Rural Poverty Reduction Strategies in sub-Saharan Africa: Market Alternatives for Agricultural Input Subsidies

A Case of Microfinance in Tanzania

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1. Introduction

Agricultural inputs subsidies (AISs) have long been used in promoting the use of modern inputs among smallholder farmers to increase farm yield, farm wages, and eventually reduce rural poverty in developing countries (Wossen *et al.*, 2017) (Harou, 2018) (Jayne and Rashid, 2013). In sub-Saharan Africa (SSA), large-scale AISs were popular rural development strategies in the 1970s and 1980s (Morris *et al.*, 2007). Due to financial constraints and failure to live up to expectations, AISs were abandoned as part of the World Bank and International Monetary Fund imposed structural adjustment programs in the 1990s (Ricker-Gilbert, Jayne and Shively, 2013). However, by the mid-2000s, some countries in SSA had re-introduced various forms of AISs (World Bank, 2014) (Banful, 2010). For poor countries, AISs require significant public funding. For instance, in 2012 alone, seven countries, namely, Nigeria, Ethiopia, Kenya, Zambia, Malawi, Tanzania, and Ghana spent roughly 2 billion US$ on government fertilizer AISs (Ricker-Gilbert, Jayne and Shively, 2013).

Because the public funds allocated in implementing AISs can be used in other public investments that can improve rural welfare (Morris *et al.*, 2007) (World Bank, 1994), the use of AISs has attracted criticisms and remains to be a contentious antipoverty intervention in SSA (Ricker-Gilbert, Jayne and Shively, 2013) (World Bank, 2014). Owing to this, there are growing interests to strengthen the use of rural markets in SSA as an alternative to costly public interventions such as AISs. In Tanzania, for instance, cash constraints and poor access to credit

have been identified as one of the significant deterrents to smallholder fertilizer demand (Benson *et al.*, 2013). In cases like this, enhancing financial inclusion through credit markets, including credit from microfinance providers (hereafter referred to as microfinance), can help in financing income-generating activities of farmers, which in turn, would improve farmers' welfare. If rural credit markets are effective in rural poverty reduction, their use can potentially replace public interventions such as AISs and thus saving a considerable amount of public funds.

Unfortunately, robust empirical evidence examining how rural credit markets can serve as an alternative to AISs in rural Africa remains scarce. This article fills this gap by examining whether the use of microfinance is more effective or at least is as effective in reducing income poverty as AISs in households involved in agriculture. Because both programs target the working poor and unbanked people in disadvantaged communities (World Bank, 2014) (Coleman, 2006) (Khandker, 2005), therefore, they are comparable and one program can substitute the other. Using household-level panel data from Tanzania, the article compares the income effects of microfinance and AISs amongst farmers and thus provides novel empirical examination on whether AISs can be replaced by rural credit markets, which in turn, could save a substantial amount of public funds. Because AISs are costly and contentious antipoverty strategies, estimates in this article, therefore, provide a sizable contribution to the literature and in development policymaking in SSA countries.

In development policymaking, public interventions are widely used to support poor households. Interventionists maintain that anti-poverty interventions are introduced to address serious instances of market failure to specific vulnerable people in the community (Lipton and Ravallion, 1995) (Datta-Chaudhuri, 1990). Current market practices exacerbated by asymmetry information and high transaction costs of administering small loans suggest that poor people do not have sufficient means to secure loans from banking institutions at fair cost

(Lipton and Ravallion, 1995) and, therefore, without state interventions they will remain trapped in chronic poverty for generations. Owing to this, most countries in SSA have targeted poor households in rural areas with AISs (Jayne and Rashid, 2013). Because the majority of the poor people in SSA are involved in agricultural activities (Collier and Dercon, 2014) (Dercon *et al.*, 2009), productivity-enhancing interventions in agriculture are expected to significantly reduce rural poverty (Wossen *et al.*, 2017) (Ricker-Gilbert, Jayne and Shively, 2013). In 2008, the government in Tanzania introduced the National Agricultural Input Voucher Scheme (NAIVS) to subsidize fertilizer and improved seeds for smallholder farmers involved in maize and rice, two crops necessary to ensure food security in the country. Despite being credited as being effective in raising yields of the two crops, evidence show that NAIVS resulted in significant implementation challenges including elite capture (Pan and Christiaensen, 2011). Further evidence shows that only one-third of beneficiaries continued buying fertilizers in the input market (World Bank, 2014).

In addition to challenges caused by the elite capture and failure to stimulate sustained usage of the targeted inputs, opponents of interventions suggest that AISs present a high-cost way of helping the poor (Morris *et al.*, 2007). Mostly, anti-poverty interventions, including AISs are seen as rent-creating, price-distorting, protectionist, inherently corrupt, and destructive of enterprise- and as preventing the state, with its limited resources, from providing under-supplied goods that have a wider contribution to development (Lipton and Ravallion, 1995). Public funds allocated to AISs would, therefore, be better spent on public investments that improve the returns to agriculture, such as rural infrastructure and agricultural research and extension (World Bank, 1994) (Lipton and Ravallion, 1995). There is, therefore, a growing discontent that AISs are not a cost-effective way of helping poor people escape poverty (Morris *et al.*, 2007). The question, which is addressed in this article, is whether the rural credit markets

can effectively provide market-based alternatives to provide sustainable funding needed by the working poor involved in farm activities.

In the existing empirical literature, this paper relates to two streams of empirical studies. The first focuses on the effect of AIS on poverty. In this strand, this article closely relates to three studies. Awotide, Karimov, Diagne, & Nakelse (2013) examined the effect of the supplementary seed voucher program (SVS) on Poverty reduction in Nigeria. They observed that SVS had a positive and statistically significant impact on annual household income and total per capita expenditure. Their findings have been confirmed recently by Wossen et al. (2017), which also concluded that receiving agricultural subsidies improves both productivity and the welfare of the households involved in SVS in Nigeria. In Malawi, Bezu, Kassie, Shiferaw, & Ricker-Gilbert (2014) used panel data to assess the effect of subsidized improved maize varieties on household welfare in Malawi. They too concluded that subsidized improved maize adoption has a stronger impact on the welfare of poorer households.

The second strand of literature related to the effect of microfinance on poverty. Despite receiving great attention among researchers, the effect of microfinance on poverty remains contested. In Tanzania, published studies on microfinance-poverty nexus can rarely be found. However, findings in the international studies present mixed evidence. One of the famous early studies was Pitt & Khandker (1998), which observed that microcredit had a large impact on income in Bangladesh, particularly for female borrowers. Their results, however, were contested in Morduch (1998), which suggested that the change in income was a result of other income smoothing techniques that are unrelated to microcredit. Despite re-affirming similar findings in their reply paper (Khandker, 2005), the lack of significant causal effect between microfinance and household consumption in Bangladesh continued to be reported (see for example Roodman & Morduch, 2014; Duvendack & Palmer-Jones, 2012). Experience from other countries also provides the same inconclusive findings. In India for instance, Imai et al.,

(2010) established that access to microfinance services significantly reduced poverty. Similar results have been reported in Bolivia (Mosley, 2001). However, in Thailand, a study by Coleman (1999) suggests that microfinance has little impact on the proxies of wealth.

This article merges the two streams to examine which of the two pro-poor programs is more effective in poverty reduction. The article provides robust estimates showing that AIS and microfinance have significant positive effects on household income per capita. This suggests that both programs have significant effects on poverty reduction. Second, estimates in this article show that the effects of both AISs and microfinance on household income are statistically comparable. This indicates that microfinance is as effective in reducing rural poverty as AISs. Because microfinance does not attract public funding, from the public policy perspective, the use of microfinance provides a cheaper poverty reduction strategy.

The article proceeds as follows. Section 2 presents the context and aspects of NAIVS and microfinance in Tanzania. Section 3 presents a description of data sets and construction of variables used; Section 4 presents descriptive statistics of the variables constructed from these data sets and used in regression analysis. Section 5 lays out the empirical approach and estimation issues involved in our estimation. Section 6 discusses the empirical results. Finally, Section 7 presents the conclusions and offers brief policy recommendations.

2.0. Policy Perspective

2.1 Aspects of Agricultural Input Subsidies in Tanzania

The history of agricultural input subsidy in Tanzania dates back to 1967 (World Bank, 2014) when the socialist government formed a state-owned Tanzania Fertilizer Company, which among other activities, it managed agricultural subsidies (Minot, 2000). However, due to economic crises in the 1980s, fertilizer subsidies were phased out in the 1990s (Putterman, 1995;Minot, 2000). Consequently, the real price of fertilizer increased by a factor of 2.5–3.9

from 1991 to 1997 causing 89.5% of farmers to abandon the usage of fertilizers (Cagley, Gugerty and Plotnick, 2009). During the early 2000s, estimates show that fertilization in the country stood at 8kg/ha and only 5.7% of rice farmers and 0.7% of maize farmers used improved seed varieties together with fertilizers (Kenneth and Henrik, 2012). This low usage of fertilizer is the main reason for low crop yields in the country (World Bank, 2014).

In responding to the falling crop productivity, the government in Tanzania introduced fertilizer transport subsidy in 2003/04 despite opposition from the donors (World Bank, 2014). However, the effectiveness of this subsidy remained contested and the government thought to replace it (World Bank, 2014). Eventually, the National Agricultural Input Voucher Scheme in Tanzania (NAIVS) was launched in 2008. The need for NAIVS was also reinforced by high food and fertilizer prices prevailing in 2007/8 (Pan and Christiaensen, 2011). Among other objectives, NAIVS was designed to increase maize and rice production, the two most used staple crops, estimated to be important to ensure food security.

NAIVS targeted 2.5 million smallholders involved in maize and rice production. When a pilot program was scaled up to 11 regions in 2008, only 737,400 households benefited. After securing additional funding from the World Bank, the coverage of NAIVS drastically increased to 1.50 million households in 2009/10 and then peaked to 2.01million in 2010/11 across 12 Regions[1] (World Bank, 2014). Although NAIVS originally targeted regions with high potential maize and rice production, however, by 2011, the peak year of voucher distribution, NAIVS had effectively been turned into a nationwide program (World Bank, 2014).

Operationally, each beneficiary household received a package[2] suitable for about ½ha (Kenneth and Henrik, 2012). The package subsidized 50% of the cost, therefore, recipients were required to contribute the other 50% (Pan and Christiaensen, 2011). To qualify for

[1] Iringa, Mbeya, Ruvuma and Rukwa in the southern highlands; and Kilimanjaro, Arusha, Manyara, Kigoma, Tabora, Mara and Morogoro, Pwani was to be added in 2009/10.
[2] One bag of urea; 2) one bag of Di-ammonium Phosphates or two bags of Minjungu Rock Phosphate with nitrogen supplement; and 3) 10 kg of hybrid or OPV maize seeds or 16 kg of rice seeds.

NIAVS, a farmer had to be engaged in full-time farming of either one or both of the two crops, cultivating less than one hectare of maize or rice, willing to follow the advice of extension workers, willing to pay 50% of the input cost (World Bank, 2014). Within this targeted population, preferences were given to female-headed households and those who had purchased little or no inputs during the previous five years (World Bank, 2014).

2.2 Microfinance Services in Tanzania

Microfinance is the provision of financial services, particularly credit, to the poor (World Bank, 2001). Although various forms of microfinance in Tanzania existed from 1967 when Village Savings & Credit Associations (SACAS) were allowed to operate, formal microfinance institutions, however, started their operations as part of financial liberalization in 1991 (Utz, 2008). During these reforms, banks and non-governmental organizations (NGOs) were allowed by the Banking and Financial Institutions Act of 1991 to provide microfinance services (Randhawa and Gallardo, 2003). Furthermore, the Cooperative Societies Act of 1991 allowed the formulation of Savings and Credit Cooperative Societies (SACCOs) as privately-owned and equity-based institutions that provide microfinance services to members (Randhawa and Gallardo, 2003).

Despite the financial reforms in 1991, the development of microfinance remained weak (Ministry of Finance (Tanzania), 2000). To address various sources of weakness, the National Microfinance policy (2000) was introduced. The microfinance policy 2000 established a basis for the evolution of an efficient and effective micro-financial system in the country (Ministry of Finance (Tanzania), 2000). The key achievements of this policy are the marked increase in the number of microfinance providers. By 2013, the last year covered in this study, estimates show that while 16.7% of the labour force was served by banks, 48.6% was served by various MFIs (FinScope, 2013). By 2015, 22 banks were offering various microfinance services, 4,093 SACCOS (with a total membership of 733,876), and over 150 financial NGOs and

microfinance companies (Ministry of Finance (Tanzania), 2017). This policy framework allows various microfinance providers, including commercial banks, microfinance companies, Savings and Credit Cooperative Societies (SACCOS), and financial NGOs (Rubambey, 2005).

3. Data and Variables

The source of data used in this study is Tanzania's National Panel Survey (NPS). This is a panel survey conducted in a two-year interval covering various microeconomic variables. NPS survey is conducted by the National Bureau of Statistics (NBS) of Tanzania as part of the National Strategy for Growth and Poverty Reduction to truck dynamics of poverty. The data sets are publicly accessible in NBS websites and World Bank data sites as part of Living Standards Measurement Study-Integrated Surveys.

NPS collects information regarding the welfare of its baseline sample of 2008/9. The currently available NPS data sets cover the year 2008/2009 (wave 1) which surveyed a sample of 3,265 households, 2010/2011 (wave 2) with 3,924 households, 2012/2013 (wave 3) with 5,010 households, and 2014/2015 (wave 4) that surveyed 5,010 households. However, during the Wave 4 Survey, the baseline sample frame was altered making it unlinked to the past three waves. Thus, at this stage, only the three waves are good for panel analysis.

By design, NPS follows a stratified, multi-stage cluster sampling procedure. The principal strata are Mainland and Zanzibar, and within these, rural versus urban areas, with a special stratum set aside for Dar es Salaam which is the most urban region in the country (National Bureau of Statistics (Tanzania), 2009). Within each stratum, designated clusters were chosen randomly, with the probability of selection proportional to their population size (National Bureau of Statistics (Tanzania), 2009). Its baseline sample designed in 2008/9 was calculated to be sufficient to produce national estimates of poverty, agricultural production, and other key indicators (National Bureau of Statistics (Tanzania), 2009).

NPS collects useful details on individuals and households and communities using specific modules of questionnaires. The individual and household module contain details regarding the characteristics of individuals and households and household income. Household income and household demographic characteristics are constructed directly from this module. Total income is aggregated from four key income activities: agricultural activities, employments, livestock, and fishing. All agricultural variables are constructed from the agricultural module. This module provides details regarding agricultural outputs and inputs during the long and short agricultural seasons. Because input vouchers were distributed coinciding with the start of the long rainy season (World Bank, 2014), I use the variable from long-rainy agricultural seasons.

This article estimates the treatment effect of two pro-poor programs, namely, AISs and microfinance. To proxy for the treatment in the agricultural input subsidy from NAIVS, I construct the total amount of input subsidy received by the household. The value of the input vouchers received is constructed directly from the agricultural module, which contains details of costs of all agricultural inputs used, including costs of subsidized inorganic fertilizers and improved seeds. If the farmer used an input voucher to purchase subsidized inputs, NPS recorded only the amount that the respondent spent by the farmer (National Bureau of Statistics (Tanzania), 2011). Because NAIVS required beneficiaries to contribute 50% of the input cost, the amount paid by the farmer, therefore, constitutes 50% of the cost of subsidized input (World Bank, 2014), which in turn equals the amount of subsidy received. Treatment in microfinance is proxied by the amount of credit borrowed from microfinance providers. The amount of microfinance was also constructed from the individual and household module, which contains credit details. Microfinance used here refers to the amount of loan borrowed from common and formal microfinance providers, namely, formal financial institutions, saving and credit cooperative organizations (SACCOs), and village cooperative banks (VICOBA).

The community-level variables used in this article include the average annual temperature, rainfall, distance from the household to the main road, and district of residence. These are constructed from the geographical variables section of the community modules. Other community-level variables include a dummy variable for the availability of farm cooperatives in the village, availability of farm inputs retailer(s), and a meeting with the seating member of parliament. These variables are constructed from the community module.

NAIVS targeted smallholder farmers involved in maize and rice farming. Therefore, variables constructed related only to households involved in maize and rice production in the three waves of surveys. The sample used has 1,600 households from Wave 1, 1,812 households from Wave 2, and 2,310 households from Wave3. Therefore, I use unbalanced panel data of 5,722 total observations. Because this is unbalanced panel data, I correct for attrition using sampling weights available in the data sets.

4 Descriptive Statistics

This article focuses on comparing the effect of AISs against that of microfinance on household income. Therefore, the discussion of descriptive statistics focuses on the comparative statistics for households between these pro-poor programs. However, to get a clear picture of the full sample, the descriptive statistic of the full sample is presented first. Table 1 presents the descriptive statistics of the whole sample. The average age of the head of the household is 48.6 years, 23.5% of whom are women. The average education in the sample is 1.3 years of schooling, which means that by average the households head did not finish primary schooling. Households have an average workforce size of 2.7.

This paper uses household income per capita as the proxy of household welfare. The average income per capita in the sample is TZS. 1,366,057. The big standard deviation suggests that the households in the sample ranged from very rich households to very poor households.

In practice, very poor households did not have sufficient income, and thus relied on donations and antipoverty safety nets (National Bureau of Statistics (Tanzania), 2014). On average, however, the income seems to be inadequate to meet consumption needs as the majority of households are poor. Based on the international poverty line of $1.25 per day in operation during the period (World Bank, 2008), 76% of the households fall below the poverty line and, therefore, are considered poor

Two main variable interests are considered in this article, namely, the use of input vouchers and microfinance. The rate of access to input vouchers and microfinance indicates that the proportions of households using the two programs are comparable. Respectively, Table 1 shows that the use of input vouchers and borrowing from MFIs in the sample stood at 6.7% and 5.6%. These rates suggest that the two programs are not widespread in the country. Despite starting by targeting the most productive regions, by the beginning of 2010, however, the programs had turned into a universal program(World Bank, 2014), with every region receiving some input vouchers, and because of the universal nature of NAIVS, the low participation rate in the sample implies failures to reach most of the farmers.

I also control for the availability of liquid assets that can be used to raise income to smoothen consumption during shocks such as crop failure or floods. Livestock is considered one of the liquid assets that are commonly available among farmers in Tanzania (Dercon, 1998). Table 1 shows that household in the sample has an average of 5.8 livestock. In addition to livestock, I also include proxies of rurality and remoteness from the urban area and transport systems. The presence of infrastructure and rurality affects farm productivity and farm income (Dercon *et al.*, 2009). By average households in the sample lived 22.1 km away from the nearest major roads and 92.5 km from the nearest agricultural market. This suggests that on average households are remotely away from the district headquarter and away from the reliable source of transport.

In addition to the aforementioned control variables, Table 1 also presents summary statistics of three instruments: the number of borrowers from all sources of credit in the district, visit by the seating member of parliament in the village of residence, and availability of agricultural input retailer in the village. Table 1 shows that the number of people in the sample who borrowed from any source in the district is 6 persons. This indicates that borrowing is considerably unpopular amongst farmers. On the other hand, access to agricultural input retailers is reasonably high. 41.1% of households in the sample lived in villages that have at least one agricultural input retailer. Similarly, 33.4% of households have had a meeting with the seating member of parliament.

Table 1: Descriptive Statistics of the Whole Sample

Variables	Obs	Mean	Std. Dev.	Min	Max
Age of the household head (Years)	5722	48.6	15.6	18	108
Female household head (%)	5722	23.5	.424	0	1
Years of Schooling of the head	5722	1.3	2.9	0	16
Workforce size	5722	2.7	3.1	1	54
Income per Capita	5722	1366057	13179619	600	6.078e+08
Ln Income per Capita	5722	12.5	1.4	6.3	20.2
Poor households (%)	5722	76	.428	0	1
Number of livestock	5722	5.8	18.1	0	504
Received input voucher (%)	5722	6.7	.25	0	1
Value of Input Vouchers (TZS)	5722	4796	36059.	0	1500000
Ln Value of Input Vouchers	5722	0.708	2.66	0	14.221
Borrowed from MFIs (%)	5722	5.6	.23	0	1
Amount of Microfinance (TZS)	5722	36675	494663	0	30000000
Ln amount of Microfinance	5722	0.7	2.9	0	17.2
Distance to the nearest major road (km)	5722	22.1	24.1	0	135.4
Distance to the district of residence (km)	5722	92.5	56	.7	257.1
Number of borrowers in the district	5722	6.0	4.4	0	22
Number of farm cooperatives in the village	5722	1.8	4.52	0	98
Have agricultural retailer in the village (%)	5722	41.1	.492	0	1
Village visited by the member of parliament(%)	5722	33.4	.472	0	1

Source: Author's estimation from Tanzania's National Panel Survey (2008/9, 2010/11 and 2012/13)

Table 2 compares the summary statistics of beneficiaries against non-beneficiaries of the two programs. Column (1) compares the descriptive statistics of input voucher recipients against those of non-recipients while column (2) compares the descriptive statistics of microfinance borrowers against those of non-borrowers. The focus is on how the beneficiaries differed significantly from non-beneficiaries.

Across the table, the age of the household head is not significantly different between the beneficiary and non-beneficiary households. However, the education of the household head is significantly higher in beneficiary groups compared to non-beneficiary households. Similarly, female-headed households were significantly fewer amongst NAIVS beneficiaries compared to non-beneficiaries. The low representation of female-headed households is opposite to the primary targets of NAIVS, which among other requirements targeted to prioritize female farmers (World Bank 2014). On the contrary, the proportion of female-headed households is comparable between microfinance borrowers and non-borrowers. Similarly, the beneficiaries had a significantly bigger workforce size compared to non-beneficiaries in both programs.

Clear disparities appear when considering proxies of household welfare. Both beneficiaries and non-beneficiaries have a high poverty rate. This shows the prevalence of poverty among farmers in the country. Poverty is higher in the agricultural sector than in other economic sectors (National Bureau of Statistics (Tanzania), 2014) (World Bank, 2019). Despite higher poverty in both beneficiary and non-beneficiary, however, the average income per capita is significantly smaller among input voucher beneficiaries than in non-beneficiaries. This indicates that beneficiaries of input subsidies were on average poorer than non-beneficiaries. This shows that NAIVS reached more farmers in poor households than it was captured by rich farmers. This aligns with the participation criteria in the scheme which targeted poor smallholder farmers (World Bank, 2014). On the contrary, non-borrowers of microfinance are significantly poorer than borrowers. This is further reinforced by the fact that the income per capita among microfinance borrowers is significantly higher than that of non-borrowers. This means that on average, microfinance borrowers are significantly richer than non-beneficiary, which suggests that MFIs might not be reaching the poorest members in the community. This is mostly related to the shift from the donor-funded microfinance where MFIs

were subsidized by donors to commercially sustainable MFIs (Cull, Demirgüç-Kunt and Morduch, 2009). Because commercially sustainable MFIs charge interests and require securities to secure the loans, this has the effect of compromising the outreach and social objectives to achieve commercial objectives and thus alienating the poorest in the community (Imai, Arun and Annim, 2010).

Table 2 also shows the existence of a significant interplay between the participation in NAIVS and microfinance borrowing. The rate of microfinance borrowers is significantly higher among input voucher recipients than among non-beneficiary. Equally, there is a significantly higher rate of voucher recipients amongst the microfinance borrowers than among non-borrowers. Because beneficiaries of the voucher schemes were required to contribute 50% of the cost of the subsidized inputs, this interplay, therefore, suggests that input voucher recipients might have sought credit from microfinance sources to finance agricultural activities, including the purchase of inputs.

There are also significant differences between beneficiaries and non-beneficiaries relating distance to major roads and district headquarter. In both programs, beneficiary households are significantly close to major roads. For the input voucher scheme, this seems to align with the participation criteria which required the farmers to be areas that can be easily accessed (Aloyce, Gabagambi and Hella, 2014). For microfinance, the significance of distance to a major road suggests that households in remote areas are not reached by sources of microfinance and, therefore, suffer from sustained financial exclusion. Distance to the district of residence, however, is not significantly different between borrowers and non-borrowers. The number of farm cooperatives in the village is comparable between subsidy beneficiaries and non-beneficiaries but it is significantly different between microfinance borrowers and non-borrowers. This suggests that microfinance is popular amongst areas where farmers work together through cooperatives than in areas where farming is less coordinated by cooperatives.

The final group of variables consists of the three instruments. The number of borrowers from any credit source is significantly higher in the group that borrowed from microfinance sources than in the group that did not borrow. The number of borrowers in the district is, however, not significantly different between input voucher recipients and non-recipients. On the other end, availability of input retailers in the village of residence and the visit by a seating member to the village of residence are significantly higher in the group that received input vouchers than in the group that did not receive input vouchers. However, such differences are not statistically significant between borrowers and non-borrowers.

Table 2: Descriptive Statistics of Key Variables

	(1) Received Input Voucher			**(2) Microfinance Borrowing**		
	Yes (n=383)	No (N=5339)		Yes (N=321)	No (N=5401)	
Variable	Mean	Mean	Difference	Mean	Mean	Difference
Age of the household head (Years)	47.8	48.7	0.9	49.3	48.6	0.7
Years of schooling of the head	1.6	1.3	0.3*	1.9	1.3	0.6***
Female household head (%)	19.3	23.8	4.5**	24.9	23.4	1.5
Household size	2.9	2.7	0.2*	3.4	2.7	0.7***
Income per Capita	90379	1399219	495426*	5111912	1143429	3968483***
Ln income per capita	12.8	12.5	0.3***	13.4	12.4	1.0***
Poor (%)	72.3	76.1	3.8*	50.5	77.4	26.9***
Number of livestock	5.3	5.8	0.5	6.1	5.7	0.4
Received input vouchers (%)	100	0	NA	12.5	6.4	6.1***
Value of vouchers (TZS)	71655	0	NA	7968	4608	3360
Ln value of voucher	10.6	0	NA	1.4	0.7	0.7***
Borrowed from MFIs	10.4	5.3	5.1***	100	0	NA
Amount of microfinance (TZS)	46070	36001	10069	653756	0	NA
Ln amount of microfinance	1.3	0.6	0.7***	12.3	0	NA
Distance to the major road (km)	16.3	22.5	6.2***	16.4	22.4	6.0***
Distance to district headquarter (km)	75.2	93.7	18.5***	92.2	96.2	4.0
Number of farm cooperatives in the village	1.9	1.8	0.1	2.4	1.7	0.7**
Number of borrowers in the district	6.0	6.1	0.1	9.2	5.9	3.3***
Farm input retailer in the village (%)	61.9	39.6	22.3***	43.9	40.9	3.0
The village visited by MP (%)	48.8	32.3	16.5%**	34.4	33.4	1.0

NB: (1) Where * = significant at 10%; ** = significant at 5% and *** = significant at 1%
Source: Author's estimation from Tanzania's National Panel Survey (2008/9, 2010/11 and 2012/13)

5.0 Conceptual Framework and Identification Strategy

5.1 Conceptual Framework

Income poverty can be reduced by participation in anti-poverty programs (Khandker, 2005), such as microfinance and input subsidy schemes. These anti-poverty programs increase farm productivity or help households self-employ, and thus increasing income or smoothening their income through subsistence credit. To examine the income effects of anti-poverty programs, I use the following income function.

$$\mathrm{Y} = \mathrm{f}(\mathrm{S}, \mathrm{M}, \mathrm{X}, \mathrm{C}, \mu) \quad (1)$$

S and M represent the value of subsidies from AISs and the amount of microfinance, respectively. Because antipoverty programs are expected to increase household income, S and M, therefore, are expected to be a positive effect on household income.

Household income can also be affected by some household characteristics, X. The characteristics of the household include the size of the workforce, age, and sex of the household head. The large size of the household workforce represents the ability to generate higher household income and the availability of people who can be actively engaged in childcare. Therefore, the size of the workforce is expected to have a negative effect on household income. The age of the household head is associated with a lower ability to work and, therefore, lower household income. Similarly, because women in Tanzania have restricted access to productive assets, have low education and, therefore, households headed by women are expected to be poorer (National Bureau of Statistics (Tanzania), 2019).

I further assume the existence of community characteristics, C, that affect household income. These characteristics include access to all-weather transportation services in the village proxied by distance from the village of residence to the nearest major road. I also

include access to agricultural markets which can improve the prices of agricultural products. The proxy of the agricultural market used here is the distance from the household to the nearest agricultural market.

There are also unobserved factors, μ, such as ambitions and willingness to work hard. These factors cannot be measured by the researcher, but they affect household income.

5.2 Identification Strategy

Our main target is to estimate equation (1). However, estimating (1) is not straightforward due to the potential endogeneity of the AISs and microfinance. The first endogeneity concern comes from the non-random nature of the selection process through which beneficiaries are selected. In most of the subsidy programs, such as NAIVS, authorities often target a certain group of farmers, such as poor smallholders. Therefore, it is likely that the selection process is biased. Because of this bias, it is, therefore, likely that the amount of subsidy that a household receives is correlated with poverty status, household income, or underlying features that influence these outcome variables (Ricker-Gilbert, Jayne and Shively, 2013). Similarly, ambitious, and well-connected households, which have better welfare, would participate in the subsidy program due to social connections. This was indeed reported to be the case, and the evidence of elite capture in Tanzania is well documented (Pan and Christiaensen, 2012). In this regard, therefore, participation in the subsidy program cannot be interpreted as exogenously determined (Chibwana, Fisher and Shively, 2012).

Similarly, the effect of microcredit is likely to suffer from various potential sources of biases in microfinance programs. First, the placement of microfinance programs is non-random, often targeting poor areas (Pitt and Khandker, 1998). Secondly, unmeasured village and household attributes, such as infrastructure, environment, entrepreneurial ambition of the head, would influence the demand for microcredit (Pitt and Khandker, 1998). In many cases,

borrowers in various microcredit programs self-select themselves based on various lending criteria, such as membership into a member-based microfinance institution and the ability to repay. Therefore, simply comparing beneficiaries and non-beneficiary groups would result in biased estimates.

If panel data is available, equation (1) could be estimated using panel data models. If the unobserved heterogeneity, μ, is time-invariant, differencing or fixed effect will eliminate it. This will, however, eliminate all time-invariant variables. Because the package of subsidized fertilizer remained relatively the same throughout the implementation period except for inflation and transportation costs, using fixed effect or differencing, therefore, would also affect the estimated effect of the subsidy package. An alternative to the fixed effect, is the use of the Mundlak-Chamberlain device discussed in Mundlak (1978); Chamberlain (1984), also known as correlated random effects (CRE). CRE allows for correlation between the unobservables and the variables of interest (AISs and microfinance), provided the unobserved effect is time-invariant. CRE allows for modelling the distribution of the omitted variables conditional on the means of the strictly exogenous variables, instead of treating the omitted variable as a parameter to estimate (Ragasa and Mazunda, 2018). CRE is implemented by including the means of all time-varying covariates in the model. By including the time-averaged variables, I still control for time-invariant unobserved heterogeneity, as with fixed effects, while measuring the effect of time-constant covariates, just like the conventional Random Effect (Wooldridge, 2002 quoted in Ragasa and Mazunda, 2018).

One of the disadvantages of CRE is that like fixed effect, it assumes the existence of time-invariant unobservables. However, in cases like participation in AISs and microfinance borrowing, it is difficult to rule out the possibility that some unobservables vary over time. For instance, participation in microfinance and AISs could be related to ambitions that decline over time due to aging. To address the effects of time-varying unobservables, researchers have relied

on the use of the instrumental variable approach (IV). IV uses the predicted value of the endogenous variable from the first stage regression.

An equivalent to IV is the use of the control function approach (CF). In the CF, residuals from the first stage regression are included in the second stage regression (Wooldridge, 2015). In using the CF, the researcher first estimates the first-stage regression for participation in an antipoverty program and then extracts residuals from this function. By combining CRE and CF (CRE-CF), the means of time-varying variables will control for the effect of time-invariant unobserved heterogeneity and the only role of the generalized residuals is to control for the relationship between time-varying unobservables and endogenous variables.

In this paper, I use CRE-CF to control for the potential endogeneity of AISs and microfinance. To obtain the two generalized residuals, I estimate the following two first-stage regressions.

$$\mathrm{v_i} = \alpha_1 \gamma_\mathrm{i} + \alpha_2 z_i + \pi_{vi} \quad (2a)$$

$$\mathrm{m_i} = \alpha_1 \gamma_\mathrm{i} + \alpha_2 z_i + \pi_{mi} \quad (2b)$$

Where v and m refer to the value of input vouchers and the amount of credit borrowed from microfinance sources. γ includes all covariates in equation (1) and the instruments. Both 2(a) and 2(b) are estimated using pooled ordinary least square (POLS).

The income function in equation (1), therefore, includes the generalized residual $\hat{\pi}_v$ and $\hat{\pi}_m$ from equation 2a and 2b, respectively. The final version of equation (1) takes the following log-linear form.

$$\mathrm{Y_{it}} = \beta_1 S_{it} + \beta_2 m_{it} + \beta_3 \mathrm{x_{it}} + \beta_4 c_{it} + \beta_5 \hat{\pi}_{vit} + \beta_6 \hat{\pi}_{mit} + \mu_{it} \quad (3)$$

By including the generalized residuals from equations (2a) and (2b), the error term μ_i in equation (3) becomes uncorrelated to the program treatment variables (Wooldridge, 2015), such that;

$$corr(s, \mu) = corr(m, \pi) = 0 \quad (4)$$

In input subsidy and microfinance studies, instruments have been widely used (Jayne *et al.*, 2013; Ricker-Gilbert, Jayne and Shively, 2013; Wossen *et al.*, 2017; Khandker, 2005). For input subsidy, I use two village-level instruments: the availability of farm-input retailers in the village (IV1) and whether a seating member of parliament visited the village (IV2). The choice of these instruments is based on their potential to influence the availability of input vouchers in the village while carrying no direct effect on productivity. First, NAIVS required beneficiaries to collect their input vouchers from their local input retailers. Therefore, the availability of a farm-input retailer was a necessary participation condition. However, having an input retailer in the local area does not directly increase household income. Second, the distribution of NAIVS was largely politicized. Thanks to the general election in 2010, by the end of 2009, NAIVS was scaled up to become a country-wide program (World Bank, 2014). Because of the strong influence of politicians, a visit by politicians in the village is expected to be strongly correlated with the receipt of input vouchers. I maintain that the visit by the member of parliament presents the political importance of the village, hence, high likelihood to receive input vouchers. However, a visit by politicians does not relate to household income. Visits by politicians have been used as AISs instruments in other subsidy evaluations (Ricker-Gilbert, Jayne and Shively, 2013)(Mason and Ricker-Gilbert, 2013).

For microfinance, I adapt the spirit in Khandker (2005) and maintain that availability of loans in the community (district) strongly correlates with household's decision to borrow but does not directly increase household's income in other ways other than through borrowing. Khandker (2005) used the total amount of credit from all sources in the village as a proxy of

the supply of loanable funds to instrument microfinance. In this article, however, I use the total number of borrowers from all sources of credit in the district of residence during the year (IV3) as an instrument.

To ensure that the instruments are exogenous, I use the covariance between the residual from the naïve estimate of equation (3) and the instruments. Following Wooldridge (2012), an instrument is exogenous if it meets the following zero covariance conditions:

$$cov\ (z, \mu) = 0 \qquad (5)$$

Where cov refers to the covariance between an instrument, z, and the generalized residuals, μ, from naïve estimation of the outcome equation.

One of the advantages of using CF is that it allows testing of endogeneity of the endogenous variable. In the spirit of (Wooldridge, 2015), I test the joint significance of the generalized residuals. If the generalized residuals, $\hat{\pi}_v$ and $\hat{\pi}_m$, are significant, then the input vouchers and microfinance are endogenous and thus the use of CF is justified. Furthermore, to produce more accurate estimates of standard errors, I bootstrap the sample with 500 repetitions.

6.0 Empirical Results

a) Determinants of the Value of Input Vouchers and Microcredit

The factors determining the amount of microfinance and the value of input vouchers received by the household are presented in Table 3. Results in Table 3 show that *ceteris paribus*, the presence of agricultural input retailers in the village increases the value of input vouchers received by 41.0%. However, the presence of input retailers is not significantly related to the amount of microfinance. Similarly, meeting with the seating member of parliament in the village increases the value of input vouchers by 15.8%. These meetings, however, do not have a significant effect on the amount of microfinance. The number of borrowers in the district is

negatively related to the value of input vouchers. This suggests that areas with more borrowers tended to receive fewer input vouchers. Because NAIVS focused on households that had never used fertilizer before (World Bank, 2014), areas with higher rates of borrowing, which tend to have higher fertilizer adaption rates, could have received less attention during voucher distribution decisions. However, the number of borrowers in the district is closely related to the amount of microfinance. Results in Table 3 show that *ceteris paribus*, the number of borrowers from all sources in the district increases the amount borrowed from microfinance providers by 11.5%. Therefore, access to input retailers in the village, a meeting by the member of parliament in the village, and the number of borrowers in the district constitute significant instruments for input vouchers. For microfinance, only the number of borrowers in the village is a significant instrument.

In addition to these instruments, Table 3 contains other control variables that have statistical relevance to the value of input vouchers and the amount of microfinance. The dummy variable for female household heads has a significant effect on the value of input vouchers but is not significant on microfinance. The coefficient suggests that households headed by women received 17.9% fewer vouchers compared to those headed by men. Further estimates show that increasing one year of schooling of the household head reduces input vouchers by 4.7%. The negative effect, in this case, suggests that participants in NAIVS had low education levels. Because households headed by educated household heads tend to be rich (National Bureau of Statistics (Tanzania), 2019), a negative effect, in this case, suggest that NAIVS benefited more those with a low level of education, who tend to be poor, and thus poverty, as a participation criterion in NAIVS (World Bank, 2014), might have been properly observed during NAIVS implementation. On the contrary, increasing one year of schooling of the household head would increase the amount of microfinance by 5.1%. This suggests that educated people tend to borrow more from microfinance sources than the poor.

The distance to the nearest major road has significant negative effects on the value of input vouchers and microfinance. This shows that households farther from the reliable transport infrastructure received fewer input vouchers and borrowed less from microfinance sources. This could be related to the fact that accessibility of farmers was one of the participation conditions in NAIVS implementation (Loyce, Gabagambi and Hella, 2014).

Table 3: Determinants of the Value of Input Vouchers and Microcredit

	(1) Pooled OLS	(2) Pooled OLS
	Ln value of vouchers	Ln microfinance
Farm input retailer in the village (1/0)	0.410***	-0.040
	(0.072)	(0.082)
Member of parliament visiting the village (1/0)	0.158*	0.011
	(0.081)	(0.085)
Number borrowers from all sources in the district	-0.018**	0.115***
	(0.008)	(0.011)
Female household head (1/0)	-0.179**	0.124
	(0.073)	(0.094)
Age of the head (years)	0.006	-0.011
	(0.006)	(0.008)
Years of schooling of the household head	-0.047*	0.051*
	(0.026)	(0.026)
Size of the workforce	0.103	0.091
	(0.054)	(0.076)
Number of livestock	-0.0001	0.006
	(0.004)	(0.004)
Distance to headquarter of the district (km)	0.0001	0.0001
	(0.001)	(0.001)
Distance to nearest major road (km)	-0.009***	-0.004***
	(0.001)	(0.002)
Number of farm cooperatives in the village	-0.001	0.020
	(0.017)	(0.019)
Average Temperature (℃)	-0.001	-0.018
	(0.095)	(0.138)
Time fixed effect	Yes	Yes
Agricultural zones fixed effect	Yes	Yes
Constant	5.301***	0.387
	(0.456)	(0.466)
R-sq	0.127	0.058
N	5722	5722

NB:(1) Bootstrapped standard errors in parentheses
(2) * = significant at 10%; ** = significant at 5% and *** = significant at 1%
(3) Every function has time mean for livestock, age, and size of the workforce, number of livestock, and temperature that are not reported
Source: Author's estimation from Tanzania's National Panel Survey (2008/9, 2010/11 and 2012/13)

b) The Income Effects of NAIVS and Microfinance

Estimates of the income function are presented in Table 4. Column (1) presents naïve estimates, which are estimated using the CRE without controlling the endogeneity further. Importantly, residuals from the naïve model are used to test for exogeneity of instruments. The main findings are presented in column (3) in which CRE is estimated using the control function (CRE-CF). However, for robustness purposes, I provide additional estimates in column (2) by estimating the CRE using instrumental variables (CRE-IV).

Because our main results rely on the use of instruments, first, I make highlights on the exogeneity of instruments used using the covariance between residuals from naïve estimation and the instruments. These covariances are presented at the end of column (1). The covariances of all instruments are very small, equivalent to zero, which suggests that the instruments are exogenous. Second, I test whether input vouchers and microfinance are indeed endogenous. This is done by testing the significance of the two generalized residuals used (Wooldridge, 2015). The generalized residuals are generated from two first-stage regressions: the function estimating determinants of the value of input vouchers and the function estimating determinants of microfinance. Results in column (3) show that the coefficients of the two residuals are statistically significant, suggesting that inputs vouchers and microfinance are endogenous to household income, and thus controlling for endogeneity was necessary.

The primary focus of this article is the estimation of the effects of input vouchers from NAIVS and microfinance on household income per capita and then examining whether microfinance is as effective as input vouchers. Therefore, the discussion focuses on the parameters of input vouchers and microfinance. Estimates in Table 4 show that *ceteris paribus*, a 1% increase in microfinance would increase household income per capita by 19.0% when the CRE-IV model is used and by 19.5% when the CRE-CF model is used. Both estimates are

stable across the two models and are statistically significant at a 1% significance level. This suggests that microfinance has a significant effect on the household income of farmers involved in maize and rice production. While these estimates present rare findings in Tanzania, they are, however, comparable to results reported in other international studies, which have shown that access to microfinance increases the income or consumption of beneficiary households (Imai et al., 2010; Khandker, 2005; Mosley, 2001; Pitt & Khandker, 1998). However, some studies have observed a lack of statistical significance on the effects of microfinance on consumption (Roodman and Morduch, 2014) and other proxies of household welfare (Duvendack and Palmer-Jones, 2012).

For input vouchers, estimates in Table 4 show that *ceteris paribus*, a 1% increase in microfinance would increase household income per capita by 21.9% when a CRE-IV model is used and by 19.3% when a CRE-CF model is used. The effect of input vouchers in a CRE-IV model is only significant at a 10% significance level but it is significant at a 5% significance level in a CRE-CF model. Despite varying levels of statistical significance, these estimates suggest that NAIVS had significant effects on the household income of farmers. Generally, these results are comparable across the two models.

Although evidence in the existing literature remains limited, these estimates are comparable to the findings in Awotide *et al.*, (2013) which observed that participation in Nigeria's Certified improved Rice Seed Voucher System reduced income poverty by 24%. Similarly, Wossen et al., (2017) found a positive and significant effect of agricultural input subsidy on both food and total consumption in Nigeria. In Malawi, Bezu et al., (2014) found that the area planted with improved maize seeds obtained from the improved seeds subsidy program was positively and significantly correlated with an increase in various proxies of household welfare, including per capita income.

Therefore, the findings indicate the two programs are effective in reducing poverty. The results are comparable across the two models. Because CRE-CF is easier to implement, in the subsequent discussions, I rely on the estimates of the CRE-CF model.

Next, I examine whether the effect of input vouchers on household income is significantly larger than that of the amount of microfinance. The size of the parameters in Table 3 shows that the effect of input vouchers is bigger than that of input vouchers. Are these effects statistically and significantly different or they are comparable? To answer this question, I conduct a Wald Test on the significance of the difference between these two coefficients. The null hypothesis of the test is that the difference between the two coefficients is not significantly different from zero. The statistics from the Wald Test are presented at the end of column (2) are not statistically significant. This means that I fail to reject the null hypothesis. Therefore, I do not find enough evidence that the effect of input vouchers on household income is significantly bigger than that of microfinance. This suggests that microfinance is as effective in poverty reduction as the use of AISs.

Table 4: The Estimated Household Income Function

	(1) CRE	(2) CRE-IV	(3) CRE-CF
	Ln income per capita	Ln income per capita	Ln income per capita
Ln microfinance	0.069***	0.190***	0.195***
	(0.006)	(0.050)	(0.045)
Ln value of vouchers	0.015**	0.219*	0.193**
	(0.007)	(0.114)	(0.093)
Female household head (1/0)	-0.240***	-0.227***	-0.226***
	(0.050)	(0.058)	(0.056)
Age of the head (years)	-0.013***	-0.013***	-0.013***
	(0.003)	(0.004)	(0.004)
Years of schooling of the head	0.018*	0.021*	0.020
	(0.010)	(0.012)	(0.012)
Size of the workforce	-0.009	-0.041	-0.039
	(0.026)	(0.031)	(0.035)
Number of livestock	0.006***	0.006**	0.006**
	(0.002)	(0.002)	(0.002)
Distance to headquarter of the district (km)	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Distance to nearest major road (km)	-0.005***	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
Number of farm cooperatives in the village	0.008	0.006	0.005

	(0.005)	(0.006)	(0.006)
Average Temperature (°C)	-0.003	0.007	0.005
	(0.055)	(0.059)	(0.067)
Residual from input voucher function			-0.179*
			(0.094)
Residual from microfinance function			-0.128***
			(0.045)
Constant	11.632***	10.451***	10.570***
	(0.270)	(0.681)	(0.540)
R-sq (Within)	0.0473	0.030	0.079
N	5722	5722	5722
Wald Test: chi2	30.61***	0.07	0.01
Cov (residual vs IV1)	0.016008		
Cov (residual vs IV2)	0.008706		
Cov (residual vs IV3)	0.111341		
Sargan-Hansen statistic: Chi-sq(2)		0.2571	

NB:(1) Bootstrapped standard errors in parentheses
(2) * = significant at 10%; ** = significant at 5% and *** = significant at 1%
(3) Every function has time mean for livestock, age, and size of the workforce, number of livestock, and temperature that are not reported
Source: Author's estimation from Tanzania's National Panel Survey (2008/9, 2010/11 and 2012/13)

c) Heterogeneity Between Poor and Rich Households

The analysis thus far has shown that both input vouchers and microfinance have positive and significant effects on household income per capita. In this section, I examine whether the effects differed between the rich and poor households. To explore this, I group households based on poverty status. I use the international poverty line of $1.25 that was internationally used during the period when the data was collected (World Bank, 2008). Households whose total consumption is below this line are considered poor and those above the line are considered rich households. Because the two programs are pro-poor, I maintain that they are more effective among poor households than rich households.

The results comparing the poor and rich households are presented in the two columns in Table 5. Column (1) presents the results of poor households while column (2) presents the results of rich households. Results in column (1) show that *ceteris paribus*, a 1% increase in the value of input vouchers would increase income per capita by 20.7% in poor households and by 13.2% in rich households. The effect on rich households, however, is not statistically

significant, suggesting that input vouchers are not effective in rich households. For microfinance, results in column (1) show that *ceteris paribus*, a 1% increase in microfinance would increase income per capita by 15.3% in poor households and by 11.5% in rich households. These effects are statistically significant in poor and rich households.

These estimates suggest that input vouchers are effective only in poor households but not effective in rich households. This potentially relates to the fact that NAIVS targeted smallholder farmers involved in maize farming (World Bank, 2014), who tend to be poor (National Bureau of Statistics (Tanzania), 2019). On the contrary, microfinance is as effective in poor households as in rich households. This could be due to the fact that although microfinance focuses on the unbanked poor, in practice, however, rich households have access to microfinance. For poor households, the strong significance of the two programs could also be related to the pre-treatment financial constraints experienced by poor households and, therefore, receipt of subsidized fertilizers increased farm productivity resulting in higher household income. Similarly, access to microfinance would have enabled households to acquire productivity-enhancing inputs, invest in income-generating activities, or stabilize their consumption through subsistence credit.

Table 5: Income Function: Heterogeneity Across Poverty Status, CRE-CF

	(1) Poor households	(2)Rich households
	Ln income per capita	Ln income per capita
Ln value of vouchers	0.207*	0.132
	(0.107)	(0.237)
Ln microfinance	0.153*	0.115**
	(0.082)	(0.052)
Female household head (1/0)	-0.128**	-0.448***
	(0.054)	(0.162)
Age of the head (years)	-0.011***	-0.007
	(0.004)	(0.017)
Years of schooling of the head	0.023*	0.003
	(0.014)	(0.032)
Size of the workforce	0.017	-0.079
	(0.038)	(0.076)
Number of livestock	0.011***	-0.004
	(0.003)	(0.006)

Distance to headquarter of the district (km)	-0.000	0.000
	(0.000)	(0.001)
Distance to nearest major road (km)	-0.000	-0.002
	(0.001)	(0.003)
Number of farm cooperatives in the village	0.008	-0.005
	(0.008)	(0.021)
Average Temperature (°C)	-0.014	0.042
	(0.071)	(0.158)
Residual from input voucher function	-0.192*	-0.124
	(0.107)	(0.240)
Residual from microfinance function	-0.099	-0.066
	(0.083)	(0.052)
Constant	10.795***	10.730***
	(0.607)	(1.617)
R-sq (within)	0.088	0.047
N	**4342**	**1380**
Wald Test: chi2	0.31	0.02

NB:(1) Bootstrapped standard errors in parentheses
(2) * = significant at 10%; ** = significant at 5% and *** = significant at 1%
(3) Every function has time mean for livestock, age, and size of the workforce, number of livestock, and temperature that are not reported
Source: Author's estimation from Tanzania's National Panel Survey (2008/9, 2010/11 and 2012/13)

Estimates in this article show that microfinance is as effective in poverty reduction as the AISs. The two programs also have comparable effects in poor households, making them equally pro-poor. To decide which of the two programs should be favoured in development policymaking especially when the government is financially constrained, policymakers must consider other aspects. First, AISs require a huge amount of public finance and, therefore, are costly to implement (Crawford, Jayne and Kelly, 2006). This fund can be used to finance other investments such as roads and extension services, which have higher returns and benefits to rural communities (Lipton and Ravallion, 1995).

Second, to achieve higher productivity, other services such as agricultural research and extension services are very important. Without proper investments in these areas, agricultural inputs may not be applied adequately, and, therefore, subsidies alone cannot produce a sustained increase in farm productivity (Jayne and Rashid, 2013). For instance, the quantity of fertilizer and improved seeds offered under NAIVS was calculated to be sufficient to cultivate a plot of less than one hectare (World Bank, 2014). However, in practice, some poor

households failed to meet the financial contribution requirements, therefore, more than one household co-financed a single subsidy package (World Bank, 2014), which suggest that some households ended up using a lower level of inputs than optimally expected, which in turn, might have resulted in sub-optimal returns (IFDC 2003 quoted in Crawford, Jayne, and Kelly 2006)

The third reason is based on the potential subsidy leakage amongst beneficiaries by reselling subsidized inputs. Experience from other countries suggests that some beneficiaries sold fertilizer and seeds received from AISPs and ended up using the proceeds in other activities, which might have had a lower return than enhancing farm productivity (Ricker-Gilbert, Jayne and Shively, 2013). This might have been the case in Tanzania. The leakages and targeting problems associated with fertilizer subsidies make them a very costly but inefficient way to transfer income to the poor (Donovan 1996). Finally, some implementation failures such as elite capture (Pan and Christiaensen, 2011), mean that input vouchers from NAIVS were diverted from the intended farmers, ending up being captured by non-poor farmers.

On the other hand, microfinance offers competitive advantages over state interventions. First, MFIs operate commercially with social objectives. In most cases, credits from microfinance sources carry some interest, and borrowers are expected to refund the principal plus the interest at a predetermined date. This incentivizes borrowers to use the loan responsibly, resulting in optimal benefits. Second, participants in microfinance are self-selected. This self-selection process potentially relates to various traits such as motivation, aspirations to do better, ambitions, and willingness to work hard (Khandker, 2005; Pitt & Khandker, 1998). These traits increase the likelihood that the borrowers will have better results leading to higher income compared to beneficiaries of AISs.

Third, unlike AISs which only subsidizes agricultural inputs, microfinance is often used based on the choices of the borrower, which could lead to responsible spending, which in turn, could lead to higher return and income. Equally important, households can borrow from MFIs to smoothen their consumption after losses caused by various shocks such as severe illness, droughts, and loss of assets or income and thus offering safety nets (Islam & Maitra, 2012; Dercon, 2002). This sustains high consumption, even amide shocks, which is not possible amongst input voucher recipients.

To this end, because the poverty reduction effects of AISs are comparable to the effects of microfinance, the fact that microfinance does not need public funding gives it considerable competitive advantages over AISs. This suggests that microfinance gives governments in SSA an effective market-based alternative to the public-funded AISs.

7. Conclusions and Policy Implications

This paper examined whether microfinance can be used as an alternative to AISs. The two programs are pro-poor but have marked differences regarding the source of finance, with AISs being funded and managed by the government whereas microfinance is mainly operated by NGOs, members, and financial cooperatives. Therefore, the comparative analysis on the poverty reduction effects of the two programs is necessary to inform policymakers on the need to balance between enhancing poverty reduction through state funding and other arrangements where the state takes a passive role, mainly as a regulator, as seen in microfinance.

Estimates in this article used panel data from the National Bureau of Statistics (Tanzania). These results show that both NAIVS and microfinance have positive and statistically significant effects on household income per capita, and, therefore, they are effective in poverty reduction. The comparative analysis further indicates that the effects of the two programs on household income are statistically comparable. This suggests that the use of

microfinance was as effective in poverty reduction amongst maize and rice farmers as NAIVS. Considering the difference between the poor and the rich households, estimates in this article show that both programs had significant effects on income per capita in poor households. This suggests that microfinance is as pro-poor as input vouchers. However, while input vouchers were not effective in rich households, on contrary, microfinance had a significant positive effect on the income per capita of rich households.

Because both programs have comparable effects on household income and target poor households, it might be possible to replace one program with the other. Unlike NAIVS, which is state-funded, the provision of microfinance is not funded by the government. Therefore, microfinance can serve as an alternative to AISs, which in turn, can save much-needed public funds, which can be used to make other rural development investments. By focusing on pro-poor lending and social lending, microfinance can reach poor farmers who are often used by politicians in SSA to justify the implementation of AISs. To achieve optimal results, however, operations of microfinance lending should be improved to ensure that it is geared towards achieving social objectives of reaching the rural poor.

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