Are farmers' organizations a good tool to improve small-scale farmers' welfare?

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Abstract

Farmers' organizations have been suggested as a tool to improve the living conditions of farmers in poor countries, both by improving their market situation and enhancing the dissemination of information. To study this, I employ unique panel data from Mozambique. The causal effect on small-scale farmers' income from being member in a farmers' organization of organization membership is estimated using a difference-in-difference matching estimator. The main finding is the effect of membership among small-scale farmers on agricultural profits is positive, while the effect on the value of plant production is not significant. This might indicate that farmers' organizations to a larger extent focus on production or crops relevant for the market than for production for own consumption. The magnitude of the effect is around 50% increase in agricultural profits. Thus, aid to farmers' organizations is beneficial for the farmers and farmers' organizations is a good tool to improve small-scale farmers' welfare.
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1. Introduction

A large share of the worlds poor live in rural areas and are small-scale farmers. It is therefore important to increase the income of small-scale farmers to reduce poverty. One policy that has been promoted to reach this goal is to create and support farmers' organization or cooperatives in developing countries. The basic idea is that farmers' organizations will strengthen the farmers' negotiation position in relation to the buyers, and reducing transaction costs faced by farmers. This will bring farmers closer to the market, enable them to benefit from comparative advantages and maybe even to connect them to the international market. Secondly, the farmers' organizations might be a good vehicle for donors to reach the small-scale farmers, which generally is a group that is difficult to reach and target for the donor as they usually live in sparsely populated rural areas with weak infrastructure.

Markets in rural Africa can be characterized as either spot markets (Fafchamps, 2004) or missing. In addition, there is an increasing importance of out-grower schemes and contract farming for cash crops or other high value crops such as horticultural crops. It is in this latter market that there is a focus on possible monopsonistic exploitation of the small scale farmer (Sivramkrishna and Jyotishi, 2008, White, 1997), and where farmers organizations have been proposed to rectify the situation. If membership does reduce transaction costs, this will enhance the probability of market participation. This effect on transaction costs from being member in a farmers' organization will be important in a situation with missing markets and spot markets.

Cooperatives are important in the agricultural sector in the developed world. The basic idea behind cooperatives is to strengthen farmers' market power relative to the buyer as so to reduce the monopsony power of the buyer. Farmers' cooperatives in the developed world originated from a situation somewhat similar to what we find in developing countries today. Through organization, farmers increased their power relative to the buyer as they consolidated as one larger seller, and in such a way they managed to get out of the monopsony situation. Today, there are several types of farmers' cooperatives in the developed world, all of which respond to different market and product situations.

Generally, a farmer's cooperative is an organization/firm that is owned by the farmers. The cooperative buys the produce from the farmers according to a certain contract, and in addition it might provide inputs and technical assistance.

There are few, if any, studies that evaluates the income effect of being member of farmers' organizations in developing countries in general, and not tied to a particular organization. There is little empirical evidence for the income generating effect of farmers' organizations in developing countries. Most of the studies focus on evaluating specific contracts and who can participate in the agreement (Becchetti and Costantino, 2008, Warning and Key, 2002). However, there is no agreement on whether the poor can participate (Warning and Key, 2002) or if it generally are the richer farmers that participate (Becchetti and Costantino, 2008). Both studies find that the participants have higher income, but only the first shows that this is due to the participation.

The objective of this article is to evaluate the effect of farmers' organization in Mozambique on a household's well-being. There have been ongoing efforts by the public sector, NGOs and donors since the mid nineties to promote farmers organizations. In this study, I am using agricultural household panel data (TIA) from 2002 and 2005 (Ministry of Agriculture, 2002 and 2005) to evaluate the impact of farmers' organizations on agricultural income of small-scale farmers who are members. I use three different estimators to evaluate this effect, first a cross-sectional propensity matching score estimator, then a fixed-effects estimator and finally a difference-in-difference matching estimator. The latter estimation method is based on Heckman et al. (1998), Heckman et al. (1997) and Smith and Todd (2005). I find that membership has a positive significant effect on overall agricultural profits, while the effect is not significant on other types of income or the overall production value.

2. Literature review

There is a relatively thin literature on cooperatives in developing countries compared to the developed world, where it is mainly a part of the agribusiness literature. This literature has received renewed interest as vertical integration has become more

widespread in the agribusiness, and has also changed the causal direction between farming and agribusiness from being led from the farm level to be led from the retail industry (Reardon, et al., 2003). This might also have an effect on how farmers' cooperatives form in developing countries today.

In the literature, there are expressed fears of monopsonistic exploitation of small-scale farmers in contract schemes due to the unequal balance of power between the contractor and the small-scale farmer. Thus, a common proposal to rectify this situation is to support the creation of farmers organizations (Glover, 1987, Sivramkrishna and Jyotishi, 2008).

Furthermore, the effect of farmers' organizations depends on how well they function, how the contract negotiations between the farmers and the company for the contract are conducted and in what context. Bingen et al. (2003) define three different type of contracts or linkages between farmers and business based on their degree of human capacity building, and thereby the possibilities of farmers' organizations to emerge and develop. Their claim is that only those types of contracts that build human capacity will lead to long term sustainable benefit to the small-scale farmer and its community, that also can last after the end of a project. They classify the contracts in three categories: i) Contract/business which is profit driven, ii) Projects initiated and run by NGOs, and iii) Process oriented human capacity development projects.

Profit driven contract/business, which by default is focused on cash crops and usually has little or no social development dimension. This can be characterized as a monopsonic situation. Projects initiated and run by NGOs and donors. They provide new or improved technology to the farmers and also possible market outlets and linkages to the agribusiness. This work is facilitated by a farmers' organization that often is initiated as part of the project. However, there are limited opportunities for the farmers in the organization to decide what the focus of the work in the organization should be and to direct the organization to focus on other relevant problems they face. The solutions and the problem definitions relevant to the organization are provided by external mediators, as well as the decisions of what to focus on in the organization. Participatory approaches

are assumed to make sure that the farmers have shared interests in the project and the organization, an assumption which might not hold. The last type of project is the process oriented human capacity development project. The main aim is to develop the human capacity, and thereby the social self-help capacity of the community and farmers. These projects often focus on literacy, marketing activities and different types of development planning. In the long run, this might take the farmers out of the setting of monopsony due to strengthened negotiation skills and in such a way creating more robust farmers' organizations.

According to Sykuta and Cook (2001) the increased need for coordination in the agricultural production chain is changing the role of cooperatives in the developed world. They also point out that the performance of a cooperative depends upon its characteristics and has identified the following five vaguely defined property rights; open versus closed membership, purchasing duty, equity share, multipurpose versus unipurpose cooperatives and membership fee. These characteristics do to a certain extent reduce some of the moral hazard issues resulting from incentives structures for the producers. For example it might be difficult to combined obligatory purchasing duty of the produce from the farmers independent of quality and quantity with an open membership. The type of equity share and membership costs of fees are also related to the degree of openness of the farmers organizations. Finally, a multipurpose cooperative might lead to heterogeneity among the members and therefore fight over the use of the resources rendering the cooperative less efficient. All these factors will also influence the efficiency of farmers' organizations in developing countries

Looking at the empirical literature on contract farming and farmers' organization, the main focus is on evaluating specific contract farming situations. In their study of contract farming in Senegal, Warning and Key (2002) find that the poor are allowed to participate in the contracting scheme and that they benefit economically. They use an IV-estimator with a measure of honesty as the instrument for participation and estimate effects on mean agricultural income per area. The variable honesty is measured from a discussion with village leaders. Another study by Becchetti and Costantion (2008) analyze effects of

Fair Trade on Kenyan farmers that also are member of a farmers organization. Their findings indicate that Fair Trade seems to be associated with farmers with superior capabilities, economic and social wellbeing. However, they did not find an identifying variable and their results therefore do not show causality. They propose to use a difference-in-difference approach to make inference. In a study on market participation in Mozambique, Boughton et al. (2007), find that membership in an association does not impact market participation. However, due to the endogeneity of assets and market participation, they cannot infer causality.

3. Mozambican agricultural and farmers' organization

Mozambique has experienced steady and high growth rates since the end of the civil war in 1992. However it remains a very poor country with a GNI per capita of 340 USD (World Bank, 2007). According to Arndt et al. (2006) poverty incidence in the country fell from around 69% to 54% between 1996-7 and 2002-2003. Annual agricultural growth of 6% contributed significantly to the overall growth (Tarp, et al., 2002). This growth was essential for reducing the poverty headcount among the poorest since it is the sector that employs the largest share of people in Mozambique. In 2003, more than 70% defined agriculture as their main economic activity and it sustained more than 80% of the work (World Bank, 2007). Despite the large share of employment, it only makes up 21,5% of the GDP. The country also has large regional differences with a strong concentration of growth in the Maputo province.

The agricultural sector in Mozambique is made up almost entirely by small-scale and subsistence farmers, around 80% of all farmers, and is characterized by a high marketing wedge which excludes many subsistence farmers from the market. Market participation is clearly dependent upon the risk and the technology facing the farmer, and market segmentation is high (Heltberg and Tarp, 2002). In Mozambique, it is not possible to own land privately, only to lease it for 50 years with a guaranteed second period of another 50 years. Small-scale farmers' access to land is governed through a mix of customary laws, inheritance, buying or borrowing the land. Mozambican agricultural policy focuses on increasing yields, through better technologies, and improving market access.

About 7,3% of the farmers belonged to a farmers' organization in 2005 while only 4% where members in 2002. Dorsey and Muchanga's report from 1999 indicates that focus on farmers' organizations in Mozambique started as early as in the mid 1990s, and one would expect to see effects of these efforts after 10 years of different interventions. These efforts fall into the two latter categories of Bingen et al.'s three categories' for market linkages or working with farmers organizations for increasing market participation. Furthermore, in Mozambique and in the cash crop sector such as tobacco and cotton, there is a long tradition for contract farming that fits into the first category of Bingens' three categories. It is difficult to assess all farmers' organizations in Mozambique generally as there are many different types. However, looking at the characterizations of cooperatives from Cook and Illipoulos (2000), one would expect to see open farmers' cooperatives with relatively low entry barriers as the operation costs are usually covered by a NGO or donor. If there is no costs to become a member, the members do not automatically have an equity share, in other words, they do not own the organization. The capital in the organization is provided by and owned by the NGO or donor, if no other status or regulations are provided for to redistribute the ownership to the members at a certain point. Thus, it might be difficult to say that the farmers' organizations in general in Mozambique are member owned. Based on the information provided, it is difficult to say anything in general on the issues of delivery duty, that is to what degree the organizations have to buy the produce and the farmer has to sell the produce to the organization. Finally, there are both unipurpose and multipurpose organizations, but many tend to focus on one product or type of product only. Due to these issues, Boughton et al. (2007) define farmers organizations as public goods in Mozambique. The public good characteristics such as free-riding and non-excludability might affect the efficiency and effectiveness of these organizations.

4. Analytic framework

The framework is based on the general factors that affect the profit for small-scale farmers where a farmer with a vector of characteristics z and membership status $m \in \{0,1\}$ obtains profit

(1) $\pi = p(m)Q(A, X; z, m) - X'r(m) - c_m$

Here, production *Q* depends on the input of land *A* and other inputs *X*, as well as his characteristics and membership status. The latter capture the effects of improved production technologies and the effect of farmer quality. The product price *p* and the input prices *r* also depend on membership status to capture the different market situation members enjoy. The cost C_m is the cost of being a member where the cost of being a member is C_1=C (1 indicates being a member) and the cost of not being a member is C_0=0 (0 indicating not being a member).

I hypothesize that membership (m) in a cooperative might influence the farmers profit through three different channels. Firstly, by securing the farmer a better price for her produce than the farmer otherwise would get, i.e. *p(1)>p(0)*. This is due to an improved negotiation position for farmers' organizations relative to single farmers, resulting from a larger quantity sold and lower transaction costs for the buyer. Second, membership can provide lower prices of the inputs (r(1)<r(0)) as the cooperative buys relatively larger quantities compared to the individual small-scale farmers. Third, the cooperative might also provide technical assistance and technology[2], so that the production function satisfies *Q(A,X;z,0)<Q(A,X;z,1)* for all *A, X, z*. Thus, one would also expect to see higher yield among farmers that are members of farmers' organizations. In the equation, I have included a variable that represent the costs of being member in a farmers' organization c_m and at the same time set this cost to be equal to 0 as there usually are no costs related to be a member of the organization in Mozambique.

My hypothesis is therefore that a member of a farmer's organization should have a higher agriculture income than a non-member farming household. The effect of the farmers' organization will depend on the characteristics of the farmers' organizations and the objective of these organizations. My analysis aims at looking at an average agricultural income effect of belonging to a farmers' cooperative, and not to tease out the effect of the

[2] Examples of technologies are inputs such as fertilizers and pesticides or extension to promote new technology.

different factors. Therefore, I will use gross and net agricultural income as my impact variable. Net income is defined as monetary income from sales minus money spent on inputs used in the production. It does not include cost of family labor and land used in the production.

5. Data

The data used in this article came from the official agricultural household survey (TIA) produced by the Ministry of Agriculture in Mozambique with the assistance of Michigan State University. This is a semi-regular agricultural household survey which started in 1992. I use the data collected in 2002 (Ministry of Agriculture, 2002) and 2005 (Ministry of Agriculture, 2005). In 2002, 4908 household were interviewed in 80 districts throughout the country. In 2005, it covered 6149 households throughout Mozambique, 657 different selected interview sites (UPA) were selected in 94 different districts, i.e. the 80 original districts and 14 new ones. The objective was to keep the sample representative and at the same time keep a panel component of the survey. At each of the selected sites, which could be small villages, rural settlements or urban city parts, 8 households were randomly picked. The survey collected detailed information on household characteristics, welfare indicators, landholdings, employment types and remittances as well as detailed information regarding farming practices, crops grown, harvested and sold. The sample was stratified and clustered. In addition there is a community level survey for both years which contains information on different issues related to marketing, prices and infrastructure.

The balanced panel covers approximately 4100 households, thus the attrition was about 17,5%. In my study, I do not focus particularly at any of the variables that might make a household move or similar actions which is particularly vulnerable to attrition. Among the members in farmers' organization, 11% of the members were lost due to attrition. Thus, attrition is not is higher in my main variable than in the overall sample, and as such reducing the problem of attrition in my case.

Table 1 describes the flows of membership in farmers' organization between 2002 and 2005 in Mozambique. The most surprising fact is that 57% of the members in 2002 left the farmers' organizations, and only 32% stayed as members[3]. Furthermore, the overwhelming majority of the surveyed households were not members in either year. This might indicate that it is not as beneficial to be member as proclaimed.

Table 1 Membership in 2002 and 2005

		Member 2005	
		Yes	**No**
Member 2002	**Yes**	47	105
	No	220	3115

At the same time, one can clearly see from the Table on descriptive statistics in Appendix 5, that members generally are better off than non-members. All the welfare indicators are higher for members and the difference is significant. Furthermore, it seems like they have higher education and use better agricultural technologies.

[3] These numbers adds up to 89% and the missing 11% is the attrition.

Table 2 Comparison of mean values between members and nonmembers in farmers organizations

	Average	Nonmembers	Members	t-value
Head of Household Characterisicts				
Age of head of household (years)	43,60	43,50	44,10	0,97
Gender of the head of the household	74,70 %	73,50 %	76,80 %	1,69
Years of schooling (School)	2,77	2,67	3,45	4,96
Self-employment among head of household (dummy variable)	38,80 %	37,70 %	44,60 %	3,26
Salary work among head of household (dummy variable)	22,10 %	22,00 %	23,90 %	1,58
Household Characteristics				
Average landholdings per household (ha/hh)	1,97	1,93	2,55	4,82
Number of persons in the household (number)	5,67	5,61	6,68	7,87
Welfare characteristics				
Radio	51,61 %	50,70 %	63,60 %	5,78
Oil lamp	48,99 %	48,48 %	57,17 %	3,95
Table	33,64 %	32,80 %	47,10 %	6,84
Latrine	41,10 %	40,20 %	54,96 %	6,78
Agricultural practices				
Irrigation (dummy variable)	9,37 %	8,67 %	20,51 %	9,21
Fertilizers (dummy variable)	4,16 %	3,50 %	14,70 %	12,79
Animal traction (dummy variable)	12,33 %	11,99 %	17,80 %	4,21
Pesticides (dummy variable)	6,00 %	5,50 %	13,70 %	6,87
Manure (dummy variable)	5,10 %	4,80 %	9,55 %	4,79

The sample used is a pooled sample of the 2002 and 2005 data.
The t-test is testing the difference of income groups between the members and non-members in farmers organizations.

In addition to these simple t-tests, I used a probit analysis to identify the determinants of being a member where membership was the binary dependent variable. The equation used for the analysis was:

$$(2)\quad prob(y=1) = prob(X\beta + \varepsilon > 0) \qquad \varepsilon \sim N(0,1)$$

The results from the analysis of the determinants of membership in a farmers' organization in Mozambique is presented in Appendix 5, Tables A.4 and A.5. This analysis shows that the family size, the ability to read and write, farm size, the use of fertilizer and irrigation, to grow crop in a row and where the farmer lives determines the probability of being member. However, other determinants such as the farmers' wealth

(table and latrine), self-employment and the type of crop grown might also influence the propensity to be a member. From the descriptive part we can say that members of farmers' organizations know better to read and write than other farmers, have larger farms, access to better agricultural technologies and have a higher tendency to grow cash crops and horticulture than other farmers. Welfare indicators such as radios, latrines, tables indicate that they are better off than other farmers. Thus, the donors do not reach the poorest of the poor when working with farmers organizations.

Income

The different income variables are shown in the table below. There are four different categories of income; i) valuation of plant production, ii) sales value of plant production, iii) income from animal production and iv) overall agricultural profit. The value of plant production is an estimate, among the people in the survey, of the overall value of production of staples and cash crops, the sales value of plant production is the sales value of all types of plant crops and includes both sales done and expected sales in the survey year and income from animal production is the realized income from animal production. The last category is the net agricultural profit which includes the sales value from plant production and income from animal production minus costs of production. The costs included are seed costs and other input costs[4], however, family labour and value of own land in production is not included. All values are measured in 1000 meticais[5].

[4] Currently, the cost of hired labor is not included.
[5] In 2004, 1 US$ is about 24000 meticais.

Table 3 Comparison income between nonmembers and members in farmers' organizations.

			pooled sample		
Variable	**Average**	**Nonmember**	**Member**	**Difference**	**t-test**
Value of plant production	2106,15 (3684,52)	2061,86 (3580,21)	2831,7 (5047,25)	769,85 (164,21)	4,69
Sales value plant production	732,43 (1987,32)	687 (1882,31)	1482,85 (3175,41)	795,84 (88,60)	8,98
Income from Animals	211,63 (932,32)	196,46 (858,67)	457,22 (1716,46)	260,76 (41,22)	6,32
Total Agricultural profit	660,18 (3426,41)	605,22 (3252,60)	1553,82 (5460,85)	948,61 (151,89)	6,25
			2002		
Variable	**Average**	**Nonmembers**	**members**	**difference**	**t-test**
Value of plant production	2975,211 (3327,65)	2917,47 (3235,52)	4376,25 (4882,79)	1458278 (261,04)	5,58
Sales value plant production	583,25 (1426,12)	559,18 (1370,99)	1177,65 (2346,56)	618,47 (112,86)	5,47
Income from Animals	142,72 (549,49)	138,41 (541,91)	245,58 (700,90)	107,17 (42,87)	2,5
Total Agricultural profit	525,82 (1874,92)	486,49 (1739,30)	1474,54 (3805,60)	988,05 (146,42)	6,74
			2005		
Variable	**Average**	**Nonmembers**	**members**	**difference**	**t-test**
Value of plant production	1370,98 (3809,92)	1312,16 (3698,01)	2120,79 (4968,51)	808,63 (206,80)	3,91
Sales value plant production	858,18 (2351,64)	798,64 (2229,30)	1621,19 (3480,98)	822,55 (127,46)	6,45
Income from Animals	269,69 (1157,55)	247,12 (1057,86)	555,04 (2013,67)	307,92 (62,37)	4,94
Total Agricultural profit	773,34 (4317,63)	708,82 (4141,29)	1590,134 (6074,53)	881,31 (233,17)	3,78

The t-test is testing the difference of income groups between the members and non-members in farmers organizations.

As one can see from the statistics, income has increased for both members and non-members in the period between 2002 and 2005 with the exception of value of plant production[6]. This is a somewhat surprising result. Kernel densities of the log income can bee seen in Appendix 2. These incomes seem to be close to the normal distribution, and thus it is reasonable to use tests based on the normal distributions.

[6] The incomes are not yet adjusted according to inflation.

5 Impact assessment and methodology

Impact assessment methods aim at identifying and isolating the impact of projects on the participants (Ravallion, 2005). The basic form is to asses the effect on an indicator of the project against the counterfactual which normally is no project. The impact is the change in the indicator, Y_i^1, from the participation in the project, also often called the treated. This should then be measured against the level of the indicator, Y_i^0, if there is no project. A main challenge is related to the missing data problem, it is logically impossible to have an observation of the same person or household with and without the project.

It is this counterfactual situation one would like to approximate with a control group. There are two main different methods for obtaining this control group, either randomized experiments or non-experimental methods. In the non-experimental methodology, the control group is obtained based on observable characteristics' of the participants. A central problem related to the control group from a non-experimental methodology is the selection bias, which means that what is measured is not only the impact of the project, or membership in this case, but difference in the unobservable characteristics between those participating in the project and the control group. The randomized experiment generates a control group that has the same distribution of observable and unobservable characteristics as the participant group. In order to use a randomization methodology there is a need to set this experimental design up before the project starts, define who is given access to the program or and who is not given access. This is not the case in my situation. I am using a non-experimental estimator to find the income effect of membership in a farmer's organization in Mozambique.

The estimation method I use is based on Heckman et al. (1998), Heckman et al. (1997) and Smith and Todd (2005)'s two step estimator, where the first step is to construct a control group by matching members of farmers' organizations to similar farmers that are not member of any farmers' organization. The second step is to look at the difference in income between the treated, the members, in relation to this control group, which is constructed by the matching estimator.

Formally, let Y_{it}^1 be the household's income in period t if it is a member of an agricultural association and let Y_{it}^0 be the income of a household that is not member of a farmers' organization. The impact of being member of a farmers' organization is then the impact of membership is described by equation (3) where Y is the agricultural income of person i at time t, and the up script 1 signifies that the individual is a member of a farmers organization and 0 indicates the counterfactual, that is not being a member.

$$(3) \quad \Delta Y_{it} = Y_{it}^1 - Y_{it}^0$$

My interest is to find the average effect of being a member of a farmers' organization on the members, that is the effect of being member on the agricultural income for those that are members in a farmers' organization. The calculations are as follows;

$$(4) \quad ATT \equiv E\left[\Delta Y_{it} \middle| X, M=1\right] = E\left[Y_{it}^1 - Y_{it}^0 \middle| X, M=1\right] = E\left[Y_{it}^1 \middle| X, M=1\right] - E\left[Y_{it}^0 \middle| X, M=1\right]$$

Where the X are the control factors and M=1 indicates membership in a farmers organization. Due to the missing data problem, equation (4) cannot be estimated as one cannot measure a person with and without the membership in any time period. Therefore, I construct a comparison group on observables characteristics X, using a propensity score estimator. This estimator builds on the following assumptions;

$$(5) \quad E\left[Y_{it}^0 \middle| X, M=1\right] = E\left[Y_{it}^0 \middle| X, M=0\right] \quad \text{for} \quad X \in S$$

Where S is the area of common support given by $S = Supp(X|M=1) \cap Supp(X|M=0)$. This says that the outcome for the control group is the same as it would have been if they where members in the area of common support. The main requirement of the assumption is that there are no factors associated with membership status that are not included in *X* that also affect income. These assumptions are necessary to compute equation (4) as it makes it possible to approximate the latter term in the difference. The second assumption is;

$$(6)\ 0 < \Pr(M = 1 \mid X) < 1$$

Assumption 6) states that one cannot use individuals where X perfectly predicts membership status since persons with such characteristics always would be members or never would have been members. As these are not in the region of common support, they are excluded from the analysis.

A simple fixed effects model for this situation would be

$$(7)\ y_{it} = \delta M_{it} + \beta_t X_{it} + c_i + d_t + u_{it}$$

Where c_i is the individual fixed effects, δ is the effect of being member and X_{it} are the control factors and u_{it} the disturbance term. By taking the difference, as is done in a difference-in-difference estimator, will eliminate c_i, as well as all the time invariant factors, and the equation becomes:

$$(8)\ \Delta y_{it} = \delta \Delta M_{it} + \beta_t \Delta x_{it} + \Delta d_t + \Delta u_{it}$$

Thus, there is a need for variation in the M over time. In my case, I have two such points of variations, those that have become members (220) and those that have left (105). Thus, the first case is the normal evaluation case, and one would expect to see an increase in the income. The latter case, where the farmers have left the organization, is more uncertain. In the simple case, as presented in the analytical framework, all effects of being member of a farmers' organization should cease as soon as they leave the organization. However, if learning has occurred, the technical improvements will not disappear. However, this is outside the scope of this work.

Using both these types of estimator, one gets a difference-in-difference matching estimator. For this estimator to be valid, assumption (4) can be relaxed to[7]:

$$(9)\ E\left[Y_2^1 - Y_1^1 \middle| P, M = 1\right] = E\left[Y_2^0 - Y_1^0 \middle| P, M = 0\right]$$

Where t=2 is after membership decision and t=1 is before membership. An additional requirement here is that the requirement in equation (5) regarding the area of common support must hold in both periods. This is affected by attrition which unfortunately also is relevant in my case. However, it should be noted that the number reported in table 1 does not include the loss of memberships due to attrition[8]. The difference-in-difference matching estimator is:

$$(10)\ \alpha_{DDM} = \frac{1}{n_1} \sum_{i \in I_{1t} \cap S_m} \left\{ \left(Y_{ti}^1 - Y_{ti}^0\right) - \sum_{j \in I_{0t} \cap S_m} w(i,j) \left(Y_{tj}^0 - Y_{tj}^0\right) \right\}$$

Where the w(i,j) represent the weighing regime in my matching estimator. I plan to use both the kernel matching estimator (Heckman, et al., 1998) and the nearest neighbor estimator. It compares on members to a group of nonmembers using a kernel-weighted average from this group. The estimator is:

$$(11)\ w(i,j) = \frac{\sum_{j \in I_0} Y_j^0 G\left(\frac{p_j - p_i}{a_n}\right)}{\sum_{k \in I_0} G\left(\frac{p_k - p_i}{a_n}\right)}$$

Where a_n is the band width of the kernel and k represent the number in the kernel group.

According to Smith and Todd (2005), there are three data requirement for making the non-experimental matching methods to perform well, particularly compared to experimental data, and these are; 1) the data source should be the same for both the

[7] Slightly changed from Smith and Todd (2005)
[8] See the data section for the discussion of the attrition

members and the non-members making the measurement error the same for both groups, 2) members and non-members belongs to the same relevant market and 3) the data contains a rich set of variables that can explain both membership in the organization and the outcome (Smith and Todd, 2005). My data clearly satisfies the first, all the data is from the same survey. The second criterion is met by including the geographical variable province in the estimation of the propensity score. Thus, the control group is in this way restricted to be in the same market. The third criterion is also satisfied as my data contains a lot of information that is very relevant to the outcome, the agricultural income, and also information relevant to becoming a member in a farmers' organization as this usually is related to agricultural factors such as actually farming, type of farming, land ownership and agricultural education. It also depends on literacy, wealth, and placement in the community, information that also is contained in the data.

There is generally not a need to have exclusion restriction when you use a matching estimator as the matching estimator constructs a comparison group (Blundell and Costas Dias, 2000). However, it is possible to partition the set of variables X that goes into the estimation into two sets, and not necessarily mutually exclusive sets, but with some exclusion restrictions (Z,W) (Heckman, et al., 1998). Where Z is the variables that explain the membership decision and W are controls for the outcome, the agricultural income in my case. I did this as certain variables such as network, remittances and the feeling of increased well-being is more important to explain membership than income, but that the agricultural factors are as important in both. Thus, I used more variables in the propensity score (Z) than as controls in the income regressions (W), see tables x and x for further details.

The main criticism against this method concerns whether the data material the analyst has access to is rich enough to do the matching, i.e. that the unobservables have a significant effect on the decision to become member or that the unobservables are strongly related to the observables (Heckman, et al., 1998). Panel data can to a certain degree overcome this in two ways; first, it makes it possible to choose a difference-in-difference propensity score matching estimator. Such an estimator takes care of the problem of time-invariant

differences between members and non-members. Additionally, using a difference-in-differences estimator enables control for some of the variation between good and bad years as some where members in 2002 and some in 2005 (Smith and Todd, 2005).

7. Estimations and results

There are three sets of results, first, the cross-sectional propensity score matching estimator, second, the results of estimations of the fixed effects model, and finally, the results of the complete difference-in-difference matching estimator.

7.1 Cross-sectional analysis

An important part in propensity score matching is to have a good model which says why people are treated, in my case why they participate in farmers' organization? What are the particular attributes that makes a farmer join a farmers' organization? There is little theory to guide my decision, however, I have focused on factors that are somewhat prior to the decision to join a farmers' organization. In Appendix 3, all the different variables I have are presented. I have categorized these variables into four different groups of descriptive variables, these are: i) characteristics of the head of the household, ii) characteristics of the household, iii) diverse information and relationship inside the village, iv) welfare indicators and v) agricultural characteristics of the household. The variables I have defined as predetermined for the membership in farmers' organizations are the characteristics of the head of the household and the household as well as whether they are born in the village, either the man or the wife. This variable tells you how well the family is connected in the village and therefore would probably be able to say something about the information that reaches them. Furthermore, I have included contact with extension officers as these can provide information about farmers' organizations as can the ownership of a radio. I have generally not included the agricultural or other welfare indicators as these can as much be a result of a membership in a farmers' organization.

The results of the propensity score matching is presented in table 4. It is a probit estimation[9] as presented in equation (2). I have over-parameterize the regression in order to establish good propensity score. In addition, it is necessary that the propensity score is balanced in the two groups, members and non-members. This is called the balancing property and it is secured with a t-test within different groups in the estimations (Gilligan and Hoddinott, 2007, Morgan and Winship, 2007).

Table 4 Propensity score in the 2002 and 2005 sample.

	2002 sample	2005 sample
	0,00245	0,00232
Age of HHH	(0,95)	(1,15)
	-0,155*	-0,101
Gender of HHH	(-1,66)	(-1,39)
	0,0184**	0,0127
Eduction of HHH	(1,97)	(1,37)
	0,00357	-0,0547
HHH has salary work	-0,03	(-0,82)
	-0,00752	
HHH born in village	(-0,10)	
	-0,0301	
Spouse of HHH born in village	(-0,38)	
		0,218***
HHH knows to read/write		(3,04)
		0,345***
Network		(7,48)
	-0,0843	-0,0591
Agriculture is primary activity	(-0,92)	(-0,92)
	0,0441***	0,0234***
Number of HH members	(3,25)	(2,85)
	0,149*	0,118*
Radio	(1,89)	(1,93)
	0,697***	0,219**
Information from extension	(8,46)	(2,3)
	-0,0164	0,00967*
Total land area	(-0,57)	(1,7)
	-2,081***	-2,006***
Constant	(-9,82)	(-15,10)
N	4223	4924

t statistics in parentheses
p<.1, ** p<.05, *** p<.01
The binary variable is membership

[9] The Stata algoritm is developed by Becker and Ichino (2002).

The factors that are significant in both years are information from extension agent, owning a radio, number of household members, and education (education in 2002 and write and read in 2005). In addition, total land area and network is signification in the 2005 sample while gender of head of household is significant in the 2002 sample. The model predicts 3,9% among the nonmembers and 7,0% among the members while the overall membership in 2002 is 4,0%.

Based on these propensity scores, I have estimated the average impact on the treated, that is membership, using two different matching estimators, the nearest neighbor estimator and the kernel estimator (presented in equation (10)). The results are presented in Tables 5 and 6.

Table 5 Average impact of membership among the members using the nearest neighbor matching estimator

	2002		2005	
Income variable	**Treat/ control**	**ATT**	**Treat/ control**	**ATT**
Value of plant production	170 161	0,336*** (0,117)	369 141	0,039 (0,146)
Sales value of plant production	170 96	0,302* (0,174)	369 181	0,388** (0,158)
Income for animal production	170 69	0,370 (0,334)	369 113	-0,131 (0,186)
Total agricultural profit	170 96	0,757*** (0,200)	369 196	0,318** (0,153)

The number of treated and the number of controls are different in each estimation
*** signifies significant at 1%, ** significant at 5%, *significant at 10%
ATT is the average treatment effect on the treated. Treatment here is membership in a farmers' organization.

Using the nearest neighbor algorithm, I find a significant effect of membership on log income related to overall agricultural profit and sales value of plant production while membership only has an effect on value of production in 2002. In all cases except for animal income in 2005, the coefficient for membership is positive, and hence indicates that membership leads to a higher income for the members. Furthermore, there seems to be a significant effect on income of being member as the increase in total agricultural profits is between 75% to 30% in all of these estimations.

Table 6 Average impact of membership on the different income groups among the members using a kernel estimator

Income variable	2002 ATT	2005 ATT
Value of plant production	0,358***	0,267**
	(0,086)	(0,108)
Sales value of plant production	0,302***	0,565***
	(0,174)	(0,111)
Income for animal production	0,370	0,312*
	(0,334)	(0,177)
Total agricultural profit	0,757***	0,610***
	(0,200)	(0,116)

For 2002 there are 170 treated and 3900 controls.
For 2005 there are 369 treated and 4352 controls.
*** signifies significant at 1%, ** significant at 5%, *significant at 10%
The number of boothstraps used to estimate the standard deviation. is 100
ATT is the average treatment effect on the treated. Treatment here is membership in a farmers' organization.

Looking at table 6, I find a significant effect for all categories of income except for income from animal production which is only significant in the 2005 sample. Also here, the coefficients are all positive indicating a positive effect of membership in farmers' organization on income. Thus, based on a cross-sectional propensity score analysis, it seems like membership contributes positively to income among the participating farmers, particularly related to overall agricultural income. The magnitude of the effect is also significant varying from 25% to 75%.

7.2 Fixed-effects estimator

These results are based on the simple fixed effects model presented in equation (8) clustered at individual level. I have estimated four different specifications of the model marked as A, B, C and D in table 7. The difference between these specifications is where the difference is the number and type of controls used. In model A, I have included all possible controls[10] which are presented in Appendix 3, however, I have excluded the characteristics that does not change over year such as gender. In model B, I have taken out the agricultural controls, in model C I have taken out the welfare indicators and in model D I have taken out both the agricultural and welfare controls.

[10] All the variables are presented in Appendix 3. Those marked with a * are used as controls in this fixed effects modell.

Table 7 Impact on the different income groups of membership from a fixed-effect estimator

Model	Value plant production	Sales value plant prod.	Income Animal prod.	Agricultural profits	specifications		
					agri cont.	welfare cont.	HHH cont.
D	0.167	0.303**	0.445*	0.489***	**no**	**no**	**yes**
	(1.28)	(2.14)	(1.89)	(3.50)			
C	0.0922	0.203	0.517**	0.380***	**yes**	**no**	**yes**
	(0.73)	(1.52)	(2.07)	(2.89)			
B	0.141	0.287**	0.423*	0.380***	**no**	**yes**	**yes**
	(1.11)	(2.14)	(1.74)	(2.89)			
A	0.0801	0.198	0.504**	0.352***	**yes**	**yes**	**yes**
	(0.65)	(1.53)	(1.98)	(2.72)			

t statistics in parentheses

* p<.1, ** p<.05, *** p<.0

ATT is the average treatment effect on the treated. Treatment here is membership in a farmers' organization.

From table 7, one can see that membership does not have any effect on the overall value of plant production while it is significant, thought at difference levels of significance for both income from animal production and agricultural profits. For sales value of plant production, it is only significant in model B and model D, indicating that the variables used in agricultural controls are very import for the results. Additionally, the magnitude of the coefficient for all except income from animal production is reduced as more and more controls are included. This indicates that the controls are significant for estimating the results. Finally, the magnitude of the significant coefficients is between 28% and 50% which indicate that membership in a farmers' organization raises income with 28 to 50 percent.

7.3 The difference-in-difference matching estimator

The difference-in-difference matching estimator is estimated for 3 different cases, becoming a member in a farmers' organization for farmers who joined between 2002 and 2005, staying as a member in a farmers' organization between 2002 and 2005 and finally leaving a farmers' organization between 2002 and 2005. Table 8 the different propensity scores for whether people become, stay or leave a farmers' organization based on their 2002 characteristics.

Table 8 Propensity score model for change in membership status between 2002 and 2005

Variables	Becoming a member	Staying member	Leaving the organization
Age of HHH	-0.00336	0.00270	-0.000827
	(-1.40)	(0.60)	(-0.26)
Gender of HHH	-0.0218	-0.196	-0.0659
	(-0.26)	(-1.27)	(-0.60)
Eduction of HHH	0.00639	0.00933	0.00600
	(0.74)	(0.63)	(0.51)
HHH has salary work	0.0531	0.0888	-0.114
	(0.59)	(0.56)	(-0.88)
HHH born in village	-0.0447	0.0186	-0.0943
	(-0.63)	(0.14)	(-1.01)
Spouse born in village	0.0000743	0.0153	-0.0258
	(0.00)	(0.11)	(-0.28)
Number of HH members	0.0233*	0.0517**	0.0248
	(1.93)	(2.50)	(1.53)
Radio	0.134*	0.179	0.197**
	(1.94)	(1.33)	(2.14)
Information from extension	-0.115	0.802***	0.554***
	(-1.15)	(6.32)	(5.72)
Total land area	0.0788***	-0.0166	0.00410
	(3.81)	(-0.35)	(0.13)
Province	0.0161	0.0750***	0.000740
	(1.21)	(2.97)	(0.04)
Constant	-1.836***	-3.382***	-2.085***
	(-10.32)	(-9.83)	(-8.91)

t statistics in parentheses
* p<.1, ** p<.05, *** p<.01

As one can see from Table 8, none of the same characteristics explain all three specifications. It is also interesting to see that almost none of the personal characteristics of the head of the household are significant for any of the changes in membership. Only gender seems to be significant for staying as a member, indicating that women tend to be more faithful to membership in farmers' organizations. This is in contrast to the findings presented in Table 4 propensity score in the 2002 and 2005 sample, where at least education or knowing to write and read where significant. Number of household members is significant for becoming and staying as member, but not for leaving the organizations. Radio is important to become and to leave the organizations, but not for staying as a member. Land seems important for becoming a member, but not for later changes in status. All these characteristics confirm the earlier results. Information from

extension services is important both for staying and for leaving the organizations, but not becoming a member. This is contrary to what I found earlier. Generally, it is surprising that the personal characteristics of the farmers' are of relatively little importance for membership. I would also like to point out that province the farmer is in seems to be crucial for the farmers to stay members, which might indicate that this has to do with options to stay as a member.

Table 9 Impact on income from changes in membership estimated by the nearest neighbor estimator

	Becoming a member		Staying a member		Leaving the organization	
Income variables	**treat./cont.**	**ATT**	**treat./cont.**	**ATT**	**treat./cont.**	**ATT**
Value plant production	218	0,343	47	-0,720**	104	-0,408
(lnValPlant)	64	(0,226)	16	(0,322)	40	(0,286)
Sales value plant prod.	218	0,247	47	0,323	104	-0,118
(lnSValPlant)	70	(0,246)	17	(0,465)	36	(0,308)
Income Animal prod.	218	1,360***	47	-0,326	104	-0,370
(lnIncAni)	28	(,427)	2	(0,464)	14	(0,364)
Agricultural profits	218	0,520**	47	0,200	104	-0,452
(lnprofitTag)	62	(0,250)	14	(0,558)	29	(0,380)

p<.1, ** p<.05, *** p<.01
ATT is the average treatment effect on the treated. Treatment here is membership in a farmers' organization.

From Table 9, we can see that becoming a member in a farmers' organization leads to a positive shift in income from animal production and overall agricultural profits. It does not seem like leaving the organization affects income at all, however, we can see that all the coefficients are negative. Staying as a member seems surprisingly to lead a significant negative shift in value of plant production. The magnitude of the positive effect on agricultural profits is still in the area of 50%, matching the earlier results. However, the magnitude of the income from animal production is surprisingly 136% and clearly the highest impact found so far.

Table 10 Impact on income from changes in membership estimated by the kernel estimator

Income variables	Becoming a member ATT	Staying member ATT	Leaving the organization ATT
Value plant production	0,202	-0,342	-0,217
(lnValPlant)	(0,16)	(0,243)	(0,247)
Sales value plant prod.	0,281	0,365	-0,444
(lnSValPlant)	(0,224)	(0,276)	(0,239)
Income Animal prod.	0,293	0,025	-0,534
(lnIncAni)	(0,319)	(0,744)	(0,362)
Agricultural profits	0,506***	0,306	-0,534**
(lnprofitTag)	(0,185)	(0,354)	(0,534)

p<.1, ** p<.05, *** p<.01
ATT is the average treatment effect on the treated. Treatment here is membership in a farmers' organization.

Using the kernel estimator, the only significant results are for agricultural profits, where becoming a member gives a positive shift in income while leaving the organization gives a negative shift in income. The magnitude of this effect is still around 50%, which is substantial and matches the earlier results, while the magnitude of leaving the organization is around the same level. Thus, it seems like membership shifts the income path upwards, but once a member, the income does not keep growing faster than other farmers. If you leave, there will be a negative shift in income taking you back to the original path.

8. Conclusion

My estimations seem to indicate that there is a positive causal effect from membership in a farmers' organization to overall agricultural profits. This group of income is always significant and positive. Furthermore, the magnitude of this effect is high and around 50% for agricultural profits. It varies from around 35% to 75% in the different estimators, but in most cases it is stable around 50%. For the other types of income, the results are more variable. The impact on income from animal production is significant in the fixed-effect model and the difference-in-difference propensity score model, but not in the cross-section model. However, it seems like membership might have a positive effect on income from animal production and that it is contributing to the overall effect on

agricultural profits. Mostly, the effect of membership is around 50% for income from animal production, except for the unusual high effect in the difference-in-difference nearest neighbor estimator. For the sales value of plant production the results are somewhat opposite those from animal production. The results are significant when using the cross-sectional estimators, but not in the difference-in-difference estimator. The effect of membership on income is stable and around 30% when the results are significant. Finally, there are probably not large effects of membership in a farmers' organization on the value of plant production, however, when the results are significant, the magnitude of the impact is around 30% increase in the value of plant production.

As we can see from the results, there seems to be a positive, significant and a rather high income potential of membership in farmers' organization. From my results, it seems like farmers' organizations put more efforts into marketable goods than production for home consumption, as well as they might focus more on plant production than animal production. Finally, we can say that members of farmers' organizations are wealthier than other farmers.

From my research, we find that farmers' organizations do contribute significantly towards higher income, and thereby welfare among small-scale farmers. Thus, farmers' organizations are a good tool to enhance small-scale farmers' welfare. Supporting farmers' organizations is therefore an efficient policy to reduce poverty among small-scale farmers, and these efforts should be strengthened. However, my research does not tell us how this increased welfare arises. Which path is the most efficient, the price path, the technology path or a combination? What are the most important characteristics of a farmers' organization for it to succeed and the project that supports the organizations? These are questions that still need to be addressed to give policy makers more detailed policy advice on how to best support of farmers' organizations, beyond the fact that it is working.

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Appendix 1 Definitions from the TIA 2005

Table A.1 Definition of Household type or more exactly farm type

Factors	**Limit 1**	**Limit 2**
Total area of cultivated land (ha)	10	50
Number of cattle	10	100
Number of small animals such as goats, sheep and pigs	50	500
Number of poultry	5000	20000

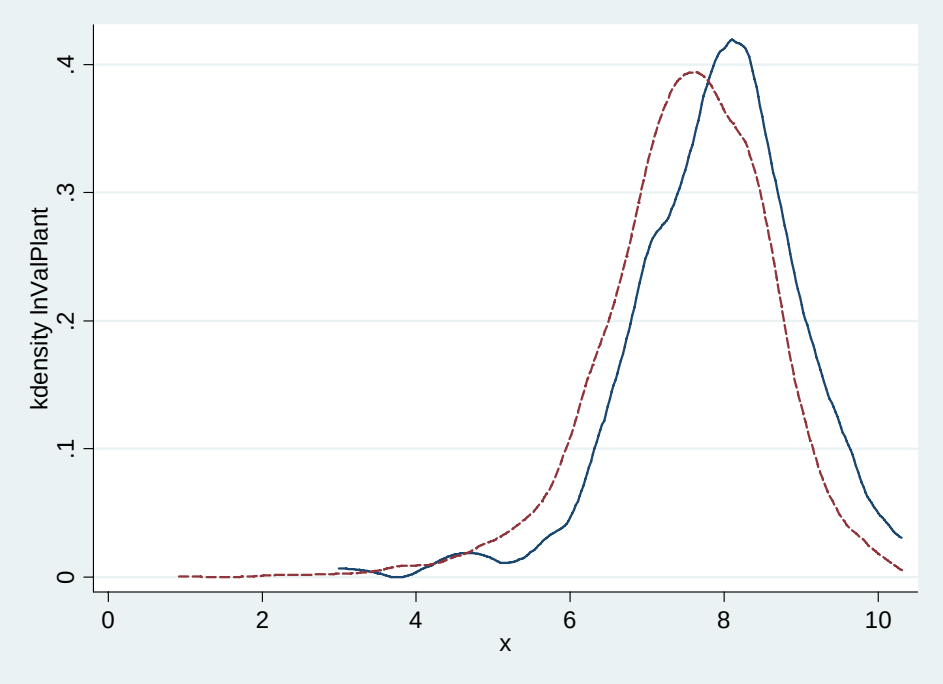
If all the factors are below limit 1, the farm is a small-scale farm. If one of the factors are equal to or above limit 1 but lower than limit 2, the farm is medium sized. If one factor is bigger or equal to limit 2, the farm is a large scale farm.

Table A.2 Overview over the provinces in Mozambique

Province	**Number**
Niassa	1
Cabo Delgado	2
Nam pula	3
Zambezia	4
Tete	5
Manica	6
Sofala	7
Inhambane	8
Gaza	9
Maputo	10

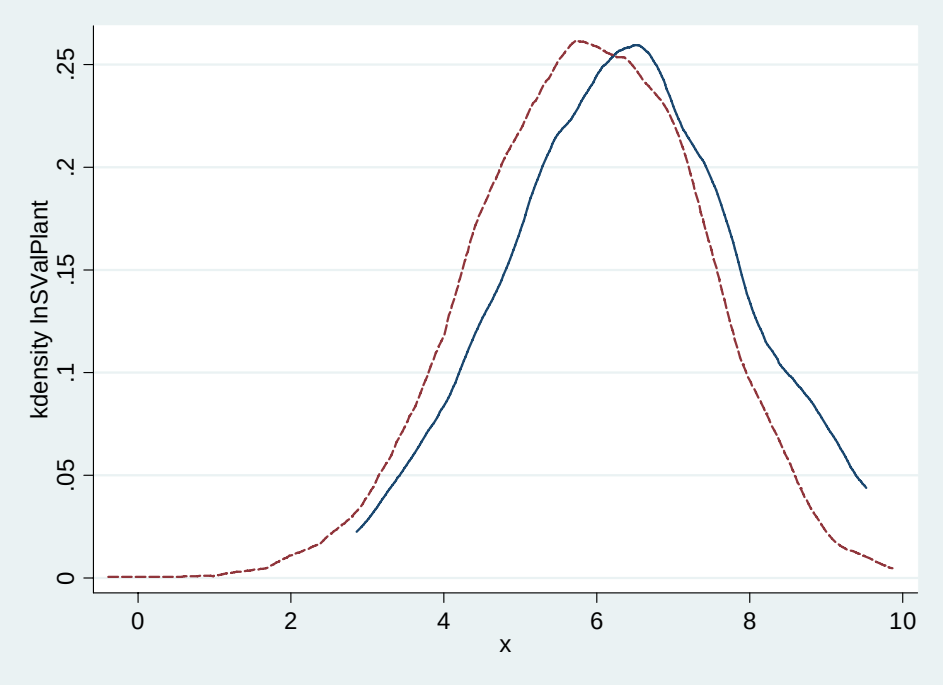
Appendix 2 Kernel densities for the different income groups

Figure A1. Kernel densities of log of value of plant production



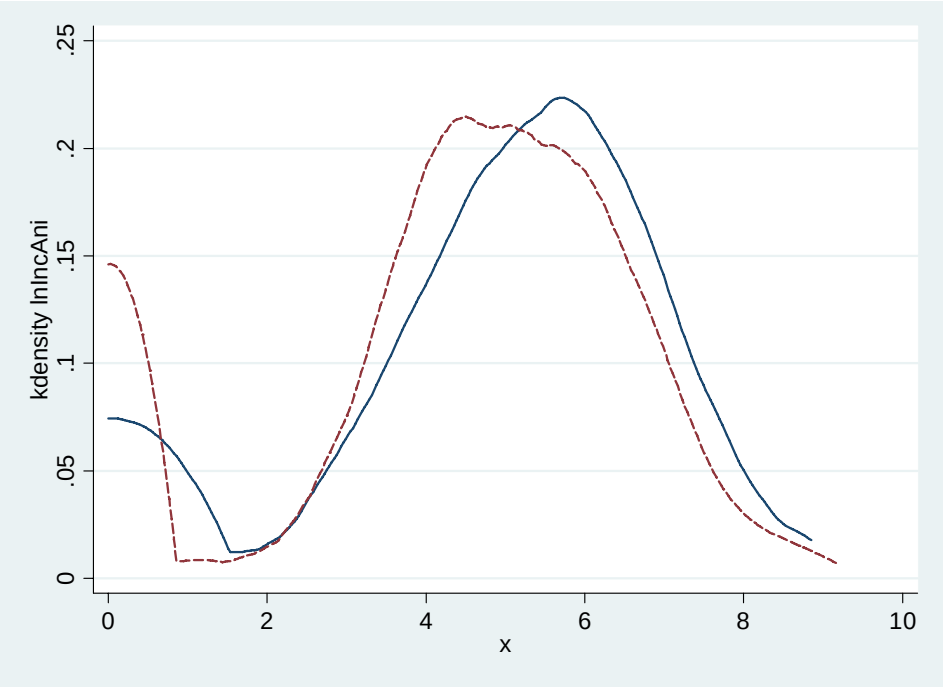
Dashed line is nonmembers and solid line is members.

Figure A.2 Kernel densities of log sales value of plant production



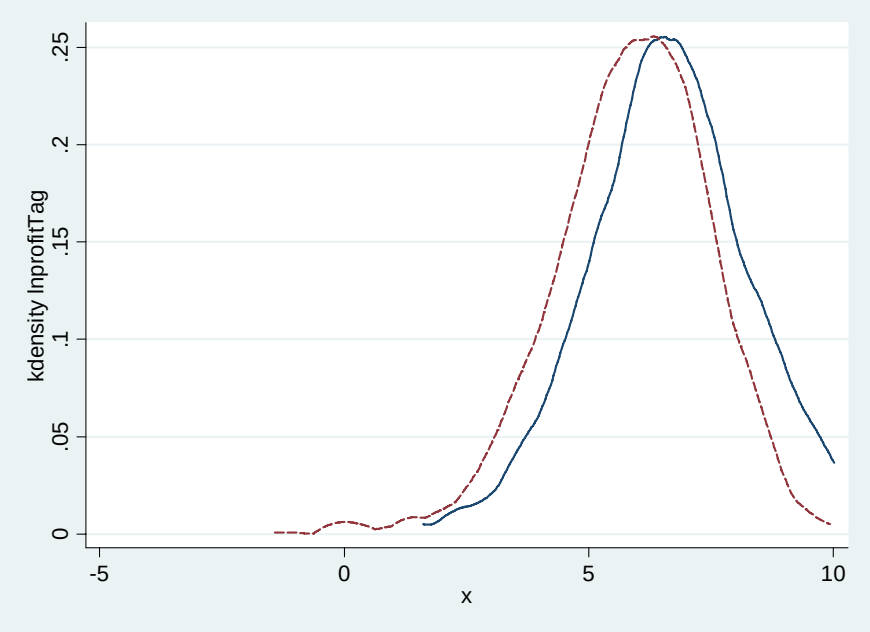
Dashed line is nonmembers and solid line is members.

Figure A.3 Kernel densities of log income from animal production



Dashed line is nonmembers and solid line is members.

Figure A.4 Kernel densities of log overall agricultural profit



Dashed line is nonmembers and solid line is members.

Appendix 3 The different characteristics of the farmers

Table A.3 Overview over the different characteristics of the farmers.

Variable group	2002	2005
Head of HH Characteristics	- sex - age - schooling - civil status - salary work - self employed - whether the HHH is born in the village - whether the spouse is born in the village.	- Sex - age - schooling* - civil status - salary work* - self-employed* - Knowledge of writing or reading - Agricultural education of 3 months
Household Characteristics	- The importance of agriculture in the HH - number of family members - rural or urban HH - the change in members in the HH - the number of sick HH members	- the importance of agriculture in the HH - number of family members* - the change in members in the HH - - the number of sick HH members
Divers Information	- Information from extension services - membership in farmers' organizations - which person is a member - price information received - network variable base on where family members were born	- Information from extension services* - Membership in farmers' organizations - which person is a member* - price information from radio - if they did receive credit - and if so from where - network variable*
Welfare Characteristics	- oil lamp - radio - latrine - table - ownership of land - -satisfaction in the last 3 years	- oil lamp* - radio* - latrine* - table * - ownership of land - satisfaction in the last 3 years* - basic staple food - reserve of food in house - survival mechanism - problem with hunger last year - meal a day during the shortage period of food
Agricultural	- Total area of land	- total area of land holdings*

Characteristics	holdings - number of cattle, - number of chicken - overall number of animals - size of family labor - use of irrigation - fertilizer - manure - pesticides - animal traction - mechanization - hired labor full and part time - experienced serious production loss the last year.	- number of cattle - number of chicken* - overall number of animals* - size of family labor* - use of irrigation* - fertilizer* - manure* - pesticides* - animal traction* - hired labor - experienced serious production loss the last year* - grow the crops in a line

*Those characteristics that are marked with a * are used in the fixed effects model.

Appendix 4 The determinants for being members in a farmers organization

Table A.4 Results of the analysis of the determinants of being members in a farmers' organization

	membass	membass	membass	membass
Familiy size	0.038***	0.033***	0.031***	0.029***
	(6.389)	(5.387)	(4.969)	(4.562)
Write & read	0.274***	0.219***	0.218***	0.215***
	(4.477)	(3.495)	(3.476)	(3.349)
Total land area	0.030***	0.027***	0.025***	0.012
	(4.765)	(4.261)	(3.824)	(1.777)
Level of school	0.011	0.007	0.006	0.000
	(1.381)	(0.918)	(0.837)	(0.030)
Latrine		0.147**	0.148**	0.061
		(2.804)	(2.787)	(1.099)
Table		0.177**	0.169**	0.142*
		(3.071)	(2.928)	(2.355)
Staple foods			-0.577*	-0.529
			(-2.056)	(-1.844)
Horticulture			0.167**	0.084
			(3.280)	(1.545)
Cash crops			0.114	-0.032
			(1.898)	(-0.484)
Fertilizers				0.463***
				(4.734)
Pesticides				0.129
				(1.395)
Animal traction				0.086
				(1.325)
Irrigation				0.356***
				(4.433)
Agriculture in a row				0.216***
				(3.918)
Rotational agriculture				0.132*
				(2.500)
_cons	-2.110***	-2.135***	-1.639***	-1.765***
	(-8.592)	(-8.601)	(-4.348)	(-4.530)
N	5392	5392	5392	5392

* p<0.05, ** p<0.01, *** p<0.001

Table A.5 Results of the analysis of the determinants of being members in a farmers' organization

	(1) membass b/t	(2) membass b/t	(3) membass b/t	(4) membass b/t
Family size	0.032***	0.029***	0.029***	0.028***
	(5.000)	(4.471)	(4.382)	(4.212)
Write & read	0.243***	0.215***	0.217***	0.215**
	(3.834)	(3.337)	(3.356)	(3.251)
Salary work	-0.008	-0.009	-0.000	0.021
	(-0.133)	(-0.140)	(-0.005)	(0.336)
Self-employment	0.150**	0.146**	0.132*	0.126*
	(2.821)	(2.722)	(2.455)	(2.286)
Total land area	0.028***	0.027***	0.024***	0.015*
	(4.330)	(4.139)	(3.678)	(2.085)
School (level)	0.005	0.004	0.003	-0.001
	(0.697)	(0.468)	(0.416)	(-0.157)
Cabo Delgado (2)	-0.347**	-0.333*	-0.299*	-0.281*
	(-2.606)	(-2.477)	(-2.201)	(-1.982)
Zambezia(4)	-0.459***	-0.446***	-0.406**	-0.391**
	(-3.562)	(-3.323)	(-2.993)	(-2.798)
Tete (5)	-0.095	-0.090	-0.098	-0.260*
	(-0.800)	(-0.740)	(-0.803)	(-2.020)
Manica (6)	-0.456**	-0.446**	-0.439**	-0.467**
	(-3.242)	(-3.076)	(-2.978)	(-3.021)
Sofala (7)	-0.736***	-0.713***	-0.759***	-0.781***
	(-4.820)	(-4.502)	(-4.731)	(-4.717)
Inhambane (8)	-0.380**	-0.376**	-0.308*	-0.363*
	(-2.808)	(-2.739)	(-2.209)	(-2.417)
Gaza (9)	0.312**	0.305**	0.337**	0.336*
	(2.729)	(2.592)	(2.763)	(2.536)
Maputo (10)	0.432***	0.416**	0.435***	0.345*
	(3.456)	(3.272)	(3.374)	(2.537)
Latrine		0.039	0.026	-0.051
		(0.680)	(0.447)	(-0.860)
Table		0.126*	0.123*	0.113
		(2.061)	(2.014)	(1.806)
Staple			-0.329	-0.276

			(-1.161)	(-0.954)
Horticulture			0.096	0.049
			(1.709)	(0.835)
Cash crop			0.225***	0.076
			(3.499)	(1.102)
Fertilizer				0.378***
				(3.625)
Pesticides				0.173
				(1.801)
Irrigation				0.174*
				(2.033)
Manure				0.219
				(1.875)
Agriculture row				0.288***
				(4.967)
_cons	-1.856***	-1.865***	-1.635***	-1.723***
	(-6.953)	(-6.895)	(-4.178)	(-4.265)
N	5392	5392	5392	5392

* p<0.05, ** p<0.01, *** p<0.001

Appendix 5 Detailed household characteristics

Table A.6 Detailed household characteristics

Household Characteristics	**Pooled sample**				**2005 sample**				**2002 sample**			
	Average	**No**	**Yes**	**t-value**	**Average**	**No**	**Yes**	**t-value**	**Average**	**No**	**Yes**	**t-value**
Age of head of household (years)	43,50	43,50	44,10	-0,97	46,12 %	45,97 %	47,67 %	-2,41	42,57	42,54	43,46	-0,79
Gender of the head of the household	74,70 %	73,50 %	76,80 %	-1,69	78,24 %	77,68 %	83,79 %	-3,1793	74,20 %	74,20 %	74,26 %	-0,02
Years of schooling (School)	2,77	2,67	3,45	-4,96	2,79	2,73	3,55	-4,45	2,63	2,60	3,24	-4,96
Self-employment among head of household (dummy variable)	38,80 %	37,70 %	44,60 %	3,26	42,38 %	42,08 %	45,26 %	-1,3771	32,34 %	32,80 %	36,26 %	-1,11
Salary work among head of household (dummy variable)	22,10 %	22,00 %	23,90 %	-1,58	25,05 %	25,25 %	23,12 %	1,0531	15,48 %	15,47 %	15,78 %	-0,11
Household Characteristics												
Average landholdings per household (ha/hh)	1,97	1,93	2,55	4,82	2,52	2,39	3,76	-9,83	1,52	1,51	1,65	-1,34
Number of persons in the household (number)	5,67	5,61	6,68	-7,87	6,7	6,6	8,5	-10,99	5,1	5,06	5,9	-4,06
Welfare characteristics												
Radio	51,61 %	50,70 %	63,60 %	-5,78	56,59 %	55,55 %	66,92 %	-5,06	49,49 %	48,99 %	61,40 %	-3,18
Oil lamp	48,99 %	48,48 %	57,17 %	-3,95	50,58 %	49,61 %	60,19 %	-4,67	50,86 %	50,41 %	60,23 %	-2,5
Table	33,64 %	32,80 %	47,10 %	-6,84	42,02 %	40,28 %	59,25 %	-6,4238	29,99 %	29,53 %	48,90 %	-3,19
Latrine	41,10 %	40,20 %	54,96 %	-6,78	45,19 %	43,86 %	58,32 %	-6,4224	38,43 %	32,90 %	50,87 %	-3,42
Agricultural practices												
Irrigation (dummy variable)	9,37 %	8,67 %	20,51 %	-9,21	8,48 %	7,01 %	22,89 %	-12,709	12,64 %	12,08 %	25,88 %	-5,32

Fertilizers (dummy variable)	4,16 %	3,50 %	14,70 %	-12,79	5,57 %	4,41 %	17,01 %	-12,268	3,87 %	3,40 %	15,20 %	-7,89
Animal traction (dummy variable)	12,33 %	11,99 %	17,80 %	-4,21	19,83 %	18,68 %	31,21 %	-6,9579	13,43 %	13,14 %	20,46 %	-2,75
Pesticides (dummy variable)	6,00 %	5,50 %	13,70 %	-6,87	6,95 %	6,16 %	14,77 %	-7,4907	6,30 %	5,68 %	16,96 %	-6,04
Manure (dummy variable)	5,10 %	4,80 %	9,55 %	-4,79	4,47 %	3,98 %	9,35 %	-5,7428	6,88 %	6,56 %	14,61 %	-4,09