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FACTORS AFFECTING THE SURVIVAL OF AGROFORESTRY TREES IN MALAWI

Setrida Mlamba
Ministry of Agriculture, Irrigation and Water Development, Lilongwe District Development Office, Private Bag 36, Lilongwe, Malawi
setridamlamba@gmail.com

Supervisors
Thamar Melanie Heijstra
University of Iceland
thamar@hi.is

Edda Sigurdis Oddsdottir
Icelandic Forest Research
edda@skogur.is

ABSTRACT

The Ministry of Agriculture, Irrigation and Water Development, non-governmental organisations and donor-funded projects have been promoting tree planting in Malawi for several years. Despite these efforts, it is difficult to trace the out-planted seedlings after a year or more due to the low survival rate. Socio-economic research studies have only addressed factors affecting adoption of agroforestry among farmers and little is known about why the survival of planted seedlings is low. This study was conducted to understand the factors that affect the survival of agroforestry trees in Malawi. The study was carried out in the Lilongwe District. It is one of the many places in Malawi where agroforestry is being promoted. Data was collected from a sample of selected farmers through the administration of a questionnaire. The questionnaire comprised closed- and open-ended questions which were developed by the researcher based on personal knowledge of the field and work expertise. Farmer contact with the extension worker was found to have a significant positive correlation with the survival of agroforestry trees. Planting with the first rains, protecting the seedlings from livestock, and planting mature and healthy seedlings were found to be the main mechanisms the farmers used to improve the survival of trees. Destruction by livestock, attack by termites and dry spells were major challenges affecting the survival of the seedlings. The need for formulation of by-laws on animals to control damage and encouragement of farmers to plant trees with the first rains to reduce the loss caused by the dry spell were some of the study

recommendations. Considering that farmer contact with the extension worker had a positive relationship with the survival of agroforestry trees it is important the government recruits more extension staff and provides mobility to increase contact with farmers. The study needs to be replicated in other areas as farmers in other areas operate under different socio-economic and ecological conditions.

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1. INTRODUCTION

Since the dawn of agriculture, humans started growing crops and domesticating animals in many areas. This has resulted in land degradation. Land degradation is the long-term reduction in the value of the biophysical environment of the land, leading to a lowering or loss of its use in terms of expected functions and level of productivity that support development and society. It is viewed as any change or disturbance to the land perceived to be harmful or undesirable. Land degradation is a global problem largely related to agricultural use. Different research writers have provided different information on land degradation depending on the area of their focus.

Land degradation through the removal of vegetative cover results in soil and soil nutrient loss (Tilman et al. 2002). Soil fertility decline is a good example. The UNCCD (2015) indicates that on a global scale, more than half (52%) of all fertile land is heavily exploited due to the food market, adoption of poor farming techniques and the degree of land change from natural forests to agricultural land. The UNCCD (2015) projected that a 12% decline in food production may result in a 30% increase in world food prices if soils are not well managed in the next 25 years. Due to the central role that land plays in human survival and development, it is imperative that measures are put in place to reverse the present status quo.

The economy of Malawi depends on agriculture, which employs 64.1% of the workforce, and about 80% of the economy contributes to foreign exchange earnings (Malawi Government 2016). However, crop production in Malawi depends mainly on rainfall and inadequate rainfall therefore makes the crop yield either low or stagnant (IMF 2007). Maize is the main staple food crop grown in Malawi; it is estimated to cover 70% of the arable land and account for 90% of the total agricultural area, combining all cereals together (Sauer & Tchale 2006). The other crops that the country grows besides maize include millet, rice, cassava, sorghum, tobacco, coffee, sugarcane, and pigeon peas, among others (Mloza-Banda & Nanthambwe 2010).

The environmental problems that the agricultural sector in Malawi is facing include soil infertility, soil erosion, low soil organic carbon, deforestation and water shortage due to inadequate rainfall (Munthali et al. 2008). These problems are partly caused by the planting methods where planting ridges are made every year in the field (Mloza-Banda & Nanthambwe 2010). This method of land preparation increases erosion, runoff and general soil degradation. Tillage of the soil speeds up oxidation of soil organic matter which reduces its ability to bind the soil and increases raindrop impact and hence susceptibility to soil erosion. Tillage also disturbs aeration and the beneficial macro- and microbial activity (Bunderson et al. 2007). Runoff carries off both macro- and micro plant elements and hence reduces crop yields (Mloza-Banda & Nanthambwe 2010). The water that accumulates between ridges moves downwards into the soil, taking the plant nutrients with it (Wiyo et al. 2000).

The practice of setting fire to crop remains as part of land preparation is widely used in Malawi and other African countries, but it decreases plant nutrient availability through the destruction of soil organic matter (Makumba et al. 2007). The practise of burning residual crops is not understandable because most farmers in Malawi complain about soil infertility due to lack of animal manure (Snapp et al. 2002). To counteract the environmental challenges that agriculture is facing, the Ministry of Agriculture through the Department of Land Resources Conservation and other developmental partners have been promoting soil and water conservation and soil fertility improvement practices, including agroforestry (Thangata & Alavalapati 2003). Agroforestry is the combination of two different practices, agriculture and forestry, where

farming is carried out together with woody plants in a defined pattern (FAO 2015). Agroforestry is a cost-effective practice and sometimes substitutes for inorganic fertilizers, if well targeted (Kaczan et al. 2013).

Studies from different researchers have indicated that the growing of trees with crops may help to solve some of the environmental problems the country is facing (Kwesiga et al. 2003). Planting of agroforestry trees has shown a great benefit to smallholder farmers, as trees provide soil fertility when the tree leaves offer shade and decompose (Meijer et al. 2015). The practice of planting trees, especially evergreen farming and planting of crops without tilling the land, has been shown to be an effective conservation measure (Mwase et al. 2015).

Ajayi and Catacutan (2012) identified relay cropping, mixed cropping and improved tree fallow as the most low-cost agroforestry technology for soil fertility improvement. In addition to increasing soil nutrients and improving land productivity, agroforestry also helps to suppress weeds, retain moisture in the soils, improve soil structure and add organic carbon to the soil (Ajayi et al. 2008). Agroforestry is a source of fuelwood and non-timber products, for instance fodder, fibre, medicine and fruits (Ajayi et al. 2008). In addition to the already stated benefits, agroforestry doesn't demand extensive areas of land as trees can be planted together with crops in the field or along field boundaries and even around the farmer's houses (Kiptot et al. 2013).

The Ministry of Agriculture, Irrigation and Water Development and non-governmental organisations have been advocating donor-funded projects and promoting tree planting for a number of years. Despite these efforts, it is difficult to trace the out-planted agroforestry seedlings after a year or more, due to a low survival rate. Socio-economic research studies have only addressed factors affecting adoption of agroforestry among farmers and little is known about why survival of out-planted seedlings is low. This study, therefore, was conducted to understand the factors that affect the survival of agroforestry trees in Malawi.

1.1 Objectives of the study

The proposed research study had the following objectives:

1. To determine factors affecting the survival of agroforestry trees in the Lilongwe district.
2. To investigate challenges in the application of agroforestry practice and draw recommendations that may help in the implementation of the practice in the future.

The key questions the study attempted to address were:

1. What factors are critical for the survival of agroforestry trees in the study area?
    - Do the socio-economic characteristics of a farmer have any effects on the survival of agroforestry trees?
    - What is the relation between the extension worker visiting the farmer and the survival of agroforestry trees?
2. What challenges are the farmers facing while implementing agroforestry?
3. What measures can be used to enhance the survival of agroforestry trees?

1.2 Importance of the research to Malawi

This study is essential to Malawi as a country since its economy is agro-based and it is estimated that 80% of it is dominated by smallholder farmers (IMF 2007). Most of the smallholder farmers

are resource poor and are being supported by the government through the Farm Input Subsidy Programme (FISP), which does not cover everybody. Agroforestry provides an alternative to inorganic fertilizer as some studies have shown a yield increase of 100% over plots which were not applied with any fertilizer (Kaczan et al. 2013). Furthermore, agroforestry is important in that it provides firewood and Malawi is heavily dependent on firewood as a source of energy since only 11% of the households are connected to the power grid (World Bank 2018). The proposed study was designed to find factors that affect the survival of agroforestry trees and enhance adoption of the practice and reduce the pressure on natural forests.

2. RESEARCH AND METHODOLOGY

2.1 Study area

The study was carried out in the Lilongwe District (Fig. 1) which is under the Lilongwe Agriculture Development Division. The Lilongwe District has an area of 6,159 sq. km. representing 6.5% of Malawi's total land area, with a total population of 1,905,282 where 946,123 are males and 959,159 female (NSO 2008). According to the soil map of Malawi (Lowole 1965), the common soil type of the Lilongwe District is ferruginous soils, which are red in colour. These soils are good for agriculture since they are deep and well drained due to good soil structure (Government of Malawi 2002).

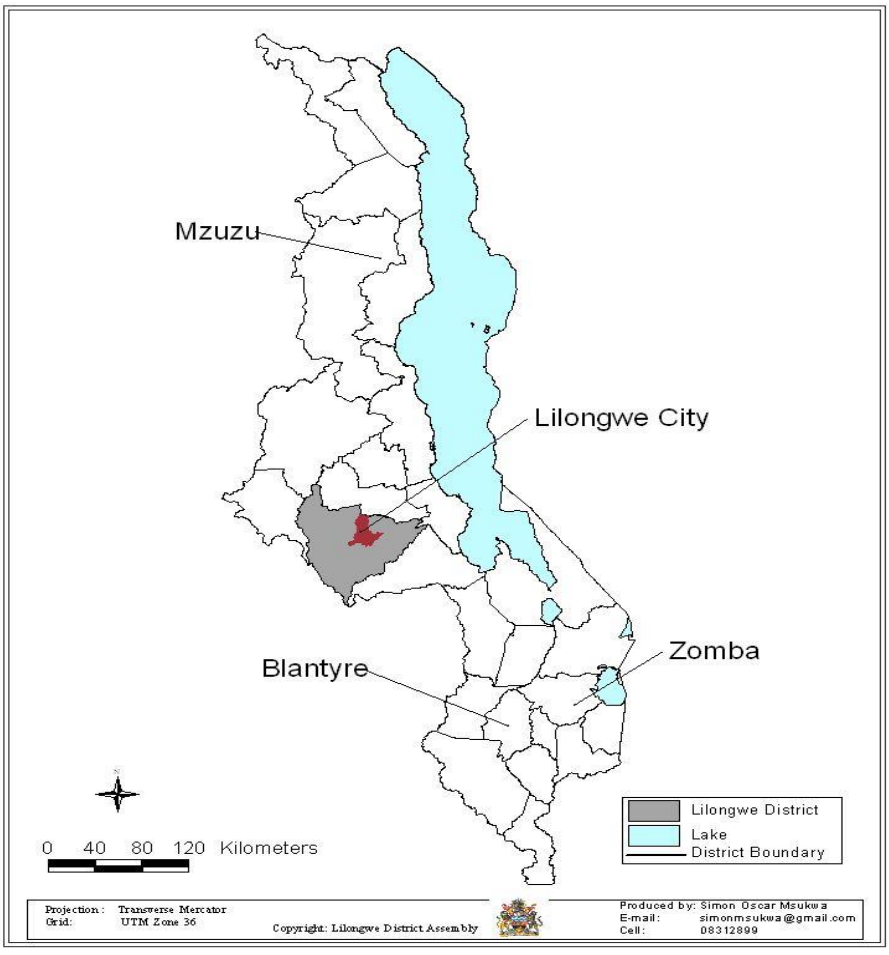

Figure 1. Map showing the location of the Lilongwe District in Malawi (Lilongwe District Council Socio-Economic Profile: 2017/2022, Unpublished).

The district was chosen because it is one of the areas where agroforestry is being implemented. For agriculture purposes, the district is divided into two District Agricultural Offices, namely Lilongwe East and Lilongwe West, which are further divided into seven and twelve Extension Planning Areas, respectively (Fig. 2). Two Extension Planning Areas, shaded in Figure 2, were selected as study sites.

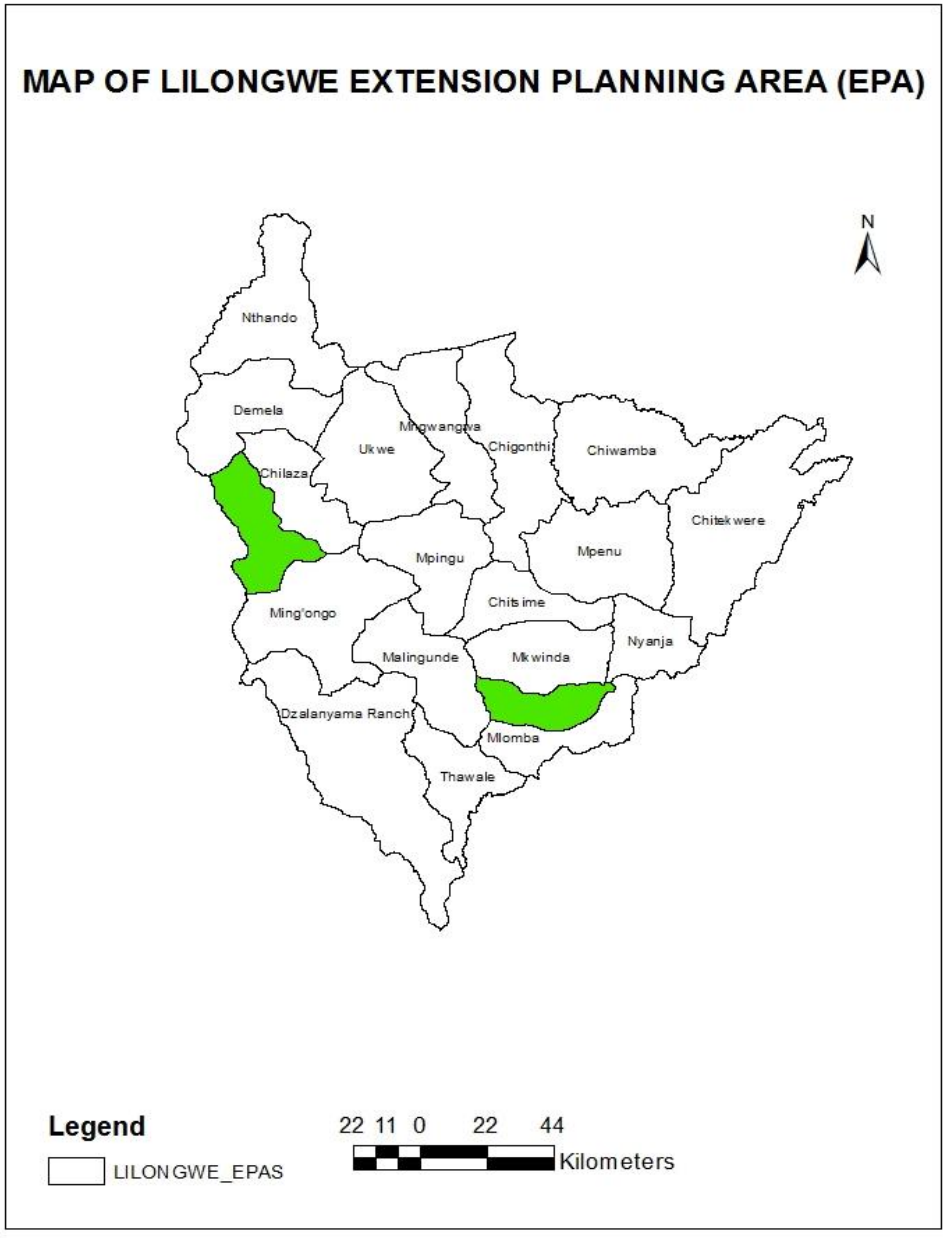

Figure 2. Map showing Lilongwe Extension Planning Areas (EPAs).

2.2 Data collection

The research study was conducted in the two Extension Planning Areas (EPAs) of the Lilongwe Agriculture Development Division, chosen for their proximity to the office for easy supervision. Interviews were conducted in early March 2018. The data was collected by six research assistants (Agriculture Extension Development Officers) in their respective EPAs, three males and three females, who administered the questionnaire by interviewing the respondents in the

local language (Chichewa). All the farmers targeted were interviewed, which gave the study response rate of 100%.

The questionnaire had 27 structured questions (Appendix I) which were developed based on personal knowledge of the field and work expertise, and was in pen and paper format. The survey looked at factors that are critical for the survival of agroforestry trees, the major problems that farmers encounter when implementing agroforestry technologies, and was aimed at finding out the available opportunities that may enhance agroforestry practices**.**

To preserve confidentiality, the original questionnaires were locked in a locker pending destruction after the research was finished.

2.3 Sampling procedure for the study

The respondents were selected from two Extension Planning Areas (EPA) within the Lilongwe West District Agriculture Office, namely Mitundu EPA, with 28,344 farming households of which 1,740 households (772 males and 968 females) were participating in agroforestry, and Chileka EPA, with a total of 23,432 farming households of which 548 households (384 males and 164 females) were participating in agroforestry. Targeted farmers were selected from each village, using a list which was provided by the Extension Planning Area office. The lists indicated farmers who have had a high survival rate of agroforestry seedlings and those who have had a low survival rate of agroforestry seedlings. Farmers with a tree survival of 50% and above were considered to be high, whereas those with a survival of less than 50% were regarded as low. A total of 30 farmers were in each group. A systematic random sampling method was used on both lists to come up with the sampled farmers. The total number of farmers with a high survival of agroforestry was divided by 30. The same process was used to determine the sampling interval for farmers with low tree survival. The sampling intervals for farmers with a high survival of agroforestry trees and those with low tree survival were 24 and 34, respectively, in Mitundu, and 5 and 13 in Chileka EPA. The study involved a total of 60 farmers who have been involved in agroforestry tree planting; 35 of them were ordinary citizens, 10 were village heads, 6 were religious leaders, 3 were extension workers, 4 were lead farmers, and 2 were community chairpersons.

2.4 Data analysis

Descriptive statistics in the form of frequencies and percentages were used when analysing, presenting and interpreting the data as it was coded and fed into the Statistical Package for Social Scientists (SPSS) manually for statistical analysis and presentation. Phi was used in relation to binary categories, and Cramer's V for all other categories. Results between 0 – 0.1 indicate a weak relation, between 0.11 – 0.3 moderate, and above 0.3 a strong relationship. The chi-square test was used for determination of the relationship between variables on factors affecting the survival of agroforestry seedlings. The chi-square test tells us if we can generalise the findings to a population or whether the findings only apply to the sample. All chi-square tests that are published in this report depend on chi-square assumptions regarding the sample size and independence. The study used a p-value of 0.05 for significance.

3. RESULTS AND DISCUSSION

3.1 Demographic and socio-economic data

3.1.1 Gender of the household head

Of the 60 farmers who were practising in agroforestry tree planting 77% of the households were headed by a male, while the remainder were headed by a female (Table 1). The study found no correlation between gender of the household head and survival of agroforestry trees at the 5% level of significance. However, 64% of the female-headed households had a higher survival of agroforestry trees compared to 46% of the male-headed households. Although there were no significant differences between genders, this indicates that women are at least not less capable than men. The sample size of the study was small, and the size can therefore contribute to a result of no significance.

The phi value was 0.16, indicating that there is a weak relation between the two variables of gender and survival rate.

Table 1. χ^2 analysis of gender of the household head and survival of agroforestry trees.

Gender of the household head	**survival rate**			
	High	**Low**	**Total**	**P-value**
Men	21 (46%)	25 (54%)	46 (100%)	0.222
Women	9 (64%)	5 (36%)	14 (100%)	

3.1.2 Age of household head

Seventy-five per cent of the household heads were older than 40 (Table 2). Even though the results from Table 2 show elderly people practicing agroforestry tree planting, there was no scientifically significant correlation found between age level and tree survival as the p-value was above the 0.05 level. This agrees with study findings done by K'Oyooh (2010) in Kenya which found there was no significant relationship between the age of the household head and the planting of agroforestry trees.

Table 2. χ^2 analysis of age categories of household head and survival of agroforestry trees.

	High survival	**Low survival**	**% of the total sample size**	**P-value**
Age category	**Frequency**	**Frequency**		
20-29	3 (100%)	0 (0%)	3 (5%)	0.524
30-39	6 (50%)	6 (50%)	12 (20%)	
40-49	6 (50%)	6 (50%)	12 (20%)	
50-59	9 (47%)	10 (53%)	19 (32%)	
>60	6 (43%)	8 (57%)	14 (23%)	
Total	30 (50%)	30 (50%)	60 (100%)	

3.1.3 Marital status

The majority of the household heads were married (83%), 10% were widowed and 7% divorced. The study found no statistically significant correlation between the marital status of the household head and the survival of agroforestry trees as the p-value was above 0.05 (Table 3).

Table 3. χ^2 analysis of the marital status of the household head and survival of agroforestry trees.

Marital status	High survival	Low survival	Total	% of the total sample size	P-Value
	Frequency	Frequency			
Married	26 (52%)	24 (48%)	50 (100%)	83	0.093
Widowed	4 (67%)	2 (33%)	6 (100%)	10	
Divorced	0 (0%)	4 (100%)	4 (100%)	7	
Total	30 (50%)	30 (50%)	60 (100%)	100	

3.1.4 Size of the Household

The research study showed that 60% of the respondents involved had more than 5 members, which is the national average household size (NSO 2011). No statistically significant difference was found between household size and agroforestry tree survival as the p-value was above the 0.05 level (Table 4).

Table 4. χ^2 analysis of household size and survival of agroforestry trees.

Household size	High survival	Low survival	Total	% of the total sample size	P-Value
	Frequency	Frequency			
1-5	12 (50%)	12 (50%)	24 (100%)	40	0.67
6-10	16 (53%)	14 (47%)	30 (100%)	50	
>10	2 (33%)	4 (67%)	6 (100%)	10	
Total	30 (50%)	30 (50%)	60 (100%)	100	

3.1.5 Level of education of the household head

Formal education is one way an individual can acquire the capacity to access knowledge and skills pertaining to agroforestry technologies through different extension services. In the sample, the majority of the respondents had at least a primary education (57%) while 17% (n = 10) did not have any formal education. From Table 5 it appears that a secondary or higher education did have a positive effect on survival rate as 69% of the participants with the highest education were in the category of the 50% or higher agroforestry survival rate. However, the statistical correlation was not significant at the 0.05 level between educational level and tree survival, which means that the findings cannot be generalised to Malawi as a whole (Table 5).

Table 5. χ^2 analysis of the level of education and survival of agroforestry trees.

Level of education	High survival rate	Low survival rate	Total	% of the total sample size	P-Value
	Frequency	Frequency			
No formal education	5 (50%)	5 (50%)	10 (100%)	17	0.191
Primary	14 (41%)	20 (59%)	34 (100%)	57	
Secondary and more education	11 (69%)	5 (31%)	16 (100%)	26	
Total	30 (50%)	30 (50%)	60 (100%)	100	

3.2 Agroforestry and influence of the farmer group

3.2.1 Farmer group

From the findings, it appears that almost all farmers were part of a farmer group (n = 58). The remaining two farmers gave lack of interest and failure to pay a membership fee as the reasons for not belonging to a farmer group.

The sampled farmers that were interviewed belonged to more than one group, which included village savings and loans, irrigation, livestock, agroforestry, soil and water conservation, conservation agriculture and tobacco. As can be seen in Table 6, 31% of the respondents were members of the livestock group. This could be due to the donor and government-funded projects that were implemented in the district that promoted ownership and handling of livestock. The association of farmers with the group they belong to seems to depend on the support they receive, which includes financing, inputs, equipment, and extension services, among others.

Table 6. Farmer Group Membership by type.

Group type	**Frequency of farmers**
Livestock	18 (31%)
Irrigation	15 (26%)
Soil and water conservation	12 (20%)
Agroforestry	9 (16%)
Conservation and Tobacco	9 (16%)
Village savings and loans	8 (13%)

3.2.2 Period of planting trees

In this study, 75% of the respondents were found to have been practising agroforestry for more than two years (Table 7). However, there was no correlation between the length of time a household had been practising agroforestry and the survival of agroforestry trees as the p-value was above 0.05**.**

Table 7. χ^2 analysis of the period of practising agroforestry and survival of agroforestry trees.

Period of planting trees	**% of the total sample size**	**High survival Frequency**	**Low survival Frequency**	**Total**	P-Value
One year	12	3 (43%)	4 (57%)	7 (100%)	0.369
Two years	13	2 (25%)	6 (75%)	8 (100%)	
More than two years	75	25 (56%)	20 (44%)	45 (100%)	
Total	100	30 (50%)	30 (50%)	60 (100%)	

3.2.3 Farmer contacts with Extension worker

All the sampled respondents indicated that an extension worker from the Ministry of Agriculture was available in the area. When asked how many times does an extension worker get visits per month, 93% of the farmers that had a high survival rate of agroforestry trees

responded that they were visited more than two times per month (Table 8). Only 7% of the farmers with a high survival rate indicated that the extension worker visited once a month or less. This is an encouraging discovery considering that extension workers usually make a maximum of two visits to a farmer group. The first visit is for training while the second one is for follow-up. On the other hand, 70% of farmers with a low survival rate indicated that the extension worker visited more often than twice a month. The results showed that there was a relationship between two variables as the p-value (0.027) was smaller than 0.05 at the 95% confidence interval. The phi analysis definitely showed that there was a strong relationship between the two variables as the phi value was 0.3. The results agreed with both Adesina et al. (2001) and Thangata and Alavalapati (2003) who found that both younger farmers and larger households were able to adopt the practice of agroforestry technologies because they came into the contact with the extension services through the extension workers.

Table 8. χ^2 analysis of farmer contacts with extension worker versus survival of agroforestry trees.

No. of visits	**High Survival Rate**		**Low Survival Rate**		**Total**	**df**	**P-Value**
	Frequency	**%**	**Frequency**	**%**			
Once a month or less	2	7	9	30	11	1	0.02
Twice a month or more	28	93	21	70	49		
Total	30	100	30	100	60		

When asked where they accessed the knowledge and skills on agroforestry tree planting, 95% of the respondents mentioned extension workers as the ones who imparted knowledge and skills to them (Table 9). This is not surprising as the Extension Planning Areas (EPAs) where the study was conducted are close to the capital city; the situation may not be the same with EPAs far away from major business centres.

Table 9. Source of knowledge and skills on agroforestry tree planting.

Source of Knowledge	**Frequency of farmers**
Extension worker	57 (95%)
Village tree planting	6 (10%)
Others e.g. students from Bunda College - research	4 (7%)
Field days	2 (3%)
Radio	2 (3%)

3.2.4 Farmer training

The study found that 97% of farmers with a high survival rate of agroforestry trees and 87% of those that had a low survival rate of trees had ever been trained in agroforestry (Table 10). The training mainly covered four areas, namely: seed treatment (17%), post-planting management (13%), nursery establishment (67%) and planting (76%). The results showed no significant differences between the farmer training and tree survival as the p-value was bigger (0.177) at the 5% level of confidence (Table 10).

Table 10. Level of farmer training in agroforestry technology and survival of agroforestry trees.

	High survival rate		Low survival rate		
Response	**Frequency**	**%**	**Frequency**	**%**	**P-Value**
Attended training	29	97	26	87	0.177
Never attended training	1	3	4	13	
Total	30	100	30	100	

3.3 Agroforestry: The benefits and challenges

3.3.1 Reasons for practising agroforestry

The reasons why farmers practised agroforestry tree planting were investigated. The majority of the households (96%) indicated that they were practising agroforestry to ease access to firewood (Table 11). It was not surprising to see many farmers mentioning this as one of the reasons for practising agroforestry as firewood still remains the major source of energy in Malawi (Jumbe &Angelsen 2006). The other reasons for practising agroforestry included easy access to poles (63%), reduced soil erosion (48%), source of income (48%), provision of shade and windbreak (27%), fresh air (27%), and soil fertility improvement (5%).

Table 11. Farmer's motive for practising agroforestry.

Reasons	**Frequency of farmers**
Easy access to firewood	54 (96%)
Easy access to poles	35 (63%)
Reduced soil erosion	27 (48%)
Source of income after the sale	27 (48%)
Availability of shade and windbreak	15 (27%)
Fresh air	15 (27%)
Beautifies the homestead	8 (14%)
Soil fertility improvement	3 (5%)

3.3.2 Challenges faced during implementation of agroforestry

Somewhat more than half of the respondents (55%) mentioned destruction by animals as one of the challenges that the farmers practising agroforestry face (Table 12). This could be due to the fact that animals, especially goats, are left to roam freely during the dry season. Other notable challenges mentioned by the respondents in the implementation of agroforestry included termites (27%), scarcity of water (22%) and burning of seedlings (10%).

Table 12. Most common challenges faced by farmers when implementing agroforestry.

Challenges	**Frequency of Farmers**
Destruction by animals	33 (55%)
Others e.g. termites	16 (27%)
Scarcity of water	13 (22%)
Lack of inputs	10 (17%)

Burning of seedlings	6 (10%)

3.3.3 Challenges contributing to the low survival of agroforestry trees

The majority of households with a low survival rate of agroforestry trees (57%) mentioned destruction by termites as the reason for low survival. A total of 13 respondents (43%) indicated that dry spells prior to or immediately after planting seedlings was the cause of low survival. Livestock damage and late planting of seedlings were mentioned by 40% of the respondents. Transplanting of immature or damaged seedlings, human damage, bushfires and pest attacks were other challenges mentioned as causes of low survival of agroforestry trees (Table 13)

Table 13. Most common challenges contributing to the low survival of agroforestry trees.

Challenges	**Frequency of farmers**
Termites	17 (57%)
Dry spells prior to and immediately after planting	13 (43%)
Livestock damage	12 (40%)
Late planting of seedlings	12 (40%)
Transplanting of immature or damaged seedlings	7 (23%)
Human damage	6 (20%)
Bushfires	6 (20%)
Pest attacks	3 (10%)
Poor sitting of woodlots	2 (7%)

3.3.4 Factors that contribute to the high survival of agroforestry trees

The greater percentage (87%) of the respondents with a high survival rate of agroforestry trees mentioned planting with the first rains as the reason for high survival (Table 14). Protecting the seedlings from livestock, and planting healthy and mature seedlings were mentioned by 47% of the respondents. The other reasons leading up to a high survival of agroforestry seedlings were protecting the seedlings from fire and dry planting of the seeds.

Table 14. Most common factors contributing to the high survival of agroforestry trees.

Strategies	**Frequency of farmers**
Planting with the first rains	26 (87%)
Protecting the seedlings from livestock	14 (47%)
Planting healthy and mature seedlings	14 (47%)
Protecting the seedlings from fire	9 (30%)
Dry planting of the seeds	1 (1%)

3.3.5 Measures to enhance agroforestry survival

Farmers' opinions were sought on measures which need to be followed to enhance the survival of agroforestry trees. Slightly fewer than 50% of the respondents (Table 15) indicated that planting with the first rains will enable the planted seedlings to grow without any difficulties.

A total of 44% of the respondents mentioned that enacting by-laws to control livestock and human damage could enhance survival of trees. Protecting the seedlings with firebreaks, planting healthy and mature seedlings and proper management of seedlings were suggested as further ways that would increase survival of agroforestry trees.

Table 15: Most common measures to enhance agroforestry survival.

Strategies	**Frequency of farmers**
Planting with first rains	29 (48%)
Setting by-laws on livestock and human damage	25 (44%)
Proper management of seedlings	14 (25%)
Use of chemicals to prevent termites	13 (23%)
Making fire breaks	5 (9%)
Planting healthy seedlings	4 (7%)
Making recommended planting holes early	2 (4%)

4. CONCLUSION AND RECOMMENDATIONS

This section gives a summary of factors and challenges affecting the survival of agroforestry trees in Malawi and proposes measures to be undertaken to enhance the high survival of agroforestry trees.

4.1 Conclusions

The objective of this research was first to determine factors affecting the survival of agroforestry trees in the Lilongwe District in Malawi. This has been an unresearched area so far, and it is important to get a better insight into these factors in order to come up with practical strategies to enhance survival of trees. From the study, it was found that the majority of the respondents had knowledge of the benefits of agroforestry trees. The study found no correlation between awareness and survival of agroforestry trees, as both farmers with a high survival rate and farmers with a low survival rate had obtained this knowledge. Socioeconomic and demographic factors, such as educational level, the age of the household head, household size, and marital status were also not found to have any correlation with the survival of agroforestry trees. This was surprising and contradicted to the researcher's expectations because farmers with high literacy were expected to have better knowledge and skills in management of agroforestry trees, older household heads were expected to have had experience in management of trees and also to attach more value to trees as over 90% of the households use wood as a source of energy, and larger households were expected to provide labour for the management of trees.

Being part of a farmers' group was also expected to influence the tree survival rate of the farmers. However, it turned out that both categories of farmers (having high survival and low survival) received training in agroforestry and belonged to at least one farmers' group but these were also found not to have any impact on the survival of trees. This means that there is more to the survival of agroforestry than what is generally believed by researchers. It is generally believed that farmers who belong to a farmers' group easily learn from one another and stand a

better chance to be reached with extension messages and this may result in the adoption of good agricultural practices. However, farmer contact with the extension worker was found to have a significant correlation with the survival of agroforestry trees. That is to say, farmers who engage more with the extension worker are more likely to get timely advice on the management of trees such as timely transplanting of the seedlings and protecting the seedlings from fire and livestock. The findings are so convincing that it is recommended that the extension workers make a maximum of two visits to a farmer group as the results showed that the majority of the extension workers are willing to do more than what is recommended. The first visit is for training whereas the second one for follow-up.

The second objective of the study was to investigate the challenges in the application of agroforestry practice. Destruction by livestock, late planting of seedlings, attacks by termites, and dry spells just before and soon after out-planting of the seedlings have negatively affected the survival of the agroforestry seedlings. It is a common practice in Malawi to allow livestock to roam free on the range during the dry season and this may lead to the destruction of trees. Farmers tend to prioritise food crops over trees and this leads to the late planting of the seedlings and the trees are not well established by the end of the rainy season. Respondents indicated that unreliability of rainfall due to climate change was another challenge affecting the survival of agroforestry trees as dry spells would set in as farmers are preparing to plant seedlings from the nursery or soon after planting. Planting with the first rains, protecting the seedlings from livestock and fire, and planting of mature and healthy seedlings were the measures being put in place by farmers to enhance survival of seedlings; note that this was not the case with farmers with low tree survival.

The third and final objective of the study was to draw recommendations that may help in the implementation of the practice in the future. These are discussed in the next and final section of the report.

4.2 Recommendations

- Considering that farmer contact with the extension worker had a positive relationship with the survival of agroforestry trees, it is important that the government recruits more extension staff and provides mobility to increase contact with the smallholder farmers.

- From the study's results it has been noted that farmers are facing challenges, among which are livestock damage, dry spells just before and soon after planting, and late planting of seedlings. There is a need to enact effective by-laws, as has been suggested by the farmers, so that animals can be controlled.

- Farmers should be encouraged to plant the trees with the first rains to avoid the damage caused by a dry spell or scarcity of water and also the extension workers should intensify the training on agroforestry technologies while emphasising the proper management of seedlings, both in the nursery and on fields so as to enhance the survival of trees and sustainability.

- Since the study was limited in sample size and only conducted in Lilongwe, it is imperative to expand the study to other areas as farmers operate under different ecological conditions in areas with high rainfall or areas with a long rainfall season. It is also important to study the effects of different planting methodologies on tree survival.

Finally, it is important to manage the out-planted agroforestry trees in order to improve both the livelihood at the household level and the environment.

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APPENDIX I. FACTORS AFFECTING SURVIVAL OF AGROFORESTRY TREES IN LILONGWE DISTRICT HOUSEHOLD QUESTIONAIRE

Start Time_____

01. District Name: _____

02. EPA Name:_____

03. T/A: _____

04. GVH: _____

05. Village: _____

06. Questionnaire Number _____

07. Enumerator Name:_____

08. Date of Interview: _____

09. Name of Household Head:_____

10. Sex of the household Head_____

11. Name of Respondent_____

INTRODUCTION:

My name is……. I am an extension worker who has been sent by the District Land Resources Conservation Officer to carry out a survey on agroforestry trees in this area and your household has been chosen to participate in the survey. The aim of the survey is to know more about the implementation of the agroforestry activities in this area and I also seek your own opinion on the implementation of the activity. The duration of our conversation will probably be 40 minutes. What will transpire here will be treated with confidentiality. Are you willing to take part in the survey? (Yes/No)

Dzina langa ndine …… ine ndine mlangizi wa boma ndipo ndatumidwa ndi alangizi akulu owona za nthaka kudzapanga kafukufuku wa ntchito zodzala mitingo yobwezeretsa chonde mmudzi muno. Ndipo khomo lanu lino lasankhidwa kutenga nawo mbali mukafukufukuyu. Ndili ndi mafunso amene ndikufuna kukufunsani. Cholinga cha kafukufuku ameneyu ndi kufuna kudziwa mene ntchito yodzala mitengo ikuyendera, komanso momwe inuyo mukuwonera ntchitoyi. Kucheza kwathu kutitengela pafupifupi mphindi…….. Zomwe titakambilane pakhomo pano zikhala zachinsinsi.
Kodi muli okonzeka kutenga nawo mbali mukafukufuku ameneyu? (EYA/AYI)

SECTION A: HOUSEHOLD HEAD CHARACTERISTICS

A1	Relationship of respondent to household head *Ubale wa inu ndi oyankha mafunso ndimutu wa banka lino ndi otani?*		*1= self 2=spouse 3=child 4=other*
A2	Gender of respondent *Oyankha mafunso ndi wa mwamuna kapena wa nkazi?*		*1= male 2= female*
A3	Age of household head *Zaka za mutu wa banja lino ndi zingati?*		1= <20; 2 = 20-29 yrs; 3 = 30-39; 4 = 40-49; 5 = 50-59; 6 = 60; and above
A4	Marital status of household head *Mutu wa banja lino ndi okwatira/okwatiwa?*		*1=married; 2=widowed; 3=divorced; 4=single*
A5	Educational level of household head *Mutu wa banja sukulu analekeza kalasi yanji?*		*0=illiterate;1= Primary;2= secondary, 3=tertiary;4=other specify*
A6	Household size ***(total)*** *Khomo lino lili ndi anathu angati?*		1 = 1-5; 2= 6-10; 3 = 11 and above
A7	Position of household head in the community ***(circle all that apply)*** *Mutu wa banja lino ali ndi udindo wina uli onse mudzi muno?*		*1=ordinary citizen 2= Village head 3=religious leader 4=teacher (primary or secondary);5=health worker 6=extension worker; 7=other(specify)*

SECTION B: INVOLVEMENT IN TREE PLANTING

B1	Do you belong to any farmer group? *Pali pa gulu lililonse lopanga za ulimi*	Yes……..1 No……2	
B2	If yes in question B1, which group? *Ngalti muli pagulu la zaulimi, gulu lake mumapanga chani*	Irrigation group……1 Livestock group……2 Soil and water conservation group……3 Agroforestry group……4 Village savings and loans……..5 [5] Others (Specify)_____	

B3	If no in B1, why don't you belong to any farmer group? *Ngati simuli pagulu, chifukwa chiyani simuli pagulu*	Not interested…….1 There is no farmer group……2 The group disbanded ……3 Can't afford membership fee……..4 Others (specify) _____	
B4	Do you have an extension worker in this area? *Muli ndi mulangizi wa zaulimi mu dela lino?*	Yes…….1 No……..2	
B5	If yes to B4, which organization does the extension belong? *Ngati mulangizi alipo, amachokera ku bungwe liti?*	Min of Agriculture…….1 NGO……2 Farmer group …….3 Others (specify) _____	
B6	How frequent does an extension worker visit you in a month? *Kodi mulangizi amabwera kangati kuno pamwezi?*	Doesn't visit ……..1 Once a month ……2 Twice a month ……3 More than twice a month……...4	
B7	Have you ever been trained in agroforestry? *Kodi munaphuzitsidwapo za mitengo yobwezeretsa chonde?*	Yes…….1 No……..2	
B8	If yes to question B7, What were the topics covered? *Ngati munaphuzitsidwapo, munaphuzira chiyani?*	Seed treatment …….1 Post-panting management……2 Nursery establishment ……..3 Planting…….4 Others (specify)_____	
B9	Does your household plant agroforestry trees of its own? *Kodi khomo lino mumadzala mitengo yobwezeretsa chonde panokha?*	Yes……..1 No but for the village/ community....……..2 No it doesn't……3	
B10	If yes on B1, for how long have you been planting trees? *Mwakhala mukudzala mitengo kwa zaka zingati?*	One year.....1 Two years.....2 More than 2 years……..….....3	
B11	How many from your household participate in tree planting activities? *Ndi angati khomo lino amene amatenga nawo mbali pa ntchito yodzala mitengo?*	Males ( ) Females ( )	
B12	How many trees do you have so far?	Less than 100……..…1 100-500…….….2 501-1000……..…...3 More than 1000……..…4	

	Pakali pano muli ndi mitengo ingati?		
B13	From where did you first acquire knowledge and skills in tree planting? *Ndikuti koyamba kumene munapeza upangili wodzala mitengo?*	Involvement in village tree planting…...1 Field days & tree planting launches.....2 Extension Worker.....3 Farmer to Farmer.....4 Radio.....5 Pamphlets.....6 Newspaper…….....7 Other Sources.....8	
B14	What drove/ inspired you to start planting trees? *Ndichani chomwe chinakukopani kuti muyambe kudzala mitengo?* *(Multiple responses possible. Please Probe)*	Long distances travelled to fetch firewood and poles for tobacco curing…..…….1 Desire to have own trees…….....2 The shade, wind break and beauty brought about by trees…….……..…...3 As a source of income after sales……....4 The erosion of soil due to lack of cover….5 To breath fresh air from trees…….……6 To improve soil fertility……..7 Other specify…….……...……...8	
B15	From where did you get assistance to plant the trees you have? *Kuti mudzale mitengo imeneyi thandizo munalipeza kuti?)*	Ministry of Agriculture……1 Forestry department (Govt)……..…..2 NGOs……...3 None……...4	
B16	What type of assistance did you get from the above mentioned sources? *Ndi thandizo lanji Lomwe munapeza kuchokera ku….* *Indicate type of assistance against the source code from B7*	source code / Type of assistance [ ] / [ ] [ ] / [ ] [ ] / [ ]	
B17	For how long have you been receiving such support *Mwakhala mukulandila thandizo limeneli kwa nthawi yayitali bwanji*	One year.....1 Two years.....2 More than 2 years……..…….....3	
B18	How do you intend to proceed with the tree planting activities after support phases out?	Use the recycled tubes and locally sourced seeds…….1 Wait for support from other sources…….2 Will not continue due of lack of support….3 Others, specify…….….4	

	Ntchito yodzala mitengo mudzapitiliza bwanji ngati thandizo lomwe mumalandira litatha akadzachoka?					
B19	What major challenges are you facing in the tree planting program? *Ndi mabvuto anji amene mwakhala mukumana nawo pa ntchito yodzala mitengo?*	Lack of inputs……..1 Lack of equipment……...2 Scarcity of water……..3 Burning of seedlings……..…..4 Destruction by animals……5 Others specify_____				
B20	How are you dealing with these challenges? *Mabvuto amenewa mumathana nawo bwanji?*	Enacting of bylaws……1 Promoting local seed collection……..2 Setting up of fire breaks……..3 Others specify_____				
B21	What benefits have your household so far obtained from planting trees? How are the trees assisting your household? *Mitengoyi ikuthandiza bwanji khomo lino?* *(Multiple responses possible. Please Probe)*	Easy access to firewood……1 Easy access to poles……..2 Availability of shade and windbreak ….....3 Beautifies the homesteads……4 Source of income after sales…….5 Fresh breeze and breathing air…….…….6 Reduced soil erosion…….……7 Others, specify……..…8				
B22	What changes have your household observed so far due to involvement in tree planting activities? List the changes *Moyo wanu wasintha bwanji Kamba ka phindu Lomwe mukupeza podzala mitengo?*	Improved yields…….1 Reduced soil erosion……..2 Easy access to firewood…….3 Easy access to timber……4 Others (specify)_____				
B23	How many trees did your household out plant in the past 3 seasons? *Refer to B2* *Ndi mitengo ingati yomwe mwakhala mukudzala kwa zaka zitatu zapitazi?* *(Indicate the number planted per each season)*	Season	Number of trees planted			
		2016/2017 2015/2016 2014/2015				
B24	Out of the out planted, how many trees are surviving from the previous two seasons?	Season	# trees planted	# Trees surviving	% survival	
		2016/2017				

	Pamitengo imene munadzala mu zaka ziwili zambuyozo ndi ingati yomwe inapulumuka? *Do a physical count.*	2015/2016				
		2014/2015				
	Survival Rate	Low survival Rate (Less than 50%)…..1 High survival rate (50% and above)…..2				
B25	What factors contributed to high survival of out-planted trees Inu mukuona ngati ndi chiyani chimene chinapangitsa kuti mitengo yambiri munadzala ipulumuke	Planting with the first rains……1 Planting healthy and mature seedlings……2 Dry planting of the seedlings……..3 Protecting the seedlings from livestock….4 Protecting the seedlings from fire…….5 Others Specify……..6				
B26	What factors contributed to the above low survival rate of trees? What has affected the survival of trees? *Ndi zifukwa ziti zomwe zapangitsa kuti mitengo yomwe munadzala isapulumuke yambiri?* *(Multiple responses possible. Please Probe)*	Late out planting of seedlings…….……..1 Transplanting of immature or damaged seedlings……..2 Dry spells prior to and immediately after out planting…….…….3 Termites attack……...4 Worms and other pests attack……5 Bush fires…….……...6 Livestock damage…….…..7 Human damage……...8 Poor siting of woodlots…….…..…9 Others, specify……10				
B27	What measures have you put in place to resolve the challenges affecting tree survival? *Ndi njira ziti zomwe mwakhazikitsa kuti mitengo isamafe motere?*					

C. What advice can you give to government in its implementation on the Tree planting program?
Ndimalangizo anji omwe mungawapase aboma pa ntchito ya kudzala mitengo?

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FINALLY THANK THE RESPONDENT FOR THE TIME SPENT
End Time_____