DETERMINANTS OF SMALLHOLDER FARMERS' ADOPTION OF IMPROVED FALLOWS IN ZAMBIA'S CHONGWE DISTRICT

A Research Report presented to the Department of Agricultural Economics and Extension of the University of Zambia.

By

JIMMY PHIRI

In Partial Fulfillment of the Requirements for the Degree of Bachelor of Agricultural Sciences

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I would also like to thank my family for all the support and assistance provided during the period that I was in school. My sincere thanks also go to the staff in the school of Agricultural Sciences for their contribution to my professional development. I also acknowledge my friends and classmates for the support given and making my stay at UNZA a memorable one. I would also like to thank the people of Chongwe specifically in Kanakantapa Resettlement Scheme for their responses during data collection in contribution to this research.

Finally, a special dedication goes to my parents Joseph Phiri, and Betty Tembo, and Uncle Mr. Bonniface Sakala and Aunt Betrice Sakala for the tireless effort and emphasis on discipline and hard work.

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KEY TO ABREVIATIONS

NAP	National Agricultural Policy
FAO	Food and Agricultural Organization
UNESCO	United Nations Educational, Scientific and Cultural Organization
MACO	Ministry of Agriculture and cooperatives
CSO	Central Statistics office
IF	Improved Fallows
SPSS	Statistical Program for Social Sciences
VIF	Variance Inflation Factor

ABSTRACT

Determinants of Smallholder Farmers' Adoption of Improved Fallows in Zambia's Chongwe District

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University of Zambia, 2012

Supervisor:
Dr. Gelson Tembo.

Adoption of Improved Fallows still remains poor among small holder farmers. Understanding the factors affecting smallholder farmers' adoption of Improved Fallows would provide a basis for an effective adoption program by providing important information for policy formulation and alterations for increased uptake in Zambia. The main objective of this study was to assess the factors that affect the adoption of improved fallows in Chongwe district in Lusaka province of Zambia. To achieve this, a study on the factors affecting its adoption was conducted. A sample size of two hundred and twenty (220) smallholder farmers from Chongwe district were both randomly and purposively interviewed. Probit analysis was used to identify factors that significantly affect the adoption decision. The dependent variable was "whether the farmer is using improved fallows or not".

The study considers explanatory variables such as sex of the household head, age of the household head, age of the household members, level of education, marital status, household size, farm size, size of off-farm income, yield of subsequent crop after improved fallows, improved fallow trees used, access to information, and livestock ownership.

The results indicated that a lot is still unknown about what really influences the smallholder farmers' adoption of improved fallows in Chongwe district. The econometric results revealed that household head belonging to an agricultural group (p=0.003), livestock ownership in terms of number of cattle (p=0.004), improved fallow tree used (p=0.055) are important determinants of improved fallows in Chongwe district.

Based on the findings, if adoption is to be enhanced, it is important that more effort in information provision through extension services in facilitating and educating the illiterate farmers on the benefits of such practices is focused upon. The Government should also introduce cattle re-stocking in the district to reduce on use of family labor in carrying out farm operations. It is also important that future studies on the same issue to consider other variables of theoretical importance not considered in this study as observed that there is still a lot which is unknown about the what influences small scale farmers' decision to adopt a farming practice .

CHAPTER ONE
INTRODUCTION

1.1 Background

Zambia's rural population depends on agriculture as a major source of income for their livelihood. The majority of these are small scale farmers. In the same line, the economic importance of soil fertility problems which have greatly affected these small scale farmers in Zambia and Sub-Saharan Africa at large cannot be overemphasized. Studies (Sanchez and Jama, 2002; Vanlauwe and Giller, 2006) have noted that a major impediment to agricultural growth and development in sub-Saharan Africa including Zambian land is declining soil fertility and low macro-nutrient levels. As land is continuously cultivated for food production, often without fertilizer as in the case of small scale farmers with no or little cash to buy fertilizer, the soils are usually left infertile lacking important plant nutrients such as nitrogen, phosphorus and potassium. According to, Smaling *et al.* (1997), soils in sub-Saharan Africa are being depleted at annual rates of 22 kg/ha for nitrogen, 2.5 kg/ha for phosphorus, and 15 kg/ha for potassium.

Literature has revealed that the major factors that have caused and aggravated the problem of soil fertility depletion in Zambia include increase in human population that has increased pressure on farming land and the removal of subsidies on farm inputs such as inorganic fertilizer (Ajayi et al. 2007). Following the major policy shift of the 1990s (liberalization) including the reduction of subsidies on fertilizers in the Zambian economy, coupled with some Structural Adjustment Programs effects earlier, saw most smallholder farmers drastically reduce if not stop using inorganic fertilizers in the cultivation of crops. Thus, in order to achieve the millennium development goal of reducing poverty and hunger by 2015 would mean that the development programs in the agricultural sector also consider in bridging the gap posed by soil fertility problems especially in an effort to help small scale farmers who are also one of the major poverty victims.

In an effort to respond to soil fertility problem and to achieve sustainable Agricultural practices, an agro-forestry based technology was developed by the World Agro-forestry Centre for use in Zambia. This agro forestry based technology involves the use of improved fallows under conservation farming. Selected fast growing trees such as Sesbania sesban, Cajanus cajan, Gliricidia sepium (Mexican lilac) etc, are encouraged to be planted and grown in the fields in order to improve soil fertility. The trees are either intercropped or grown alone so as to fix nitrogen (N) in the soil. The nitrogen is made available to the intercropped or subsequent crop thereby increasing yields of those crops highly dependent on nitrogen as well as any other nutrient fixed.

In the case of a poor country like Zambia, with most small scale farmers who can't afford to buy synthesized fertilizers for their crops, use and adoption of improved fallows is one of the strategies that was introduced to reduce rural hunger and poverty. Being a tree-based land use practice, improved fallows has been appreciated for its beneficial aspects to the environment. Among the environmental services provided include enhancing soil biodiversity, reducing soil erosion through the improvement of soil physical structure and carbon capture (Ajayi *et al* 2007). The practice also serves the farmer with firewood which can be obtained from the trees grown to be used as fuel. Despite the potential benefits of the technology especially to resource constrained farmers, its uptake has not been as expected.

1.2 Problem statement

Despite the efforts by the government through extension education to the small scale farmers on the use of improved fallows, there is still a dearth of empirical evidence as to why very few small scale farmers have positively responded to the practice. Over time, similar research have focused on the agronomic importance of improved fallows in few selected areas (Mafongoya, *et al.* 2000), much to the exclusion of the factors that influence its adoption. Literature was that most studies conducted concentrated in only one region of the country, Eastern Zambia. Due to this, it still leaves a justification for other areas of the country like Chongwe to be evaluated.

Going by several studies and valuations (Ajayi *et al*, 2007 and Franzel 2004), they have confirmed the agronomic as well as economic importance of improved fallows on farms. The studies have shown that maize grain yields are substantially high on previously improved fallowed field compared to smallholder farmers' practice of continuous maize cropping without nutrient inputs such as fertilizer (Mafongoya, *et al.* 2000; Franzel *et al.* 2002).

The major reasons for the low levels of adoption of this practice are not known in Chongwe district despite the earlier mentioned agronomic as well as economic benefits. It is against this background that this study attempted to find out the factors behind the adoption of this practice.

Adoption in this context means taking up of the technology by farmers to continue putting it in practice up to date (i.e. to continue planting the improved fallow trees every year after witnessing the benefits of the technology).

1.3 Study Objectives

The overall objective of this study was to determine the factors that affect smallholder farmers' adoption of improved fallows in the district.

The specific objectives were

i) To find out the farmers' perceptions and feelings about the use of improved fallows in improving the soil.
ii) To determine the extent to which the factors identified influence adoption of improved fallows.

1.4 Rationale

In the National Agricultural Policy (NAP), the government has reiterated its commitment to ensuring the development of a competitive, sustainable and efficient agricultural sector that assures food security and poverty reduction. Therefore, determining the factors correlated with the adoption decisions by small scale farmers for improved fallows (Sesbania sesban, Cajanus Cajan, Terphrosia, Gliricidia sepium) would provide a basis for an effective adoption program by providing important information for policy formulation and alteration for increased uptake of such a technology subject to utility maximization of a farmer.

According to Belbase, *et al.*, 1995, "identifying sources of inefficiency would be more cost effective than varietal development as a means of increasing output". Intuitively, the adoption and non-adoption of a certain improved fallow by a rational farmer will depend on such factors as the geographical location (i.e. agro-ecological regions) of the area as well as people's perception of the practice and so the need to identify the factors in each of these locations. Therefore, this study was also going to help in widening the source of information on the factors that influence the adoption of the technology regarding the country as a whole. Moreover, most research conducted had concentrated on the adoption rate in few selected areas such as eastern Zambia, leaving other areas such as Chongwe district unevaluated. Therefore, the finding, besides bridging the gap in knowledge of the factors, can also lead to efficient literature on the performance of improved fallows in Zambia as a whole region.

1.5 Conceptual framework

At the core of this study was the assumption of farmers' optimization behavior in which they attempt to maximize the objective function subject to a set of constraints. That is to say that, a farmer just like any other rational producer the decision to adopt a technology is based on the assumption of maximization of utility as earlier stated.

The farmer has to use his resources efficiently to maximize the net benefit. In the case of improved fallows as well as any other method of improving the soil e.g. synthesized fertilizers etc, economic theory suggest that the farmer has to ensure that the marginal cost (i.e. explicit and implicit costs) of the effort put in is equal to the marginal returns in all the available methods (technologies) of improving the soil. Shapiro et al, 1992 conceived that if there is a higher net gain in any one of the technology, then it becomes advantageous to continue investing (i.e. adoption) in that method until the marginal benefit is just equal to marginal cost.

In some cases, some non-adoption behavior by farmers may occur and so the study requires the use of empirical models which use a binary variable response so as to reflect the situations of both when there is adoption as well as non-adoption. The models that can be used include probit, Logit and Tobit. In this study, a Probit model was used to analyze the major factors behind adoption as well as the extent to which each of the factors has in the adoption process of the small scale farmer.

The general equation that represents the preference of the farmer for improved fallows, **y**, is given as;

$$P(y = 1|x) = G(\beta_0 + \beta_1 x_1 + .. + \beta_k x_k) = G(\beta_0 + x\beta)$$

G is a function taking on values strictly between zero and one: $0 < G(z) < 1$, for all values of the parameters and the x_j. The function G is also called the standard normal cumulative distribution function (cdf) which is expressed as an integral;

$$G(z) = \varphi(z) \equiv \int_{-\infty}^{z} \emptyset(v)dv,$$

Where $\varphi(z)$ is the standard normal density, y = dependent variable (.i.e adoption) and represent the cultivation area in hectares where improved fallows have been planted.
X = vector of dependent variables. β is a vector of unknown coefficients or parameters to be estimated.

1.6 Organization of the Report

This report is sub-divided into five (5) chapters; Chapter one provides an overview and background information of the driving forces of the study from Zambia and Africa at large. It also gives the problem statement, study objectives and rationale. Chapter two presents a review of the relevant literature to the study. Chapter three outlines the research methods and procedures, specifically looking at the data collection and analysis procedures used. It also presents a theoretical and empirical model for determining the factors correlated with adoption. In chapter four the study findings are presented, interpreted and discussed. Finally, chapter five presents the summary and conclusions drawn from the empirical data, implications for future research and recommendations.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews relevant literature on adoption as a concept as well as the scope of the study. It also presents the adoption studies that have been conducted so far, their objectives and the methods employed, it points out the observed weaknesses in some of the studies and possible knowledge gaps that can be bridged.

2.2 Overview

As land is continuously cultivated for food production, often without fertilizer or with very little use of it, the soils in many areas are left infertile and lack important plant nutrients such as nitrogen, phosphorus and potassium. This is particularly noticeable in areas where the main soil types are Acrisol and Ferralsols (FAO-UNESCO), Smaling *et al.* (1997) estimates that soils in sub-Saharan Africa are being depleted at annual rates of 22 kg/ha for nitrogen, 2.5 kg/ha for phosphorus, and 15 kg/ha for potassium, hence the need to introduce and adopt sustainable methods of improving the soil such as using improved fallows.

2.3 Definitions

By definition, natural fallow is land resting from cultivation, usually used for grazing or left to natural vegetation for a long period to restore soil fertility lost from growing crops. However, improved fallow is land resting from cultivation but the vegetation comprises planted and managed species of leguminous trees, shrubs and herbaceous cover crops. A fallow is 'improved' over natural bush fallow only if the plant species used are more efficient than the species in the local vegetation—at least in improving the chemical and physical properties of the soil (Franzel *et al*, *an extension guideline*, 2003).

On the other hand, following Rodgers (1995), adoption is defined as a decision to make a full use of an innovation as the best course of action once the individual has known and assessed the attributes of the innovation. Most empirical studies using econometric models often relate the adoption decision to households and technological characteristics.

2.4 Agronomic and Economic Significance of improved fallows

The fact that the use of improved fallows by farmers can render an affordable and sustainable farming practice (Ajayi *et al*, 2007 and Franzel 2004) which will be able to replenish the soil with almost all the required nutrients by food crops so as to increase their yield, makes it a more attractive practice of improving the soil than others. Some improved fallows such as Sesbania, have a very deep root system and thereby effectively capture mineral nitrogen which may have been leached below the crop rooting zone. This leads to a better recycling of nitrogen and reducing nutrient losses.

2.5 Empirical studies on the adoption of improved fallows

Most empirical studies using econometric models often relate the adoption decision to households and technological characteristics. Numerous studies also have found that constraints imposed by these factors have discouraged technology adoption (Umali and Schwartz 1994; Nicholas *et al*, 1999). While on introduction of improved fallows in other African countries like Kenya, Monitoring in 17 villages (Kenya) found only about 22% of farmers had been consistently (adopted) using improved fallows in 2001 (Amandala B, Jama *et al*,2003).

A study was conducted on adoption of improved fallows in eastern province of Zambia; the focus of the study was just to highlight the main factors in the region affecting the farmers' decision to adopt this technology after testing its performance. The study revealed that a decision on technology adoption constituted a matrix of factors including household characteristics, community level factors, access to information, macro policies in Agriculture and incentives that farmers face (Ajayi *et al*, 2003).

However, the study only managed to dig and bring the factors onto the surface, but did not try to go further in determining the relative importance of each of the factors in the adoption matrix. Therefore, there was still need to determine the extent to which the identified factors influence the adoption of the technology.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the methods and procedures used to achieve the stated objectives. It gives information on the study sites, data collection and data analysis tools that were used in the study. A Probit regression model was employed to identify the factors that influence small scale farmers' of improved fallows.

3.2 Study area

The study was conducted in Zambia's Chongwe district in Lusaka province. It covered eight villages namely Ndabala, Mukunya, Kasokomo, Chipelya, Lubansa, Chisholeka, Ndulika and Njobvu. The area was of interest as it comprises typical small holder farmers whose such a technology under study was designed for. Initially, due to resource limitations, climatic and soil types as reasons, not every part of the country was covered to facilitate the use and adoption of improved fallow technology. This meant that only few selected areas were chosen and Chongwe district happened to be the best feasible area for the study to be successful.

3.3 Data collection and Analysis

A sample size of 220 farm households was randomly selected from a sampling frame comprising all farm households from the eight villages were improved fallows were introduced and advocated. A simple random sampling from the above mentioned villages was used to ensure representation of all categories of households.

The study involved the use of primary data which was achieved through interviews on small scale farmers using a structured questionnaire. Primary data was collected through personal interaction as well as interviews with all smallholder farmers from different camps through translation in local languages from a structured questionnaire which was developed around the objectives of the study. The data collected was entered into SPSS and analyzed using both SPSS and STATA. The data was tested using the Breusch-Pagan Godfrey test for potential heteroskedasticity which may be present across households due to the use of cross sectional data. Heteroskedasticity was insignificant at 5% level.

CHAPTER FOUR
STUDY FINDINGS AND DISCUSSION

4.1 Introduction

This Chapter presents a discussion on the study findings. A description of sample characteristics is first presented starting with the demographic characteristics of the respondents followed by the results of the factors influencing the adoption of improved fallows. It goes on to present the Probit regression estimates with a discussion of the resulting output.

4.2 Demographic Characteristics

Table 1 below shows that the age of the household head ranged between 18 and 83 years with a mean of 45.83 years and a standard deviation of 12.623. The majority of household heads in the survey are aged below 50 years indicating the ability to comprehend new technologies. The average value of off-farm income (petty trade) received by the households amounted to ZMK 673,000 with a minimum and maximum of ZMK0.00 and ZMK1,000,000 respectively.

Table 1: Descriptive statistics on the variables

	Observed	**Mean**	**Minimum**	**Maximum**	**Std. Deviation**
Sex of Household Head	220	1.21	1	2	0.408
Education Level of Household Head	220	3.04	1	6	1.158
Yield of crop after Improved Fallow	218	0.8936	0	14	1.175
Age of Household Head	220	45.83	18	83	12.623
Income From Petty Trading	219	673,000	0	10,000,000	1,664,031
Household Head Belonging to Agric. Group	218	0.74	0	1	0.44
Number of Radios	220	0.98	0	4	0.699
Number of T.Vs	220	0.43	0	3	0.588
Total Land Owned	220	3.2641	0.41	15	1.994

Source: Own Survey Data (2012)

The average yield from a previously improve fallowed field was 0.8936 tonnes per hectare (tones/ ha) with a minimum of 0.00 (tonnes per ha) and a maximum of 14 (tonnes per ha). The sample survey also showed that most (0.74) .i.e. 74%, of the households had a participation in some agricultural group indicating the availability of social groupings from where people can share ideas about the goodness or badness of such a practice like IFs.

Table 2 below presents some of the descriptive statistics of the respondents. It specifically focuses on the age groups and sex of the farmer, trying to highlight which of the age group do most of the small scale farmers in the survey fall.

Table 2: Distribution of Farmers by Age and Gender

Age Group	**Sex of Respondent**		**Total**	**Percent**
	Female	**Male**		
18 - 30	1	20	21	9.5
31 - 43	13	65	78	35.5
44 - 56	22	69	91	41.4
57 - 69	5	11	16	7.3
70 - 82	5	8	13	5.9
83 & Above	0	1	1	0.5
Total	46	174	220	100
Percent	20.9	79.1	100.0	

Source: Own Survey Data (2012)

The data showed that the majority (79.1%) of household heads in the survey were males compared to (20.9%) females. This means, therefore, that there were more male headed farm households than female headed farm households. A majority (41.4%) of the farmers had their ages ranging from 44 to 56 years (with most falling below the age of 50years) and thus a big indicator for the ability to adapt new technologies.

dependent on sex of the household head, whether the household head belongs to an agricultural group, the improved fallow tree used and livestock ownership in terms of the number of cattle owned by the farmer.

4.4 Probit Regression (dependent variable: whether the farmer is using improved fallows on his farm).

Probit regression was estimated using maximum likelihood estimator in STATA using the data collected from the sample survey. The table below presents the Probit regression parameters for the adoption of IFs. The model had a log likelihood of -35.293712 for 220 observations. (Dependent variable: whether the household is using improved fallows).

Probit regression	Number observ	=	**216**
	LR chi2(**19**)	=	**225.71**
	Prob > chi2	=	**0.0000**
Log likelihood = -35.293712	Pseudo R2	=	**0.7618**

Table 4: Probit Regression.

Variable	Label	Coef	Std. Err.	z	P>z	[95% Conf.Interval]	
HHsex	Sex of household head	0.786	0.513	1.53	0.126	-0.220	1.791
HHedu	Education level	-0.012	0.191	-0.06	0.951	-0.386	0.363
HHage	Age of household head	0.012	0.019	0.61	0.545	-0.026	0.050
Group	H/hold belonging to agric. group	2.610	0.890	2.93	**0.003**	0.865	4.355
Radios	Number of radios	0.426	0.276	1.55	0.122	-0.114	0.967
Tvs	Number of TVs	0.129	0.335	0.39	0.7	-0.528	0.787
Pettytrade	Income from petty trading	0.000	0.000	-1.49	0.137	0.000	0.000
Farmsi	Total land owned	-0.033	0.182	-0.18	0.858	-0.389	0.323
Specie	IF trees used	-0.452	0.236	-1.92	**0.055**	-0.914	0.009
YieldIF	Yield of crop after Ifs	1.686	1.867	0.9	0.367	-1.974	5.345
FertLMz	Fertilizer in local maize	-1.964	1.607	-1.22	0.222	-5.113	1.185
FertHMz	Fertilizer Hybrid maize	-0.716	0.963	-0.74	0.457	-2.603	1.172
Cattle	Number of Cattle	0.105	0.036	2.89	**0.004**	0.034	0.175
Donkeys	Number of Donkeys	-0.303	2.294	-0.13	0.895	-4.800	4.194
Oxplough	Number of ox-ploughs	-0.387	0.369	-1.05	0.295	-1.110	0.337
FHsi1649	Female members 16 - 49yrs	-0.355	0.333	-1.07	0.287	-1.007	0.298
MHsi1649	Male members 16 - 49yrs	0.325	0.238	1.37	0.172	-0.141	0.792
FHsi50	Female members above 49	0.399	0.504	0.79	0.428	-0.589	1.387
MHsi50	Male members above 49	-0.347	0.580	-0.6	0.55	-1.484	0.790
_cons		-0.663	2.624	-0.25	0.801	-5.806	4.481

From the Probit regression table above, it can be said that adoption of improved fallows is significantly explained by the household head belonging to an agricultural group, livestock ownership in terms of number of cattle owned and to some extent the specie of improved fallow tree used. There is a positive relationship between adoption and whether the household belongs to an agricultural group. This is because an agricultural group e.g. cooperatives will act as an information centre in the community from which people get to be aware of existence of technologies during interacting and sharing of ideas. Further, it is from these interactions that those who haven't yet been aware or taken up the new practice will be aroused to try it and later adopt it. Therefore, an individual belonging to an agricultural grouping will be likely to adopt the new idea or farming practice being advocated due to knowledge gotten on "how to" about a certain farming practice such as the use of improved fallows.

The model also significantly proved that livestock ownership of the small scale farmer affect the adoption of improved fallows. This is in line with the theory that a well doing farmer is likely to take advantage of the introduced technologies due to economies of scale. Livestock such as cattle provides draft power on the farm. Livestock will also save as assets which can be turned into cash income by a small scale farmer whenever he/she wants to hire extra labor on the farm. Thus, indicating a positive relationship to adoption. The role of education in technology adoption has been extensively discussed in the literature. Education enhances the allocative ability of decision makers (.i.e. farmers) by enabling them to think critically and use information sources efficiently. The negative sign in the coefficient of education variable though not significant indicates that as one goes higher in the level of education, he/she is likely to find other better ways of getting income either by reducing farming activities as a whole or start buying synthesized fertilizer as an alternative for improved fallows in improving soil fertility, therefore, the more educated one is, the less likely that he will use and adopt on using the improved fallows.

Yield of the crop in the previously improved fallowed field though also observed not to be statistically significant, is a major motivation factor for the farmer to continue using improved fallows in his farm for the coming seasons (i.e. on the adoption of improved fallows). Its positive sign is due to the fact that if high yields of the crop are realized from using improved fallows,

most farmers will accept and continue using the practice unlike when low yields result from the practice. This is because the yields realized, are seen as immediate gains of every small scale farmer whenever a farming venture is undertaken.
The adoption study considers age to be positively related to adoption based on the assumption that with age farmers gain more experience and acquaintance with new technologies and hence are expected to have higher ability to use new technologies more efficiently.

On the other hand, the farmers' perceptions on the technology indicated a positive support for the practice on the ground that it is an affordable and sustainable way of improving soil fertility to a small scale farmer. Most small scale farmers responded that synthesized fertilizer was too expensive for them to buy and the best alternative was the use of improved fallows. In farmers' specific views, the practice had some other advantages in that it was a source of fuel (in form of firewood) and most importantly, some species like Cajanus cajan (i.e. pigeon peas) provided peas which are consumed as food.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The use of improved fallows is essential to improving the food security of smallholder farmers as well as providing a sustainable way of earning income. This technology allows constrained smallholder farmers to benefit from the advantages of using this technology.

The study focused on determining the factors that affect the smallholder farmers' decision to adopt the use of improved fallows. The sample consisted of 220 smallholder farm households. Econometric analysis using probit model was employed to analyze and discuss the individual factors hypothesized to affect the adoption of the technology. The factors studied included sex of the household head, age of the household head, age of the household members, level of education, marital status, household size, farm size, size of off-farm income, yield of subsequent crop after improved fallows, improved fallow trees used, access to information, and livestock ownership.

The econometric assessment revealed that source of information (.i.e. farmer belonging to an agricultural group), livestock ownership (number of cattle owned) and type of improved fallow tree used were the significant determinants among the hypothesized factors in the adoption of improved fallows.

5.2. Recommendations

Based on the findings, if adoption of improved fallows is to be enhanced amongst smallholder farmers in Zambia, it is important that;

Stakeholders especially the government, to concentrate on information provision by putting more effort in extension services in facilitating and educating the illiterate farmers on the benefits of such practices because more resources are spent during research. The government should employ enough agricultural extension officers so that they can adequately facilitate information and provide technical assistance necessary for adoption of a new technology.

Researchers & stakeholders should also concentrate on finding & advocating for those farming practices where it will be easier for a smallholder farmer to have immediate gains. In the case of improved fallows, it takes more than one year for the farmer to expect the benefits of improved soil fertility translated to high yield of the subsequent crop grown in that field and that's no immediate in the farmer's perspective.

The Government should also introduce cattle re-stocking in the district to reduce on use of family labor in carrying out farm operations.

5.3. Implications for Future Research

Having identified that most of the hypothesized variables in the study were analyzed to be insignificant, it is important that future studies on the same issue to include other factors of theoretical importance not considered in this study.

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Appendix 1

Questionnaire

An Assessment of Factors Affecting the Smallholder Farmer's Adoption of Improved Fallows in Zambia's Chongwe District.

Section A: Identification information

District..
Chiefdom Name...[ ]
Camp name...[ ]
Date..[ ]
Name of the Farmer.. [ ]

Section B: Demographic Data ....[ ]

1. Age as at last birthday...[ ]
2. Sex
   (a) Male.. [ ]
   (b) Female... [ ]
3. What is your marital status?
   (a) Married........................ [ ]
   (b) Single.......................... [ ]
   (c) Divorced...................... [ ]
   (d) Widow/widower..............[ ]
4. What is your highest level of Education?
   (a) Primary.. [ ]
   (b) Secondary..[ ]
   (c) Tertiary..[ ]
   (d) Never attended school... [ ]

   (e) Other, specify.. [ ]
5. What is your main source of income?

On Farm Income	(Tick)	Off-Farm Income	(Tick)
Sale of crops		Salary (formal)	
Sale of livestock		Gifts	
Sale of farm assets		Other businesses	
Others, specify..................................		Others, specify..	

6. What is the total number of your household? .... [ ]

Complete the table below of your household status:

Years	Children		Dependants	
	Male	Female	Male	Female
Between 0 – 15 Between 15 – 36 Above 35 Total on each section				

Section C: Agricultural Data

7. Have you been a farmer throughout your life?
   (a) Yes... [ ]
   (b) No.. [ ]
8. If no to question 7, what have you been doing before you started farming? ....[ ]
9. What do you do apart from farming? ....[ ]
10. If yes to question 7, have you heard about the use of improved fallows in improving soil fertility? ....Yes [ ] No [ ]
11. If yes to question 10, what is your view for using this technology in improving the soil fertility?...
12. What is the size of your farm? ....[ ]
13. What size of farm do you cultivate? ....[ ]
14. How much of it is under improved fallow technology? ....[ ]
    Not applicable.. [ ]
15. Did you receive training in improved fallow technology?
    (a) Yes...[ ]
    (b) No... [ ]
16. If yes to question 15, who trained you
    (a) Government ....[ ]
    (b) NGOs.. [ ]
    (c) Friends.. [ ]
    (d) Others, specify...[ ]
17. Do you have an access to?

	Yes	No
(a) Technical assistance	[ ]	[ ]
(b) Credit services	[ ]	[ ]
(c) Incentives in form of inputs (Seed or fertilizer)	[ ]	[ ]

18. If yes, from who? Specify..[ ]
19. How much money do you spend as a household?
    Per month............................... (Kwacha)
    Per Annual.............................. (Kwacha)
20. What is the main source of labour for improved fallow and no nutrient addition method?

(a) Seed? ....
(b) Fertilizer? .... [ ]
(c) Labor? .... [ ]

29. Do you hire any labor? .... [ ]
(a) Yes...
(b)No... [ ]

30. If yes to question 29, what is the form of payment? .... [ ]

31. What crop do you grow under the following? .... [ ]

	Improved Fallow	No nutrient addition method
Sorghum		
Maize		
Beans		
Groundnuts		
cowpeas		

Economic and Socio-Economic factors

32. Has the area under improved fallow increase / decrease or the same for the past three years?
(a) Increased..
(b) Decreased.. [ ]
(c) Same.. [ ]

33. Depending on the answer in question 31 above, why is that so..................... [ ]

34. How would you compare the workforce between improved fallow and that for no any nutrient addition method? [ ]

Improved fallow	No any nutrient addition	
High	Low	
Same	Same	
Low	High	

35. How would you compare the inputs quantities required between improve fallow and that method where no any nutrient addition per ha is used

Improved fallow	No any nutrient addition	
More	Less	
Same	Same	
Low	More	

36. How would you compare the yield per ha between improved fallow and no any nutrient

addition method?

Improved fallow	No any nutrient addition	
High	Low	
Same	Same	
Low	High	

37. Physical capital / assets of the household. **Fill in the following table about the Household's asset Ownership.**

ASSET TYPE	Dose the H/hold have? (tick)	How many of each type dose the H/hold own?	When was it bought? (year)	How many did the H/hold have when started IF technology?	How much money did the H/hold earn from the sale of any of the assets in the past one year?
Tractor					
Trailer					
Truck					
Van					
Ox-cart					
Plough					
Ox-drawn implements					
T.V					
Radio					
Bicycle					
Oxen					
Cow					
Donkey					
Other livestock					

I thank you for sharing your experience with me and taking your time