



MALAWI

STRATEGY SUPPORT PROGRAM | WORKING PAPER 20 | August 2017

Impact of Malawi's Farm Income Diversification Programme on Household Welfare

Empirical evidence from eleven districts

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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.

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ABSTRACT

This study used cross sectional data from the government of Malawi's Farm Income Diversification Programme (FIDP) to examine the impact of FIDP on household welfare. Total annual household income, food security, and the wealth status of households were used as measures of household welfare. A propensity score matching procedure was used to make statistically valid comparisons between the welfare of households which participated and did not participate in FIDP. The results show that households which participated in FIDP had higher incomes and their food security status improved more than among similar households which did not participate in the program. The results further reveal that FIDP improved the wealth of participating households compared to their counterparts who did not participate. Those FIDP participating households engaged in livestock production, in particular, experienced considerable growth of income, which suggests that livestock enterprises coupled with income from crops could be an important pathway for improving the wellbeing of households in Malawi.

Keywords: Household welfare, household income, food security status, wealth index, propensity score

1. INTRODUCTION

Poverty reduction has been a principal development goal of the government of Malawi as articulated in the development strategies it has implemented since 2002 (MEPD 2011)¹. The Farm Income Diversification Programme (FIDP), introduced in 2005, was one of the programs implemented to address problems of food insecurity and poverty in the country. However, despite strenuous efforts by government, food insecurity remains a challenge at household level. Many households still experience food shortages, especially in the lean period of the year from December to March, contributing to malnutrition and households adopting unsustainable economic coping strategies (MoAFS 2011). In consequence, poverty remains widespread in the country, hampering government efforts in the fight against economic malaise. Consumption inequality (Gini coefficient) did not register much decrease in 2013, declining to 0.39 from 0.40 in 2010, mostly in rural areas. Poverty incidence measured by the headcount poverty rate remained very high at 39 percent in 2013 from 40 percent in 2010 and was even worse in the rural areas at 41 percent. The GDP at current prices was at MK2.18 billion in 2014 (NSO 2015).

Although farm income diversification had been identified as an essential strategy for addressing household welfare and poverty problems in Malawi, little effort has been made to assess its impact on household welfare in rural areas using advanced econometric analysis. Previous studies on FIDP assessed the impact of the program using descriptive analysis techniques which pose several research challenges, including selection bias and the impact of other programs implemented in FIDP implementation areas that could interfere with program outcomes. Zant (2012) assessed the impact of FIDP on productivity in Malawi. However, this assessment did not focus directly on the problems that FIDP was addressing, such as chronic food insecurity, poverty, and low household incomes. Due to lack of using advanced impact evaluation methods on FIDP that focus directly on areas the program was striving to address, the contribution of the program to improving food security and reducing poverty in Malawi cannot be fully recognized.

¹ The Malawi Government implemented the Malawi Growth and Development Strategy (MGDS) II from 2011 to 2016; MGDS I from 2006 to 2011, and the Malawi Poverty Reduction Strategy (MPRS) from 2002 to 2005

A number of studies have been conducted in other countries to determine the impact of income diversification on inequality, household welfare, and poverty levels using advanced impact evaluation approaches which deal with selection bias and isolate of the impact of other programs in implementation areas. Therefore, a similar study was conducted on FIDP, using advanced impact evaluation techniques in order to appreciate its contribution to poverty reduction and welfare enhancement in the country.

Objectives of the Study

The objectives of the study were to assess the impact of FIDP on household welfare and, consequently, its contribution to the poverty reduction. This study focuses on several unidimensional poverty measures, rather than multidimensional poverty measures, by assessing the impact of FIDP on annual income, food security, and wealth status of participating households, rather than through the use of one measure of poverty which is all encompassing.

Background to the Farm Income Diversification Programme

The Ministry of Agriculture, Irrigation and Water Development (MoAIWD) introduced the Farm Income Diversification Programme (FIDP) in 2005 with the support of the European Union (EU) in order to address the problems of food insecurity and poverty. The program was implemented in recognition that food insecurity is a multifaceted problem which requires a holistic approach to deal with, and, therefore, food production, especially of maize, cannot be the only means of tackling the problem (MoAFS 2011; MEPD 2011). In this regard, in addition to maize self-sufficiency, diversification of smallholder farming systems was expected to increase food availability through the creation of economically attractive production options for drought-resistant crops, such as cassava, sorghum, and millet, and providing opportunities to farmers to venture into farm enterprises.

The overall objective of FIDP was 'to achieve a sustainable improvement in livelihood of rural communities through diversifying farmers' income to increase food security and income levels of rural households while ensuring sustainable use of soil and water resources by encouraging business development and employment as well as improved marketing of agricultural products in selected communities (GoM 2012). In order to achieve the overall objective, the program focused on four major result areas namely:

- sustainable management of natural resources,
- improved post-harvest storage and processing,
- increased and diversified smallholder agriculture productivity, and
- agri-business promotion.

The program also had three cross-cutting activities:

- improved capacities of FIDP communities, MoAFS and other stakeholders,
- enhanced social development of FIDP communities, and
- enhanced co-ordination and knowledge management.

FIDP was implemented in two phases termed Phase 1 and 2, using an overall EU grant valued at Euro 36.5 million. After a FIDP inception phased in 2005/06, Phase I activities were implemented from April 2007 to August 2009. Phase II ran from April 2010 to March 2014. The four focus result areas were implemented in both phases, whereas the three cross-cutting areas were only implemented in Phase II, which made Phase II to be broader than Phase I. Phase II retained all the geographical areas of Phase I, except that Nkhata Bay district which was added to support production and processing of cassava, which was formerly funded through the 2008 Stabilization of Export Earnings Programme under EU. The focus of the study for this paper was on Phase II implementation from April 2010 to October 2011.

In total, FIDP Phase II was implemented in 11 districts, namely; Balaka, Chiradzulu, and Thyolo in Southern region; Salima, Nkhatakota, Dowa, and Lilongwe in Central region; and Chitipa, Karonga, Rumphi, Nkhata Bay, and Mzimba in Northern region. FIDP Phase II was designed to target 1,220 villages and over 82,000 households across the country. However, only 825 villages (63 percent) and just over 59,000 (72 percent) households were reached.

FIDP focused on four income sources: crop, livestock, forest, and non-farm incomes. However, a broader definition of income diversification refers to an increase in the number of income sources or the balance across a variety of income sources. FIDP's focus on the four major sources of income covers both definitions of income diversification. Overall, the project framework was crafted to have an impact on household incomes that could lead to food security and to reducing poverty levels of rural communities. A special focus of FIDP on agribusiness and market-oriented activities was envisaged to push more farmers into non-farm enterprises. This was intended to cushion farmers against the risk of being food insecure, thereby reducing poverty levels.

2. LITERATURE REVIEW

Studies have been conducted in different countries to determine the impact of income diversification on inequality, household welfare, and poverty levels. Although different methodologies have been used, in most studies diversification programs have been found to play a significant role in increasing household welfare and reducing income inequality and poverty. An increase in income sources increases rural incomes and subsequently reduces poverty levels.

Studies on income diversification can be grouped into two categories. The first use the Gini-decomposition method to break down income sources into various categories and assesses their contribution to the outcome variables of interest. In a study of income diversification and poverty in Uganda, Malunda (2000) found that households dependent on wage employment and agriculture had relatively high poverty headcounts of over 34 percent, while those relying on other non-farm activities for income had a lower poverty headcount at 10 percent. Minot et al. (2006) noted the influence of income diversification on income growth which translated into lower poverty levels in the Northern Upland region of Vietnam. Among different factors affecting income growth, diversified crop income contributed 6 percent of income growth in this region of Vietnam between 1993 and 1998. These studies show that income diversification results in a rise in rural incomes that leads to poverty reduction and economic growth.

The second category of income diversification studies employed statistical counterfactual methodologies such as propensity score matching, fixed/random effect modeling, double-difference, and instrumental variable approaches. Following macroeconomic policy changes and droughts of the early 1990s in Zimbabwe, the government implemented an income and economic activity diversification program (Ersado 2006). Results of a fixed-effect model analysis of this program showed that income diversification in Zimbabwe had a significant positive impact on per capita consumption both before and after the shocks. Moreover, after the shocks, the positive impact of income diversification on consumption levels was significant. Kimsun and Sokcheng (2013) used fixed and random effects modeling with instrumental variables to determine the role of income diversification in Cambodia during the global financial crisis. Their results confirm that income diversification is strongly and positively associated with per capita consumption, but is less likely to help smooth consumption during a crisis.

In the case of propensity score matching impact evaluation approaches, Debalen and Pirre (2004) assessed the welfare impact of non-farm diversification through a comparison of earnings of households who had income sources from household enterprises and those which did not. Their empirical results show that non-enterprise households were worse off than enterprise households with respect to their wellbeing. In northern Ghana, Owusu et al. (2011) employed propensity score matching to assess the impact of non-farm

activities on food security status and households income. Their study reveals that non-farm activities have a positive influence on household income and food security status. Similarly, in Ethiopia, Ali and Peerlings (2012) used propensity score matching technique to examine the impact of non-farm enterprise diversification on household wellbeing. They found that there was a positive significant impact of non-farm enterprise diversification on household wellbeing. From these studies, it is clear that income diversification is strongly related to positive changes in income and, consequently, to improved poverty levels.

A number of studies have been undertaken to understand the impact of socio-economic factors on poverty along different dimensions. Poverty is defined as lack of command over commodities or as a severe constriction of the choice set over commodities, leading to pronounced deprivation in wellbeing (World Bank 2000). Studies on poverty have used different indicators and approaches to examine the impact of programs on poverty different dimensions. The first approach employs the three poverty measures – the headcount ratio, the poverty gap, and the poverty gap squared. In Mexico, Becerril and Abdulai (2009) used the poverty headcount ratio to estimate the impact of improved maize varieties on welfare through propensity score matching. The study showed that adoption of the improved maize varieties by rural households increased household incomes and reduced poverty headcount levels. The second approach employing poverty measures involves the use of a dummy variable, which takes the value of zero if a household is poor and one otherwise. A household is classified as poor if their income level falls below some minimum level necessary to meet basic needs. Omilola (2009) used a double-difference approach to estimate the effect of new agricultural technology on poverty reduction in rural Nigeria using a dummy variable for poverty.

Another approach is the examination of the impact of socio-economic variables on welfare measures, such as income, per capita income, expenditure, food security, malnutrition, or wealth status. This approach is indirect rather than direct, thus not using poverty status in its multi-dimensional nature. However, an evaluation of these socio economic variables of welfare reveals the socio-economic status of the households and the severity of poverty in the communities to a large extent. Nkhata et al. (2014) used daily per capita caloric intake and annual agricultural income variables to study the impact of household participation in the Bwanje Valley Irrigation Scheme in Malawi on food security and uni-dimensional poverty. They concluded that participation in the irrigation scheme had a positive impact on agricultural income and daily per capita caloric intake, thereby reducing both food insecurity and poverty.

3. THEORETICAL FRAMEWORK AND EMPIRICAL MODEL

Theoretical Framework

A simple difference between participants and non-participants using descriptive statistics can be employed to measure the impact of participating in a particular program. However, evaluating the impact of participation in a program encounters issues of selection bias which emerge due to either observed or unobserved factors (Baker 2000). In most cases, selection of project beneficiary households through targeting results in a non-randomized sample. Therefore, a simple difference between program participants and non-participants often fails to control for potential differences in characteristics between participants and non-participants. This leads to overestimation of program impact on the outcome variables. To overcome such problems, an analysis of what would have happened to those, who, in fact, participated in a program, had they not participated in the program can be used to model the impact of the program (Becker and Ichino 2002). This is referred to as the evaluation counterfactual. Winship and Morgan (1999) point out that the underlying assumption is that households which were selected into the program (treatment group) and those which did not get selected (control group) have potential outcomes under both scenarios.

Following Acheampong and Owusu (2015), let $A=1$ denote a situation when the i th household participates in a program, and $A=0$ representing a situation when a household does not participate in a program. Also let Y_i denote the actual observed outcome of individual household i . Then Y_{1i} is the outcome of i th household when it participates in the program and Y_{0i} is the outcome if the household does not participate in the program. The outcome of the i th household can therefore be defined as:

$$Y_1 = \gamma_1 X + u_i \quad (1)$$

and

$$Y_0 = \gamma_0 X + u_0 \quad (2)$$

where X is a vector of observed characteristics, and u_i and u_0 are unobserved error terms given that $u_1 \neq u_0$. Following Heckman et al. (1998) and Smith and Todd (2001), the impact for a household participating in the program is the mean difference in the outcomes attributed to participation in the program that can be expressed as:

$$\Delta Y = Y_1 - Y_0 \quad (3)$$

where ΔY denotes the impact for a given household.

The computation of the mean difference in equation (3) is applicable if an individual is involved in both cases (treatment and control group) during the same period. However, since an individual can only be involved in one case at a time, measuring the treatment effect for this individual household in equation (3) has profound limitations, as only one of the potential outcomes for an individual household can be observed at a time. In this case, either Y_1 or Y_0 for each individual household can be observed, implying that outcomes Y_1 and Y_0 cannot be observed concurrently. This is the problem of missing data, as pointed out by Smith and Todd (2005). To address the problem of missing data, sample averages for the impact of the treatment have to be utilized. The average impact of the treatment on the treated (ATT), which focuses mainly on the effect of those who benefited from the program, is applied. In this respect, the expected value of ATT is defined as the difference between the expected outcome values with and without treatment for those who actually benefited from the program (Heckman et al. 1998). This is expressed as,

$$\Delta Y_{ATT} = ATT \{AY|X; Z = 1\} = E\{Y_1 - Y_0 | Z=1\} = E\{Y_1 | Z=1\} - E\{Y_0 | Z=1\}, \quad (4)$$

In equation (4), Z denotes whether a household benefited from the program or not. Thus, $Z=1$ if the household is a beneficiary of the program, and $Z=0$ otherwise. X indicates a set of covariates, such as household and community characteristics.

Empirical Approach

The empirical approach adopted for this study is propensity score matching (PSM) which was developed by Rosenbaum and Rubin (1983). This approach was chosen to isolate the effect of selection bias with the aim of finding the closest comparison group from a sample of non-participants to the sample of program participants.

Welfare impact of FIDP was measured in terms of food security, household income, and the wealth status of the households, which was subsequently used to establish FIDP's contribution in reducing poverty. To explore the impact of FIDP on household income, food security, and wealth status, the PSM, expressed as the probability of program participation conditional on pre-intervention variables, as applied by Becerril and Abdulai (2009), was adopted. The propensity score is the probability of each household participating into the program and this was generated using the following expression of PSM;

$$p(X) = \Pr[D = 1|x] = E[D|X]; p(X) = F\{h(X_i)\} \quad (5)$$

where $F\{.\}$ is a normal or logistic cumulative distribution and X is a vector of pre-treatment characteristics.

To overcome attribution problems, two samples were used from FIDP group members and non-FIDP group members within the same geographical area, as suggested by Shehu and Siddique (2014). Selection bias was overcome by using only those households with the same probabilities from FIDP group members and non-FIDP group members in order to estimate ATT. Following Rosenbaum and Rubin (1985), ATT was estimated as follows:

$$\begin{aligned}
 ATT &= E \{Y_{iA} - Y_{iN} \mid D = 1\}, \\
 ATT &= E[E \{Y_{iA} - Y_{iN} \mid D = 1, P(X)\}], \\
 ATT &= E[E \{Y_{iA} \mid D = 1, P(X)\} - E\{(Y_{iN} \mid D = 0, P(X))\} \mid D = 1],
 \end{aligned}
 \tag{6}$$

where Y is the outcome variable – household income, food security status, or wealth index – and X is a set of household characteristics.

It should be pointed out that the estimation of treatment effects through propensity scores rests on two assumptions. The first is the conditional independence assumption (CIA), which states that, for any given set of pre-treatment characteristics, participation is independent of potential program outcomes. The assumption can be expressed as;

$$\text{(Unconfoundedness)} \quad Y(0), Y(1) \perp Z \mid X \tag{7}$$

In equation (7), X represents a vector of confounders, Z denotes treatment assignment, and $Y(0)$ and $Y(1)$ are potential outcomes under control and treatment conditions, respectively. The assumption in equation (3) is that participation in FIDP is based on observed, rather than unobserved factors, such that all variables that strongly influence FIDP participation, but not potential outcomes, are included in the participation model.

A second assumption is that the average treatment effect for the treated (ATT) only lies within the region of common support. This assumption ensures that individuals with the same X values have a positive probability of being both treated and non-treated (Becerril and Abdulai 2009). This is also called the common support or overlap condition and can be expressed as;

$$\text{(Common Support Condition)} \quad 0 < p(D=1 \mid X) < 1 \tag{8}$$

Equation (8) means that the probability of receiving treatment for each X values falls between 0 and 1. Likewise, the probability of not receiving treatment falls between the same range 0 and 1.

In the literature, there are a number of matching techniques suggested to match treatment and control group members. This study uses nearest neighbor matching to estimate the treatment effect on the treated cases. However, two other matching techniques, namely, radius and kernel matching, were used in order to test the robustness of the results and to check how sensitive results were to unobserved factors. The nearest neighbor matching estimation procedure entails pairing every treated unit with an untreated unit which has the closest propensity score (Becker and Ichino 2002). With radius matching, all the comparison units available within the radius are utilized. For the kernel-based technique, all participants are matched with a weighted average of all non-participants, using weights that are inversely proportional to the distance between the propensity scores of participants and non-participants group (Becker and Ichino 2002).

Before the welfare impacts of FIDP were examined, it was important to assess if the program had really helped diversifying household incomes of participating farmers. There is no consensus on the appropriate measure of income diversity in the literature. However, most studies have used the Simpson index, the Herfindahl index, or the inverse Herfindahl index to capture the processes through which households expand their income sources as well as creating a greater balance of shares of income sources in their income portfolio (Joshi et al. 2003; Minot et al. 2006; Ersado 2006; Nghiem 2010). This study used the Herfindahl index to measure income diversification because it recognizes both the number of income

sources and the importance of each income source to total household income. The Herfindahl index is expressed as the sum of squares of the shares of different income sources in household income. The index ranges from zero to one. The closer the index is to zero, the higher the degree of income diversification, and the closer it is to one, the lower the degree of income diversification. The Herfindahl index is constructed as follows:

$$HI = \sum_{i=1}^N s_i^2 \quad (9)$$

where s_i = proportion of each income source on total household income, and N =number of income sources.

4. DATA SOURCES, DESCRIPTION OF VARIABLES AND ASSUMPTIONS

The study used secondary data from the Ministry of Agriculture, Irrigation, and Water Development which was collected by the FIDP Project Management Unit annually to assess project impact. As part of the monitoring and evaluation of FIDP, each fiscal year of the two Phases had a data collection exercise. Data used for this study was that collected in the second year of Phase II. A questionnaire was developed to collect information on household characteristics, land use, technology adoption, use of storage facilities, crop and livestock production, value addition, input use, marketing, credit access, dietary diversification, farming practice and extension, capacity building, income sources, poverty profile, coping strategies, and food security status.

The planned sample size was 3008 in 211 villages with a 50:50 ratio between FIDP members and Non-FIDP members (1,504). The sample was based on a total population of 32,973 households of which 7,222 and 25,751 were direct beneficiaries and non FIDP beneficiaries, respectively. Practically, a total sample size of 3,002 households in 209 villages of which 1497 were FIDP group members and 1505 were non-FIDP households was achieved for the survey. To achieve this, an average of 18 villages per district were sampled randomly from the 12 FIDP districts, except for Nkhatabay and Thyolo district where one village in each was dropped and in Karonga where the programme was only covering 13 villages due to the nature of the FIDP enterprise in the district. The sample respondents from these sampled villages were then drawn randomly from members of FIDP groups and non-FIDP households, separately.

Variable Description

A total of four outcome variables were included in the study, namely income diversification, annual household income, food security status, and wealth status. Income diversification was included to measure if FIDP had helped to broaden the income sources of households. Incomes were diversified into crops, livestock, forest, and off-farm incomes. The latter includes income from employment, casual labor, remittances, gifts, small-scale business, and any other income apart from crop, livestock, and forest sources.

Household welfare was understood in three forms.

- Average annual household income, as modeled by Bezu and Barrett (2014) and Talukder (2014). Other studies on impact evaluation have used total annual consumption expenditure as a measure of household welfare. However, this variable was not available in the data. The unavailability of expenditure data prompted the use of another variable that measures an implicit change in household's expenditure decisions in order to assess the economic condition of the households (Filmer and Pritchett 1998).
- An asset index used to measure the wealth status of households as a proxy in the absence of expenditure data. The asset index measures the implicit change in expenditure and welfare since family assets normally require cash to buy, which is generally regarded as difficult to collect accurately through surveys. The index was applied as developed by Schwarze and Zeller (2005).

Compared to other measures of welfare, this measure considers other dimensions of welfare, such as asset ownership of households. In this analysis, total weights for the households were calculated and then expressed as a percentage of the wealth bar (470 units) such that the wealth scale ranged from 0 to 100 percent, which in this context is the wealth/asset index. A higher asset index signifies that a household is better off in terms of wealth and, consequently, have an improved welfare. Improving asset ownership of households to improve their wealth status was an important design feature of FIDP. Therefore an asset index was a useful measure of welfare change for the program, since it suited the project design in assessing the wealth profile of households after the project.

- Food security status, as applied by Shehu and Sidique (2013). Households were asked on how many meals were taken on a particular day and the food security status of a household was captured by a binary variable with a value of 1 if household had equal to or greater than 2 meals per day and 0 otherwise.

The study also included a number of covariates, which are potential confounders of these outcome variables. Rainfall variability was computed as deviations from the mean for particular rainfall stations, using data obtained from Malawi Metrological Services. As the FIDP data did not include information on distances from households to markets, market access variable was measured through a proxy indicator: a household was considered to have market access if it sold or purchased any agricultural input or produce from the market or any agro dealer. A binary variable for membership of an out-grower scheme was another covariate including in the study. This variable was defined as a contractual partnership between a household and a processing company through which growers were engaged to cultivate crops solely for use by the processing company. The company, in turn, guarantees agreed prices and a market for the crops. This variable is important as it measured the provision of markets to households. Another binary variable included in the study was household's access to credit. This was measured by whether or not households obtained a loan or credit from a financial institution or any other sources. Access to agricultural extension was measured by whether households' has received agricultural extension services provided by either FIDP or another service provider. Household access to inputs was defined as acquisition of agricultural inputs through either cash or free from any other sources. Finally, two other binary variables on technology adoption were incorporated in the study: contour ridge alignment and vetiver hedgerows. Adoption of these technologies was defined of the household had practiced the technology for two or more years.

Test of Assumptions

A logit model was used to estimate propensity scores of household who participated in FIDP. There is no agreement in the literature pertaining to the inclusion (or exclusion) of covariates in a propensity score model. However, the matching was built on the CIA which requires that outcome variable(s) must be independent of treatment conditional on the propensity score. The study therefore used economic theory combined with knowledge of previous studies and information about the institutional setting of FIDP in building up the participation model of probit. Annex Table 1 shows the results of a probit model based on participation in FIDP.

A test of balancing property was performed to check if one of the conditions of PSM is fulfilled. The study used standardized difference to check the percent bias reduction after matching as suggested by Rosenbaum and Rubin (1985). Other tests like t-test and joint significance test were not used because most of the variables in the data did not satisfy normality tests. After matching was performed, all the variables had standard bias of less than 20 percent, indicating that all variables were well balanced, satisfying the balancing condition, as shown in Annex Table 2. The fulfillment of the balancing condition implies that the distribution of covariates across participant and non-participant groups in matched samples were not different as shown in the left figure in Annex Figure 1.

Another important assumption of common support or overlap condition was validated to ensure that observations with the same x-values are bearing the positive probability of being both treated and untreated (Becerril and Abdulai 2009). Using visual analysis of the density distribution of the propensity scores of the two groups, the right figure in Annex Figure 1 shows there is perfect overlap. Furthermore, the region of common support for all participants was between 0.10 and 0.95 with 2.5 percent of the sample size outside the common support. In this regard, dropping of observations whose propensity scores fall outside the area of overlap fulfils the common support condition.

A sensitivity analysis was conducted on matching estimates to check the influence of unobserved factors on the outcome variables. First, the results were tested using other matching estimators as applied by Shehu and Siddique (2013). Results indicated that there were no large variations in ATT for the three matching estimators. Secondly, sensitivity of the estimated impact against the unobservable was checked using the bounding approach developed by Rosenbaum (2002), who developed the following expression on the odds ratio:

$$\frac{1}{\tau} \leq \frac{P_i(1 - P_i)}{P_j(1 - P_j)} = \tau \quad (10)$$

Where $\tau = 1$ ($\gamma = 0$) will indicate that hidden bias is nonexistent, while every increase in the value of τ would also imply that hidden bias does not exist. It is pointed out that if τ is not large enough, i.e., smaller than 2, then it is safe to conclude that the likelihood of having an unobserved covariate influencing the treated impact is very high and the estimated results are therefore associated with unobserved factors (DiPrete and Gangi 2004).

Results from the sensitivity analysis using Rosenbaum's test for the three outcome variables of the study (food security, income, and the asset index) are shown in Annex Tables 4 and 5. For the two continuous variables, (income and the asset index, the r-bounds test was used, whereas for the binary variable of food security, the MH bound test was used. From the results in Annex Table 5, the lowest value of τ generating a 95% confidence interval including zero is 1.4 for household incomes. Whereas for the Hodges-Lehmann point, the critical value, τ hits 1.6 at the interval in which zero is included. For wealth status, the minimum value of τ is 1.2 where the 95% confidence interval is encompassing the value of zero, while the Hodges-Lehmann point, the critical value, τ hits 1.4. These relatively low values are below and closer to the benchmark 2.0 and imply that household incomes and wealth status treatment outcomes are sensitive to unobserved characteristics. For food security status, the interest of this study stretches on the bounds under the assumption of overestimated treatment effect having produced positive ATT results. The Q+MH reveals that results are significant for $\tau = 1, 1.05, 1.15, 1.2,$ and 1.25 . These values of τ in Annex Table 4 are less than 2, indicating that study results are also sensitive to unobserved factors. The fact that sensitivity exists does not mean that FIDP had no impact on household incomes, food security, and wealth status of households. Out of the many factors that may influence changes in our outcome variables, the FIDP role should not be underestimated.

5. RESULTS AND DISCUSSIONS

In this section, the socio economic characteristics in terms of income, food security, and wealth status for FIDP participants and non-participants are presented. Correlation coefficients are estimated to analyze the relationship between explanatory variables and outcome variables before the empirical results are discussed in detail.

Descriptive Analysis

Except for gender, the socio economic status between FIDP participants and non-participants varies considerably, as captured in Table 1. There are also considerable differences in outcome levels between the two groups. Households participating in FIDP earned an average annual income of MK 249,995 (USD 393) compared to their counterparts in the non-participant group who earned an average of MK 157,133 (USD 247).²

The nature of income diversification was examined to establish if FIDP helped diversify the income base of beneficiary households. Descriptive statistics show a 0.54 Herfindahl Index for participants compared to 0.60 for non-participants. A lower Herfindahl index indicates greater diversity in income sources. These results show that income sources for FIDP participants are more diversified than their counterparts who did not participate in the program.

There are significant variations in the wealth profile of households who participated in FIDP compared with those who did not participate in the program. The wealth index for the participant group averaged 43.9 whereas that of households who did not participate was at 37.6, representing a 17 percent difference in wealth profile of households. This implies that households who did not participate in FIDP program were more impoverished than those who participated in the program.

We also observe in Table 1 that a larger proportion of households who participated in FIDP were food secure than were their counterparts who were not involved in the program. Almost 79 percent of those who were engaged in FIDP were food secure compared to 70 percent of those who were not engaged in the program.

Table 1: Socio-economic status between participants and non-participants, descriptive statistics

Variable	Participants			Non-participants		
	Mean level	Standard Error	Observations	Mean level	Standard Error	Observations
Male, 0/1	0.743	0.0113	1,491	0.722	0.0115	1,505
Age, years	45.45*	0.3851	1,492	42.81*	0.4039	1,506
Household size, number	5.65*	0.0649	1,492	5.36*	0.0621	1,506
Landholding size, ha	2.10	0.0445	1,492	1.699	0.0353	1,504
Received extension, 0/1	0.923	0.0068	1,492	0.7840	0.0106	1,505
Market access	0.164	0.0096	1,492	0.061	0.0061	1,506
Credit access	0.045	0.0054	1,492	0.014	0.0030	1,506
Input access	0.859	0.0090	1,492	0.794	0.0104	1,506
Income diversification, Herfindahl Index	0.539	0.0069	1,482	0.597	0.0069	1,468
Food security status, ate 2 or more meals in a day, 0/1	0.786	0.0106	1,492	0.695	0.0119	1,506
Wealth index, based on assets, runs from 0 to 100	43.9	0.6128	1,492	37.6	0.6091	1,506
Annual total income, MK	249,995	10,564	1,492	157,132	6,747	1,506

Source: Author's calculation

Note: *means values statistically significant at 5 percent level.

² 1 USD= MK636.48 based on Malawi to USD exchange rate obtained from the Monthly Statistical Bulletin for January 2016, National Statistical Office, Government of Malawi.

FIDP participants have higher incomes than non-participants. However, there are significant variations across the regions in the income levels for the two groups, although consistently FIDP participants have higher incomes than non-participants (Table 2).

Table 2: Mean annual household income by region, MK

Region	FIDP	Non FIDP	Full Sample
South	153,244	108,308	130,579
Central	189,032	134,990	162,041
North	353,579	203,256	278,008

Source: Author's calculation

Statistics in Table 3 show that the poverty headcount for FIDP beneficiaries and non-participants in FIDP were 39.9 and 48.8 percent, respectively. These figures are higher than those computed by NSO (2013) for Malawi as a whole, at 38.7 percent, indicating that poverty was higher in the samples for this FIDP study than for the country as a whole. The depth of poverty index for FIDP beneficiaries and non-beneficiaries in the analytical sample were 0.529 and 0.572, respectively, compared with 0.111 for the nation as a whole from the NSO poverty estimates. This suggests that the households in the study sample were not only poorer than most Malawians, they were considerably poorer.

Table 3: Poverty indices between participants and non-participants

Sample	Poverty Headcount, %	Depth of poverty index (poverty gap)	Severity of poverty index (poverty gap squared)
FIDP Full Sample	44.9	0.553	0.335
FIDP Members	39.9	0.529	0.363
Non FIDP Members	48.8	0.572	0.404
NSO	38.7	0.111	0.045

Source: Author's calculation

Crop income contributes significantly to annual income, providing for 45 percent of average total income for participants and 44 percent for non-participants. However, crop income grew by one percent only over the period that FIDP was in place. This is an indication that the crops sector had been almost stagnant with limited potential for growth in the study area. Off-farm income sources are also important, contributing 33 percent and 43 percent of total income, respectively. Off-farm income as a share of total income for FIDP participants was 10 percent lower for participants than for non-participants. In contrast, FIDP beneficiary households experienced considerable growth in livestock productivity, which grew from contributing 8 percent of their total average income to 17 percent, representing a 112 percent increase. This suggests that livestock was the most productive sector in the study area and has a higher potential for growth than other sectors. As households participate in FIDP, crop income increases faster than off-farm income and the importance of off-farm income in total annual income decreases. This suggests that FIDP was counterproductive in terms of enhancing off farm income but still contributed positively to growth in agricultural income sources.

Table 4: Pairwise correlation between socio-economic variables and outcome variables

Variables	Participation	Household Income	Wealth Status	Food Security
Household size	0.0592*	0.0744*	0.1801*	0.0334
Age of household head	0.0862*	-0.0243	0.1730*	-0.0007
Male household head	0.0239	0.0773*	0.0675*	0.0653*
Landholding size	0.1302*	0.2313*	0.2162*	0.1869*
Contour ridge alignment	0.1693*	0.0279	0.1171*	0.0446*
Inputs access	0.0852*	0.0712*	0.1815*	0.1264*
Diversification	-0.1090*	-0.0014	-0.0916*	-0.0967*
Extension received	0.1971*	0.0750*	0.1158*	0.0745*
Market access	0.1629*	0.1179*	0.1280*	0.1236*
Credit access	0.0915*	0.0235*	0.0946*	0.0757*
Household income	0.1139*	1.0000		
Wealth status	0.1329*	0.2196*	1.0000	
Food security	0.1041*	0.1434*	0.3137*	1.0000

Source: Author's calculation

Note: * means 5% level of significance, otherwise not significant.

A pairwise correlation analysis was conducted between the socio-economic variables and FIDP participation, average annual household income, wealth status, and food security status (Table 4). Household size is shown to be positively correlated with program participation, household income, and wealth, but not food security status. This implies that the size of the household had no bearing on the food security status of the household in the study area. Another interesting result is on the age of the household head, which is positively correlated with program participation and wealth, but negatively correlated with food security status. The negative correlation between age and food security status of households implies that as age of a household head increases, the food security status of the household in the study area deteriorates. Almost all the variables tested are correlated with program participation, except for the sex of the household head. However, the Herfindahl income source diversification index of households is negatively associated with participation. This suggests that a household with more diversified income sources was more likely to participate in the FIDP program than a less diversified household.

Empirical Results

The Impact of Farm Income Diversification Program on Household Welfare

In order to investigate the impact of FIDP on household welfare, three outcome variables were used for welfare analysis, namely, annual average household income, food security, and wealth status. The average treatment effect for the treated (ATT) was estimated using three algorithms, nearest neighbor, radius, and kernel matching, to check the robustness of the results.

Table 5: Impact of income diversification on household income

Variable	Annual Average Household Income (MK)			
	Unmatched	Nearest Neighbor	Radius	Kernel
Sample		ATT	ATT	ATT
Treated Units	249,714	249,714	249,714	249,540
Control Units	157,833	166,466	171,485	172,173
Difference	91,881	83,248	78,229	77,367
Standard Error	12,675	15,945	13,032	13,068
T-value	7.25	5.22	6.00	6.94
Treated Observations		1,477	1,464	1,477
Control Observations		1,459	1,479	1,459

Source: Author's calculation

The first measure of welfare which was examined was annual household income. Table 5 indicates that there were significant differences between matched and unmatched estimates using the nearest neighbor matching estimator. Matched results using this estimator show that households who participated in FIDP earned an average of MK 83,248 (USD 131) more than their counterparts who did not benefit from FIDP. In consequence, the unmatched results overestimated the impact of FIDP on household income using the simple difference – the difference in the unmatched results averaged MK 91,881.

The results in Table 5 show that the impact of FIDP on annual average household income was a 50 percent increase, which is significant at 5 percent level of significance. Results from the radius and kernel matching approaches were similar in level and significant at the 5 percent level of significance.

Using average daily per capita income as an alternative measure of household welfare, the results were also significant and the program impact on per capita income ranges from MK 0.24 to MK 0.27, depending on the matching estimators (Table 6).

Table 6: Impact of income diversification on daily per capita income, MK

Variable	Daily Per Capita Income			
	Matching Estimator	Nearest Neighbor	Radius Matching	Kernel Matching
Sample	Unmatched	ATT	ATT	ATT
Treated Units	11.60	11.60	11.60	11.60
Control Units	11.20	11.36	11.34	11.34
Difference	0.40	0.24	0.27	0.26
Standard Error	0.492	0.068	0.052	0.052
T-value		3.5	5.15	4.99

Source: Author's calculation

With regards to sources of income, the detailed results in Annex 9 for significant changes on income show that livestock income experienced a considerable growth of 54 percent compared to other incomes whose growth ranges from 21 to 37 percent.

Table 7: Impact of income diversification on average total annual income by source, MK

Variable	Livestock Income		Crop Income		Off-Farm Income		Forest Income		Farm Income	
	Unmatched	ATT	Unmatched	ATT	Unmatched	ATT	Unmatched	ATT	Unmatched	ATT
Treated Units	40,721	40,721	111,619	111,619	88,641	88,641	12,382	12,382	171,276	171,276
Control Units	14,771	18,717	76,728	88,708	73,655	65,077	8,144	7,811	90,817	99,150
Difference	25,951	22,004	34,891	22,910	14,985	23,563	4,238	4,571	80,459	72,126
% Change		54		21		27		37		42
Standard Error	4,614	4,870	9,658	12,741	6,159	7,411	3,315	5,462	10,404	11,754
T-value		4.52		1.80		3.18		0.84		6.14

Source: Author's calculation

Note: Farm income includes livestock, and crop incomes. Matched ATT computed using nearest neighbor matching.

The study also investigated the impact of FIDP on food security using a dummy variable as a measure of welfare through equation (5) and (6). Study results indicate that FIDP had a positive and significant impact on food security status of households engaged in the program. The estimated average treatment effect on the treated (ATT) was 9, 5, and 4 percent using nearest neighbor, radius, and kernel matching estimators, respectively (Table 8). Households that were engaged in FIDP were more food secure compared to their counterparts who did not benefit from FIDP.

Table 8: Impact of income diversification on food security, percentages

Variable	Food Security Status					
	Nearest Neighbor		Radius Matching		Kernel Matching	
Matching Estimator	Unmatched	ATT	Unmatched	ATT	Unmatched	ATT
Treated Units	79	79	79	79	79	78
Control Units	69	70	69	77	69	74
Difference	10	9	10	5	10	4
Standard Error	0.018	0.018	0.018	0.019	0.018	0.020
T-value	5.50	4.87	5.50	2.41	5.50	2.22
Treated Observation		1,202		1,202		1,202
Control Observations		1,242		1,242		1,242

Source: Author's calculation

In order to assess the impact of FIDP on wealth status, the asset index was used as an outcome variable using equations (5) and (6). Results in Table 9 indicate that there were significant differences between unmatched and matched estimates. The estimated ATT for the asset index using nearest neighbor matching was 44 for participants compared to 38 of their counterparts which did not benefit from FIDP, a statistically significance at the 5 percent level. Results for other matching estimators were consistent with this estimate. This indicates that households which participated in FIDP had wealth indices that were on average 5 percentage points higher than their counterparts who did not participate in the program. This reflects a 13 percent improvement in the wealth status of households that can be attributed to FIDP.

Table 9: Impact of income diversification on wealth status of households, asset index

Variable	Wealth Status					
	Nearest Neighbor		Radius Matching		Kernel Matching	
Matching Estimator	Unmatched	ATT	Unmatched	ATT	Unmatched	ATT
Treated Units	44.02	43.77	44.02	44.02	44.02	44.02
Control Units	37.78	37.78	37.78	40.63	37.78	40.79
Difference	6.24	5.00	6.24	3.40	6.24	3.24
Standard Error	0.871	0.872	0.871	0.917	0.871	0.924
T-value	7.16	6.87	7.16	3.70	7.16	3.50
Treated Observation		1,459		1,459		1,477
Control Observations		1,459		1,477		1,459

Source: Author's calculation

The Impact of Farm Income Diversification Program on Poverty

In addition to welfare analysis, another focus of the study was to address the question of whether FIDP was central in reducing the poverty of the rural households.³ This was achieved through an examination of the three critical features of poverty in the rural community. Study results reveal that there were significant changes in indicators of welfare which are highly associated with poverty levels of the rural households. The implementation of FIDP had an impact on the annual incomes and food security status of households. This implies that households which were not engaged in the program were more impoverished than their counterparts which benefited from FIDP, in terms of household income and food security status. Another important feature of poverty is the wealth status of households drawn from the household ownership of various assets. The study indicates that FIDP improved ownership of various assets by households leading into improved wealth or economic status for the households. As an important feature of poverty, the improvement in the wealth status of households tells us that FIDP made remarkable progress in taking rural households out of chronic poverty.

Sensitivity Analysis

Results were tested to check how sensitive the study results are to unobserved selection bias. Firstly, study results based on nearest neighbor matching methods were tested against radius and kernel matching estimators to check if our nearest neighbor results are sensitive to other matching estimators. Results of the two alternative matching estimators are quite robust and comparable to the nearest neighbor estimates. However, although nearest neighbor matching results are consistent with other matching techniques; the results from the matching method are slightly lower than the estimates based on the other two matching methods for income, but higher for both food security and wealth status. The second procedure for sensitivity analysis was using Rosenbaum tests. Findings from these tests indicate that the results were sensitive to unobserved factors (Annex Table 3 and Annex Table 4). However, this does not mean that FIDP had no impact on the welfare levels of household which were engaged in the program. The implication is that out of the many factors that may contribute to changes in welfare in the study area, the role of FIDP on welfare levels should not be underestimated. Based on these results it is concluded that the average treatment effect on the treated are pure impacts on household welfare attributed to FIDP.

6. CONCLUSION AND POLICY IMPLICATIONS

This study applies a propensity score matching procedure to explore the impact of FIDP on household welfare in Malawi using data from the Ministry of Agriculture, Irrigation and Water Development. The matching procedure allows comparisons between households who participated in FIDP with those who did not participate. The study evaluates household welfare by using average annual income, food security status, and the wealth of households as well-being indicators. Study findings revealed that the FIDP program played a role in improving household welfare by increasing average annual income and the food security and wealth status of those households who participated in the program. The evaluation further implies that FIDP had an impact on poverty. This has been revealed through examination of welfare indicators. The study is therefore consistent with the literature that participation in a program that focuses on diversification of household incomes increases household welfare and, consequently, reduces the poverty of rural households.

³ The study focused on uni-dimensional nature of poverty through an assessment of the impact on individual measures of poverty rather than using a measure which is all encompassing.

The role of FIDP in improving household income and food security resulting in a reduction of poverty levels cannot be overemphasized in this study. However, studies in other developing countries suggest that livestock and non-farm income tend to increase income inequality. Therefore, the central question that needs to be posed in this study is whether farm income diversification contributed to poverty reduction in a way that addresses the real barriers that poor rural households confront as they construct their pathways out of poverty. By promoting more diversified household incomes, a better program should help increase household incomes of the poor in a way that will reduce the gap between the poor and the better off. This will ultimately reduce poverty levels and bring major policy implications in a country. This suggests that future studies on programs of this nature should explore the impact of such programs on income inequality to guide policy formulation and implementation.

Results further revealed that livestock and off-farm income had significantly different effects on the well-being of participants and non-participants, implying that livestock and off farm activities had greater potential for income growth than other income sources. This shows that, if FIDP had invested more in the livestock and off-farm sectors, there could have been a substantial increase in average annual income. The study therefore recommends that Government should put in place policies that would encourage investment in livestock and the off-farm sectors. Programs such as the provision of credit facilities to rural households could stimulate investment in the livestock sector and increase business activities in the rural off-farm sector.

The study further revealed that as households experienced income growth, non-farm incomes increased more than crop incomes. However, as non-farm income increased faster than crop income, the rural non-farm economy decreased its importance to total annual income. This trend on non-farm income casts doubts on whether FIDP was designed in a way that would allow rural non-farm income to play a potentially significant role in reducing poverty and increasing food security. Barrett and Reardon (2001) point out that rural non-farm income provides cash that assist farm households to purchase food during a drought or after a drop in harvest and crop income, and provides savings used for food purchases in difficult times and investment in the other sectors of agriculture. Therefore, the increased importance of off farm income would result in significant impacts on food security and poverty among rural households.

The study, therefore, offers two recommendations both in the fields of research and government policies. In the first place, the study recommends that further studies should be conducted to establish why programs aiming at diversifying the income sources for rural households, such as the FIDP, tend to succeed more in enhancing on-farm than off farm income. This implies that more need to be done to ascertain why the importance of non-farm income to total income decreases as off-farm income increases faster than crop income. Factors that affect the growth of off-farm incomes in the rural economy need to be investigated, especially in a different country contexts. These factors should be given critical consideration when developing policies to promote growth and poverty reduction in rural area.

Secondly, the study recommends that, when addressing problems of food security and poverty, policies that can reduce the bottlenecks that rural farmers face in investing in the rural non-farm sector should be put in place. Programs, such as microfinance and revolving funds for farmer groups, which improve access to credit facilities by rural households would encourage investment in business activities in the rural economy and also enhance agricultural productivity through adoption of improved agricultural technologies. This would ultimately increase household incomes, thereby reducing food insecurity and poverty in the rural sector.

ANNEXES

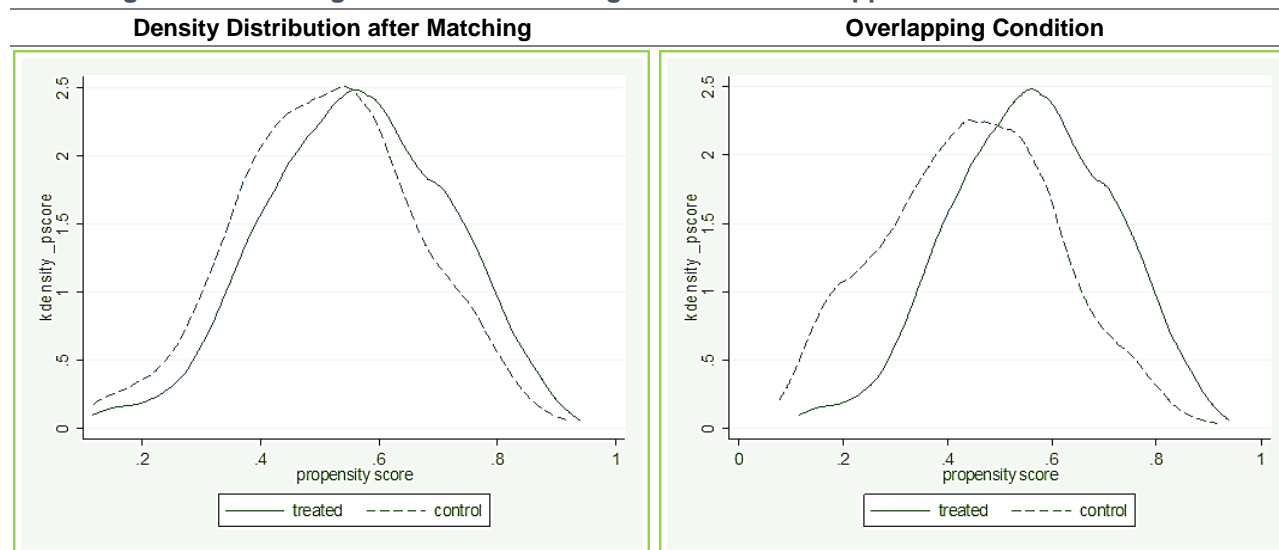
Annex Table 1: Regression results from logit model

Dependent Variable=Participation in FIDP			
Variable	Coefficient	Standard Error	P-value
Male head of household (0/1)	-0.0094	0.0552	0.864
Age of head of household, years	0.0077	0.0016	0.000*
Household size, number	0.0077	0.0010	0.440
Landholding size, ha	0.0704	0.0170	0.000*
Extension received, 0/1	0.6369	0.0731	0.000*
Market access, 0/1	0.5122	0.0802	0.000*
Rainfall deviation, mm	-0.0003	0.0001	0.009*
Diversification Index	-0.3482	0.0920	0.000*
Credit access, 0/1	0.5567	0.1517	0.000*
Out grower, 0/1	0.2591	0.0914	0.005*
Food security status, 0/1	0.1349	0.0582	0.021*
Input access, 0/1	0.1304	0.0653	0.046*
District	0.0439	0.0081	0.000*
Livestock ownership, 0/1	0.3073	0.0913	0.001*
Number of observations	2,944		
LR chi2(14)	315.7		
Prob > Chi ²	0.0000		
Pseudo R ²	0.0774		
Log likelihood	-1882.721		

Source: Author's calculation

Note: *means significant P-values at 1%, 5% & 10%

Annex Figure 1: Balancing of covariates and region of common support



Source: Author's calculation

Annex Table 2: Results of standard bias test

Variable	Mean			t-test		V(T)/V(C)
	Treated	Control	% bias	t	P> t	
Male household head	0.743	0.750	-1.5	-0.42	0.673	1.02
Age of household head	45.393	45.932	-3.5	-0.96	0.336	0.90
Household size	5.650	5.769	-4.8	-1.27	0.203	0.94
Landholding size	2.109	2.160	-3.3	-0.81	0.420	0.93
Extension received	0.922	0.924	-0.4	-0.14	0.890	1.02
Credit access	0.045	0.045	0.0	0.00	1.000	1.00
Input access	0.861	0.863	-0.7	-0.21	0.831	1.02
Diversification Index	0.539	0.531	2.9	0.80	0.422	1.07
Rainfall variation	76.766	89.601	-4.8	-1.28	0.202	0.95
Livestock ownership	0.943	0.933	3.6	1.14	0.252	0.86*
Contour ridge alignment	0.635	0.611	4.8	1.33	0.184	0.98
Vetiver hedgerows	0.510	0.484	5.3	1.40	0.162	1.00
Food security status	0.787	0.780	1.6	0.45	0.655	0.98
Market access	0.165	0.158	2.2	0.50	0.618	1.03
District	6.522	6.748	-6.4	-1.77	0.077	1.05

Source: Author's calculation

Annex Table 3: Rosenbaum sensitivity test for food security

Gamma	Q_mh+	Q_mh-	p_mh+	p_mh-
1.00	3.983	3.983	0.000	0.000034
1.05	3.546	4.423	0.000	4.90E-06
1.10	3.130	4.843	0.001	6.40E-07
1.15	2.733	5.245	0.003	7.80E-08
1.20	2.354	5.631	0.009	8.90E-09
1.25	1.990	6.003	0.023	9.70E-10
1.30	1.641	6.362	0.050	1.00E-10
1.35	1.306	6.708	0.096	9.90E-12

Source: Author's calculation

Note: Gamma: odds of differential assignment due to unobserved factors
 Q_mh+: Mantel-Haenszel statistic (assumption: overestimation of treatment effect)
 Q_mh-: Mantel-Haenszel statistic (assumption: underestimation of treatment effect)
 p_mh+: significance level (assumption: overestimation of treatment effect)
 p_mh-: significance level (assumption: underestimation of treatment effect)

Annex Table 4: Rosenbaum bounds sensitivity analysis for income and wealth status

Γ	Treatment: Income (N=1479)				Treatment: Wealth Status (N=1479)			
	Hodges-Lehmann Point Estimates		95% Confidence Intervals		Hodges-Lehmann Point Estimates		95% Confidence Intervals	
	Min	Max	Min	Max	Min	Max	Min	Max
1.0	32749	32749	22397	43415	2.1277	2.1277	1.50E-06	4.2553
1.2	16836	49575	6800	61395	-4.80E-07	4.2553	-2.1277	6.3830
1.4	3864	65000	-6130	77700	-2.1277	7.4468	-4.2553	8.5106
1.6	-7200	79100	-17525	92925	-4.2553	8.5106	-6.3830	10.6380
1.8	-17100	92350	-27855	107035	-6.3830	10.6383	-8.5106	12.7660
2.0	-26124	104716	-37650	120375	-7.4468	11.7021	-9.5745	13.8300
2.2	-34620	116275	-47000	133293	-9.5745	13.8298	-10.6383	14.8940

Source: Author's calculation

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Acknowledgments

This paper was selected for the Malawi Strategy Support Program (MaSSP) "Bunda Grant Scheme" for 2014/15. Under this capacity building program, IFPRI provides financial and supervisory support to students to extract a journal-length article from their MSc theses. The authors would like to thank Bob Baulch for guidance in this regard.

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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.

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