Impact of social capital on agricultural productivity: Evidence from the moderating role of youth empowerment in North Central Nigeria

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ABSTRACT

The study examines the relationship between social capital, measured through cooperative, social media, and social club memberships, and agricultural productivity in North-Central Nigeria. It also evaluates the moderating effect of youth empowerment. Data was collected via a structured questionnaire from 447 smallholders. Multiple linear regression analysis with interaction terms was employed to interpret the data. The model explains 47.4% of the variation in agricultural productivity, with youth empowerment emerging as the most significant predictor (b = 0.405, p < 0.001), followed by social media membership (b = 0.226, p < 0.001). Participation in cooperative membership also showed a substantial effect (b = 0.128, p = 0.010), while social club membership had a marginal influence (b = 0.089, p = 0.079). The interaction effects reveal that youth empowerment significantly moderates the relationship between social club membership and productivity (B = 0.049, p < 0.001), and has a smaller but notable moderating role in the association between social media membership and productivity (B = 0.025, p = 0.055). However, it does not significantly influence the relationship between cooperative membership and productivity. The interaction model accounts for 48.9% of the variance in productivity. These findings underscore the importance of empowering youth through skills development, leadership training, digital literacy, and access to finance and technology to enhance social networks and increase farm income. The study recommends integrating empowerment programs with digital inclusion and cooperative initiatives to maximize their impact on agricultural productivity.

Contribution/Originality: This study contributes to the existing literature by modeling the interaction of youth employment with social capital in North-Central Nigeria. It uses multiple regression and interaction terms to assess the moderating impact of youth employment. The paper established that agricultural productivity is primarily driven by social clubs and digital networks, rather than cooperatives, and is enhanced by youth empowerment.

1. INTRODUCTION

Agriculture remains an important aspect of the Nigerian economy, especially in the North-Central states, where farming is the primary source of food security and livelihoods for the majority of the population. Nevertheless, despite its importance, Kehinde, Adeyemo, and Ogundeji (2021) and Obi-Egbedi and Adeoye (2023) observed that agricultural productivity in the region is lower than it could be due to limited access to credit, lack of quality infrastructure, and weak institutional support (Ekadina, Budhi, Yasa, & Yuliarmi, 2022). It has been observed that social capital, or networks, norms, and trust that facilitate cooperation between individuals and groups, has become one of the primary sources for overcoming these barriers (Cofre-Bravo, Klerkx, & Engler, 2019; Seferiadis, Cummings, Zweekhorst, & Bunders, 2015). Rahe, Van Leuven, and Malone (2025) state that by acting together, farmers can mobilize resources, knowledge, and even gain access to new markets, thereby enhancing productivity and income.

Cooperative societies have been advantageous because they have helped smallholder farmers in the North-Central regions of Nigeria; they have also lowered transaction costs, provided social collateral for credit, and increased bargaining power (Ekadina et al., 2022; Kehinde et al., 2021). Likewise, in some cases, social clubs have an informal support network, including labor trades, cash donations, and knowledge exchange (Cofre-Bravo et al., 2019; Darko & Halseth, 2025). Furthermore, Wen and Ma (2024) and Chen, Gao, Zhang, and Wu (2025) emphasized that social media has further reinvented the role of agriculture by enabling farmers to share ideas, build relationships with extension agents, and access market data in real time. All these social capital dimensions suggest that networks and associations can be used to enhance farm incomes and promote agricultural productivity in the region.

Meanwhile, the increasing importance of digital inclusion has become essential for understanding agricultural performance in North-Central Nigeria, where access to digital technologies now determines whether farmers can participate in recent forms of social capital. Research has demonstrated that digitally mediated networks, including social media platforms, enhance farmers' access to information, markets, and extension services in ways that traditional associations cannot provide (Chen et al., 2025; Wen & Ma, 2024). However, these benefits depend on digital skills, connectivity, and farmers' ability to use online platforms, which remain unevenly distributed among rural populations and are particularly scarce among young people lacking proper training or resources (Ekadina et al., 2022). This digital gap limits the future potential of social networks to increase productivity, as those who are digitally incompetent have a lower capacity to take advantage of the speed of information exchange and market connections that online platforms can provide. The connection of digital inclusion to the research problem highlights a fundamental dilemma: the lack of sufficient empowerment and competency development prevents farmers, especially young farmers, from maximizing their cooperative relationships, social club memberships, or social networking systems into productive benefits in the area (Cofre-Bravo et al., 2019; Obi-Egbedi & Adeoye, 2023).

Despite social capital being a valued asset, it is not diverse in society, especially among youth farmers, who have limited access to leadership, land, and credit. The use of youth empowerment, facilitated by training, technologies, and leadership opportunities, has been suggested as a key moderating variable that enhances the effectiveness of social networks in the agricultural sector (Ekadina et al., 2022; Obi-Egbedi & Adeoye, 2023; Somwethee, Ru-Zhue, Aujirapongpan, Chanthawong, & Usman, 2025). More so, Chen et al. (2025) and Peiro-Palomino et al. (2025) have pointed out that empowered young people will employ cooperative societies, social clubs, and social media to increase productivity and farm incomes. Additionally, since a large percentage of Nigeria's population is young, their participation is essential for the continued development of agriculture and the transformation of rural areas.

The study, therefore, examines the effects of social capital on agricultural productivity in the North-Central states of Nigeria, with youth empowerment as the moderating variable. Specifically, the research hypotheses are: (i) to analyze the effect of cooperative societies on the farm income of the North-Central states; (ii) to analyze the effect of social media on farm income; (iii) to analyze the effect of social clubs on the relationship between social capital and farm income; and (iv) to analyze the moderating role of youth empowerment on the relationship between social capital and farm income. By addressing these objectives, the literature on the topic will be enriched. The policy will be better informed about how social systems, digital spaces, and youth empowerment can increase agricultural output in Nigeria (Cofre-Bravo et al., 2019; Ekadina et al., 2022; Kehinde et al., 2021; Obi-Egbedi & Adeoye, 2023).

Focusing the scope on North-Central Nigeria, three concrete dimensions of social capital, cooperative societies, social clubs, and social media, and farm income as the productivity outcome are justified by both contextual need and analytic clarity. To monitor the role of social connections in lowering transaction costs, enhancing market access, and mobilizing credit and knowledge, this region is suitable because it is agriculturally dominant but productivity is limited (Ekadina et al., 2022; Kehinde et al., 2021; Obi-Egbedi & Adeoye, 2023). Focusing on cooperatives and social clubs, other established, place-based networks of resource flows and collective action are also captured. The social media channel is being added to this list as a fast-growing, digitally mediated platform, which, combined with these, provides an overall picture of bonding, bridging, and connecting capital (Chen et al., 2025; Cofre-Bravo et al., 2019; Darko & Halseth, 2025; Wen & Ma, 2024). Moderation by youth empowerment of the documented heterogeneity among network beneficiaries and testing of network participation to achieve measurable income gains among a demographically crucial cohort (Ekadina et al., 2022; Higgins, Neves, Huguenin, Da Costa, & Timóteo, 2025; Somwethee et al., 2025) acknowledges the heterogeneity within the cohort. The scoped design enhances causal interpretation and policy relevance through specific interventions and aligns with emerging evidence that social structures and empowerment co-determine rural transformation (Peiró-Palomino, Gianmoena, Picazo-Tadeo, & Rios, 2025; Rahe et al., 2025).

This research paper fits into the literature of social capital and agriculture by concurrently analyzing both place-based networks (cooperative societies, social clubs) and an increasingly crucial digital channel (social media) within one

regional framework, which provides a comparative, mechanism-oriented explanation of how bonding, bridging, and linking ties can result in farm income in North-Central Nigeria (Chen et al., 2025; Cofre-Bravo et al., 2019; Wen & Ma, 2024). It advances theory by explicitly modeling youth empowerment as a moderator, addressing a documented but underexplored source of heterogeneity in who benefits from networks, and thereby tests whether skills, leadership opportunities, and technology access amplify returns to social capital (Kehinde et al., 2021; Somwethee et al., 2025). Empirically, it provides context-specific evidence from a productivity-constrained yet agriculturally central region, quantifying the relative contributions of cooperatives, social clubs, and social media to farm income, and identifying empowerment thresholds with the greatest payoff for younger farmers (Kehinde et al., 2021; Obi-Egbedi & Adeoye, 2023). Policy-wise, the findings inform targeted interventions that couple youth-focused training and digital inclusion with cooperative strengthening to unlock income gains and rural transformation (Peiró-Palomino et al., 2025; Rahe et al., 2025).

2. LITERATURE REVIEW

2.1. Theoretical Framework

Social Capital Theory explains why cooperative societies, social clubs, and social media can function as bonding, bridging, and linking ties that lower coordination and search costs, widen information flows, and ease access to credit and markets for farmers in North-Central Nigeria. The classic theory emphasizes that networks are endowed with resources such as trust, reciprocity, and norms, which can be translated into economic benefits (Bourdieu, 1986; Coleman, 1988; Putnam, 2000). The mechanisms are observable in agricultural settings: cooperatives and clubs organize collective action, diffuse agronomic knowledge, and enhance power positions, thereby increasing productivity and incomes (Kehinde et al., 2021; Obi-Egbedi & Adeoye, 2023; Rahe et al., 2025). The type of network is important: place-based associations tend to provide strong-tie support and social collateral in credit (Ekadina et al., 2022), whereas digitally mediated networks increase the range of weak ties to extension agents and markets, increasing the rate of information diffusion and adoption (Chen et al., 2025; Cofre-Bravo et al., 2019; Wen & Ma, 2024). These channels, combined, determine distinct routes between social capital and farm income, which will be compared in the current study across cooperatives, clubs, and social media.

Empowerment theory emphasizes the importance of individuals' abilities and agency, along with their access to facilitating resources, in determining their success in utilizing network opportunities (Kabeer, 1999; Sen, 1999; Zimmerman, 1995). In agriculture, youth empowerment, through skills training, leadership roles, digital literacy, and improved access to finance and technology, should enhance the returns to social capital by transforming membership and connections into actionable outcomes such as adoption, entrepreneurship, and market participation (Ekadina et al., 2022; Somwethee et al., 2025). Evidence that empowered groups better translate social ties into earnings and innovation supports modelling empowerment as a moderator rather than a mere covariate (Higgins et al., 2025; Rahe et al., 2025). Accordingly, this study is anchored on Social Capital Theory and Empowerment Theory, theorising that youth capabilities intensify the effects of bonding, bridging, and linking ties on farm income and clarifying where policy, coupling cooperative strengthening with youth-focused training and digital inclusion, yields the most significant marginal gains.

2.2. Empirical Consideration

Social capital has consistently been observed to improve agricultural productivity in Nigeria by enhancing farmers' access to resources, information, and credit. According to the study by Kehinde et al. (2021), the social network among cocoa-based agricultural households in Southwestern Nigeria significantly enhanced farm productivity and food security. Also, Adesina and Ayinde (2018) indicated that social capital enhances access to credit facilities, thereby increasing yields among smallholder farmers. Obi-Egbedi and Adeoye (2023) highlighted that in Oyo State, the use of social associations to determine the productivity of cassava farmers depends on gender, and the networks utilize these associations. Taken together, these findings show that Nigerian farmers' ability to utilize group membership and trust networks is an important factor in agricultural performance.

Empirical evidence indicates that the influence of social capital is not cross-cutting, as it is mediated through gender roles in agricultural systems. Obi-Egbedi and Adeoye (2023) have shown that group homogeneity and attendance at meetings were in the interest of male cassava farmers. Conversely, productivity growth by female farmers was also influenced by membership density and contributions. This observation aligns with Aiyedogbon's (2016) argument that gender disparities in access to resources and decision-making are commonly reproduced within the social structures of capital in rural Nigeria. Similar to Oladele (2022) results, the researchers found that women's and youth empowerment in farming networks improves the adoption of technologies and reduces productivity gaps. All these works stress the necessity of gender- and age-sensitive approaches in utilizing social capital in agricultural development.

In addition to group membership, social capital also interacts with empowerment initiatives to influence productivity outcomes. In the case of the Simantri Program in Bali Province, Ekadina et al. (2022) concluded that farmers' productivity increased with empowerment and social networks but was not sustainable without government support. Ogunyemi (2019) demonstrated in Nigeria that youth agricultural empowerment interventions enhanced involvement in farming cooperatives and improved productivity, but the implementation process still faced difficulties. On the same note, the World Bank (2017) also found that youth involvement in agricultural social networks supported innovation and entrepreneurship. However, institutional support was lacking to sustain the impact in the long term.

According to these studies, the relationship between social capital and productivity is strengthened by empowerment, an essential moderator.

The cross-border experience demonstrates the flexibility of social capital in facilitating innovation and change. Cofre-Bravo et al. (2019) discovered that Chilean fruit growers employed various types of social capital: bonding, bridging, and linking, to explore and exploit opportunities for innovation concurrently. According to Yami, Vogl, Hauser, and Temesgen (2019), collective action also enhanced bargaining power and productivity among African farmers, but cautioned that younger farmers tended not to belong to the network. Similar to Akinola (2021), who states that social capital in Sub-Saharan Africa can only help agricultural transformation if the generational gap is bridged through institutions. Both ideas demonstrate that the importance of social capital extends beyond direct productivity, thereby promoting resilience and innovation in agricultural production.

Lastly, resilience and rural transformation also center around social capital, which can be applied to non-agricultural aspects. According to Darko and Halseth (2025), in communities where the industry was in decline in Canada, social capital supported adaptation and resilient solidarity, similar to the problems rural farmers faced in Africa. Oluwatayo (2015) also demonstrated that families in Nigeria with stronger networks exhibited higher productivity and resilience in the face of shocks such as price changes and climate risks. Aiyedogbon (2016) also held the view that building social capital, which links different groups, is more efficient for development than bonding social capital, which exists within homogeneous groups. Such results indicate that in a setting such as North Central Nigeria, where insecurity and migration undermine livelihoods, social capital and youth empowerment may be a significant force for sustainable rural development.

Despite extensive evidence that networks are significant for agriculture, the literature leaves several gaps that this study aims to address: (i) few Nigerian studies compare jointly place-based (cooperatives, clubs) and digitally mediated (social media) forms of social capital within a single model, limiting understanding of how bonding, bridging, and linking ties differentially influence farm income (not just yields or adoption) (Chen et al., 2025; Cofre-Bravo et al., 2019; Kehinde et al., 2021; Wen & Ma, 2024); (ii) prior Nigerian work is concentrated in the Southwest or single states, leaving a geographic gap for North-Central contexts with distinct market and institutional conditions (Adesina & Ayinde, 2018; Obi-Egbedi & Adeoye, 2023); (iii) youth empowerment is rarely modelled as a moderator of social capital's effects, even though empowerment interventions and demographic realities suggest heterogeneous returns across age cohorts (Ekadina et al., 2022; Ogunyemi, 2019; World Bank, 2017); (iv) studies often treat "social capital" as a composite, with limited measurement clarity separating bonding/bridging/linking and potential endogeneity or selection bias that weaken causal interpretation (Aiyedogbon, 2016; Yami, Vogl, Hauser, & Temesgen, 2019); and (v) evidence on policy-relevant thresholds, which combinations of networks and empowerment levers yield the greatest marginal income gains, remains scarce, especially under conditions of insecurity, migration, and market volatility (Darko & Halseth, 2025; Oladele, 2022; Rahe et al., 2025).

3. METHODOLOGY

The study employed a descriptive survey design to collect structured questionnaire data in North-Central Nigeria to test social capital, youth empowerment, and agricultural productivity. Following the research design rules and principles, the study used statistical procedures to assess relationships and moderation effects and to generate policy implications for the region.

Table 1. Estimated Youth Population in North Central Nigeria.

State / Territory	Estimated Youth	Sample
Benue	2,187,531	$\frac{2{,}187{,}531}{11{,}260{,}621} * 480 = 93$
Kogi	1,591,074	$\frac{1{,}591{,}074}{11{,}260{,}621} * 480 = 68$
Kwara	1,264,866	$\frac{1{,}264{,}866}{11{,}260{,}621} * 480 = 54$
Nasarawa	1,027,993	$\frac{1{,}027{,}993}{11{,}260{,}621} * 480 = 44$
Niger	2,416,211	$\frac{2{,}416{,}211}{11{,}260{,}621} * 480 = 103$
Plateau	1,680,302	$\frac{1{,}680{,}302}{11{,}260{,}621} * 480 = 72$
FCT (Abuja)	1,092,644	$\frac{1{,}092{,}644}{11{,}260{,}621} * 480 = 46$
Total	11,260,621	480

Source: Information from the Nigeria Population Commission.

3.1. Population and Sample

The estimated youth population in the North Central region is 11,260,621, as shown in Table 1. Thus, Krejcie and Morgan (1970) are used to determine the sample size. It is most suitable for determining sample size when the population is too large (Uzochukwu, Nwoye, & Azu, 2025).

$$\frac{x^2\,N\,P\,(1-P)}{e^2(N-1)+x^2P(1-P)} \qquad (1)$$

x^2=Chi-Square (3.841) at 95% level of confidence; e=Margin of error, N=Population (11,260,621), P=Proportion of Population (40%).

$$\frac{3.841 * 11,260,621 * 0.4 * 0.6}{0.05^2 * (11,260,621 - 1) + (3.841 * 0.4 * 0.6)} = \frac{10,380,490.9}{0.0025 * 11,260,620 + 0.92184}$$

$$= \frac{10,380,490.9}{28151.55 + 0.92184} = \frac{10,380,490.9}{28152.4718} = 369 \; approx$$

Due to large population figures, it is pertinent to increase the sample size by 30% to arrive at 480.

3.2. Model Specification

In evaluating the impact of social capital on poverty reduction in Benue State, Nigeria, Shiaki, Ogbole, and Kula (2024) presented an augmented model as follows.

$$PVT_i = \theta_1 + \beta_1 CM_i + \beta_2 SM_i + \beta_3 SC_i + \varepsilon_i \qquad (2)$$

Where PVT stands for Poverty Reduction in Benue State, Nigeria. CM stands for Cooperative Society in Benue State, SM represents social media in Benue State, and SC represents social clubs in Benue State.

Including youth empowerment (YE) as a control variable is justified because it influences both social and economic outcomes that drive agricultural productivity. Empowerment, access to education, skills, employment, and decision-making, enhances youths' capacity to utilize networks effectively (Akpan, 2015; Food and Agriculture Organization of the United Nations (FAO), 2025). In Benue State, empowered youths can transform cooperative societies, social media, and ties to social clubs into more productive individuals within the agricultural sector, potentially significantly impacting social capital. In the augmented model, the independent effects of CM, SM, and SC on agricultural productivity (AP) are controlled for by the influence of empowerment, thereby strengthening the analytical statements and the relevance of policies aimed at farmer-targeted interventions (Shiaki et al., 2024). The concept of poverty reduction (PVT) is replaced with agricultural productivity (APP) to align with the research objectives.

$$AP_i = \theta_1 + \beta_1 CM_i + \beta_2 SM_i + \beta_3 SC_i + \beta_4 YE_i + \varepsilon_i \qquad (3)$$

Youth empowerment (YE) is integrated with social capital, which comprises cooperatives, social media, and social clubs, to magnify returns to agricultural productivity (AP). They are better educated, have skills, resources, and a voice, and thus empowered youth can better leverage networks (Akpan, 2015; Food and Agriculture Organization of the United Nations (FAO), 2025). Training and entrepreneurship activities help them transform cooperative membership into adequate entry-level inputs and market connections. Youths are enabled through social media to access information on the latest innovations, prices, and funding promptly, increasing adoption and output. The youth are empowered and take control of the clubs and rural groups, mobilizing the action of the people. They also have policy involvement to align the programs with the needs of farmers, which enhances the network effect on productivity and inclusive rural transformation. Thus:

$$AP_i = \theta_1 + \beta_1 CM_i + \beta_2 SM_i + \beta_3 SC_i + \beta_4 YE_i + \beta_5 (CS * YE)_i + \beta_6 (SM * YE)_i + \beta_7 (SC * YE)_i + \varepsilon_i \qquad (4)$$

3.3. Method of Data Analysis

Three dimensions of social capital, including cooperative membership (CM), social media membership (SM), and social club membership (SC), of smallholder farmers in North-Central Nigeria were used to conduct this quantitative research using correlation and multiple regression analyses to determine the impact of these dimensions on agricultural productivity (AP) (Shamaki, Ibrahim, & Azu, 2022; Uzochukwu et al., 2025). The information was collected through a designed 5-point Likert scale and processed in such a way that it allows estimating the personal and joint influences of CM, SM, and SC on AP, which fits the object of the study, which is to determine which of the network channels contributes the most to farm income and productivity in the regional context.

The model was further extended to measure the potential of youth empowerment (YE) as a moderating factor, examining whether capabilities (skills, leadership, digital literacy, finance/technology access) can enhance or undermine the social capital-productivity relationship. These conditional effects were captured in terms of interaction (CM*YE, SM*YE, SC*YE). The coefficient of determination (R^2/Adjusted R^2) quantified the share of variance in AP explained by the predictors; significance levels identified the most influential variables; and standard diagnostics (e.g., VIF/tolerance, Durbin–Watson) evaluated multicollinearity and residual independence. This framework provides empirical guidance on prioritising empowerment and specific network levers to raise agricultural productivity. SPSS 27 was used for the analysis.

3.4. Validity and Reliability of Research Instrument

The study established the validity and reliability of its 5-point Likert questionnaire on social capital, youth empowerment, and agricultural productivity through expert review, piloting, and statistical checks. Face and content validity were confirmed by academics and practitioners in agricultural economics/rural development, who assessed clarity, relevance, and alignment with the constructs of cooperative membership, social media membership, social club membership, youth empowerment, and agricultural productivity. A pilot with smallholder farmers and extension officers informed refinements to the wording and uniformity of scale. Reliability analysis demonstrated strong internal consistency across all scales (Cronbach's α ≥ 0.80), exceeding the 0.70 benchmark: agricultural productivity (α = 0.810; standardized α = 0.824), cooperative membership (α = 0.829; 0.858), social media membership (α = 0.827; 0.839), social club membership (α = 0.853; 0.868), and youth empowerment (α = 0.812; 0.829). These results affirm the instrument's

adequacy for the primary empirical analyses of relationships among social capital, empowerment, and productivity (see Table 2).

Table 2. Reliability statistics.

Variables	Cronbach's alpha	Cronbach's alpha based on standardised items	N of items
Agricultural productivity	0.810	0.824	10
Cooperative membership	0.829	0.858	10
Social media membership	0.827	0.839	10
Social club membership	0.853	0.868	10
Youth empowerment	0.812	0.829	10

4. RESULTS AND DISCUSSION

Regarding the response rate, 480 questionnaires were distributed, and 447 were returned, resulting in a high response rate of 93.1%. The age distribution of respondents now covers the entire sample: 20–30 years = 201 (45.0%), 15–20 years = 128 (28.6%), and 30+ = 118 (26.4%) (see Table 3). This balanced distribution maintains a youth majority while also including a substantial number of older farmers, allowing for meaningful comparisons of youth-empowerment effects across different age groups. In other words, the youthful profile supports analyses focused on youth empowerment but also indicates the need to check for potential nonresponse bias related to age.

Table 3. Demographic analysis of the questionnaire.

1	Distribution	Distributed		Received
		480		447
2	Participant's age	15–20	20–30	30 and above
		128	201	118
3	Education	SSCE/NCE/ND	HND/BSC	MSC/Ph.D
		119	238	90

Education profile and implications. Educational attainment is well distributed and totals the full sample (N = 447): HND/BSc = 53.2% (238/447), SSCE/NCE/ND = 26.6% (119/447), and MSc/PhD = 20.1% (90/447) (see Table 3). The majority with tertiary education implies a strong capacity to utilize information and technology channels (e.g., social media), potentially enhancing the productivity effects of social capital. Together, the high response rate, youthful composition, and substantial tertiary education provide a solid foundation for investigating how empowerment and network participation influence agricultural productivity.

Table 4. Descriptive statistics and correlation matrix.

Panel A: Descriptive statistics					
Statistics	CM	SM	SC	YE	AP
N	447	447	447	447	447
Range	3.0	3.0	3.0	3.4	3.4
Minimum	2.0	2.0	2.0	1.6	1.6
Maximum	5.0	5.0	5.0	5.0	5.0
Sum	1191.8	1175.0	1179.8	1176.2	1163.4
Mean	4.182	4.123	4.140	4.127	4.082
Std. Deviation	0.4973	0.5360	0.5208	0.5305	0.5351
Skewness	-0.782	-0.259	-0.625	-0.638	-0.587
Kurtosis	1.468	0.195	1.265	1.780	1.486
Panel B: Correlation matrix					
Variables	CM	SM	SC	YE	AP
CM	1	0.411**	0.348**	0.436**	0.416**
SM	0.411**	1	0.554**	0.578**	0.549**
SC	0.348**	0.554**	1	0.607**	0.523**
YE	0.436**	0.578**	0.607**	1	0.633**
AP	0.416**	0.549**	0.523**	0.633**	1

Note: **. Correlation is significant at the 0.01 level (2-tailed).

4.1. Descriptive Statistics and Correlation

Table 4 Panel A presents the Descriptive Statistics. It shows that with N = 447 across all variables, the sample reports uniformly high levels of cooperative membership (CM), social media membership (SM), social club membership (SC), youth empowerment (YE), and agricultural productivity (AP): means cluster just above 4 on a 1.6–5.0/2.0–5.0 range (CM = 4.182; SM = 4.123; SC = 4.140; YE = 4.127; AP = 4.082). Standard deviations are compact and similar (~0.50–0.54), indicating moderate dispersion around these high means. There is moderate ceiling contamination (-0.26 to -0.78), which indicates that many respondents respond with scores above the middle, but kurtosis is near normal (0.20-1.78), indicating that there are no extremely tailing values. In substance, the respondents tend to be fairly well

integrated into farmer networks (cooperatives, clubs, and online communities), feel fairly empowered, and report fairly high productivity outcomes, which is enough to conduct inferential tests but is strong enough to ensure ceiling effects do not obscure smaller differences.

Table 4 Panel B presents the correlation matrix. All bivariate associations are positive and significant at the 1% level, aligning with the theory that social capital and empowerment co-move with productivity. The strongest correlate of AP is YE (r = 0.633), followed by SM (r = 0.549), SC (r = 0.523), and CM (r = 0.416), implying that empowerment and digitally mediated ties are most directly linked to higher farm productivity, with clubs and cooperatives also important. Inter-construct correlations are moderate-to-high, YE–SC (r = 0.607) and SM–SC (r = 0.554) are notable, indicating theoretically coherent overlap across social capital dimensions and empowerment. Overall, the pattern supports the study's framework: diverse network forms and empowerment are mutually reinforcing and jointly associated with improved agricultural outcomes. It further demonstrates that there are no issues of multicollinearity expected.

4.2. Social Capital and Agricultural Productivity

The regression results, as presented in Table 5, explain a substantial share of variance in agricultural productivity (AP): R^2=0.474, indicating that the four predictors jointly account for 47.4% of the dispersion in AP. The Adjusted R^2=0.467 suggests minimal shrinkage, so the explanatory power is not driven by overfitting. The Durbin–Watson statistic of 1.948 is very close to 2, indicating no meaningful first-order autocorrelation in residuals. Collinearity is low, with VIFs ranging from 1.30 to 1.80 (tolerances 0.556–0.771), which are well below the standard concern threshold of VIF $\geq$ 5, suggesting coefficient estimates are likely stable. The fitted equation (unstandardized) is as follows: AP=0.606+0.138CM+0.226SM+0.068SC+0.409YE.

Table 5. Impact of social capital on agricultural productivity.

Variables	Unstandardised coefficients		Standardised coefficients	t	Sig.	Collinearity statistics	
	B	Std. error	Beta			Tolerance	VIF
(Constant)	0.606	0.238		2.542	0.012		
CM	0.138	0.053	0.128	2.582	0.010	0.771	1.297
SM	0.226	0.055	0.226	4.072	0.000	0.613	1.630
SC	0.068	0.039	0.089	1.761	0.079	0.749	1.335
YE	0.409	0.059	0.405	6.937	0.000	0.556	1.799
R-Square	0.474	Adjusted R-Square		0.467	Durbin Watson		1.948

Note: Dependent Variable: AP-Agricultural Productivity.
Independent Variable: CM-Cooperative Membership; SM-Social Media Membership; SC-Social Club Membership; YE-Youth Empowerment

It is reported that youth empowerment is the strongest predictor of agricultural productivity both in raw terms (B = 0.409, SE = 0.059, t = 6.937, p < .001) and standardized terms (β = 0.405). Substantively, holding other factors constant, a one-unit increase in youth empowerment is associated with a 0.409-point rise in agricultural productivity on the study's scale. This is consistent with the idea that skills, agency, and access to resources translate network participation into concrete productivity gains. On the other hand, social media membership is the next strongest predictor (B = 0.226, SE = 0.055, t = 4.072, p < .001; β = 0.226), indicating that digitally mediated ties add distinct informational and market-access benefits beyond cooperatives and clubs. Youth empowerment and social media membership make the most significant marginal contribution to agricultural productivity after adjusting for other dimensions of social capital.

Cooperative membership has a positive, statistically significant relationship with agricultural productivity (B = 0.138, SE = 0.053, t = 2.582, p = 0.010; b = 0.128), which means that cooperatives nonetheless have an impact, although the impact is smaller than on youth empowerment and social media membership, since it reduces transaction costs and simplifies access to inputs/credit. Membership in social clubs is favorable yet insignificant (B = 0.068, SE = 0.039, t = 1.761, p = 0.079; b = 0.089); this indicates that club membership may lead to productivity through softer benefits (trust, informal help) that become less significant or more differentiated when other avenues are controlled. The positive intercept (0.606, p = 0.012) indicates the productivity at the baseline when the predictors have a zero value on their scale. On the policy front, outcomes emphasize skills and opportunities for youth and digital inclusion, with enhanced collaborative capabilities; clubs can produce benefits in combination with youth initiatives, digital enablement, or program design.

Figure 1 illustrates the marginal effects plot with 95 per cent confidence intervals illustrates the relative impact of the key predictors on agricultural productivity. Youth Empowerment (YE) has the most significant and statistically significant coefficient of 0.409 and a 95 percent confidence interval of 0.293 to 0.525. Social Media Membership (SM) also shows a significant and statistically significant effect (B = 0.226, CI [0.118, 0.334]), which suggests its applicability in productivity gains. Cooperative Membership (CM) makes an intermediate but significant contribution (B = 0.138, CI [0.034, 0.242]) and indicates that the factor contributes to enhancing farm performance. However, Social Club Membership (SC) has the least effect, with a coefficient of B = 0.068 and a confidence interval [CI: -0.008, 0.144], indicating that it is statistically marginal and less able to explain the dependent variable than other predictors.
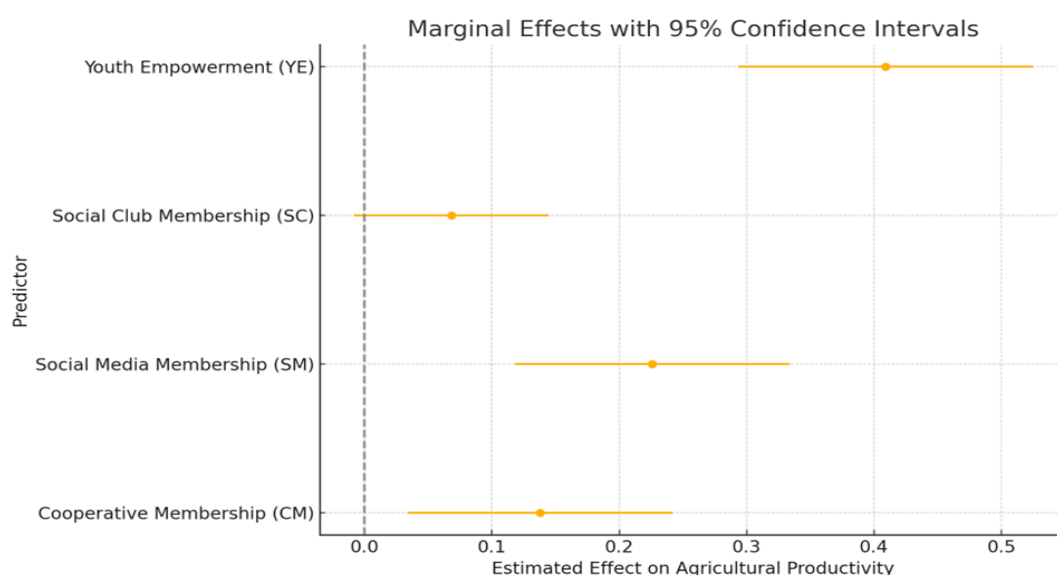
Figure 1. Marginal effect plot.

4.3. The Moderating Effect of Youth Empowerment

The interaction model accounts for a substantial share of variation in agricultural productivity (AP): $R^2 = 0.489$ (adjusted $R^2 = 0.476$), so roughly 49% of agricultural productivity differences are explained by youth empowerment and its interactions with the social-capital dimensions (see Table 6). The Durbin–Watson statistic = 1.918 is close to 2, indicating no material first-order autocorrelation in residuals. The constant term is not significant ($p = 0.725$). Collinearity is moderate rather than severe: VIFs = 3.81–7.88 (tolerances 0.127–0.262) are below the standard red-flag threshold of 10 but still high enough to warrant good practice, such as mean-centering components used in interactions. The estimation examines whether youth empowerment alters the strength of the social capital–agricultural productivity relationship.

Table 6. Mediating effect of youth empowerment on the impact of social capital on agricultural productivity.

Variables	Unstandardised coefficients		Standardised coefficients	t	Sig.	Collinearity Statistics	
	B	Std. error	Beta			Tolerance	VIF
Constant	-0.403	1.146		-0.352	0.725		
YE	2.342	0.243		9.642	0.000		
CMYE	-0.011	0.124	-0.011	-0.089	0.929	0.127	7.882
SMYE	0.025	0.013	0.165	1.930	0.055	0.262	3.811
SCYE	0.049	0.014	0.357	3.527	0.000	0.186	5.377
R-Square	0.489	Adjusted R-Square		0.476	Durbin Watson		1.918

Note: Dependent variable: AP-agricultural productivity.
Independent variable: CM-cooperative membership; SM-social media Membership; SC-Social Club Membership; YE-Youth Empowerment; CMYE-Cooperative Membership*Youth Empowerment; SMYE-Social Media Membership*Youth Empowerment; SCYE--Social Club Membership*Youth Empowerment

Youth empowerment shows a strong, positive, and highly significant association with agricultural productivity (B = 2.342, SE = 0.243, t = 9.642, $p < 0.001$). Substantively, holding the interaction terms constant, a one-unit increase in youth empowerment is associated with about a 2.34-point increase in agricultural productivity on the study scale. Because interactions are included, this is the simple effect of youth empowerment when the social-capital variables that form the interactions are at their reference values (typically zero if mean-centered; if not centered, interpret cautiously). The magnitude and precision of this estimate reinforce the theoretical claim that empowerment (skills, agency, access to enabling resources) directly enhances productivity outcomes.

Two interaction terms indicate that the payoff from specific social-capital channels increases with empowerment. The coefficient of the interaction between social club membership and youth empowerment is positive and significant (B = 0.049, SE = 0.014, t = 3.527, $p < 0.001$). As youth empowerment increases, the slope of social club membership on agricultural productivity becomes steeper, implying that empowered youth convert club ties into larger productivity gains. The interaction between youth empowerment and social media is positive and marginal (B = 0.025, SE = 0.013, t = 1.930, $p = 0.055$), suggesting that the productivity benefit of social media engagement strengthens at higher levels of youth empowerment, consistent with complementarity between digital participation and capabilities. By contrast, the interaction of youth empowerment with cooperative membership is null (B = −0.011, $p = 0.929$), indicating no evidence that the cooperative membership–agricultural productivity link varies with youth empowerment in this model. Policy-wise, these patterns prioritize pairing empowerment interventions with investments in social clubs and digital

inclusion to maximize returns, while cooperative effects may be more additive (beneficial regardless of empowerment level) rather than conditional.
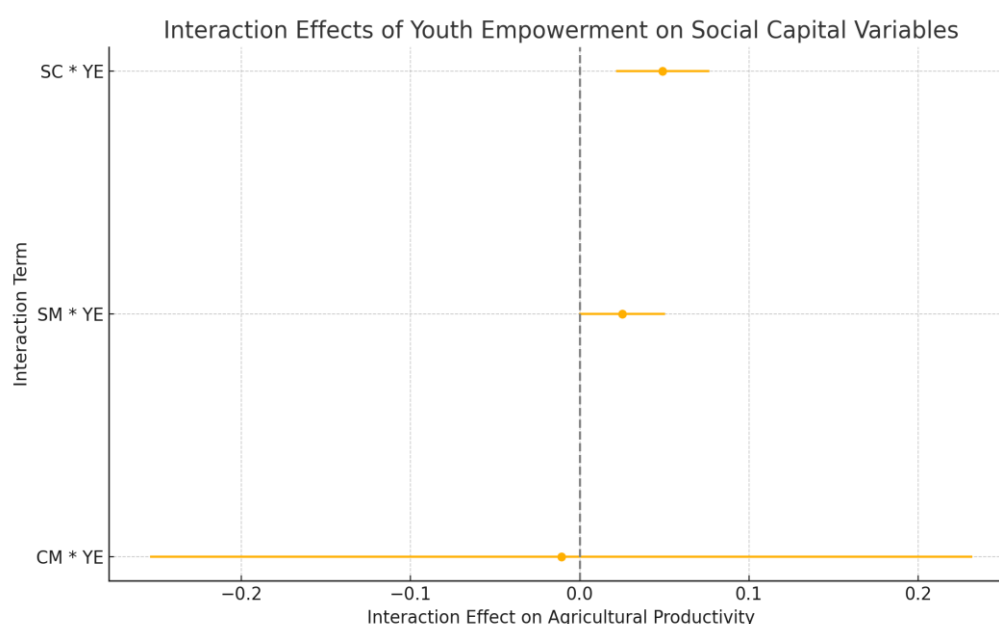

Figure 2. Marginal effect of the interaction.

Figure 2 illustrates the marginal effect of the interaction. The interaction effect of youth empowerment on the variables of social capital is reflected in the plot, which shows different levels of influence. Cooperative Membership (CM*YE) also indicates a weak negative interaction effect, suggesting that youth empowerment is not a decisive factor in improving the relationship between cooperative membership and productivity. Conversely, Social Media Membership (SM*YE) shows a low positive interaction, suggesting that empowered youngsters would benefit slightly more from using digital social media platforms. A positive and significant interaction is shown in Social Club Membership (SC*YE), indicating that the productivity gains derived from participation in the social club are significantly enhanced by youth empowerment. This visualization highlights that the effectiveness of the various types of social capital is mediated by youth empowerment, with varying impacts on agricultural productivity.

4.4. Discussion of Findings
The strength of youth empowerment as the leading predictor of agricultural productivity aligns squarely with evidence that capabilities, agency, and access to enabling resources translate network participation into tangible gains. Nigerian and broader SSA studies show that when farmers, especially youth, gain skills, leadership opportunities, access to technology, and financial resources, they convert social ties into higher adoption, market participation, and earnings (Ogunyemi, 2019; Oladele, 2022; World Bank, 2017). This is consistent with Empowerment Theory (Kabeer, 1999; Zimmerman, 1995) and with recent findings that empowered groups realise larger income effects from similar networks (Higgins et al., 2025; Rahe et al., 2025). The significant, independent effect of social media echoes research showing that digitally mediated, weak-tie connections accelerate information diffusion and link farmers to extension services and markets beyond their locality (Chen et al., 2025; Wen & Ma, 2024), complementing social capital accounts that emphasize bridging and linking ties for innovation and market access (Cofre-Bravo et al., 2019).

Findings on cooperative membership and social club membership also align with the literature, although their effects are smaller once youth empowerment and social media membership are controlled. Nigerian studies consistently report that cooperatives reduce transaction costs and facilitate access to credit and inputs, thereby increasing productivity and food security (Adesina & Ayinde, 2018; Kehinde et al., 2021). The more modest and marginal standalone effect of social clubs is plausible: clubs often provide softer benefits such as trust and informal help, whose income effects are heterogeneous and easily overshadowed by digital information flows and empowerment (Aiyedogbon, 2016; Obi-Egbedi & Adeoye, 2023). International evidence similarly shows that while bonding ties offer important support, the largest productivity and innovation gains typically arise when those ties are complemented by bridging/linking connections and capability upgrades (Akinola, 2021; Yami et al., 2019).

The moderation results further harmonize with prior work. A significant interaction between social club membership and youth empowerment suggests empowered youth extract greater productivity from club participation, consistent with studies where empowerment programs amplify the payoffs from existing associations (Ekadina et al., 2022) and with observations that inclusive, capability-building initiatives help younger farmers convert social participation into entrepreneurial and market outcomes (Akinola, 2021; World Bank, 2017). The marginal interaction effect between social media membership and youth empowerment indicates a complementarity between digital engagement and empowerment; digitally literate, resource-enabled youth derive greater benefits from online networks (Chen et al., 2025; Wen & Ma, 2024). Conversely, the null effect of cooperative membership on youth empowerment

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suggests that cooperatives provide relatively additive gains across different levels of empowerment, through credit/input pooling and bargaining (Adesina & Ayinde, 2018; Kehinde et al., 2021), rather than gains that are conditional on empowerment. Overall, the estimates echo the empirical consensus: social capital matters, but its returns are largest where empowerment, especially among youth, unlocks the information, adoption, and market channels that convert ties into income.

This paper is based on the Social Capital Theory and Empowerment Theory, and on the assumption that bonding, bridging, and linking ties, which are mechanisms that decrease coordination and search costs, increase information flow, and facilitate access to credit and marketplaces, can be a result of farmers having long-standing ties within cooperative societies, social clubs, and social media (Bourdieu, 1986; Coleman, 1988; Putnam, 2000). Existing empirical studies in the agricultural sector demonstrate that the following channels can be effective: coordination of collective action by cooperatives and clubs, sharing of agronomic expertise, and strengthening of bargaining power (Kehinde et al., 2021; Obi-Egbedi & Adeoye, 2023; Rahe et al., 2025) and network intermediated through digital means extends the reach of weak ties to extension agents and markets, speeding up diffusion and adoption (The Empowerment Theory is the theory of heterogeneity in these returns: The productivity payoff of a given stock of social ties is increasing by capabilities, agency, and access to enabling resources, in particular, among the youth through skills, leadership roles, digital literacy, and finance/technology) (Ekadina et al., 2022; Kabeer, 1999; Sen, 1999; Somwethee et al., 2025; Zimmerman, 1995). Accordingly, the study theorizes that youth empowerment moderates the link between social capital and farm income, yielding the greatest marginal gains where cooperative strengthening and digital inclusion are paired with targeted empowerment initiatives (Higgins et al., 2025; Rahe et al., 2025).

5. CONCLUSIONS

The study shows that social capital and empowerment jointly shape agricultural productivity in North-Central Nigeria. Youth empowerment is the strongest predictor of farm productivity, followed by social media membership; cooperative membership remains beneficial, though smaller in magnitude, and social club membership is positive but marginal once other channels are controlled. Moderation tests indicate that empowerment amplifies the payoff from certain networks, especially social club membership (and to a lesser extent social media membership), while cooperative effects appear broadly additive rather than conditional on empowerment. Overall, roughly half of the variance in productivity is explained by empowerment and the three social-capital channels, underscoring that those capabilities (skills, agency, access to finance/technology) and network structure (bonding, bridging, linking ties) must be considered together to raise farm incomes.

Prioritize youth-focused empowerment programs that bundle practical skills, leadership opportunities, digital literacy, and facilitated access to finance and appropriate technologies; these should be tightly integrated with digital inclusion measures (e.g., subsidized data/smartphones, community Wi-Fi hubs, WhatsApp/Telegram extension groups) to unlock the strong social media pathway. Strengthen cooperative functions, timely input/credit access, aggregation, and market linkage, while preserving inclusivity for younger farmers; where possible, link co-ops to fintech/MFIs for social-collateral lending. Activate social clubs as productivity vehicles by pairing them with empowerment content (peer mentoring, business planning, climate-smart practices), since social club gains are largest at higher empowerment levels. Public agencies and NGOs should coordinate hybrid extension models (field demos + social media micro-lessons), target women and youth to close participation gaps, and embed results-based monitoring (income, adoption, market access) to identify thresholds at which combining empowerment with targeted network investments yields the highest marginal returns.

This study also has limitations, though it offers valuable insights. Its geographic area of interest in North-Central Nigeria is likely to limit the extrapolation of the results to areas with various socio-economic and institutional settings. Also, the self-reported information analyzed using Likert scales can be influenced by social desirability or recall bias. Although the cross-sectional research design is suitable for initial exploration, it does not allow the researcher to infer causality. Longitudinal or experimental studies would be better in the future to ensure dynamic relationships between social capital, youth empowerment, and productivity. It is also possible to conduct subgroup analyses, such as by gender, education, or digital access, to identify subtle patterns. It would be beneficial to expand the study to other regions or countries in Sub-Saharan Africa to determine the broader applicability and strength of the results.

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