Male (n=203)			Female (n=196)		
	more profit	less profit	NR	more profit	less profit	NR
FA**	22 (10.8)	3 (1.5)	178	10 (5.1)	20 (10.2)	166
AC	16 (7.9)	3 (1.5)	184	4 (2.0)	0	192
RC	28 (13.8)	8 (3.9)	167	10 (5.1)	5 (2.6)	181
IF	48 (23.6)	5 (2.5)	150	18 (9.2)	2 (1.0)	176

df=1 for all technologies. ** significant at p=.01, * significant at p=.05
Note: Numbers in brackets are percentages. NR is non respondents. FA is *Faidherbia albida*, AC is alley cropping, RC is relay cropping and IF is improved fallows.

b) Distribution of respondent perceptions regarding the effect of contour hedgerows on profitability.

The percentages of respondents who perceived the practice of contour hedgerows (27.1%) as more profitable than their previous practices was higher than that of respondents who perceived the practice as less profitable than their previous practices (2.5%) see Table 4.50.

Table 4.50: A Distribution of Respondent Perceptions Regarding the Effect of Contour Hedgerows on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	More profitable		Less profitable		Not sure/no response	
	number	%	number	%	number	%
CH	108	27.1	10	2.5	281	70.4

Note: Numbers in brackets are percentages. CH is contour hedgerows.

The percentage of respondents exposed to the MAFE project who perceived the practice of contour hedgerows as more profitable than their previous practices was not significantly different from that of respondents who were not exposed to the MAFE project (Table 4.51).

Table 4.51: A Comparison of Respondent Perceptions between Respondent who were and those who were not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Contour Hedgerows on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Exposed (n=64)			Not exposed(n=335)		
	more profits	less profits	NR	more profits	less profits	NR
CH	33 (51.6)	1 (1.6)	30	75 (22.4)	9 (2.7)	251

df=1, ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, CH is contour hedgerows.

Similarly there were no significant differences between the percentages of male and female respondents who perceived the practice of contour hedgerows as more profitable than their previous practices (Table 4.52).

Table 4.52: A Comparison of Male and Female Respondent Perceptions Regarding the Effect of Contour Hedgerows on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-soil erosion control	Male (n=203)			Female (n=196)		
	More profit	less profit	NR	more profit	less profit	NR
CH	76 (37.4)	8 (3.9)	119	32 (16.3)	2 (1.0)	162

** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents and CH is contour hedgerows.

c) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for the production of fruit, fuelwood and other products on profitability.

The percentages of respondents who perceived the practice of selected agroforestry technologies designed for the production of fruit, fuelwood and other products as more profitable than their previous practices were higher than the percentages of respondents who perceived these practices as less profitable than their previous practices: woodlots 27.1% as compared to 6.8%; trees in garden boundaries 17.0% as compared to 4.3%; trees in croplands 24.8% as compared to 10.3%; and, trees at 42.1% as compared to 6.5%, (Table 4.53).

Table 4.53: A Distribution of Respondent Perceptions Regarding the Profitability of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and Other Products in Njolomole EPA of Ntcheu RDP.

Agroforestry technology- fruit, fuelwood & other products	More profitable		Less profitable		Not sure/no response	
	number	%	number	%	number	%
WL	108	27.1	27	6.8	264	66.2
TGB	68	17.0	17	4.3	314	78.7
TC	99	24.8	41	10.3	259	64.9
TH	168	42.1	26	6.5	205	51.4

Note: Numbers in brackets are percentages. WL is woodlots, TGB is planting and caring for trees in garden boundaries, TC is planting and caring for trees in croplands and TH is planting and caring for trees at homesteads.

The percentages of respondents exposed to the MAFE project who perceived the practices of woodlots and planting and caring for trees in croplands as more profitable than their previous practices were significantly higher than those of respondents who were not exposed to the MAFE project ($p=<.05$) see Table 4.54. There were however no significant differences in the percentages of respondents between those who were and those who were not exposed to the MAFE project who perceived the practices of planting and caring for trees in garden boundaries and planting and caring for trees at homesteads as more profitable than their previous practices.

Table 4.54: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Selected Agroforestry Technologies Designed for Production of Fruit, Fuelwood and other Products on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit, fuelwood & other products	Exposed (n=64)			Not exposed (n=335)		
	more profit	less profit	NR	more profit	less profit	NR
WL*	27 (42.2)	1 (1.6)	36	81 (24.2)	26 (7.8)	228
TGB	19 (29.7)	1 (1.6)	44	49 (14.6)	16 (4.8)	270
TC**	33 (51.6)	2 (3.1)	29	66 (19.7)	39 (11.6)	230
TH	32 (50.0)	1 (1.6)	31	136 (40.6)	25 (7.5)	174

df =1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, WL is woodlots, TGB is trees in garden boundaries, TC is trees in croplands and TH is trees at homesteads.

There were also no significant differences between male and female respondents who perceived the practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and planting and caring for trees at homesteads as more profitable than their previous practices (Table 4.55).

Table 4.55: A Comparison of Male and Female Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Fruit, Fuelwood and other Products on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-fruit & other products	Male (n=203)			Female (n=196)		
	more profit	less profit	NR	more profit	less profit	NR
WL	81 (39.9)	21 (10.3)	101	27 (13.8)	6 (3.1)	163
TGB	41 (20.2)	11 (5.4)	151	27 (13.8)	6 (3.1)	163
TC	80 (39.4)	33 (16.3)	90	19 (9.7)	8 (4.1)	169
TH	119 (58.6)	18 (8.9)	66	49 (25.0)	8 (4.1)	139

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, WL is woodlots, TGB is trees in garden boundaries, TC is trees in croplands and TH is trees in at homesteads.

d) Distribution of respondent perceptions regarding the effect of selected agroforestry technologies designed for the production of livestock feed and protection on profitability

The percentages of respondents who perceived the practices of fodder banks and living fences as more profitable than their previous practices were higher than those of respondents who perceived these practices as less profitable than their previous practices: fodder banks 4.8% as compared to 0.3%; and, living fences 15.8% as compared to 2.0%, (Table 4.56).

Table 4.56: A Distribution of Respondent Perceptions Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-livestock feed and protection	More profitable		Less profitable		Not sure/no response	
	number	%	number	%	number	%
FB	19	4.8	1	0.3	379	95.0
LF	63	15.8	8	2.0	328	82.2

Note: Numbers in brackets are percentages. FB is fodder banks and LF is living fences.

The percentage of respondents exposed to the MAFE project who perceived the practice of fodder banks as more profitable than their previous practices (28.1%) was significantly higher than that of respondents who were not exposed to the MAFE project (Table 4.57).

Table 4.57: A Comparison of Respondent Perceptions between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project, Regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-livestock feed & protection	Exposed (n=64)			Not exposed (n=335)		
	more profit	less profit	NR	more profit	less profit	NR
FB	18 (28.1)	1 (1.6)	45	1	0	334
LF	14 (21.9)	1 (1.6)	49	52 (15.5)	6 (1.8)	277

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FB is fodder banks and LF is living fences.

The percentages of male and female respondents who perceived the practices of fodder banks and living fences as more profitable than their previous practices were not significantly different (Table 4.58).

Table 4.58: A Comparison of Male and Female Respondent Perceptions regarding the Effect of Selected Agroforestry Technologies Designed for the Production of Livestock Feed and Protection on Profitability in Njolomole EPA of Ntcheu RDP.

Agroforestry technology-livestock feed & protection	Male (n=203)			Female (196)		
	more profit	less profit	NR	more profit	less profit	NR
FB	16 (7.9)	1 (0.5)	186	3 (15.8)	0	193
LF	54 (26.6)	7 (3.4)	142	9 (4.6)	1 (0.5)	186

df=1 for all technologies. ** significant at p=.01, * significant at p=.05.
Note: Numbers in brackets are percentages. NR is non respondents, FB is fodder banks and LF is living fences.

HYPOTHESES TESTING USING LOGISTIC REGRESSION MODELS

This section of the chapter discusses the results of logistic regression models. The main objective of these analyses was to test the following sets of null hypotheses:

1. Respondents' exposure to the MAFE project did not influence their decisions to practice selected agroforestry technologies.

2. Respondents' perceptions regarding the effect of selected agroforestry technologies on food crop yields did not influence their decisions to practice those agroforestry technologies.

3. Respondents' perceptions regarding the effect of selected agroforestry technologies on

the control of soil erosion did not influence their decisions to practice those agroforestry technologies.

4. Respondents' perceptions regarding the effect of selected agroforestry technologies on fuelwood availability did not influence their decisions to practice those agroforestry technologies.

5. Respondent perceptions regarding the effect of the selected agroforestry technologies on profitability did not influence their decisions to practice those agroforestry technologies.

6. The following demographic factors: gender; respondent's age; respondent's highest level of formal schooling attained; the amount of income the respondent received in 1996; landholding size; land tenure system and tree tenure system did not influence their decisions to practice selected agroforestry technologies.

Since there were eleven agroforestry technologies selected for the study, there should have been eleven logistic regression analyses conducted, one for the practice of each agroforestry technology. However, due to missing data only five logistic regression analyses were included in this chapter. These models are for the practices of: contour hedgerows; woodlots; planting and caring for trees in garden boundaries; planting and caring for trees in croplands; and, planting and caring for trees at homesteads.

Logistic regression model for the practice of contour hedgerows.

The variables initially entered in the model were:

X_1= exposure to the MAFE project,

X_2= respondent perception of the effect of the practice of contour hedgerows on food crop yields,

X_3= respondent perceptions as to whether they experienced soil erosion problems on their farm

X_4= whether respondents practiced contour hedgerows in order to control soil erosion,

X_5= respondent perceptions as to whether the practice of contour hedgerows reduced soil erosion,

X_6= respondent perceptions as to whether they experienced problems of shortage of fuelwood,

X_7= whether respondents practiced contour hedgerows in order to increase fuelwood,

X_8= respondent perceptions as to whether the practice of contour hedgerows increased fuelwood,

X_9= respondent perceptions as to whether the practice of contour hedgerows was more or less profitable than their previous practices,

X_{10}= gender

X_{11}= respondent's highest level of formal education attained,

X_{12}= respondent's age,

X_{13}= total income received in 1996

X_{14}= landholding size,

X_{15}= land tenure system and

X_{16}= tree tenure system.

X_3, X_4 and X_5 were all measures of respondent perceptions regarding the effect of the practice of contour hedgerows on soil erosion while X_6, X_7 and X_8 were all measures of respondent perceptions regarding the effect of the practice of contour hedgerows on fuelwood availability. The variable X_{13} had seven categories. It was therefore transformed into six dummy variables before entering it into the model.

The variables which remained after the variable selection process were X_1= exposure to the MAFE project, X_3= respondent perceptions of soil erosion problems on their farm, X_4= whether respondents practiced contour hedgerows in order to control soil erosion, X_{13}= land tenure system (table 4.59). The variable X_3= respondent perceptions of soil erosion problems on their farm was not removed during the variable selection process but also did not come up as a significant predictor in the final model. There were 186 cases included and the model correctly classified 79.57% of the cases. The -2 log likelihood improved from 220.42 (model with constant alone) to 176.45 with the four variables (Appendix B). Table 4.59 shows that the respondents who were exposed to the MAFE project, who also felt that they had secure rights of land tenure and perceived that the practice of contour hedgerows controlled soil erosion were more likely to practice contour hedgerows.

From Table 4.59, the probability of respondent decision to practice contour hedgerows can be estimated as follows $e^z/1+e^z$

where $z=.4928 + .1317X_3 -.7525X_1 -1.4359X_4 -.9790X_{15}$

Table 4.59: Maximum Likelihood Estimates for the Practice of Contour Hedgerows in Njolomole EPA of Ntcheu RDP in Malawi.

Variable	Estimate	S.E.	Wald	df	*p* level
X_1	-.7525	.3039	6.1302	1	.0133*
X_3	.1317	.2321	.3218	1	.5705
X_4	-1.4359	.6412	5.0146	1	.0251*
X_{15}	-.9790	.2326	17.7124	1	.0000**
constant	.4928	.6761	.5313	1	.4661

** significant at p=.01, * significant at p=.05.

Logistic regression model for the practice of woodlots.

The variables entered for the practice of woodlots were the same as those entered for the practice of contour hedgerows but using data for woodlots.

The variables which remained after the variable selection process were X_1= respondent's exposure to MAFE project, X_8= respondent's perception as to whether the practice of woodlots increased fuelwood, X_{10}= gender and X_{13}= total income received in 1996 (table 4.60). There were 164 cases entered and the model correctly classified 84.76% of the cases (see Appendix B). The -2 log likelihood improved from 172.62 (model with constant alone) to 111.88 in the final model. As Table 4.60 shows, X_{10}= gender and X_{13}= total income received in 1996 came out as significant predictors of respondent's decision to practice woodlots. Respondent perceptions as to whether the practice of woodlots increased fuelwood and respondent's exposure to the MAFE project did not meet the removal criteria but were also not significant. Table 4.60 shows that male respondents who received income which was more than K499.00 in 1996 were more likely to practice woodlots.

Table 4.60: Maximum Likelihood Estimates for the Practice of Woodlots in Njolomole EPA of Ntcheu RDP in Malawi.

Variable	Estimate	S.E.	Wald	df	*p* level
X_1	-.8674	.4816	3.2440	1	.0717
X_8	.3301	.2652	1.5489	1	.2133
X_{10}	-1.2438	.2603	22.8403	1	.0000**
X_{13}	.8718	.2714	10.3162	1	.0013**
constant	-1.7404	.4449	15.3004	1	.0001**

** significant at p=.01, * significant at p=.05.

From Table 4.60 above, the probability of respondent decision to practice woodlots can be estimated by $e^z/1+e^z$

where $z=-1.7404 +.3301X_8 + .8718X_{13} -.8674X_1 -1.2438X_{11}$

Logistic regression model for the practice of planting and caring for trees in garden boundaries.

The variables entered for the practice of planting and caring for trees in garden boundaries were the same as those entered for the practice of contour hedgerows but using data for planting and caring for trees in garden boundaries.

The variables which remained after the variable selection process were X_1=respondent's exposure to the MAFE project, X_2= respondent perception regarding the effect of the practice of planting and caring for trees in garden boundaries on food crop yields, X_3= whether respondent perceived that they experienced soil erosion problems on their farm, X_{10}= gender, X_{12}= respondent's age, X_{13}= total income received in 1996 and X_{14}= landholding size.

There were 348 cases entered and the model correctly classified 86.21% of the respondents. The -2 log likelihood improved from 409.95 (from model with constant only) to 263.46 in the final model (see Appendix B). Respondent perceptions regarding the effect of the practice of planting and caring for trees in garden boundaries on food crop yields, total income received in 1996, and gender were the variables which came out as significant predictors of the decision to practice planting and caring for trees in garden boundaries (Table 4.61). Respondent perceptions of soil erosion problems on their farms, respondent exposure to the MAFE project, age, and landholding size did not come up as significant predictors but they remained in the model during the variable selection process. Male respondents who received income in excess of K499.00 in 1996 and perceived the practice of planting and caring for trees in garden boundaries as increasing food crop yields were more likely to practice planting and caring for trees in garden boundaries. From Table 4.61, the probability of farmer decision to practice planting and caring for trees in garden boundaries can be estimated by $e^z/1+e^z$

where $z= .1599 + .0998X_3 + .0120X1_2 + .4163X_{13}{}^a + .0765X_{14} - .3008X_1 - 1.9592X_2 - .3382X_{10*} - .9346X_{13}{}^b$

Table 4.61: Maximum Likelihood Estimates for the Practice of Planting and Caring for Trees in Garden Boundaries in Njolomole EPA of Ntcheu RDP in Malawi.

Variable	Estimate	S.E.	Wald	df	*p* level
X_1	-.3008	.2218	1.8393	1	.1750
X_2	-1.9592	.2247	76.0394	1	.0000**
X_3	.0998	.1780	.3144	1	.5750
X_{10}	-.3382	.1683	4.0409	1	.0444*
X_{12}	.0120	.0117	1.0481	1	.3060
X_{13}^{a}	.4163	.1910	4.7487	1	.0293*
X_{13}^{b}	-.9346	.4907	3.6281	1	.0568
X_{14}	.0765	.1567	.2382	1	.6255
constant	.1599	.7700	.0431	1	.8355

** significant at p=.01, * significant at p=.05.
[a] Respondent received income of K499.00 or other in 1996.
[b] Respondent received income of K1000.00-1,999.00 or other in 1996.

Logistic regression model for the practice of planting and caring for trees in croplands.

The variables which were entered for the practice of planting and caring for trees in croplands were the same as those entered for the practice of contour hedgerows but using data on planting and caring for trees in croplands.

The variables which remained after the variable selection process were X_1=respondent's exposure to MAFE project, X_2=respondent's perception of the influence of the practice of planting and caring for trees in croplands on food crop yields, X_3=whether respondent perceived that he/she experienced soil erosion problems on his/her farm, X_8= whether respondent perceived the practice of planting and caring for trees in croplands as having helped to increase fuelwood and X_{10}=gender. The model correctly classified 91.03% of the respondents and the -2 log likelihood improved from 140.58 (from the model with constant only) to 94.47 in the final model. The number of cases included was 156 (see Appendix B). As Table 4.62 shows, respondent's perception regarding the effect of the practice of planting and caring for trees in croplands on food crop yields and gender were significant. Male respondents who perceived the practice of planting and caring for trees in croplands as increasing food crop yields were more likely to practice planting and caring for trees in croplands.

Table 4.62: Maximum Likelihood Estimates for the Practice of Planting and Caring for Trees in croplands.

Variable	Estimate	S.E.	Wald	df	*p* level
X_1	-.1805	.4913	.1349	1	.7134
X_2	-1.1464	.3829	8.9637	1	.0028**
X_3	.7093	.5798	1.4965	1	.2212
X_8	.0175	.3464	.0026	1	.9596
X_{10}	2.1778	.5430	16.0873	1	.0001**
constant	-5.8199	1.1246	26.7801	1	0000**

** significant at p=.01, * significant at p=.05

From the Table 4.62 above, respondent's decision to practice planting and caring for trees in garden boundaries can be estimated by $e^z/1+e^z$

where $z= -5.8199 + .7093X_3 + .0175X_8 + 2.1778X_{10} -.1805X_1 -1.1464X_2$

Logistic regression for the practice of planting and caring for trees at homesteads.

The variables entered for the practice of planting and caring for trees at homesteads were the same as those entered for the practice of contour hedgerows but using data for planting and caring for trees at homesteads.

There were 348 cases entered in the model and it correctly classified 83.33% of the respondents. The -2 log likelihood improved from 481.28 (from model with constant only) to 301.33 in the final model (see Appendix B). The variables which remained after the variable selection process were X_9= whether respondent perceived the practice of planting and caring for trees at homesteads as more or less profitable than his/her previous practices and X_{12}= age (Table 4.63). Respondent perception as to whether the practice of planting and caring for trees at homesteads was more or less profitable than previous practices was significant at the .01 level. Respondents who perceived the practice of planting and caring for trees at homesteads as more profitable than their previous practices were more likely to practice the technology. Fruits were the main product which were produced and sold from this technology.

Table 4.63: Maximum Likelihood Estimates for the Practice of Planting and Caring for Trees at Homesteads in Njolomole EPA of Ntcheu RDP in Malawi.

Variable	Estimate	S.E.	Wald	df	*p* level
X_9	1.9363	.1933	100.3037	1	0000**
X_{12}	-.0134	.0097	1.8987	1	.1682
constant	-4.0559	.6543	38.4247	1	0000**

** significant at p=.01, * significant at p=.05.

From Table 4.63 above, the probability of respondent decision to practice planting and caring for trees at homesteads can be estimated by $e^z/1+e^z$

where $z = -4.0559 + 1.9363X_9 - .0134X_{12}$

Chapter V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

Existing high population density, along with increasing population growth is putting extreme pressure on the limited land for cultivation in Malawi. Consequences of this population growth are the high demands for fuelwood as a major source of energy thus causing serious declines in soil fertility, soil erosion and reduction of natural forest resources. Research, initiated to address these issues, has generated specific agroforestry technologies which are being recommended to farmers. Efforts to improve land resources continue to be hindered by failure of farmers to adopt the proposed technologies. Thus, a situation has been created, generating a need for further investigation of the factors influencing farmer adoption of the technologies.

Review of the problem and purpose of the study

The main problem of the study was to determine the factors that have influenced farmer attitudes towards adoption of selected agroforestry technologies. The purpose of the study was to generate information to be used for re-designing extension efforts to increase farmer practice of the selected agroforestry technologies.

The specific research hypotheses were:

1. Farmer exposure to the MAFE project influenced their decisions to practice selected agroforestry technologies.

2. Farmer perceptions regarding the effect of selected agroforestry technologies on food crop yields influenced their decisions to practice those agroforestry technologies.

3. Farmer perceptions regarding the effect of selected agroforestry technologies on soil erosion control influenced their decisions to practice those agroforestry technologies.

4. Farmer perceptions regarding the effect of selected agroforestry technologies on fuelwood availability influenced their decisions to practice those agroforestry technologies.

5. Farmer perceptions regarding the effect of selected agroforestry technologies on profitability influenced their decisions to practice those technologies.

6. The following demographic factors; gender, farmer's age, farmer's highest level of formal schooling attained, the amount of income the farmer received in 1996, farmer's landholding size, land tenure system and tree tenure system influenced farmer decisions to practice selected agroforestry technologies.

Review of research methods

Data collection was done through interviews by a team of five male and four female interviewers. The males interviewed male respondents while the females interviewed female respondents. A total of 399 out of a targeted 449 questionnaires were used for analysis. Sixty four questionnaires came from respondents who were exposed to the MAFE project and 335 from respondents who were not exposed. In terms of gender, 203 questionnaires were from male respondents while 196 questionnaires were from female respondents.

Logistic regression analyses were conducted for the practices of contour hedgerows, woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and planting and caring for trees at homesteads. Logistic regression analyses for the practices of systematic interplanting with *F. albida,* alley cropping, relay cropping, improved fallows, fodder banks and living fences were not included because of missing data[7].

Discussion of results and findings

Introduction

Four agroforestry technologies were more widely practiced than others: contour hedgerows; woodlots; planting and caring for trees in croplands; and, planting and caring for trees at homesteads. These were practiced by at least forty percent of the respondents. Systematic interplanting with *F. albida*, alley cropping, relay cropping, improved fallows, planting and caring for trees in garden boundaries, fodder banks and living fences were practiced by less than forty percent of the respondents.

The single most important reason expressed by farmers for not adopting the practice of selected agroforestry technologies was not having been exposed to their benefits. The following section provides a brief summary of the findings for each hypothesis.

Hypothesis 1: Exposure to the MAFE project

A comparison of farmers exposed to the MAFE project with farmers who were not exposed was made. Farmers exposed to the MAFE project were more likely to adopt selected agroforestry technologies presented through the project endeavors. Farmer exposure to the MAFE project significantly influenced their decisions to practice contour hedgerows ($p=<.05$). Farmers who were exposed to the MAFE project practiced contour

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[7] A minimum of 100 cases was used as criteria for accepting the logistic regression analyses. Any model with less than 100 cases entered was rejected as having insufficient sample size.

hedgerows more often than those who were not exposed to the project. Exposure to other technologies influenced practice but were not statistically significant:

Contour hedgerows, exposed/adopted 85.9%- not exposed/adopted 30.7%;

Woodlots, exposed/adopted 60.9%- not exposed/adopted 37.9%;

Planting and caring for trees in garden boundaries, exposed/adopted 39.1%- not exposed/adopted 25.7%;

Planting and caring for trees in croplands, exposed/adopted 89.1% -not exposed/adopted 42.4%.

Farmer exposure to the MAFE project also resulted in a positive attitude towards the selected agroforestry technologies. The farmers who were exposed to the project perceived the agroforestry technologies as increasing food crop yields, controlling soil erosion and as being profitable. It therefore seems that providing extension services, like those provided by the MAFE project, to all the farmers in Njolomole EPA would increase the number of farmers practicing the selected agroforestry technologies.

Planting and caring for trees at homesteads was on the other hand a technology which enjoyed wide popularity both among farmers who were exposed to the MAFE project (64%) and those who were not exposed (56%).

Hypothesis 2: Food productivity

Farmers who were influenced by the impact of the selected agroforestry technologies on increased food crop productivity were more likely to practice those agroforestry technologies. Two agroforestry technologies were significant ($p=<.01$); planting and caring for trees in garden boundaries and in croplands.

There were generally higher proportions of respondents who perceived the practices of selected agroforestry technologies as having increased their food crop productivity.

Hypothesis 3: Soil erosion

Farmer perception regarding the effect of contour hedgerows on soil erosion control significantly influenced their decision to practice the contour hedgerows ($p=<.05$). Farmers who perceived that the practiced of contour hedgerows controlled soil erosion tended to practice the technology more often. Although not statistically significant, farmers perceived the practices of woodlots, trees in garden boundaries, trees in croplands and trees at homesteads as controlling soil erosion.

Hypothesis 4: Fuelwood production

Farmer perceptions of the effect of selected agroforestry technologies on fuelwood availability did not significantly influence farmer decisions to practice the agroforestry technologies.

Hypothesis 5: Profitability

Farmer perceptions regarding the effect of the practice of planting and caring for trees at homesteads significantly influenced their decisions to practice planting and caring for trees at homesteads ($p=<.01$). Farmers who perceived the practice of planting and caring for trees at homesteads as being more profitable than their previous experiences practiced it while those who perceived it as less profitable than their previous experiences did not. The majority of the farmers perceived the practice of planting and caring for trees at homesteads as more profitable than their previous practices. Fruits were the main product which was produced and sold.

Farmers make decisions to practice or not practice new technologies by calculating the income effect of those new technologies (Lee, 1983). Agarwal (1983) discussing factors that influence diffusion of innovations argued that the nature of innovation characteristics defines the ease or difficulty of diffusion. She stated that, the advantages of innovations which provide direct high financial benefits are likely to be perceived more readily than those of innovations whose benefits are indirect and non financial. Perhaps farmer perception of the financial profitability of the practice of planting and caring for trees at homesteads was an explanation for its wide popularity. Profitability was, however, defined only in terms of farmer perceptions. There is need to confirm these perceptions with actual financial data obtained under farmer practice.

Profitability did not significantly influence farmer decisions to practice the other technologies.

Hypothesis 6: Demographic factors

1. Gender: Gender significantly influenced the practice of planting and caring for trees in garden boundaries (p=<.05) and the practice of planting and caring for trees in croplands (p=.<01). Male farmers were more likely to plant and care for trees in garden boundaries and in croplands.

The proportions of male farmers practicing the selected agroforestry technologies were higher than those of female farmers. This gender difference in the practice of selected agroforestry technologies was most notable in the practices of selected agroforestry technologies designed for the production of fruit, fuelwood and other products. This observation was consistent with farmer perceptions of whether the agroforestry technologies designed for the production of fruit, fuel wood and other products helped to increase fuel wood availability. Male farmers perceive the practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and planting and caring for trees at homesteads as helping to increase fuelwood availability while female farmers did not. One plausible explanation for this difference in perceptions lies in the reasons for which male and female farmers established the agroforestry technologies. As discussed in chapter II studies have shown that the purposes for which women plant and care for trees are different from those of men (Chavangi et al, 1988). Women tend to be more concerned with preparing and providing food for their families (Molnar and Screiber, 1989; Chavangi et al, 1988; Agarwal, 1986). Their reason for planting and caring for trees is usually for the production of fuelwood for food preparation. Men on the other hand tend to be more concerned with income generation and construction. The products of choice for men are poles and timber. Fuelwood production is considered as a minor product by the male members of the family. This means that while the practices of woodlots, planting and caring for trees in garden boundaries, planting and caring for trees in croplands and planting and caring for trees at homesteads could have made a significant contribution to the fuelwood availability situation in the EPA, women did not have access to such fuelwood. As a result, women could not perceive such technologies as having helped increase fuelwood availability.

Age: The influence of age on farmer decisions to practice the selected agroforestry technologies was not significant.

3. Income: There was a significant relationship between the amount of income received in 1996 and farmers' decisions to practice woodlots (p=<.01) and planting and caring for trees in garden boundaries (p=<.05). Farmers who received more than K499.00 in 1996 were more likely to practice woodlots and trees in garden boundaries than those who received less than that amount. A possible reason for this is the capital which is normally required in order to establish and maintain these technologies. Capital is required for the establishment and maintenance of the technologies for such things as purchase of tree seedlings, fertilizers and chemicals for controlling termites. Capital may also be required to pay for hired labor which is usually needed for field preparation at establishment, weeding and protecting the trees from fire. It would therefore be necessary to provide credit facilities for those farmers who do not have sufficient capital required for establishment and maintenance of the technologies.

It should however be noted that farmer perceptions of the profitability of the practices did not come up as a significant predictor of the practices. That is not to say that the practices were not profitable but that the proportions of farmers who perceived the practices as more profitable than their previous practices were not large enough. It would therefore be prudent to conduct economic studies aimed at investigating the financial profitability of the practices. Such studies would provide useful data for designing appropriate credit schemes designed for promoting the practices.

4. Land tenure system: Land tenure system had a significant influence on farmer decisions to practice contour hedgerows (p=<.01). Farmers who perceived that they had secure rights of ownership to the land that they cultivated practiced contour hedgerows more often when compared to farmers who did not have secure rights of land ownership. Security of land tenure is an important requirement for the practice of contour hedgerows. Farmers who indicated that they did not practice the contour hedgerows due to insecure rights of land tenure were predominantly male and cited the system of Chikamwini[8] as a reason for not being willing to invest in the agroforestry technology. The practice of contour hedgerows is a land improving technology. Its main benefit is the control of soil erosion which leads to the long term productivity of the land. Farmers who perceive the long term productivity of the land as directly beneficial to them are probably more likely to want to practice the technology. While farmers who do not perceive the long term profitability of the land as directly beneficial to them are probably not likely to want to invest in the practice of contour hedgerows.

Farmers therefore, need to be assured of the long term ownership of their land if they are to practice planting contour hedgerows. Farmers who do not perceive that the land will belong to them for a long time are probably not likely to invest in contour hedgerows. In the case of Njolomole EPA, the major problem lies with chikamwini system. People of Njolomole EPA practice a matrilineal type of marriage system. At marriage the man is supposed to leave his home and go to settle at his wife's home. The farm land which he works does not in principle belong to him but to his wife. In the case of divorce or death of his wife, he is supposed to go back to his original home and has no

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[8] Chikamwini refers to the system whereby a man follows his wife at marriage. By tradition the man works on land allocated to his wife by her relations. In the case of divorce or death of the wife, the man is required to go back to his original home and therefore loses the fruits of any investment made on the land.

further access to the land he was working during marriage. This creates a situation whereby the male farmers perceive themselves as not having secure rights of land tenure. They therefore, become less willing to invest in land improving technologies like the practice of contour hedgerows.

It should also be noted that the benefit of long term productivity of the land was of more interest to the women than men. As already observed, women tend to be more concerned with production and provision of food for the family while men tend to be interested in generating income. Productivity of the land seems to be more of a concern of women than of men.

5. Landholding size: The influence of landholding size on farmers' decision to practice the selected agroforestry technologies was not significant.

Tree tenure system: The influence of tree tenure system on farmers' decisions to practice the selected agroforestry technologies was not significant

GENERAL RECOMMENDATIONS

There is need to increase the number of farmers practicing selected agroforestry technologies in Njolomole EPA of Ntcheu RDP. Most of the farmers in the EPA are not able to produce enough food to last them from one harvest to another. Soil erosion and shortage of fuelwood are very serious problems. As the population is growing, the problems of land pressure, declining soil fertility, soil erosion and reduction of natural forests are also growing. Efforts are required address these problems. Implementation of agroforestry technologies is one way of addressing such problems.

Recommendation 1: It is recommended that extension programs designed to promote the practice of the selected agroforestry technologies be provided to all the farmers in Malawi. Specifically, it is recommended that the Government of Malawi, either though its Ministries of Agriculture and Livestock Development and Forestry and Natural Resources or through non governmental organizations, develop a strategic plan of action for providing information and demonstrations on recommended agroforestry technologies.

Recommendation 2: It is further recommended that the Malawi extension program design demonstrations in locations where farmers can make observations and access information. The demonstrations should be designed in such a way that they emphasize the advantages of the selected agroforestry technologies. Farmers who perceive the advantages of the technologies such as increased food production, control of soil erosion and profitability will likely practice the technologies. As observed, however, each technology has its own unique advantages. Those technologies which have the benefits of increasing food crop yields are different from those which have the benefits of controlling soil erosion and also different from those which have the benefits of profitability. The demonstrations must therefore be designed to emphasize specific advantages of each technology.

Recommendation 3: It is recommended that a collaborative effort be made between the Ministry of Agriculture and Livestock Development and Forestry and Natural Resources for an extensive establishment of agroforestry tree nurseries. These nurseries should be made in places close to the farmers so that tree seedlings such as those of *F. albida can* be made readily available to the farmers at a reasonable cost. This will help to address the problem of shortage of seedlings. Another approach would be to train farmers in nursery management and then provide them with tree seed. This would help to reduce cost of seedlings.

Recommendation 4: Special agroforestry extension programs for women need to be implemented. Creative programs like woodlots for women might have significant impact on increasing fuelwood availability. Although, selected agroforestry technologies, especially those designed for the production of fruit, fuelwood and related products are supposed to be an important source of fuelwood, such fuelwood was not readily made available to female farmers. As a result, these technologies did not reduce the shortage problem of fuelwood in the households. Women are still required to make their long treks in search of firewood from the declining natural forests or government plantations. This is causing significant negative impact on household food availability and nutrition as well as forest and environmental degradation. Implementation of special extension efforts targeted at women farmers would help to reduce these problems.

Recommendation 5: It is recommended that efforts be made to develop marketing opportunities for agroforestry products, such as, fruits. The practice of planting and caring for trees at homesteads is a technology which was very popular partly due to its profitability. Fruits were the major product sold. It is therefore very important to promote markets for fruit producing technologies.

Recommendation 6: It is recommended that government loans be provided to enable farmers with low income to practice the selected agroforestry technologies. Shortage of income was a major factor influencing farmer adoption of selected agroforestry technologies. Farmers who received more income in 1996 tended to practice the selected agroforestry technologies as compared to those who received less income. Income was required as capital for establishing and maintaining selected agroforestry technologies.

Recommendation 7: It is recommended that agroforestry programs be introduced in schools, youth organizations and clubs. The Malawi government needs to introduce agroforestry in the curriculums and syllabi of both primary and secondary schools. Early primary school dropouts tend to become smallholder farmers. Targeting them early in the schools may be a very important strategy for increasing the number of farmers willing to practice agroforestry technologies.

Recommendation 8: A form of incentives is recommended to encourage farmers to practice those technologies which may not benefit them directly. The value of this is the long term sustainability of the national resource base. Technologies like contour hedgerows are very important for maintaining the long term productivity of the land. Male farmers in the matrilineal system of marriage need to be encouraged to practice selected agroforestry technologies especially contour hedgerows. Incentives may be the answer. The Ministry of Forestry and Natural Resources already provides some incentives in order to encourage farmers to plant trees. Such incentives should be extended for encouraging practices like contour hedgerows.

One type of creative incentive would be food for work programs. As observed in chapter II, farmers were not able to produce enough food for their family needs from one season to the next. Instead of government providing free food to such farmers, they could be encouraged to implement these technologies in exchange for the food.

RECOMMENDATIONS FOR FURTHER RESEARCH

Recommendation 1:. This study basically relied on farmer perceptions of the effect of selected factors influencing farmer practice of selected agroforestry technologies. Further research directed at generating physical and economic evidence substantiating farmer perceptions of those factors influencing the practice of selected agroforestry technologies needs to be conducted. Physical evidence of such factors as profitability, effect of the specified technologies on improving food crop yields, increasing fuelwood supplies and benefits of controlling soil erosion should be the focus of such research. Although several economic studies pertaining to selected technologies have been reported in the literature very few of the technologies discussed in this study were considered in those studies. Information is lacking about such technologies as: planting and caring for trees in garden boundaries; planting and caring for trees in croplands; and, planting and caring for trees at homesteads.

Recommendation 2: It is recommended that efforts be made to develop improved fruit varieties for inclusion in the agroforestry programs. Fruit production was one area which made the practice of planting and caring for trees at homesteads more profitable. Improved varieties which would result in higher yields of good quality and palatable fruit would make the technology much more profitable and attractive to farmers.

Recommendation 3: Studies to determine the feasibility of including fruit trees in contour hedgerows need to be conducted. This technology is very important in terms of protecting the soil from erosion and ensuring the long term productivity of the land. However, male farmers tended not to see benefits from this technology because of the land tenure problems. Inclusion of fruit production would make the technology profitable and this would possibly cause male farmers to recognize its benefits.

PERSONAL REFLECTIONS AND OBSERVATIONS

This section briefly describes personal reflections and observations made by the researcher. These reflections and observations are based on personal experiences and informal observations.

1. The practice of planting and caring for trees at homesteads was widely practiced in the EPA, yet the level of tree management was below recognized standard in most cases. Farmers could have been making much higher profits from this technology if they were better informed about tree management. Husbandry practices like pruning, weeding and manuring could possibly have increased fruit yields and improved fruit quality which would lead into higher profits.

2. The fact that the Malawi Agroforestry Extension Project was piloted to some farmers in the EPA seems to have created animosity among the farmers who were left out. Most of the farmers who did not respond to the study argued that they saw no benefit in providing information when they did not benefit from the programs.

3. Farmers who were not exposed to the MAFE project seemed to perceive that they were being alienated by the project and therefore refused to participate in the interview.

4. The number of technologies investigated in this study were too many. If I were to replicate this study I would reduce the number of technologies investigated.

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APPENDIX A

APPENDIX A

Respondents' exposure to information and demonstrations

Table A1: Number of Respondents who Received Information and Seen Demonstrations of Selected Agroforestry Technologies in Njolomole EPA of Ntcheu RDP.
(N=399)

Agroforestry technology	Received information		Seen demonstration		Not sure/no response	
	number	%	number	%	number	%
FA	143	35.8	108	27.1	148	37.1
AC	103	25.8	93	23.3	203	50.9
RC	79	19.8	73	18.3	247	61.9
IF	105	26.3	73	18.3	221	55.4
CH	143	37.1	128	32.1	128	32.1
WL	140	35.1	125	31.3	134	33.6
TGB	104	26.1	86	21.6	209	52.4
TC	94	23.6	82	20.6	223	55.9
TH	135	33.8	108	27.1	156	39.1
FB	89	22.3	85	21.3	225	56.4
LF	88	22.1	76	19.1	235	58.9

Table A2: A Comparison of Respondent Perceptions Between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project Regarding their Exposure to Extension Information Designed to Promote the Practice of Selected Agroforestry Technologies.

Agroforestry technology	Exposed to MAFE project (n=64)			Not exposed to MAFE project (n=335)		
	received information	did not receive information	not sure/non respondent	received information	did not receive information	not sure/non respondent
FA	54 (84.4)	4 (6.3)	6 (9.4)	89 (26.6)	172 (51.3)	74 (22.1)
AC	54 (84.4)	5 (7.8)	5 (7.8)	49 (14.4)	196 (58.5)	90 (26.9)
RC	43 (67.2)	4 (6.3)	17 (26.6)	36 (10.8)	214 (63.9)	85 (25.4)
IF	41 (64.1)	5 (7.8)	18 (28.1)	64 (19.1)	190 (56.7)	81 (24.2)
CH	58 (90.6)	4 (6.3)	2 (3.1)	90 (26.9)	182 (54.3)	63 (18.8)
WL	44 (68.8)	14 (21.9)	6 (9.4)	96 (28.7)	180 (53.7)	59 (17.6)
TGB	43 (67.2)	7 (10.9)	24 (37.5)	61 (18.2)	203 (60.6)	71 (21.2)
TC	43 (67.2)	18 (28.1)	3 (4.7)	51 (15.2)	216 (64.5)	68 (20.3)
TH	42 (65.6)	18 (28.1)	4 (6.8)	93 (27.8)	190 (56.7)	94 (28.1)
FB	57 (89.1)	4 (6.3)	3 (4.7)	32 (9.6)	206 (61.5)	97 (29.0)
LF	42 (65.6)	17 (26.6)	5 (7.8)	46 (13.7)	207 (61.8)	82 (24.5)

FA is *F. albeda*, AC is alley cropping, RC is relay cropping, IF is improved fallows, CH is contour hedgerows, WL is woodlots, TGB is trees in garden boundaries TC is trees in croplands, TH is trees at homesteads, FB is fodder banks and LF is living fences.

Table A3: A Comparison of Respondent Perceptions Between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project on Whether they had Seen Demonstrations Mounted by Extension Staff on the Selected Agroforestry Technologies-

Agroforestry tecnology	Exposed to MAFE project (n=64)			Not exposed to MAFE project (n=335)		
	seen	not seen	not sure/non respondent	seen	not seen	not sure/non respondent
FA	54 (84.4)	9 (14.1)	1 (1.6)	54 (16.1)	206 (61.5)	75 (22.4)
AC	48 (75.0)	11 (17.2)	5 (7.8)	45 (13.4)	204 (60.9)	86 (25.7)
RC	44 (68.8)	11 (17.2)	9 (14.1)	29 (8.7)	216 (64.5)	90 (26.9)
IF	43 (67.2)	13 (20.3)	8 (12.5)	30 (9.0)	214 (63.9)	91 (27.2)
CH	54 (84.4)	9 (14.1)	1 (1.6)	74 (22.1)	185 (55.2)	76 (22.7)
WL	43 (67.2)	18 (28.1)	3 (4.7)	82 (24.5)	194 (57.9)	59 (17.6)
TGB	46 (71.9)	11 (17.2)	7 (10.9)	40 (11.9)	214 (63.9)	81 (24.2)
TC	44 (68.8)	17 (26.6)	3 (4.7)	38 (11.4)	216 (64.5)	81 (24.2)
TH	44 (68.8)	16 (25.0)	4 (6.3)	64 (19.1)	205 (61.2)	66 (19.743)18
FB	52 (81.3)	10 (15.6)	2 (3.1)	33 (9.9)	210 (62.7)	92 (27.5)
LF	44 (68.8)	17 (26.6)	3 (4.7)	32 (9.6)	215 (64.2)	88 (26.3)

FA is *F. Albida*, AC is alley cropping, RC is relay cropping, IF is improved fallows, CH is contour hedgerows, WL is wood ltos, TGB is trees in garden boundaries TC is trees in croplands, TH is trees at homesteads, FB is fodder banks and LF is living fences.

Table A4: A Comparison of Respondent Perceptions of Whether they were Influenced by Information and Demonstrations Provided by Extension to Practice the Selected Agroforestry Technologies Between Respondents who were and those who were not Exposed to the Malawi Agroforestry Extension Project.

Agroforestry technology	Exposed to MAFE project(n=64)			Nto exposed to MAFE project (n=335)		
	influenced	not influenced	not sure/non respondent	influenced	not influenced	not sure/non respondent
FA	45 (70.3)	13 (20.3)	6 (9.4)	24 (7.2)	204 (60.9)	107 (31.9)
AC	21 (32.8)	25 (39.1)	18 (28.1)	13 (3.9)	198 (59.1)	124 (37.0)
RC	25 (39.1)	22 (34.4)	17 (26.6)	9 (2.7)	219 (65.4)	107 (31.9)
IF	23 (35.9)	20 (31.3)	21 (32.8)	15 (4.5)	209 (62.4)	111 (33.1)
CH	54 (84.4)	8 (12.5)	2 (3.1)	47 (14.0)	187 (55.8)	101 (30.2)
WL	29 (45.3)	25 (39.1)	10 (15.6)	57 (17.0)	193 (57.6)	85 (25.4)
TGB	27 (42.2)	20 (31.3)	17 (26.6)	18 (5.4)	215 (64.2)	102 (30.5)
TC	43 (67.2)	20 (31.3)	1 (1.6)	17 (5.1)	226 (67.5)	92 (27.5)
TH	28 (43.8)	29 (45.3)	7 (10.9)	48 (14.3)	211 (63.0)	76 (22.7)
FB	29 (45.3)	20 (31.3)	15 (23.4)	8 (2.4)	204 (60.9)	123 (36.7)
LF	22 (34.4)	31 (48.4)	11 (17.2)	7 (2.1)	218 (65.1)	110 (32.8)

FA is *F. Albida*, AC is alley cropping, RC is relay cropping, IF is improved fallows, CH is contour hedgerows, WL is wood ltos, TGB is trees in garden boundaries TC is trees in croplands, TH is trees at homesteads, FB is fodder banks and LF is living fences.

APPENDIX B

APPENDIX B

1. LOGISTIC REGRESSION MODEL FOR CONTUOR HEDGEROWS

Number of selected cases: 399
Number rejected because of missing data: 213
Number of cases included in the analysis: 186

Dependent Variable.. PRACTCH1 Do you practice contour hedgerows?
Initial Log Likelihood Function

-2 Log Likelihood 220.42735

Variable(s) Entered on Step Number

CHERO	Did you impliment contour hedgerows for erosion control?
EROSION2	Do you experience soil erosion problems on your farm?
LANDTENU	Do you have secure rights of land tenure?
PROJECT	Do you belong to MAFE project?

Estimation terminated at iteration number 4 because
Log Likelihood decreased by less than .01 percent.

-2 Log Likelihood 176.109
Goodness of Fit 186.190

	Chi-Square	df	Significance
Model Chi-Square	44.319	4	.0000
Improvement	44.319	4	.0000

Classification Table for PRACTCH1

		Predicted 1.00 (1)	Predicted 2.00 (2)	Percent Correct
Observed 1.00	1	124	10	92.54%
Observed 2.00	2	28	24	46.15%
			Overall	79.57%

---------------------- Variables in the Equation ------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
CHERO(1)	-1.4359	.6412	5.0146	1	.0251	-.1169	.2379
EROSION2(1)	.1317	.2321	.3218	1	.5705	.0000	1.1407
LANDTENU(1)	-.9790	.2326	17.7124	1	.0000	-.2670	.3757
PROJECT(1)	-.7525	.3039	6.1302	1	.0133	-.1369	.4712
Constant	.4928	.6761	.5313	1	.4661		

APPENDIX B

2. LOGISTIC REGRESSION MODEL FOR WOODLOTS

Number of selected cases: 399
Number rejected because of missing data: 235
Number of cases included in the analysis: 164

Dependent Variable.. PRACTWL1 Do you practice woodlots?

Beginning Block Number 0. Initial Log Likelihood Function

-2 Log Likelihood 172.62308

Variable(s) Entered on Step Number
1.. PROJECT Do you belong to MAFE project?
GENDER Male or female?
INCOME1 less than K499.00
WLFUEL2 Was fuel shortage solved by woodlots?

Estimation terminated at iteration number 5 because
Log Likelihood decreased by less than .01 percent.

-2 Log Likelihood 111.876
Goodness of Fit 167.318

	Chi-Square	df	Significance
Model Chi-Square	60.747	4	.0000
Improvement	60.747	4	.0000

Classification Table for PRACTWL1

Observed		Predicted 1.00 (1)	Predicted 2.00 (2)	Percent Correct
1.00	1	125	3	97.66%
2.00	2	22	14	38.89%
			Overall	84.76%

---------------------- Variables in the Equation ----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
PROJECT(1)	-.8674	.4816	3.2440	1	.0717	-.0849	.4200
GENDER(1)	-1.2438	.2603	22.8403	1	.0000	-.3475	.2883
INCOME1(1)	.8718	.2714	10.3162	1	.0013	.2195	2.3912
WLFUEL2(1)	.3301	.2652	1.5489	1	.2133	.0000	1.3911
Constant	-1.7404	.4449	15.3004	1	.0001		

APPENDIX B

3. LOGISTIC REGRESSION MODEL FOR TREES IN GARDEN BOUNDARIES

Number of selected cases: 399
Number rejected because of missing data: 51
Number of cases included in the analysis: 348

Dependent Variable.. PRACTXX1 Do you practice planting and caring of trees in garden boundaries

Beginning Block Number 0. Initial Log Likelihood Function

-2 Log Likelihood 409.94581

Beginning Block Number 1. Method: Enter

Variable(s) Entered on Step Number

1..	XXYIELD4	Did the practice of planting and caring for trees in garden boundaries increase or decrease your food crop yields?
	INCOME1	Income received in 1996 (less than K499.00 or otherwise)
	INCOME3	" " " (K2,000.00 to K2,999.00 or otherwise)
	AGE	
	GENDER	Male or female
	PROJECT	Do you belong to MAFE project?
	EROSION2	Do you experience soil erosion problems on your farm?
	LANDH	landholding size in hectares

Estimation terminated at iteration number 4 because Log Likelihood decreased by less than .01 percent.

-2 Log Likelihood 263.459
Goodness of Fit 335.365

	Chi-Square	df	Significance
Model Chi-Square	146.486	8	.0000
Improvement	146.486	8	.0000

Classification Table for PRACTXX1

		Predicted 1.00 (1)	Predicted 2.00 (2)	Percent Correct
Observed 1.00	1	56	40	58.33%
2.00	2	8	244	96.83%
			Overall	86.21%

---------------------- Variables in the Equation ----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
XXYIELD4(1)	-1.9592	.2247	76.0392	1	.0000	-.4250	.1410
INCOME1(1)	.4163	.1910	4.7487	1	.0293	.0819	1.5164
AGE	.0120	.0117	1.0481	1	.3060	.0000	1.0121
GENDER(1)	-.3382	.1683	4.0409	1	.0444	-.0706	.7130
PROJECT(1)	-.3008	.2218	1.8393	1	.1750	.0000	.7402
EROSION2(1)	.0998	.1780	.3144	1	.5750	.0000	1.1049
LANDH	-.0765	.1567	.2382	1	.6255	.0000	.9264
INCOME3	-.9346	.4907	3.6281	1	.0568	-.0630	.3927
Constant	.1599	.7700	.0431	1	.8355		

APPENDIX B

4. LOGISTIC REGRESSION MODEL FOR TREES IN CROPLANDS

Number of selected cases: 399
Number rejected because of missing data: 243
Number of cases included in the analysis: 156

Dependent Variable.. PRACTTC1 Do you practice planting and caring of trees in croplands

Beginning Block Number 0. Initial Log Likelihood Function

-2 Log Likelihood 140.5751

Variable(s) Entered on Step Number
1.. PROJECT Do you belong to MAFE project?
TCYIELD4 did trees in croplands increase yield
TCFUEL2 Was fuel shortage solved by trees in croplands?
EROSION2 Do you experience soil erosion problems on your farm?
GENDER Male or female

Estimation terminated at iteration number 6 because
Log Likelihood decreased by less than .01 percent.

-2 Log Likelihood 94.470
Goodness of Fit 456.383

	Chi-Square	df	Significance
Model Chi-Square	46.105	5	.0000
Improvement	46.105	5	.0000

Classification Table for PRACTTC1

		Predicted 1.00 (1)	Predicted 2.00 (2)	Percent Correct
Observed 1.00	1	124	6	95.38%
2.00	2	8	18	69.23%
			Overall	91.03%

---------------------- Variables in the Equation ----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
PROJECT(1)	-.1805	.4913	.1349	1	.7134	.0000	.8349
TCYIELD4(1)	-1.1464	.3829	8.9637	1	.0028	-.2226	.3178
TCFUEL2(1)	.0175	.3464	.0026	1	.9596	.0000	1.0177
EROSION2(1)	.7093	.5798	1.4965	1	.2212	.0000	2.0326
GENDER	2.1778	.5430	16.0873	1	.0001	.3166	8.8272
Constant	-5.8199	1.1246	26.7801	1	.0000		

APPENDIX B

5 LOGISTIC MODEL FOR TREES AT HOMESTEADS

Number of selected cases: 399
Number rejected because of missing data: 51
Number of cases included in the analysis: 348

Dependent Variable.. PRACTTH1 Do you practice planting and caring for trees in croplands?

Beginning Block Number 0. Initial Log Likelihood Function

-2 Log Likelihood 481.28038

Variable(s) Entered on Step Number
1.. AGE
THPROF2 Was the practice of planting and caring for trees in croplands more or less profitable than your previous practices?

Estimation terminated at iteration number 4 because
Log Likelihood decreased by less than .01 percent.

-2 Log Likelihood 301.328
Goodness of Fit 351.188

	Chi-Square	df	Significance
Model Chi-Square	179.953	2	.0000
Improvement	179.953	2	.0000

Classification Table for PRACTTH1

		Predicted 1.00 (1)	Predicted 2.00 (2)	Percent Correct
Observed 1.00	1	140	44	76.09%
Observed 2.00	2	14	150	91.46%
			Overall	83.33%

---------------------- Variables in the Equation -----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
AGE	-.0134	.0097	1.8987	1	.1682	.0000	.9867
THPROF2	1.9363	.1933	100.3037	1	.0000	.4519	6.9327
Constant	-4.0559	.6543	38.4247	1	.0000		

APPENDIX C

APPENDIX C

RESEARCH QUESTIONNAIRE

PRACTICE OF SELECTED AGROFORESTRY TECHNOLOGIES: FARMER PERCEPTIONS OF INFLUENTIAL FACTORS

IMPORTANT NOTE TO INTERVIEWER: Read these comments to the respondent and be sure to get his or her consent before starting the interview.

We are part of a research team from Michigan State University. We are studying farmer perceptions of selected factors influencing farmer practice of recommended agroforestry technologies in Njolomole EPA of Ntcheu RDP. We would like to ask you some questions concerning the factors you consider important for the practice of selected agroforestry technologies. Your responses will be used in designing appropriate research and extension programs on agroforestry.

The interview takes about one hour to complete. Your participation in this interview is voluntary. You are free to not participate in the interview. You are also free to not answer any of the questions you choose. You may also discontinue the interview at anytime.

Your answers will remain confidential and will not be disclosed in any way that you can be identified.

Do you wish to participate? Yes no
(circle the right answer)

You indicate your voluntary agreement to answer any of the questions by answering them.

MALE AND FEMALE FARMER PERCEPTIONS OF SELECTED FACTORS INFLUENCING THE PRACTICE OF RECOMMENDED AGROFORESTRY TECHNOLOGIES IN NJOLOMOLE EPA OF NTCHEU RDP IN MALAWI.

RESEARCH QUESTIONNAIRE

Part A: Demographic information

Note to interviewer: Read the following to the respondent. "In this part of the interview I am going to ask for some demographic information about you".

1. Name of farmer ______________________

2. Village ______________________

3. Male __________ female __________

4. Marital Status
   - married __________
   - divorced __________
   - widowed __________
   - never married __________
   - other (specify __________

5. What is your year of birth? __________

6. What is the highest level of education you attained?
   - primary school (grade) __________
   - secondary school (form) __________
   - teacher training (number of years) __________
   - technical school (number of years) __________
   - university (qualification) __________

7a. What is the size of your farm (total acreage f
or all gardens)?

____

7b. How many gardens do you have?

____

8a. Do you consider yourself as having secure rights of ownership of your farm land?

yes. ____________
no ____________
not sure ____________

8b. Do you consider yourself as having secure rights of ownership of trees growing on your farm land?

yes ____________
no ____________
not sure ____________

8c. In the case of divorce, who would have control of ?

(a) your farm land
yourself ____________
your spouse ____________
your children ____________
other relative (specify relationship) ____________
other (specify) ____________

(b) trees you have planted on your farm land
yourself ____________
your spouse
your children ____________
other relatives (specify relationship) ____________
other (specify) ____________

10. What was your total family income from all sources in the year 1996. (interviewer, just circle the letter representing the category).

A. less than K499.00
B. K500.00-999.00
C. K1,000.00-1,999.00
D. K2,000.00-2,999.00
E. K3,000.00-3,999.00
F. K4,000.00-4,999.00
G. K5,000.00-5,999.00
H. above K6,000.00

Part B: Practice

Note to interviewer: Read the following to the respondent. "In this part of the interview I am going to ask you questions relating to information about the utilization of selected agroforestry technologies in your farming practices.

11a. Do you practice the following agroforestry technologies?

	yes	no
Faidherbia albida	________	________
trees in cropland	________	________
contour hedgerows	________	________
fodder banks	________	________
alley cropping	________	________
wood lots	________	________
trees on garden boundaries	________	________
trees on homesteads	________	________
improved fallows	________	________
relay cropping	________	________
living fences	________	________

11b. Please indicate the extent to which you practice the following agroforestry technologies.

Faidherbia albida

number of trees ________ estimated area (acres) ________

trees in cropland

number of trees ________ total area (acrea) ________

contour hedgerows

number of rows________ estimated length (total for all rows in meters) ________

fodder banks

number of rows ________ estimated length (total for all rows in meters)________

alley cropping

number of rows________ estimated length (total for all rows in meters)________

wood lots

number of wood lots________ area in acres (total for all wood lots)________

trees on garden boundaries

number of trees ________ length of boundaries with trees (total)________

trees on homestead

number of trees ________ total area (acres)________

improved fallows

number of trees ________ total area (acres) ________

relay cropping

number of trees ________ total area (acres)________

living fences

number of rows ________ total length (metres)________

12. Which of the following agroforestry technologies were you practicing prior to 1992? (check)

Faidherbia albida ____________

trees in croplands ____________

contour hedgerows ____________

fodder banks ____________

alley cropping ____________

wood lots ____________

trees on garden boundaries ____________

trees on homestead ____________

improved fallows ____________

relay cropping ____________

living fences ____________

Part c: Project

Note to interviewer: Read to the respondent. The Malawi Government set up the Malawi Agroforestry Extension Project in 1992. The main objective of the project is to develop an agroforestry extension system which will to promote the adoption and practice of recommended agroforestry technologies nationwide. This project is piloted in five extension planning areas including Njolomole EPA. The project is therefore implementing extension activities to promote the adoption and practice of recommended agroforestry technologies in this EPA. Some of the activities include farmer training, demonstrations, meetings, distribution of posters, pamphlets and other publications on recommended agroforestry technologies.

"In this part of the interview I will ask you questions relating to information about the extension activities of the Malawi Agroforestry Extension Project.

13a. Have you received information provided by the Malawi Agroforestry Extension Project on the following agroforestry technologies?

	yes	no
Faidherbia albida	______________	______________
trees in croplands	______________	______________
contour hedgerows	______________	______________
fodder banks	______________	______________
alley cropping	______________	______________
wood lots	______________	______________
trees on garden boundaries	______________	______________
trees on homestead	______________	______________
improved fallows	______________	______________
relay cropping	______________	______________
living fences	______________	______________

13b. Have you seen demonstrations conducted the Malawi Agroforestry Extension Project on the following agroforestry technologies?

	yes	no
Faidherbia albida	________	________
trees in croplands	________	________
contour hedgerows	________	________
fodder banks	________	________
alley cropping	________	________
wood lots	________	________
trees on garden boundaries	________	________
trees on homesteads	________	________
improved fallows	________	________
relay cropping	________	________
living fences	________	________

Note to interviewer: Ask question 14 only if the respondent is practicing the particular technology

14. Did the information and demonstrations provided influence your decision to practice the following agroforestry technologies?

	yes	no
Faidherbia albida	________	________
trees in croplands	________	________
contour hedgerows	________	________
fodder banks	________	________
alley cropping	________	________
wood lots	________	________
trees on garden boundaries	________	________
trees at homestead	________	________
improved fallows	________	________
relay cropping	________	________
living fences	________	________

15. For which of the following agroforestry technologies were you invited to participate in the extension activities provided by the Malawi Agroforestry Extension Project? (check)

	invited
Faidherbia albida	________
trees on croplands	________
trees on croplands	________
contour hedgerows	________
fodder banks	________
alley cropping	________
wood lots	________
trees on garden boundaries	________
trees at homestead	________
improved fallows	________
relay cropping	________
living fences	________

Part D:. Profitability

Note to interviewer: Read the following to the respondent. "The term profit in this study is defined in financial terms as the surplus income realized at the farm level after all the production costs have been accounted for. Accordingly the term profitability is defined in relative terms as the degree to which one technology gives more profit than other technologies. The term profitability is therefore restricted to financial terms only. Other benefits which are not financially quantifiable at farm level like some of the benefits relating to environmental protection are not included in this definition.

In this part of the interview I will ask you questions relating to the profitability of the agroforestry technologies that you practice".

Note to interviewer: Please refer only to those technologies which the respondent has indicated that he /she practices when asking questions 16, 17, 18, 19, 20, 21, 22 and 23

16. Are the technologies which you practice more or less financially profitable to you than your previous practices?

	more profitable	less profitable	If less profitable, why do you continue to practice them?
Faidherbia albida	________	________	____________________
trees in croplands	________	________	____________________
contour hedgerows	________	________	____________________
fodder banks	________	________	____________________
alley cropping	________	________	____________________
wood lots	________	________	____________________
trees on garden boundaries	________	________	____________________
trees on homesteads	________	________	____________________
improved fallows	________	________	____________________
relay cropping	________	________	____________________
living fences	________	________	____________________

17. What produce/ products are you getting from the woody species of the following agroforestry technologies? (check)

a) *Faidherbia albida*

fruit	______	firewood	______	charcoal	______
staking sticks	______	poles	______	livestock feed	______
medicines	______	pesticides	______	timber	______

others (specify) ____

____

trees in croplands

fruits ______ firewood ______ charcoal______

staking sticks _____ poles ______ livestock feed______

medicines ______ pesticides________ timber _____

other (specify) ____

____

b) Contour hedgerows

fruits _____ firewood _______ charcoal _______

staking sticks _____ poles _______ livestock feed _______

medicines ________ pesticides ________ timber ______

others (specify) ____

____

c) fodder banks

fruits ______ firewood _______ charcoal ______

stacking sticks _____ poles _______ livestock feed ______

medicines ______ pesticides ________ timber ______

others (specify) ____

____

d) alley cropping

fruits ______ firewood ______ charcoal _______

staking sticks _____ poles ______ livestock feed _____

medicines ______ pesticides _______ timber ______

others (specify) ____

____

e) wood lots

fruits ______ firewood ______ charcoal ______

stacking sticks ______ poles ______ livestock feed ______

medicines ______ pesticides ______ timber ______

others (specify) ______________________________

____

f) trees on garden boundaries

fruit ______ firewood ______ charcoal ______

staking sticks ______ poles ______ livestock feed ______

medicines ______ pesticides ______ timber ______

others (specify) ______________________________

____

g) trees on homesteads

fruits ______ firewood ______ charcoal ______

staking sticks ______ poles ______ livestock feed ______

medicines ______ pesticides ______ timber ______

others (specify) ______________________________

____

improved fallows

fruit ______ firewood ______ charcoal ______

staking sticks ______ poles ______ livestock feed ______

medicines ______ pesticides ______ timber ______

other (specify) ______________________________

____

relay cropping

fruit ________ firewood _______ charcoal _________

staking sticks ______ poles _____ livestock feed ______

medicines ______ pesticides _____ timber ______

other (specify) ____

____

living fences

fruits ________ firewood ______ charcoal _______

staking sticks _______ poles ______ livestock feed _______

medicines ______ pesticides ______ timber ________

others (specify) ____

____

18a. How close is the nearest market where you can sell the produce/products?

kilometers

fruit ________________________

firewood ________________________

charcoal ________________________

staking sticks ________________________

livestock feed ________________________

poles ________________________

timber ________________________

medicines ________________________

pesticides ________________________

others (specify) ________________________

18b. Do you sell the produce/products at the identified market? If not why?

	yes	no	if no why
fruit	________	________	________________________
firewood	________	________	________________________
charcoal	________	________	________________________
staking sticks	________	________	________________________
livestock feed	________	________	________________________
poles	________	________	________________________
timber	________	________	________________________
medicines	________	________	________________________
pesticides	________	________	________________________
others (specify)	________	________	________________________

18c. For the products which you sell at the identified market, are you satisfied with the prices offered?

	yes	no
fruit	________	________
firewood	________	________
charcoal	________	________
staking sticks	________	________
livestock feed	________	________
poles	________	________
timber	________	________
medicines	________	________
pesticides	________	________
others (specify)	________	________

18d. Do you sell your products through middlemen?

	yes	no
fruit	________	________
firewood	________	________
charcoal	________	________
staking sticks	________	________
livestock feed	________	________
poles	________	________
timber	________	________
medicines	________	________
pesticides	________	________
others (specify)	________	________

18e. If you sell through middlemen, are you satisfied with the prices you get from them?

	yes	no
fruit	________	________
firewood	________	________
charcoal	________	________
stacking sticks	________	________
livestock feeds	________	________
poles	________	________
timber	________	________
medicines	________	________
pesticides	________	________
others (specify)	________	________

Part E: Food productivity

Note to the interviewer: Read to the respondent. "Some agroforestry technologies have been reported to increase crop yields, through various processes like improvement of soil fertility and improvement of soil organic matter content. In fact implementation of agroforestry technologies has sometimes been promoted in order to increase crop yields and crop production.

In the following part of the interview, I will ask you questions relating your food productivity".

19. If you practice the following agroforestry technologies, have these practices helped you to increase or have they decreased your food crop yields?

	practice	increased yields	decreased yields	not sure
Faidherbia albida	____	________	________	________
trees in croplands	____	________	________	________
contour hedgerows	____	________	________	________
fodder banks	____	________	________	________
alley cropping	____	________	________	________
wood lots	____	________	________	________
trees on garden boundaries	____	________	________	________
trees on homesteads	____	________	________	________
improved fallows	____	________	________	________
relay cropping	____	________	________	________
living fences	____	________	________	________

Note to the interviewer: Please refer to only those technologies which resulted in decreased yields.

20. Why do you continue to practice the technologies when you are experiencing decreased yields of your food crops?

Faidherbia albida ______________________________

____

trees in cropland ______________________________

____

contour hedgerows ______________________________

____

fodder banks ______________________________

____

alley cropping ______________________________

____

wood lots ______________________________

____

trees on garden boundaries ______________________________

____

trees on homesteads ______________________________

____

improved fallows ______________________________

____

relay cropping ______________________________

____

living fences ______________________________

____

Part F: Control of soil erosion

Note to interviewer: Read the following to the respondent. "Some agroforestry technologies have been reported to be very effective in controlling soil erosion. In fact implementation of agroforestry technologies has in some cases been promoted in order to control soil erosion.

In this section of the interview I will ask you question relating to the control of soil erosion.

21. Do you experience soil erosion problems on your farm?

yes ______________

no ______________

not sure ______________

22. Which of the following agroforestry technologies did you implement for purposes of controlling soil erosion? (check)

Faidherbia albida ______________

trees in croplands ______________

contour hedgerows ______________

fodder banks ______________

alley cropping ______________

wood lots ______________

trees on garden boundaries ______________

trees on homesteads ______________

improved fallows ______________

relay cropping ______________

living fences ______________

23. Was soil erosion controlled by the use of the following agroforestry technologies?.

	yes	no	not sure
Faidherbia albida	________	________	________
trees in croplands	________	________	________
contour hedgerows	________	________	________
fodder banks	________	________	________
alley cropping	________	________	________
wood lots	________	________	________
trees on garden boundaries	________	________	________
trees on homesteads	________	________	________
improved fallows	________	________	________
relay cropping	________	________	________
living fences	________	________	________

Part G Fuelwood

Note to the interviewer: Read the following to the interviewer.. In some cases agroforestry technologies have been promoted in order to produce fuelwood (firewood and charcoal). In the following section of the interview, I will ask you questions relating to fuelwood.

24. Do you experience problems of fuelwood shortage?

yes ________

no ________

25. Which of the following agroforestry technologies did you implement for purposes of producing fuelwood?

	yes	no
Faidherbia albida	______	______
trees in croplands	______	______
contour hedgerows	______	______
fodder banks	______	______
alley cropping	______	______
wood lots	______	______
trees on garden boundaries	______	______
trees on homesteads	______	______
improved fallows	______	______
relay cropping	______	______
living fences	______	______

26. Were your problems of fuelwood shortage solved by the following agroforestry technologies?

	yes	no
Faidherbia albida	________	________
trees in croplands	________	________
contour hedgerows	________	________
fodder banks	________	________
alley cropping	________	________
wood lots	________	________
trees on garden boundaries	________	________
trees on homesteads	________	________
improved fallows	________	________
relay cropping	________	________
living fences	________	________

27. If you have other reasons why you practice agroforestry technologies apart from those mentioned above, please indicate them.

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