Article

Specialization of Agricultural Cooperatives and Prospects for the Development of Cooperative Relations

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Abstract: This paperanalyzes the function ofagricultural cooperatives in promoting farmers economic efficiencyand integration into markets. Using a two-stage analytical framework, the first stage involves estimation of farmers' cooperative membership probability by logit regression model and second stage due to assessment of income following such membership is achieved by Ordinary Least Squares (OLS) regression. The results suggest that financial security, access of technological resources, exports profitability and knowledge about the benefits from cooperative participation positively influence the odds of being a member; while distrust negatively impacts them. The agricultural cooperatives in turn play their role in resource pooling, access to financial and technical resources; they could provide systemic arrangements for production and marketing activities, that would ultimately improve the competitive edge of the farmers within domestic as well as international markets. They conclude that being member to cooperatives might be linked to higher mechanization, growth in income and access to market. Both logit and OLS estimations confirm the argument that cooperatives are very essential institutional arrangements which serve as channel to integrate small- and medium-held farmers into wider market networks as well as part structures and agencies of development in support of sound socio-economic livelihood. Export participation, financial solvency and technical support emerged as leading factors of member livelihood growth. Therefore, the favorable environment that would encourage and guide the formation of agricultural coops should be a focal concern in our theory of agricultural policy. Furthermore, the analysis estimates that production efficiency could rise by 18–22%, and average incomes by approximately 30% if at least 60% of farmers in the agricultural sector become members. Membership in cooperatives also helps to reduce the risks that arise from logistics issues, quickens the process of exports and facilitates pre-pricing contracts on a contract basis all of this results in the reduction of economic risks for farmers. Agricultural cooperatives, on the whole, are indispensable for generating rural employment and maintaining economic sustainability, providing linkages to market and sustainable agricultural development through aggregating numerous fractured smallholdings into consolidated competitive market entities.

Keywords: Agriculture cooperatives, logit model, classical regression model

1. Introduction

Farming companies are able to generate farm produce but have organisational and financial difficulties accessing domestic and international markets including exports. Smallholders usually experience inadequate logistics and marketing services and could not afford modern agricultural equipment with individual ownership becoming uneconomical [1].

The maximum utilization of available resources in agricultural production with profit maximization aims at stable income for farming enterprises and an overall improvement in market integration, it is necessary to introduce modern management practices [2], [3]. In this regard, membership in farmer cooperatives becomes an important fisher folks' tool for economic and relatively social-economic stability. Cooperatives allow farmers to pool resources and access technical advice, financial assistance, organize ordering and marketing of produce efficiently, thereby increasing their competitiveness on domestic as well as foreign markets [4].

Ahmed and Mesfin examined the impact of membership in agricultural cooperatives on the well-being of smallholder farmers in eastern Ethiopia. The study utilized cross-sectional data and applied a logit model along with endogenous switching regression (ESR) methodology. The results indicate that cooperative membership significantly improves farmers' income and overall well-being [5], [6]. Furthermore, the study found heterogeneous effects, with resource-rich or better-informed farmers benefiting more from cooperative participation. This research highlights the importance of promoting cooperative membership as a policy tool to enhance both the economic and social conditions of smallholder farmers [7].

Achilleas Kontogeorgos found that farmers' education level, urban location, participation in cooperative management processes, and readiness to adopt future strategies positively influence their willingness to invest in agricultural cooperatives. Furthermore, the presence of heirs on their farms and larger farm sizes negatively affects their willingness to invest in cooperatives [8], [9].

2. Materials and Methods

According to Niyazmetov although cooperative membership provides economic benefits, farmers often perceive membership as a compulsory process due to the top-down implementation of state policies. These findings highlight the necessity of considering not only economic but also social and institutional factors in the development of cooperatives. The study also emphasizes that improving institutional compatibility is essential to enhance the effectiveness of policies aimed at promoting cooperative membership.

3. Results

Through cooperatives, farmers unite within a mutually beneficial system and are able to organize the entire process - from production to sales - in a systematic manner. Below, the impact of cooperative membership in four main areas is scientifically justified and explained [10].

Author's hypothesis on farmers' membership activity in agricultural cooperatives

Cooperative organizational activities are generally established on the basis of population size, land area, and membership fees. The success of a cooperative is based on membership participation, pooling resources among members, and an organized manner to operate [11-12]. Large size of Land holding and no. of members may have the economies of large production, reduce the cost and improve the efficiency. This in, itself, is a crucial aspect for management centralization, technical services distribution and work schedules coordination.

When it comes to finance, cooperatives mean many options for farmers. (2009) Membership fees and joint financial resources, in particular, provide access to credit. Small farmers, including also through cooperatives, can get access through low-cost credit

by which they may cover costs of equipment purchase, seeds or fertilizers [13]. Meanwhile, the financial monitoring and control systems executed at the cooperative level help optimize farmers' economic activities [14].

Cooperative members receive considerable benefits in product certification, logistics setup and exploitation of export opportunities. By establishing market prices and signing contracts for the sales of products in outlets, at export, cooperatives provide clarity and stability of income to farmers. And the unified management in the logistics system can make products' timely delivery to markets and avoid product losses.

(Most likely, one would add.) Nothing could bee further from the truth and cooperatives are key to development in much more than an economic sense. They add to income, employment and local infrastructure. Especially, cooperatives are recognized as a sound vehicle for youth and female employment. As a result, rural people have better quality of life and migration levels decrease [15].

n our analysis, the membership of agricultural cooperative and its economic impact are investigated through a two-step framework. In the first model, we employ a logit model to estimate the likelihood of farmers participating in a cooperative. This model is used for binary outcome variable(membership or non-membership) which will help us to statistically test out the probability effects of factors determining a farmer's decision making. Viable options such as the land size of the farm, access to credit facilities, possession of technical resources and involvement in organizational ventures are dominant independent variables at this stage. With the logit model we examine the impact of each one of these elements on cooperatives joining decision.

53 In this second step, we concentrate on the determinants of income growth once a farmer has joined into a cooperative. For this kind of analysis, we use a traditional regression model: Ordinary Least Squares (OLS). The dependent variable is the farmer's annual or average net income, and the independent variables are both socio-economic characteristics and post-membership services, like logistical convenience, product certification or market linkage.

With this model, the impact of the cooperative membership on farmers' income can be tested for statistical significance and even positive effect.

This two-step model is scientifically justified, as it enables a detailed exploration of the reasons for which farmers join ACOOPs as well as after-effects on their personal economic situation. The decision-making process is described by the first model, and a result of such a decision — by the second one. This way, the efficiency of cooperatives as well as their contribution to improve the welfare of farmers can be empirically and scientifically proved.

We apply the logit model in our study in order to determine the likelihood that farmers participate in agricultural cooperatives. This model provides a framework for dealing with discrete (binary) outcome variables and also expresses the process of decision making in terms of probability. That is, the probability (% yes) a farmer decides to organize in such a cooperative or not (0=no/1=yes), is estimated as an outcome resulting from explanatory variables like land size, credit access and technical resources. We then estimate, using the logit model, the way in which each of those factors impacts on a person's decision i.e. whether it increases or decreases the probability that one will belong to a co- operative.

The motivations influencing farmers to join agricultural cooperatives were analyzed in this study with a logit regression model. The model is fitting for this study since it considers binary outcome variables as here are cooperation (1) and defection (0), and the decision-making process can be translated into probabilistic form.

Four stand-alone logit models were generated, each representing a different set of factors that could influence farmers' determinations to join.The dependent variable Pi represents whether a farm household is a member of a cooperative (1 = member, 0 = non-member).

The general specification of the model is as follows:

$$\text{Logit}(Pi) = \ln = \left(\frac{Pi}{1 - Pi} \right) = \beta_0 + \beta_1 X_1 i + \beta_2 X_2 i + \cdots + \beta_k X_k i + \varepsilon_i$$

- Y_i– denotes the probability that a farmer joins a cooperative; i-th farmer (1 = member, 0 = non-member);
- $X_1 i$, $X_2 i$, $X_3 i$ ….. $X_k i$ – explanatory variables representing factors such as land size, access to credit, availability of machinery, and participation in organizational activities
- β_{10}, β_1, + β_2 ….. β_k are the estimated parameters;
- ε_i-random error term.

Among the factors analyzed are technical provision, export opportunities, financial stability, landholding size, production efficiency, level of trust, **and** knowledge about cooperation.

Table 1. Estimation of the probability of cooperative membership using the logit model

Factors/Models	Model 1	Model 2	Model 3	Model 4
Machenery/Equipment	0.12			0.18
Export			0.20	0.33
Financial stability	0.35	0.30		
Land area			0.17	0.44
Efficiency	0.17	0.10		
Uncertainty	-0.25		-0.30	
Knowledge about cooperatives		0.22		0.28

The first model is constructed based on factors such as technical equipment, financial stability, efficiency, and distrust. According to the analysis results, financial stability (0.35) significantly increases the probability of joining a cooperative. This indicates that economically stable farms are more likely to participate in cooperatives. Efficiency (0.17) also has a positive effect, suggesting that productive farmers perceive cooperation as beneficial. Distrust (-0.25), on the other hand, has a negative effect, meaning that when farmers have low trust in cooperative activities, their likelihood of membership decreases. Although the technical variable (0.12) is positive, its effect is relatively weaker. Overall, this model demonstrates the relationship between cooperation and both economic and psychological factors.

In the second model, attention is placed on farmers' knowledge regarding cooperation and economic features. The coefficient of the variable for cooperation awareness (0.22) is positively influencing to probability member and significant at $p<0.05$ level. This implies that farmers' knowledge directly affects their trust in cooperatives. Financial stability (+0.30) and efficiency (+0.10) are also positive effects. These results imply that farmers who can manage the farm well and recognize the advantages of cooperation are more open to cooperative membership.

In the third model, part of models (0.20), occupancy area (0.17) and distrust (-0.30) are influential someone with dating sites all considered significant factors. Farms oriented towards exports are likely to put a greater value on the possibility of reaching markets through cooperatives, leading to an increased probability of membership. The positive sign on the land area coefficient signifies that farms with abundant resources will tend to join cooperatives. The negative sign of distrust (-0.30) is however significant also with this model - and that enables us to conclude that the amount of trust one feels is still a central psychological feature for cooperators in the decision to cooperate.

The fourth model is developed on a dyadic level, which is the most aggregative approach considering export opportunities, land area and technical capacity, combined with knowledge for cooperation. The export variable (0.33) has the largest positive coefficient value implying that cooperatives significantly increase export openings. Land size (0.44) also has a strong positive influence, suggesting that cooperatives seem to benefit large farms most. Cooperation knowledge (0.28) reveals that well informed farmers have a positive perception regarding joining cooperatives. The positive coefficient of technical capacity (0.18) indicates that farmers are willing to seek technical input from the cooperatives. In sum, this model strongly supports the idea that the performance of cooperatives is multidimensional and always conditioned by common pool resources.

Based on the four logit models, the analysis was able to pinpoint specific factors that stimulated farmers' willingness to belong in a cooperative. Positive effects were observed for export opportunities, larger farm size, increased technical and financial capability and more knowledge about cooperation. On the other hand, there was a negative effect on distrust in all models, showing that its reduction is essential for cooperatives to grow. Findings reveal that joining a cooperative is a composited process and requires an integrated approach of the economic, institutional, and psychological dimensions.

The probability of cooperative membership (1 = the default value, 0 otherwise) was estimated using a logit regression model. The covariates incorporated into the model – mechanisation level, efficiency, financial viability and mistrust and knowledge on cooperation – showed how they affect the log-odds of belonging to one category of the dependent variable. For instance, the positive sign of financial stability (0.35) means that those financially stable farmers are more positively linked to join in cooperative except other's institutional arrangement in rural or remote area. On the contrary the negative coefficient of distrust (-0.25) indicates that farmers who have lower trust in cooperatives are less probably to join them. During the modeling process, the statistical significance of each coefficient was tested using the t-test (z-value). Most of the indicators were significant at the 5% level, with p-values < 0.05. This confirms that the factors included in the model have a statistically significant impact on the probability of cooperative membership.

To assess the overall quality of the model, several evaluation approaches were applied, including the Likelihood Ratio (LR) test and the Hosmer–Lemeshow test. In the LR test, the *p*-value was very small (<0.01), leading to the rejection of the null hypothesis that all coefficients are equal to zero. This indicates that the model, as a whole, is statistically significant.

The Hosmer–Lemeshow test was used to evaluate the goodness of fit between the predicted and observed values, and the results showed a satisfactory level of alignment. Additionally, the Pseudo R^2 (McFadden's R^2) values ranged between 0.22 and 0.31, which is considered reasonably good for a logit model. This suggests that the models are well-fitted and capable of accurately predicting the probability of cooperative membership based on the included factors.

In the present study, the determinant factors for economic growth of farmerâ€ members in agricultural cooperative were examined by OLS regression model. The logit model that analyzed the likelihood of cooperative membership, -- answering which farmers are more probably to join— this phase concentrates only the subsequent economic effects after having become a member.

That is, the primary focus of this analysis is to identify what increases in farm income farmers experience after joining a cooperative. Being income as the dependent variable, the ci tation includes essential factors like accessibility to machinery, availability of export prospects, extent of landholding livelihood and financial stability, and assess their correlation with farmer's income.

The study finds that on the average farmers raised at least some production factor thereby increased level of mechanization after their entry to cooperatives and adoption by

one unit in access to machinery would increase income about 22 percent. This shows that cooperatives allow farmers to lease expensive equipment together, and help them in reducing cost and increasing productivity.

The cooperatives' structured technical services enable farmers to keep the production efficiency level and not merely depend on buying individual equipment. Financial stability had the highest positive impact (0.31) on income, supporting that being a member of cooperative allows farmer to have an easier access to bank credit, improves their financial planning and provides them enhanced financial stability.

According to us, the membership of farmers in cooperatives is considered as one of the significant approach for enhancing easy access for financial resources. In particular, for small farms this is a better alternative than using each such device individually.

Activities related to export were among the most significant economic drivers for cooperative members. The value of 0.35 also clearly reflects the improvement in income from engaging with export-based activities. Once they joined coops, farmers were able to take advantage of these services for product packaging and export facilitation - services that individual farmers did not have much access to.

Landholding size also had a positive impact on income growth, with a coefficient of 0.28. It appears that in larger areas, the land is more rationally used when under cooperative management because resources can be better exploited.

We are convinced that the cooperative society format is keen to increasing farmers' income, as it brings together relations of smaller and medium sized landowners, which allows for their scale production profile, obtaining a better quality of product; ensuring an access to market.

4. Conclusion

In conclusion, the empirical evidence indicates that cooperative membership is associated with significantly higher levels of economic efficiency among farmers. The results of the OLS regression analysis statistically confirm this relationship. Notably, export activity, financial stability, and technical support emerge as key determinants contributing to the substantial income growth of cooperative members. These findings imply that cooperatives function as vital institutional mechanisms for integrating small-scale farmers into markets while enhancing their access to financial and technical resources.

According to our scientific position, cooperation serves as a decisive factor in increasing farmers' income, achieving economic stability, and ensuring employment in rural areas. Therefore, supporting the activities of agricultural cooperatives, developing them systematically, and strengthening their institutional foundations should be considered one of the key and priority directions of agricultural policy.

The OLS (Ordinary Least Squares) regression model was constructed based solely on farmers who are members of cooperatives, analyzing the key factors influencing income - namely, technical provision, export activity, landholding size, and financial stability. All coefficients in the model were positive and economically meaningful, with export (0.35) and financial stability (0.31) emerging as the most influential factors. The t-test results for each variable confirmed their statistical significance within the model. For the factors of technical provision, export activity, and financial stability, the p-values were less than 0.05, indicating a significant impact on income. These findings were further supported by high t-statistics ($t > 2$).

In assessing the overall quality of the model, the significance of the regression was tested using the F-test. The F-statistic was 9.45, indicating that the model as a whole is statistically reliable ($p < 0.001$). This implies that the set of variables included in the model explains a significant portion of the variation in income. The R^2 value of 0.48 and the Adjusted R^2 value of 0.44 demonstrate that the model accounts for approximately 48 percent of the variance in income - a sufficiently high level for socio-economic models.

Furthermore, no multicollinearity was detected (VIF < 2), the residuals were normally distributed, and the assumption of homoscedasticity was not violated. These results confirm that the OLS model fully satisfies the statistical requirements for validity.

If at least 60 percent of farmers in the agricultural sector become members of cooperatives, it is possible to estimate the resulting change in production efficiency based on the OLS model coefficients obtained from our empirical analysis.

Under this scenario, farmers' financial stability increases by 20%, export potential by 25%, and the level of mechanization by 15%. This, in turn, allows forecasting at least an 18–22% growth in overall productivity. Moreover, the income indicators are expected to rise by approximately 30% on average. Therefore, broader membership in cooperatives not only enhances production volume but also significantly strengthens the overall stability of farming enterprises.

In addition, according to alternative calculations based on the scenario, regions with a higher probability of cooperative membership - as estimated through the logit model - demonstrate better economic outcomes. Specifically, these regions experience reduced logistics challenges, faster export delivery times, and shorter certification processes. The increase in cooperative membership also expands the practice of contract-based pre-pricing, which helps farmers mitigate economic risks. Overall, if government-level strategies to support cooperative activities are strengthened, this will lead to higher efficiency, stable incomes, and enhanced export potential in the agricultural sector.

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