IFPRI MALAWI

STRATEGY SUPPORT PROGRAM | WORKING PAPER 23

The Impact of a Farmer Business School Program on Incomes of Smallholder Farmers: Insights from Central Malawi

Joanna Chilemba and Catherine Ragasa

This Working Paper is an output of the Bunda Grant Scheme of the Strengthening Evidence-Based Agricultural Policy (SEBAP) project of IFPRI-Malawi. The Grant Scheme provides selected Masters-level students from the Lilongwe University of Agriculture and Natural Resources (Bunda College) with opportunities to improve, publish, and disseminate the research that they undertook during their MSc training.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Various models and approaches are being implemented to provide technical assistance and support to improve smallholder farmers' incomes and welfare in Malawi. This study evaluates the impact of farmer business schools (FBS) on crop incomes of smallholder farmers in Dedza district in central Malawi. The FBS approach, which has been implemented nationally by the Government of Malawi since 2011, consists of one year of group training and learning sessions for smallholder farmers focusing on improving market access and establishing profitable agribusiness ventures. This study used a multi-stage sampling procedure to collect data from 455 smallholder farmers: 162 FBS graduates, 84 FBS dropouts, and 209 non-participants. Using propensity score matching and difference-in-difference techniques, crop incomes from two groups of farmers were evaluated; FBS participants and FBS non-participants as well as FBS graduates and FBS dropouts. The study finds a positive yet small impact of FBS participation on crop income and production (US$20 per year on average), and no significant difference in crop income and production for farmers who graduated from FBS versus those who dropped out. Insights from the qualitative research component of this study suggest that this is primarily due to the limited financial resources smallholder farmers have to implement the agricultural techniques and business models taught in FBS.

Keywords: Farmer business schools, extension services, market access, impact evaluation, income generation, Malawi

1. INTRODUCTION

Various models and approaches are being implemented to provide technical assistance and support to improve smallholder farmers' incomes and welfare in Malawi. Input subsidies and transfers, both cash and in-kind, as well as extension services and information provision, are commonly used approaches to target these farmers. Impacts of input subsidies have been widely-studied[1] but impact evaluations of extension services are more elusive due to the inherent difficulty of attrition, information spillovers, and measuring knowledge over time (Birkhaeuser, Evenson and Feder 1991; Birner et al. 2006; Ragasa and Mazunda 2018; Faure et al. 2017).

This paper examines the farmer business school (FBS) concept, a year-long group-based learning approach aimed at equipping smallholder farmers to make better agricultural production decisions that can enhance productivity and farm incomes. The FBS concept stems from the farmer field school (FFS) concept developed by the Food and Agriculture Organization of the United Nations (FAO), which was initially used to promote Integrated Pest Management (IPM) in Asia in the 1990s and is now used in numerous countries. FBS aims to provide farmers with knowledge and skills in market-oriented farm business planning and management through a "learning by doing" approach. Different variants of the FBS learning modules are being promoted by various development organizations and implemented in countries across Africa south of the Sahara (SNRD 2015; CARE 2013; GIZ 2012; GoM 2011).

In Malawi, a modified version of FBS has been implemented nationwide by the Ministry of Agriculture, Irrigation and Water Development (MoAIWD) since 2011. Most applications of FBS have been small-scale or pilot programs, such that the nationwide implementation in Malawi is a unique and interesting case for assessing any broad-based development impacts of the approach. Malawi's FBS program aims to address low levels of agricultural commercialization, as well as poverty and malnutrition among smallholder farmers. Agriculture is the mainstay of the country's economy, accounting for 30 percent of Gross Domestic Product (GDP) and over 80 percent of national export earnings (GoM 2016; GoM 2015). In addition, the agricultural sector employs about 64 percent of the nation's workforce (NSO 2014). As such, a productive agricultural system is key to attaining food and nutrition security and cannot be overlooked in enhancing economic growth and human development (MoAIWD 2016). While the Government has consistently allocated over 10 percent of the national budget to the agricultural sector, in line with the Comprehensive Africa Agriculture Development Program (CAADP) key principles and targets, the CAADP target of agricultural GDP growth of at least 6 percent per annum has not been achieved in most years (GoM 2016). Many smallholder farmers still face challenges in accessing information on good agricultural practices, value addition, and profitable agribusiness ventures (Ragasa and Niu 2017). Malawi's National Agriculture Policy (NAP) identifies lack of market information and poor access to commercial services - such as transportation, agro-processing, packaging and storage facilities - as major obstacles for smallholder farmers (GoM 2016). These obstacles contribute to problems such as low margins for agricultural products, which keep farmers trapped in poverty and limit their participation in agricultural commercialization activities (GoM 2016).

Using Dedza district in central Malawi as a case study, this paper evaluates the impact of the FBS program on the incomes of smallholder farmers. Since no baseline data was available, the study used a simple difference-in-difference approach based on recall data, together with matching

1 See Jayne and Rashid (2013) for a review of evidence on the impacts of input subsidies in Africa, and Hanna and Karlan (2016) and Alderman, Gentilini and Yemtsov (2018) for a review of the evidence on transfers.

techniques. This was complemented by five focus group discussions conducted with 34 farmers in the study district. While there are various impact evaluations of the sister farmer field school (FFS) program globally, there is limited evaluation of the FBS program beyond individual project documents. This paper is the first to formally evaluate the impact of the nationally-implemented FBS program in Malawi, using the case of Dedza district in central Malawi to provide insights on its implementation and development impacts. It aims to identify program areas that can be scaled up as well as areas where program design and implementation can be further improved.

While the GoM is currently reviewing and developing its National Agricultural Extension Strategy, the results of this paper will directly inform this strategy development process and draw lessons for both Malawi and other countries. From a methodological perspective, this study showcases the use of mixed methods, combining both qualitative and quantitative techniques, and within the latter, various estimation approaches to ensure that selection bias and unobserved heterogeneity are minimized given the lack of baseline data and non-randomized placement of the program.

1.1 Overview of Farmer Business Schools

The concept of FBS was developed to build capacity among farmers, to improve their farm business knowledge and decision-making skills, and to change attitudes towards commercialization. FBS, like FFS, are characterized by a focus on adult and experiential learning ("learning by doing"), group-based and participatory approaches, facilitation rather than structured teaching, and capacity building and long-term engagement with farmers. Both FFS and FBS have been likened to models such as farmer-to-farmer extension, farmer-centered extension, and participatory extension approaches.

However, there are important differences between the FBS and FFS approaches. While FFS focus on crop production and addressing technological constraints on the farm, promoting environmentally sustainable management practices, and productivity increases, FBS focuses on marketing, entrepreneurial and management skills (FAO 2011). The FBS program is an interactive program designed to support smallholder farmers who are beginning to or already sell produce in the market. The aim is to increase the capacity of farmers to manage their farms effectively and increase their profitability. Some organizations have combined these into farmer field and business schools (FFBS), while others have developed variants of FFS or FBS which include modules on nutrition, gender equality, or group formation.

FBS are implemented over multiple years, beginning with the adaption or modification of existing modules by the implementing organization, followed by training of Master Trainers. Master Trainers are ultimately responsible for training the district-level trainers, who serve as the facilitators of the FBS at the farmer level. Training and facilitation with farmers usually lasts one year, starting before the planting season and continuing through a full cropping season.

The Government of Malawi's FBS program

Within the nationwide implementation of FBS in Malawi, the District Agribusiness Officers (ABOs), who are among the subject-matter-specialists (SMS) based in the District Agricultural Development Offices (DADO), participated in a training-of-trainers in order to train the Agricultural Extension Development Officers (AEDOs) at the section level. In Malawi, a "section" is

comprised of several villages.[2] The training-of-trainers focused on market-oriented farm business planning and management, using a manual initially developed by FAO and adopted and modified by the Department of Agricultural Extension Services (DAES) to suit the needs of smallholder farmers in Malawi. To this end, the materials for the FBS are specially designed for farmers with limited resources, who need to be basically literate and numerate but who do not necessarily have any significant formal education (FAO 2011). Although there is no strict criterion regarding the maximum farm size for participation, primarily smallholder and resource-poor farmers are targeted for the FBS program because of the focus on commercialization and agribusiness ventures for those with limited resources. This is confirmed by a maximum land size of 2.5 hectares among FBS participants.

FBS is adopted as an extension approach by the MoAIWD to be implemented nationwide. The training of AEDOs as FBS facilitators is usually done for five days, where both ABOs (the trainers) and AEDOs (trainees) receive travel and accommodation allowances. Since FBS activities are expected to be a standard extension approach used by the AEDOs and an essential part of their work, no additional allowances or funds are provided to them beyond the general operating funds they receive monthly, which is reported to be minimal (Ragasa et al. 2017). Also, it should be noted that not all AEDOs in the district are trained at once, due to limited government resources. Depending on the strategies and criteria put in place in each DADO, some AEDOs are selected to undergo the training sessions. In Dedza district, about 30 of 89 AEDOs were selected for these training sessions. These AEDOs were selected from Bembeke, Linthipe, Lobi, Kanyama and Mayani extension planning areas (EPA), where this study was conducted.

At the outset of the program, AEDOs conducted field-level awareness and sensitization meetings regarding FBS. This sensitization is usually organized by the AEDO, in collaboration with the village chief and other community leaders. Anybody in the village who is interested can join the sensitization meeting, in which the FBS program and the criteria for participation are explained. The program is quite inclusive: basically any farmer can join a FBS. The main criteria for participation are that farmers (1) have the ability to read and write, (2) have access to some land for crop cultivation (although there is no specific minimum land size required for participation), (3) be actively engaged in farming, and (4) be a permanent resident in the village who can start and complete training sessions for one year without relocating. The second and third criteria open the participation to all farmers who are cultivating land and farming that cropping season. The first criterion requires basic literacy, but not formal education. The fourth criterion restricts the program to those who can stay in the village, without migrating, within the duration of the program.

Considerations emphasized during the sensitization phase are the need to work in groups for the FBS and the time required for FBS meetings throughout the program. FBS groups are typically comprised of 10-20 farmers who meet once a week in a local field setting guided by an AEDO. The time for participation as per the training manual guidelines is two hours per week, for a period of one year, although there is some flexibility. The program is designed to allow farmers to work in small groups at their own agreed upon time and duration. While field experience shows that only one member per household typically participates and in turn shares information with other non-participating household members, in some cases, multiple members of a household are involved

2 In a district, there are 80-90 AEDOs on average who operate in designated sections in the field. Currently, the ratio of extension workers to farmers in Dedza district is 1:3150.

in an FBS. After sensitization and awareness meetings, all farmers who satisfy the eligibility criteria can participate in FBS voluntarily.

Facilitation by the AEDO is divided into three parts; the pre-season, on-season and post-season, guided by a FBS handbook for farmer participants. In the pre-season, farmers are taken through theories of market-oriented farm business planning and management, including the selection of profitable agricultural enterprises. Then, farmers are organized in sub-groups based on the agricultural enterprises they are most interested in. Notably, the enterprises farmers select are based on profitability and management assessments that are developed using concepts learned in the pre-season FBS component. During weekly meetings, farmer sub-groups present and discuss their findings during plenary sessions, which are followed with planning of the coming week's activities. Depending on the agroecological zone, farmers focus on production of various crops or livestock. In Dedza district, cash crops being promoted are beans, soybeans, groundnuts, Irish potatoes, sweet potatoes, and other vegetables, along with livestock such as poultry, goats, and cattle. After the growing season, a post-season session is conducted to review pre-season and on-season activities. During this session, farmers discuss their performance and draw lessons for better planning and management in the next growing season.

After the year-long program, graduating farmers are expected to serve as lead farmers, whereby they are advised and guided by extension workers in establishing parallel FBS in their respective locations while practicing what they learned on their own farms. This means that the first-trained farmers help to increase the number of farmers trained in FBS concepts in a particular locality. The FBS concept as implemented by the MoAIWD also highlights the value of cross-FBS sharing and learning, as well as regular follow-up by facilitators.

FBS implementation has not yet been evaluated in Malawi, nor are the authors aware of any evaluation of FBS in other countries beyond internal project documents. A reconnaissance survey conducted by a Dedza DADO in 2015 noted that farmers were dropping out of FBS, but no formal monitoring and evaluation was undertaken. According to SNRD (2015), FBS implemented by the German development agency (GIZ) in several countries showed promising results in terms of increasing productivity and farm incomes, although these results are self-reported by project teams without external validation and evaluation. A modified, condensed agribusiness training, with heavier focus on group formation, was implemented on a pilot scale in Lilongwe district among youth groups, with promising results in terms of gained knowledge (Highfill et al. 2017). However, more research is needed to understand the extent to which participants are able to implement FBS concepts and skills, and to what extent such implementation can contribute to improved farm productivity and incomes.

Nonetheless, many lessons can be learned from evaluations of the FFS approach and inform possible impact pathways for FBS. A number of empirical studies worldwide show a positive impact of FFS participation on agricultural production and income (Godtland et al. 2004; Davis et al. 2010; Todo and Takashi 2011; Panurak 2010; Van den Berg 2004; Van den Berg and Jiggins 2007). Van den Berg and Jiggins (2007) provide a synthesis of 25 evaluation studies of integrated pest management (IPM) FFS and report considerable reductions in pesticide use, with some studies also showing an increase in yields. They also found that FFS were successful in facilitating collective action, leadership, and organization, and improved problem-solving skills. Research has

also emphasized the role of FFS in farmers' empowerment and social capital building (Davis 2006; Van den Berg and Jiggins 2007).

However, many questions remain about the sustainability of FFS (Davis 2006), their cost-effectiveness (Quizon, Feder and Murgai 2001; Feder, Murgai and Quizon 2004), and how impacts can be scaled up beyond the relatively small number of farmers that can be reached directly (Braun et al. 2006).

Furthermore, FFS impacts have not translated into changes beyond the pilot or small-scale level; several studies suggest that FFS have had limited or no effect on agricultural sector or economic performance, environmental sustainability, or on the dissemination of information by FFS participants to other farmers (Quizon, Feder and Murgai 2001; Feder, Murgai and Quizon 2004; Braun et al. 2006; Davis 2006). These questions must be explored further for both FFS and FBS, as the related approaches spread and are adapted in new countries and contexts. The nationwide implementation of FBS in Malawi provides an opportunity to analyze potential broad-based development impacts of FBS and identify lessons for scaling-up of such approaches in Malawi and other countries.

2. METHODOLOGY

2.1 Study Area

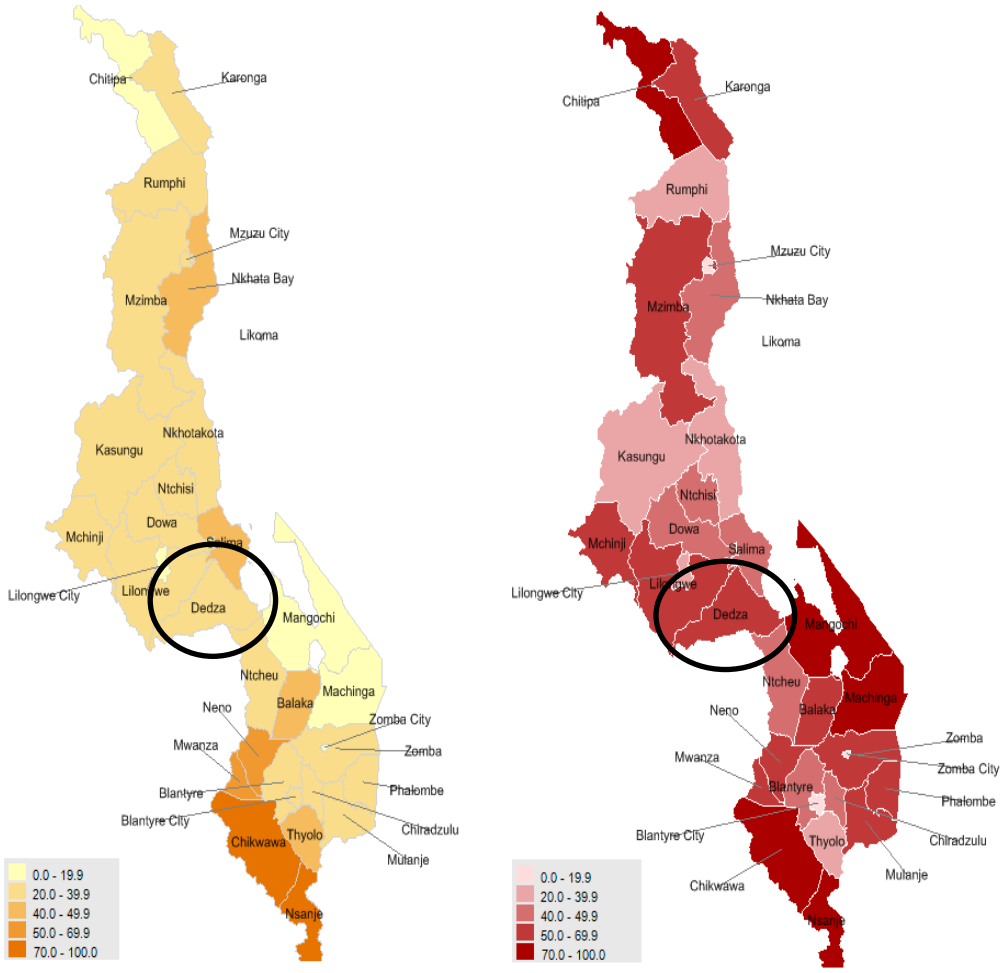
This study was conducted in the Dedza district of central Malawi. Dedza covers an area of 3,624 square kilometers south of the capital city, Lilongwe, between Mozambique and Lake Malawi. The landscape is a mixture of grassland with granite outcrops, natural woodlands and commercial pine plantations on the mountains, with some bamboo forest nearer to Lake Malawi. The western part of Dedza rests on the Central African Plateau, at an altitude of 1,200 to 1,600 meters. The rainy season spans November to April, with very little rainfall during other months of the year. Average temperatures range from 21 degrees Celsius in November, typically the warmest month of the year, to 14 degrees Celsius in July (DDA 2001).

Dedza shares many similarities with other districts in Malawi in terms of crops produced, socio-economic characteristics of households, poverty levels, and FBS implementation. In Dedza, as in much of the rest of the country, agricultural production and food consumption are dominated by maize. Other crops such beans, soybeans and groundnuts are also produced in the district, as are Irish potatoes, which are primarily grown in high altitude areas such as Dedza and other select areas of the country (GoM 2012). In Dedza, various programs are promoting these as suitable cash crops, along with vegetables and livestock, as part of a broader push for crop diversification to improve farmer incomes, soil fertility, and dietary diversity (Mazunda et al. 2014; Henry et al. 2012; Ecker et al. 2012; Ecker and Qiam 2011; GoM 2011).

In terms of socio-economic characteristics, most smallholder farmers across Malawi depend largely on farming as source of livelihood (GoM 2012), and their highest level of education is mostly sprimary school (Chirwa and Matita 2012; Maonga, Maganga and Haraman 2013; Maonga, Maganga and Kankwamba 2015). In Dedza, 57 percent of the population was considered to be impoverished in 2010/2011, compared to 51 percent nationally (NSO 2012). In 2011, nearly 32 percent of the population in Dedza was defined as having very low food security, with another 5 percent having low food security (NSO 2012). These figures are similar to the average in the

Central region and to the national average. Dedza represents an average and representative district of Malawi in terms of food security and poverty (Figure 1).

Figure 1. Prevalence of severe food insecurity and poverty by district, Malawi 2010/11.



Source: NSO 2012.
Note: Left: prevalence of severe food insecurity incidence; Right: prevalence of poverty. Based on self-report during the week prior to the third Integrated Household Survey (2010/2011).

The approach to FBS implementation by DAES is similar in Dedza and other districts across Malawi. As earlier indicated, all ABOs were trained as Master Trainers, and in turn trained AEDOs to serve as facilitators for smallholder farmers in the FBS. In progress reports produced at the district level, monitoring indicators are the number of farmers and frontline staff trained, as well as the number of FBS established. There are no monitoring indicators regarding agricultural production nor farm income. FBS implementation ends at farmers' graduation, and there is no follow-up with graduates to determine whether changes in agricultural production or incomes occur. These indicators and practices are consistent across districts, following the general guidelines and process of implementation determined by the national FBS program. While this study focuses on Dedza district, experiences with FBS in Dedza are likely similar to other districts. Nonetheless, the results are not meant to be an evaluation of FBS nationally as levels of production and incomes are very much dependent on the weather, soil, resources and attitudes of the population, which may vary across districts. However, lessons from Dedza could be used as reflections on the

challenges of FBS implementation and lessons that can be applied to improve FBS and other similar approaches used by the extension system in Malawi and other countries.

2.2 Data and Sampling

This study used data from various sources, including a household survey, focus group discussions (FGD) and key informant interviews (KII). Data were obtained from 455 households in five Extension Planning Areas (EPAs) of Dedza district: Bembeke, Linthipe, Lobi, Kanyama and Mayani. A household unit listing comprising 498 FBS participants (of which 345 were graduates) within these five EPAs was obtained from the DADO. From this list, a sample of 162 FBS graduates (47% of graduates) and 84 FBS non-graduates (60% of non-graduates) were randomly selected. In the communities where FBS was implemented, 100 non-participating households were selected from the household listing exercise. Similarly, in communities with no FBS, 103 households were randomly selected from comparable and nearby non-FBS communities, to represent a pure control for the study. A list of comparable nearby communities with no FBS in each district was produced and discussed among the DADO and other key informants.

In two of the EPAs of Dedza where the survey was conducted, Mayani and Kanyama, there was overlap of the DAES-implemented FBS and the Rural Livelihood Economic Enhancement Programme (RLEEP)-piloted FBS funded by International Fund for Agricultural Development (IFAD) and implemented from 2011 to 2017. The potential that a household was involved in both FBS projects was controlled for by specifically asking households which FBS they participated in.

The household survey was implemented in May 2017 by a team of five enumerators and one supervisor. Face-to-face interviews lasted between 30 and 60 minutes using a 14-page questionnaire, consisting of modules on household characteristics, assets, farm and non-farm income, access to services, production and market access, and involvement in projects or programs. FBS participants were also asked about the details of their FBS participation.

The household survey was complemented by five FGDs, which were conducted with two groups of female participants, two groups of male participants and one group of female dropouts. FGDs had an average of seven participants and were designed to acquire additional insights on FBS implementation in Dedza district. Key Informant Interviews (KIIs) were also conducted to this end.

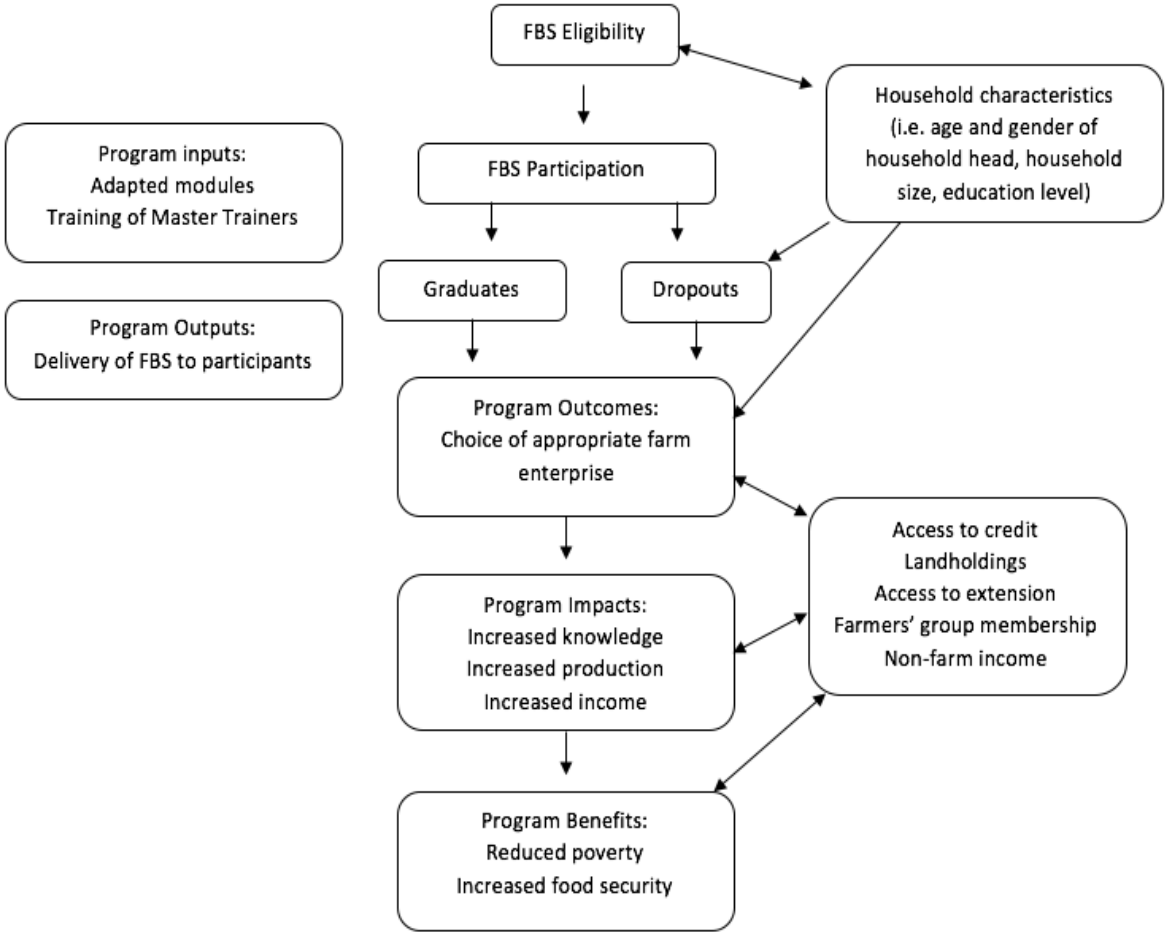
In all cases, the data collection tools were pre-tested. The survey questionnaire was pre-tested in the Mitundu EPA of Lilongwe as well as Bembeke EPA in Dedza district. Both FGDs and KIIs were pre-tested in Bembeke EPA.

In this study, the household formed the unit of analysis. Only those household members who farmed and participated in FBS were interviewed, to ensure validity of data regarding FBS participation, crop production, input use, and input and output prices. Using FBS participants' household listing, simple random sampling procedures were used to select only one member who participated in FBS for interviews in households with multiple FBS participants. However, there were very few cases where multiple FBS participants were found in a single household. Understanding opportunities and challenges in FBS participation among females and males in the households was addressed through the FGDs.

2.3 Conceptual Framework

Figure 2 presents a conceptual framework of the potential impact pathways of FBS participation, and indicates that there are stipulated eligibility conditions that farmers must satisfy in order to participate in FBS. Among those eligible to join FBS, farmers can choose whether or not to participate in the program, a decision which is assumed to be influenced by socio-demographic factors such as age, sex, marital status, education, landholding size, household size, non-farm income, distance to market, access to extension services, membership in farmer clubs and access to credit, among others.

Figure 2. Conceptual framework of pathways through which FBS participation affects crop incomes.



Source: constructed by authors

Among those who make the initial decision to participate in the program, some farmers graduate while others drop out. Depending on the point at which individuals leave the program, dropouts may or may not acquire the same knowledge as FBS graduates, and may or may not experience the program outcomes, impacts and benefits described in Figure 2.

2.4 Variable Description

Table 1 presents descriptions and expected influence of the explanatory variables on FBS participation that were used in this analysis.

The age of household head was expected to have mixed effects on a farmer's decision to join FBS. Younger farmers may be more willing to participate in FBS relative to older farmers, who may be

more risk averse than the former (Bocquého et al. 2011; Alexander and Van Mellor 2005; Mauceri et al. 2005). On the other hand, older farmers who have experienced benefits from farming may be more interested in exploring other ways of increasing agricultural production and farm income than their younger counterparts (Maganga et al. 2015; Mignonouna et al. 2011; Kariyasa and Dewi 2011).

Table 1. Explanatory variables' units of measurement and expected effects on FBS participation.

Variable	Unit of measurement	Expected effect
Household head's and participant's age	Continuous; years	+/-
Household head's and participant's gender	Binary; 1= Male 0 = Female	+/-
Household head's and participant's marital status	Binary; 1= Married, 0 = otherwise	+/-
Household head's and participant's education	Continuous; Number of years in school	+/-
Household size	Count; Number of adults in household	+
Cultivated cropland (2011)	Continuous; hectares	+/-
Main occupation of household head and participant	Binary; 1= Farming	+
Access to off-farm income	Binary; 1=Yes	-
Value of off-farm income	Continuous; Malawian Kwacha (MWK) per year	-
Membership in farmer clubs	Binary; 1= Yes	+/-
Household credit constrained	1= did not borrow but needed it 0= did not borrow because did not need it	-
Have access to extension services	Binary; 1= Yes	+
Distance to nearest produce market	Continuous; Kilometers	+
Community has agricultural project	Binary; 1 = Yes	
Produce maize	Binary; 1 = Yes	-
Produce beans	Binary; 1 = Yes	+
Produce soybeans	Binary; 1 = Yes	+
Produce groundnuts	Binary; 1 = Yes	+
Produce Irish potatoes	Binary; 1 = Yes	+

The effect of the gender of household head on joining FBS was analyzed from the viewpoint that men and women play different economic roles on the farm. The variable was measured as 1 and 0 for households whose head was male and female, respectively. It was expected that female household heads would be more willing to participate in FBS when the content promotes food production, as women tend to be more concerned with attainment of household food security while men focus more on cash crops (Mignonouna et al. 2011, Obisesan 2014, Lavison 2013, Jaitner et al. 2001). This study expected sex of household head to have mixed effects on household participation in FBS.

Being married was hypothesized to have a positive influence on a farmer's decision to join FBS. The dummy variable was measured as 1 if farmers were married and 0 otherwise (combining never married, widowed, separated and divorced). Farmers who are married make unified decisions with minimum risk aversion to adopt an improved technology if it is believed to improve the socioeconomic status of the household (Maonga, Maganga and Haraman 2013). Moreover, being married may indicate more available human resources to attend to various activities, including FBS participation. Household size, which was measured as the number of adults living under one roof and sharing food from the same pot, can similarly indicate availability of human

resources for different tasks. In households with more adults (15-65 years old) than children and adolescents (0-14 years old), there is increased division of responsibilities (NSO 2014). A larger household with more adults stands a greater chance of being represented in various agricultural activities, including FBS (Mignouna et al. 2011; Bonabana-Wabbi 2002).

Education was expected to have mixed effects on a farmer's decision to join FBS. Education was measured as the number of years that the household head spent in school. We expected that educated farmers would have an increased ability to understand, process and evaluate the benefits and costs of new technologies and interventions, and thereby adopt or not (Mignouna et al. 2011; Lavison 2013; Namara, Weligamage and Barker 2003; Waller et al. 1998; Uematsu and Mishra 2010).

Cropland cultivated, measured as the total number of hectares that the entire household cultivated across various crops, was included. This study expected cropland to positively influence the decision to join FBS. With larger farm sizes, households may manage to diversify land use decisions, such as having multiple farm enterprises, cropping systems or patterns (Mignouna et al. 2011; Ahmed 2004; Uaiene, Arndt and Masters 2009). These motivate the household to seek more knowledge of farm planning and management from different agricultural development interventions, including FBS.

The household head's main occupation was included in the analysis as a dummy variable equal to 1 if the main occupation was farming. Households who rely on farming as their primary livelihood are expected to be more willing to participate in FBS to improve their main source of income (Maonga et al. 2013). It is also expected that these households would have fewer competing demands on their time and be able to better implement agricultural activities and suggestions from FBS.

Off-farm income was included both as a dummy variable, measured as 1 if a household has off-farm income and 0 otherwise, and as a continuous variable measured in Malawi Kwacha (MWK) per year. The study hypothesized that off-farm income would positively influence a farmer's decision to participate in FBS, as off-farm income can be used as capital to purchase farm inputs, particularly when credit is a constraint (Diiro 2013; Reardon, Stamoulis and Pingali 2007; Ellis and Freeman 2004).

Membership in a farmers' club was expected to have a positive effect on a farmer's decision to join FBS. Farmers' clubs are the most basic, informal forums of farmers, organized for purposes such as easy access to inputs and collective marketing. Farmers who are members of farmers' clubs may already experience benefits from sharing information and learning from one another (Davis et al. 2010; Uaiene, Arndt and Masters 2009; Mignouna et al. 2011). Having experienced the benefits of being in clubs, farmers may be interested and more willing to participate in FBS to learn about market-oriented farm business planning and management not taught in their respective farmers' clubs.

The study hypothesized that credit-constrained households would be less likely to participate in FBS. Credit constraints were included in the analysis as a dummy variable, measured as 1 if the household did not borrow credit but needed it and 0 if household did not borrow credit because they did not need it. Agricultural credit is key to providing capital for on-farm investments related

to improved management (Maonga, Maganga and Kankwamba 2015). Farmers who are unable to access needed loans may be less willing to participate in FBS, as they lack the means to act on the knowledge acquired (Muzari and Muvhunzi 2012; Mohammed and Temu 2008).

The study hypothesized that farmers with access to field-level extension workers would be more likely to participate in FBS than those who do not receive extension services. The variable was measured as 1 if a farmer received extension advice from any source, and 0 otherwise. Agricultural extension workers serve as the main carriers of extension advice, and they also serve as agricultural intervention awareness agents for farmers (Genius et al. 2010; Mignouna et al. 2011; Akudugu et al. 2012). Coupled with the opinion that many farmers have of extension workers as credible and reliable sources of information (Rogers 2003), it is easier for farmers in contact with extension workers to participate in FBS than farmers who do not have this connection.

Distance to the nearest produce market was expected to have a negative influence on a farmer's decision to join FBS. Farmers trying to increase agricultural production to increase their household income are reliant on bringing their products to market. Farmers who travel fewer kilometers to market would be motivated to participate in FBS to learn about farm business planning and management for improved agricultural production, which they can sell more easily than their counterparts who must travel long distances (Davis et al. 2010; Muzari and Muvhunzi 2012). Being closer to markets is also associated with reduced transportation costs, which may free up capital for re-investment in improved technologies or other farm inputs.

The presence of other agricultural projects in the community, measured as a dummy variable equal to 1 when other agricultural projects were ongoing, was expected to have a negative effect on farmers decision to participate in FBS. In this study, agricultural projects were defined as ongoing activities with a focus on raising agricultural productivity, access to markets, reducing risk and vulnerability, or improving farm incomes. Therefore, the presence of other projects whose objectives are similar to the objective of FBS would result into less willingness to participate in the new intervention like FBS.

The study hypothesized that households growing maize in 2011, at the onset of the FBS program, would be less likely to participate in FBS than farmers who did not grow maize. This is because maize is taken as food crop rather than a cash crop for most smallholder farmers in Malawi (GoM 2012). Maize does not require special skills or knowledge apart from extension advice on crop husbandry practices provided by field extension workers. Therefore, farmers would not be willing to participate in the yearlong FBS in order to gain agribusiness knowledge related to maize production. The variable was measured as 1 if the household grew maize and 0 otherwise.

Production of cash crops in 2011 was hypothesized to have a positive effect on a farmer's decision to join FBS. Separate dummy variables were included for the production of beans, soybeans, groundnuts and Irish potatoes. Farmers who grow cash crops were assumed to be more willing to participate in FBS in order to learn to make better market-oriented production decisions and generate higher farm incomes.

2.5 Empirical Strategy

This section presents an overview of the framework used to measure the impact of FBS participation on farmer incomes. In this analysis, gross margin was calculated as the total revenue minus the total variable cost of production for maize, beans, soybeans, groundnuts and Irish potatoes, represented as:

$$\text{Gross margin} = \Sigma \text{ Total revenue} - \Sigma \text{ Total Variable Cost} \quad (1)$$

where total revenue and total variable cost are the sum of all values for maize, beans, soybeans, groundnuts and Irish potatoes. Variable costs of production are defined as costs that change with the level of output or scale of production. These are usually direct materials or labor used in production, such as inputs like seed, fertilizer and chemicals, the cost of transporting inputs and produce, labor (both hired and family labor) for farm activities, or rent paid for a piece of land. Therefore, total revenue and total variable cost are presented as:

$$\text{Total revenue} = \text{Total quantity of crops produced} * \text{Market price} \quad (2)$$
$$\text{Total variable cost} = \text{Total quantity of output} * \text{Variable cost per unit of output} \quad (3)$$

Gross margin was chosen as the basis for evaluating the impact of FBS because it accounts for the value of all crop production, before considering consumption, sale, or seed recycling. It provides a clear picture of crop production levels and income realized from the selected crops analyzed in this study. Other measures of FBS program evaluation are presented in the Appendix.

The study specifically measured the Average Treatment on the Treated (ATT), expressed in equation 4 below. It should be noted that the study evaluated the impact of FBS by comparing both farmers who participated in FBS (treated) and farmers who did not participate in FBS (control), as well as farmers who participated in FBS and graduated (treated) relative to farmers who participated in FBS and dropped out (control).

$$ATT = E(Y_i\ (1) - Y_i\ (0) | D_i\ = 1, X_i\ ) \quad (4)$$

where D_i denotes a binary dependent variable indicating household i participation in FBS or graduating from FBS, Y_i represents an outcome variable of household i as a function of participation or graduation, X_i are characteristics of household i. ATT is the average difference between gross margin of treated and counterfactual gross margin if they had not participated in FBS or graduated from FBS.

To identify ATT, strong ignorability assumptions as indicated by Ruben (1978), and also known as unconfoundness by Imbens and Angrist (1994) were considered, as given in equation 5. If valid, the assumption implies that there is no bias resulting from omitted variable once X is incorporated in the equation, and hence there will be no confounding. Another assumption considered was the overlap assumption, which certifies that each value of X has both treated and untreated cases, implying that the treated and control groups have comparable observed characteristics (Rosenbaum and Rubin 1983), given as:

$$Y(1), Y(0) \perp\!\!\!\perp D | X \quad (5)$$
$$0 < \Pr(D = 1) \equiv P(X) < 1 \quad (6)$$

The overlap assumption given by equation 6 implies a positive probability of participation and non-participation, as well as graduating and dropping out.

Estimation of ATT was based on propensity score matching (PSM). PSM uses observable characteristics, for example household or individual-level demographics, to estimate the probability of participating in a treatment (i.e. FBS) and create a statistical control group. The probability of participation is then used to match "observationally similar" participants and non-participants, in order to measure the average difference between a chosen outcome (i.e. gross margin) between the two groups (Khandker, Koolwal and Samad 2009). This approach is useful given that the treatment, participation in FBS, was not randomized.

Various PSM approaches were used in this analysis, including Nearest Neighbor Matching (NNM), Radius Matching, Kernel Based Matching (KBM) and Stratification. To ensure that there are no variations across the observations between treated and control groups, the process of coming up with the best match is more or less like trial and error, hence using several matching algorithms widens the chance of getting the best match. NNM was conducted with replacement, whereby all observations in the treated group are matched with the nearest observations in the control group using propensity scores. Radius matching uses all the comparison observations contained in a pre-defined distance around the propensity scores. This allows higher precision than fixed NNM in regions that have many similar comparison observations. KBM matches every treated observation with all the control observations, and a higher weight is given to treated and control observations with the closest propensity score. Stratification divides the common support of propensity scores into a set of intervals or strata and calculates the impact in each strata by taking the mean difference in outcomes between treated and control groups.

Considering the assumption of ignorability, potential outcomes are independent of treatment, conditional on the probability that the farmer participates in FBS, or the propensity score $P(X)$. The first term in the left-hand side of equation 4 denotes the average of the actual outcomes of participants or graduates, and on the left denote average outcome of the non-participants or dropouts who were matched with participants or graduates according to the propensity scores.

3. RESULTS AND DISCUSSION

3.1 Descriptive Analysis

The descriptive analysis compares socioeconomic and outcome indicators among FBS participants, non-participants, graduates, and dropouts (Table 2). Means presented for binary variables can be interpreted as response frequencies; for example, 74 percent of participants and 79 percent of non-participants were in male-headed households.

A total of 37 percent of FBS participants did not complete the FBS program (henceforth referred to as "dropouts"); the most common reasons given for drop-out were that the facilitator was unavailable or the program did not continue for various reasons (i.e., lack of resources). Some participants who dropped out reported simply losing interest.

There were significant differences between households participating in FBS and those not participating, signaling selection bias that needed to be controlled for (Table 2). FBS participants were older on average than non-participants. Participants had higher average non-farm incomes, and were less credit constrained than non-participants. Participants also had greater access to

extension services on average, and were more likely to be part of farmers' clubs than non-participants. They are also more likely to grow all crops examined (maize, beans, soybeans, groundnuts and Irish potato).

On the other hand, graduates and those who did not continue the program were very much alike, with a few exceptions. Graduates were generally older than dropouts and located in communities closer to market. Further, graduates were more likely to be in communities with agricultural projects and programs, and they had greater off-farm incomes. This shows that both graduates and dropouts are both productive and income-oriented, although the value of off-farm income for graduates is significantly higher than dropouts. Graduates were also more likely to grow maize and groundnuts than FBS dropouts. Having completed FBS training sessions, graduates are able to determine viable and profitable crop enterprises, such as maize and groundnuts, unlike FBS dropouts.

Table 2. Descriptive Statistics of Explanatory Variables

Explanatory variables	Total	Participants	Non-participants	Diff. /a	Graduates	Dropouts	Diff. /b
			Mean (standard deviation)				
HHH Age	45.00 (15.25)	47.00 (12.00)	41.00 (13.00)	***	48.00 (12.00)	44.00 (12.00)	**
HHH Gender (1=male)	0.75 (0.43)	0.74 (0.43)	0.79 (0.40)		0.75 (0.42)	0.71 (0.45)	
HHH formal education (years)	6.00 (3.75)	6.00 (3.00)	6.00 (3.00)		6.00 (3.00)	6.00 (3.00)	
Distance to market (km)	6.73 (5.90)	6.60 (6.10)	6.70 (5.30)		6.50 (6.10)	7.10 (6.10)	***
HHH marital status (1=married)	0.74 (0.55)	0.73 (0.44)	0.78 (0.41)		0.74 (0.44)	0.72 (0.45)	
HH size (# of adults)	3.00 (1.00)	3.00 (1.00)	3.00 (1.00)		3.00 (1.00)	3.00 (1.00)	
HHH Main occupation (1=farming)	0.90 (0.29)	0.92 (0.26)	0.80 (0.40)	***	0.92 (0.26)	0.94 (0.23)	
HH has off-farm income (1=yes)	0.62 (0.48)	0.60 (0.49)	0.66 (0.47)		0.62 (0.48)	0.58 (0.49)	
Value of non-farm income (MWK/year)	132,785 (263,113)	144,946 (312,890)	97,569 (163,758)	**	160,228 (348,331)	128,399 (227,476)	***
Cultivated cropland (2011) (hectares)	1.10 (0.77)	1.07 (0.43)	0.83 (0.45)		1.20 (1.10)	1.30 (1.10)	
HH credit-constrained (1=yes)	0.58 (0.48)	0.54 (0.49)	0.73 (0.44)	***	0.55 (0.49)	0.49 (0.50)	
Access to extension (1=yes)	0.88 (0.27)	0.95 (0.21)	0.67 (0.47)	***	0.94 (0.23)	0.96 (0.17)	
Member of farmers' club (1=yes)	0.71 (0.41)	0.81 (0.39)	0.4 (0.49)	***	0.82 (0.38)	0.82 (0.38)	
Community has agricultural project (1=yes)	0.36 (0.47)	0.43 (0.49)	0.23 (0.42)	***	0.46 (0.50)	0.33 (0.47)	**
Produce maize (1=yes)	0.97 (0.12)	0.98 (0.10)	0.93 (0.24)	***	0.98 (0.13)	1.00 (0.00)	**
Produce beans (1=yes)	0.52 (0.49)	0.56 (0.49)	0.41 (0.49)	***	0.58 (0.49)	0.54 (0.50)	
Produce soybeans (1=yes)	0.61 (0.49)	0.65 (0.48)	0.52 (0.5)	***	0.66 (0.47)	0.61 (0.49)	
Produce groundnuts (1=yes)	0.51 (0.49)	0.57 (0.49)	0.36 (0.48)	***	0.62 (0.48)	0.50 (0.5)	*
Produce Irish potato (1=yes)	0.30 (0.44)	0.35 (0.48)	0.12 (0.33)	***	0.34 (0.47)	0.38 (0.48)	

*NOTES: *p < 0.10, **p < 0.05, ***p < 0.01.*
HH = household; HHH = household head
/a = statistical significance of the mean difference between participants and non-participants
/b = statistical significance of the mean difference between graduates and dropouts.

With regard to outcome variables, participants were very different from non-participants (Table 3). Participants produced higher quantities of maize than non-participants. In terms of the cash crops, more beans, soybeans, groundnuts and Irish potatoes were produced by participants than non-participants. Participants had greater values of production overall and higher incomes. On the other hand, FBS graduates are generally similar to the dropouts. A few noticeable differences include lower maize and Irish potato production, and lower value of production overall than dropouts. Nonetheless, graduates and dropouts had similar levels of farm incomes on average.

Table 3. Descriptive Statistics of Outcome Variables

	Total	Participants	Nonparticipants	Statistical difference /e	Graduates	Dropouts	Statistical difference/f
N	455	252	203		162	84	
Mean (standard deviation) of production in kilograms							
Maize	1444 (1,224)	1,616 (307)	880 (1,004)	***	1,575 (1,357)	1,707 (1,228)	***
Bean	95 (428)	109 (179)	48 (116)	***	105 (190)	119 (1,228)	
Soybean	165 (192)	189 (264)	102 (152)	***	193 (190)	175 (163)	
Groundnuts	124 (212)	143 (228)	73 (186)	***	157 (249)	122 (184)	
Irish potato	259 (618)	324 (789)	91 (364)	***	291 (701)	328 (618)	***
Total (all crops)	1,018 (1,220)	1,197 (1,382)	520 (979)	***	1,131 (1,260)	1,223 (1,260)	***
Mean (standard deviation) value in Malawian Kwacha (MWK)							
Crop produce /b	477,140 (401,188)	557,331 (474,631)	249,710 (294,034)	***	539,467 (422,744)	562,051 (413,341)	
Produce sold /c	247,072 (3025,48)	299,343 (387,105)	112,892 (204,477)	***	277,522 (297,309)	298,529 (321,303)	
Gross margin /d	217,543 (307,554)	301,286 (383,790)	-15,316 (177,209)	***	291,608 (354,410)	292,595 (314,808)	

*NOTES: * p < 0.10, ** p < 0.05, *** p < 0.01. Standard deviation in parentheses*
/a = total average quantity produced from maize, beans, soy beans, groundnuts and Irish potatoes.
/b = total average quantity of the five selected crops produced times average market prices for each crop.
/c = total average quantity that was sold only by households times average market prices for each crop.
/d = difference of gross income and total cost of production for the five selected crops.
/e = mean difference between participants and non-participants.
/f = mean difference between graduates and dropouts.

3.2 The Impact of FBS Participation

Farmers' Satisfaction with FBS Facilitation and Implementation

In terms of farmers' satisfaction with FBS facilitation and implementation, the majority of participants (both FBS participants who graduated and those who dropped out) were satisfied with FBS facilitation and implementation. With regard to participation, respondents were asked primarily about how the facilitator conducted training sessions and delivery of the training materials to participants. Questions regarding FBS implementation were meant to capture how participants felt that the FBS program faired in general. Seventy-nine percent of participants reported being very satisfied with FBS facilitation, while 14 percent indicated to have been somewhat satisfied, and the rest were not satisfied. In terms of implementation, 67 percent indicated they were very satisfied with FBS implementation, while 21 percent were somewhat satisfied, and the rest were not satisfied (see Appendix, Figure A1).

Among participants who indicated they were very satisfied with FBS facilitation, the stated reasons were[3]: (1) the facilitator explained things very well, using practical examples; (2) participants were able to understand what they were being taught; (3) the facilitator taught patiently, and was committed and dedicated; (4) group lessons were very good; (5) training sessions were taught in vernacular language; (6) the trainer was approachable; and (7) the training sessions were interactive.

[3] Questions were open ended and as such the responses came directly from respondents.

Among participants who indicated they were very satisfied with FBS implementation, the stated reasons were: (1) farmers received certificates for FBS attendance; (2) FBS helped farmers plan markets for produce; (3) the training sessions were educational; (4) FBS as a program did not lack resources; (5) farmers who were participating received notebooks; and (6) farmers completed training sessions. However, as previously noted, these reasons all relate to the implementation of FBS and do not necessarily translate to actual outcomes in terms of production or income increases.

Farmers who were somewhat or not satisfied with FBS facilitation stated the following reasons for their dissatisfaction: (1) the facilitator was mostly unavailable; (2) the facilitator was blunt; (3) the facilitator was a drunkard; (4) the facilitator was not very serious; and (5) the facilitator did not provide participating farmers with manuals. In terms of FBS implementation, participants who were somewhat or not satisfied felt that way because: (1) participants did not receive the certificates after completing the training sessions; (2) there were no follow-up visits after training; (3) farmers still have problems with access to markets; (4) farmers were promised improved seed and bicycles but did not receive them; (5) there were no field visits (visiting fellow FBS participants in other districts to learn what other FBS farmers are doing), only field practical applications; and (6) farmers were not allowed to ask questions.

> *"Some facilitators were not available all the time; as a result some sessions were not completed and even certificates were not given." - Female FGD participant*
>
> "*After graduation they no longer came to visit us, that was the time they stopped visiting us." - Male FGD participant*

Topics Learnt by Farmer Business School Participants

The majority of participants indicated that they learned new concepts from the FBS training sessions. Figure A2 in the Appendix lists topics learned by FBS participants. The majority of participants (54 percent) reported having learned about gross margin analysis, while 32 percent learned about food planning. The topic the fewest number of farmers reported learning about was credit, which only 10 percent reported having learned about. Other topics that the farmers recalled learning about were new farming technologies, manure production and application, hybrid seed varieties, climate change adaptation, groundnut production and marketing, as well as crop husbandry practices. One FGD respondent also reported, "*We were taught on food consumption, nutrition and commercial farming. These concepts helped us to raise income out of farming, and thereby defeating poverty which was our earlier purpose of participating in FBS" (Female FGD participant).*

Through FGDs, Some FBS participants attested to the good practices that the program had brought to their communities. The training sessions provided participants with information on best practices in time management, calculating break-even crop prices, crop husbandry practices such as crop rotation and appropriate spacing, recordkeeping, searching markets for good prices, calculating profits and gross margins, and modern storage techniques.

"I learned how to calculate the cost of all farm inputs and the totals from all farm outputs." - Female FGD participant

"*Farming is business, so differentiating the returns and harvests from hybrid and local seeds is important, and also how to calculate a base price for commodities and making farm records" - Male FGD participant*

Some FGD participants also alluded to changes in people's behavior after attending FBS. Some participants mentioned being able to teach others about modern farming techniques, as well as being able to pay school fees for their children; "*Yes, we have changed. We belong to clubs and we have taught our fellow farmers about farm business management and we have reached out to 20 people in our club" (Male FGD participant)*.

Changes in Outcome Indicators Before and After Farmer Business Schools

The study examined the changes in outcome indicators, such as farm income, quantities of various crops produced, and household assets and expenditures, before and after FBS participation. In order to derive a comparable measure of change in outcome indicators among non-participants, non-participants were asked about changes in these outcome indicators between 2011 and 2016. While FBS is an ongoing program, the time period between 2011 and 2016 served as the time period that FBS was implemented when the survey was conducted in 2017. Almost all non-participants reported no change in the outcome indicators examined between 2011 and 2016. As such, the change in outcomes for participants is similar to the difference-in-difference between participants and non-participants.

Table 4 compares average values for outcome indicators among participants and non-participants, as well as between graduates and dropouts. FBS participation had positive effects on some outcome indicators, although the magnitude of these effects was minimal. Outcome indicators include measures of crop production and ownerships of assets. Earlier fieldwork by the authors showed that smallholder farmers often report measures of progress in the form of building houses with iron sheets, purchases of irrigation equipment and knapsack sprayers, bicycles, cellphones, radio, livestock, fertilizer, opening of bank accounts and payment of school fees for household members.

Only 13 percent of FBS participants reported experiencing positive changes in farm income from FBS participation, while the remaining 87 percent did not experience any change. The average change in farm income that can be attributed to FBS participation is MWK 14,730 (USD 20) per household per year, in comparison to zero for non-participants. Greater funds allocated for school fees reported by FGD participants did not materialize among surveyed households; only 8 percent of surveyed households allocated more money to school fees. Across all outcome indicators, only a few FBS participants experienced substantial changes in their incomes and assets, while the vast majority did not experience any change. It is also important to note that there is little difference between graduates and dropouts in terms of their outcome changes before and after FBS.

Table 4. Differences in the changes in outcome indicators before and after FBS between participants and non-participants, and between graduates and dropouts.

Outcome indicators	% of FBS participants with positive effect	Diff. in changes in outcomes between participants and non-participants	Diff. in changes in outcomes between graduates and dropouts
Farm income and production			
Farm income (MWK) [/a]	13	14,730.00*** (2,379.00)	-13,766.00 (3,740.00)
Quantity of maize produced (kg)	29	564.00*** (264.00)	-16.00 (209.00)
Quantity of beans produced (kg)	8	30.00*** (13.00)	-62.00* (65.00)
Quantities of soybean produced (kg)	13	66.00*** (11.00)	-45.00 (48.00)
Quantities of groundnuts produced (kg)	10	35.00*** (17.00)	33.00 (18.00)
Quantities of Irish potato produced (kg)	10	50.00** (23.00)	-120.00* (19.00)
Quantities of tomato produced (kg)	2	35.00 (17.00)	-3.00 (6.00)
Assets and Expenditures			
Iron sheets house (0/1)	13	0.13*** (0.34)	-0.02 (0.34)
Irrigation equipment (#)	6	0.06*** (0.14)	0.04 (0.08)
Knapsack sprayer (#)	1	0.00 (0.06)	0.01 (0.11)
Bicycle (#)	4	0.04*** (0.23)	-0.02 (0.23)
Cell phone (#)	2	0.02 (0.15)	-0.05*** (0.01)
Radio (#)	2	0.02** (0.18)	0.00 (0.15)
Livestock (#)	19	1.28*** (4.00)	0.70 (0.26)
Fertilizer (quantity purchased in kg)	17	12.60*** (1.25)	-10.00 (4.40)
Bank account (0/1)	7	0.07*** (0.25)	-0.02 (0.26)
School fees (MWK)	8	2,570.00** (1,956.00)	1,558.00 (2,319.00)

*NOTES: Significantly different between participant and non-participant; and between graduate and dropout at *p < 0.10, ** p < 0.05, *** p < 0.01. Standard deviations are in parentheses.*

Given the reliance on recall data to mimic the baseline data, which may have some degree of bias, we compared the results from employing matching techniques, which are discussed next.

Impact of FBS Participation and Graduation based on Matching Procedures

To ensure comparability between the intervention and comparison groups, we first examined how FBS participation and FBS graduation is determined using a probit model to derive propensity scores. The FBS participation probit results indicated that age of household head, cropland, receipt of agricultural extension advice, club membership and production of cash crops such as beans, soybeans, groundnuts and Irish potatoes had a positive and significant effect on FBS participation, while credit constraints had a negative and significant influence on FBS participation (Table 5).

Table 5. Determinants of FBS participation and graduation.

	Participants v. non-participants		Graduates v. dropouts	
Explanatory variables	**Coefficient**	**standard error**	**Coefficient**	**Standard error**
HHH age /a	0.018***	0.006	0.018*	0.007
HHH gender (1=male)	-0.035	0.234	0.590	0.376
HHH education (years)	0.009	0.211	0.044	0.027
Distance to market (km)	-0.013	0.012	-0.009	0.014
Married (0/1)	-0.238	0.234	-0.438	0.050
HH size	0.026	0.037	0.076	0.358
Main occupation farming (0/1)	0.027	0.210	-0.147	0.476
HH has non-farm income (0/1)	0.164	0.417	0.520	0.041
Log non-farm income (MWK/year)	-0.011	0.036	-0.030	0.203
Cultivated cropland (ha) (2011)/b	0.336**	0.156	-0.130	0.179
HH Credit constraint (0/1)	-0.432***	0.144	0.104	0.406
Access to extension (0/1)	0.966***	0.209	-0.270	0.234
Member of farmers' club (0/1)	0.843***	0.152	0.027	0.183
Community has agricultural project (0/1)	0.186	0.153	0.320*	0.829
Produce maize (0/1)	0.496	0.371	0.115	0.207
Produce beans (0/1)	0.210*	0.127	0.159	0.171
Produce soybeans (0/1)	0.268**	0.130	0.080	0.178
Produce groundnuts (0/1)	0.533***	0.129	0.259	0.181
Produce Irish potato (0/1)	0.840***	0.161	-0.050	0.207
Constant	-2.261		-0.965	
P-value	0.000		0.000	
Pseudo	0.258		0.059	
Observations	455		246	

*NOTES: Statistical significance is indicated by * p < 0.10, ** p < 0.05, *** p < 0.01. HH= household, HHH= households head*
/a = Instead of household head, participant's characteristics were also tried. Results are similar since almost all participants are the household heads themselves.
/b = total farm size used for production of crops before joining FBS in 2011

Table 5 implies that, as the head of household head ages, members of the household are more likely to participate in FBS. This can be attributed to the fact that as they age, farmers become knowledgeable and experienced in assessing technology and interventions information, resulting in farmers becoming less risk averse and more willing to adopt new technologies (Maonga, Maganga and Haraman 2013; Mignouna et al. 2011; Kariyasa and Dewi 2011). With larger farm sizes, farming households are more likely to diversify land use decisions, such as having multiple farm enterprises, or cropping systems or patterns, and would be more willing to participate in FBS in order to acquire agribusiness knowledge.

Farmers who receive agricultural extension advice are more likely to participate in FBS. This is likely because FBS was primarily promoted amongst farmers through extension workers; who are viewed as important source of reliable and credible information (Rogers 2003). The results therefore indicate a positive correlation between extension services and agricultural technology adoption (Mignouna et al. 2011; Karki and Soegfried 2004; Uaiene, Arndt and Masters 2009; Sserunkuuma 2005; Akudugu et al. 2012). This aligns with FGDs responses, in which most participants indicated they became aware of FBS through field extension workers.

Farmers who were members of a farmers' club were more willing to participate in FBS. Farmers who are already active in a club may be aware of the benefits of collective learning and collaboration, and therefore more willing to explore other ways of improving their livelihoods (Mignouna et al. 2011; Uaiene, Arndt and Masters 2009; Davis et al. 2010). In some FGDs, farmers indicated that they were already members of a horticultural association which provided them with the opportunity to be integrated in FBS. Farmers growing cash crops such as beans, soybeans, groundnuts and Irish potatoes may be more willing to participate in FBS to learn better ways of producing and marketing these crops. This is also in line with the FGDs, in which farmers indicated that they joined FBS in order to market their commodities collectively, specifically Irish potatoes, with the aim of adding value and increasing their profits through aggregation.

Lack of credit decreased the likelihood of farmers' participation in FBS, possibly because moving from subsistence farming to farming as business requires capital for enterprise growth and expansion. Farmers without access to capital may be less motivated or discouraged from participating in FBS knowing that they will not be able to apply the knowledge gained in their respective agricultural enterprises. This is in line with FGD participants reporting being discouraged by their non-participating counterparts that FBS were a waste of time because the program did not issue loans.

Age of household head, household size and growing of groundnuts were positively associated with FBS graduation. Farmers whose household heads are older are also more likely to complete FBS training sessions and graduate. Presence of other agricultural projects influences farmers motivation to graduate from FBS; given the opportunities granted by interventions aimed at increasing agricultural productivity and farm incomes in their communities, farmers are motivated to explore and exploit all the existing opportunities to improve their livelihoods.

Having ensured that the treatment and the comparison groups satisfy the balancing property, we estimated the PSM estimator using serval matching algorithms; Nearest Neighbor Matching (NNM), Kernel Based Matching (KBM), Radius Matching and Stratification. The standard errors were obtained by bootstrapping based on 50 replications (Smith and Todd 2005). Bootstrapping of standard errors is done to prevent larger variations in PSM estimators, which use several steps in estimating PSM such as propensity score estimation and matching procedures. The results of ATT on crop enterprise gross margin are presented in Table 6.

Table 6. ATT on crop enterprise gross margin

Matching algorithm	Treated (N)	Comparison (N)	ATT[/a]	Standard Error[/b]
Participants v. non-participants				
NNM	252	80	194,000***	43,472.35
KBM	252	148	150,000***	39,838.84
Radius	252	148	159,000***	38,213.17
Stratification	252	148	149,000***	51,333.81
Graduates v. dropouts				
NNM	162	54	-13,600	72,293.04
KBM	162	80	-326	50,463.90
Radius [/b]	162	80	-5904	61,200.72
Stratification	162	62	-15,100	53,822.18

*NOTES: Statistical significance is indicated by * p < 0.10, ** p < 0.05, *** p < 0.01.*
/a where ATT is negative, it implies that the cost of variable cost of production was higher than the total revenue from sales of crops
/b = radius of 0.1

The results of PSM estimation indicate that the differences in crop gross margin between participants and matched non-participants groups ranged from MWK 149,000 (USD 207) to MWK 194,000 (USD 269) (Table 6). All these differences are statistically significant at the 1 percent level. However, if graduates and dropouts of FBS are considered, the differences in negative gross margin ranged from just MWK 326 (USD 0.45) to MWK 15,100 (USD 21) and are not statistically different from each other.

We also estimated the ATT on average total quantity of crops produced, average value of crops produced, and the average value of crops sold (Appendix, Tables A1-A3). The results are similar to the gross margin analysis: there were statistically significant differences in the ATT between participants and non-participants of FBS, but no differences in ATT between FBS graduates and dropouts was detected. Farmers who participated in FBS had higher quantities of crops produced, value of crops produced, value of crops sold, and farm incomes. On the other hand, farmers who graduated from the program had slightly lower quantities and values of crop production and sales (although not statistically different) than those who dropped out of the program. These findings suggest that completing the FBS program does not result in higher farm production, sales and income. The positive and statistically significant ATTs between participants and non-participants in FBS reflect unobserved differences (heterogeneity) between those who choose to join FBS and those who did not.

Putting the results from various techniques together (FGDs, DID, and PSM), we observed mixed results of the impact of FBS on the incomes of smallholder farmers. For participation, our results seem to be consistent with earlier findings of FFS in other countries. Todo and Takashi (2011) indicated that FFS participation increased farmers' incomes by 46 to 164 percent in Ethiopia, while Davis et al. (2010) found that FFS participation increased farmers' incomes by 61 percent in Kenya, Tanzania and Uganda. Nonetheless, the insignificant difference between graduates and dropouts points to a more nuanced interpretation of the results. The simple difference-in-difference analysis based on recall data shows some positive effect of FBS, but the magnitude is minimal, and only a few farmers have experienced any positive effect after FBS participation. The FGDs also paint a mixed picture of the performance of FBS, in which there is clearly knowledge gained by farmers, but this is often not translated into increased production and incomes.

3.3 Challenges for Farmer Business Schools and the Way Forward

The challenges that emerged from both the household surveys and FGDs for FBS are summarized in table 7, along with proposed adjustments to the FBS suggested by FGD participants.

Table 7. Challenges and proposed adjustments to FBS from surveys and focus groups discussions

Challenges encountered in FBS	Proposed Adjustment to FBS
No follow up visits were made by field extension workers after graduation	Implement routine follow-up visits to farmers after graduation
No updates on new developments in agricultural activities provided to graduates after graduation	Issue certificates after graduation
Promises extension workers made to participants related to improved seed varieties were not met	Reference books should be supplied in Chichewa
Poor farmers had no access to loans, and as such perceived participation in FBS to be a waste of time	Full time facilitators should be employed to provide regular re-training and support to farmers
No promotion of peer interaction through exchange programs	Peer exchange programs should be promoted
FBS certificates were not issued to graduating farmers	Physical infrastructure for FBS should be improved
FBS facilitators were not present to facilitate the training sessions, leading to farmers dropping out.	Instructors should work hard, be honest, committed and teach step by step for everybody to understand
	Loans should be issued to poor farmers

Note: Challenges were derived from household surveys; proposed adjustments emerged from Focus Group Discussions. Suggestions are in no particular order.

> *"They need to routinely check on us check on us after the program ends for schooling does not end and keep their words when it comes to giving certificates"- Male FGD participant.*
>
> *"The participants to FBS should be able to make trips to see and learn from farmers who are successfully implementing the practices that they are learning"- Female & Male FGD participants*

4. CONCLUSION

This study examines the impact of the implementation of Farmer Business Schools (FBS) by the Ministry of Agriculture, Irrigation and Water Development (MoAIWD) in central Malawi. Using the case of Dedza district, the study provides insights on the impact of FBS participation on smallholder farmers' crop incomes. We use a simple difference-in-difference (DID) method based on recall data, along with Propensity Score Matching (PSM) techniques, to measure impact while correcting for sample selection bias, and triangulate the responses with focus group discussions. We also compare those who graduated from the program with those who did not complete the program (37 percent of FBS participants). The various techniques suggest mixed results concerning the impact of FBS. The PSM results show that FBS participants have 66 percent higher crop incomes than non-participants. Nonetheless, an insignificant difference between the incomes of FBS graduates and dropouts points to a more nuanced interpretation of the results. The DID analysis shows some positive effect of FBS on farm income, but the magnitude of this effect is small (USD 20 per year on average), and only a few households experienced any positive effect after FBS participation. FGDs highlight mixed perceptions of FBS, as participants clearly gained knowledge but were not always able to translate this into to increased production and incomes. The FGDs also highlight many challenges and areas for improvement in the implementation of FBS.

REFERENCES

Ahmed, S. 2004. "Factors and Constraints for Adopting New Agricultural Technology in Assam With Special Reference to Nalbari District: An Empirical Study." *Journal of Contemporary Indian Policy* 11: 359-376.

Alderman, H., Gentilini, U., & Yemtsov, R. (Eds.). (2017). *The 1.5 Billion People Question: Food, Vouchers, or Cash Transfers?* The World Bank. https://doi.org/10.1596/978-1-4648-1087-9

Akudugu, M., E. Guo, and S. Dadzie. 2012. "Adoption of Modern Agricultural Production Technologies by Farm Households in Ghana: What Factors Influence their Decisions?" *Journal of Biology, Agriculture and Healthcare 2(3).*

Alexander, C.E., and T. van Mellor. 2005. "Determinants of Corn Rootworm Resistant Corn Adoption in Indiana." *AgiBioForum* 8(4): 197-204.

Bocquého, G., Jacquet, F. and Reynaud, A. 2011. *Determinants of Miscanthus adoption: An Empirical Investigation among French Farmers.* Paper for the 5émes *Journées Smallholder Farmers' de recherché en sciences socials*, INRA/SFER/CIRAD, December 8-9, Dijon,France, pp. 1-42.

Bonabana-Wabbi, J. 2002. "Assessing Factors Affecting Adoption of Agricultural Technologies: The Case of Integrated Pest Management (IPM) in Kumi District, Eastern Uganda". MSc. thesis, Virginia Polytechnic Institute and State University.

Birkhaeuser, D., R. Evenson, and G. Feder. 1991. "The economic impact of agricultural extension: A review." *Economic development and cultural change,* 39(3): 607-650.

Birner R., K. Davis, J. Pender, E. Nkonya, P. Anandajayasekeram, J. Ekboir , A. Mbabu, D. Spielman, D. Horna, S. Benin, and M. Cohen. 2006. *From Best Practice to Best Fit. A Framework for Analyzing Pluralistic Agricultural Advisory Services Worldwide.* ISNAR Discussion Paper No. 5, International Food Policy Research Institute, Washington, DC.

Braun, A., J. Jiggins, N. Röling, H. van den Berg, and P. Snijders. 2006. "A Global Survey and Review of Farmer Field School Experiences." Report prepared for the International Livestock Research Institute. Final Report, June 12. www.share4dev.info/kb/documents/1880.pdf.

CARE USA. 2013. *The Farmer Field and Business School*. Innovation Brief.

Chirwa, E.W., and M. Matita. 2012. *From Subsistence to Smallholder Commercial Farming in Malawi: A Case of NASFAM Commercialisation Initiatives*. Futures Agriculture Consortium (FAC) Working Paper 037. FAC, Brighton, UK.

Davis, K. 2006. "Farmer Field Schools: A Boon or Bust for Extension in Africa?" *Journal of International Agricultural and Extension Education* 13(1): 91-97.

Davis, K., E. Nkonya, E. Kato, D. Mekonnen, M. Odendo, R. Miiro, and J. Nkuba. 2010. *Impact of Farmer Field Schools on Agricultural Productivity and Poverty in East Africa*. IFPRI Discussion Paper 00992, International Food Policy Research Institute, Washington, D.C.

DDA (Dedza District Assembly). 2001. *Dedza District Socio-economic Profile*. Dedza, Malawi: Dedza District Assembly.

Diiro, G. 2013. *Impact of Off-farm Income on Technology Adoption Intensity and Productivity: Evidence from Rural Maize Farmers in Uganda*. International Food Policy Research Institute, Working Paper 11, Washington, DC.

Ecker, O., and M. Qiam. 2011. "Analyzing Nutritional impacts of Policies: An Empirical Study from Malawi." *World Development*, 39(3): 412-428.

Ecker, O., K. Pauw, and I. Verduzco-Gallo. 2012. *Did Malawi's Food and Nutrition Security Really Improve? A Comparative Analysis of 2004/05 and 2010/11 Data*. Report Prepared for Irish Aid, Malawi. International Food Policy Research Institute, Lilongwe, Malawi.

Ellis, F., and H. Freeman. 2004. "Rural Livelihoods and Poverty Reduction Strategies in Four African Countries." *Journal of Development Studies* 40(4): 1-30.

FAO (Food and Agriculture Organization of the United Nations). 2011. *Farm Business School Handbook: Training of farmers programme for South Asia.* FAO Corporate Document Repository, Regional Office for Asia and the Pacific, Bangkok, Thailand.

Faure, G., K. Davis, C. Ragasa, S. Franzel, and S. Babu. 2016. *Operational Framework to Assess Performance and Impact of Pluralistic Agricultural Extension System*, IFPRI discussion paper 01567, International Food Policy Research Institute, Washington, D.C.

Feder, G., R. Murgai, and J. B. Quizon. 2014. "Sending farmers back to school: The impact of farmer field schools in Indonesia." *Applied Economic Perspectives and Policy* 26(1): 45-62.

Genius, M., M. Koundouri, C. Nauges, and V. Tzouvelekas. 2010. "Information Transmission in Irrigation Technology Adoption and Diffusion: Social Learning, Extension Services and Spatial Effects." *American Journal of Agricultural Economics* 96(1): 328-344.

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit). 2012. *A Business Approach to Diversification Concepts and Experience of the FBS: An FBS Approach to Cocoa Farming*. GIZ.

Godtland E.M., E. Sadoulet, A. Janvry, R. Murgai, and O. Ortiz. 2004. "The Impact of Farmer-Field-Schools on Knowledge and Productivity: A Study of Potato Farmers in the Peruvian Andes." *Economic Development and Cultural Change* 53: 63-92.

GoM (Government of Malawi). 2011. *Malawi Agricultural Sector Wide Approach: A Prioritized and Harmonised Agricultural Development Agenda: 2011-2015*. Lilongwe, Malawi: Ministry of Agriculture, Irrigation and Water Development.

———. 2012. *Guide to Agricultural Production and Natural Resources Management.* Lilongwe, Malawi: Ministry of Agriculture and Food Security Agricultural Communication Branch.

———. 2015. *Annual Economic Report*. Blantyre, Malawi: Ministry of Agriculture, Irrigation and Water Development.

———. 2016. *National Agriculture Policy.* Lilongwe, Malawi: Ministry of Agriculture, Irrigation and Water Development.

Hanna, R., and D. Karlan. 2016. "Designing Social Protection Programs: Using Theory and Experimentation to Understand how to Help Combat Poverty." Draft paper accessed on February 2, 2018 at https://www.theigc.org/wp-content/uploads/2016/06/HannaKarlan_revision_v7.pdf

Hillfill, R., A. Moore, and P. McNamara. 2017. Malawi Youth in Agriculture (YIA) Project: Integrating Youth into Extension Systems in Central Malawi. Report for USAID, Feed the Future, Lilongwe, Malawi.

Imbens, G.W., and J.D Angrist. 1994. "Identification and Estimation of Local Average Treatment Effects." *Econometrica* 62: 467-476.

Jaitner, J., J. Sowe, E. Secka-Njie, and L. Demple. 2001. "Ownership Pattern and Management Practises of Small Ruminants in the Gambia: Implications for Breeding Programmes." *Small Ruminant Research* 40(3): 101-108.

Jayne, T.S., and S. Rashid. 2013. "Input Subsidy Programs in Sub-Saharan Africa: A Synthesis of Recent Evidence." *Agricultural Economics* 44(6): 547–562.

Kankwamba, H., M. Mapila., and K. Pauw. 2012. *Determinants and Spatiotemporal Dimensions of Crop Diversification on Malawi.* Report Prepared for Irish Aid, Malawi. International Food Policy Research Institute, Lilongwe, Malawi.

Kariyasa, K., and A. Dewi. 2011. "Analysis of Factors Affecting Adoption of Integrated Crop Management Farmer Field School (Icm-Ffs) in Swampy Areas." *International Journal of Food and Agricultural Economics* 1(2): 29-38.

Karki, B., and B. Siegfried. 2004. *Technology Adoption and Household Food Security; analyzing factors determining technology adoption and impact of project intervention: A case of smallholder peasants in Nepal*: Conference Paper in The Deutscher Tropentag held on 5 - 7 October, 2004. Berlin: Humboldt-University.

Khandker, S., B. Koolwal, and H. Samad. 2009. *Handbook on Impact Evaluation: Quantitative Methods and Practices*. The World Bank, Washington, DC.

Khatam, A., S. Muhammad, K. M. Chaudhry, A. A. Mann, I. Haq, Z. U. Khan, M. Idrees, and H. Amin. 2010. "Strengths and weaknesses of farmers field schools approach as perceived by farmers." *Sarhad J. Agric* 26(4): 685-688

Lavison, R. 2013. *Factors Influencing the Adoption of Organic Fertilizers in Vegetable Production in Accra.* MSc. Thesis, University of Ghana, Accra, Ghana.

Mazunda, J., H. Kankwamba and K. Pauw. 2014. *Food and Nutrition Security Implications of Crop Diversification in Malawi's Farm Households. In Mapping the linkages between agriculture, food security and nutrition in Malawi. Chapter 5.Pp 44-49.* Lilongwe, Malawi and Washington DC: International Food Policy Research Institute.

Mangisoni, J. 2008. "Impact of Treadle Pump Irrigation Technology on Smallholder Poverty and Food Security in Malawi: A Case Study of Blantyre and Mchinji Districts." *International Journal of Agricultural Sustainability* 6: 248–266.

Maonga B.B., A.M. Maganga, and E.M.K. Haraman. 2013. "Adoption of Small Metallic Grain Silos in Malawi: A Farm Level Cross-sectional Study." *International Journal of Development and Sustainability,* 2(2): 1534-1548.

Maonga B.B., A.M. Maganga, and H. Kankwamba. 2015. "Smallholder Farmers Willingness to Incorporate Biofuel Crops into cropping systems in Malawi." *International Journal of Food and Agricultural Economics* 3(1): 87-100.

Mauceri, M., J. Alwang, G. Norton, and V. Barren. 2005. *Adoption on Integrated Management Technologies: A Case of Potato Farmers in Carchi, Ecuador.* Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005. Blacksburg, Virginia: Agricultural and Applied Economics Department, Virginia Tech.

Mignouna, B., M. Manyong, J. Rusike, S. Mutabazi, and M. Senkondo. 2011. "Determinants of Adopting Imazapyr-Resistant Maize Technology and its Impact on Household Income in Western Kenya." *AgBioforum*, 14(3): 158-163.

Mohamed, K., and A. Temu. 2008. *Access to credit and its effect on the adoption of agricultural technologies: The case of Zanzibar*. *African Review of Money Finance and Banking*: 45-89.

Muzari, W. G., and S. Muvhunzi. 2012. "The Impacts of Technology Adoption on Smallholder Agricultural Productivity in Sub-Saharan Africa: A Review." *Journal of Sustainable Development* 5(8): 69-77.

Namara, E., P. Weligamage, R. Barker. 2003. *Prospects for Adopting System of Rice Intensification in Sri Lanka: A Socioeconomic Assessment.* Research Report 75. International Water Management Institute: Colombo, Sri Lanka.

NSO (National Statistical Office). 2012. *Integrated Household Survey 2010/2011: Household Socio-economic Characteristics Report*. NSO: Zomba, Malawi.

———. 2014. *Malawi Labour Force Survey, 2013.* NSO: Zomba, Malawi.

Obisesan, A. 2014. *Gender Differences in Technology Adoption and Welfare Impact among Nigerian Farming Households*. MPRA Paper No. 58920, Munich, Germany.

Pananurak, P. 2010. *Impact Assessment of Farmer Field Schools in Cotton Production in China, India and Pakistan*. Special Issue Publication Series No. 14. Leibniz University of Hannover, Germany.

Rao, P.S. 2000. *Sampling Methodologies with Applications*. New York: Rochester.

Ragasa, C. and C. Niu. 2017. *The State of Agricultural Extension and Advisory Services Provision in Malawi: Insights from Household and Community Surveys.* MaSSP Technical Report, IFPRI, Lilongwe, Malawi.

Ragasa, C., and J. Mazunda. 2018. "The Impact of Agricultural Extension Services in the Context of a Heavily Subsidized Input System: The Case of Malawi." *World Development* 105: 25-47.

Ragasa, C., D. Mzungu, E. Kaima, C. Kazembe, and K. Kalagho. 2017. "Capacity and Accountability in the Agricultural Extension System in Malawi: Insights from the Survey of Service Providers in 15 Districts." IFPRI Discussion Paper 01673, International Food Policy Research Institute: Washington, DC.

Reardon, T., K. Stamoulis, and P. Pingali. 2007. "Rural Nonfarm Employment in Developing Countries in an era of Globalization." *Agricultural Economics* 37: 173–183.

Rogers. E.M. 2003. *Diffusion of innovations* (5th ed.). New York: Free Press.

Rosenbaum, P.R., and D. Rubin. 1983. "The Central Role of the Propensity Score in Observational Studies for Causal Effects." *Biometrika* 70(1): 41 – 55.

Rubin, D.B. 1978. "Bayesian Inference for Causal Effects: The Role of Randomization." *Annals of Statistics* 6(1): 34-58.

Simtowe, F., M. Kassie, S. Asfaw, B. Shiferaw, B. Emonyo, and E. Siambi. 2012. *Welfare Effects of Agricultural Technology Adoption: The case of Improved Groundnuts Varieties in rural Malawi.* Selected paper prepared for presentation at the International Association of Agricultural Economists Triennial conference, Foz do Iguaçu, Brazil, 18-24 August.

Smith, J.A., and P. Todd. 2005. "Does matching overcome Lalonde's critique of nonexperimental estimators?" *Journal of Econometrics* 125(1-2): 305–353.

SNRD (Sector Network Rural Development Africa). 2015. *Experiences with the Farmer Business School (FBS) approach in Africa.* GIZ.

Sserunkuuma, D. 2005. "The Adoption and Impact of Improved Maize and Land Management Technologies in Uganda." *The Electronic Journal of Agricultural and Development Economics* 2(1): 67-84.

Todo, Y., and R. Takashi. 2011. "Impact of Farmer Field Schools on Agricultural Income and Skills: Evidence from an Aid-Funded Project in Rural Ethiopia." *Journal of International Development* 25 (3): 362-381.

Uaiene, R., C. Arndt, and W. Masters. 2009. *Determinants of Agricultural Technology Adoption in Mozambique.* Discussion papers No. 67E, National Directorate of Studies and Policy Analysis, Ministry of Planning and Development, Mozambique.

Uematsu, H., and A. Mishra. 2010. *Can Education Be a Barrier to Technology Adoption?* Selected Paper prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA,CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27.

Van den Berg, H. 2004. "IPM Farmer Field Schools: A Synthesis of 25 Impact Evaluations." Report prepared for the Global IPM Facility, Wageningen University: Wageningen, the Netherlands. ftp://ftp.fao.org/docrep/fao/006/ad487E/ad487E00.pdf.

Van den Berg, H., and J. Jiggins. 2007. "Investing in Farmers—The Impacts of Farmer Field Schools in Relation to Integrated Pest Management." *World Development* 35 (4): 663–686.

Waller, B., W. Hoy, L. Henderson, B. Stinner, and C. Welty. 1998. "Matching Innovation with Potential Users: A Case Study of Potato IPM Practices." *Agric. Ecosyst. Environ*. 70: 203-215.

World Bank. 2007. *Malawi Poverty and Vulnerability Assessment Report: Investing in Our Future, Synthesis Report.* World Bank, Washington, DC.

APPENDICES

Figure A1. Overall FBS facilitation and satisfaction by FBS participants.

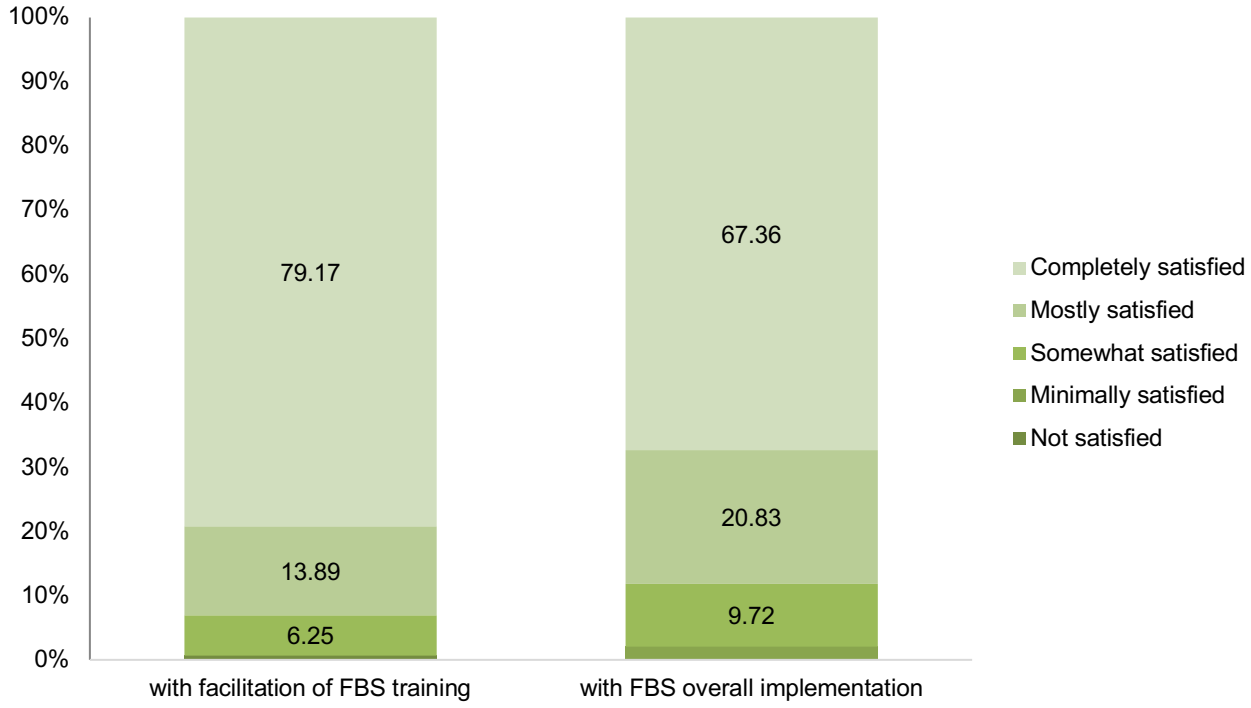


Figure A2. Topics learnt by FBS participants

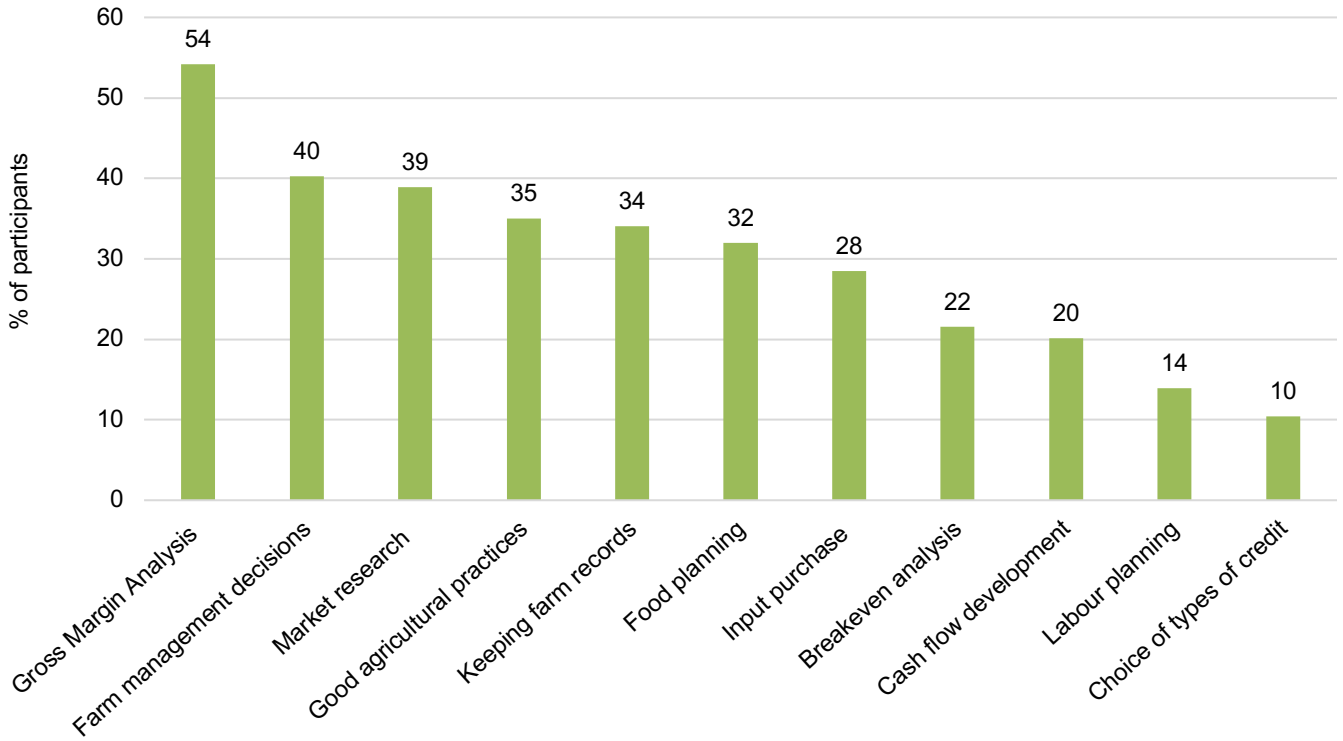


Table A1. ATT on average total crop production (kg)

Matching algorithm	Treated (N)	Control (N)	ATT	Standard Error/a
NNM^{PN}	252	80	619.59**	188.23
KBM^{PN}	252	148	460.07**	179.98
Radius^{PN}	252	148	487.62**	148.95
Stratification^{PN}	252	148	473.93*	144.06
NNM^{GD}	162	54	-55.10	258.36
KBM^{GD}	162	80	-46.00	191.11
Radius^{GD}/a	162	80	-61.45	175.28
Stratification^{GD}	162	62	-87.51	217.62

NOTES: ATT for all crops; maize, beans, soybeans, groundnuts and Irish potatoes in kg of total crop production.
PN =Participants vs Non-participants. GD = Graduates vs Dropouts.

Table A2. ATT on average value of crops sold (MWK)

Matching algorithm	Treated (N)	Control (N)	ATT	Standard Error/a
NNM^{PN}	252	80	172,000.00***	31,056.95
KBM^{PN}	252	148	143,000.00***	37,131.73
Radius^{PN}	252	148	148,000.00***	31,627.61
Stratification^{PN}	252	148	142,000.00***	35,854.34
NNM^{GD}	162	54	-12,300.00	57,548.12
KBM^{GD}	162	80	-8,784.00	44,727.94
Radius^{GD}/b	162	80	-11,700.00	42,992.56
Stratification^{GD}	162	62	-13,700.00	47,377.31

NOTES: ATT for all crops; maize, beans, soy beans, groundnuts, Irish potatoes
/a = radius of 0.1
PN =Participants vs Non-participants. GD = Graduates vs Dropouts.

Table A3. ATT on average value of crop production (MWK)

Matching algorithm	Treated (N)	Control (N)	ATT	Standard Error/a
NNM^{PN}	252	80	254,000.00***	50,382.00
KBM^{PN}	252	148	204,000.00***	44,865.74
Radius^{PN}	252	148	208,000.00***	42,750.70
Stratification^{PN}	252	148	199,000.00***	43,409.10
NNM^{GD}	162	54	-31,000.00	90,985.40
KBM^{GD}	162	80	-21,600.00	64,662.03
Radius^{GD}/a	162	80	36,200.00	69,296.82
Stratification^{GD}	162	62	32,900.00	60,717.29

NOTES: ATT for all crops; maize, beans, soy beans, groundnuts, Irish potatoes.
/a = radius of 0.1.
PN =Participants vs Non-participants. GD = Graduates vs Dropouts.

Table A4. Quality of matching.

Ps R2	LR chi2	p>chi2	Mean Bias	Med Bias	B	R	%Var
0.011	7.52	0.985	4.3	3.7	25.3*	0.97	17

** if B>25%, R outside [0.5; 2]*

About the Author

Joanna Chilemba received a Master's of Science from Lilongwe University of Agriculture and Natural Resources (LUANAR). Joanna currently works with the Ministry of Agriculture, Irrigation and Water Development in the Dedza District Agriculture Office. The paper draws on the student's M.Sc. thesis, written under the supervision of **Professor D.H.N Ng'ong'ola, Professor C. Jumbe and Mr. A. Maganga,** lecturers in the Department of Agricultural and Applied Economics at LUANAR.

Catherine Ragasa is a research fellow at IFPRI in Washington, DC. Catherine provided substantial guidance on the research design, sampling method and questionnaire, and technical support on the econometrics and analysis.

Acknowledgments

The authors are grateful to the following organizations and persons whose assistance made this work possible. We thank the African Economic Research Consortium (AERC) for the research grant that was provided. The IFPRI project titled "Assessing and enhancing the capacity, performance and impact of the pluralistic agricultural extension system in Malawi", with generous funding from the Government of Flanders and the German Agency for International Development (GIZ), has provided funding for data collection and analysis for this study, which we are very grateful for. We are also thankful to Professors Davies Ng'ong'ola and Charles Jumbe at Lilongwe University of Agriculture and Natural Resources (LUANAR) for providing technical support.

This working paper is an output of the Bunda Grant Scheme of the Strengthening Evidence-Based Agricultural Policy (SEBAP) project of IFPRI-Malawi. The Grant scheme provides selected MSc students from the Lilongwe University of Agriculture and Natural Resources (Bunda College) with opportunities to improve, publish, and disseminate the research that they undertook during their MSc training. The SEBAP project was made possible by the generous support of the American people through the United States Agency for International Development (USAID). The views expressed in this working paper imply no endorsement by IPFRI-Malawi, USAID, or any other party than the authors.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
1201 Eye Street, NW | Washington, DC 20005-3915 USA
T: +1.202.862.5600 | F: +1.202.862.5606
Email: ifpri@cgiar.org | www.ifpri.org

IFPRI-Lilongwe
P.O. Box 31666 | Lilongwe 3, Malawi
T +265-1-771780 | Email: ifpri-lilongwe@cgiar.org

The Malawi Strategy Support Program (MaSSP) is managed by the International Food Policy Research Institute (IFPRI) and is financially made possible by the generous support of the American people through the United States Agency for International Development (USAID) in connection with the Strengthening Evidence-Based Agricultural Policy Project. The research presented here was conducted as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by IFPRI. This publication has been prepared as an output of MaSSP. It has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and do not necessarily reflect those of IFPRI, USAID, PIM, or CGIAR.