











Article

The Impact of Cooperative Membership on Fish Farm Households' Income: The Case of Ghana

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Abstract: The emergence of agricultural cooperatives is extensively viewed as a necessary institutional arrangement that can help farmers in developing countries overcome the constraints that impede them from improving sustainable agricultural production and acquiring new marketing opportunities. Therefore, this study examines the determinants of cooperative membership and its impact on fish farm household income, using data collected from two regions in Ghana. An endogenous switching regression (ESR) model is utilized to address the potential sample selection bias issue. The results show that household heads' decisions to join cooperatives are affected by their access to credit, off-farm work, education level, and peer influence. Cooperative membership can increase both household and farm income by 28.54% and 34.75%, respectively. Moreover, we show that different groups of households' cooperative impacts on farm and household income are heterogeneous. Our findings highlight the importance of cooperative patronization and provide implications that can improve households' welfare.

Keywords: cooperative membership; fish farms; household income; endogenous switching regression model; Ghana



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1. Introduction

The source of animal protein of about one billion individuals in the world is fish [1]. Captured fisheries and aquaculture sector contributions to world development cannot be concealed. For example, millions of people in the world obtain food, nutrition, and income from the fishery sector [2]. In Ghana, fish accounts for 60% of the animal protein consumption, i.e., three times higher than that of the entire world, which is 15% [3]. Ghana is ranked among the high fish-consuming nations in Africa, i.e., a per capita consumption of 26 kg, which is higher than the 10 kg average for Africa and 20.3 kg for the world [4]. Also, about 10% of the population in Ghana depends on the fishery sector for their subsistence. Thus, the fishery sector serves as a source of livelihood enhancement and food security for people [5].

In Ghana, a nation surrounded by lakes, rivers, and the sea, dependency on captured fisheries is prominent. However, due to challenges such as illegal fishing, land pollution due to mining, over-fishing, poor management practices, and an increasing population [1,6], the nation currently imports over 60 percent of its fish. The Ministry of Fisheries and

Aquaculture Development (MoFAD) further revealed that Ghana, in 2016, imported \$135 million worth of fish because of the reduction in the country's fish stock [6]. Therefore, improving aquaculture has been one of the core policies of the governments and NGOs in Ghana because it serves as a necessary technology to bridge the gap between supply and demand for fish [7] and help improve household livelihood [5].

Despite the attention given by the government to improving aquaculture and its growth in the country, its core players (fish farmers) are faced with challenges such as inadequate capital and credit facilities and high cost of production [4,8]. These problems affect aquaculture production detrimentally. Nevertheless, many of these problems can be remedied if household income increases. A rise in income could make the farmers better off in responding to these kinds of challenges, thus making them financially sound and improving fish supply and, hence, enhancing economic growth through food security and job creation. Improved household income, which includes farm income, is a prerequisite for farmers to reinvest in their farms to improve farm production and household living standards. Improving farm household income can help farmers' own assets, help them reinvest in their farms and in other profitable ventures, create jobs, ensure food and nutrition security, and help reduce the economic burden on society at large [9–11]. In recent times, goals to alleviate poverty and ensure food and nutrition security in most developing countries have been at the forefront of national and international policy agendas. The reason is that the United Nations Sustainable Development Goals (SDGs) emphasize the need to significantly reduce poverty and ensure food and nutrition security 2030 [12]. Therefore, understanding the factors likely to influence fish farm household income, a key element of household livelihood empowerment, is essential. Improving household income is an approach that can help national governments to achieve the United Nations poverty alleviation goal domestically. One of the key determinants of farmers' income is agriculture cooperative [13–15].

Agricultural cooperatives are a significant factor in the agricultural sector, helping farmers alleviate poverty through high production and profitability [9,10,15,16]. For instance, Zhang et al. [10] revealed that cooperatives make it possible for farmers to have a collective power by which they can have access to inputs, services, and markets to boost their income, which cannot be acquired individually. Thus, agricultural cooperatives are ideal member-owned organizations that offer the institutional structures through which farmers can control the production and marketing of their farm produce and facilitate access to services to boost their income and strengthen their economic situation [15].

Also, agricultural cooperatives can enhance farmers' access to markets, financial and non-financial services, and strengthen their economic situation. For example, cooperatives empower their members (farmers) to succeed in collective bargains with both buyers of farm produce and sellers of farm inputs [16]. In all, agricultural cooperatives have generally been regarded as an effective means to help farmers improve their productivity and wellbeing [10,13,17]. In spite of all the benefits derived from agricultural cooperatives, Hailu et al. [18] study in Ethiopia showed that cooperatives have an insignificant effect on farmers' efficiency level. The reason for this insignificant result could be attributed to the use of inappropriate estimation methods. The study did not account for selection biases.

Research on the impact of agricultural cooperatives on farm productivity, price and household welfare [18–21] farm inputs [22], and farmers' adoption of new technologies [23] in developing countries have been explored. However, this existing research focused on crop farmers or households rather than fish farm households. Again, prior studies that have examined the effect of cooperatives on fish farming are either qualitative analyses [24,25] or quantitative analyses [26], which fail to account for selection bias. Therefore, this present study's primary objective is to explore the impact of cooperative membership on fish farm household income. The empirical analysis of this study is estimated by using fish farm households survey data collected from two regions in Ghana. This paper's contributions to the literature are twofold. First, to the best of the authors' knowledge, this is the first study to explore the quantitative impact of cooperative membership on fish farm household

income. Thus, the paper focuses on how cooperatives influence fish farmer or farm household income (welfare), which has not received much attention. Prior studies [16,24,27,28] mostly focus on the cooperative membership effect on crop farmers or farm households. Second, the study employed an appropriate estimation method, the endogenous switching regression (ESR) model. The model takes into consideration the selection biases caused by observable and unobservable characteristics. Aside from the study of Ma and Abdulai [29], which employed the ESR model to explore the impact of cooperatives on agriculture production, the remaining research used the propensity score matching (PSM) estimation method, which only accounts for observable factors. However, our paper focuses on fish farm households, while Ma and Abdulai's [29] study focused on crop farm households.

2. Conceptual Analysis

The role of cooperatives on household income may have dynamic pathways. Thus, joining a cooperative may have both a positive and negative impact on household income. On the one hand, as individuals become members of a cooperative association, they enjoy the benefits attached. The FAO [2] and Stutzman et al. [27] revealed that several constraints and difficulties (e.g., inadequate credit facilities, poor market accessibility, extension services problems) bombarding fish farmers in Sub-Saharan Africa (SSA) are curbed by the presence of cooperatives associations. For example, Stutzman et al. (2017) showed that fish farm cooperatives have helped enhance fish farm income growth through financial supports and socialized services from other members, hence improving household welfare. Financial support enables farmers to acquire needed inputs to improve productivity [28,30,31]. As farm income increases, farmers can diversify their income by securing off-farm activities to boost household income [32,33]. However, while off-farm work contributes to household income, it may have a detrimental effect on farm income. The reason is that farmers with off-farm activities may have divided attention; thus, they may spend less time on farm activities, decreasing productivity [32]. Therefore, analyzing the impact of cooperative membership on household income heterogeneously for farmers with and without access to off-farm activities is explored in this study.

Also, access to credit and the market and some input acquisition may be more difficult for low-income households to acquire than high-income households. The reason is because of high transaction costs (e.g., the cost incurred in a loan application or in searching for buyers and buying inputs) [34]. However, these costs are reduced through cooperative marketing, financial support, and socialized services [21,35]. For instance, Goyal's [35] study in India revealed that the establishment of kiosks by farm cooperatives to improve members' market accessibility enhanced poor members' productivity and income. Therefore, we will examine the heterogeneous cooperative membership effect on income for low- and high-income household groups in this study.

On the other hand, joining a cooperative may add less or no value to household income. For example, a cooperative association may lack effective and efficient leaders who can promote the development of the association to improve the wellbeing of the members; thus, farmers' performances may decrease rather than increasing [36]. Another reason for the negative impact of cooperatives on household income can be related to householder/household members' health statuses. For example, if a householder or household member suffers from a chronic disease, farm and household income are detrimentally affected [37]. The reason is that the funds and time needed to increase productivity and income are spent on unhealthy members. Also, the household labor force may be reduced due to health problems [38]. Therefore, being a cooperative member does not always guarantee a high household income. The study also examines the heterogeneous cooperative membership effect on income for households who have members with chronic disease and those without such members.

However, with well-educated and enthusiastic cooperative leaders, joining a fish farm cooperative association is likely to empower the farm household welfare. The motivation for

this study is based on the analysis above. Our study contributes significantly to policymakers and fish farmers through the beneficial policy implications of our findings.

3. Methodology and Descriptive Analysis

3.1. Econometrics Model

The objective of this study indicates that there might be potential endogeneity issues in cooperative membership; therefore, it is vital to address them. The reason why the cooperative variable is endogenous is that joining a cooperative association is a choice and, also, all fish farm households have an equal chance to join an association [39–41]. Again, factors influencing a fish farmer to join a cooperative may affect household income as well. Therefore, employing an appropriate econometric model, rather than an ordinary least square (OLS) method, to overcome this endogeneity problem is essential. Econometrics methods, such as the propensity score matching (PSM) model and endogenous switching regression (ESR) model, are mostly considered as appropriate methods to deal with endogeneity problem. However, in this study, the ESR model is selected over the PSM due to various reasons. First, the ESR model accounts for selection bias by treating selectivity as an omitted variable problem [42]. Second, unlike the PSM, which does not account for unobserved characteristics such as the household head's innate attitudes, perceptions, and motivations, selection bias arising from both observed and unobserved characteristics can be resolved by the ESR model [29,43]. Employing the ESR model also helps in capturing the different responses from the two groups (those who are not cooperative members and those who are not members); thus, a whole sample of members and non-members can be observed [44,45].

Let I_i^* represent the outcome variables (farm and household income). In this linear equation, the outcome variables are regressed on both the exogenous (γ_i') (e.g., age, access to credit, household size) and the endogenous (cooperative membership (CM_i)) variables.

$$I_i^* = \gamma_i'Z + \alpha CM_i + v_i \quad (1)$$

We also assume that farmers become cooperative members after they have analyzed the expected utility gain derived from being a member or not. After observing that the utility gain for being a member (U_{i1}^*) is greater than not being a member (U_{i0}^*), the farmer then joins the cooperative association. Thus, a farmer becomes a member if $CM_i^* = U_{i1}^* - U_{i0}^* > 0$, where cooperative membership refers to CM_i^* . This phenomenon can be expressed by a latent variable equation (Equation (2)) because of the impossibility of observing the utility differences directly.

$$CM_i^* = \beta X_i + \mu_i \quad CM_i = \begin{cases} 1 & \text{if } CM_i^* > 0 \\ 0 & \text{if } CM_i^* \leq 0 \end{cases} \quad (2)$$

where CM_i^* is household head i cooperative membership status; CM_i is equal to one (1) if the household head is a member of a cooperative and takes the value of zero (0) otherwise; X_i is the vector of exogenous variables, including household head and household characteristics, as well as other factors (e.g., pond size, distance to the market, access to credit, extension services and off-farm work, and many others (see Table 1)); β and μ_i represent the vector of parameters and the random disturbance term, respectively.

In the second stage, the empirical estimation method follows [46] and is depicted as: Regime 1 (cooperative membership)

$$I_{1i} = \gamma_{1i}Z_1 + \varepsilon_{1i}, \text{ if } Y_i = 1 \quad (3)$$

Regime 2 (non-cooperative membership)

$$I_{2i} = \gamma_{2i}Z_2 + \varepsilon_{2i}, \text{ if } Y_i = 0$$

where I_{1i} and I_{2i} refer to the incomes of a household whose head joins a cooperative and those that of a household whose head does not join a cooperative, respectively; γ_{1i} and γ_{2i} are vectors of exogenous variables. These variables also include household socioeconomic, demographic, and other characteristics that influence the outcome variable. Z_1 and Z_2 are vectors of parameters and ε_{1i} and ε_{2i} are random disturbance terms.

In addition to this approach, the creation of correlations between the error terms of the selection (Equation (2)) and outcome (Equation (3)) equations caused by unobserved factors must be undertaken; thus, $\rho_1 = \text{corr}(\mu_i, \varepsilon_{1i})$ and $\rho_2 = \text{corr}(\mu_i, \varepsilon_{2i})$ differ from zero [46–48]. However, both observable and unobservable factors creating this selection bias are dealt with using the ESR model by, first, calculating the inverse mills ratios (λ_{1i} and λ_{2i}) based on Equation (2) and, second, inserting them in Equation (3). Thus, Equation (3) can now be expressed as:

$$\begin{aligned} E(I_{1i}|Y_i = 1) &= \gamma_{1i}Z_1 + \sigma_{1\mu}\lambda_1 \\ E(I_{2i}|Y_i = 1) &= \gamma_{2i}Z_2 + \sigma_{2\mu}\lambda_1 \end{aligned} \quad (4)$$

where $\sigma_{1\mu} = \text{cov}(\mu_i, \varepsilon_{1i})$ and $\sigma_{2\mu} = \text{cov}(\mu_i, \varepsilon_{2i})$ in Equation (4). Therefore, in this study the authors estimated both the selection and outcome equations simultaneously using a full information maximum likelihood (FIML) method [46,49]. The use of the ESR model requires some variables as instruments. Thus, at least one variable identified as an instrument in X in Equation (2) should be omitted in γ in Equation (3) (that is, variables that have no direct influence on the outcome indicators (farm and household income) but directly influences the treatment (cooperative membership)). Therefore, in this study we used the variable “peer influence” (whether the farmer’s friend/relative is a farm cooperative member) as an instrument for the treatment, following Zhang et al. [10]. This instrument is chosen because it indirectly correlates with the outcome variable but also correlates with the treatment variable. For example, [10] revealed that farmers join cooperative associations based on good information or reports gathered from friends or relatives who have already obtained their membership.

The average treatment effect on the treated group (ATT) is also taken into account in this study. It is calculated by the conditional expectations of the treated group (Equation (5)), i.e., those who join cooperatives. It is expressed as;

$$\begin{aligned} ATT &= E(I_{1i}|Y_i = 1) - E(I_{2i}|Y_i = 1) \\ ATT &= (Z_1 - Z_2)\gamma_{1i} + (\sigma_{1\mu} - \sigma_{2\mu})\lambda_1 \end{aligned} \quad (5)$$

Dealing with Potential Endogeneity in Cooperative Membership Status

Some of the determining variables, i.e., access to credit and extension services of cooperative membership in Equation (2), are potentially endogenous. The reason for this endogeneity issue is the reverse causality issues. Thus, access to credit and extension services affects farmers’ decisions to join a cooperative. For example, the ability of cooperatives to support their members financially through flexible means may encourage farmers to join a cooperative. Also, extension officers may influence farmers to join cooperatives in order to gain knowledge and information on new technologies they have provided to the farmers; therefore, farmers join cooperatives. However, on the other hand, these variables are affected by cooperatives. For example, cooperatives reduce information asymmetry and help farmers to obtain credit. Furthermore, because of cooperative meetings and discussions, farmers may be aware of the benefits associated with extension services; thus, they are likely to access them. The authors followed the strategies employed by Ma and Abdulai [29], due to the binary nature of the dependent variable (cooperative status), in order to deal with this endogenous problem. In this approach, we specified the potential endogenous variables (access to credit and extension services) as functions of all other

explanatory variables given in Equation (2). Instrumental variables were then added in the first stage regression and expressed as:

$$H_i = \beta X_i + \omega T_i + \varphi_i \quad (6)$$

where H_i means extension contact and access to credit, the observed potential endogenous variables, X_i is explained in the previous section, and T_i is a vector of instruments. These selected instruments, which should not correlate with the “peer influence” variable in the ESR model, should have a direct effect on the given potential endogenous variables, but not the cooperative membership status. Here, the selected instruments include; “perception”—whether the farmer perceives that extension services are useful or not (employed in the extension service equation); and “distance”—the distance to the farmers’ source of credit (e.g., bank, friends, relatives) in kilometers (employed in the access to credit equation). Thus, in conclusion, the new cooperative membership status specification must include both the observed factors and the residual predicted from Equation (6). The model is expressed as:

$$CM_i^* = \delta X_i + \alpha H_i + \theta R_i + \theta_i \quad (7)$$

where R_i is the endogenous variables’ residual terms predicted from Equation (6) [50]. The addition of appropriate residuals in estimating the second stage equation changes the endogenous variables to appropriate exogenous variables because these residuals serve as control functions. The approach leads to a robust, regression-based Hausman test for endogeneity of the suspected variables [51].

3.2. Data Source

This study’s data comes from a fish farm household survey in Ghana in the period February–April 2018; 131 fish farms households were involved in the survey. A multistage sampling technique was applied in generating our sample size. Two (2) regions, namely Ashanti and Bono East, were selected in the first stage. We selected these two regions due to the high level of smallholder fish farming participation in most the districts [6]. In the second stage, we purposively selected pond fish farm households because the most patronized fish farming method in these regions compared with other methods is earthen pond fish farm production. Again, these farms were selected from zones under the authority of the regional fisheries commissions for administrative and monitoring interventions. With the help of farmers’ cooperative association leaders and other farmers, 70 farm households were selected from each region. These farm households included both cooperative and non-cooperative members. However, 9 out of the 140 questionnaires administered were found to be not accurate enough for the analysis and were thus withdrawn. In all, 86 cooperatives and 45 non-cooperative members were used for the analysis.

Interview schedules and questionnaires were used for the collection of data from rural farm households in Ghana. The authors, together with enumerators who spoke the local language, conducted face-to-face interviews with the farmers by employing a pretested and structured questionnaire, due to the complex nature of the questionnaire. We included in the questionnaire questions on household/householder socioeconomic characteristics (e.g., age, gender, income, education), farm characteristics, access to credit, market and off-farm jobs, household cooperative member status, and various other variables contributing to the study’s aim. The income in this study was gathered at the household level and included total net farm and household income. Household income in this study meant the addition of farm and off-farm income together with other sources of income such as rent, remittances, and dividends. All these incomes were measured as Ghana cedis (GH¢)1000/capita. Concerning the cooperative membership status, we assigned the value one (1) to a household head who was a member for the past 12 months and the value zero (0) otherwise. The reason for dealing with the head of the family was because they implement most household decisions. Using SPSS 26 and Stata 14, we generated our results for the study.

3.3. Descriptive Analysis

Table 1 shows the characteristics of the variables used in the analysis of the study. From Table 1 it can be seen that the majority of the respondents (66%) were fish farm cooperatives members. The average total net household and farm incomes were GH¢5.01 and GH¢3.16 per capita. The average pond size was 0.5 per hectare. While 72% of the respondents were male, 58% and 44% of them had friends or relatives who were cooperative members and family members with chronic diseases, respectively.

Moreover, 52%, 63%, and 74% of the respondents had access to credit, extension services, and off-farm work, respectively. The mean years of schooling, age, and farming experience of the respondents was approximately 11, 40, and 12 years, respectively. The average family size was four, while the mean distance to the market was about 7.22 km. Most of the respondents had more than ten years of experience in farming, which gives a fair basis of comparison, whether being part of the cooperative provides more benefits or otherwise.

Table 1. Socioeconomic, demographic and other characteristics of the respondents.

Variables	Description	Mean	Std. Dev.
Household income	Total net household income (in GH¢1000/capita)	5.01	4.26
Farm income	Total net farm income (kg/ha in GH¢1000/capita)	3.16	3.82
Cooperative membership	1 if the household head is a member of a cooperative association and 0 otherwise	0.66	0.47
Chronic disease	1 if the household has a member with a chronic disease and 0 otherwise	0.44	0.47
Pond size	Total fish farmland (in hectares)	0.49	0.78
Access to credit	1 if the household has access to credit and 0 otherwise	0.52	0.46
Access to extension services	1 if the household has access to extension services and 0 otherwise	0.63	0.48
Off-farm employment	1 if the household head has off-farm employment and 0 otherwise	0.74	0.51
Education	Household head years of formal education	10.90	4.51
Age	Respondents age	40.13	7.72
Experience	Year of farming experience	11.75	2.43
Household size	Total number of household size	3.49	1.13
Gender	1 if respondent is male; 0 otherwise	0.72	0.51
Peer influence	1 if the household head's friend/relative is a farm cooperative member	0.58	0.47
Ashanti	1 if household resides in Ashanti; 0 otherwise	0.53	0.48
Bono East	1 if household resides in Bono East; 0 otherwise	0.47	0.51

Source: survey results, February–April 2018. Note: 1 USD = GH¢4.9.

The differences between the means of the cooperative and non-cooperative members are shown in Table 2. Households who are part of a cooperative were likely to hold higher household and farm income than non-cooperative members. Also, cooperative members had easy access to credit, making it easier for them to embark on any kind of expansion exercise on their farms. Table 2 further shows that non-cooperative members had fewer friends or relatives who were cooperatives members than cooperative members. Again, cooperative members tended to have more considerable farm income, a longer distance from the farm to the market, higher education, and more significant farming experience compared with their counterparts. There were significant differences between members and non-members based on their regions. This comparison gives the impression that one key element to improving agricultural productivity and farm household wellbeing is agricultural cooperatives, considered relative to non-members. However, using the findings in Table 2 to conclude that being a cooperative membership improves household income is inappropriate because the mean differences between these two groups do not take into consideration confounding factors such as unobserved factors (e.g., farmers' intuitive knowledge, perceptions about risks, and what motivates a farmer to be a member).

Table 2. Differences between means of cooperative and non-cooperative members key variables.

Variables	Member	Non-Member	Difference
Household income	6.11 (3.44)	3.91 (2.76)	2.20 ***
Farm income	4.24 (2.97)	2.08 (1.11)	2.16 **
Chronic disease	0.48 (0.49)	0.40 (0.51)	0.08
Pond size	0.57 (0.47)	0.41 (0.47)	0.16 *
Access to credit	0.68 (0.55)	0.36 (0.43)	0.32 ***
Access to extension service	0.64 (0.48)	0.62 (0.50)	0.02
Off-farm employment	0.79 (0.57)	0.69 (0.49)	0.10
Education	12.68 (7.87)	9.12 (5.91)	3.56 **
Age	39.51 (9.73)	40.75 (9.51)	−1.24
Experience	12.66 (3.98)	10.84 (2.55)	1.82 *
Household size	3.87 (0.97)	3.11 (1.22)	0.76
Gender	0.71 (0.52)	0.73 (0.49)	−0.02
Peer influence	0.67 (0.50)	0.49 (0.49)	0.18 ***
Ashanti	0.56 (0.47)	0.50 (0.46)	0.06 **
Bono East	0.53 (0.49)	0.41 (0.45)	0.12 **

Source: survey results, February–April 2018. Note: 1 USD = GH¢4.9. Note: *, ** and *** represent significance at 10%, 5% and 1% levels, respectively; Standard errors are presented in parentheses.

4. Results and Discussions

4.1. Determinants of Cooperative Membership

The factors influencing the cooperative membership status of household heads are presented in Tables A1 and A2. In this section, the influence of significant variables found in the selection equations in both Tables A1 and A2 on the choice of cooperative membership is considered. As shown in the results, the distance to the market variable was positive and significant, indicating that fish farmers with their farmlands far from the main market were more likely to associate with cooperatives. This is because cooperatives may help members find a market for their product [10,52], which may reduce other transaction cost incurred through transportation. Thus, cooperatives are beneficial to farmers living far away from the market. This finding contradicts the studies of Verhofstadt and Maertens [21], who revealed that farmers living near the market area are likely to become cooperative members.

Similarly, household heads who had access to credit were more likely to be members of a cooperative association compared to those without access to credit. Cooperatives help their members to acquire financial support through trade credit and credit from financial institutions. Also, access to credit can help farmers improve their productivity and efficiency [53], all other things being equal, which may lead to the search for a vast market to sell their products. However, since one of the main aims of cooperatives is to promote access to the market for its member, farmers with high productivity are willing to join. This result is consistent with the findings of [28,54,55]. The coefficient value of off-farm employment was positive and significant. This suggests that having an off-farm job increased the likelihood of belonging to cooperative associations. Off-farm work may take up most of the time spent on farm activities; therefore, farmers are willing to join a cooperative to receive supports when the need arises.

Moreover, the probability of fish farmers being a cooperative member increased with the years of formal education of household heads. Relative to less or no educated farmers, educated farmers may have learned more about the importance of joining a cooperative, i.e., educated heads well understand the opportunity cost of not being a cooperative member. This finding confirms the results of [20], which showed that formal education is likely to increase the awareness of the benefits of joining cooperatives. Cooperative membership status was also positively and significantly affected by the peer influence variable. This suggests that household heads who have friends or relatives in a cooperative association are more likely to become members. The trust and willingness to join a cooperative increase when farmers see the benefits enjoyed by their friends or relatives who are members of

an association [10]. Fish farmers located in the Ashanti region were more likely to join cooperatives compared to farmers who reside in other regions. This finding is consistent with [29], who showed that variance in agricultural climate, different environment resources, availability, and access to agricultural institutions and infrastructure in different regions affect the decision of farmers in choosing to join cooperatives.

4.2. The Impact of Cooperative on Household and Farm Income

In this section, the results of the ESR model, which can be found in Tables A1 and A2 in the Appendix A, are presented. As expected, the impact of “peer influence,” the instrumental variable, on the cooperative membership status was statistically significant and positive. The outcome equation results are also presented in the tables. The authors decided not to give detailed explanations of other factors that affected any of the outcome variables in Tables A1 and A2 due to the objective of the study and also to save space. However, we are willing to provide explanations on request.

As depicted in the two tables, ρ_1 and ρ_2 have significant signs, suggesting that the decision to join a cooperative association was not randomly distributed and that a selection bias exists. Further, the farm and household income equations’ Wald tests for joint independence showed a significant sign at the 1% level, indicating that rejecting the null hypothesis of no correlation between the treatment error μ_i and the outcome errors (ε_{1i} and ε_{2i}) is appropriate. The findings reveal that both unobserved and observed factors simultaneously contribute to selection bias; therefore, the ESR model serves as the appropriate estimation method.

Since the effects of cooperative membership on both farm and household incomes are not well specified in Tables A1 and A2, we calculated the ATTs. As shown in Table 3, the ATTs reveal the quantitative impact of cooperative membership on the outcome variables. Unlike the mean differences that did not take into account confounding factors in Table 2, the results of the ATTs in Table 4 are estimated by accounting for the selection biases. Table 3, which depicts the results of the change in the ATTs, reveals that fish farmers who were members of cooperatives could increase their household and farm incomes by 28.54% and 34.75%, respectively. The results confirm that cooperative associations aim as a mechanism at promoting agriculture performance and household welfare [10]. Members acquire skills and ideas to overcome challenges causing a detrimental effect on fish farms’ profitability and productivity through educational training and lectures organized by the association [54,56]. Lectures on topics like how to participate in the financial market, start a new business, and various other ways to improve income are often discussed during meetings, thus enabling the farmers to diversify their income to pursue more lucrative ideas and enhance household sustainable development [55]. Also, members can secure off-farm jobs to boost household income through social networking from other members [33]. Although fish farm households may be looking for an avenue to enhance household livelihood, this study indicates that joining a cooperative association can be a better tool for sustainable income growth for farm households.

Table 3. Impact of cooperative membership on income.

Outcome Variable	Mean Outcome		ATT _{ESR}	t-Value	Change
	Members	Non-Members			
Household income	6.26(4.15)	4.87(2.70)	1.39	6.18 ***	28.54%
Farm income	4.77(2.71)	3.54(1.98)	1.23	4.94 ***	34.75%

Source: survey results, February–April 2018. Note: 1 USD = GH¢4.9, *** represents statistical significance at 1% alpha levels. All numbers in parentheses are robust standard errors.

Table 4. Impact of cooperative membership on income with reference to household member chronic disease status, access to off-farm job and household income group.

		Mean Household Incomes			t-Value	Change
Variables		Members	Non-Members	ATT _{ESR}		
Chronic disease	Yes	5.41(3.21)	4.83(2.07)	0.58	6.49 **	12.01%
	No	6.96(3.95)	5.72(2.14)	1.04	4.77 ***	18.18%
Access to off-farm job	Yes	7.22(4.02)	5.40(2.91)	1.82	5.61 ***	33.70%
	No	5.87(3.18)	4.69(2.08)	1.18	3.38 **	25.16%
Income group	High	7.81(3.71)	6.19(3.52)	1.62	8.76 **	26.17%
	Low	5.53(2.01)	4.61(1.84)	0.92	5.41 ***	19.96%
		Mean Farm Income			t-Value	Change
Variables		Members	Non-Members	ATT _{ESR}		
Chronic disease	Yes	4.17(2.92)	3.81(1.54)	0.41	4.77 *	9.45%
	No	5.13(2.34)	4.54(1.19)	0.59	3.19 **	13%
Access to off-farm job	Yes	5.47(3.93)	5.19(3.09)	0.28	6.07	4.52%
	No	5.29(2.37)	4.57(2.10)	0.72	4.72 **	15.75%
Income group	High	6.06(4.52)	5.47(2.72)	0.59	1.30 **	10.78%
	Low	4.47(2.10)	3.75(1.54)	0.52	5.581 **	13.87%

Source: survey results, February–April 2018. Note: 1 USD = GH¢4.9, *, **, and *** represent statistical significance at 10%, 5%, and 1% alpha levels, respectively. All numbers in parentheses are robust standard errors.

4.3. Heterogeneous Effect of Cooperative Membership on the Farm and Household Income

This study explored the heterogeneous impacts of cooperative membership on income based on different factors or characteristics of fish farm householder/household. These different factors included: whether the householder or household had a member with a chronic disease, access to off-farm jobs, and whether the household belonged to a high-income or low-income group; the results are shown in Table 4. Here, high-income and low-income households were determined by dividing the sample into two groups based on total household income, with the median in the sample as the breakpoint. The results depict a positive and significant relationship between cooperative membership and income, even within the different groups of households. Specifically, the estimates indicate that cooperative membership could help increase household income by 12.01%, 33.70%, and 26.17% for households having members with chronic diseases, access to off-farm work, and with high income, respectively. Furthermore, the estimation shows that cooperative membership could help increase the household income by 18.18%, 25.16%, and 19.96% for households having no members with chronic diseases, no access to off-farm work, and with low income, respectively. From the findings, it can be seen that the percentage increases in household income for high-income households and households with no members with chronic diseases were greater than their counterparts. This indicates that the impact of cooperatives on household income becomes profound when household members are healthy [34]. Furthermore, high-income households may not be financially constrained; therefore, they can diversify their income by participating in off-farm jobs and the financial market (e.g., investment) to increase household income [55]. Also, farmers who are members of cooperatives and also engage in off-farm activities are more likely to increase their household income.

In terms of farm income, the estimates show that cooperative membership could increase farm income by 9.45% in households who had members with chronic diseases and by 10.78% in high-income households. The relationship between cooperative and farm income for households whose household head engages in off-farm work was insignificant. However, cooperative membership could increase farm income by 13%, 15.75%, and 13.87% in households with members without chronic diseases, households whose household heads did not engage in off-farm work, and low-income households, respectively. Although the results reported in Table 4 show that cooperatives increased farm income even within the different groups of households, their impact on farm income was prominent among households who had no members with chronic diseases, households whose household head did not engage in off-farm work, and low-income households. The results at this stage imply that farm income may be detrimentally affected if the household head engages

in off-farm activities and also if household members are unhealthy. The results of Siaw et al. [32] and Ma et al. [47] support our findings. They revealed that off-farm activities reduce the time and attention needed for farm activities to increase productivity; hence, farm income is affected. Also, Mojo et al. [20] and Mitra et al. [57] revealed that poor farm households become better-off if there are strategies to alleviate hindrances (e.g., credit constraint, high transaction cost, inadequate required inputs) that make fish farm productivity enhancement difficult. Low-income fish farm households may be marginalized in terms of credit accessibility, but financial support from cooperatives may enhance their financial stability and improve farm income [21].

4.4. Robustness Test

To check the robustness of the results depicted by the ESR model, we employed the following strategy with the result presented in Table A3. We changed the econometrics model from the ESR model to the endogenous switching probit (ESP) model by replacing the dependent variables, net farm income and household income, with a binary variable (1 if the net farm income or household income was above their median value and 0 otherwise) [58]. As shown in Table A3, the ATT coefficients were positive and significant, suggesting that cooperative membership increases farm and household incomes regardless of the estimation model. Thus, the results in Table A3 further confirm the estimated results of the ESR model and also provide evidence that the results of this research are robust.

5. Conclusions, Policy Implications, and Limitations

Many studies have argued that cooperatives' influence on agriculture activities cannot be concealed. However, the determinants of cooperative membership of fish farmers or households have been less explored in most developing countries, like Ghana. Also, according to the best of the authors' knowledge, the studies on the impact of cooperatives on fish farm household income do not exist for Ghana, and those existing for other developing countries are mostly qualitative rather than quantitative.

The empirical results showed that cooperative membership was positively and significantly influenced by household/householder access to credit, off-farm work, education, and peer influence. Regarding the impact of cooperatives on income findings, it was revealed that cooperatives could help increase household and farm incomes by 28.54% and 34.75%, respectively. Also, regarding the heterogeneous impacts of cooperatives on household income, the estimates indicated that the percentage increases in household income for high-income households (26.17%), households whose heads engaged in off-farm activities (33.70%), and households with no members with chronic diseases (18.18%) were greater than their counterparts. The estimates further indicated that the percentage increases in farm income for low-income households (13.87%), households whose heads did not engage in off-farm activities (15.74%), and household having no members with chronic diseases (13%) were greater than their counterparts, i.e., high-income households (10.78%), households whose heads engaged in off-farm activities (4.52%)—which is insignificant—and households having members with chronic diseases (9.45%). In a nutshell, this study showed that cooperatives play a significant role in ensuring households' and farms' sustainable development through income enhancement. Thus, as farm household income grows, fish farmers may increase their productivity by adopting new or improving old technologies and purchasing the correct and needed production inputs.

From the above results, this study can offer some policy implications. One primary concern of most developing countries is household welfare improvement; therefore, highlighting strategies to achieve this goal is essential. This study confirmed that being a cooperative member increases household income, hence improving the standard of living for household members. Our findings indicate that designing policies that make cooperative associations more meaningful, attractive, and sustainable is vital. Through cooperative groups, fish farmers can get access to tools (e.g., credit facilities, farm inputs) and infor-

mation (e.g., adoption of new fish farming skills and technologies), which are difficult to acquire individually.

Moreover, the findings suggest that improving access to credit and extension services for the fish farmer is another way of enhancing their household welfare. Therefore, governments, NGOs, and policymakers should provide strategies to make credit and extension services more accessible and reliable. The interest rate on credit should be moderate and the payment period should be favorable. Furthermore, given the significant positive impact of off-farm activities on household income, national policymakers should aim at enhancing off-farm accessibility avenues for fish farm households. In the same manner, policymakers should educate farmers on the importance of the division of labor in their farm activities when they take on off-farm activities since engaging in off-farm work may reduce farm income if proper actions are not taken.

This study has several limitations that can be addressed by future researchers. First, the study focused on only two regions in Ghana due to financial constraints. Future researchers could consider a larger sample size, probably the entire nation as a whole. Second, this study explored how cooperative membership influences household income. However, future researchers could consider how cooperatives affect other segments of fish farm households (e.g., fish farms' production efficiency or productivity). Finally, this study focused on only earthen pond fish farms; future researchers can further explore other segments of fish farming, such as cage pond fish farms, to see if their conclusions support or contradict this study.

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Appendix A

Table A1. Determinants of cooperative membership and determinants of household income.

Variables	First Stage Selection Equation	Household Income	
	Cooperative Membership	Member	Non-Member
Chronic disease	−0.045 (0.033)	−0.118(0.135) *	−0.137(0.021) *
Pond size	0.053 (0.021)	0.043 (0.011) **	0.022(0.007)
Access to credit	0.039 (0.012) **	0.181 (0.105) **	0.097(0.053) **
Access to extension service	−0.026 (0.109)	1.033(0.122) *	0.233(1.163) **
Off-farm employment	0.027 (0.040) **	0.391 (0.155) **	0.271(0.193) *
Education	0.131 (0.017) ***	0.065(0.019) ***	0.053(0.044) *
Age	−0.012 (0.003)	−0.043(0.021)	0.124 (0.023)
Experience	0.108 (0.071)	0.041(0.005)	0.161(0.018) *
Household size	0.221(0.062)	0.051(0.014) ***	0.013(0.010) *
Gender	−0.030 (0.057)	0.021(0.025)	−0.071(0.031)
Peer influence	0.089 (0.052) ***		
Ashanti	0.031(0.011) *	0.055(0.004)	0.017(0.008) **
Residual(access to extension services)	−0.071(0.032)		
Residual(access to credit)	0.244(0.191)		
Constant	1.032 (1.322) **	0.066(0.025) ***	1.078(0.115)
σ_1	0.351(0.125)		
σ_2	0.349(0.089)		
ρ_1	0.164(0.133) **		
ρ_2	−0.127(0.061) *		
LR test of indep. eqns.: chi2(1) = 119.41 Prob > chi2 = 0.0009			

Source: survey results, February–April 2018. Note: 1 USD= GH¢4.9, *, **, and *** represent statistical significance at 10%, 5%, and 1% alpha levels respectively. All numbers in parentheses are robust standard errors.

Table A2. Determinants of cooperative membership and determinants of farm income.

Variables	First Stage Selection Equation	Farm Income	
	Cooperative Membership	Member	Non-Member
Chronic disease	−0.046 (0.031)	−0.013(0.050)	−1.145(0.117) *
Pond size	0.052 (0.019)	0.152(0.102) **	0.068 (0.047) **
Access to credit	0.041 (0.012) **	0.046(0.068) *	0.042(1.045) *
Access to extension service	−0.027 (0.118)	0.147(0.022) ***	0.184(0.060) **
Off-farm employment	0.027 (0.040) **	−0.044(0.15)	−0.163(0.094) **
Education	0.131 (0.017) ***	0.019 (0.004) **	0.004(0.000) *
Age	−0.012 (0.003)	0.149(1.185)	0.075 (0.018)
Experience	0.105 (0.071)	1.015(0.129) **	0.623 (0.002) *
Household size	0.221 (0.062)	0.013(0.009)	0.061(0.044) *
Gender	−0.030 (0.057)	−2.417(1.101)	1.314(1.186)
Peer influence	0.092 (0.052) ***		
Ashanti	0.031 (0.011) *	0.003(0.020)	−0.031(0.007)
Residue(access to extension services)	−0.071 (0.032)		
Residue(access to credit)	0.244 (0.191)		
Constant	1.041 (1.322) **	0.156(1.085) **	0.065(0.037)
σ_1	0.542(1.017) *		
σ_2	0.417(0.122)		
ρ_1	0.441(0.109) **		
ρ_2	−0.316 (0.219)		
LR test of indep. eqns. chi2(1) = 89.71 Prob > chi2 = 0.0012			

Source: survey results, February–April 2018. Note: 1 USD= GH¢4.9, *, **, and *** represent statistical significance at 10%, 5%, and 1% alpha levels respectively. All numbers in parentheses are robust standard errors.

Table A3. Impact of cooperative membership on incomes (ESP model).

Items	Household Income	Farm Income
	Coefficient	Coefficient
ATT	1.22 *	0.81 **
Control variable	Yes	Yes
Regional dummies	Yes	Yes
σ_1	0.047(0.115) **	0.039(0.021) **
σ_2	0.109(0.106)	0.102(0.106)
ρ_1	0.092(0.037) **	0.032(0.014)
ρ_2	−0.225(0.094) ***	−0.205(0.133) ***
LR test of indep. eqns	chi2(1) = 33.68 **	chi2(1) = 51.32 **

Source: survey results, February–April 2018. Note: 1 USD= GH¢4.9, ** and *** represent statistical significance at 5% and 1% alpha levels, respectively. All numbers in parentheses are robust standard errors.

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