Journal of Advanced Research in Economics and Administrative Sciences

ISSN 2708-9320 (Print) and 2709-0965 (Online)

Volume 3, Issue 2 Article 2

DOI: https://doi.org/10.47631/jareas.v3i2.498

THE IMPACT OF COOPERATIVE MEMBERSHIP ON RURAL HOUSEHOLDS' FARM INCOME: THE CASE OF AQUACULTURE FARMERS IN THE EASTERN REGION OF GHANA

Bright Senyo Dogbe **Li Houjian** **Ernest Kwarko Ankrah**

[1] College of Management, Sichuan Agricultural University, Chengdu 611130, China
[2] College of Economics, Sichuan Agricultural University, Chengdu 611130, China
[3] College of Management, Sichuan Agricultural University, Chengdu 611130, China

ARTICLE INFO

Recieved: 15 April 2022
Revised: 14 June 2022
Accepted: 18 June 2022

Keywords:
Aquaculture
Cooperatives
Endogenous Switching Regression

JEL: G32, H21, C33, O54, G30.

Corresponding Author:
Bright Senyo Dogbe

Email:
dogbebrightsenyo@yahoo.com

ABSTRACT

Purpose: *This study examined the effect of farmers' involvement in aquaculture cooperatives on rural households' farm income in the Eastern Region of Ghana.*
Approach/Methodology/Design: *The data were gathered through questionnaires administered to four hundred (400) rural fish farming households. The endogenous switching regression (ESR) technique was used to resolve the self-bias of variables selection. For robustness of the results, Heckman selection model was later used to assess the treatment impact while accounting for endogeneity bias resulting from selection on unobservable variables. The heterogeneous analysis was performed to examine the impacts of cooperative involvement on rural fish farming households' farm income.*
Findings: *Based on the ESR outcomes, the study found that households' credit access, extension services accessed by household heads, educational attainment by household heads, and household size significantly influence cooperative members' farm income. However, farm (pond) size, household heads' age, and households' farming experience had no significant impact on cooperative members' farm income. Using the problem confrontation index, the cooperative aquaculture farmers claimed that the deployment of primitive tools, high post-harvest losses, unavailability of improved feeds, high costs of chemicals, and low yield were the most severe obstructions in fish production. In contrast, the study established that the topmost pressing constraints confronting the non-cooperative member farmers were the inaccessibility to credit facilities, low productivity, high post-harvest losses, unavailability of improved feeds, and high costs of chemicals.*
Originality/value: *This study highlighted that technical training, credit access, market outlets, bargaining power, input supplies, and increased prices of their products were the benefits the members derived from their involvement in aquaculture cooperatives in the study area.*

INTRODUCTION

Fish is the primary source of animal protein for almost one billion people worldwide (Food and Agriculture Organisation(FAO, 2018). The contributions of the aquaculture sector to global growth cannot be challenged, given that the aquaculture sector provides income, nutrition, and

food to millions of citizens around the globe (FAO, 2016). Fish contributes 60% of animal protein intake in Ghana, threefold more than the global average of 15%. (Nunoo et al., 2014). Ghana is one of the most fish-consuming African countries, with a per capita intake of 26 kilograms, more significant than the African average of 10 kilograms and the global average of 20.3 kilograms (Asiedu et al., 2017). Furthermore, the aquaculture sector serves as a means of living for around 10% of Ghana's populace, thus providing employment and food security for individuals (Kassam, 2013).

Ghana, a country characterized by wetlands, rivers, and the sea, is heavily reliant on trapped fisheries. Meanwhile, due to illegal fishing, mining-related land degradation, overfishing, ineffective management systems, and a growing population (FAO, 2018; Ministry of Fisheries and Aquaculture Development (MoFAD, 2019), the country reportedly imports more than 60% of its seafood. According to the MoFAD (2019), Ghana imported $135 million value of fish in 2016 due to a decrease in the nation's fish supply. As a result, developing aquaculture has become one of the central policies of Ghana's government and non-governmental organizations (NGOs) since it functions as a critical technology to fill the supply-demand gap for fish (Mantey, 2020) and ultimately promote household livelihoods (Kassam, 2013).

Farmers in developing economies confront many complicated production and marketing obstacles that impede their chance to enhance their livelihoods. Some of these issues stem from market flaws that result in high transaction costs, inadequate farmer infrastructure and physical distribution, a lack of financial services, and farmers' technological incapacity to manage cutting-edge technology and change customer tastes (e.g., food safety standards). Several studies demonstrate that farmers can overcome these obstacles by joining farming organizations (Narrod et al., 2009; Bernard et al., 2010; Brown et al., 2015; Wanyama et al., 2015).

A cooperative is a collective group of individuals who boost their members' economic well-being by creating a democratically controlled business enterprise. Farmers join agricultural cooperatives to address obstacles such as hunger, business loss, missing resources in the manufacturing chain, reduced wages, higher financing costs with trades, and a commitment to productivity expansion (Karli et al., 2006). Cooperatives have a significant effect on the success of businesses. Cooperatives must increase their productivity to assist their members. However, they are meant to improve members' well-being, mitigate distress, and function as tools for allocating national capital (Mahazril et al., 2012). Karli et al. (2006) indicate that, in most developing nations, efficiently managed agriculture co-operatives have a considerable resource for rural and agricultural development. According to Karli et al. (2006), effectively run agriculture co-operatives are a significant resource for rural and agricultural development in most developed countries.

Although numerous studies have indicated that agricultural cooperatives have a positive impact on farmers' acceptance of enhanced farming technologies and household economic well-being in many parts of the world (Francesconi and Heerink, 2011; Fischer and Qaim, 2012; Getnet and Anulo, 2012; Ito et al., 2012; Abebaw and Haile, 2013; Mbanza, 2013; Verhofstadt and Maertens, 2014a, 2014b; Ogbeide, 2015; Nefale, 2016; Barati et al., 2017), limited studies in Ghana (Calkins and Ngo, 2010; Twumasi et al., 2021) have concentrated mainly on the correlation between farming cooperative and rural household welfare. Thus, there is a cavity in the literature regarding how farming cooperatives will improve Ghana’s rural households’

economic well-being. Based on the discrepancies in the literature identified above, there is a need to determine the contributions of farming cooperatives to enhancing rural households' farm income in Ghana to ascertain whether they are essential in increasing farm income and lessening economic inequality as declared by the government. The main objective is to assess whether cooperative involvement has enhanced rural households' farm income in Ghana. The contribution of the study includes the following. First, we use a country whose population main source of protein is fish but fish farmers are finding it difficult to improve their income; hence affecting their productivity. Finally, we used an econometrics method that deals with the issue of endogeneity to prevent inconsistency in our findings. Polices to improve aquaculture development in Ghana are provided in this study as well.

METHODOLOGY AND PROCEDURES

The Data source and method of data collection

This study used primary data for its empirical analysis. The primary data were garnered using a structured questionnaire to solicit information from fish-farming households with and without cooperative involvement. The household-level data regarding the subject matter covered farm-level features, household characteristics, financial resources, and institutional elements. To ensure that the sample fairly represents people who are pertinent to the issues relating to cooperative membership on aquaculture farming households' farm income in the Eastern Region of Ghana, two sampling techniques were employed. First, the purposive and quota sampling techniques used to select the rural households from six districts, namely, Asuogyaman, Upper Manya Krobo, Fanteakwa, Kwahu South, Kwahu Afram Plains South, and Kwahu Afram Plains North Districts out of the thirty-three districts in the Eastern Region. It is captured in the 2010 Ghana population census estimates that 517560 people reside in the six chosen districts representing 19.66% of the Eastern region population estimate of 2,633,154 people. To this end, the target population for this study was estimated at 517,560.

According to Kothari (2004), the sample size is the number of elements selected from the population to constitute a sample for conducting a study. It is, therefore, very prudent to choose a typical sample for the comprehensiveness of the population for this study. The sample size for this study was determined using Yamane's (1967) sample size formula as:

$$n = \frac{N}{1 + N(\alpha)^2}$$

Where n the sample is size; N represents the study population estimated at 517560, and α indicates the margin of error is 5%.

$$n = \frac{517560}{1 + 517560(0.05)^2}$$

$$n = 399.69$$

$$\therefore n = 400$$

The sample size for this study is, therefore, estimated at 400 aquaculture farming households. The purposive technique was adopted because those chosen are the key informants who can provide the needed information for the study. Finally, the quota sampling technique was employed to select the rural households from the chosen districts based on their characteristics of interest under investigation.

Model Specification

The choice of participating in an agricultural cooperative and household welfare

This study assumes that fish farmers decide to participate and not participate in a farming cooperative. The hypothesis is that the peasants are risk-neutral and therefore opt between membership and non-membership to maximize potential net benefits (R_M^*) derived from fish production from participating in farming cooperative and the potential net benefits (R_N^*) derived from non-participation. With this assumption, the study defines the disparity between the potential net benefits from participation and non-participation as $R_i^* = R_M^* - R_N^*$, then a peasant would opt to participate in a farming cooperative if $R_i^* > 0$. Meanwhile R_i^* is an unobserved variable, but it can be written as a function of observable characteristics in the ensuing latent variable model.

$$R_i^* = \eta_i X_i + \mu_i \qquad for\ R_i = 1\ if\ R_i^* > 0 \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where R_i^* indicates a binary variable (1 equals a farmer's involvement in farming cooperative and 0 suggests otherwise), X_i is a vector of fish-farming household and farm-level characteristics, η_i represents a vector of parameter coefficients to be computed, and μ_i shows the error term, which is normally dispersed with zero mean. The likelihood of participating in a farming cooperative is written as:

$$\Pr(R_i = 1) = \Pr(R_i^* > 0) = \Pr(\varepsilon_i - \eta_i X_i) = 1 - F(-\eta_i X_i) \dots\dots\dots\dots\dots\dots\dots (2)$$

$$for\ F\ is\ the\ cumulative\ distribution\ function\ for\ \varepsilon_i$$

The study presumes that rational peasants maximize their net benefits from fish production to associate the cooperative participation with the expected outcome. This proposition can be expressed as follows:

$$\pi_{max} = PQ(Z, X) - OZ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Where P represents fish price, Q connotes the quantity of fish produced, Z indicates a vector of input factors, and O denotes a vector of input prices. Output Q is defined by a production function in which $^{\partial Q}/_{\partial Z} > 0\ and\ ^{\partial^2 Q}/_{\partial^2 Z} < 0$. Net benefits can be written as a function of fish price (P), input prices (O), the option to join a farming cooperative (R), and the fish-farming household and farm-level features (X) as follows:

$$\pi = \pi(P, O, R, X) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

Deriving the first-order condition of equation (3) results in a reduced-form of fish output supply function:

$$Q = Q(P, O, R, X) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

The parameters in equation (5) indicate fish output (Q), described by cooperative participation preference, fish price, input prices, and fish-farming household and farm-level features.

Impact assessment of a cooperative farming participation

It is not easy to estimate the effect of cooperative membership on fish-farming household well-being using non-experimental observations. The possible explanation is that the outcome variable for participants cannot be observed in a situation where they chose not to participate in a farming cooperative. It is imperative to note that cooperative membership is not randomly distributed to the two sets of fish-farming households (members and non-members). But instead, fish farmers decide to join an agricultural cooperative given the potential net benefits they derived from cooperative participation; hence the members and

non-members are systematically different (Amare *et al.*, 2012). Given the dependent variable (farm income) is specified as a linear function of the independent variables D_i. The decision model can be expressed as:

$$Y_i = \phi D_i + \psi R_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(6)$$

Where the dependent variable is Y, and D_i is a vector of independent factors such as farm-level features, household characteristics, financial resources, and institutional elements. The variable R_i is an indicator of whether a farmer is involved in a farming cooperative, ε_i is a random error term, and ϕ and ψ are the parameter coefficients to be computed empirically.

In equation (6), since opting to participate in a cooperative farming society is exogenously determined, applying an ordinary least square (OLS) approach may generate erroneous inferences and conclusions. Moreso, unobserved heterogeneities lead to the correlation between the error terms in equations (1) and (6), respectively. Failure to consider this sample bias causes spurious estimates. The propensity score matching (PSM) approach commonly helps resolve omitted variables in non-experimental studies using field data. However, the PSM approach determines the treatment impacts of cooperative farming involvement by considering only known heterogeneities (observed characteristics). As such, this study will deploy the endogenous switching regression (ESR) model to fix the problem of self-selection by considering both observed and unobserved characteristics (Lokshin & Sajaia, 2004; Shiferaw et al., 2014; Narayanan, 2014).

Endogenous switching regression (ESR) model

This study utilized an endogenous regression model to fix the issue of self-selection owing to observed and unobserved variables. In the ESR approach, the decision to participate in a farming cooperative is considered as a switch or participation status indicator, with two outcome regimes. The ESR model is specified as follows:

$$Regime\ 1\ (Members): Y_{iM} = \Omega_{iM} D_i' + \varepsilon_{iM} \quad for\ R_i = 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(7)$$

$$Regime\ 2\ (Non-members): Y_{iN} = \Omega_{iN} D_i' + \varepsilon_{iN} \quad for\ R_i = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(8)$$

Where Y_{iM} represents the outcome (say farm income) for cooperative participants, Y_{iN} denotes the outcome for non-participants of farming cooperative, D_i refers to the explanatory factors that might affect the explained (outcome) variable concerned, and ε_i shows the error term regarding the explained variables. Shiferaw *et al.* (2014) stated that it is critical for the variables (X_i) in the decision equation to include a selection instrument for the ESR model to be appropriately identified. An appropriate instrument will affect farmers' decision to join a farming cooperative, but it will not influence the welfare outcome. Here, the researcher used neighbour's involvement in a farming cooperative as a selection instrument. The plausible reason is that the farmers' decision to participate in cooperative society was observed to have a substantial positive relationship with their neighbour's involvement in the cooperative community (Ito *et al*., 2012). Nevertheless, it is not predicted that neighbour's membership would significantly affect household welfare outcome. To verify the validity of this instrument (neighbour's involvement in cooperative), the researcher ran a basic Probit model for the decision model and the OLS method for outcome model separately. These estimations helped determine whether it was significant when included in the decision model but not substantial when incorporated in the outcome model. Again, the study performed a correlation test to ascertain whether this instrument is not associated with outcome variable, say farm income.

Computation of treatment effects

The application of the ESR model helps in taking account of observed and unobserved heterogeneity between members and non-members of arming cooperative in the two regimes. The technique assists in creating counterfactual scenarios for the two regimes, enabling comparisons of the anticipated benefits for cooperative members against their counterfactual outcomes to derive the average treatment effect on the treated (ATT). In particular, the unobserved and observed counterfactual scenarios for cooperative farming members are express as:

Peasants with involvement in a farming cooperative (observed):

$$E(Y_{iM}|R=1) = \Omega_{iM}D_i' + \theta_{\mu M}\lambda_{iM} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (9a)$$

Peasants without involvement in a farming cooperative (counterfactual):

$$E(Y_{iN}|R=1) = \Omega_{iN}D_i' + \theta_{\mu N}\lambda_{iM} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (9b)$$

Therefore, unbiased treatment effects (ATT) are derived from the possible results in equations (9a) and (9b) correspondingly.

$$ATT = E(Y_{iM}|R=1) - E(Y_{iN}|R=1) = D_i(\Omega_{iM} - \Omega_{iN}) + \lambda_{iM}\left(\theta_{\mu M} - \theta_{\mu N}\right) \dots\dots\dots\dots (10)$$

RESULTS AND DISCUSSION

Descriptive Statistics

Out of 400 respondents, 250 respondents were cooperative members indicating 62.5%, whereas 150 respondents were non-cooperative members, suggesting 37.5% of the sampled population. The statistics shown in Table 1 indicate the socio-economic demographic characteristics of the respondents who participated in the study. According to the evidence gathered, male fish farmers comprise 64% of the overall number of cooperative members, compared to female fish farmers (36%). It also demonstrates that 48.7% of female farmers are non-cooperative against 51.3% of males. The findings show that in the study area, more males are members of aquaculture cooperatives. It might be because males make up a larger percentage of those who participate in agricultural operations and are thus in charge of their households. Of the total responses, 61.2% of the cooperative members, and 46.7% of the non-members were between the ages of 36 to 50 years. It indicates that most farmers in the study area are of an age when they can produce food.

The study further shows that 52% of aquaculture cooperative members do not have any formal education, 18% of the members had attained a basic education, and 28% of the cooperative farmers had gone through secondary education. Only 2% of the cooperative members had higher post-secondary education. Similarly, many non-cooperative farmers (46.7%) lack formal education, 20% of the non-cooperative members had attained elementary education, and 33.7% had only gone through secondary education. These results imply that many fish farmers in the Eastern Region of Ghana, whether they are cooperative members or otherwise, lack academic training.

Additionally, 84% of cooperative farmers and 78.7% of non-cooperative farmers were married. Besides, the study found that most cooperative farmers (68%) carter for 5 to 10 dependents, and 16% of the cooperative members had dependents within the range of 11 and 15. Also, 27(10.8%) cooperative farmers had less than five dependents, and 5.2% had more than 15 dependents. However, most non-cooperative farmers (60%) had 5 to 10 dependents, 35(23.3%) non-cooperative farmers had 11 to 15 household members, with 16 (10.7%) non-cooperative farmers catering for less than five household members. Also, 9(6%) of them had over 15 dependents during the study period. According to Msimango and Oladele (2013),

farming households with large dependents provide more workforce to engage in agricultural activities.

The results revealed that 213(85.2%) cooperative farmers had access to extension services relative to 37(14.8%) member farmers who had no access to extension services. On the other hand, many non-cooperative farmers (92.7%) opined that they have not had access to extension services compared to a fewer portion of non-members (7.3%) who had received extension services. These findings suggest that extension services are aimed towards cooperative farmers since they are more easily accessible. Agricultural cooperative members are inclined to access extension services as collective participation lowers the cost of delivering extension services (Abu et al., 2014). Farmers who receive extension services are more likely to accept new technology that can enhance their productivity. In most African nations, agricultural extension is the most important source of information for farmers, and it has a significant impact on the adoption of contemporary technology by farmers (Msimango and Oladele, 2013).

Moreover, farmers' access to credit significantly influences their purchase of modern agricultural innovations to improve farm production. The findings revealed that 90.6% of the cooperative fish farmers had access to credit facilities, whereas 9.4% of the cooperative farmers have no access to credit facilities in the Eastern Region of Ghana. In the case of non-cooperative participants, the study indicated that most farmers (69.3%) do not have access to credit facilities to fund their farming activities, with 30.7% having access to credit facilities. Besides, the data gathered revealed that slightly more than half of the cooperative farmers (58%) have been working within the period of 10 to 20years, 60(24%) cooperative farmers have been doing fish farming for less than ten years, whereas 40(16%) and 5(2%) cooperative farmers have been involved in fish farming for 21-30 years and over 30 years, correspondingly. Nevertheless, the study found that 48.7% of the non-cooperative farmers had been working for 10-20years in fish farming, and 30% of them were found to be involved in fish farming for less than 10 years in the study area. Also, 13.3% (20) and 8% (12) of the non-cooperative farmers had engaged in fish production for 21-30years and over 30years, respectively. From the results, most fish farmers have been involved in fish production for 10-20 years in the study area. The study further indicated that 28 (11.2%) cooperative farmers earned less than 5000 Ghana cedis (GHS), 130 (52%) earned between GHS5000 and GHS20000, 62 (24.8%) made between GHS20000 and GHS40000, and 30 (12%) earned above GHS40000 (GHS). However, 41 (27.3%) non-cooperative members made less than GHS5000, 90 (60%) earned between GHS5000 and GHS20000, 12 (8%) made between GHS20000 and GHS40000, and the remaining 7 (4.7%) earned above GHS40000.

Table 1. Profile of the study respondents

		Non-cooperative participants		Cooperative participants	
		Count	Percent	Count	Percent
Gender	Male	77	51.3	160	64
	Female	73	48.7	90	36
	Sub-total	150	100	250	100
Age of household heads	Less than 36 years	36	24	40	16
	36-50 years	70	46.7	153	61.2
	Above 50 years	44	29.3	57	22.8
	Sub-total	150	100	250	100
Educational level	No formal education	70	46.7	130	52
	Basic education	30	20	45	18
	Secondary education	50	33.3	70	28

	Above secondary education	-	-	5	2
	Sub-total	150	100	250	100
Education (in years)	Less than 3 years	6	7.5	10	8.3
	3 – 6 years	24	30	33	27.5
	7 – 9 years	26	32.5	29	24.2
	10 – 12 years	24	30	48	40
	Sub-total	80	100	120	100
Are you married?	Yes	118	78.7	210	84
	No	32	21.3	40	16
	Sub-total	150	100	250	100
Household size	Below 5	16	10.7	27	10.8
	5 – 10	90	60	170	68
	11 – 15	35	23.3	40	16
	Above 15	9	6	13	5.2
	Sub-total	150	100	250	100
Access to extension services	Yes	11	7.3	213	85.2
	No	139	92.7	37	14.8
	Sub-total	150	100	250	100
Access to credit facilities	Yes	46	30.7	226	90.4
	No	104	69.3	24	9.6
	Sub-total	150	100	250	100
Farming experience	Below 10	45	30	60	24
	10 – 20	73	48.7	145	58
	21 – 30	20	13.3	40	16
	Above 30	12	8	5	2
	Sub-total	150	100	250	100
Household income	Less than GHS5000	41	27.3	28	11.2
	GHS5000 – GHS20000	90	60	130	52
	GHS20001 – GHS40000	12	8	62	24.8
	Greater than GHS40000	7	4.7	30	12
	Sub-total	150	100	250	100
Farm income	Less than GHS5000	33	22	24	9.6
	GHS5000 – GHS20000	100	66.7	136	54.4
	GHS20001 – GHS40000	9	6	58	23.2
	Greater then GHS40000	8	5.3	32	12.8
	Sub-total	150	100	250	100

Source: Authr

Mean differences between cooperative and non-cooperative participants

Table 2 shows the mean disparity of household heads' age, gender, educational attainment, farm (pond) size, household size, farming experience, credit access, and farm income between rural fish farming households who are cooperative and non-cooperative members. The study revealed that the means difference in household heads' gender between the cooperative and non-cooperative participants is different from zero. Thus, the mean difference of household heads' gender of cooperative participants is substantially greater than that for non-cooperative participants in the study area.

In Table 2, the findings of the difference in averages indicate that household heads' age, educational attainment, farm (pond) size, household size, and farming experience are not statistically significant for cooperative and non-cooperative participants. These negligible average disparities imply no substantial differences in household heads' age, educational attainment, farm (pond) size, household size, and farming experience between cooperative and cooperative farmers. The findings also revealed that fish farming households with access to credit have a higher income than those who do not. The mean difference in credit access between cooperative and non-cooperative participants was statistically significant. The likelihood that farmers will receive loans to sustain their agricultural operations tends to rise if they get involved in farm-based organizations (Abu et al., 2014).

Besides, the study showed that the difference of means in agricultural extension between cooperative and non-cooperative fish farmers was significantly different from zero. The enormously significant mean disparity of 0.739 indicates that non-cooperative farmers have less access to agricultural extension. The study further found that farm income for cooperative participants is significantly higher than the income earned from fish production by non-cooperative participants in the Eastern Region of Ghana. The mean difference of farm income between cooperative and non-cooperative participants was statistically significant at a 1% threshold. These substantial average disparities suggest that these factors may influence the farmers' involvement in aquaculture cooperatives.

Nonetheless, the comparison of mean differences does not account for confounding variables, leading to erroneous findings. This notion highlights the presence of self-selection bias. It is imperative to deploy the endogenous switching regression (ESR) technique to assess the impact of farmers' involvement in aquaculture cooperatives on farm income.

Table 2. Mean differences between cooperative and non-cooperative participants

Variable	Non-cooperative participants		Cooperative Participants		Mean Difference	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	t-Statistics
• Household heads' gender	1.487	0.502	1.360	0.481	0.127***	2.509
• Household heads' age	44.607	11.856	44.004	10.105	0.603	0.541
• Educational level	5.540	5.372	4.660	5.319	0.880	1.596
• Farm (pond) size	0.807	0.413	0.872	0.410	-0.065	-1.514
• Household size	9.273	3.474	8.704	3.430	0.569	1.599
• Farming experience	15.80	9.683	15.296	7.311	0.504	0.590
• Farm income	16050	10007.27	20945.6	14405.87	-4895.6***	-3.664
• Extension services	1.927	0.262	1.188	0.392	0.739***	20.518
• Credit access	1.693	0.463	1.096	0.295	0.597***	15.762

*Note: *** indicates a 1% level of significance*

Empirical Analysis

T*he effect of rural households' involvement in cooperative on farm income*

Tables 3 presents the effect of rural fish farming households' involvement in cooperative on farm income. This study employed the Endogenous switching regression approach to estimate the income equations jointly for the first step (selection function) and the second step (outcome equation). The results captured in columns 2 and 3 of Table 3 represent the estimations of the selection function which explains the factors that influence farmers to join cooperatives. Comparable to the mean difference, factors such as household head's age, household size, and farm size do not significantly determine farmer's involvement in cooperatives. Also, access to agricultural extension services was not a factor that influence

farmers to join cooperatives in the Eastern region of Ghana. However, the study established that educational attainment, farming experiences, and credit access have a substantial positive impact on farmers' decision to join cooperative.

In addition, the estimated results of the outcome equation are presented in columns 4 and 5 for cooperative members and in columns 6 and 7 for non-cooperative members. The study indicated that access to extension services positively and substantially affected farm income from cooperative membership as presented in Table 3. The approximate value of extension access (0.8366) indicates that a rise in agricultural extension services corresponds to an increment of 0.84% in farm income from the involvement aquaculture cooperative, which is significant at the 1% threshold. Therefore, farmers' earnings may benefit from increased access to agricultural extension. Therefore, this means that cooperatives are a good option for fish farmers who want agricultural extension boosting their prospects of improving farm income. This result agrees with Birkhaeuser et al. (1991) and Owens et al. (2003), who discovered that extension services enhance farm production and revenue.

Nevertheless, having access to agriculture extension does not significantly raise the farm income of non-members of aquaculture cooperatives. This result implies that non-cooperative farmers may obtain generic information, which may not be relevant to fish production, as the extension information is not unique. Also, since most non-cooperative farmers have no access to agricultural extension, specific fish production extension services must be designed and communicated to farmers because of these findings.

Education had a positive and significant impact on farm income from cooperative membership. With its coefficient of 0.0678, higher educational attainment will improve farm income levels of rural fish farming households in the Eastern Region of Ghana. This outcome suggests that increased levels of education by the cooperative farmers will likely improve their farm income. As a result, farmers who have a comprehensive understanding of cooperative principles may enhance their farm income. Concerning non-cooperative participants, the empirical evidence again indicated that educational attainment is directly and profoundly associated with rural fish farming households' farm income. The approximate value of 0.0334 suggests that an upsurge in the level of education triggers non-cooperative farmers' farm income to rise in the study area, ceteris paribus. This result implies that schooling tends to equip farmers with the requisite technical know-how in agricultural practices, improving their farm productivity, and increasing their farm income.

Furthermore, the study revealed that farm (pond) size negatively correlated with farmers' farm income with approximate values of -0.1153 and -0.0267 for cooperative and non-cooperative farmers, respectively. This result implies that all other factors being held constant, an increase in farm size of cooperative and non-cooperative farmers will adversely affect their farm income by 0.12% and 0.0.3%, correspondingly. However, this impact on farm income was negligible among fish farmers in the study area, regardless of whether they are involved in aquaculture cooperatives or otherwise.

Access to credit facilities had a positive and substantial impact on the farm income of cooperative farmers at a 1% significance level. The coefficient of credit access was 0.3478, implying that increased access to credit facilities by cooperative members will help to enhance their fish production, thereby increasing their farm income, all things being equal. Hansen et al. (2002) claimed that farmers partake in cooperatives to improve their financial situation. The study further observed that the farm incomes of non-cooperative fish farmers were positively affected by the accessibility to credit facilities. Its coefficient of 0.0773 indicates that a 1% rise in credit accessibility leads to a 0.08% upsurge in farm income of

non-cooperative farmers, all the factors being held constant. However, the impact of credit access was not statistically significant on their farm income since most non-members have limited access to credit. This outcome, therefore, infers that as the credit accessibility of non-cooperative farmers increases, their prospects of generating higher farm income will also be intensified. The plausible explanation is that most non-cooperative farmers have less access to credit to fund their fish farming activities in the study area.

Age is a crucial factor in influencing farm income among cooperative farmers. Given the coefficient (0.0465) of age, it implies that the older farmers' ages, the more inclined they are to witness higher farm income from cooperative involvement. However, this relationship between age and farm income from cooperative membership among rural fish farming households was insignificant. Likewise, the results showed that the ages of non-cooperative fish farmers have no significant association with their farm income.

As expected, the study found that farming experience was positive and significant, suggesting that farming experience positively influences non-cooperative fish farmers' farm income. With its approximate value of 0.3237, a 1% increase in farming experience contributes to a rise of 0.32% in farm income of non-cooperative farmers. This result implies that experienced non-cooperative farmers are better positioned to enhance their fish production, which helps increase their farm income. The findings, however, revealed that farming experience does not significantly improve the farm income of cooperative farmers.

Another significant factor of farm income is household size. Consistent with its expected sign, the study showed that household size significantly affects the farm income of cooperative farmers in the Eastern Region of Ghana. Its coefficient of 0.5285 suggests that farm income will rise by 0.53% for a 1% surge in the household size of rural fish farming households who are aquaculture cooperative members. This relationship was significant at a 1% threshold. Similarly, it was observed that the household size significantly and positively influences farm income for non-members of aquaculture cooperatives.

Table 3. ESR estimates for determinants of cooperative involvement and rural households' farm income

Regressors	Selection function (Cooperative Participation)		Outcome function (farm income) Participant		Non-participant	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Educational attainment	0.6156***	0.1597	0.0678***	.0076	0.0334***	0.0097
Log of household heads' age	0.6364	0.8766	0.0465	0.1953	0.2117	0.1839
Log of household size	0.5101	0.6625	0.5285***	0.0979	0.2453***	0.0984
Log of farming experience	1.0832*	0.6149	0.0963	0.0850	0.3237***	0.1065
Farm (pond) size	0.5532	0.6303	-0.1153	0.0739	-0.0267	0.1023
Credit access	5.4283***	45.9825	0.3478***	0.1320	0.0773	0.1046
Extension services	-0.1932	0.3057	0.8366***	0.1142	-0.0849	0.1320
Neighbour involvement	2.00e+11	-	-	-	-	-

	-15.1708***	4.679556	8.3598***	0.6602	7.7816***	0.6730
Constant						
/lns0					-1.0910***	0.0629
/r0					-1.7940***	0.4229
/lns1			-0.8258***	0.0454		
/r1			-2.2759***	0.3470		
Number of observations	400					
Wald chi2 (7)	434.85***					
Log likelihood	-212.094					
LR test of independence of equations:	434.85***					

*Note: * and *** indicate statistically significant at 10% and 1% level, respectively*

CONCLUSION AND SUGGESTION

Agricultural cooperatives are institutions that help rural farmers produce more and earn more from their farm production. However, despite the many advantages of cooperative farming membership, few farmers participate in agricultural cooperatives. This study examined the effect of farmers' involvement of aquaculture cooperatives on rural households' farm income in the Eastern Region of Ghana. The data were gathered through questionnaires administered to four hundred (400) rural fish farming households. The endogenous switching regression (ESR) technique was used to resolve the self-bias of variables selection. Based on the ESR outcomes, the study found that households' credit access, extension services accessed by household heads, educational attainment by household heads, and household size significantly influence cooperative members' farm income. However, farm (pond) size, household heads' age, and households' farming experience had no significant impact on cooperative members' farm income.

The researcher provides the following suggestions because of the study: The government of Ghana must put in place interventions to address barriers to formal education among rural populations. Meanwhile, rural farming households with formal education should be encouraged to partake in farming cooperatives since formal education has a substantial and beneficial impact on their ability to generate a better farm income. Farmers' membership in aquaculture cooperatives can be increased if they are adequately informed about the benefits of cooperative organizations. This may be achieved by teaching farmers about collective ideals and their advantages. Therefore, authorities should establish more initiatives to educate rural farmers about aquaculture cooperatives and encourage them to join them.

This study shows the importance of aquaculture cooperatives in boosting rural households' farm income in Ghana. Nonetheless, this study's purview was restricted because the sample was drawn from fish farmers in Ghana's Eastern Region. Future research should broaden the purview of the investigation to include all fish producers in Ghana's sixteen regions to shed light on comprehensive policy initiatives in the development of the Ghanaian aquaculture sector.

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