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Do collective actions reduce household poverty? Evidence from empirical evaluation of farmers cooperatives in East Shewa, Ethiopia

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Abstract

Purpose – Cooperatives are used as one of the strategic tools to reach smallholder farmers and reduce household poverty through augmenting access to inputs, technologies, farm productivity and markets. Our study aims to investigate the impacts of the Meki Batu Cooperative Union on reducing household poverty.

Design/methodology/approach – This study employed a cross-sectional survey of households in the Dugda district of the East Shewa zone in the Oromia region. A two-stage sampling design was applied, where four rural Kebeles were first randomly picked, followed by stratified random samples of 217 producers comprising 100 members and 117 non-members of cooperatives. The standard probit model was estimated with a set of observable factors. Propensity score matching (PSM), doubly robust inverse probability weighting and treatment effect estimation were performed along with matching techniques.

Findings – The results reveal that education, livestock assets, access to irrigation and extension contact positively determine participation in cooperatives. As the income-based poverty attests, the poverty gap was reduced by 5.9–6.3% and the severity of poverty by 3.7–3.8% due to the cooperative membership.

Research limitations/implications – The investigation suggests the need for continued and comprehensive social services to address development challenges through the facilitation of producers' engagement in collective actions and agribusinesses.

Originality/value – Existing research evidence is inconclusive with the view of impacts of collective actions on housed welfare in Ethiopia. This study empirically tested the impacts in connection to the production and marketing of high-value crops.

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Keywords Impact, Farmer cooperatives, Membership, Poverty gap, Severity of poverty

Paper type Research paper

1. Introduction

Unlike Africa, most of the developing regions of the world have succeeded in Millennium Development Goals (MDG) in reducing poverty by half between 1990 and 2015 (Fukuda-

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Parr *et al.*, 2014). Agriculture remains the mainstay of the economy in many parts of the African region; nevertheless, the envisaged growth of the sector is minimal (Diao *et al.*, 2012) due to low productivity and inefficient input-output markets (Tittonell and Giller, 2013). Over the last 4 decades, in Sub-Saharan Africa (SSA), the productivity of agriculture has shown an increment of only 2.4%, while the output efficiency for the developing world increased by 4% (Loison, 2015).

The contribution of cooperatives to social and economic development has been recognized by governments, donors and non-governmental organizations. In Ethiopia, agricultural cooperatives have been given the centric role in gearing the rural development and poverty reduction interventions (Chagwiza *et al.*, 2016; Emana, 2009). Farmers' cooperatives are considered strategic tools to achieve economic targets including food security, promotion of export-oriented commodities, supply of raw materials to the industry and cross-cutting issues in poverty reduction (Bernard and Taffesse, 2012). Farmer cooperatives play a great role in engaging whole families in a new working culture in food production, capacity building and fair allocation of resources (Kakati *et al.*, 2021).

Cooperatives enable them to overcome the influence of intermediaries that exercise market power (Chagwiza *et al.*, 2016; Devaux *et al.*, 2009). Thus, cooperation is a strategy through which the productivity, profitability and sustainability of smallholder farming are improved. It is also an instrument to overcome market input-output failure as an economic development pathway in developing countries like Ethiopia (Emana, 2009; Bernard *et al.*, 2010), particularly in reducing rural poverty (Verhofstadt and Maertens, 2015). Because of underdeveloped basic infrastructure, such as all-season roads, transport, market facilities and limited access to productive resources (Tefera *et al.*, 2017), in which smallholder farmers face high production and transaction costs, policy interventions that hasten the cooperative service are much favored.

Several studies analyzed the vital roles of cooperatives with the interest of differing impact indicators. Farmer cooperatives improve the livelihood of the farmers by enhancing the uptake of new technologies (Ahmed *et al.*, 2017; Ma *et al.*, 2018; Kumar *et al.*, 2013). As the most available literature has uncovered, agricultural cooperatives have positive impacts on farm commercialization (Francesconi and Heerink, 2011; Bernard *et al.*, 2008) by reducing transaction costs and information asymmetry and strengthening farmers' negotiation ability (Zanello *et al.*, 2014). The impacts of cooperative membership in the agricultural sector reduced the price of agricultural inputs and improved the prices for producers. Overall, members received higher prices compared to non-members of cooperatives (Gezahegn *et al.*, 2020). Other studies have discovered impacts on productivity, technical efficiency (Bernard *et al.*, 2010; Ma *et al.*, 2018; Abate *et al.*, 2014; Akinola *et al.*, 2023; Li and Ito, 2023), adoption of fertilizers (Getnet and Anullo, 2012), pesticides (Abebaw and Haile, 2013) and household income (Chagwiza *et al.*, 2016). The evaluation of coffee cooperatives declared both the absence and significant impacts on assets and income status (Mojo *et al.*, 2017a).

On the other hand, the literature revealed that farmer cooperatives did not bring about an impact or lead to livelihood improvement (Chagwiza *et al.*, 2016; Bernard and Taffesse, 2012). This is due to several reasons, such as a dearth of working capital, free rider, corruption, shortage of skilled human power and managerial capacity for policy advocacy and influence (Kodama, 2007). Cooperatives have poor linkage with other member-based organizations, for instance, workers' unions, employers' organizations and their members (Emana, 2009).

Recent investigations explored the impact of cooperatives on farmers' choice of marketing channels (Hao *et al.*, 2018) and household income (Ma and Abdulai, 2016; Ma *et al.*, 2018; Ma and Abdulai, 2018), employing endogenous selection models that deal with unobserved factors that are unlikely captured by the propensity score matching (PSM) method. Similarly, Wossen *et al.* (2017) assessed the impacts on asset accumulation, household consumption and progress out of poverty index (PPI). The available research evidence on the likely impacts of farmer cooperatives on household poverty in particular is scarce or mixed. Our study assesses the resultant welfare impacts by addressing the poverty gap and poverty severity with the perspective of an income-based absolute poverty line. The poverty reduction role of cooperatives embeds upon increased farm productivity and income due to accrued benefits from enhanced access to inputs, extension, training, finance, market bargaining and linkages to high-value customers. We evaluated the PSM method against doubly robust inverse probability weighted regression adjustment (IPWRA). The sensitivity test was performed to diagnose the robustness against unobserved confounding factors.

In Ethiopia, the Meki Batu Cooperative Union is one of the strongest farmer-based organizations that supports smallholders in the production and export of horticultural produce. Organized under the union, primary cooperatives are engaged in the delivery of inputs, produce marketing and contracting with key domestic farms and horticultural export markets (Royer *et al.*, 2017; Tiruwuha, 2010). The success of cooperative services or impacts is immensely linked with cooperative governance, member commitment, commodities and market opportunities. Hence, this study aims to determine the factors influencing participation in producer cooperatives based on observable household attributes. Our investigation further intends to empirically assess the impacts of membership in the Meki Batu Cooperative Union on household welfare. The research has an important contribution to understanding the divergence of the performance of cooperatives under the context of differing commodity, production and market circumstances.

2. Agricultural cooperatives in Ethiopia

Agricultural transformation strategies encourage both increased productivity and improved market access by providing inputs, services and information. The cooperatives also sell back their farm products to the union to get a wide range of markets in an organized form (Royer *et al.*, 2017; Emana *et al.*, 2015). Through cooperatives, smallholders obtain inputs, adopt new agricultural technologies, seeds, and chemicals (Abebaw and Haile, 2013), access technical assistance and get credit services that help them ease production constraints.

The primitive society history of cooperatives in Ethiopia embraces labor-sharing arrangements (*Debo or Wenfal*), traditional insurance during shocks, credit associations (called *Idir* for the cause of funereal) and rotated savings (known as *Ikub*) (Emana, 2009; Tefera *et al.*, 2017). The modern foundation of agricultural cooperatives was started by the regime of imperialism (the 1930s–1974) (Bernard *et al.*, 2008). The next socialist regime (1974–1991) established a new cooperative society by Proclamation No. 138/78 and expanded commercial systems, where cooperative membership was not voluntary. After the fall of *Derg*, the Ethiopian People's Revolutionary Democratic Front (EPRDF) (1991–2018) implemented economic liberalization (Getnet and Anullo, 2012), and Proclamation No. 85/1994 paved the door for cooperatives in a new form (Bernard *et al.*, 2008; Francesconi and Ruben, 2012). Cooperatives in Ethiopia have a long history of ups and downs following these political regimes and policy changes (Tefera *et al.*, 2017; Kodama, 2007).

The cooperative service covered 35% of the rural kebeles, whereas only 17% of the households were the beneficiaries of cooperatives (Bernard *et al.*, 2008). In 2010, the Federal Cooperative Agency (FCA) had targets of raising the cooperative outreach to 70% of the population by establishing primary cooperatives in each of the kebeles (Emana, 2009; Abate *et al.*, 2014). Over a 15 year period from 2006 to 2021, cooperative participation has shown an increasing trend. In 2006, the number of primary cooperatives was 20,437 comprising 3,642,602 members (Mojo *et al.*, 2017b). In 2021, the figure has increased to 92,755 with corresponding members of 21,043,370 and employment for 1,987,379 job seekers (ICA, 2021). In 2012, agricultural cooperatives constituted 26.5% of all available cooperatives (Bernard and Taffesse, 2012). On the other hand, about 70% of the cooperative members belonged to either agricultural or multipurpose cooperatives. In Oromia, there were about 22,613 primary cooperatives organized under 121 unions. The Cooperative Commission of Ethiopia (CCE), under its former name FCA, declared that the capital of primary cooperatives elevated to 28.8 billion Ethiopian birr, whereas it approximated 10.4 billion in the Oromia region (Fekadu, 2022).

3. Study methods and data

3.1 Meki Batu Cooperative Union

The Meki Batu Cooperative Union was established in May 2002 in the East Showa Zone, Dugda district (Gebrehiwot and Rao, 2014). It is located 135 km southeast of Addis Ababa and 85 km from Adama city. The operational areas of the union include Adami Tulu, Dugda, Bora, Ziway Dugda and Adama districts, encapsulating about 150 primary cooperatives involving about 8,000 households.

The Meki Batu Fruits and Vegetables Producer Cooperatives Union is one of the agricultural cooperative unions that consolidates and sells produce to domestic and foreign markets. The union supplies production inputs of agrochemicals, fertilizers, seeds, water pumps, storage services and training for fruit (papaya) and vegetable (tomato, onion, pepper, potato, cabbage and snap beans) farmers. The union also plays its role against asymmetric information (Emana *et al.*, 2015) and facilitates access to credit, technical and advisory support, training and education (Royer *et al.*, 2017; Hengsdijk *et al.*, 2021).

3.2 Data source and methods

To generate the required dataset, a cross-sectional household survey was conducted in the Dudga district in the East Shewa Zone in 2020. Required information regarding the identification of functional cooperatives, households that have land in the respective *kebele*, and cooperative membership status was gathered from the Dugda district's Bureau of Agriculture (BOA) and Cooperative Development offices.

A structured and pre-designed questionnaire was used for face-to-face interviews with selected respondent farmers. Experienced and well-trained enumerators undertook the interview, and the recorded data were converted to a statistical database by the data clerk. The questionnaire captured household characteristics, farm inputs, production and farm gate prices of produced commodities. It also includes cooperative membership status, services obtained and constraints. The outcome variables of farm income and household-level poverty indices were computed.

3.3 The sampling design

Purposive sampling was performed to select the district. Though cooperative service is relatively better with primary cooperatives that are located in proximity to the union, the union is also operating in other far-located areas. The survey was targeted to be conducted in four randomly selected rural *kebeles* among 34 *kebeles* in the Dugda district.

After the simple random selection of the *kebeles*, farmers were categorized based on the cooperative membership criteria to take a total sample size of 217 households using the Yamane 1967 formula (Madow, 1968). Then, stratified sampling of 100 cooperative members and 117 non-member groups was devised to get sufficient samples for matching. The corresponding samples drawn from the horticultural crop-producing *kebeles* of Bekele Girisa, Woyo Gebriel, Shubi Gemo and Abono Gebriel are apportioned to be 63, 69, 55 and 30, respectively.

3.4 Model specification

The most common econometric approaches applied for dealing with selection bias and heterogeneity issues that may arise in non-experimental designs include PSM, generalized propensity score (GPS) matching, endogenous switching regression (ESR) and treatment effect (TE) models.

3.4.1 Probit model. The PSM model requires a step-wise sequence of steps, which proceeds with the determination of the probability outcome as a function of observable factors. The standard probit and logit models are often fitted to determine the propensity score of factual and counterfactual households. The standard probit model was applied after appropriate model fitness and variable selection procedures, which could be denoted as follows:

$$P(Y) = F(X) \tag{1}$$

where, P represents the probability, Y is the cooperative membership outcome and X refers to the independent variables (gender, farm experience, education level, family size, dependency ratio, farmland owned, assets, off-farm income, access to irrigation, credit use, extension contact and distance to market). Household demographics, farm characteristics and institutional factors affect the farmer's membership in agricultural cooperatives. The variables used for the estimation were chosen based on theory, empirical studies (Abate *et al.*, 2014; Ma and Abdulai, 2016; Wossen *et al.*, 2017; Ahmed and Mesfin, 2017) and model specification tests. The compact representation of the cumulative standard normal distribution function $\Phi\,(\cdot)$ of the probit model is given as follows:

$$P(Y= 1|X) = \Phi(\beta_0 + \beta_k X_k) \tag{2}$$

where, $\beta_0 + \beta_k X_k$ in eq. (2) plays the role of a quintile z. $\Phi\,(z) = p(Z \leq z), Z \sim N\,(0, 1)$ such that the probit coefficient $\beta\,(k = 1, 2, 3, \ldots)$ is the change in z associated with a one unit change in X. However, the link between z and the dependent variable y is non-linear since Φ is a non-linear function of x.

The specification of the model confirmed that the joint statistical significance of the explanatory variables, $\chi^2\,(13) = 57.87, p > \chi^2 = 0.000$) adequately fitted the data. As the test of the goodness of fit was verified, the model was correctly specified with the decision probability (p = 238).

3.4.2 Propensity score matching (PSM), inverse probability weighting and treatment effects. Estimation of an impact intervention on welfare outcome variables for non-experimental observations is a big challenge in the empirical assessment since the intervention is on own choice and not randomly distributed between the treated and control groups (Rosenbaum and Rubin, 1983; Heckman and Robb, 1985). For instance, the empirical study of Feleke *et al.* (2016) employed the ESR approach to find out the impacts of technology adoption on the outcomes of poverty rate, poverty gap and severity of poverty. The PSM technique enables contrasting intervention program participants and non-participants (Heckman and Todd, 2009) through the computation of the average treatment effect on treated (ATT). The propensity score is defined as the conditional probability of receiving a treatment given pre-treatment characteristics:

$$P(X) = Pr\{D_i = 1|X\} \tag{3}$$

Given a population of units denoted by ith household, and if the propensity score $P(X_i)$ is known, the ATT can be estimated as follows:

$$\begin{aligned} ATT &= E\{Y_1 - Y_0|D = 1\} = E(Y_1|D = 1) - E(Y_0|D = 1) \\ &= E(Y_1|D = 1, p(X) - E(Y_0|D = 1, p(X)) \end{aligned} \tag{4}$$

where the ATT is the difference in the mean outcome of matched members and non-members that have common support conditional on the propensity score. D = 1 if the household participates in Farmers' Cooperative Union (FCU) and D = 0 otherwise, Y_1 is the outcome for the treated group and Y_0 for the non-treated group.

With the presence of selection bias, the literature indicated that matching estimators are not robust (DiPrete and Gangl, 2004). To address this problem, following the work of Abebaw and Haile (2013) and Ahmed and Mesfin (2017), different covariates were included in the probit model specification to reduce bias, which could appear due to omitted variables. It has been denoted that the IPWRA estimator deals with the specification problem that pertains to either the treatment or the outcome variables. If either one of the models is adequately specified, the alternative yields a more robust estimate (Słoczyński *et al.*, 2022; Zheng and Ma, 2023).

3.5 Income-based poverty and poverty line

Absolute poverty occurs when people fail or not afford to satisfy their minimum physical needs of food and non-food items determined by the economy due to income earning or expenditure incurred per day (Jolliffe *et al.*, 2022). Relative poverty is drawn when households receive half less than the average household income of the country (Belay *et al.*, 2022).

To express the unidimensional income-based poverty, the measure proposed by Foster *et al.* (1984) could be given by

$$P_a = \frac{1}{N}\sum_{i=1}^{n}\left(\frac{z-y_i}{z}\right)^a i(y_i \le z), \alpha \ge 0 \tag{5}$$

where P_a is the measure of poverty, N is the number of households in the sample, z is the poverty line, y_i is the per capita income of the ith household, n is the number of poor people in the sample (those whose per capita income is at or below the poverty line) and a is a parameter of poverty aversion.

For $\alpha = 0$, the index is referred to as the headcount/rate poverty index (P_0), which indicates the proportion of the population whose income per capita is below the poverty line. When $\alpha = 1$, it captures the poverty depth index (P_1) or depth of poverty and informs how far the household is from the poverty line. Finally, when $\alpha = 2$ implies the severity poverty index (P_2), it defines inequalities among the poor beyond separating distance from the poverty line (Amankwah *et al.*, 2018). Demarcation of poverty is computed at the global poverty line based on an income of \$1.90 per day at 2011 purchasing power parity (PPP) (Jolliffe and Espen, 2016).

4. Results and discussion

4.1 Factors influencing participation in farmer cooperatives

The probit estimates of the decisions on farmer cooperative membership results are indicated in Table 1. Among the hypothesized variables, the education status of the household has a positive impact on cooperative membership. As the education level of the head increases by one year, the probability of cooperative membership increases by 2%. The services of cooperatives, such as access to farm inputs and improved crop varieties, animal feed and feed delivered basically through cooperatives, could be better understood by educated household heads than by the illiterate (Abate *et al.*, 2014). In general, the result is consistent with similar studies, and it has an important role in enhancing cooperative membership (Abate *et al.*, 2014; Akinola *et al.*, 2023; Hao *et al.*, 2018; Ma and Abdulai, 2018; Wossen *et al.*, 2017).

Households with male heads and large dependent members are less likely to participate in farmer cooperatives. The magnitude of the marginal effects further attests that male-headed households and households with large dependent members have 23 and 9.3% lower probability of participation, respectively. Related studies concluded that the household dependency ratio has a negative influence on cooperative membership decisions (Akinola *et al.*, 2023; Ahado *et al.*, 2021). The result corroborates the investigation by Mojo *et al.* (2017a), whereas it diverges from Abebaw and Haile (2013), who declared that male heads have more involvement in farmer cooperatives. In other studies, household gender is not a limiting factor

Variables	Description	Coef	SE	Z-value
Household sex	Dummy variable takes 1 if the head of the household is male or 0, otherwise	−0.727*	0.413	−1.76
Age	Age of the household head in years	0.000	0.010	−0.02
Grade completed	Number of years of completed education	0.058*	0.034	1.71
Family size	Number of family members	0.025	0.034	0.74
Dependency ratio	Number of dependents to active members ratio	−0.294***	0.112	−2.61
Land owned	Total land size owned (ha)	0.061	0.169	0.36
Total livestock	Livestock owned (TLU)	0.057**	0.024	2.42
Off-farm activity	Income from non-farm activities (000 birr)	0.003	0.030	0.09
Irrigation access	Dummy variable takes 1 if the household has access to irrigation or 0, otherwise	0.980***	0.249	3.94
Credit use	Amount of credit accessed (birr)	0.015	0.024	0.63
Extension contacts	Frequency of contact with extension	0.091***	0.033	2.78
Distance to market	Distance to main market (km)	−0.038	0.031	−1.22
Constant		−0.764	0.748	−1.02
$\hat{y}$		1.060***	0.172	6.15
$\hat{y}^2$		0.120	0.144	0.83
Observations			217	
Wald χ^2(12)			42.510	
P(χ^2)>0			0.000	
Log-likelihood			−121.364	
Pseudo-R2			0.190	

Note(s): * SE = robust standard error. ***, ** and * significant at 1, 5 and 10%, level of probabilities, respectively, $\hat{y}$ = predicted dependent variable and $\hat{y}^2$ = power of the predicted dependent variable

Table 1. Determinants of membership in the FCU and estimated coefficients

or it does not sufficiently explain the cooperative membership (Ma and Abdulai, 2016; Wossen *et al.*, 2017; Ahmed and Mesfin, 2017).

The study finds that livestock ownership has a positive impact on cooperative membership decisions. The ownership of an additional livestock unit (TLU) leads to a 2% increase in the probability of participation in farmer cooperatives. Households that own more livestock have better financial capacity to buy inputs delivered by farmers' cooperatives than non-member households, and the result is in line with the findings of Ma and Abdulai (2018) and Wossen *et al.* (2017).

Access to irrigation and extension contact in the same way has a positive influence on the decisions of membership. The households that have access to irrigation and extension services have a 31.2 and 29% higher likelihood of participation in farmer cooperatives. Frequent contact with extension importantly persuades the farmers to enhance their awareness and skills, disseminate information, uptake new agricultural technologies and active involvement in cooperatives. Similar studies concluded that the farmers who had access to irrigation and frequent contact with extension had a higher tendency to participate in farmer cooperatives (Akinola *et al.*, 2023; Wossen *et al.*, 2017; Zhang *et al.*, 2021).

4.2 Contrasting the distribution of propensity scores

The propensity score estimation with the observable household factors illustrates the region of common support for the treatment and control groups under study. The proportions of households that fall outside the common support region are demarked as shown in Figure 1.

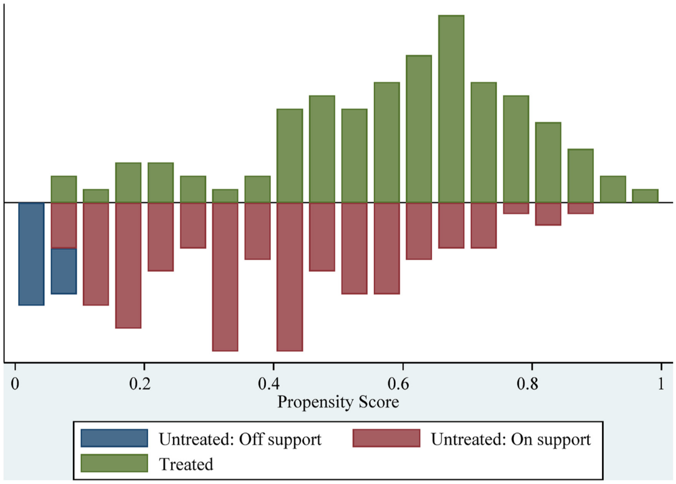

Figure 1.
Region of common support and matching

Source(s): Authors' own computation

A visual inspection of the density distributions of the estimated propensity scores for the two groups before matching (Figure 2) indicates that the common support condition is satisfied. After matching, there is a substantial overlap in the distribution of the propensity scores of both member and non-member groups.

4.3 Balancing property and matching techniques

The covariate balancing tests before and after matching are presented in Table 2. The standardized mean difference for covariates used in the propensity score of 105.6% before matching is reduced to less than 24.3% after matching. The p-values of the likelihood ratio tests indicate that the joint significance of covariates is always rejected after matching. The pseudo-R^2 also dropped significantly from around 0.190% before matching to about 0.009–0.01% after matching under the three matching algorithms, namely the nearest neighbor

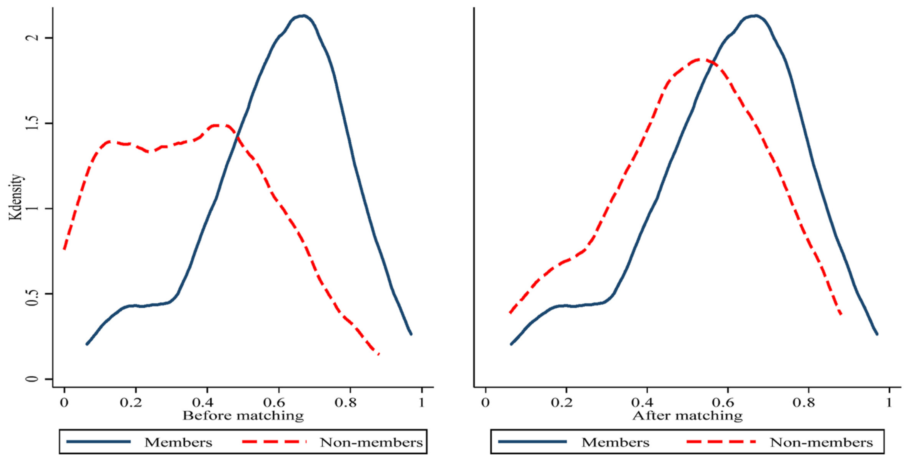

Figure 2.
Propensity score by membership and matching

(NNM), caliper (CALM) and kernel matching (KERM) methods. The low pseudo-R^2 and insignificant p-values of the likelihood ratio test after matching suggest that the proposed specification of the propensity score is successful in terms of balancing the distribution of covariates (Figure A1).

4.4 Impacts of cooperative membership on household welfare

As the preliminary test indicates, the incidence of poverty is higher among non-members (93%) than it is among members (43%) by taking the headcount absolute poverty index. The poverty gap and severity of poverty are 16 and 10% higher at the 1% probability of significance among non-members than members, respectively. The average reduction of the gap of poverty among members ranges from 5.9–6.3% under the caliper matching (CALM) and kernel matching (KERM) algorithms, which turns out to be statistically significant at less than 10% probability. In the same way, the severity of poverty is 3.7–3.8% less if all the farmers were members of the cooperative compared to when none of them were members (Table 3).

Unlike the PSM approach, the IPWRA estimator further confirmed a lower poverty gap and severity of poverty in all the NNM, CALM and KERM methods. With the assumption that there is no selection bias due to unobservable factors, household poverty among cooperative members is significantly lower than among non-members.

The evaluation results are found to be consistent with the conclusions of Chagwiza *et al.* (2016) and Mojo *et al.* (2017a). Agricultural cooperatives have had impacts on the livelihoods

Matching algorism	Observation	Pseudo-R2	LR-$\chi 2$	p-value	Mean bias	Absolute standardized difference
NNM	Unmatched	0.190	56.76	0.000	26.0	105.6
	Matched	0.009	2.26	0.999	6.5	22.7
CALM	Unmatched	0.190	56.76	0.000	26.0	105.6
	Matched	0.010	2.70	0.997	6.8	23.5
KERM	Unmatched	0.190	56.76	0.000	26.0	105.6
	Matched	0.011	2.89	0.996	7.0	24.3

Note(s): NNM-nearest neighbor matching, CALM-caliper matching and KERM-kernel matching

Table 2. Covariate balancing tests before and after matching

Matching algorism	Outcome variables	Members	Non-members	ATT Propensity matching	ATT IPWRA	Γ- critical values
CALM	Poverty gap	0.114	0.194	−0.063***	−0.059**	1.75
	Severity of poverty	0.060	0.111	−0.038**	−0.037*	2.50
KERM	Poverty gap	0.111	0.176	−0.063***	−0.059**	2.0
	Severity of poverty	0.060	0.100	−0.038**	0.037*	2.50
NNM	Poverty gap	0.114	0.194	−0.041	−0.060**	1.75
	Severity of poverty	0.062	0.108	−0.022	−0.038*	2.25

Note(s): NNM-nearest neighbor matching, CAL-caliper matching, KERM-kernel matching, ATT-average treatment effect, S.E-standard error and Γ-gamma values for hidden bias

Table 3. Impact of the FCU on members in the gap and severity of poverty

and reduction of poverty in China (Olumeh and Mithöfer, 2024) and Rwanda (Verhofstadt and Maertens, 2014). Similarly, cooperatives are negatively inducing household poverty, while studies have concluded a positive impact on household welfare in Uganda (Asfaw *et al.*, 2012), Tanzania and Malawi (Temesgen and Franklin, 2017).

4.5 Sensitivity analysis

The robustness of the propensity score and treatment effect estimation is validated with Rosenbaum's sensitivity test (Rosenbaum *et al.*, 2005). The assumption denotes the absence of a hidden bias that arises due to unobserved factors that have a simultaneous effect on both participation and impact outcomes. As the test of the outcome of the severity of poverty reveals, the inference is insensitive to bias with the gamma statistic of Γ (e^{γ}) = 2.25–2.50, based on the NNM, CALM and KERM methods. The test further suggests inspection of underestimation (t-hat-) of poverty gap where the test statistic becomes insignificant at critical values of 1.75–2.0. In the latter case, it implies that results are sensitive to bias that increases participation by 75% to about a double. However, these are the worst-case scenarios (DiPrete and Gangl, 2004) and do not mean that cooperative membership has no impact on the gap of poverty (Amankwah *et al.*, 2018).

4.6 Impacts evaluated at relative poverty measures

Referencing the absolute poverty measure, 43% of the cooperative members are poor, but this decreases to 27% in the case of the relative poverty line. Similarly, about 93% of non-members are found to be poor using the absolute poverty line, while it reduces to about 87% when we use the relative poverty line of 9,219 birr, the mean of agricultural income. Overall, the rate of relative poverty is estimated at 41%, compared to 68% in the case of the absolute poverty approach. The evidence justifies that the relative measure has the drawback of underestimating the poverty estimates, and it is less applicable in the context of developing countries.

5. Conclusion and implications

This study evaluated the potential impact of the FCU on rural household welfare as denoted by household-level poverty indexes. Investigation of the impact of the FCU requires data from both the participant and non-participant households. Practically, it is impossible to obtain data simultaneously due to a missing counterfactual problem. Thus, to reduce the problem of biasedness, PSM, IPWRA and sensitivity analysis were applied.

As the estimation of the probit model indicates, the variables that have the influence on cooperative membership include household gender, education, livestock holding and dependency ratio. Non-member farmers, for example, are more likely constrained by the lack of access to irrigation, services and contacts with extension, and they are less likely to participate in collective actions. Education and training are found to be crucial in determining the farmers' decision to membership in the FCU. These emphasize the importance of human capital development through access to agricultural knowledge, skills and experience. The government and other stakeholders have to give due attention to strengthening and establishing both formal and informal types of farmers' education, training centers and technical and vocational schools.

The causal impact estimation of propensity score matching illustrates that membership in Meki Batu FCU has a significant negative impact on household poverty. The evidence finds that cooperative membership leads to a lower poverty gap and poverty severity than among non-member households. The attributed impact of membership in FCUs is a reduction of the poverty gap in the range of 5.9–6.3 and 3.7–3.8% for that of poverty severity employing the three matching techniques.

The incidence of poverty is higher among non-members (93% below the absolute poverty line) than it is among members (43%) considering the headcount absolute poverty measurement index. The unconditional headcount ratio of poverty for the members is about 50% lower compared to non-members. Similarly, both the poverty gap and the poverty severity are also lower among non-members than among members, suggesting that membership in the Meki Batu Cooperative Union is positively correlated with well-being.

The results and conclusions of the analyses provide important insights into the effects of the ongoing policy of promoting farmers to participate in farmer cooperative unions. It is also relevant for policies promoting the integration of smallholders into high-value horticultural crop value chains.

Farmer cooperatives enable addressing the vital development challenges through enhancing extension services, access to credit and input-output markets that simulate members of the FCU. Given the agricultural cooperative service bottlenecks, further promotion, deepening, strengthening and enabling of the cooperative services are essential for improving farm production, markets and the welfare status of the households. Therefore, the government and stakeholders should support FCUs by tackling the governance challenges and hindrances for effective participation.

References

Abate, G.T., Francesconi, G.N. and Getnet, K. (2014), “Impact of agricultural cooperatives on smallholders’ technical efficiency: emperical evidence from Ethiopia”, *Annals of Public and Cooperative Economics*, Vol. 85 No. 2, pp. 257-286, doi: 10.1111/apce.12035.

Abebaw, D. and Haile, M.G. (2013), “The impact of cooperatives on agricultural technology adoption: empirical evidence from Ethiopia”, *Food Policy*, Vol. 38 No. 1, pp. 82-91, doi: 10.1016/j.foodpol.2012.10.003.

Ahado, S., Hejkrlík, J., Enkhtur, A., Tseren, T. and Ratinger, T. (2021), “Does cooperative membership impact the yield and efficiency of smallholder farmers? Evidence from potato farmers in Mongolia”, *China Agricultural Economic Review*, Vol. 13 No. 4, pp. 736-755, doi: 10.1108/CAER-01-2021-0013.

Ahmed, M.H. and Mesfin, H.M. (2017), “The impact of agricultural cooperatives membership on the wellbeing of smallholder farmers: empirical evidence from eastern Ethiopia”, *Agricultural and Food Economics*, Vol. 5 No. 1, p. 6, doi: 10.1186/s40100-017-0075-z.

Ahmed, M.H., Geleta, K.M., Tazeze, A., Mesfin, H.M. and Tilahun, E.A. (2017), “Cropping systems diversification, improved seed, manure and inorganic fertilizer adoption by maize producers of eastern Ethiopia”, *Journal of Economic Structures*, Vol. 6 No. 1, p. 31, doi: 10.1186/s40008-017-0093-8.

Akinola, A., Kehinde, A., Tijani, A., Ayanwale, A., Adesiyan, F., Tanimonure, V., Ogunleye, A. and Ojo, T. (2023), “Impact of membership in agricultural cooperatives on yield of smallholder tomato farmers in Nigeria”, *Environmental and Sustainability Indicators*, Vol. 20, 100313, doi: 10.1016/j.indic.2023.100313.

Amankwah, A., Quagrainie, K.K. and Preckel, V.P. (2018), “Impact of aquaculture feed technology on fish income and poverty in Kenya”, *Aquaculture Economic and Management*, Vol. 22 No. 4, pp. 410-430, doi: 10.1080/13657305.2017.1413689.

Asfaw, S., Shiferaw, B., Simtowe, F. and Lipper, L. (2012), “Impact of modern agricultural technologies on smallholder welfare: evidence from Tanzania and Ethiopia”, *Food Policy*, Vol. 37 No. 3, pp. 283-295, doi: 10.1016/j.foodpol.2012.02.013.

Belay, M., Bekele, G. and Ibrahim, M. (2022), “Heliyon Measuring the poverty reduction effects of adopting agricultural technologies in rural Ethiopia : findings from an endogenous switching regression approach”, *Heliyon*, Vol. 8, e09495, doi: 10.1016/j.heliyon.2022.e09495.

Bernard, T. and Taffesse, A.S. (2012), "Returns to scope? Smallholders' commercialisation through multipurpose cooperatives in Ethiopia", *Journal of African Economies*, Vol. 21 No. 3, pp. 440-464, doi: 10.1093/jae/ejs002.

Bernard, T., Taffesse, A.S. and Gabre-Madhin, E. (2008), "Impact of cooperatives on smallholders' commercialization behavior: evidence from Ethiopia", *Agricultural Economics*, Vol. 39 No. 2, pp. 147-161, doi: 10.1111/j.1574-0862.2008.00324.x.

Bernard, T., Spielman, D.J., Taffesse, A.S. and Gabre-madhin, E.Z. (2010), *Cooperatives for Staple Crop Marketing: Evidence from Ethiopia*, Research Monograph, International Food Policy Research (IFPRI), Washington, DC. doi: 10.2499/9780896291751rr164.

Chagwiza, C., Muradian, R. and Ruben, R. (2016), "Cooperative membership and dairy performance among smallholders in Ethiopia", *Food Policy*, Vol. 59, pp. 165-173, doi: 10.1016/j.foodpol.2016.01.008.

Devaux, A., Horton, D., Velasco, C., Thiele, G., López, G., Bernet, T., Reinoso, I. and Ordinola, M. (2009), "Collective action for market chain innovation in the Andes", *Food Policy*, Vol. 34 No. 1, pp. 31-38, doi: 10.1016/j.foodpol.2008.10.007.

Diao, X., Thurlow, J., Benin, S. and Fan, S. (2012), *Strategies and Priorities for African Agriculture: Economywide Perspectives from Country Studies. IFPRI Issue Brief 73*, International Food Policy Research Institute, Washington, DC. doi: 10.2499/9780896298125.

DiPrete, T.A. and Gangl, M. (2004), "Assessing bias in the estimation of causal effects: Rosenbaum bounds on matching estimators and instrumental variables estimation with imperfect instruments", *Sociology Methodology*, Vol. 34 No. 1, pp. 271-310, doi: 10.1111/j.0081-1750.2004.00154.x.

Emana, B. (2009), "Cooperatives: a path to economic and social empowerment in Ethiopia", CoopAFRICA Working, International Labour Office (ILO), Dar es Salaam.

Emana, B., Afari-sefa, V., Dinssa, F., Ayana, A., Balemi, T. and Temesgen, M. (2015), "Characterization and assessment of vegetable production and marketing systems in the Humid tropics of Ethiopia", *Quarterly Journal of International Agriculture*, Vol. 54 No. 2, pp. 163-187, doi: 10.22004/ag.econ.210313.

Fekadu, D. (2022), "Contributions of cooperatives and encountering challenges in Ethiopia", *American Journal of Research in Business and Social Sciences*, Vol. 2 No. 1, pp. 1-14, doi: 10.7176/jpcr/55-03.

Feleke, S., Manyong, V., Abdoulaye, T. and Alene, A.D. (2016), "Assessing the impacts of cassava technology on poverty reduction in Africa", *Studies in Agricultural Economics*, Vol. 118 No. 2, pp. 101-111, doi: 10.7896/j.1612.

Foster, J., Greer, J. and Thorbecke, E. (1984), "A class of decomposable poverty measures", *Econometrica*, Vol. 52 No. 3, p. 761, doi: 10.2307/1913475.

Francesconi, G.N. and Heerink, N. (2011), "Ethiopian agricultural cooperatives in an era of global commodity exchange: does organisational form matter?", *Journal of African Economies*, Vol. 20 No. 1, pp. 153-177, doi: 10.1093/jae/ejq036.

Francesconi, G.N. and Ruben, R. (2012), "The hidden impact of cooperative membership on quality management: a case study from the dairy belt of Addis Ababa", *Journal of Entrepreneurial and Organizational Diversity*, Vol. 1 No. 1, doi: 10.5947/JEOD.2012.005.

Fukuda-Parr, S., Yamin, A.E. and Greenstein, J. (2014), "The power of numbers: a critical review of millennium development goal targets for human development and human rights", *Journal of Human Development and Capabilities*, Vol. 15 Nos 2-3, pp. 105-117, doi: 10.1080/19452829.2013.864622.

Gebrehiwot, T. and Rao, M. (2014), "Experiences and challenges of cooperative marketing in Ethiopia (a case of Meki Batu fruit and vegetable growers ' cooperative union, Oromia region)", *International Journal of Marketing Finance Service Management Research*, Vol. 3 No. 10.

Getnet, K. and Anullo, T. (2012), "Agricultural cooperatives and rural livelihoods: evidence from Ethiopia", *Annals of Public and Cooperative Economics*, Vol. 83 No. 2, pp. 181-198, doi: 10.1111/j.1467-8292.2012.00460.x.

Gezahegn, T.W., Van Passel, S., Berhanu, T., D'haese, M. and Maertens, M. (2020), "Do bottom-up and independent agricultural cooperatives really perform better? Insights from a technical efficiency analysis in Ethiopia", *Agrekon*, Vol. 59 No. 1, pp. 93-109, doi: 10.1080/03031853.2019.1663223.

Hao, J., Bijman, J., Gardebroek, C., Heerink, N., Heijman, W. and Huo, X. (2018), "Cooperative membership and farmers' choice of marketing channels – evidence from apple farmers in Shaanxi and Shandong Provinces, China", *Food Policy*, Vol. 74, pp. 53-64, doi: 10.1016/j.foodpol.2017.11.004.

Heckman, J.J. and Robb, R. (1985), "Alternative methods for evaluating the impact of interventions. An overview", *Journal of Econometrics*, Vol. 30 Nos 1-2, pp. 239-267, doi: 10.1016/0304-4076(85)90139-3.

Heckman, J.J. and Todd, P.E. (2009), "A note on adapting propensity score matching and selection models to choice based samples", *Economic Journal*, Vol. 12 No. 1, pp. 230-234, doi: 10.1111/j.1368-423X.2008.00269.x.

Hengsdijk, H., Sertse, Y., Tesfaye, S. and Likoko, E. (2021), "Scoping study on fruits and vegetables; results from Ethiopia", Wageningen Economic Research, Report 2021-108, Wageningen, available at: www.wur.eu/economic-research

ICA (2021), *Mapping: Key Figures National Report, Ethiopia*, International Cooperative Alliance (ICA), Nairobi, available at: https://coops4dev.coop/sites/default/files/2021-06/Ethiopia%20Key%20Figures%20Report.pdf

Jolliffe, D. and Espen, P. (2016), "Estimating international poverty lines from comparable national thresholds", Policy Research Working Paper No WPS 7606, World Bank Group, Washington, DC, available at: http://documents.worldbank.org/curated/en/837051468184454513/Estimating-international-poverty-lines-from-comparable-national-thresholds

Jolliffe, D., Mahler, D.G., Lakner, C., Atamanov, A. and Tetteh-Baah, S.K. (2022), "Assessing the Impact of the 2017 ppps on the international poverty line and global poverty", Policy Research Working Paper No WPS 9941, World Bank Group, Washington, DC.

Kakati, B.K., Sarmah, A.K. and Kakoty, S. (2021), "Cooperative is an economically viable social enterprise in the study of JWSSPCFL", *Local Development and Society*, Vol. 2 No. 1, pp. 80-96, doi: 10.1080/26883597.2021.1907214.

Kodama, Y. (2007), "New role of cooperatives in Ethiopia: the case of Ethiopian coffee farmers cooperatives. Institute of developing economies", *African Study Monography JETRO*, Vol. 35, pp. 87-108, doi: 10.14989/68489.

Kumar, A., Shinoj, P. and Jee, S. (2013), "Do dairy co-operatives enhance milk production, productivity and quality? Evidences from the indo-gangetic plain of India", *Indian Journal of Agricultural Economics*, Vol. 68 No. 3, pp. 457-468, doi: 10.22004/ag.econ.206348.

Li, X. and Ito, J. (2023), "Multiple roles of agricultural cooperatives in improving farm technical efficiency: a case study of rural Gansu, China", *Agribusiness*, pp. 1-21, doi: 10.1002/agr.21901.

Loison, S.A. (2015), "Rural livelihood diversification in Sub-Saharan African: a literature review", *The Journal of Development Studies*, Vol. 51 No. 9, pp. 1125-1138, doi: 10.1080/00220388.2015.1046445.

Ma, W. and Abdulai, A. (2016), "Does cooperative membership improve household welfare? Evidence from apple farmers in China", *Food Policy*, Vol. 58, pp. 94-102, doi: 10.1016/j.foodpol.2015.12.002.

Ma, W. and Abdulai, A. (2018), "IPM adoption, cooperative membership and farm economic performance", *China Agricultural Economic Review*, Vol. 11 No. 2, pp. 218-236, doi: 10.1108/CAER-12-2017-0251.

Ma, W., Renwick, A., Yuan, P. and Ratna, N. (2018), "Agricultural cooperative membership and technical efficiency of apple farmers in China: an analysis accounting for selectivity bias", *Food Policy*, Vol. 81, pp. 122-132, doi: 10.1016/j.foodpol.2018.10.009.

Madow, W.G. (1968), "Elementary sampling theory", *Technometrics*, Vol. 10 No. 3, pp. 621-622, doi: 10.1080/00401706.1968.10490610.

Mojo, D., Fischer, C. and Degefa, T. (2017a), “The determinants and economic impacts of membership in coffee farmer cooperatives: recent evidence from rural Ethiopia”, *Journal of Rural Studies*, Vol. 50, pp. 84-94, doi: 10.1016/j.jrurstud.2016.12.010.

Mojo, D., Degefa, T. and Fischer, C. (2017b), “Development of agricultural cooperatives in Ethiopia: history and a framework for future trajectory”, *Ethiopian Journal of the Social Sciences and Humanities*, Vol. 13 No. 1, pp. 1-29, doi: 10.4314/ejossah.v13i1.3.

Olumeh, D.E. and Mithöfer, D. (2024), “Impact of collective action on household welfare: empirical evidence from baobab collectors in Malawi”, *Annals of Public and Cooperative Economics*, Vol. 95 No. 2, pp. 385-411, doi: 10.1111/apce.12448.

Rosenbaum, P.R. and Rubin, D.B. (1983), “The central role of the propensity score in observational studies for causal effects”, *Biometrika*, Vol. 70 No. 1, pp. 41-55, doi: 10.1093/biomet/70.1.41.

Rosenbaum, P.R. (2005), “Sensitivity analysis in observational studies”, in Everitt, B.S. and Howell, D.C. (Eds), *Encyclopedia of Statistics in Behavioral Science*, Vol. 4, pp. 1809-1814.

Royer, A., Bijman, J. and Abebe, G.K. (2017), “Cooperatives, partnerships and the challenges of quality upgrading: a case study from Ethiopia”, *Journal of Co-operative Organization and Management*, Vol. 5 No. 1, pp. 48-55, doi: 10.1016/j.jcom.2017.04.001.

Słoczyński, T., Uysal, D. and Wooldridge, J.M. (2022), “Doubly robust estimation of local average treatment effects using inverse probability weighted regression adjustment”, Discussion Paper Series, IZA DP No. 15727, IZA – Institute of Labor Economics, 3 Bonn, Germany.

Tefera, D.A., Bijman, J. and Slingerland, M.A. (2017), “Agricultural co-operatives in Ethiopia: evolution, functions and impact”, *Journal of International Development*, Vol. 29 No. 4, pp. 431-453, doi: 10.1002/jid.3240.

Temesgen, F.B. and Franklin, S. (2017), “Profit efficiency analysis among groundnut farmers from Malawi”, *Journal of Development and Agricultural Economics*, Vol. 9 No. 10, pp. 278-288, doi: 10.5897/jdae2017.0774.

Tiruwuha, A. (20102010), “Contract farming in Ethiopia: an overview with focus on sesame”, *Agenda Setting Workshop which was Part of the DGIS-WUR programme*. June 26, Addis Ababa.

Tittonell, P. and Giller, K.E. (2013), “When yield gaps are poverty traps : the paradigm of ecological intensification in African smallholder agriculture”, *Field Crops Research*, Vol. 143, pp. 76-90, doi: 10.1016/j.fcr.2012.10.007.

Verhofstadt, E. and Maertens, M. (2014), “Smallholder cooperatives and agricultural performance in Rwanda: do organizational differences matter?”, *Agricultural Economics*, Vol. 45 No. 1, pp. 39-52, doi: 10.1111/agec.12128.

Verhofstadt, E. and Maertens, M. (2015), “Can agricultural cooperatives reduce poverty? Heterogeneous impact of cooperative membership on farmers’ welfare in Rwanda”, *Applied Economic Perspectives and Policy*, Vol. 37 No. 1, pp. 86-106, doi: 10.1093/aepp/ppu021.

Wossen, T., Abdoulaye, T., Alene, A., Haile, M.G., Feleke, S., Olanrewaju, A. and Manyong, V. (2017), “Impacts of extension access and cooperative membership on technology adoption and household welfare”, *Journal of Rural Studies*, Vol. 54, pp. 223-233, doi: 10.1016/j.jrurstud.2017.06.022.

Zanello, G., Srinivasan, C.S. and Shankar, B. (2014), “Transaction costs, information technologies, and the choice of marketplace among farmers in northern Ghana”, *The Journal of Development Studies*, Vol. 50 No. 9, pp. 1226-1239, doi: 10.1080/00220388.2014.903244.

Zhang, C., Benjamin, W.A. and Wang, M. (2021), “The contribution of cooperative irrigation scheme to poverty reduction in Tanzania”, *Journal of Integrative Agriculture*, Vol. 20 No. 4, pp. 953-963, doi: 10.1016/S2095-3119(21)63634-1.

Zheng, H. and Ma, W. (2023), “Smartphone-based information acquisition and wheat farm performance: insights from a doubly robust IPWRA estimator”, *Electronic Commercial Research*, Vol. 23 No. 2, pp. 633-658, doi: 10.1007/s10660-021-09481-0.

Further reading

Bizikova, L., Nkonya, E., Minah, M., Hanisch, M., Turaga, R.M.R., Speranza, C.I., Karthikeyan, M., Tang, L., Ghezzi-Kopel, K., Kelly, J. and Celestin, A.C. (2020), "A scoping review of the contributions of farmers' organizations to smallholder agriculture", *Nature Food*, Vol. 1 No. 10, pp. 620-630, doi: 10.1038/s43016-020-00164-x.

Appendix

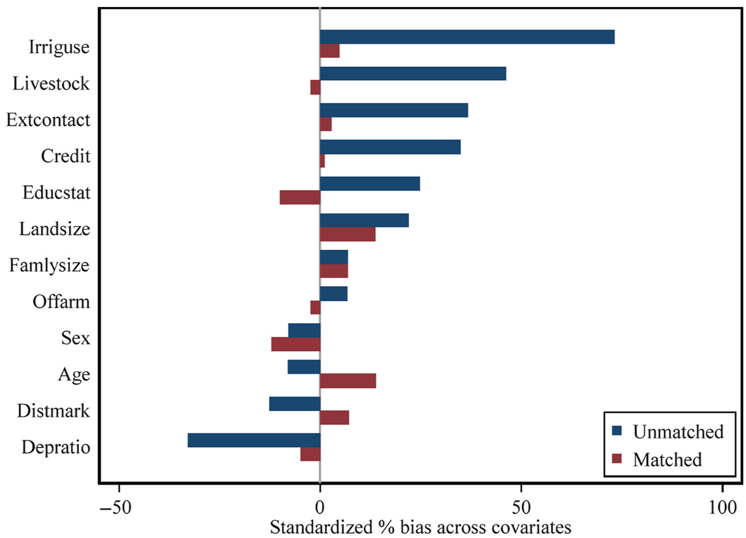

Figure A1. Standardized bias and variables balancing test after caliper matching

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