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ORIGINAL ARTICLE

What is the influence of government programs on farmer organizations and their impacts? Evidence from Zambia

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Abstract

Governments and donors often promote farmer organizations (FOs) in the implementation of their agricultural development programs. Yet, there is a lot of uncertainty whether externally supported FOs provide benefits beyond the channelling of programs. This paper uses Propensity Score Matching (PSM) and representative data from 4,074 Zambian households to estimate FO impacts on members, with and without controlling for a national input-subsidy program. The results show that Zambian FOs tend to attract better-educated households with larger farm sizes, but can lead to female integration when external subsidies are involved. FOs also have a significantly positive effect on members' farm performance, irrespective of whether members receive input subsidies, while the presence of the external program leads to an unequal distribution of benefits within the FOs: positive impacts on farm performance are, on average 13–44% lower amongst members who do not benefit from the Zambian government program. Overall, these findings imply that Zambian FOs seem to provide benefits that go beyond the intention of the subsidy-program, which can be used to promote women empowerment

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and smallholder farm performance. The findings also demonstrate, however, that governments need to carefully design their programs to not reinforce inequality amongst farmer organizations and their members.

KEYWORDS

agricultural cooperative, collective action, input subsidy program

1 | INTRODUCTION

Recently, a considerable amount of research has grown around the theme of farmer organizations and their potential contributions to rural development (Bijman et al., 2016; Grashuis & Su, 2018; Kwapong & Hanisch, 2013; Tefera et al., 2017). The empirical literature suggests overall positive impacts of farmer organizations on members and their production systems. It is argued that these effects can contribute to large-scale poverty reduction and improved overall food security for a large number of smallholder farmers (Grashuis & Su, 2018). More specifically, by offering a variety of services to their members, farmer organizations have been found to improve members' farm performance by raising their incomes and production quantities, while also offering better prices and linking members to input or new output markets (Abebaw & Haile, 2013; Fischer & Qaim, 2012; Verhofstadt & Maertens, 2015).

Notably, a large share of these studies analyze farmer organizations that have received some form of external support from governments, donor agencies or non-governmental organizations. To exemplify, Verhofstadt and Maertens (2014) study impacts of maize organizations on members' farm performance in Uganda, mentioning that all of the organizations considered were channelling free or subsidized inputs to members. Other impact studies from livelihood and marketing organizations in Ethiopia (Francesconi & Heerink, 2011), apple cooperatives in China (Ma et al., 2016), wool cooperatives in Mongolia (Hilliova et al., 2017) and maize cooperatives in Mexico (Hellin et al., 2009) provide additional examples of farmer organizations linking their members to subsidized inputs and output prices or external support in the form of extension services.

Overall, these studies have found a positive association between membership and the performance of member farms. However, while most of the studies critically reflect on the respective policy environments, they do not control for possible external program effects in their impact analyses. Not controlling for such external effects can result in overestimation of treatment (membership) effects (Bernard et al., 2008b), thereby possibly contributing towards overly optimistic views on what to expect from farmer collective action. Meanwhile, a much-debated question remains regarding whether farmer organizations that have benefited from external programs can actually generate benefits on their own (Shiferaw et al., 2011; Thorp et al., 2005). As very little attention has been paid to empirically analyzing such 'net benefits' of farmer organizations, it remains unclear how they would impact their members in scenarios without external support.

The aim of this article is to assess the influence of external development programs on farmer organizations and their impacts on members' farm performance, seen in terms of production output, market participation and income. The following questions have guided my research process: (1) What impacts do farmer organizations have on members' farm performance? and (2) What are the effects of external programs on these impacts? I use Propensity Score Matching (PSM) to

estimate the individual and combined treatment effects from external and organizational benefits. A simultaneous PSM analysis evaluates treatment effects for a reduced sample of members and non-members who remain without external support. Comparison of both treatment effects seeks to determine the influence of external programs on the members overall. The results of this analysis are expected to reveal whether farmer organizations already under external support could be economically justified on their own.

Zambia and its traditional Farmer Input Support Program (FISP) provide the empirical context for this analysis. Here, farmer organizations have played a key historical role in the targeting and channelling of subsidized inputs, as smallholders wishing to participate in the FISP program need to prove organizational membership to receive benefits (MAL, 2014b; Lolojih, 2009). As the FISP is a rationed program, subsidized inputs have been insufficient to serve all eligible farmers or even all members (Minah & Malvido Pérez Carletti, 2019; Mason et al., 2013). With some members benefiting from the FISP and others missing out, Zambia provides an interesting case to investigate whether farmer organizations have also been successful in improving farm performance for members who remain without external subsidies.

The remainder of the paper is organized as follows. The next section provides a conceptual framework to analyze farmer organizations and their relationship with external support programs. Section 3 describes the state of farmer organizations in Zambia and the data used in the subsequent analysis, while Section 4 explains the analytical approach. Section 5 presents and discusses the analytical results, while Section 6 draws conclusions.

2 | THEORETICAL BACKGROUND

2.1 | Smallholder farmers and collective action

Rural areas in developing countries continue to face exacerbated transaction costs that stem from poor infrastructure, asymmetric information between buyers and sellers or due to the bargaining, negotiating and monitoring of formal and informal contracts (Kirsten et al., 2009; Wiggins et al., 2010; Dorward et al., 2009). Small transaction sizes, low literacy levels, lack of technical or managerial skills as well as information asymmetries increase transaction costs for smallholder farmers and make them particularly prone to being subjected to cheating and opportunism along the value chain (Kirsten et al., 2009; Shiferaw et al., 2011; Poulton et al., 2010).

Against this background, farmer organizations are expected to reduce individual transaction costs and better integrate smallholder farmers into markets and value chains. The theory of collective action is intended to aid understanding of the rationale(s) for farmer organizations, suggesting that individual smallholders can gain economies of scale and strengthen their market power by pooling their time, labour, money or tools (Markelova & Mwangi, 2010). Farmer collective action allows smallholders to buy and sell larger volumes, thereby spreading costs amongst a large group of farmers. To exemplify, smallholders can organize collective purchasing of agricultural inputs through their organizations which allows them to negotiate for lower input prices and reduce individual transportation costs. Also, they may use their farmer organizations to engage in collective marketing activities, allowing them to trade larger volumes, bypass intermediaries, enter into more stable relationships with retailers and ask for better prices (Stringfellow et al., 1997; Ortmann & King, 2007). As member-owned enterprises, the activities and services of farmer organizations respond to the needs of their members. In this way, farmer organizations can offer a variety of services that are only accessible through collective action and are otherwise likely to be

unavailable or too costly for individual smallholders to access. These services can facilitate access to input, output or financial markets as well as extension or processing activities (Gouët et al., 2009; Thorp et al., 2005; Shiferaw et al., 2011).

2.2 | Farmer organizations and external support

Given their service-delivery function, it is not surprising that governments, donors and non-governmental organizations generally seek to promote farmer organizations in rural areas. In addition, farmer organizations are seen as a cost-effective tool for channelling development benefits such as subsidies, credit or training to a large number of farmers when state and private actors fail to do so (Bernard & Taffesse, 2012; Chirwa et al., 2005). Organizing a large number of smallholders, farmer organizations can reduce unnecessary program costs that would otherwise occur when working with individual and often widely dispersed farmers. Also, within participatory and community-based development contexts, farmer organizations can help to decentralise targeting and decision-making processes for local communities, thereby reducing program operating costs even more (Mansuri & Rao, 2013; Schüring, 2014).

In addition, it has been argued that external support may well be a success factor for farmer organizations to reach their objectives. Smallholders have rarely been found to organize formally on their own and, when they do, their organizations usually operate in a challenging and competitive environment (Hellin et al., 2009; Shiferaw et al., 2011). One important function of external support is, therefore, to ease the formation and start-up phase of farmer organizations, particularly in light of limited financial capacities (Chirwa et al., 2005). Also, long-term support can raise the asset levels of such organizations, thereby contributing to their competitiveness and investment opportunities (Markelova & Mwangi, 2010). At a later stage, building linkages with external actors is important for sustaining the competitiveness of these organizations (Cook & Burrell, 2009); meanwhile, governments, donors or NGOs may be important sources for gaining access to networks, information and capacity building (Braverman, 1991; Rondot & Collion, 2001).

Despite the above-mentioned benefits, the literature on farmer organizations provides far more arguments against the involvement of external actors, which is seen to undermine successful farmer collective action. In fact, many authors see the influence of external development programs on farmer organizations as problematic and one of the reasons why many organizations have failed in the past (Hellin et al., 2009; Shiferaw et al., 2011; The World Bank, 2007; Poulton et al., 2010). Scepticism towards external programs is not new, dating back to pre-liberalization times, when farmer organizations were seen as government agents rather than as member-owned institutions, which led to passive attitudes amongst members, wide undercapitalisation, inefficiencies and mismanagement (Wanyama et al., 2009; Hussi et al., 1993; Thorp et al., 2005; Collion & Randot, 2001; World Bank, 2007). Also today, there is evidence that external support can lead to malfunctioning and weak performance of farmer organizations (Wouterse & Francesconi, 2016). A number of studies have analyzed the question of why external benefits may be counterproductive for farmer organizations, pointing towards two propositions that are relevant to the analysis at hand.

One group within the literature suggests a negative relationship between the performance of farmer organizations and the types of farmers that they attract when external benefits are involved. According to Platteau (2004) and Platteau and Gaspart (2003), community-driven development is highly vulnerable to elite capture in rural areas of developing countries. Similarly, Arcand and Fafchamps (2012) show that donor support is positively associated with elitism in

farmer organizations, arguing that the promise of external benefits attracts influential members of the society into such groups. Looking at the motive of such households, it is clear that they typically seek access to handouts rather than initiating and engaging with other group activities (Stringfellow et al., 1997). With members like this showing little interest in the promotion of collective action, willingness to invest in the group and its services remains low and can crowd out equity capital formation (Francesconi & Wouterse, 2015).

A second group within the literature deals with the types of farmer organizations that are formed around external benefits. Studying farmer organizations in Mexico, Hellin et al. (2009) show that the majority of organizations have been found to have the sole purpose of accessing public subsidies while otherwise qualifying as widely inactive and dormant. Paradoxically, examples from Senegal and Burkina Faso show that development programs often target the most active and well performing organizations, thereby disadvantaging them with providing public goods to their members (Bernard et al., 2008a). Imposing such external program criteria onto farmer organizations has been found to undermine their economic justification, overstrain management and distract them from focusing on their core commercial activities (Francesconi & Wouterse, 2019; Chirwa et al., 2005; Bernard & Taffesse, 2012). This is often seen to create unfavorable dependencies and undermine the ability of organizations to improve members' farm performance on their own (Hellin et al., 2009; Shiferaw et al., 2011; Thorp et al., 2005; Wouterse & Francesconi, 2016). This may also explain why many organizations cease to exist once external programs come to an end, making them hardly sustainable in the long-term (Collion & Randot, 2001; Hussi et al., 1993).

Overall, the various strands within the literature have proposed that farmer organizations can enhance members' farm performance, indicating that there are good reasons for external actors to promote farmer collective action. Yet, external development programs have frequently attracted opportunistic farmers and ended up engendering passive organizations, thereby undermining successful collective action.

3 | EMPIRICAL CONTEXT AND DATA

3.1 | Farmer organizations in Zambia

The development of farmer organizations in Zambia resembles that of many other African countries. Once introduced by white settlers, it was not until after liberalization in the 1960s that the indigenous population started to form organizations (Bowman, 2011; FAO, 1993). In the years that followed, farmer organizations were heavily promoted as instruments for national development programs to introduce mechanization and input credit schemes. Governments and development partners expected farmer organizations to bring economic growth to rural areas, absorb surplus labour and win over political support amongst the masses (Bowman, 2011). To fast-track the process, the government offered cash incentives to households that cleared land for farming and became members of formal groups (Gez & Schler, 2018). In 1991, farmer organizations counted more than 800,000 members and controlled more than 90% of the agricultural sector (FAO, 1993; Lolojih, 2009). However, with the government withdrawing direct support under the liberalization process of the 1990s, the movement of farmer organizations widely collapsed. One factor contributing to this result was widespread dissatisfaction amongst members, who did not see their organizations as autonomous, member-owned institutions (FAO, 1993).

With the introduction of the traditional FISP in 2002, a new generation of farmer organizations emerged. The program has offered subsidized inputs to farmers, aiming to raise agricultural

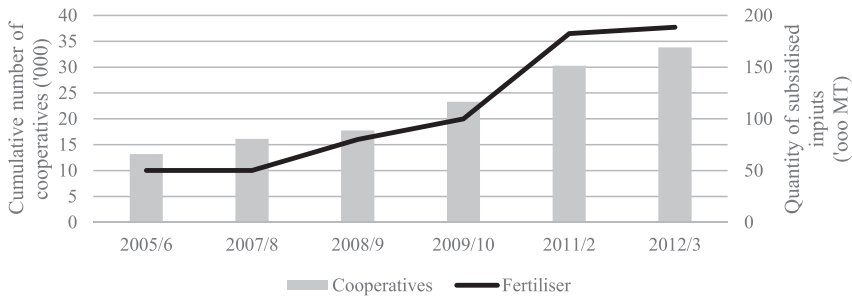


FIGURE 1 Cumulative number of registered cooperatives and quantities of subsidized inputs in Zambia (2005–13), based on MAL (2014a) and Resnick and Mason (2016)

production in order to achieve food security and reduce widespread poverty. It targets vulnerable but viable farmers that cultivate between 0.5 and 5 hectares, have not defaulted on the previous credit program and are not simultaneously benefiting from the Food Security Program (MAL, 2014b). Most importantly for the analysis here, the FISP requires potential beneficiaries to show proof of membership in a farmer organization.

In this way, farmer organizations provide the institutional link between the FISP and its target group. Their role is to identify potential beneficiaries from amongst their members and collect upfront payments, while also fetching and distributing the assigned subsidized input packs. The FISP operates on a cost-sharing basis, meaning that it reduces the commercial price of inputs and members make upfront payments to cover the rest (Mason & Smale, 2013). With about 87% of the population cultivating maize and most of them qualifying as poor, FISP can be considered an attractive or even the only channel to access improved seeds and fertilizer for the majority of smallholders (Resnick & Mason, 2016).

Farmer organizations in Zambia can have different legal forms, of which agricultural cooperatives are most prominent. Figure 1 shows that both the volume of FISP and the number of cooperatives in Zambia consistently increased during the period of 2005 to 2013, indicating a possible relationship between the two. More specifically, it is likely that cooperatives have been formed in response to the availability of subsidized inputs (Minah & Malvido Pérez Carletti, 2019). The effect of the FISP on group formation may be even stronger when also considering other types of farmer organizations, such as associations, clubs or unions, which can also be involved in program implementation.

It remains unclear what additional activities farmer organizations engage in, however, other than channelling subsidized inputs. According to Chamberlin et al. (2014), farmer organizations are also formed to access extension and other services from governmental or non-governmental actors that do not always require formal membership but, nevertheless, prefer working through group structures. The same authors also find that farmer organizations have few assets and rarely engage in collective maize marketing activities for a variety of reasons, including the small volumes that their members produce, heterogeneous production and marketing preferences and limited trust in leaders. Furthermore, farmers see maize prices to be exogenous and, thus, do not feel that they have any collective bargaining power.

The effects of farmer organizations in Zambia are mixed, irrespective of their involvement in the FISP. A recent study from Southern Zambia finds a positive association between membership and food security (Nkomoki et al., 2019). Other studies suggest that the contribution of Zambian farmer organizations to socio-economic development has been marginal at best (Lolojih, 2009).

TABLE 1 Overview of sample households' participation in farmer organizations and the FISP

Participation in the FISP	Membership in farmer organization		Total
	Yes	No	
Yes	2,056	42	2,098
No	372	1,605	1,977
Total	2,428	1,647	4,075

Overall, a notion has gained prominence that the majority of organizations should be categorised as being opportunistic and inactive, hardly generating any benefits that go beyond channelling subsidized inputs (Minah & Malvido Pérez Carletti, 2019; Mason et al., 2016). Meanwhile, organizations without external support have been found to provide minimal net benefits (Chamberlin et al., 2014). It is, therefore, not surprising that only 12% of Zambian farmer organizations have been classified as active (Pollet, 2009). In contrast, around 80% are considered dormant organizations that are likely to discontinue any joint activities after having received their share of subsidized inputs (Lolojih, 2009).

3.2 | Data

I use two panel datasets from the nationally representative Rural Agricultural Livelihood Survey (RALS) to analyze the effects of farmer organizations on members' farm performance, with and without controlling for external support. The RALS survey is conducted by the Central Statistical Office (CSO) of Zambia in cooperation with the Ministry of Agricultural and Livestock (MAL) and the Indaba Agricultural Policy Research Institute (IAPRI). The RALS sampling frame is derived from the 2010 Zambian Census of Housing and Population and is designed to be representative of rural farming households that cultivate up to 20 hectares of land for agricultural purposes, thus excluding large-scale and commercial farms or non-agricultural households. See IAPRI (2012) and CSO (2012) for more information on the RALS sampling procedure.

The present analysis draws on the RALS datasets for 2012 and 2015. For analytical purposes, I use the 2012 dataset to estimate the determinants for becoming a member of a farmer organization, whereas the 2015 dataset provides information on household participation in the FISP and farm performance indicators during the 2013–14 agricultural year and the 2014–15 marketing season.

The original dataset included 8,839 resampled households. Because the FISP is primarily organized around farmer organizations that have been active for at least two years and that promote maize production, I have subset the dataset into households (1) growing maize in 2012 and 2015, (2) indicating membership in a farmer organization in 2012 and 2015 to control for continued membership, (3) that were not excluded from the FISP because their farmer organizations were not participating in the program. After dropping households with missing values, a final sample of 4,075 households was retained for analysis, including 2,428 members and 1,647 non-members. Table 1 summarises household participation in farmer organizations and the FISP, indicating whether or not a household accessed external benefits. In the following, I refer to all members and non-members as the full sample ($N = 4,075$) and to members and non-members without external support as the sub-sample ($N = 1,977$).

In the full sample, it can be seen that 2.5% of non-member households benefitted from the FISP, albeit not meeting its membership criteria. This result would appear to point towards inefficiencies and inclusion errors during program targeting, meaning that the FISP criteria have not

been strictly enforced during implementation. This is in line with previous studies and does not undermine the estimation of overall membership effects in the full sample (Resnick & Mason, 2016). The FISP participation becomes more relevant when estimating membership effects in the sub-sample, where it can be seen that around 15% of member-households do not participate in the FISP, which is hardly surprising, as benefits from the FISP are rationed and insufficient to serve all farmers who potentially qualify for it.

4 | ANALYTICAL APPROACH

Using Propensity Score Matching (PSM), I aim to analyze impacts of farmer organizations on members' farm performance under external support. The objective is to calculate Average Treatment Effects on the Treated (ATTs) on-farm performance, where treatment refers to membership, the treated to members of farmer organizations, and non-members constitute the control group (Caliendo & Kopeinig, 2008).

The PSM method is used to address the empirical problem of self-selection, as it enables modelling of a counterfactual situation in which only members and non-members with similar observable characteristics are compared (Heckman, 1979; Rosenbaum & Rubin, 1983), and is performed in two stages (Dehejia & Wahba, 2002; Stuart, 2010; Caliendo & Kopeinig, 2008). First, I perform a logit regression to generate propensity scores indicating the probability of each observed farmer to belong to a farmer organization. I then use propensity scores to match members and non-members with similar probabilities of being a member. In the second stage, I derive ATTs by comparing farm performance of members and non-members within the matched sample. Because this article aims to assess the influence of external development programs on farmer organizations and their impacts on members' farm performance, two PSMs are performed, with and without controlling for external support. Each step of the PSM is thus separately performed for the full sample (all members and non-members) and the sub-sample (members and non-members without external benefits).

4.1 | Estimating propensity scores

The membership decision for farmers is modelled through a random utility framework (Fischer & Qaim, 2012; Abebaw & Haile, 2013). Individual utility can be expressed through the following model:

$$FO_i^* = \beta Z_i + \varepsilon_i, \quad (1)$$

where FO_i^* is the latent variable of membership in a farmer organization, Z_i is a vector of observed household characteristics and ε_i is the error term. The latent variable FO_i^* describes a household's FO membership status, taking $FO_i = 1$ when membership is observed and $FO_i = 0$ when membership is not observed:

$$FO_i = \begin{cases} = 1 & \text{if } FO_i^* > 0 \\ = 0 & \text{otherwise.} \end{cases} \quad (2)$$

I use this utility framework to estimate an observed farmer's predicted probability of being a member, from which propensity scores are obtained to identify members and non-members

TABLE 2 Definition of variables

Variable	Definition and measurement
Male-headed	Male-headed household (No = 0, Yes = 1)
Household size	Number of household members
Education	Household head's years of education
Age	Age of household head (years)
Mobile phone	Household owns mobile phone (No = 0, Yes = 1)
Price information	Household has access to price information (No = 0, Yes = 1)
Farm size	Total cultivated land (ha)
Distance to road	Distance to feeder road (km)
Distance to market	Distance to market (km)
Business income	Household has income from informal business activities (No = 0, Yes = 1)
Credit	Household has obtained loan or credit to support agricultural production (No = 0, Yes = 1)
Production assets	Total value of productive assets (100,000 ZWK)
Livestock	Household owns livestock (No = 0, Yes = 1)
Bike	Household owns bike (No = 0, Yes = 1)
Radio	Household owns radio (No = 0, Yes = 1)

with similar observable characteristics. Using logit regression, I calculate propensity scores as follows:

$$p(Z_i) = \text{Prob}(FO_i = 1|Z_i), \quad (3)$$

where I derive the propensity score $p(Z_i)$ from regressing membership in farmer organizations against a list of household characteristics. The binary dependent variable is coded as 0 for non-members and 1 for members. The choice of explanatory variables in vector Z_i is motivated by theory and empirical studies (see Table 2). I include variables that influence membership decisions and farm performance in order to control for any pre-treatment characteristics (Caliendo & Kopeinig, 2008). Following Wyss et al. (2013), a single generic model is used to investigate membership effects on multiple farm-performance outcomes.

Amongst other factors, the set of explanatory variables includes demographic characteristics such as the gender of the household head, as men and women tend to perceive different costs and benefits from membership (Pandolfelli et al., 2008; Meinzen-Dick & Zwartveen, 1998; Dohmirth & Hanisch, 2017). To exemplify, women face higher opportunity costs from their household and reproductive responsibilities while also having less control over land and other resources (Meier zu Selhausen, 2016). I therefore expect membership to be higher among male-headed households (Abebaw & Haile, 2013). Equally, it is assumed that larger households can devote more labour towards collective activities (Mojo et al., 2015; Shumeta & D'Haese, 2016; Bernard & Spielman, 2009). Previous research has also found a positive relationship between the educational status or age of the household head and their membership probability, possibly because farmers with higher levels of human capital and farming experience are better equipped and motivated to join farmer organizations and implement innovative approaches (Bernard & Spielman, 2009; Verhofstadt et al., 2015; Mojo et al., 2015; Fischer & Qaim, 2012).

I further include variables on information access and radio ownership, as access to information can raise awareness about the potential benefits of farmer organizations. Previous evidence also suggests that mobile phones can reduce the cost of information and positively influence membership decisions (Fischer & Qaim, 2012).

Against the very low population densities in Zambia, I assume a positive relationship between market or road distance and membership, as more remote farming households may expect higher returns from participation (Fischer & Qaim, 2012; Abebaw & Haile, 2013). In addition, I include a dummy variable for bike ownership to control for the ability to physically access and participate in farmer organizations.

Moreover, several wealth-related indicators have been found to affect membership. To exemplify, farm size has been found to matter, as farmers cultivating larger fields are likely to be wealthier and have more resources to pool (Fischer & Qaim, 2012; Francesconi & Heerink, 2011). They may also benefit more from economies of scale while exhibiting higher potential to expand their agricultural production. Access to credit can exhibit an effect on membership too, as it is often linked to multiple financial commitments. Other wealth proxies that suggest a higher ability to invest in innovation or inputs include production assets and livestock ownership (Abebaw & Haile, 2013).

Finally, alternative income sources may also affect the choice to join a farmer organization. Following Shumeta and D'Haese (2016), I assume a negative relationship, as alternative income sources reduce a household's dependency on its own agricultural production.

4.2 | Estimating average treatment effects on the treated

I matched members and non-members against their propensity scores using the nearest neighbour matching technique (Dehejia & Wahba, 2002; Stuart, 2010; Caliendo & Kopeinig, 2008), and dropped those without suitable matches from the analysis to fulfil the condition of common support. A balancing test was then performed to ensure that all pre-matching differences between members and non-members had turned non-significant, indicating successful matching results. The ATTs on-farm performance outcomes, Y , were derived from the matched sample as follows:

$$ATT = E[Y(1)|FO = 1, P(Z)] - E[Y(0)|FO = 0, P(Z)], \quad (4)$$

where $Y(1)$ and $Y(0)$ are farm performance outcomes for members and non-members, respectively. I calculated the ATTs for five indicators to describe expected farm performance with and without membership (Caliendo & Kopeinig, 2008). Following Verhostadt and Maertens (2014), farm performance is conceived in a broad way to include indicators on intensification, market participation and income. Because the analysis is framed in the context of an external support program that channels subsidized inputs through farmer organizations, the impact of farmer organizations on technology adoption would appear to be particularly relevant. Thus, a performance indicator to measure the quantity of fertilizer used per hectare (kg/ha) was also included. Furthermore, membership effects on maize yields (ton/ha) were analyzed to capture impacts on farm productivity. The share of maize sold (%) and the share of maize value in relation to overall crop value (%) were included to assess impacts on commercialization and crop specialization in the household. Finally, ATTs on net farm income (log) were calculated to capture potential impacts on overall household welfare.

4.3 | Testing the robustness of PSM results

The PSM method is based on the conditional independence assumption, which requires selection into treatment to be exclusively based on observable characteristics (Rosenbaum, 1991; Heckman et al., 1997; Caliendo & Kopeinig, 2008). Because membership decisions and performance indicators can also be influenced by unobservable factors, the independence assumption will be difficult to meet strictly, which could result in what is referred to as hidden bias (Rosenbaum, 1991).

I performed various sensitivity tests to test the robustness of results derived from PSM. First, I used Rosenbaum bounds sensitivity analysis to assess the influence of unobserved variables on self-selection (Rosenbaum, 2010). The method starts by assuming the hypothesis of no hidden bias, after which the assumption is gradually relaxed until the effects of unobserved heterogeneity become so severe that they would render PSM results insignificant. Rosenbaum bounds analysis uses different levels of unobserved heterogeneity to estimate the upper and lower bounds of significance levels (DiPrete & Gangl, 2004). Second, I calculated ATTs from variations in the logit model specifications or matching technique and compared them to the results of the main analysis (Caliendo & Kopeinig, 2008).

It should be noted that membership decisions to join Zambian farmer organizations are strongly motivated by households' expectations regarding access to subsidized inputs. As the FISP requires potential beneficiaries to show proof of membership, the program has likely skewed the voluntary character of self-selecting into farmer organizations. Following Francesconi and Heerink (2011) and Bernard et al. (2008b), it is assumed here that unobservable factors and hidden bias did not have a strong influence on PSM results obtained in the full sample. Therefore, I restricted sensitivity testing to the sub-sample, where smallholders may be motivated by other factors than the promise of external benefits.

5 | RESULTS AND DISCUSSION

5.1 | Descriptive analysis of member and non-member characteristics

Table 3 provides descriptive statistics of members and non-members in the full and sub-samples.

Comparing members and non-members in the full sample suggests that member households are more likely to be male-headed, older, better educated and have, on average, larger household sizes. There are also differences with regard to access to information, with 72% and 76% of member households owning mobile phones and radios vis-à-vis 41% and 55% of non-member households, respectively. It is therefore not surprising that a larger share of member households has better access to price information. When looking at wealth indicators, households differ substantially with respect to farm size, with member households cultivating on average 72% more land than their non-member counterparts. Members also appear considerably wealthier, with a larger share of households accessing credit and owning livestock while their assets are, on average, worth twice the value of non-member households. Considering farm location, members and non-members live on average between 1.54 and 2.27 km or 24.78 and 27.48 km away from the nearest feeder road or market place, respectively. Members are, on average, located closer to roads and markets, suggesting better market access. Business income is the only variable that does not demonstrate a significant difference, with 44 and 45% of member and non-members receiving income from informal activities, respectively.

TABLE 3 Farm and household characteristics in the full and sub-samples

	Full sample				Sub-sample	
	Member		Non-member		Member without external benefits	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Male-headed	0.86 ^{***}	0.35	0.78	0.42	0.88 ^{***}	0.33
Household size	6.78 ^{***}	2.83	5.48	2.47	6.65 ^{***}	2.61
Education	6.79 ^{***}	3.63	5.37	3.63	6.34 ^{***}	3.50
Age	47.58 ^{***}	13.70	45.77	15.51	47.22	14.06
Mobile phone	0.72 ^{***}	0.45	0.41	0.49	0.69 ^{***}	0.46
Price information	0.94 ^{***}	0.24	0.81	0.40	0.95 ^{***}	0.21
Farm size	3.25 ^{***}	2.58	1.90	1.86	3.34 ^{***}	2.65
Distance to road	1.54 ^{***}	5.36	2.28	7.29	1.41 [*]	3.54
Distance to market	24.76 ^{***}	29.74	27.68	33.99	23.98	27.09
Business income	0.45	0.50	0.44	0.50	0.47	0.50
Credit	0.23 ^{***}	0.42	0.16	0.37	0.30 ^{***}	0.46
Production assets	298.10 [*]	2,803.34	145.87	1,029.89	281.49 [*]	1,422.09
Livestock	0.94 ^{***}	0.24	0.80	0.40	0.94 ^{***}	0.24
Bike	0.83 ^{***}	0.38	0.55	0.50	0.80 ^{***}	0.40
Radio	0.76 ^{***}	0.43	0.55	0.50	0.75 ^{***}	0.43
Observations	2,428		1,664		372	

Notes: T-tests were used to assess mean differences between member and non-member observations in the full and sub-samples. ***, **, * denote statistical significance at the 0.001, 0.01 and 0.05 levels, respectively. Non-member characteristics in the sub-sample ($N = 1,605$) are similar to that of non-members in the full sample and omitted due to space limitations.

Similar patterns between members and non-members appear in the sub-sample, though a few differences do exist. In this regard, members and non-members who remain without external benefits do not significantly differ in terms of their age, distance to markets and business incomes.

5.2 | Membership determinants in Zambian farmer organizations

I used logit regression to derive membership determinants in full and the sub-sample. The estimated membership probabilities are used to derive propensity scores for individual households. The results from both logit regressions in full and the reduced samples are presented in Table 4.

One of the surprising aspects with regard to the full-sample regression is that households with male heads have a significantly lower likelihood of membership in farmer organizations. In contrast to previous empirical studies (Abebaw & Haile, 2013), the results presented here suggest that female-headed households are more likely to become members of farmer organizations, which is encouraging from a women's empowerment perspective (Pandolfelli et al., 2008). One possible explanation could be that female-headed households have a stronger motivation to become members, because they purchase significantly less fertilizer from commercial markets (results from chi-square analysis with a p -value of 0.00). The literature suggests that women have limited access to markets because of gender-specific barriers, including lack of financial resources to cover transportation costs, higher risk of insecurity or violence during transportation, and lack

TABLE 4 Results from logit regression on membership in farmer organizations

	Full sample		Sub-Sample without external benefits	
	Coefficient	Robust Std. Error	Coefficient	Robust Std. Error
Male-headed	-0.34**	0.12	-0.11	0.20
Household size	0.08***	0.02	0.09***	0.03
Education	0.06***	0.01	0.03	0.02
Age	0.05*	0.02	0.02	0.03
Mobile phone	0.73***	0.09	0.69***	0.15
Price information	0.89***	0.12	1.10***	0.27
Farm size	0.44***	0.05	0.45***	0.09
Distance to road	-0.02	0.01	-0.03*	0.01
Distance to market	0.00	0.00	0.00	0.00
Business income	-0.12	0.09	0.00	0.13
Credit	0.13	0.14	0.51**	0.17
Production assets	0.00	0.00	0.00	0.00
Livestock	0.78**	0.12	0.78**	0.25
Bike	0.71***	0.10	0.54***	0.16
Radio	0.24**	0.09	0.21	0.14
Age squared	0.00	0.00	0.00	0.00
Farm size squared	-0.02**	0.00	-0.03***	0.01
Constant	-4.78***	0.46	-6.15	0.77
Observations	4,075		1,977	
Pseudo R2	0.20		0.18	

Notes: Standard errors are cluster corrected and robust.

***, **, * denote statistical significance at the 0.001, 0.01 and 0.05 levels, respectively.

of time or negotiation skills (Quisumbing & Pandolfelli, 2010). Overall, however, this could lead to female-headed households becoming more dependent on accessing subsidies or free inputs through farmer groups.

Meanwhile, other demographic variables suggest that the probability of membership increases with household size, better education and age, results which are in line with previous studies linking age and education to farming experience and group membership (Verhofstadt & Maertens, 2015; Mojo et al., 2015). Additional dominant variables linked to membership in the full sample are related to access to information. Owning a radio, mobile phone or being able to access price information increases the probability of being a member by 4%, 13% and 16%, respectively. This can be tied to increasing awareness about the role and potential benefits of farmer organizations as, for example, the government of Zambia makes FISP-related announcements over the radio to disseminate relevant information.

Furthermore, wealth-related indicators also seem to matter. Here, the likelihood of being a member increases by 8% for each additional hectare of cultivated land until a maximum of 9.3 hectares is reached, after which deciding to become a member becomes less probable. These results are in line with previous evidence from Ethiopia and Kenya, indicating a concave relationship and decreasing probabilities for farm sizes exceeding 4, 4.5 or 9 hectares of land (Francesconi

& Heerink, 2011; Fischer & Qaim, 2012; Bernard & Spielman, 2009). Membership appears unaffected by farm location, though bike ownership shows a strong and significant effect on membership, suggesting that farmer mobility is important.

Now turning to the results from the sub-sample of members and non-members who remained without external support, comparison of the two logit regressions reveals similar effects with regard to wealth and information-related indicators, though effect sizes are consistently smaller in the sub-sample. To exemplify, a one hectare increase in farm size is associated with a 6% increase in the likelihood of membership without benefitting from external support. Surprisingly, the results from the sub-sample reveal that almost all variables measuring demographic household characteristics, including gender, education or age, show no significant effect on membership, suggesting that such farming households are less targeted than those in the full sample. Also surprising, and in contrast with the full-sample results, it seems that radio ownership does not affect the likelihood of being a member, possibly related to the fact that farming households in the sub-sample are motivated by benefits other than subsidized inputs that do not depend on radio announcements. After controlling for external support, credit access and road distance stand out as significant membership determinants. With credit access increasing the likelihood of being a member by 6%, the result is intuitive as, without external benefits, members possibly gain from economic services that afford additional investments and pooling of resources.

Overall, the results from both regressions show that membership in Zambian farmer organizations is strongly associated with household and farm characteristics, and the effects are less pronounced after controlling for external support. These results point to a middle-class effect, suggesting that poorer and wealthier farmers are less likely to participate (Bernard & Spielman, 2009). Its noteworthy, however, that the results in both samples suggest a higher likelihood of participation for wealthier and better-informed farmers while, at the same time, participation of female-headed households is more likely in the presence of external benefits. This can be taken as a positive signal, since external program effects on poverty reduction and severity turn out to be disproportionately larger for female-headed households as compared to others (Mason et al., 2020).

The results support previous findings from Zambia suggesting that the external support program attracts farmers who are wealthier and better-off, while poorer farmers tend to be excluded (Gez & Schler, 2018). It has been argued that particularly resource-poor farmers find it difficult to meet financial contributions to farmer organizations, such as registration and membership fees or the buying of shares. Burke et al. (2012) estimate that membership contributions in combination with upfront payments for the FISP amount to 20% of the annual income of 60% of rural households. Also, Mofya-Mukuka et al. (2013) and Mason et al. (2020) suggest this as one of the reasons why smaller farmers are underrepresented in the FISP. Overall, such factors are likely to limit the level of inclusiveness in farmer organizations (Bijman & Wijers, 2019), though the presence of better-off farmers has also been found to create incentives for disadvantaged farmers to participate (Minah & Malvido Pérez Carletti, 2019).

5.3 | Impacts of farmer organizations

The results from the logit regression are used here to match members and non-members against their propensity scores. To fulfil the condition of common support, members and non-members without matches have been dropped from the analysis. Also, balancing tests were performed to

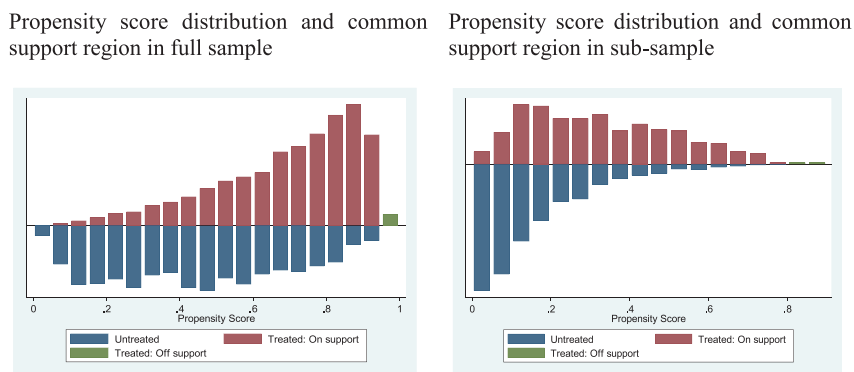


FIGURE 2 Propensity score distribution and common support region [Colour figure can be viewed at wileyonlinelibrary.com]

assess the quality of matching (Caliendo & Kopeinig, 2008). The results show that both the common support condition (see Figure 2) and balancing properties have been met.

Because this study aims to assess the influence and impacts of external development programs on farmer organizations, I used the matched samples to estimate ATTs on farm performance, with and without controlling for external support. The PSM results are presented in Table 5, revealing strong and positive effects from group membership on farm performance, irrespective of whether members access external benefits or not. What stands out is that effects are 13–44% larger for members in the full-sample compared to members in the sub-sample, which points to possible overestimation of membership effects when external program benefits are not controlled for.

5.3.1 | Impacts on members' farm performance in the full sample

With regard to the full sample results, it can be seen that farmer organizations have improved input access, with members using twice (+109%) the amount of fertilizer as compared to their non-member counterparts and, as a consequence, member performance increasing by a margin of 98.37 kg/ha compared to non-members. This large and significant effect is in line with expectations and can be largely attributed to the FISP, which makes subsidized inputs available through farmer organizations. Similar results have been found in Rwanda and Mexico, where maize organizations were used to channel free or subsidized inputs to members (Hellin et al., 2009; Verhofstadt & Maertens, 2014).

Second, membership increases maize yields by 0.92 t/ha to 2.98 t/ha, which is equivalent to a 47% increase. This effect can be considered very large, revealing that membership in farmer organizations has resulted in above-average maize yields for Zambia of 2.78 t/ha which, however, remain far below the world average of 5.59 t/ha obtained in 2014 (FAOSTAT, 2019).

Third, membership effects are also positive for market participation, with members commercializing 23% more maize than if they had not joined an organization. This result is unexpected, considering the relatively dormant state of farmer organizations and the fact that marketing is primarily done at the individual rather than the group level (Chamberlin et al., 2014). One likely explanation for these results is that productivity gains in combination with relatively stable market outlets, such as the Food Reserve Agency, can allow individual farmers to market more of their own produce.

TABLE 5 Average treatment effects on the treated (ATTs) in farmer organizations on members' farm performance

	Full sample		Sub-sample without external benefits			
	Members	Non-members	ATT (S.E.)	Members	Non-members	ATT (S.E.)
Fertilizer use (kg/ha)	188.87	90.50	98.37 ^{***} (5.67)	142.69	83.78	58.91 ^{***} (9.08)
Maize yield (ton/ha)	2.87	1.95	0.92 ^{***} (0.07)	2.50	1.87	0.63 ^{***} (0.11)
Share of maize sold (%)	0.51	0.28	0.23 ^{***} (0.01)	0.39	0.26	0.13 ^{***} (0.02)
Share of maize in total crop value (%)	0.62	0.33	0.29 ^{***} (0.02)	0.46	0.32	0.14 ^{***} (0.03)
Log farm income	8.83	8.47	0.36 ^{***} (0.06)	8.62	8.42	0.20 [*] (0.08)
On support	2,397	1,647		370	1,605	
Off support	31	0		2	0	

Notes: Results are obtained by matching with the five nearest neighbours.

***, **, * denote statistical significance at the 0.001, 0.01 and 0.05 levels, respectively.

Finally, membership exhibits positive effects on the economic status of households, as members specialize more in maize production and their farm incomes increase by 43%. Given the positive and significant effect on market participation, these results are hardly surprising and also align with Verhofstadt and Maertens (2014), who report a 40% income gain for members of Rwandan maize organizations under external support.

5.3.2 | Impacts on farmer organization members without external benefits

As this article aims to assess the influence of external development programs on farmer organizations and their impacts, it seems particularly important to estimate treatment effects for members who do not benefit from such external support. In this regard, Table 5 shows that farmer organizations increase farm performance, even for members who do not officially participate in the input subsidy program. More specifically, membership increases fertilizer use, maize yields, commercialization rates, the economic relevance of maize and farm incomes by 70, 34, 50, 44 and 22 percentage points, respectively.

These results are generally in line with those of previous studies that, to enhance comparability with sub-sample results, were not explicitly framed within the context of input subsidy programs. Several studies from Ethiopia, for example, found positive and significant membership effects on fertilizer-adoption rates, commercialization and incomes (Abebaw & Haile, 2013; Mojo et al., 2017; Getnet & Anullo, 2012), while evidence from Côte d'Ivoire and Ghana points towards positive effects on member yield levels (Calkins & Ngo, 2010).

Overall, a possible explanation for positive treatment effects is that farmer organizations have improved members' access to commercial input and output markets (Gouët et al., 2009; Thorp et al., 2005; Shiferaw et al., 2011). This is an important hypothesis to be tested in the current analysis, as Zambian organizations are generally portrayed as inactive and dormant (Mason et al., 2016; Pollet, 2009; Chamberlin et al., 2014; Lolojih, 2009). To this end, OLS regression is used here to analyze the effects of some background characteristics on fertilizer use amongst members in the sub-sample. Table 6 presents regression results where fertilizer use (kg/ha) is the dependent variable, related to household characteristics and a set of dummy variables indicating member access to fertilizer, loans and extension services.

As expected, members who purchased fertilizer from farmer organizations exhibit higher fertilizer use as compared to members who did not buy fertilizer through groups (Table 6). This also means that a 100% increase in a farmer organization's ability to acquire fertilizer for its members will, *ceteris paribus*, lead to something in the range of an 85% increase in fertilizer use. In contrast, other services that are made available through farmer organizations, such as loan or advisory services, display no pronounced effects. This suggests that farmer organizations in Zambia actually do play an important role as input providers – which is contrary to their image as passive institutions.

Though encouraging overall, this finding must be interpreted with caution, as research from Zambia, Malawi and Nigeria has shown that subsidized inputs are often redistributed on a cost-sharing basis at the group or community levels (Minah & Malvido Pérez Carletti, 2019; Üllenberg et al., 2017; Chirwa & Dorward, 2013; Liverpool-Tasie, 2014). This could mean that members in the Zambian sub-sample may have in fact purchased subsidized rather than commercial fertilizer from their groups, as the data does not allow differentiation between the two. Since the FISP is a rationed program that does not serve all members, groups generally end up reselling some of the subsidized fertilizer to members who have missed out on getting support from the program. Next

TABLE 6 Factors influencing fertilizer use amongst Zambian farmer organization members without external support

	Coefficient	Robust Std. Error
Male-headed	-32.51	21.02
Education	1.92	2.49
Mobile phone	50.29 ^{***}	13.91
Distance to road	-0.11	1.57
Distance to market	-0.38	0.24
Bike	18.64	16.62
Fertilizer farmer organization	84.22 ^{***}	19.74
Fertilizer private retailer	116.23 ^{***}	12.95
Fertilizer out-grower scheme	14.97	22.88
Advice farmer organization	-1.15	19.40
Loan farmer organization	83.31	52.18
Constant	47.67	29.99
Observations	370	
R2	0.26	

Notes: The dependent variable is fertilizer use (kg/ha).

***, **, * denote statistical significance at the 0.001, 0.01 and 0.05 levels, respectively.

to promoting equal access to subsidized inputs, redistribution also occurs when FISP beneficiaries fail to make their upfront payments and, consequently, pair with non-beneficiaries to share these costs (CSPR, 2011).

Table 6 further shows that purchasing fertilizer from private retailers increases member fertilizer use by 116.3 kg/ha. A possible explanation here is that members who do not benefit from subsidized fertilizer turn to commercial input markets to meet their input needs. Also, members could be benefiting from the geographic location of their farmer organizations, which are often closer to rural centres where private traders are found, thus indicating synergies between the two. In any case, private retailers seem to have a larger effect on fertilizer use compared to farmer organizations, which may be due to more restricted access through farmer organizations and/or fertilizers that are shared with members on the basis, for example, of their farm size or activeness within the organization. In order to augment inadequate fertilizer supply, members consequently buy additional fertilizer from private retailers, hence increasing total fertilizer application per hectare. Anecdotal evidence also suggests that Zambian farmer organizations are widely under-capitalised, which could limit their capacity to pre-finance input purchases, particularly when facing high transaction costs.

Finally, Table 6 also indicates a positive association between mobile phones and fertilizer use, with phone-owning members consuming 51.59 kg/ha more fertilizer than those without. This seems reasonable, as mobile phones reduce search costs for input prices while also influencing production decisions at the household level (Aker & Ksoll, 2016). This result supports a recent study that found a positive association between mobile phone use and the technical efficiency of Zambian smallholders while also showing that farmers use their phones to interact with farmer organizations on a frequent basis (Mwalupaso et al., 2019).

TABLE 7 Results from alternative model specifications and matching algorithms in the sub-sample

	Nearest neighbour		Extended model		Reduced model		Radius matching ¹		Kernel matching	
	ATT (S.E.)		ATT (S.E.)		ATT (S.E.)		ATT (S.E.)		ATT (S.E.)	
Fertilizer use	198.01 ^{**}	(55.96)	195.60 ^{**}	(58.99)	199.91 ^{**}	(55.83)	211.24 ^{**}	(54.11)	191.23 ^{**}	(53.38)
Maize yield	0.63 ^{***}	(0.11)	0.66 ^{***}	(0.11)	0.63 ^{***}	(0.10)	0.62 ^{***}	(0.10)	0.58 ^{***}	(0.10)
Share of maize sold	0.13 ^{***}	(0.02)	0.15 ^{***}	(0.03)	0.13 ^{***}	(0.02)	0.12 ^{***}	(0.02)	0.12 ^{***}	(0.02)
Share of maize in total crop value	0.14 ^{***}	(0.03)	0.17 ^{***}	(0.03)	0.14 ^{***}	(0.03)	0.13 ^{***}	(0.03)	0.14 ^{***}	(0.03)
Log farm income	0.20 [*]	(0.08)	0.23 [*]	(0.09)	0.27 ^{**}	(0.08)	0.20 [*]	(0.08)	0.19 [*]	(0.08)

Notes: ^{***}, ^{**}, ^{*} denote statistical significance at the 0.001, 0.01 and 0.05 levels, respectively.

¹Radius matching has been estimated with a 0.008 calliper.

5.4 | Robustness of ATT results

The above-discussed results of the PSM performed for this study may be sensitive to unobserved variables or affected by the specification of the logit model or matching algorithm. Because the FISP requirement of membership as a condition of support has likely skewed the voluntary character of self-selecting into farmer organizations, robustness tests were only performed for the sub-sample (Francesconi & Heerink, 2011; Bernard et al., 2008b).

First, estimating Rosenbaum bounds shows that PSM results are sensitive to hidden bias if an observed variable causes the odds ratio of treatment (membership) by a factor of 1.4–1.8. Second, the problem of hidden bias was further assessed by comparing different model specifications and matching algorithms in the PSM. The results are presented in Table 7, whereas information on model specifications is presented in the Appendix. All estimation strategies yielded similar results overall in terms of effect signs and significance levels. Following Fischer and Qaim (2012), the results from the sub-sample can thus be considered robust, even in the presence of unobserved heterogeneity.

6 | CONCLUSIONS

The aim of this article has been to assess the influence of an external development program on farmer organizations and the impacts of the latter on members' farm performance in Zambia. I used nationally representative survey data and Propensity Score Matching to compare the impacts of farmer organizations with and without controlling for external program benefits in order to explain in how far these impacts can be explained as being due to the external program. Zambia has provided an interesting case, as it requires potential beneficiaries of its national subsidy program (FISP) to belong to a farmer organization. At the same time, input subsidies are insufficient, leaving some members with and other without external benefits.

The results from the present study suggest overall positive effects from the external program on farmer organizations and their impacts on members. Membership in farmer organizations generally leads to improved production, market participation and income, not only for members receiving external benefits but also for members who remain without them. Explicitly examining what influences performance for members who remain without subsidized inputs, I have found that purchasing fertilizer from farmer organizations helped them to significantly increase their fertilizer use despite not participating in the FISP. Meanwhile, other loan or advisory services that are offered through such organizations do not appear to have any pronounced effects. Essentially, these findings support the idea that organizing smallholders into formal groups around an agricultural development program has the potential to induce wider effects from collective action.

Although farmer organizations seem to make important contributions towards agricultural development, this study also suggests that policymakers and practitioners need to be careful when relying on them to implement their programs. First, it has been found that the FISP requirements may have influenced membership, in that it attracts older, better-educated and more well-informed households with larger farm sizes. This result can at least partly explain why the program has not yet reached more disadvantaged households. To improve program targeting, policymakers are advised to enhance inclusion in farmer organizations by, for example, reaching out to younger and smaller-scale farmers or providing information about the FISP and benefits of collective action in a way that does not depend on technology and meets the needs of disadvantaged households. What is encouraging, however, is that farmer organizations already

seem to be boosting the membership of female-headed households. Overall, this means that government and donors can rely on farmer organizations to promote women's empowerment but need to ensure that group dynamics do not prevent women from accessing program benefits.

Second, the study has shown that the presence of external development programs can lead to an overestimation of treatment effects in farmer organizations, which in the case considered here have been found to be 13–44% larger for average members than for members who did not benefit from the FISP. While organizing smallholders for the purpose of participating in a development program can also be considered a benefit due to collective action, it should be noted that treatment effects derived from external programs are hardly sustainable. In most situations, these effects are bound to the amount, terms and duration of the programs, requiring governments and donors to consider possible exit strategies. To unlock broader and more long-term impacts, this study has shown that policymakers can promote economic diversification within farmer organizations, such as by reducing transaction costs associated with collective input purchases, creating synergies between farmer organizations and commercial input providers or easing access to and use of mobile phones.

Taken together, these findings do imply strong influence from the FISP on Zambian farmer organizations and their impacts on members, though it remains unclear whether and how these organizations would operate with less or no FISP involvement. This is an important question, as the government of Zambia has changed implementation of the program in recent years. The new e-voucher system still requires potential beneficiaries to belong to a farmer organization, but now members can collect their subsidized inputs individually from private agro-dealers instead of accessing them through their groups. While future research is needed to re-evaluate the effects of this policy change, it can be expected that the FISP will lose some of its influence on farmer organizations. Government and smallholders should see this as an opportunity to revamp the movement and support farmer organizations towards becoming economically more sustainable and diversified.

In conclusion, the results presented in this article make a strong case for future research to consider external benefits more explicitly in their analysis in order to more fully understand the long-term contributions of farmer organizations in developing countries. While this study has investigated influence from a large-scale public input-subsidy program, future research could usefully explore effects from other types of development programs that may operate at different scales, offer different benefits (e.g. supporting output marketing or extension services) or are implemented by different actors. More broadly, to make external programs more responsive to the needs of smallholder farmers and their organizations, it could also be helpful to investigate in what ways and to what extent farmer organizations can influence the design of such programs.

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APPENDIX: SPECIFICATION OF EXTENDED AND REDUCED MODELS

The first and second rows of Table 7 present the ATTs from both the base and extended models. Following Fischer and Qaim (2012) and Mojo et al. (2015), the extended model adds new variables to the logit model to minimize the hidden bias effect. As unobserved characteristics are often related to individual levels of motivation, skills and preferences, I include three dummy variables, coded with 1 if a household in the sub-sample (a) participated in a women's or loan group, indicating general motivation to participate in collective action; (b) received some form of extension service, which is a proxy for skill level; or (c) indicated that it was uninterested in membership, controlling for adverse membership preferences. Also, to capture different types of production, I include two variables on irrigation use and the quantity of cash crops (sunflower, soybeans, cotton, tobacco, paprika, sugarcane) harvested (kg). Finally, I added a measure of a household's relationship to the traditional chief or village, as it has been found to influence access to technology and information. The third row in the table presents results from a reduced model in which I dropped all potentially endogenous variables – including ownership of phones, bikes and radios; total value of production assets; and access to price information – from the logit model (Fischer & Qaim, 2012).