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Impact of Microcredit on Small Farmers' Livelihoods in Rwanda: An Empirical Analysis using Propensity Score Matching

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Abstract

Microcredit has a very important role in poverty alleviation in developing countries. Access to credit by small farmers' households helps them to increase their standard of life. However, even though the Rwandan authorities have tried their best for the implementation of microfinance institutions in rural areas, the access to microcredit programmes by small farmers remains the key obstacles for their economic development. This research study examines the impacts of microcredit on small farmers' livelihood in Rwanda. For the purpose of this study, a structured questionnaire has been used as an instrument of primary data collection. The samples of 300 small farmers selected randomly from 3 sectors of Huye District namely Maraba, Mukura and Ngoma were considered in this study. Descriptive statistics and the Propensity Score Matching Methodology (PSM) have been used to analyze the data. Results from Descriptive statistics revealed that the main reasons for participating in microcredit programmes were to pay for their children's' tuition fees, to pay for health services, to start businesses and for food daily consumption. The results from propensity score matching revealed that small farmers who participated in microcredit programmes had increased their total annual income and their total annual expenditure than non-participants. The study recommends that the Government of Rwanda and other private institutions should take into consideration for better promotion of microcredit programmes to improve small farmers' livelihoods.

Key Words: Microcredit, Small Farmers, Livelihood, Propensity Score Matching, Rwanda

JEL Classification: G21, B23

Paper Classification: Research Paper

Introduction

Impact assessment of microcredit conducted in many countries indicates dramatic improvement in household income levels. In Rwanda, microcredit programme has played a very important contribution in the country's development. By its Vision 2020, the Government of Rwanda has made efforts and implemented strategies through microcredit programmes directed at the economic empowerment of rural poor (MINECOFIN, 2012). Increasing agricultural productivity and farmers' income are always important considerations for the Rwandan Government.

According to Rahji & Fakayode (2009), the agriculture is the main activity of farmers who are usually living in rural areas. Microcredit programmes has a positive impact on agricultural productivity Zahidul & Shimelles, (2009); Abdullah, (2011); Abdul Wadud, (2013); Asadul Islam et al., (2015). Household's participants in microcredit programmes have increased the standard of living and reduced unemployment Hasan, (2003; Datta, (2004) and Sherin, (2012). The supply of credit helps rural households to invest in agricultural production and to enhance their off-farm income Asmelash, (2003); Hakim, (2004).

Sriram (2007) found the same results and started that increased supply of credit helped to increase in agricultural productivity and the well being of farmers. Li Xia (2010) stated that microcredit considerably increase the households' wellbeing such as income and consumption. However, other studies have shown that microcredit is not reaching the marginalized farmers for increasing their livelihood and agricultural productivity Zahidul Islam & Shimelles Tenaw, (2009); Nosiru, (2010). Impact of microcredit was limited to household assets and the credit scheme has been ineffective for the poor families Aschale et al, (2012).

In Rwanda, although a number of microfinance institutions have been implemented, the low access to microcredit programmes by the majority of small farmers is the main barrier for improvement of their livelihood. The lacks of capital and collateral security have been considered as the major challenges to this scenario. However, microcredit programme accessibility has the potential benefit at both the macro and the micro levels but exploitation of this potential in Huye District is still not well documented and not much scientific research has been done to evaluate the microcredit impact on small farmers' livelihood.

Literature Review

The impact of microcredit on household has been much debated in the literature. Several studies have shown positive impact of microcredit on poverty reduction and also on household s' standards of living. Other studies have shown negative impact of microcredit programmes. Quibria (2012) stated that microcredit has enhanced the borrowers' income and has improved family well-being.

Develtere, Patrick and Huybrechts (2005) reported that the Grameen Bank and BRAC s' members have reduced their vulnerability after accessing microcredit. A study carried out by Karlan and Zinman (2010) in Philippines showed that entrepreneurs who access credit had reduced their businesses investment risks and had increased their profits. Asmamaw (2014) reported that almost all microfinance clients have improved their livelihood thus their empowerment. A study conducted by Khandker (2005) revealed that there was a positive effect on microcredit borrowers by raising their household expenditures which are helping their poverty alleviation. Ashaolu et al, (2011) reported that the total cost and profit per hectare of credit user farmers was higher than that of non-credit user farmers. By using Propensity Score Matching Score method, Owuor (2009) evaluated the impact of lending program on small farmers' performance. He found that education, farm engagement, exposure to agricultural seminar, gender and credit sources accessibility were significant and have an effect on microfinance credit participants. However some studies have shown the negative impact of microcredit on household participants. For instance, the study carried out by Islam (2008) revealed that there was a lower micro-loans impact on poor household borrowers and their effects are not healthy for all participants. Banerjee et. al., (2009) found that microcredit programmes accessibility has had no impact on poverty reduction of non- participants.

Research Gaps

Studies above simply demonstrate that microcredit programmes are playing a vital role in poverty reduction for the rural poor. The impacts of microcredit on its members in terms of empowerment and access to credit have been found positive. Though there are a number of studies which are related to functioning of microcredit but only a few studies have been taken so far to analyze the impact of microcredit on small famers. In spite of the existing figures, the supply side of microcredit in Rwanda is still inadequate to fill the gap between demand and supply of microcredit but it hold the promise to act as a great opportunity for the financial sector and the economy as a whole.

Contribution of the study

Besides contributing to an understanding on how access to microcredit has the potential to change the standards of living of small farmers, this study serve to guide the policy makers and other stakeholders through appropriate interventions to support small farmers to improve their livelihood. The study helps microfinance institutions to achieve their goals and objectives by providing credit to small farmers which could potentially increase their agricultural productivity.

Research Methodology for the study

a. Type of Study

The present study is an empirical study and the purpose is to examine the impact of microcredit on small farmers livelihoods in the selected 3 sectors namely Maraba, Mukura and Ngoma located in Huye District, Southern Province of Rwanda.

b. Sample

The sample size was determined by using the Cochran formula to estimate 300 respondents. All respondents located in three sectors of Huye District, namely Maraba, Mukura and Ngoma were investigated in this study. These areas were purposively selected to represent the diverse economic backgrounds in agricultural activities. In this study, 136 respondents have access to and participated in microcredit programmes and 164 respondents have never had access to and participated in the programme.

c. Data Collection Methods

In order to generate the data needed to address the objectives of the study, a cross-sectional survey of small farmer's households in Huye District of Rwanda was undertaken to collect primary data. Data were collected using structured questionnaires that focus on agricultural households' access to and participation in microcredit programmes. The questions have been elicited for both personal and households' participation in microcredit programmes.

Secondary data were obtained from microfinance institutions, including Savings and Credit Cooperatives (SACCOs), National Bank of Rwanda (NBR), Rwanda Cooperatives Agency (RCA), published and unpublished documents (books, Theses, Journals, Research working papers, and Rwandan Government reports).

d. Variables used in the study

Gender

Gender refers to the sex of the household head. It is a dummy variable which takes a value of ''one'' for male head household and ''zero'' for female head household.

Education

Education level of small farmer households measure the number of school years attendance. Five levels of education were used in the study and coded as follows: 1=illiteracy, 2= Primary, 3=Secondary, 4= University and 5 =vocational.

Household size (HHsize)

Household size refers to the number of people living in a same homestead. Large household sizes are expected to increase the household labor resources resulting in higher output and though, these bigger household sizes could have greater need for consumption smoothening. Therefore, it is likely to resort to access microcredit to meet these needs.

Household Off- farm Income (Off_farm_inc)

Off-farm income refers to the portion of farm household income obtained off the farm sources including employment, salaries, and other business activities. Small farmers with low income are expected to have higher tendency to participate in microcredit programme for increasing their livelihoods.

Household Land size (Sizeland)

Land size of the household is measured in Acres. Land has been the most important collateral demanded by formal lenders. Small farmers' household with larger land size is expected to a higher repayment capacity.

Cooperative membership (Coop._membership)

Cooperative membership takes the value of 1 if the small farmers is a member of any cooperative in the study areas and 0=otherwise.

Distance from homestead to the Financial Institution Office (Distance)

Distance is measured in (km). Distance from homestead to the financial institutions office could be an influencing factor to access microcredit. Household located far from financial Institutions office is less likely to access microcredit programme than those located nearby. This is because households located very far would incur high transport costs.

Annual interest rate (Ann_Int_rate)

The annual interest rate is calculated in percentage. It plays an important role in the demand and supply of credit in the financial institutions.

e. Hypothesis of the study

Microcredit does not have any significant impact on small farmers' livelihoods in Rwanda.

f. Research Models Used

The data were analyzed by using descriptive statistics and Propensity Score Matching Approach.

1. Descriptive Statistics

Demographic and Socio-economic characteristics of small farmers in Huye District were presented in the forms of frequencies and graphs.

2. Propensity Score Matching Method (PSM)

The PSM method has been employed to estimate the impact of microcredit programmes on small farmers' livelihood in Huye District.

According to (Caliendo and Kopeinig, 2005; Smith and Todd, 2005) the Propensity Score probability function is presented as:

P (X) = Pr {D = 1\ X} = E {D\ X} ………………………………….(1)

Where D = {0, 1} is the binary variable on whether a household has access and participated in microcredit programme (1) or not (0). X is the multidimensional vector of household characteristics.

Average Treatment Effects on the Treated (ATT)

The Average Treatment Effect on the Treated was computed using Nearest Neighbor Matching (NNM), Radius Matching (RM) and Kernel Based Matching (KBM) methods to analyze the impact of microcredit on the livelihoods of small farmers. The value of Average Treatment Effects on the Treated is the difference between expected outcome values of treated group (participants) and Control group (non-participants) in microcredit programmes. The outcome variables considered in this study are: *''Total Annual Income''* and *''Total annual Expenditure''*.

Nearest Neighbor Matching and Radius Matching (NNM and RM)

With NNM, each treated group is matched with a control group (Caliendo & Kopeinig (2008).

According to (Mingxiang Li, 2012) in Radius Matching, the outcome of the control group matches with the outcome of the treated group only when the propensity scores fall in the predefined radius of the treated units.

Average Treatment Effect on the Treated was estimated using NNM and RM.

The formula could be written as:

$$ATT = \frac{1}{N^T}\left(\sum_{i\in T} Y_i^T - \frac{1}{N_i^c}\sum_{j\in c} Y_j^c\right) \text{……………………………………..(2)}$$

Where,

N^T is the number of cases in the *treated group* and N^e_1 is a weighting scheme that equals the number of cases in the control group (Becker and Ichino, 2002).

Kernel Based Matching (KBM)

With KBM, all treated groups are matched with a weighted average of all control groups using weights that are inversely proportional to the distance between the propensity scores of treated and control groups. The weighting value is determined by distance of propensity scores, bandwidth parameter h_n, and a kernel function k (.).

The KBM estimator is given by the formulation:

$$ATT^{K} = \frac{1}{N^{T}} \sum_{i \in T} \left\{ Y_i^{T} - \frac{\sum_{i \in c} Y_j^{c} G\left(\frac{P_j - P_i}{h_n}\right)}{\sum_{k \in c} G\left(\frac{P_k - P_i}{h_n}\right)} \right\} \text{..... (3)}$$

Where G (.) is a kernel function and h_n is a bandwidth parameter, under standard conditions on the bandwidth and kernel and the formulation below is consistent estimator of the counterfactual outcome Y_{0i}.

$$\text{Outcome } Y_{0i} = \frac{\sum_{i \in c} Y_j^{c} G\left(\frac{P_j - P_i}{h_n}\right)}{\sum_{k \in c} G\left(\frac{P_k - P_i}{h_n}\right)} \text{..... (4)}$$

Covariance Balance Method

The study also used the method of Covariate Balance to apply the Standardized Bias (SB) and the Bias Reduction (BR) methods to check the balance of the score and covariates.

The Standardized Bias (SB)

The SB approach calculates the difference of sample means in the treated and the matched control groups. Each covariate X is defined as the difference of sample means in the treated and matched control as a percentage of the square root of the average of sample variances in both groups. The SB is also used to quantify the bias between both groups (Rosenbaum and Rubin, 1985).

Before matching, the SB is given by this formula:

$$SB_{Matching}(X) = 100 \frac{\overline{X}_{Treatment} - \overline{X}_{Control}}{\sqrt{\frac{V_{Treatment}(X) + V_{Control}(X)}{2}}} \text{.....(5)}$$

where

$\overline{X}_{Treatment}$ and $\overline{X}$ denotes the sample mean of covariate in treated and untreated groups respectively, whereas, $V_{treatment}$ and $V_{Control}$ denotes the sample variance of the covariate in treated and untreated groups respectively.

The bias reduction (BR)

The bias reduction (BR) can be computed as:

$$BR = 100\left(\frac{1 - B(X)_{After}}{B(X)_{Before}}\right) \quad \text{..... (6)}$$

Common support condition

The assumption besides conditional independence is called the common support or overlap condition. The assumption is that the probability P(X) lies between 0 and 1. It is also assumed that for all X there is positive probability of either participating in microcredit programmes (D=1) or not participating (D=0).

Common support ensures that individuals with the same characteristics have positive probability of being treated or not treated in the program. Individuals that fall outside the common support region would be excluded in the treatment effect estimation. This is an important condition to guarantee the quality of the matching used to estimate the ATT (Becker and Ichino, 2002).

The common support is expressed as:

$$0 \prec \Pr(D = 1/X) \prec 1 \quad \text{..... (7)}$$

g. Statistical Tools Used

The statistical tools used to analyze data were both SPSS 18 and STATA 12.

Data Analysis and Results Discussions

Results from Descriptive Statistics

Participants and non-participants in microcredit programmes by sector in Huye District

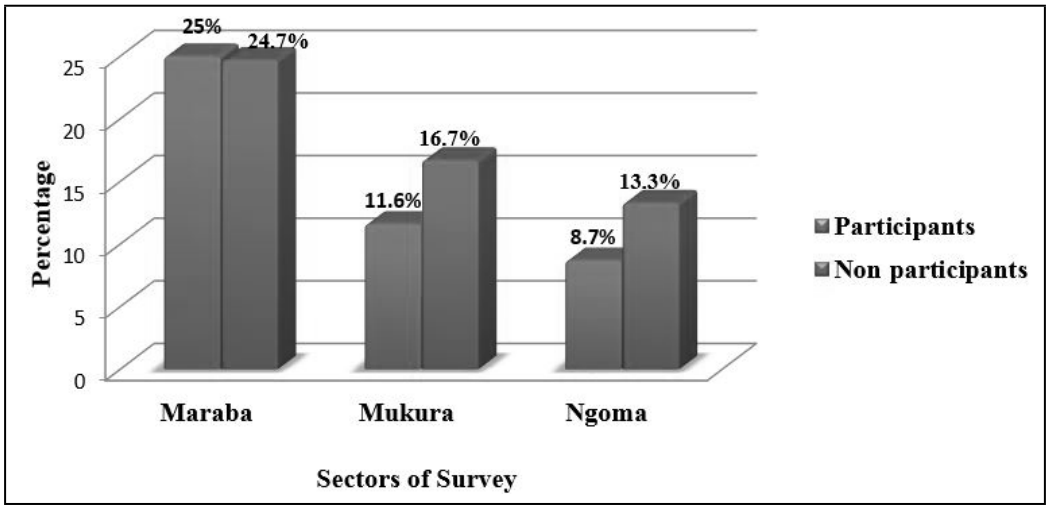


Figure 1: Figure shows participants and non-participants in microcredit programmes by sector

Source: Author Field survey, 2015

In order to analyze the participation in microcredit programmes by respondents in 3 sectors of Huye District, the respondents were asked to indicate whether they had ever participated in microcredit programmes provided by formal or informal financial institutions. Therefore, the participation differed for different sectors (Figure 1). More small farmers Maraba Sector have participated in microcredit programmes than in the other two sectors of Huye District.

In fact, in Maraba sector, 75(25 percent) of the respondents had participated in microcredit programmes and 74 (24.7 percent) of the respondents had not participated in microcredit programmes. One factor explains this finding is that the level of coffee commercialization is much higher in Maraba Sector than in the others.

The majority of small farmers interviewed participated in microcredit programmes in better increasing their coffee production which is the main export crop production in Rwanda.

The figure 1 shows also that in Mukura Sector, 35(11.6 percent) of respondents had participated in microcredit programmes while 50(16.7 percent) had not participated in microcredit programmes. The participation in microcredit programmes was lowest in Ngoma sector, where only 26 (8.7 percent) of respondents were the participants and 40(13.3 percent) were not the participants in microcredit programmes.

Characteristics of Microcredit Loans from different sources of microcredit in Huye District

Table 1: Table showing characteristics of microcredit loans in Huye District

Characteristics	Sources of Microcredit						
	Commercial Banks N=14 (10.3%)	MFIs N=35 (25.7%)	SACCOs N=32 (23.5%)	SHG N=25 (18.3%)	Cooperative Society N=17 (12.5%)	Friends/ Relatives N=13 (9.7%)	Total N=136 (100%)
Loan Duration							
3 to 6 months	3 (2.2)	25 (18.4)	20 (14.7)	17 (12.5)	8 (5.9)	6 (4.4)	79 (58.2)
7 to 12 months	4 (2.9)	6 (4.4)	8 (5.9)	5 (3.7)	6 (4.4)	4 (2.9)	33 (24.2)
1 to 2 Years	5 (3.7)	3 (2.2)	3 (2.2)	2 (1.5)	3 (2.2)	2 (1.5)	18 (13.2)
More than 2years	2 (1.5)	1 (0.7)	1 (0.7)	1 (0.7)	0 (0)	1 (0.7)	6 (4.4)
Mode of Loan Repayment							
Weekly	2 (1.5)	12 (8.8)	9 (6.5)	13 (9.5)	11 (8.1)	4 (2.9)	32 (23.5)
Monthly	8 (5.9)	22 (16.2)	21 (15.3)	10 (7.3)	5 (3.7)	6 (4.4)	89 (65.5)
Annually	4 (2.9)	1 (0.7)	2 (1.5)	2 (1.5)	1 (0.7)	3 (2.2)	15 (11)
Types of Collaterals required							
Land	5 (3.7)	17 (12.5)	20 (14.7)	13 (9.5)	9 (6.6)	7 (5.2)	71 (52.2)
House	3 (2.2)	7 (5.1)	6 (4.4)	1 (0.7)	0 (0)	0 (0)	17 (12.5)
Salary	2 (1.5)	4 (2.9)	1 (0.7)	5 (3.7)	3 (2.2)	2 (1.5)	17 (12.5)
Forest	1 (0.7)	5 (3.7)	3 (2.2)	2 (1.5)	3 (2.2)	1 (0.7)	15 (11)
Coffee plantations	3 (2.2)	2 (1.5)	2 (1.5)	4 (2.9)	2 (1.5)	3 (2.2)	16 (11.8)

Sources: Author Field survey, 2015
Note: Figures in parentheses represent percentages

Loan Duration

In the three sectors of Huye District, different sources of credit were presented in table 1.The table 1 revealed that 79 (58.2 percent) participants in different sources of credit have reported that loan duration was 3 to 6 months while 33 (24.2 percent) reported that loan duration was 7

to 12 months, 18 (13.2 percent) reported that loan duration was 1 to 2 years and only 6 (4.4 percent) reported that loan duration was more than 2 years. In general, different sources of credit such as Commercial Banks, microfinance Institutions, Saving and Credit Cooperatives Societies (SACCOs), Self –Help Groups (SHG), Cooperative Societies and relative / Friends have implemented the short term loan duration.

Modes of Loan Repayment

The table 5 revealed that different mode of loan repayment for small farmers was short term and medium terms periods. Therefore, 32(23.5 percent) of small farmer's participants in microcredit programmes mentioned that their mode of loans repayment was weekly while the majority 89(65.5 percent) reported monthly loan repayment and only 15 (11 percent) mentioned annual loan repayment. In general, the mode of loan repayment for small farmers in Rwanda is the short time period.

Types of collaterals required to obtain a Loan

The table 1 revealed that the probability to obtain loan from different sources of credit depend on collateral required. According to financial Institutions policy, before small farmers obtain loans, they must show evidence that they have collateral for their loans security. The most types of collaterals in the study areas were lands, houses, salary, forests and coffee plantations. The table 1 revealed that the main collateral required by different sources of credit in study areas were lands. Therefore, 71(52.2 percent) household participants in microcredit programmes had reported that collateral required by formal or informal financial Institutions were lands while 17 (12.5 percent) respondents reported houses, 17 (12.5 percent) respondents reported salaries, 15 (11 percent respondents reported forests and 16 (11.8 percent) respondents reported coffee plantations. These financial institutions put high importance on collateral to reduce risks of payment defaults by small farmers. Once they fail to repay the loans provided, these collaterals are sold to cover the non- payment of loans.

Results of Propensity Score Matching Estimation

The results from Nearest Neighbor Matching (see table 2), results from Kernel Based Matching (see table 3 and Results from Radius Matching (see table 4) show that out of eight explanatory variables, five variables were found significant. It is evident from the tables that ''education, household size, land Size and cooperative membership'' have a positive impact on small farmers' livelihood while distance to lenders' office have a negative impact on small farmers' livelihoods.

Education

Small farmers' education was found to be statistically significant level at 10 percent. However, small farmers with higher education might require more microcredit for increasing their agricultural production and income compared to uneducated small farmers. Educated small farmers may affect the decision to borrow. The likelihood in the accessibility to microcredit programme should increase with knowledge and better educated household heads.

Household size

The size of household was significant at 5 percent and had a positive impact on household livelihood. Therefore, higher household sizes could have influence on the participation in microcredit programmes in order to improve their livelihood and for various consumption needs.

Household land size

The coefficient Household land size variable was significant at 10 percent and influences positively the participation in microcredit programmes. That means that small farmers will be willing to take loans from different sources of credit in order to increase their household land sizes which is the main collateral required by financial institutions in Huye District.

Cooperative membership

Cooperative membership was found to be significant at 1 percent and influence positively the participation in microcredit programmes. However, to be a member of cooperative will help small farmers to access microcredit very easily for increasing their livelihoods.

Distance

The Distance from homestead to microcredit sources Office was found to be significant at 1 percent and influence negatively the participation in microcredit programmes. Therefore, small farmers located far from microcredit sources office are less likely to participate in microcredit programme compared to those located nearby due to high transport costs.

Estimation of ATT using Nearest Neighbor Matching

Table 2: Table Showing the estimation of ATT using Nearest Neighbor Matching

Variables	Coef.	Std. Err.	z	P>|z|
Gender	.2815604	.2695499	1.04	0.296
Education	.3205724	.1751017	1.83	0.067*
HHsize	.1494227	.0746688	2.00	0.045**
Off_farm_inc	-.0520488	.0397523	-1.31	0.190
SizeLand	.2925444	.1666172	1.76	0.079*
Coop_Member	.957471	.2666872	3.59	0.000***
Distance	-.4670435	.160032	-2.92	0.004***
Ann_Int_rate	-.0128951	.054362	-0.24	0.812
_Cons	-2.120218	1.167294	-1.82	0.069

Variables	Sample	Treated	Controls	Difference	S.E	T-Stat
Tot_Ann_Inc	Unmatched	524,716.544	235,927.134	288789.41	64,825.89	4.45
	ATT	524,716.544	250,175.674	274,540.87	72,437.037	3.79***
	ATU	235,927.134	403,605.996	167,678.862	.	.
	ATE			216,122.972	.	.
Tot_Ann_Exp	Unmatched	750,213.971	457646.372	292,567.599	50962.2052	5.74
	ATT	750,213.971	498,574.73	251,639.24	59354.6171	4.24***
	ATU	457,646.372	677,748.272	220,101.9	.	.
	ATE			234,398.828	.	.

Number of Obs = 300, LR chi2(8) = 67.13, Prob > chi2 = 0.0000, Pseudo R2 = 0.1624, Log likelihood = -173.07194
Source: Computed by the author from Field Survey data, 2015
****, **, * Represent 1 percent, 5 percent and 10 percent of the level of significance respectively*
Notes: 1USD = 804.79 Rwf : Exchange Rate on 22th September, 2016

Estimation of ATT using Kernel Based matching

Table 3 : Table 3 showing the estimation of ATT using Kernel Based Matching

Variables	Coef.	Std. Err.	z	P>|z|
Gender	.2815604	.2695499	1.04	0.296
Education	.3205724	.1751017	1.83	0.067*
HHsize	.1494227	.0746688	2.00	0.045**
Off_farm_inc	-.0520488	.0397523	-1.31	0.190
SizeLand	.2925444	.1666172	1.76	0.079*
Coop_Member	.957471	.2666872	3.59	0.000***
Distance	-.4670435	.160032	-2.92	0.004***
Ann_Int_rate	-.0128951	.054362	-0.24	0.812
_cons	-2.120218	1.167294	-1.82	0.069

Variables	Sample	Treated	Controls	Difference	S.E	T-Stat
Tot_Ann_Inc	Unmatched	524,716.544	235,927.134	288,789.41	64,825.8899	4.45
	ATT	524,716.544	248,412.735	276,303.809	70,899.8399	3.90***
	ATU	235,927.134	494,208.478	258,281.344	.	.
	ATE			266,451.528	.	.
Tot_Ann_Exp	Unmatched	750,213.971	457,646.372	292,567.599	50,962.2052	5.74
	ATT	750,213.971	473,889.301	276,324.67	55,040.7644	5.02***
	ATU	457,646.372	702,392.609	244,746.237	.	.
	ATE			259,061.793	.	.

Source: Computed by the author from Field Survey data, 2015
****, **, * Represent level of significance at 1 percent, 5 percent and 10 percent respectively*
Notes: 1USD = 804.79 Rwf : Exchange Rate on 22th September, 2016

Estimation of ATT using Radius matching

Table 4: Table showing estimation of ATT using Radius Matching

Variables	Coef.	Std. Err.	z	P>|z|
Gender	.2815604	.2695499	1.04	0.296
Education	.3205724	.1751017	1.83	0.067*
HHsize	.1494227	.0746688	2.00	0.045**
Off_farm_inc	-.0520488	.0397523	-1.31	0.190
SizeLand	.2925444	.1666172	1.76	0.079*
Coop_Member	.957471	.2666872	3.59	0.000***
Distance	-.4670435	.160032	-2.92	0.004***
Ann_Int_rate	-.0128951	.054362	-0.24	0.812
_cons	-2.120218	1.167294	-1.82	0.069

Variables	Sample	Treated	Controls	Difference	S.E	T-Stat
Tot_Ann_Inc	Unmatched	524,716.544	235,927.134	288,789.41	64,825.8899	4.45
	ATT	524,716.544	244,818.214	279,898.33	70,667.5114	3.96***
	ATU	235,927.134	509,167.699	273,240.565	.	.
	ATE			276,258.752	.	.
Tot_Ann_Exp	Unmatched	750,213.971	457,646.372	292,567.599	50,962.2052	5.74
	ATT	750,213.971	469,453.664	280,760.307	54,331.3586	5.17***
	ATU	457,646.372	719,242.117	261,595.745	.	.
	ATE			270,283.68	.	.

Source: Computed by the author from Field Survey data, 2015
****, **, * Represent level 1 percent, 5 percent and 10 percent level of significance*
Notes: 1USD = 804.79 Rwf : Exchange Rate on 22th September, 2016

Average Treatment Effect of the Treated (ATT) from Nearest Neighbor matching

Table 2 shows the ATT from Nearest Neighbor Matching results. The Average Treatment Effect of the Treated (ATT) on small farmers' total annual income was 274,541 Rwandan francs approximated to 341.14 USD. That means that small farmers who had participated in microcredit programmes had increased their total annual income by (341.14 USD) than non-participants and t-statistics (t=3.79) was significant at 1 percent level.

The results also show that the ATT on total annual expenditure for small farmers' participation in microcredit programmes was 251,639 Rwandan Francs approximately 312.67 USD. That means small farmers who had participated in microcredit programmes had more annual expenditure equivalent to 312.67 USD as compared to non-participants. The t-test for annual total expenditure was (t= 4.24) which was significant at 1 percent level.

Average Treatment Effect of the Treated (ATT) from Kernel Based matching

Table 3 shows the ATT from Kernel Based matching results. The Average Treatment Effect (ATT) was 276,304 Rwandan Francs approximated to 343.32 USD. That is means small farmers who had participated in microcredit programmes had increased their total annual income by 343.32 USD) than non-participants. The t -test for total annual income was (t=3.9) means that the impact is significant at 1 percent level.

The results show also that the average treatment effect on total annual expenditure was 276,324 Rwandan Francs approximately 343.35 USD. That means small farmers who had participated in microcredit programmes had more annual expenditure of 343.35 USD compared to non-participants. The t-test for total annual expenditure was (t= 5.02) which is significant at 1 percent level.

Average Treatment Effect of the Treated (ATT) from Radius matching

Table 4 shows the ATT from Radius matching results. The Average Treatment Effect on total annual income was 279,898 Rwandan Francs approximated to 347.8 USD. That means small farmers who had participated in microcredit programmes had increased their total annual income

by 347.8 USD than non- participants. The t -test for total annual income was (t=3.96) means that the impact is significant at 1 percent level. The results also show that the average treatment effect on total annual expenditure was 280,760 Rwandan Francs approximately 348.9 USD. That means small farmers who had participated in microcredit programmes had more annual expenditure than non- participants by 348.9 USD. The t-test for annual total expenditure was (t= 5.17) which is significant at 1 percent level.

Furthermore, the ATT using radius matching result shows that there is an increased significant impact (347.8 USD) on more small farmers' total annual income (t=3.96) of small farmers' participation in microcredit programmes and also there was an increased impact of (348.9 USD) on more household expenditure (t=5.17) of small farmers' microcredit programmes participation on total annual expenditure.

The results from NNM, Radius Matching and KBM indicate that participation in microcredit programmes has a significant impact on small farmers' livelihood. Specifically, the results from NNM, Radius Matching and the KBM show that small farmers that participated in microcredit programmes have increased their total annual income and their total annual expenditure more than non- participants which lead to the improvement of their livelihood.

However, all matching algorithms used below gives similar results from Logit regression. The results from ATT show also that T-statistics from NNM, Radius Matching and KBM were all statistically significant at 1 percent.

Indicators of covariate balancing before and after Matching

The propensity score matching estimator is also used to estimate the distribution of relevant variables in small farmers' participants and non-participants in microcredit programmes. To estimate the balancing power, the standardized bias between the matched and unmatched was analyzed.

Table 5 : Table showing Covariance Balancing indicators before and after Matching

Variables	Mean			T-Test		V(T)/ V(C)
	Treated	Control	% Bias	t	p>|t	
Gender	.40441	.39765	1.4	0.11	0.910	1.01
Age	5.1397	5.1181	2.0	0.16	0.872	0.74
Education	2.1985	2.0157	21.6	1.75	0.082	1.80*
HHsize	4.9559	4.7671	10.2	0.80	0.423	0.92
SizeLand	1.8593	1.9272	-9.1	-0.72	0.472	0.90
Off_farm_inc	8.0074	8.0076	-0.0	-0.00	1.000	0.95
Coop_membership	.54412	.49488	10.2	0.81	0.418	0.99
Distance	1.4118	1.5068	-11.2	-1.01	0.315	0.66*
Ann_Int_rate	12.154	11.983	7.0	0.57	0.568	0.88

Source: Computed by Author from field survey, 2015
*Notes: * if variance ratio outside [0.71; 1.40]*

Table 6 : Table showing the results of balancing before and after Matching

Before Matching	
LR Chi2	67.13
Pseudo-R2	0.1624
P -value	0.0000***
After Matching	
Nearest Neighbor Matching	
LR Chi2	2.76
Pseudo -R2	0.007
P –value	0.973
Kernel Based Matching	
LR Chi2	7.58
Pseudo R2	0.020
P –value	0.577
Radius Matching	
LR Chi2	13.76
Pseudo R2	0.037
P –value	0.131

Sources: Computed by Author from field survey, 2015
*Notes: *** Significant at 1 percent.*

The Table 5 shows that before matching, some variables are statistically significant while after matching the covariate is balanced, some variables are not statistically significant.

The Table 6 shows that before matching, the P-value was significant at 1 percent while after matching P-Value for both NNM, Kernel Based Matching and Radius Matching were not significant. The table 6 also shows that the Pseudo-R2 value is 0.1624 while after matching for NNM, Kernel Based Matching and Radius matching, the Pseudo-R2 values were 0.007; 0.020 and 0.037 respectively. With the above indicators of matching quality, the Pseudo-R2 value from NNM is very low and it was selected as a best fit matching estimator. However, there was no systematic differences in the distribution of covariates between both participants and non- participants in microcredit programmes after matching. The low Pseudo-R2 supports the hypothesis that both participants and non-participants in microcredit programmes have the same distribution in covariates after matching.

These results are used to assess the impact of microcredit programmes among participants and non-participants households in microcredit programmes who have similar characteristics. This also allows us to compare the observed outcomes for participants with non-participants sharing the common support.

Propensity Score Matching Graph on Treated and Non-Treated (Control group)

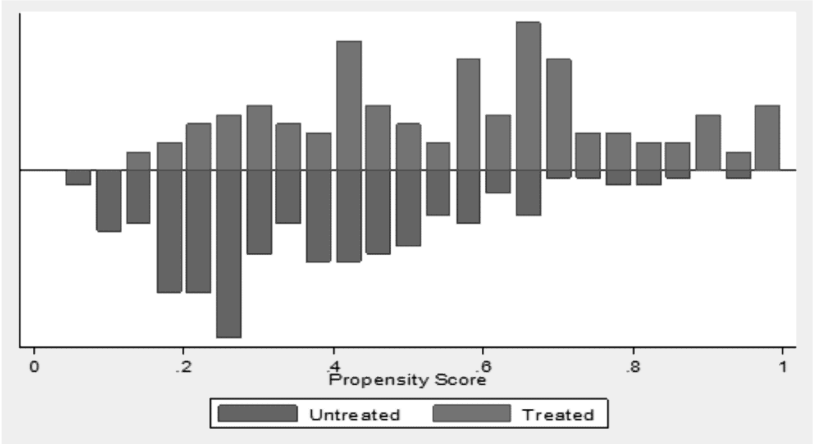
The Figure 2 presents diagram on the distribution of the propensity score for treated as well

as non-treated households. In this figure, two groups of small farmers' participants and non-participants in microcredit programme have been considered where 136 households are treated and 164 households are untreated. Treated on support show small farmer's participants in microcredit programmes while untreated on support represents non- participants in microcredit programme.

However, the common support assumption is satisfied and the propensity scores for treated and non-treated overlap reasonably well. The propensity score distribution for the treated is the upper half of each graph, while the bottom half refers to untreated individuals.

Propensity Score Matching Graph

Figure 2 : Figure 2 show the Propensity Score Matching Graph



Source: Computed by Author from the field Survey data, 2015

Conclusion and Policy implications

This study analyzed the impact of microcredit on small farmers' livelihoods in Rwanda. The results showed that the greater part of small farmers located in Maraba Sector have participated in microcredit programmes than those located in Mukura and Ngoma sectors of Huye District. The study revealed that the main reasons for participating in microcredit programmes were to pay for their children s' tuition fees, to pay for health services, to start their businesses and for daily food consumption.

The results also show that the variables ''education, household size, size land, cooperative membership and distance have influenced the probability to access microcredit programmes. However, this study also revealed that the small farmers who participated in microcredit programmes have increased considerably their total annual income and their total annual expenditure. The studies revealed that microcredit programmes have significantly improved the households' livelihoods such as total annual income and total annual expenditure.

This study recommends that:

- Financial institutions should be located in rural areas for accessing microcredit programmes, it makes it very easy without high transport cost.
- The government should take necessary steps to improve the availability of agricultural credit to better small farmers' livelihoods.

- Microcredit institutions should organize training for their clients and particularly for small farmers on how they could utilize appropriately the credit provided for increasing their income.
- Small farmers should be encouraged to become members of cooperatives societies in order to enable them to access easier microcredit programmes.
- Government and financial institutions must work together to support small farmers in enhancing their agricultural production.

Limitation of the study

- The borrowers were afraid of prohibition and others refused to request credit due to the lack of collateral.
- Some small farmers with lower education found it difficult to manage the complex procedures for the application of credit.
- Inadequate provision of credit to small farmers is another lacuna.

Scope of Further Research

Microcredit is an important tool to bring into being better outcomes in terms of income, assets and livelihood of borrowers especially small farmers. The study was limited as it confined to impact of microcredit on small farmers' livelihood in three sectors of Huye District. The future researchers should analyze the impact of microfinance institutions on small farmers at national and regional level with special focus on risk facing attitude on rural financial sectors in Rwanda.

References

Abdullah- Al- Mamun (2011). Examining the Effect of Microcredit on Employment in Peninsular Malaysia. *Journal of Sustainable Development,* 4(2), 174-183.

Aschale, D.S., Dorothea, H., & Alula, P. (2012). The Differential Impact of Microcredit on Rural Livelihoods: Case study from Ethiopia. *International Journal of Development and Sustainability*, 1(3), 1-19.

Ashaolu, O.F & Momoh S., Phillip B.B., & Tijani I.A (2011). Microcredit Effect on Agricultural Productivity: A Comparative Analysis of Rural Farmers in Ogun State, Nigeria. *International Journal of Applied Agricultural and Apiculture Research,* 7(1), 23-35.

Asmelash, H. (2003). *The Impact of Microfinance in Ethiopia: The Case of DECSI in Ganta-Afeshum Woreda of Eastern Tigray* (Unpublished Master's Thesis, Addis Ababa University, Ethiopia). Retrieved from http://etd.aau.edu.et/bitstream/123456789

Banerjee, A., Duflow, E., Glenerster, R. & Kinman, C. (2009). *The Miracle of Microfinance? Evidence from a Randomized Evaluation*. Massachusetts Institute of Technology : National Bureau of Economic Research , Department of Economics.

Becker, S. O., & Ichino, A. (2002). Estimation of Average Participation Effects on Propensity Scores, *The Stata Journal*, 2(4) 358-377.

Caleindo, M., & Kopeinig, S. (2005). *Some Practical Guidance for the Implementation of Propensity Score Matching* (Discussion Paper no.1588). University of Cologne, Bonn : Germany. Retrieved from http://ftp.iza.org

Caliendo, M. & Kopeinig, S. (2008). Some Practical Guidance for the implementation of Propensity Score Matching. *Journal of Economic Surveys*, 22 (1) 31–72.

Chirkos, A.Y. (2014). The Impact of Microfinance on Living Standards, Empowerment and Poverty Alleviation of the Poor People in Ethiopia: A Case Study in Amhara Credit and Savings. *Research Journal*

of Finance and Accounting, 5, (13), 43-66.

Datta, D. (2004). Microcredit in Rural Bangladesh: Is It Reaching the Poorest? *Journal of Microfinance,* 6(1), 55–81.

Develtere P. & Hybrechts A. (2005). Impact of Microcredit on the Poor in Bangladesh. *Alternatives*, 30 (2),165-189.

Hakim, M.A (2004). *Microcredit and Agriculture: How to make it Work.* Retrieved from www. microcreditsummit.org/uploads/resource/document/socr-2004-final-complete-73234.pdf

Hasan, M. E. (2003). Implication of Financial Innovations for Poorest of the Poor in the Rural Area: Experience from Northern Bangladesh. *Journal of Microfinance/ESR Review, 5(2)*, 56–78.

Islam, A. (2008). *Who Benefits from Microfinance? The Impact Evaluation of Large Scale Programs in Bangladesh.* Retrieved from https://www.monash.edu/-data/assets/pdf-file/0007/925531/who-benefits-from-microfinance-the-impact-evaluation-of-large-scale-programs-in-bangladesh.pdf

Islam, A., Chandana Maitra, C., Pakrashi, D. & Smyth, R. (2015). Microcredit Program Participation and Household Food Security in Rural Bangladesh. *Journal of Agricultural Economics*, 67(2),448-470.

Islam, Z. & Tenaw, S. (2009). Rural Financial Services and Effects of Microfinance on Agricultural Productivity and on Poverty. (*Discussion Papers Series* 1, 28). University of Helsinki: Department of Economics and Management.

Karlan, D., & Zinman, J. (2010). *Expanding Microenterprise Credit Access : Using Randomized Supply Decisions to Estimate the Impacts in Manila.* Retrieved from http://www.dartmouth.edu/~jzinman/Papers/ expandingaccess_manila_jul09.pdf

Khandker, S.R. (2005). Microfinance and Poverty: Evidence using panel data from Bangladesh. *The World Bank Economic Review*, 19(2), 263-86.

Li X. (2010). *An Empirical Analysis of Microcredit on China Rural Household* **(**Unpublished Doctoral Thesis**,** Lincoln University). Retrieved from https:// researcharchive.lincoln.ac.nz

Mingxiang Li (2012). Using the Propensity Score Method to Estimate Causal Effects: A Review and Practical Guide. *Organizational Research Methods*, 16(2), 1-39, DOI: 10.1177/1094428112447816

Ministry of Finance and Economic Planning (MINECOFIN, 2012). *Annual Report*, 2012 Government Printed; Kigali Rwanda

Nosiru, M. O. (2010). Micro-credits and Agricultural Productivity in Ogun State, Nigeria. *World Journal of Agricultural Sciences,* 6(3), 290-296.

Owuor, G. (2009). *Is Micro-finance achieving its goal among smallholder farmers in Africa? Empirical evidence from Kenya using propensity score matching.* Retrieved from https://ageconsearch.umn.edu/ bitstream/51470/2/%20Owuor_%20Visual%20Paper%20_Reference%20Number%2012_%20on%20 Micro%20Finance%20in%20Af.pdf

Quibria M.G. (2012). *Microcredit and Poverty Alleviation: Can microcredit close the deal*? (No 2012/78, WIDER Working Paper). Helsinki : Finland.

Rahji, M.A.Y. & Fakayode, S.B. (2009). A multinomial Logit Analysis of Agricultural Credit Rationing by Commercial Banks in Nigeria. *International Research Journal of Finance and Economics,* 24(91), 97-103.

Sherin G.A. Taha (2012). *The Effectiveness of Microcredit Programmes on Alleviating Poverty and Empowering Women in Cairo, Egypt* (Master's Thesis, University of Agder).

Smith, J. A. & Todd, P. E. (2005). Does matching overcome Lalonde's critique of non- experimental estimators*? Journal of Econometrics*, 125(1-2), 305–353.

Sriram. M.S (2007). Productivity of Rural Credit: A Review of Issues and some Recent Literature. *International Journal of Rural Management*, 3(2), 245-268.

Wadud, A. (2013). Impact of Microcredit on Agricultural Farm Performance and Food Security in Bangladesh, *Institute of Microfinance*,14,47. Retrieved from http://inm.org.bd/publication/workingpaper

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