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Full Length Research Paper

Access to Micro credit and its Impact on Farm Profit among Rural Farmers in Dryland of Sudan

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Despite the efforts that have been made by government and NGOs to provide credit for rural farmers, yet credit is lacking where it is most needed. This study is primarily intended to assess the access to credit problem that persists in dryland of Sudan, taking North Kordofan as case in point. In addition, it tries to sort-out factors influencing the profit of farmers from agriculture. The study relies on filed survey that is conducted in 2009, using structured questionnaire. It surveyed 200 farm households, which were selected through a multi-stage random sampling technique. Descriptive statistical analysis and Heckman model were applied to analyze the data. Results showed that, farm profits for all categories were SDG 920 (100 SDG ≈ 18 €). The credit users were found to be better off with a profit of SDG 955 compared to SDG 882 for credit non-users. Results obtained from a probit model showed that savings, value of assets and incomes are significant variables determining the credit constrained conditions. In addition, the results of Heckman model showed that credit has limited effect on farm profits. This indicates that loan volumes may be too small for making a significant impact on farm production. Knowing the fact that using OLS for testing the parameters produces a bias in sample, the study used the Heckman model to correct the expected biases. The study suggests that in order for the farm profits to be improved, the agricultural investment should be improved, particularly the adoption of efficient and sustainable technology. This could be possible through increasing the loan amount with faultless repayment records.

Keywords: Micro credit, Farm profits, Heckman model, Credit conditions, Poverty

INTRODUCTION

Most developing countries depend on their agricultural sectors for economic growth, food security and poverty reduction. Cited literature suggests that gross domestic product (GDP) growth deriving from agriculture is twice as effective in reducing poverty compared to GDP growth associated with non-agricultural sectors (MILLER, et al., 2010). At the same time, agriculture in developing countries generates on average 29% of GDP and employs 65% of the labour force (WORLD BANK, 2008). In Sudan, the agricultural sector contributed 31.3% to GDP in 2010 (CBOS, 2011). Although its contribution to economic development has declined steadily during the past years due to the focus devoted to the oil sector, agriculture remains important to the majority of the Sudanese population, especially those who live in remote areas. More than 80% of farm

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households engage in agriculture and 70% obtain their livelihoods from agricultural earnings (SIFSIA, 2011). Empirical evidence suggests that economic development in Sudan is possible only through investment in the agricultural sector due to the availability of resources in terms of water, arable land and livestock (MOI, 2012). Total arable land in Sudan is estimated to be 84 million hectares, constituting about one third of the total area of the country, however, only 21 percent of this land is actually cultivated (TARIG, 2008 and SIFSIA, 2011). It is for this reason that Sudan's agricultural policy for the past two decades has concentrated on agricultural investment, such as production inputs and technology accessible to farmers. Adoption of new technology significantly influences agricultural productivity and income generation from agricultural activities. In addition, the adoption of innovative technology is important in improving agricultural production and profitability of farms. It is therefore believed that investing in agricultural enterprises through microcredit services will continue to be seen as a potential option for improving the income and food security of rural households in Sudan (ISSAM, 2010).

Recognizing the potential contribution of credit to enhancing the productivity of farms, the Government of Sudan has been pursuing a microcredit policy that seeks to provide essential business that improves the livelihood of poor people. To do so, the Government in the past engaged in the credit market by establishing the agricultural bank of Sudan, Savings and Social Development Bank, Social funds and other special programs such as a national poverty eradication strategy. The main objective of government intervention in the provision of credit for rural farmers is to promote rural financial institutions with the purpose of reaching the poor in a sustainable manner, especially the poorest of the poor who are mostly excluded from the formal financial system. In this respect, the government liberalized the financial market during the 2000s and since then, there has been proliferation of microfinance institutions involved in the landscape of the microfinance sector in Sudan (FNCFM, 2007). Above all, the government adopted flexible policies to increase agricultural productivity and reduce poverty through instructing the banks to channel 12 percent of their loans portfolio to microfinance activities (CBOS, 2011). Nevertheless, both government and non-agricultural organization's efforts in developing the microfinance policies that promote agricultural investment remain limited and less coordinated especially in North Kordofan State, which is the subjected of this research paper.

Statement of the Problem

A large number of microfinance institutions exist in North Kordofan; however, most of them are weak in their outreach, not self-dependent and unsustainable. The weak financial performance of these institutions and the rate of deterioration are a source of major concern in the state. Among the multiple causes of rural poverty, the lack of access to formal and adequate financial services remains a major impediment to the socio-economic choices of the rural small-holder farmers. However, the limited access to income opportunities keeps many people in abject poverty. Unemployment is high, forcing many rural people to seek work in neighboring cities. Rather than improve the conditions of the poor farmers, most of the microfinance programs operated in North Kordofan have left the so-called beneficiaries in debt and with deficient farm production. Evidence from literature and past studies have identified a number of key factors determining the rural household demand for credit. According to ADEBAJO (2010) high interest rates, collateral risk, the bureaucratic loan process, asymmetric information and high transaction costs are the major factors influencing the demand for formal credit. ANYANWU (2004) argues that, although formal and informal financial sectors have been working for a long time in Africa and other developing countries, their contribution to serve the poorer section of the community is ambiguous. Recent studies conducted in the study area revealed that the main problems facing the agricultural sector are the low productivity of farms, lack of agricultural inputs and limited access to credit, particularly the seasonal finance constraints and market facilities **(**NKS-SC/UNDP, 2010). Furthermore, the level of agricultural investment in the State is still expected and the policy issued by the government to promote the investment in the agricultural sector is exposed to failure and consequently needs to be revised (ABS, 2008). On the other hand, credit rationing of farmers often results in credit constraint conditions that lead to low productivity (AKINTERINWA, 2005; OYEDELE *et al.*, 2009). Therefore, small farmers may be trapped in poverty due to lack of funds needed to finance productive investment in agricultural sector. This successive credit rationing is projected to cause misallocations of resources in farm production. The misallocation of inputs in agricultural production may lead the credit-constrained farmer to reap lower profit than the non credit-constrained farmer (NUNUNG *et al.,* 2005). The lower profit levels could be due to lower investment levels and a misallocation of variable inputs. As a result, farmers will not have adequate capital to invest in new technology, no matter how profitable it might be (OYEDELE *et al.*, 2009).

Previous research also stated that without increased demand for agricultural products and/or more efficient markets for their distribution, growth in agricultural productivity could quickly lead prices to decline, which counteract the benefits of productivity growth for producers and discourage investment (DIAO *et al.,* 2003).

Based on these backgrounds and problems, this study tries the answer the following questions:

1. What are the factors that determine households being credit constrained in rural Sudan?
2. What is the relationship between credit use and profitability in the agricultural sector?
3. Does greater access to credit distinguish between credit users and non-users?

In this study more focus is given to how access to credit affects agricultural profits of farm households' beneficiaries. In addition, it tries to allow circumventing the problem of identifying empirically both the selection process of farm credit rationing and its effects on farm profits. Moreover, to take advantage of policy issued by government of Sudan to promote microfinance, the study attempts to investigate the linkages between access to credit and government policies applied to the agricultural sector. Therefore, the aim of this paper is to assess the impact of microcredit on the profitability of farm households in rural Sudan that are mostly credit constrained, specifically, to identify the factors influencing the credit constrained conditions and farm profitability in North Kordofan State of Sudan. The result is expected to improve the knowledge of policymakers and the concerned people about the effectiveness of microfinance in enhancing the livelihoods of the poor in the rural Sudan.

The paper is structured as follows. Section 2, outlines the previous literature of credit constraints and agricultural production. Section 3, introduces the conceptual framework of the study, sources of data and the methods of its collection and analytical tool. Section 4, presents the descriptive statistical results of household's capital sources, assets and investment based on group category. The results from the empirical results are presented in Section 5. In the model empirical analysis we distinguish between credit users and non-users using Heckman selection model for the determinants of factors influencing access to credit. Finally, we conclude in section 6.

Credit constraints and agricultural production

Credit constraints in agricultural production are a common problem in developing economies. Most of these problems are linked to imperfect information and imperfect enforcement (RAHJI *et al.*, 2010). Previous research on credit shows a number of market imperfections, which lead some potential borrowers to be rationed out of the loan market. These imperfections include: (1) interest rate ceilings usually imposed by the government, (2) monopoly power in credit markets often exercised by informal lenders (BELL *et al.,* 1996), (3) large transaction costs incurred by borrowers in applying for loans (KEY, 1997), and; (4) moral hazard and adverse selection problems (CARTER, 1988; KOHANSAL and MANSOORI, 2009). In many cases, a number of these imperfections combined to drive a proportion of farmers out of the loan market.

As a result of the imperfections and costly information encountered between the lenders and the borrowers, rationing of credit becomes necessary for agricultural investment and economic well-being of the farmers (GUIRKINGER and BOUCHER, 2008). A number of studies regarding the microcredit and its impact on farm profits and productivity have been mentioned in the review of literature. Here the results of a few studies are mentioned.

FENGXIA *et al.*, (2010) stated that access to credit is always a key factor for improving farm profits and rural living standards in developing countries. He also reported that credit had a positive impact on production and can be expected to reduce the pattern of structurally unbalanced growth of agriculture in Nicaragua.

RAHJI *et al.*, (2010) argue that farm credit is not only necessitated by the limitation of self-finance, but also by uncertainty pertaining to the level of farm inputs and output and the time lag between inputs and output. This situation encouraged rural households to balance their budgets during the season when there is a small amount of revenue to cover the high expenditures of input purchases and home consumption. Given the lack of access to credit, the budget balance within the year can become a constraint to agricultural production. If liquidity is a limiting constraint, the amounts and combinations of inputs used by a farmer may deviate from optimal levels that in turn limit the optimum production or consumption choices.

ZELLER, DIAGNE, and MATAYA (1998) noted that participation in an agricultural credit program was able to raise the cropping share for hybrid maize and tobacco, and membership in credit programs had a sizable effect on crop income in Malawi. This implies that the expansion of credit access can have crucial effects on agricultural production and the income of rural farmers.

ASOGWA *et al.,* (2011) reported that high level of cost inefficiency is connected to the low profitability that results from inadequate organization of farmers into collective farmers' institutions in Nigeria.

Correspondingly, some studies indicate that in rural areas of developing countries credit constraints have significant adverse effects on farm output (FEDER *et al*., 1990; PETRICK, 2004), farm investment (CARTER and OLINTO, 2003), and farm profits (CARTER, 1989; FOLTZ, 2004). However, other studies concentrate on the determinants of access to formal credit with the idea of valuing the benefits to a future formal loan program (PEROTTI, 1993; ZELLER, 1994; CONNING, 1995; BRATKOWSKI, GROSFELD and ROSTOWSKI, 2000).

Conceptual Framework

The study conceptualized that credit is the most important component of agricultural production inputs in the study area. The major agricultural inputs provided by microfinance institutions are improved seeds, fertilizers and cash loans.The provision of credit on sustainable basis and rational use of these inputs in the right proportion and time are crucial to increasing output and productivity. The profit of agricultural farming is measured by calculating the gross margin, which is used as proxy of farm profit. Participation in the borrowing is considered as function of the households for credit demand and access to credit market. As result, the outcome of the previous process is amount of loan borrowed on one hand and occurrence of loan rationing on the other hand. To analyze, such situation, both demand and supply determinants need to be investigated. However, chronological decisions need to be taken by borrowers and lenders. Firstly, households should be able to access the different sources of credit before they decide whether to apply for credit or not. Secondly, the lenders decide about, whether to give the applicant all loans they requested, partially reduce the credit amount, to fully reject his or her request. Therefore, one must distinguish between those who have no credit because they have no demand and those who have no credit because they received insufficient supply. Similarly, households with a positive supply of credit may not have received the full amount of credit they asked for. Thus, one must divide those who received credit into those who received sufficient credit and those with excess demand who did not. Apparently, this decision is expected to affect the profitability of agricultural farming for rural households in Sudan. It is also expected that access to affordable credit will enhance farm profits especially, among the rural farmers who are the most needy. Therefore, this framework is much relevant and applicable to this study. More specifically, this applicability of framework may assist in deriving recommendations for the sustainability of microcredit services in rural credit markets of Sudan.

RESEARCH METHODOLOGY

Database and study area

The data used in this study are derived from an interview-based sample survey of farm households (credit users and non-users) in North Kordofan State of Sudan. The survey was conducted in July and August 2009. North Kordofan is an interesting area to study, due to the particularity of its location and considerable socio-economic heterogeneity. This state is a gateway between the eastern and western parts of Sudan. It is endowed with abundant quantities of fruitful renewable resources including arable lands, livestock, and forests of economic importance. North Kordofan State (NKS) has a total population of 2.9 million inhabitants, of them, 75% can be classified as peasant farmers (CENSUS, 2008). Local farm produce is often sold to local traders, and the presence of the traders encourages off-farm business and income diversification among farmers. The farming systems suffer from low land fertility, low population density, and lack of livestock based cropping patterns. Farm enterprises are generally small, so that in spite of own production, most households are net buyers of food, at least during the off season period. The production pattern varies from pastoralist in the north to sedentary traditional small farms in the middle, and gum Arabic belt in the south (ABDELATEIF, 2005).

The surveyed sample consists of 200 farm households, which were selected through a multi-stage random sampling technique based on proportionality with the size of the community. Three out of nine localities in the state were randomly selected in the first stage. In the second stage, eight out of 29 administrative units were randomly selected. Afterwards, 20 villages were randomly chosen from each administrative unit, and finally 10 households were selected from each village. To ensure the validity of the local lists, control lists from microfinance institutions have been used for comparison. A standard questionnaire was used to collect information on household assets, socioeconomic characteristics, consumption and income, including details of participation in different farm and off-farm activities. The data collected were analyzed using descriptive statistics and Heckman selection model (two-step estimates).

Analytical tool

The concept of household demand for credit used in this study is based on the theory of consumer behaviour. The level of household demand for credit is defined as the preference of households for a certain amount of credit in SDG at a specified interest rate and time, other factors are assumed to remain constant. Households are credit constrained if they required loans but were unable to borrow. When markets are not fully cleared through price adjustments, household credit status will be a function of factors affecting both supply and demand for credit (FENGXIA *et al.*, 2010).

Several studies among the existing literature on provision of credit have indicated that there is heterogeneity between credit users and non-users when they deal with credit demand and procedures (FEDER *et al.,* 1990; FENGXIA *et al.*, 2010). Moreover, farm households are quite heterogeneous in terms of resource endowments, production and consumption

opportunities. For instance, some clients drop out after one or a few cycles of credit and yet others do not ask for credit whatsoever, because they have sufficient liquidity, while some do not borrow because they are credit constrained. Moreover, the effect of credit on agricultural profitability may not be independent from credit status. Under credit constraints, there are many factors influencing both the choice of technology and other decision variables in agricultural production, which are known to the farmers but unobserved by the researchers (FUGLIE AND BOSCH, 1995). Therefore, estimation methods that pool all sampled observations such as Ordinary Least Squares (OLS) to determine the impact of credit on farm profits would be biased because of sample selection bias (MADDALA, 1983). If sample selection bias is not considered in the criterion equation, there will be an omitted variable specification. Thus, the polychotomous nature of this study calls for the use of a Heckman selection model, (HECKMAN, 1976), which provides consistent estimates at the OLS equation by adding an estimate of the expected value of the error terms, the inverse Mill's ratio or lambda (LONG, 1997). The analysis is performed in two steps. In the first step, a Probit model was applied to identify factors that contribute to credit constrained conditions of households. It was used to determine the relationship between a household's credit condition and a number of socio-economic and credit variables. The model is expressed as follows:

$$Y^{*}_{i} = X'_{i}\beta + u_{1i} \quad \text{..... (1)}$$

Y_i = dependent variable of outcome equation

X_i' = vector of covariate for unit i for outcome equation

U_{1i} = random disturbance for unit i for outcome equation

β = parameter to be estimated

Y_i = dichotomous (1, 0) explaining whether observation i is a credit user or not. In fact, Y^*, which is the excess demand function for credit, is not observed, but responses from the data are used to determine those households who applied for credit to finance their productive activities but did not get it if the credit demand exceeded the credit supply, which means $Y^* > 0$. In other words, to understand the determinants of credit status we are interested in the characteristics of farmers and farms, which influence the probability that $Y^* > 0$.

Since, the selection criterion function is not observed we observe only the binary outcome given by the probit model as:

$$y_i = 1; \text{if } y^{*}_{i} = x_i'\beta + U_{1i} \geq 0$$
$$y_i = 0; \text{otherwise} \quad \text{..... (2)}$$

When $\rho \neq 0$ applying OLS to estimate a profit function will yield bias because the expected value of the error term is conditional on the sample selection criterion being non-zero (MADDALA, 1983). Since, β can be estimated only up to a scale factor, it is then assumed that U_{1i} and U_{2i} have binary normal distributions with zero means and non-singular covariance matrices. It is further assumed that U_{1i} is correlated with U_{2i}. Parameters of the selection criterion function (equation 2) can be estimated by the probit maximum likelihood method. Maximizing the bivariate probit likelihood function for this function is feasible but time consuming (MADDALA, 1983). It has been stated that it is useful to estimate the system equations by applying a simple two-stage estimation method (LEE, 1978; FEDER *et al.,* 1990; NURYATONO *et al.*, 2005). However, others used least weighted squares to account for the heteroscedastic errors (FREEMAN, *et al.,* 1998).

In the second step, for those households that have access to formal credit, we examined the determinants that empirically can explain the amount of farm profits that can be obtained from agricultural activities.

$$Z^{*}_{i} = W_i'\alpha + u_{2i} \text{ selection equation..... (3)}$$

Z^*_i = dependent variable of selection equation

W_i' = vector of covariate for unit i for selection equation

α = vector of coefficients for selection equation

U_{2i} = random disturbance for unit I for selection equation

$$U_{1i} \approx N(0, \sigma)$$
$$U_{2i} \approx N(0,1)$$
$$\text{Corr}(u_{1i}, u_{2i}) = \rho$$

Thus, the Heckman selection model allows the use of information from non-credit users to improve the estimates of the parameters in the regression model. The Heckman selection model provides consistent, asymptotically efficient estimates for all parameters in the model.

Table 1. Descriptive statistics of selected socio-economic characteristics of households

Household characteristics	All sample N=200		Credit non-users N=100		Credit users N=100		
	Mean	Std	Mean	Std	Mean	Std	T-statistics
Age of household (Yrs)	45.9	13.4	44.6	13.5	47.1	13.3	1.35
Household size (persons)	6.9	3.3	7	3.4	6.9	3.2	- 0.26
Education level (Yrs)	7.5	3.9	6.8	3.4	8.1	4.4	2.08**

Source: own data, 2009. ** indicates significant level of 5%

RESULTS AND DISCUSSION

Household characteristics

The household characteristics considered in this study include age of the head of household, number of family members and education level of credit users and non-users in the three localities under study. The comparison and description of the variables is presented in Table 1. The average age of the total samples was 45.9 years, credit users (47.1 years) and credit non-users (44.6 years). This indicates that a higher proportion of sampled household heads in the study area are in their unproductive years. The effect of age of head of the households is considered important in terms of experience and responsibility. Households headed by older individuals are more likely to have more experience in agricultural production accumulated over the years, which may account for higher levels of farm profit. However, the households headed by younger individuals are often associated with more risk taking behavior than the elderly. Old age is the human capital that is frequently associated with non-adoption in most studies. Typically, older farmers have a tendency to stick to their old production techniques and that they are usually unwilling to accept change (SIMTOWE, and ZELLER, 2006). Another important characteristic is the average of family size of farm households. The analysis indicated that the average of family size for credit users and non-users were 6.9 and 7 persons respectively. However there is no significant difference among the credit users and non-users, regarding the number of family members. This result is approximately resonant with the national census of 2008 which found that households in Sudan had 7 persons. Furthermore, education level of head of households (proxy for human resources) was measured by years of schooling. The analysis indicates that the average education level generally was 7.5 years. However, the average education level for credit users and non-users were 8.1 and 6.8 years respectively. Typically, heads of households who attained more than six years of formal education are able to communicate and interpret business information better than those who have less or no education. Although the descriptive statistics showed that credit users are more educated, with statistical significance (T = 2.08**) compared to non-credit users, a lot of work needs to be done to improve the education among the groups. Research has shown that, access to education enables households in the rural area to adapt to new agricultural methods, cope with risk, and respond to market signals and consequently improve agricultural productivity (ROSALYN, 2002).

Capital Resources

With the gradual increase of the degree of market orientation of farm households, capital becomes of prime importance (DOPPLER, 2001). Lack of capital resources is a major constraint for farming activities in the study area. The available formal sources for obtaining agricultural credit are beyond their reach. This is because of the collateral and other institutional conditions needed to obtain such loans which most of the farmers cannot afford (OBAMIRO, 2004). Therefore, livestock sales and remittances from relatives within the country and abroad are the most important sources of capital.

They also borrow money from formal institutions, especially microfinance programs, and from each other. The informal sources of credits are not without collateral, which are stringent but sometimes affordable for the farmers. Table 2 indicates the average number of loans obtained in the localities under study (Shiekan, Um Rwaba and Enuhud) is 1.0, 1.89 and 1.57, respectively. It is clear that in each of these localities, loan repetition is great problem for the credit users. Furthermore, the mean difference between credit users is statistically significant (F = 13.48***).

With respect to the time gaps to receive loans, the mean difference between credit users in the three localities are found to be highly significant (F = 25.24***). While the time gaps are 53 and 59 days in Um Rwaba and Shiekan localities, respectively. The credit users in Enuhud have noted time gaps to receive the loans of more than 86 days. These long time gaps have

Table 2. Factors affecting the efficiency of loans repayment categorized by region

Descriptive statistics for explanatory variables		Farm households categorized by region				
		All sample N=100	Sheikan N=34	Um Rwaba N = 36	Enuhud N=30	F-statistics
Number of loans obtained to date	Mean	1.53	1.00	1.89	1.57	13.48***
	Std	0.76	0.00	0.82	0.77	
Time gaps to receive loans in days	Mean	62.8	59.1	53.1	86.2	25.24***
	Std	21.5	20.5	18.3	4.9	
Distance between MFIs and commune in km	Mean	58.3	27.9	89.1	64.9	19.26***
	Std	46.1	19.1	16.5	62.7	
Frequency repayment in months	Mean	2.7	3.00	2.1	3.00	15.13***
	Std	0.83	0.00	1.1	0.00	
Application fees in SDG	Mean	50.1	30.2	61	54.1	13.13***
	Std	26.3	9.5	26.1	27.6	
Total loan volume in SDG	Mean	241.9	135	338.7	228	27.56***
	Std	110.3	0.00	114.3	0.00	
Profit margin in SDG	Mean	67.8	75.5	24.3	94.7	16.96***
	Std	50.2	36.7	12.7	56.4	

Source: own data, 2009. **, *** indicate significant at 5% and 1% respectively.

Table 3. Moveable asset ownership categorized by sampled farm households

Descriptive statistics	All sample N=200		Credit non-users N=100		Credit users N=100		
	Mean	Std	Mean	Std	Mean	Std	T- statistics
Farm Profits in SDG	920	678.1	882.1	684.5	955.9	676.4	- 0.576
Saving in SDG	1865.5	1477.7	2223.1	1834.6	1607.2	1144.3	- 1.15
Value of assets in SDG	996.4	709.7	871.1	638.3	1129.6	760	2.35**

Source: own data, 2009. ** indicates significant level of 5%.

encouraged many borrowers to drop out after one cycle of credit or not to ask for credit in the future.

Table 2 also shows that the average distance between microfinance institutions and the commune is too far in the study area, especially in the localities of Um Rwaba and Enuhud, where the distance is 89.1 km and 64.9 km, respectively. However, the average distance in Shiekan is only 27.9 km. This is due to the fact that the majority of microfinance institutions are located in Shiekan, which hosts the capital of the state. The mean distance between borrowers in all localities is statistically significant (F = 19.26***).

The results in Table 2 indicate that the average loan size is about SDG 241.9. The largest loans received by the borrowers in Um Rwaba were SDG 338.7 on average. The smallest loans received by clients in Shiekan were on average SDG 135. It appears that most of the farming households that borrowed from formal institutions have received less than the amount they originally asked for. However, the most common collateral for acquisition of loans was group solidarity membership followed by personal collateral.

Table 2 further indicates that the profit margin varies across the study areas. While the government of Sudan used to impose profit margin ceilings, especially for microfinance programs, credit users in Shiekan and Um Rwaba remain having below average profit margins at approximately less than 1% per month, other borrowers in Enuhud have an average profit margin just greater than 1%. This can be justified by the fact that the government of Sudan has recently adopted different approaches to enhance rural credit markets, in which it provides soft loans (low interest rates) with various financial modes to improve the investment in agricultural activities in rural areas. The different mean of credit

users in the three localities have shown significant differences (F = 16.96***).

The average costs of loan application fees for localities vary with distance of localities from microfinance institutions. For instance, farm households who live in Um Rwaba pay the highest cost (SDG 61), while those who live in Shiekan and Enuhud localities pay the lowest (SDG 30.2 and 54.1) respectively. These costs include transport, important documents needed to obtain loans, and collateral. Other costs that are not incorporated in the analysis due to estimation problems are the opportunity cost of the time lost during the application procedure.

The results in Table 2 also show that the average frequency of repayment of loans for all studied areas is less than six months. Most households living in Shiekan and Enuhud recorded a six month loan repayment period, however, only households in Um Rwaba have been subject to three month repayments. The differences between the three localities are found to be statistically significant (F = 15.13***). These short periods of repayment affect very much the decision of farm household credit demand in the future. Many farming households were imprisoned due to loan default or loan diversion. It is however, conditional on this study; that frequency of repayment is found to be associated with a tradeoff between long and short repayment installments. As many scientists believe that if individuals are rational, and function in a full information environment, then a less rigid repayment schedule should never increase default or client delinquency. Rather, encouraging longer term investment may improve clients' long run repayment capacity. On the other hand, the survey indicated that the repayment period varies with the nature of the existing enterprises. For example, projects such as poultry or food services have repayment periods of 3 to 12 months, while feeding or fattening of animals have repayment periods between 12 to 18 months.

Household assets and investment

The findings in Table 3 show a summary of moveable assets variables of various categories in three localities under study. These variables include farm profits, total savings and value of assets owned by households. The mean farm profit for all categories in the study area was found to be SDG 920. On a category basis, the farm profit (gross margin) of credit non-users is SDG 955, while that of credit users is SDG 882. Although the descriptive statistics showed that credit non users are better off in terms of farm profits than credit users, the mean difference between credit users and non-users was not significant with the (T = 0.576). The insignificance between two categories of household could be due to the insufficiency of the loan size to significantly improve the farm profits of households. On the other hand, the total savings for all samples was SDG 1865. However, the total savings for credit non-users is SDG 2223, while for the credit users it was SDG 1607. The insignificant differences between the two groups (T = 1.15) can be justified by fact that farming households with higher accumulated savings require no additional credit, since they have enough money to cover their expenditures. Moreover, farm household assets were also examined in this study using market value of assets. The analysis shows that the average value of assets for all categories was SDG 996. Similarly, the mean value of assets for credit users was SDG 1129, while for the credit non-users the value of assets was SDG 871. The mean difference between the two categories are statistically significant (T = 2.35**). Details of assets variables and household various categories are given in Table 3.

Dependent variables

Two dependent variables were considered in this study: binary and continuous variables. The binary variables were used to identify the factors affecting credit constrained conditions of farm households, while the continuous variables were applied to estimate the impact of credit on farm profits in agricultural activities. In the dummy variable, it is assumed that a household uses formal credit (equal to one) or not (equal to zero). For the determinants of the impact of access to credit on farm profits (continuous) we used Heckman selection model (two- step estimates).

Explanatory variables

As indicated in Table 4 and 5, the set of explanatory variables used for the outcome equation include: education level of the household head, age of the household head, household size, total land owned, value of assets, total savings, total income of farm household, sex of household head, main occupation and household geographical distribution (locality) in the study area. While for the selection equation, it is hypothesized that labor used in agricultural activities, distance between microfinance institutions and the commune, loan volume obtained, off-farm income, extension services, age of the household head, education level, household size, land owned and value of assets of the farm household influence farm profits.

Higher level of education: is believed to be associated with access to sources of information on agricultural technology (NORRIS and BATI, 1987). Some studies indicated that a high level of education contributes

Table 4. Descriptive statistics of the variables used in Heckman model and expected sign

Explanatory variables	Descriptive statistics		Expected sign	
	Mean	Std	Model (A)	Model (B)
Age in years	45.9	13.4	+/-	+/-
Education level in years	7.5	3.9	+	+
Household size (persons)	6.9	3.3	+/-	+/-
Distance between MFIs and commune in km	58.3	46.1	ni	+/-
Total off farm income in SDG	5230.6	2901.2	ni	+
Total loan volume in SDG	241.9	110.3	ni	+
Labor used for crops production in man-days	53.2	39.1	ni	+
Total income in SDG	5309.9	4072	+/-	ni
Total market value of assets in SDG	996.4	709.7	+	+
Total land owned in hectares	16.3	12	+	+
Total savings in SDG	1865.5	1477.7	+	ni

Note: (A) refers to the first step in the Heckman selection model, (B) refers to the second step in the Heckman selection model, (ni) variable is not included in the analysis.

Table 5. Dummy variables used in Heckman selection model and expected sign

Explanatory variables	Descriptive statistics		Expected sign	
			Model (A)	Model (B)
Gender (Male = 1, 0)	Male = 78%	Female = 22%	+/-	ni
Main occupation (Farmer =1,0)	Farmer = 67%	Other = 33%	+/-	ni
Extension services (Yes =1,0)	Served = 47%	Not served = 53%	ni	+
Localities (Shiekan = 1,	Shiekan = 31%	Other = 69%	+/-	ni
0, Um Rwaba = 1, 0,	Um Rwaba = 31%	Other = 69%		
Enuhud = 1, 0)	Enuhud = 35%	Other = 65%		

Note: (A) refers to the first step in the Heckman selection model, (B) refers to the second step in the Heckman selection model, (ni) variable is not included in the analysis.

significantly to the level of agricultural profitability of the households (OYEDELE *et al.,* 2009; FOLTZ, 2003). Therefore, households with higher education levels are able to get credit from formal institutions and more likely to manage their businesses successfully.

Age of household head: is considered an important variable in terms of experience and responsibility. Households headed by older individuals are more likely to have experience with agricultural production accumulated over the years, which may account for higher levels of farm profits (OYEDELE *et al.,* 2009). However, the households headed by younger individuals are often associated with more risk-taking behaviour. This implies that their tendency to demand credit is higher. Therefore, their chance of getting loans may be low, since they are considered by the lenders as inexperienced, bearing in mind that the survey revealed that the average age of household heads was 45.9 years old.

Household family size: the influence of this variable can be understood in various ways. Households with many family members may encourage youths to migrate to the areas where they can work as laborers in order to generate additional income to support their families (YIRGA, 2007). On the other hand, large family size is usually associated with abundant labour endowment. According to CROPPENSTEDT *et al.,* (2003), households with large family size are more likely to adopt agricultural technology and use it efficiently at peak times. GODWIN (1998) reported that household size was positively related to the increase in household debt. Thus, the need to finance a larger amount of living expenses could be reflected in borrowing money from credit institutions.

Land owned or (landholding): is usually associated with household wealth and it is hypothesized that larger land size will lead to a lower probability of credit rationing. It is also expected that farm households with larger land area would have higher repayment rates. Moreover, it has been observed during the survey that farm households are more likely to use land as collateral to reduce their risks.

Household assets: The assets examined in this study include; house furniture, televisions and other moveable assets. The value of the assets was estimated by their current equivalent market value. It is hypothesized that the more value of assets the household have, the better access to credit it will have. The findings of DUCA and WHITESELL (1995) revealed that the amount or value of assets can be an important indicator of consumers' repayment patterns.

Savings of farm household: is accumulative savings per year in SDG. If farm households have greater savings, the probability of being credit rationed will be low. Thus, for this study it is hypothesized that increases of savings will increase the repayment capacity of farm households.

Total income of farm household: is used as an indicator of welfare status. It is hypothesized that increases in total income of a farm household will reduce the probability of a household being credit constrained. Meanwhile, higher income households may be less risk vulnerable and have less demand for credit because they have enough capital from previous earnings (NUNUNG *et al.*, 2005). It was observed during the field survey that lenders consider the welfare status of applicants (clients) before providing a loan.

Gender of farm household head: the variable used in this study is a dummy variable. If the household head is male, the value assigned is "1" otherwise, it is "0". Male-headed households are more likely to take risky decisions. According to ASFAW and ADMASSIE (2004), male headed households tend to get information about new technologies rapidly as compared to those headed by women. Although previous studies in the study area showed that farm households make joint decisions to take out loans, the effect of gender on the probability of access to credit is ambiguous.

Main occupation: is a dummy variable. It represents an important occupation practiced by farm households. This variable takes a value of "1" if the household is one of farmers; and it is zero otherwise. It is hypothesized that if a farm household, the farmer will have priority in getting a loan as the program policy mainly targets farmers in remote areas.

Labour: this variable is measured in man days. The variable is continuous and it is hypothesized to have a positive impact on farm profits. According to CROPPENSTEDT *et al. (*2003), households with larger number of laborers are able to accomplish various agricultural tasks (Family labour contributes to the agricultural activities and increase profit in agricultural production).

Extension service: is a dummy variable that indicates whether a farm household does or does not receive extension service. According to YIRGA (2007), there is a positive relationship between access to agricultural information and adoption behaviour of farmers in most developing countries. Thus, this study hypothesized that access to information through extension will increase farm profits in agricultural activities.

Localities under study: are dummy variables that describe the geographical distribution of farm households. The variable takes a value of "1" if farm household head is living in Shiekan; "2" if she/he lives in Um Rwaba; and "3" if she/he lives in Enuhud. It is hypothesized that farmers living in Shiekan and Um Rwaba are more likely to exchange information about agricultural activities, since the majority are mainly dependent on farm activities. Moreover, farmers living in Enuhud are hypothesized to have less information about credit as compared to those in Shiekan and Um Rwaba. This is due to the fact that Enuhud has only recently joined the microfinance programs.

Loan volume: refers to the total amount of loans that the household has received from different microfinance institutions. This continuous variable is measured in Sudanese guineas (SDG) per household. The variable is expected to have a positive impact on farm profits. Thus, for this study it is assumed that if farm households received a large amount of loans they are more likely to invest it in running a business and consequently reduce their poverty levels.

Distance of microfinance institutions: is a variable that is always associated with high transaction costs. It is hypothesized if the average distance between commune and microfinance institutions is too far, then farm households will be expected to incur high transaction costs and consequently will have lower farm profits. Therefore, this variable is expected to have a negative impact on farm profits.

Off farm income: refers to access to liquid assets which might be required to provide investment in various economic activities. This variable is expected to have a negative impact on farm profits due to fact that farm households always consider off farm income as support to crop income or to potentially compete with farm income. It is measured by the amount of income the household received from various activities such as salaried work, local trade and wage earnings in SDG during the study period.

EMPIRICAL RESULTS AND DISCUSSION

The Heckman selection model (two-step estimates) was

Table 6. Effects of formal credit on the profitability of agricultural crops

Dependent variable	**Credit users**		**Farm profits (Log_GM)**	
	Probit estimation		Heckman selection model	
Explanatory variables	Coefficient	Std. Err.	Coefficient	Std. Err.
Log_education (Yrs)	0.15224	0.12815	0.66956	0.4873
Log_age (Yrs)	0.60792	0.37760	1.3867	1.7090
Log_HHs (Persons)	-0.0792	0.17907	-1.2912*****	0.75632
Log_total_land (Hectares)	0.01455	0.07788	0.14769	0.276
Log_M_assets (SDG)	0.26306*******	0.09905	1.2994*******	0.40207
Log_tot_labor (Man/days)	-	-	1.070*******	0.29909
Log_distance (Km)	-	-	0.5824*******	0.20924
Log_loan_size (SDG)	-	-	0.18274	0.27604
Log_off_farm_income (SDG)	-	-	-0.20043******	0.10195
Ex_service (No = 1, Yes = 0)	-	-	1.0939*****	0.61539
_cons	-	-	-18.960******	8.1404
Log_total_saving (SDG)	0.05330*****	0.03153	-	-
Log_t_income (SDG)	-0.3213*******	0.10972	-	-
Gender (male = 1, 0)	-0.00993	0.27867	-	-
M_occup (farmer = 1, 0)	-0.05956	0.27024	-	-
Local_Sh (Shiekan = 1, 0)	0.17326	0.2530	-	-
Local_Um (Um Rwaba = 1, 0)	0.19876	0.23133	-	-
_cons	-1.7133	1.6871	-	-
IMR or Lambda	-	-	3.5942**	1.3789
Nr. of observations	198			
Censored observations	99			
Uncensored observations	99			
Wald Chi2 (10)	50.41***			
rho	0.9169			
Sigma	3.9199			

*******, ****** and *****Significant at 1%, 5% and 10% respectively**.**

applied and tested for its validity and found to fit and be appropriate. The results of the Heckman model presented in Table 6 show that there is a sample selection problem that needs to be controlled. The Wald ratio test of separate equations rejects the assumption of the null hypothesis that the correlation between disturbance error terms is equal to zero. Moreover, the significance of the estimated lambda confirms the appropriateness of the use of Heckman's selection model and that the use of OLS would have yielded biased estimates.

The results of the probit analysis in the first step indicate that there are three explanatory variables found to be statistically significant at 1 or 10 percent significant levels. As hypothesized, value of assets, total savings and total income are the significant variables that determine the probability of access to credit. The asset values of farm households positively and significantly (P<0.01) influenced the probability of the household being credit constrained. This result implies that as the value of assets owned by a farm household increases, the probability of the household being credit constrained decreases.

The coefficient of total savings is positive and significantly (P<0.1) influenced the credit constrained condition of farm households. The result indicates that increases in the amount of savings will decrease the probability of a household being credit constrained. This result agrees with findings of FENGXIA *et al.,* (1990) and FENGXIA *et al.,* (2010).

Household total income per year, an indicator of welfare status, negatively and significantly (P<0.01) influenced the credit constrained condition of farm households. The result implies that households with higher incomes (welfare status) are more likely to be credit constrained. It could also imply that higher household income would be expected to increase the credit supply rather than credit demand. This result is in line with the findings of FOLTZ (2003), NURYATONO *et al*., (2005) and OYEDELE *et al.,* (2009).

The results from the second step of the Heckman model revealed that most of the variables that influence farm profits (proxied by the gross margin) are statistically significant with coefficient signs consistent with expectations. However, the factors that are statistically significant are not the same as those in the first stage, (except the value of assets) suggesting the existence of differences in the determinants of being credit constrained and the amount of the farm profits obtained. The results in Table 6 show the estimated coefficients for the profit function of agricultural production activities. The relevant significant variables influencing farm profits in the study area include household size, value of assets, labour used in agricultural production, distance between microfinance institutions and commune, off-farm income and extension services.

Household size negatively and significantly (P<0.1) influenced the profitability of agricultural production activities of the credit beneficiaries. This result implies that family members do not show a significant contribution to agricultural production activities and farm profits. This result confirms the earlier findings of OYEDELE *et al.,* (2009) and contradicts the result of NURYATONO *et al*., (2005).

The coefficient for value of assets positively and significantly (P<0.01) influenced farm profits of credit beneficiaries. This implies that increases in the amount of assets value of farm households will have a positive impact on increasing farm profits of agricultural activities. This result agrees with the findings of NURYATONO *et al*., (2005) OYEDELE *et al.,* (2009), in which credit users have a positive and significant coefficient for the value of assets.

As expected, the likelihood of labour used in agricultural production positively and significantly (P<0.01) influenced farm profits. This result suggests that both family and hired labor used in production have a significant contribution to farm profitability of agricultural activities. This result is in consonance with the earlier findings of NURYATONO *et al*., (2005) and contradicts OYEDELE *et al.,* (2009).

Unlike the prior expectations, the coefficient of distance between microfinance institutions and commune as a proxy of credit market access is positive and significant (P<0.01) implying that farm households living far from the locations of microfinance institutions are more likely to show more profit compared to those who live close to where the institution is stationed. This result is unexpected because if the households were not credit constrained, distance should not have a positive relationship with farm profits as longer traveling time would seem to increase the transaction costs. The probable reason for the positive relationship between farm profits and distance could be attributed to the fact that households who live in remote areas with limited access to credit are more likely to seek informal credit and use it in agricultural activities. This result confirms that even without credit constraints, more liquidity in the household can still improve farm profits perhaps through a self-insurance mechanism (FENGXIA *et al.,* 2010).

The amount of off-farm income had a negative and significant (P<0.01) effect on the likelihood of farm profits. Literature review suggests that households with higher off-farm income may be less vulnerable to risk, have more access to agricultural technologies and a longer term planning horizon (CIMMYT, 1993). Likewise, households with higher off-farm incomes are more likely to investment in necessary technology (FENGXIA *et al.,* 1985; SIMTOW E, F. ZELLER, M., 2006). However, conditional on this study, households with high off-farm incomes will have lower farm profits, owing to the small portions allocated to the investment in agricultural activities. It could also be explained by the fact that most households in the study area derive their livelihoods from marginalized work in urban cities such that the amount of off-farm income earned is not reinvested in crop production. Our observation at the time of survey indicated that most farm households (70%) have a tendency to invest their additional money in livestock rather than agricultural crops.

Based on our prior expectations, households that are close to extension service centers are more likely to access information and technologies and consequently this increases their farm profits and reduces transaction costs. The coefficient of agricultural extension services has shown a positive and significant (P<0.1) relationship between use of advice and increase in farm profits. This result confirms the earlier findings of EFSE (2009). Among other reasons that could explain the positive effect of extension service on farm profits is the fact that access to information through extension packages will encourage farm households to be more flexible to accept change, adopt production techniques and learn the best practices. In contrast, if a farm household had less access to extension services, its probability of having lower profits were found to be higher.

Other remaining variables such as age of farm household, education level of farm household, land owned and loan volume obtained were not significant but had positive signs. This result suggests that farm households have advantageous profits along with increasing age, years of education and land owned. Although insignificant, loan volume of farm households has a positive impact on farm profits. This implies that the effect of loan volume on farm profits is limited. This result deviates from the findings of NURYATONO (2005), OYEDELE *et al.,* (2009) and is consistent with that of SIMTOW E, F. ZELLER, M., (2006) who found that credit access will have an effective impact only for those clients with access to remunerative businesses and investment opportunities who are unable to pursue the opportunities for lack of financial resources. The other explanation to

the insignificant effect of loan volume on farm profits could be that the loan volume provided is not enough to significantly improve the farm profits. This result is in line with findings of AHMAD (2007), COLEMAN (1999), and MORDUCH (1998) who failed to show any significant impact of microfinance on poverty alleviation. The result is also in consonance with earlier findings of CBOS and UNICONS (2006) that the credit limits imposed by formal lenders in Sudan were relatively small, covering only (1-3%) of potential demand. A number of studies reviewed by this study reported that to enhance the role of loans on the profitability of farms, two action plans should be considered; first to gradually increase loan amounts to repeat borrowers (ZELLER and DIAGNE, 2001) and secondly, to provide small businesses with loans that are appropriate to the needs of the borrowers and tailored to their conditions (CBOS and UNICONS, 2006).

CONCLUSION AND POLICY IMPLICATIONS

In this paper, we analyzed the impact of microcredit on farm profits among household beneficiaries that are credit users and non-users in dryland of Sudan, taking North Kordofan State as case in point. A Heckman selection model (two- step estimates) was used for data analysis. In the first step, a Probit model was applied to determine the relationship between a household's credit condition and a number of socio-economic and credit variables. In the second step, a Heckman selection model was applied to investigate the impact of access to credit on farm profits in agricultural activities. The results of the Heckman model revealed that most of the variables which influence the farm profits (proxied by gross margin) are statistically significant with coefficient signs consistent with expectations. However, the factors that are statistically significant are not the same as those in the first stage suggesting that there are differences in the determinants of being credit constrained and amount of the farm profits obtained. The results of the impact of credit on farm profits in the agricultural activities show that although access to credit has positive signs, but it has a limited effect on farm profits. This indicates that loan volumes may be too small for making a significant impact on farm production. To improve the profitability of farm businesses, there is a need for policy to support the investment in the agricultural sector through efficient and sustainable technology. This would also suggest gradually increasing the volume of loans without default repayment records.

Unlike the prior expectations, most of the socio-economic variables such as age of farm household, education level, household size and sex were not significant. This indicates that under credit constraints, increases or decreases of such variables does not effect farm profits and consequently, may have ambiguous effects on the sustainability of agricultural production at least for the short run. This suggests the need for policy first, to assist clients by providing various "credit plus" services that include skill training, marketing facilities and business development services. Second, as poverty incidence is deeply rooted in rural Sudan, poor people need to be targeted through safety net schemes beside credit programs to enable them to run their small businesses. Third, to increase the low-income earnings of targeted groups, there is an urgent need to reduce the credit constraints in remote areas by providing soft loans (with very low interest) through solidarity groups to which the members belong. Other than credit impact, a number of extreme constraints of agricultural development need be addressed, such as bargaining power of households and road infrastructure in rural areas. During the time of the survey, more than 70 percent of farm households were living at distance farther than 65 kilometers from a market.

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