

Extended Abstract

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Paper/Poster Title	Are Agro-clusters Pro-Poor? Evidence from Ethiopia
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Abstract <p>Governments and development actors are increasingly promoting agro-clusters as a pathway to improving smallholder incomes and ensuring inclusive rural development through mitigating production and market risks. However, there is little or no empirical evidence to support this promise. This study uses a large farm household survey of 3,969 smallholder farmers in Ethiopia growing teff, maize, barley, and sesame to examine the relationship between agro-clusters and smallholder welfare and poverty. The study uses ordinary least squares and instrumental variable estimators to establish a positive association between agro-clusters and per capita income. Agro-clusters are also shown to reduce income poverty and the income poverty gap. These results are robust over different agro-cluster proxies and alternative estimators, such as the augmented inverse probability weighting method. The findings are also unlikely to be driven by omitted variable bias. Moving beyond average effects and in the interest of understanding heterogeneous effects, quantile regressions are performed at different income levels. The results suggest that agro-clusters are associated with welfare gains for all income quantiles. However, the most significant gains are observed for the wealthier households, indicating some form of income inequality. Despite this rising inequality, this analysis suggests that agro-clusters may be an essential mechanism in sustainably reducing poverty in all its forms. We therefore conclude that agro-clusters may be an excellent tool to make farming a profitable enterprise with income implications and a means of ensuring that smallholder farmers obtain a 'piece of the pie'. To end, our findings provide credence to the scaling up of agro-clusters to increase smallholder incomes and reduce poverty.</p>	200 words max
Keywords	agro-clusters, welfare, poverty, Ethiopia

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Introduction	100 – 250 words
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Poverty is a persistent problem in many parts of the world, especially in sub-Saharan Africa (SSA), where chronic poverty remains high, despite some pro-poor growth spurts in the region¹ (Dang and Dabalén, 2019). Poverty is exceptionally high in rural areas, where development is challenging (Mwabu and Thorbecke, 2004). The vast majority of people (approximately 82%) in SSA live in these rural areas, mainly employed in agriculture, which remains their primary source of livelihood (Dercon and Gollin, 2014). To promote economic growth and development in rural areas and achieve shared prosperity, many governments and development agencies have emphasized agriculture as a necessary pathway out of poverty, especially in the poorest areas (Barrett et al., 2019).

Governments increasingly promote agro-clusters and development actors as a pathway to increasing smallholder incomes and ensuring inclusive rural development through mitigating production and market risks (Dirven, 1999; Wardhana et al., 2017). They may also be effective in linking smallholder farmers to emerging food value chains and markets, further leading to welfare gains (Burger, 1999; Poulton et al., 2010). Agro-clusters could help smallholder farmers attain economies of scale to be more productive, profitable, and competitive. Furthermore, clusters could lead to sustainable rural development through their implications on communities' economic, socio-cultural, and environmental spheres (Brasier et al., 2007).

Beyond such community-level effects, agro-clusters can stimulate technology adoption (Joffre et al., 2019; Joffre et al., 2020), and because they increase the use of improved technologies in production, they may also affect agricultural productivity (Wardhana et al., 2017). The extant literature highlights increased interaction and cooperation as building trust and leading to the impacts of agro-clusters (Joffre et al., 2019; Joffre et al., 2020; Wardhana et al., 2020). These clusters are usually characterized by social and economic interactions between farmers, mutual relationships and drive toward stated production and commercialization goals, and enhanced linkages with external actors, such as development actors, research institutions, and the state. These clusters could also improve smallholder welfare and reduce poverty by increasing income or generating employment in communities; however, empirical analysis is limited.

This study examines the relationship between agro-clusters, welfare improvements, and rural poverty in Ethiopia. Ethiopia is an interesting case study to understand the effects of agro-clusters, given the government's recent interest in using agro-clusters as vehicles for reducing poverty and stimulating rural development. This analysis is based on a farm household survey of 3,969 households growing maize, teff, barley, and sesame, which are priority crops for the clusters and some of the country's main staple crops. This study uses ordinary least square (OLS) and instrumental variable estimators (IV) to estimate the association farmers' share of allocated land to a cluster with income, per capita income, income poverty, and income poverty gap.

¹ This growth was accompanied by a nine percent reduction in poverty and a growing middle class. About 60 percent of the poor in Africa are chronically poor, while 40 percent are in transient poverty.

Methodology

100 – 250 words

This study is interested in estimating the relationship between agro-clusters and rural welfare and poverty. Given the cross-sectional data, the following regression model is estimated:

$$Y_i = \beta_0 + \delta C_i + \gamma' X_i + \varepsilon_i, \quad (1)$$

Where Y_i is the welfare and poverty indicator for household i , C_i is the share of land allocated to the cluster by every representative household, X_i is a vector of control variables, and ε_i is the stochastic error term. Two different models are estimated for each outcome variable; the study controls for various farm household characteristics associated with rural welfare and poverty through channels other than participating in agro-clusters. The analysis first uses the OLS estimator for all the continuous dependent variables. Income poverty, which is a dummy, uses OLS in the framework of the linear probability model, which usually avoids identification by functional form common in logit and probit models.

The main parameter of interest from Equation (1) is δ , which indicates the relationship between agro-clusters and rural welfare and poverty. Based on the theory of change underlining agro-clusters, a positive relationship is expected between agro-clusters and income measures, and a negative relationship is anticipated with income poverty and the income poverty gap; the parameter estimate of δ should be positive for income indicators and negative for poverty outcomes. Assuming strict exogeneity, the OLS estimations should prove whether agro-clusters increase income and reduce poverty. However, strict exogeneity is difficult to assume in real life, and the share of land allocated to a cluster may be potentially endogenous. In this case, not controlling for the correlation between C_i and ε_i may lead to biased effects of agro-clusters on rural welfare and poverty. Endogeneity of agro-clusters may arise from measurement error, reverse causality, and unobserved heterogeneity.

In the case of measurement error, it is always challenging to claim the accuracy of the data generating process. Still, we are certain that the cluster participation was captured along with the actual amount of land allocated by farmers, given that these processes are well supervised and monitored. For unobserved heterogeneity, it is possible that unobserved factors, such as risks, preferences, and managerial abilities, may drive the amount of land that households allocate to clusters. As this study only obtained cross-sectional data, it is not possible to control for this eventuality. However, the coefficient stability is observed after the inclusion of different controls. Additionally, this study follows Oster's (2019) procedure to evaluate the robustness of the estimated coefficients to omitted variable bias.

Finally, there could be reverse causality issues between agro-clusters and the welfare and poverty indicators. Allocating more land to clusters may increase income and reduce poverty through the associated benefits of pooling resources from other households and enjoying economies of scale. However, when it comes to input purchases and commercialization, households generally more advantaged in income may allocate more land than their peers. This relationship is not straightforward,

given that land is an exogenous factor in Ethiopia². This relationship may only hold for households who allocate only small shares of their landholdings. There may be little or no income-land allocation effect for households that allocate most or all of their lands to the cluster.

Nevertheless, instrumental variable estimators are employed to control for any residual endogeneity. Two instruments are specified: awareness of the existence of agro-clusters and neighbor participation in clusters. Both instruments capture some level of social connectedness, which is critical to households' involvement in such new developmental schemes and programs. These instruments are motivated by the premise that networks ease information flow and reduce the barriers facing farmers in rural areas (Di Falco et al., 2020). Information spreads among neighbors, friends, and peers through a process of social learning (Krishnan and Patnam, 2014).

Given that agro-clusters are a new concept in study areas, awareness about their existence and functioning are necessary pre-conditions to participation. In such cases, it is intuitive to expect households to exhibit free-riding behavior to observe their neighbors and peers (Bandiera and Rasul, 2006). Awareness of agro-clusters is significantly correlated and positively determines our welfare and poverty indicators ($R^2= 26\%$, $p=0.000$). Neighborhood participation is also positively related to the outcome measures ($R^2= 26\%$, $p=0.06$). These two findings already validate the instruments based on the relevance condition (full results are provided in the appendix).

Examining the second condition of instrument exogeneity requires asking if the instruments directly affect welfare and poverty; intuitively, no effects are anticipated, except through agro-clusters. Being aware of an agro-cluster, or knowing if a peer is participating in these clusters, seemingly does not affect the outcomes. Apart from conceptually motivating this condition, there is typically no statistical test for this. However, since this study has two instruments, Wooldridge's score test of over-identifying restrictions, which is heteroscedasticity-robust, can be conducted (Wooldridge, 1995). As shown in the appendix, statistically insignificant estimates are obtained. Thus, this study fails to reject the null hypothesis that the instruments are valid. Based on the above checks, the instruments may be valid, but it is important to mention that eliminating all endogeneity sources is challenging when using cross-sectional data.

Effect Heterogeneity

Given that the effects of agro-clusters may have a heterogeneous association with household welfare and rural poverty, the authors are curious to understand this heterogeneity and establish which group of households benefit most; such understanding has implications for development plans and policy formulation. This is important for meeting the needs of more diverse households and avoiding

² Here, one must assume that income is directly related to land ownership, which may not be true; landholdings cannot be increased above a threshold no matter the growth of the income stream.

unintended effects on the poor and vulnerable, usually the intended targets of such rural development efforts.

Quantile regressions are employed, as they generally offer the possibility of moving beyond average effects to understand the heterogeneity of the estimated effects. Using the same connotations as in Eq. 1, the following regression model is estimated:

$$Y_i = X_i' \partial_\varphi + \varepsilon_i, \quad (Y_i | X_i) = X_i' \partial_i \quad (2)$$

X_i is a vector of explanatory variables, including agro-clusters. $(Y_i | X_i)$ is the conditional quantile of Y_i at quantile φ . The association between agro-clusters and rural poverty is estimated using nine different quantiles ($\partial_\varphi = 0.10, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80,$ and 0.90). $\partial_\varphi = 0.10$ represents the poorest group of households, which increases up until 0.90 .

Results

100 – 250 words

The OLS and IV estimates of the association between agro-clusters and income shows that belonging to an agro-cluster is positively associated with income and per capita income increases. The signs and magnitudes of the estimated coefficients are similar for both OLS and IV regressions, suggesting the robustness of the findings. Looking at the IV estimates, a 10 percentage point increase in the share of land allocated to agro-clusters increases income by approximately 104 USD. Similar insights are also obtained for per capita income; keeping other factors constant, a 10 percentage point increase in the share of land allocated to agro-clusters increases per capita income by about 16 USD. One possible explanatory mechanism is the likelihood of farmers to cooperate more in these clusters (Ostrom, 2010; Wardhana et al., 2020), as agro-clusters have been shown to improve interactions between members while building trust (Joffre et al., 2019; Joffre et al., 2020; Wardhana et al., 2020). Further, the results on income poverty indicate that agro-clusters reduce poverty; agro-clusters have the possibility of reducing income poverty by about 20 percentage points. A higher reducing effect is observed for the income poverty gap, where a percentage point increase in the share of land allocated to agro-clusters reduces the income poverty gap by about 29 percentage points. This is suggestive of the pro-poor nature of agro-clusters. These findings align with Wardhana et al. (2017), who earlier found that agro-clusters reduce poverty rates in Indonesia, with significant spillover effects.

Looking at effect heterogeneity using quantile regressions, all households (poor and non-poor) benefit from belonging to agro-clusters. However, high-income and wealthy households obtain the most significant gains. The benefits from belonging to agro-clusters increase steadily across the income quantiles. Given this finding, agro-clusters may be an effective strategy to increase household welfare and reduce rural poverty in Ethiopia. That said, disparities still exist between the different income categories. The results show that higher-income households may benefit more than low-income households, who are the intended targets, which may signify some form

of rural inequality. Nevertheless, with insights from the average and heterogeneous effects, agro-clusters may be instrumental in reducing rural poverty. Still, more emphasis could be placed on critically targeting and including the poor.

These findings are robust to alternative estimators, such as augmented inverse probability weighting regression and different measures and proxies of agro-clusters. The results are also unlikely to be driven by omitted variable bias after verifying using Oster bounds.

Discussion and Conclusion

100 – 250 words

Overall, the results suggest that agro-clusters could be an essential mechanism in achieving the sustainable reduction of poverty in all its forms. The findings provide further credence to the scaling up of agro-clusters as they have the possibility of increasing smallholder incomes and reducing poverty and the poverty gap. Fostering or scaling up agro-clusters will require strengthening rural and community institutions, such as access to land, extension support, and financial services. Moreover, access to financial and credit services may potentially help to avoid economic inequality. It will be crucial to direct these services specifically to push the poor and vulnerable households from their current conditions. Strengthening the extension and outreach system will also benefit smallholder farmers by reducing information asymmetry regarding knowledge and understanding of the existence and operations of agro-clusters. These actions would reduce fixed costs incurred by farmers in assessing and joining agro-clusters.

Given the inequality concerns, agricultural and development policies must consider heterogeneous household groups and resource levels when promoting novel programs and initiatives, like agro-clusters. As agro-clusters can provide different welfare gains to diverse smallholder households, it is crucial to adjust and tailor program activities to the local needs and realities and ensure that the poor, the intended targets, benefit sufficiently from these initiatives and programs.