



NEXUS OF IMPROVING AGRICULTURAL COMMERCIALIZATION AND POVERTY ALLEVIATION IN WEST AFRICA

Denzel Eshwanu Ulric Strasser-King¹, Augustine Sarfo²,
Essah Paulina Adobe³, Eliasu Issaka^{4,*}

¹ School of Economics, Zhejiang University of Technology, Hangzhou, 311100, PR China

² School of Finance, Yangtze Normal University, Chongqing, 408100, PR China

³ College of Economics and Management, Fujian Agriculture and Forestry University, Fuzhou City,
Fujian Province, 350002, PR China

⁴ School of Environmental Science and Engineering, Jiangsu University, Zhenjiang 212013, P.R. China.

*Corresponding Authors: Eliasu Issaka; 301 Xuefu Road, Zhenjiang, 212013, PR China;

Article DOI: <https://doi.org/10.36713/epra12324>

DOI No: 10.36713/epra12324

-----ABSTRACT-----

The desire to establish food security and alleviate poverty among the people of many West African countries has resulted in the passage of numerous pieces of legislation, including the Agricultural Productivity Program (WAAPP), to sustain agricultural growth and contribute to the development of a food-secure future. Many nations' food security programs have prioritized agricultural automation and commercialization. Agricultural commercialization entails a steady shift from subsistence to mechanized farming, with profit maximization driving production and input decisions and deepening vertical links between input and output markets.

This novel strategy aims to empower people at the grassroots level because the majority of the indigenous peoples in these nations are farmers, with the foresight that these nations would achieve their financial zenith when the people are economically secure. In this study, the authors sought to explore literature from the previous decades on expanding agricultural sector involvement and its implications for poverty reduction and food security in West Africa. Furthermore, the agricultural sector's advancement via mechanization and scientific and technological developments, the relationship between agricultural sector growth and food security, and the impact of agricultural development on poverty reduction in West Africa are discussed. Finally, agricultural commercialization and its influence on family economic development, and hence on poverty reduction and food security, are thoroughly examined.

KEYWORDS: *Agricultural sector, Poverty alleviation, West Africa, Food security, Commercialization*

1. INTRODUCTION

The agricultural sector in West Africa is primarily defined by economic expansion, which results in job creation in both the formal and informal sectors, and serves as a source of income for a large portion of the indigenous people [1]. The strong reliance of West African economic growth on agricultural practices necessitates the use of updated and enhanced scientific technology to increase output and profitability for industrial workers. The present agricultural growth trend requires West African countries to upgrade diverse agricultural systems [2,3]. Several west African nations have made boosting agricultural sector effectiveness a top development goal to meet the zero-hunger target established by the Sustainable Development Goals (SDG). Based on this context, West African governments have established the West Africa Agricultural Productivity Program (WAAPP) to sustain agricultural growth and contribute to the development of a food-secure future. Notwithstanding this increasing focus on agricultural policy, West African agricultural productivity and output continue to fall behind other areas, both in the food-producing and export sectors. Limited access to bank financing (and hence underdevelopment financial markets) has been identified as a key agricultural output and productivity limitation in Sub-Saharan Africa (SSA), particularly for small farmers in West Africa [2].

Access to agricultural mechanization (science and technology) and the productivity improvements that ensue are seen as critical to long-term development goals [4]. Despite some reported advances, technology adoption rates in West Africa, where smallholding agriculture predominates, have remained persistently low. While there is universal agreement that providing access to technology for these smallholders is critical for



agricultural and economic progress, empirical data shows that even when potentially effective technologies are accessible, they are rarely broadly embraced. This sluggish adoption of agricultural technology, particularly in West Africa, has resulted in persistently poor agricultural output, resulting in decreased household income and food security [5]. Supply-side restrictions such as availability and exposure to technology and agricultural techniques, as well as demand-side issues such as risk aversion and behavioural biases, are important causes of low adoption rates. The WAAPP was created largely to address some supply-side restrictions by expanding farmers' exposure to new technologies and making these technologies more accessible [5,6].

Commercial Agriculture Development is often seen as a means to commercialize agriculture, reduce poverty, and promote pro-poor growth in emerging nations [7]. Agricultural marketing strategies that encourage commercialization can be an effective way of enhancing agricultural efficiency, raising agricultural household income, and, as a result, improving household food and nutrition security [8]. Furthermore, commercialization may have an impact on dietary improvements and nutrition by expanding the availability of self-produced goods and changing gender roles in the home [9]. Because of this, most developing nations, particularly in West Africa, have made it a major priority in their development plans to include initiatives that might boost agricultural production [7]. Increased foreign direct investment in this area, government promises, public expenditure commitments under multiple new programs, and major donor assistance in agriculture all support this argument. Furthermore, to capitalize on the potential benefits of this industry, governments, donor organizations, and even the private sector have made large-scale commercial investments in it [7,10]. There is no question that African agriculture is rapidly commercializing [9]. We analyze literature from the last decades on increasing agricultural sector participation and its implications on poverty reduction and food security in West Africa in this study. This study has three possible contributions. (i) Agricultural sector enhancement via mechanization and scientific and technological advances (ii) We investigate the link between agricultural sector progress and food security. (ii) The influence of agricultural development on poverty reduction in West Africa.

2. METHODOLOGY – REVISION OF EXISTING LITERATURE

Applying the Web of Science (WoS) showed published manuscripts in the area of “agricultural commercialization and poverty alleviation”. 23 manuscripts on “agricultural commercialization and poverty alleviation” have been published in the last decade. Furthermore, according All databases, 31 publications have been published in the last decade. **Figure 1 below shows data on literature on “agricultural commercialization and poverty alleviation”.** This vividly shows that there is the need for extreme research in the said topic. This paper seeks to fill some the gap left by this situation.

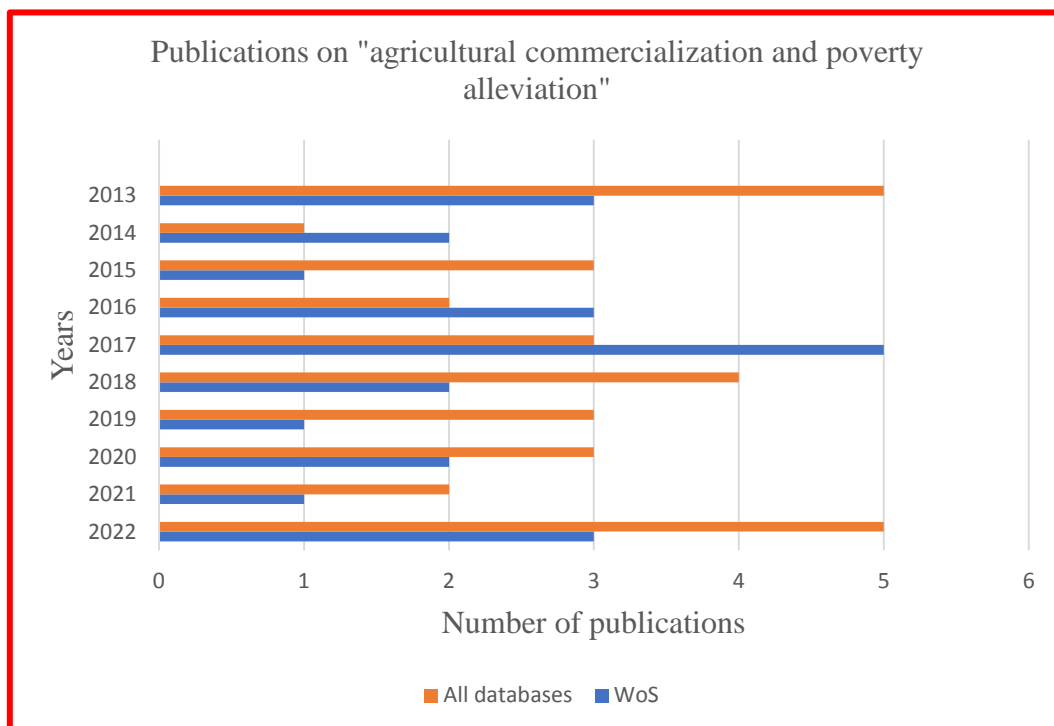


Figure 1 Historical evolution of published research on “agricultural commercialization and poverty alleviation” in the Web of Science database (Retrieved on January 5, 2023;



<https://www.webofscience.com/wos/woscc/summary/04e257b0-32c7-4381-9ca9-f58353e9261c-6bd46515/relevance/1>) and all databases (Retrieved on January 23, 2023; <https://www.webofscience.com/wos/allldb/summary/b4e13fa6-d485-41a1-b206-2364c1a0d2f1-6bd47459/relevance/1>).

Applying the Web All databases showed published manuscripts in the area of “agricultural commercialization in west Africa”. 80 manuscripts on “agricultural commercialization in west Africa” have been published in the last 10 years. 45 manuscripts were published in the last 3 years making up 56 % of the publication. Furthermore, 64 manuscripts have been published in WoS in the last 10 years. 28 of which is published in the last 3 years making up 44 % of the said topic. Figure 2 below indicates a sharp increase in the number of published articles on “agricultural commercialization in west Africa”.

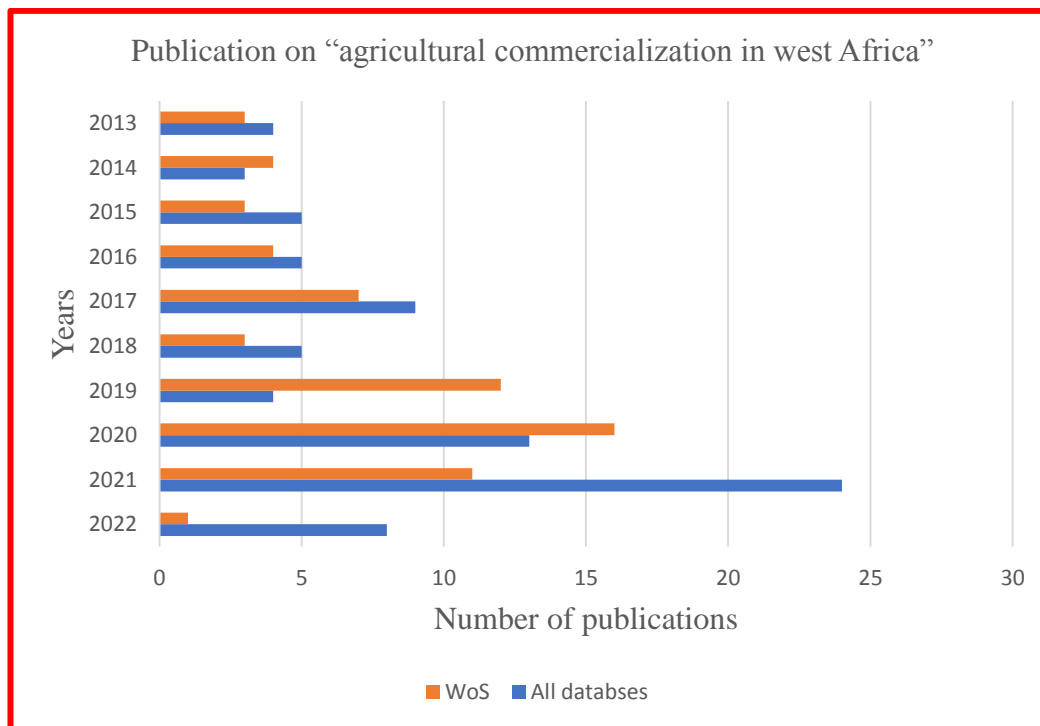


Figure 2 Historical evolution of published research on “agricultural commercialization in west Africa” in the WoS (Retrieved on January 5, 2023; <https://www.webofscience.com/wos/woscc/summary/6a58ecd3-4dbb-4045-8c33-97e6be6b3b89-6bd4daa2/relevance/1>) and all databases (Retrieved on January 23, 2023; <https://www.webofscience.com/wos/allldb/summary/6909e05a-e3d5-4745-ad8b-a5163d3fc735-6bd4c0a5/relevance/1>).

Applying the Web of Science (WoS) showed published manuscripts in the area of “poverty alleviation in west Africa”. 104 manuscripts on “poverty alleviation in west Africa” have been published in the last decade. 31 manuscripts were published in the last 3 years making up 30 % of the publication. Furthermore, according All databases, 148 publications have been published in the last decade. 51 manuscripts were published in the last 3 years making up 34 % of the publication. Figure 3 below shows data on literature on “poverty alleviation in west Africa”. This vividly shows that there is the need for extreme research in the said topic. This paper seeks to fill some the gap left by this situation.

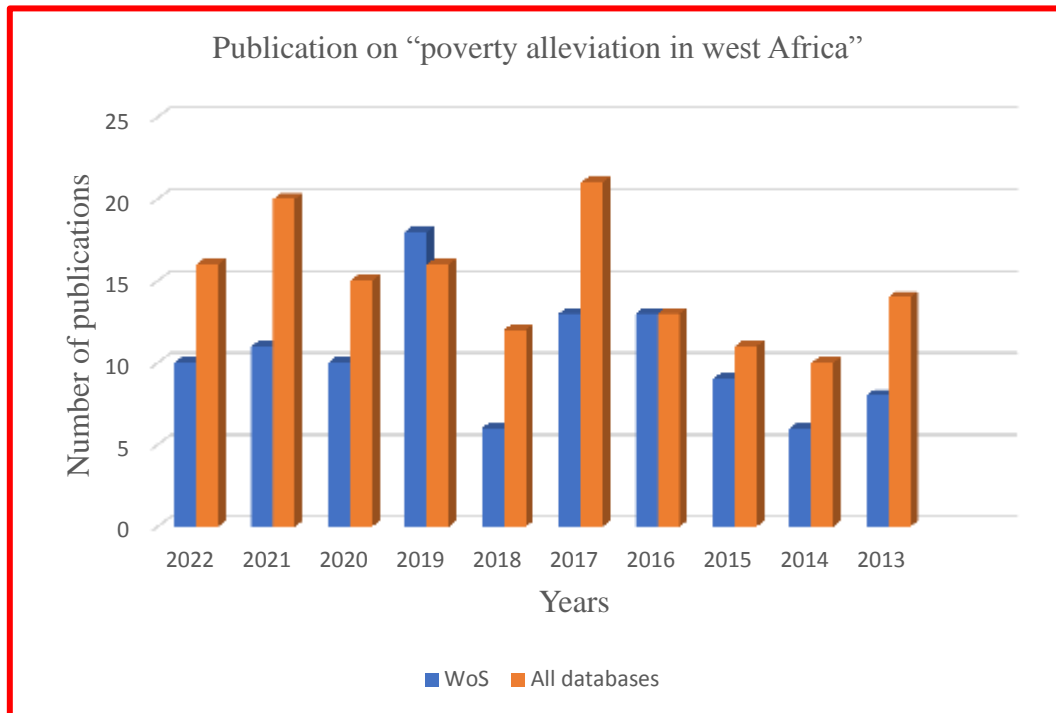


Figure 3 Historical evolution of published research “poverty alleviation in west Africa” in the WoS (Retrieved on January 5, 2023; <https://www.webofscience.com/wos/woscc/summary/fb5ab33b-df51-4738-8815-fef1ae194f51-6bd4e4a5/relevance/1>) and all databases (Retrieved on January 23, 2023; <https://www.webofscience.com/wos/alldb/summary/ee7a4a31-90e9-43e9-a619-49c13dfd3374-6bd4f2bc/relevance/1>).

2.1 Informal agricultural commercialization

Many West African households receive their income from the "informal agricultural sector" or "informal agricultural economy," and most of their food is provided via social ties that are not or only partially captured by official statistics and traditional national accounting systems [11]. Food insecurity in cities, which has resulted in "food riots" in recent years, mostly affects disadvantaged individuals working in the informal economy. It would be inaccurate to approach poverty reduction without taking into consideration a substantial section of the economy that provides employment, money, and important services to both urban and rural populations. Regardless of its importance, the informal economy is still loosely understood, poorly assessed, and hence poorly accounted for in food security and poverty reduction initiatives. This note assesses the size and significance of this economy, as well as how it functions [11,12].

Agricultural commercialization implies a gradual transition from subsistence to modernized farming, with production and input decisions based on profit maximization and reinforcing vertical linkages between input and output markets [11,13]. Commercialization, when properly utilized, results in welfare gains for farmers through comparative advantage and increased total factor productivity growth. It should be noted that agricultural commercialization extends beyond the marketing of agricultural outputs, implying that product selection and input use decisions are based on the profit maximization principle. According to conventional wisdom, the transition from subsistence (or semi-subsistence) to commercial agriculture is critical for low-income countries' economic development [14,15]. Comparative advantage enables agricultural commercialization to improve trade and efficiency, resulting in national economic growth and welfare improvement. This is also expected to create a virtuous circle, increasing household income and, as a result, improving consumption, food security, and nutritional outcomes in rural households [16].

The agricultural commercialization theory is based on agricultural transition, population and livelihood results, and the importance of enhanced agricultural production, labour productivity, market development, and industrial sector expansion. Increased productivity is possible via commercialization. Commercialization is critical to the structural transformation process because it improves the market for industrial goods and technology required for production, rises household welfare through job creation and enhanced labour productivity, and allows surplus to be transferred from the agrarian sector to other sectors in the form of food, labour, and capital [13,17]. Over the last few decades, the theoretical literature on commercialization has mainly relied on Rostow's theoretical model of economic growth [9]. Subsequent research builds on the earlier theoretical framework of agricultural commercialization, which is linked to staged growth and distinctive



changes in farming systems or transition stages. This divergence sees commercialization as a shift from subsistence to market-oriented manufacturing with the goal of profit maximization. Commercialization is defined as not just the sale of products, but also product selection and input utilization decisions based on the profit maximization concept. The influence of commercialization on marketable output, inputs, current tools and technologies, and the degree of commercialization is well established [18,19].

3. DETERMINANTS OF AGRICULTURAL COMMERCIALIZATION ON POVERTY ALLEVIATION

The existing research has reported on a variety of variables that motivate farmers to commercialize their crops and participate in the market. In general, farmers' demographic qualities, socioeconomic factors, and institutional and situational aspects all favour commercialization. According to one study, the age of farmers determines their level of commercialization [20]. As a result, they imply that older farmers participate in the market more than younger farmers. They also stated that farmers' education level and land size are important factors in commercialization [20,21]. Similarly, commercialization is dependent on the age and size of the farmer's land. Surprisingly, there is conflicting research about the impact of age and farm size on commercialization [22]. According to these academics, farm size and age have no bearing on commercialization. Furthermore, the agricultural experience was shown to be adversely related to commercialization [20].

On the one hand, it was discovered that the distance between farmers' homes and local markets influences their level of commercialization favourably [23]. Farmers who are close to a local market, on the other hand, are believed to be in a better position to commercialize. This suggests that farmers' closeness to markets makes commercialization easier. Farmers' market participation in another jurisdiction is unaffected by access to extension agents. However, the data indicate that extension contact has a considerable impact on farmer commercialization [20,21]. Moreover, multiple studies have found that involvement in training programs, farm size, membership in a community-based organization, and proximity to the nearest local markets are all important determinants of farmers' market participation. Furthermore, financing availability, seed technology, and farm location all had a key role in farmers' market involvement. According to another research, urbanization variables such as growing population, technological improvement, improved markets and market access, crop intensification, and asset accumulation are drivers of agricultural commercialization [21,24].

3.1 Endogenous variable: Endogeneity test

Each possibly endogenous independent variable is subjected to a series of successive tests for endogeneity, relevance, and validity [25]. First, each of these variables is regressed on the accessible instruments as well as the model's exogenous variables. These regression equations were estimated utilizing ordinary least squares for each of the potentially endogenous variables, with the primary instruments for the potentially endogenous variables being their lagged values [26,27]. First, the projected residual values from the reduced form equations were incorporated in the original equation, and Wu-Hausman F tests and Durbin-Wu-Hausman χ^2 tests is performed to assess if the variables are endogenous to the system under the null hypothesis of exogeneity. The null hypothesis is rejected if the coefficient on the anticipated residuals is considerably different from zero, and the variable is endogenous. Considering that exogeneity was excluded, the instruments' relevance was assessed based on their significance and explanatory power in the reduced-form equations [28]. Finally, the validity of instruments for endogenous variables was assessed by regressing the original equation's errors on the exogenous variables and the instruments, then applying Sargan's χ^2 test under the null hypothesis that the instruments are valid. The statistic NR^2 is used in the test, where N is the sample size and R^2 is the coefficient of determination, with degrees of freedom equal to the number of instruments [8,29].

4. IMPACT OF AGRICULTURE COMMERCIALIZATION ON POVERTY ALLEVIATION

West Africa is being selected as one of the locations for urban demographic growth. As a result, the agricultural sector represents the major source of employment, and its expansion is useful in guaranteeing food security and poverty reduction [30–32]. This is because agriculture employs over 60% of the people in these nations. Agriculture in west Africa, on the other hand, is primarily traditional and heavily reliant on smallholders and pastoralists [30,33]. Persistent productivity gains are still required today to feed the world's growing population, eradicate poverty, and achieve the SDGs [34]. Agricultural commercialization is critical for developing nations to achieve long-term growth and poverty reduction. Many low-income nations are currently embracing commercialization tactics to enhance productivity, raise farm revenue, create rural jobs, and eventually alter their economies [35].

Agricultural commercialization boosts commerce and productivity by capitalizing on competitive advantages, resulting in economic development and improved healthcare at the national level. The majority of this research has been conducted in rural settings, regardless, **Table 1 below shows the impact of urban**



agriculture commercialization on poverty in parts of Ghana (Bono region and Greater Accra region) employing Two-Stage Least Squares Regression (2SLS) and hetero-skedastic linear regression models.
Table 1 Impact of urban agriculture commercialization on poverty in parts of Ghana (Bono region and Greater Accra region). Adapted from [30].

Urban region/city	Variables	Coefficient × 10 ²	Standard error × 10 ⁻²	p-value × 10 ⁻²
Bono region	Socioeconomic characteristics			
	Age	0.1106	27.8	***0.000
	Gender	0.263	782.3	***0.1
	Educational level	0.10754	261.5	***0.000
	Experience	-0.00702	42.3	*9.7
	Household size	-0.08615	164.2	***0.000
	Agribusiness characteristics			
	Postharvest losses	0.2301	285.8	42.1
	Commercialization	0.72246	4457.6	*10
	Institutional characteristics			
	Extension contacts	0.01052	442.3	81.2
	Constant	0.64585	3041.3	**3.3
	Wald Chi 2(8)	0.6489	np	np
	Prob>Chi 2	***0.0000	np	np
	Endogenous variable; Endogeneity test Ho: variables are exogenous			
	Durbin score chi 2	0.03114 (p=0.0776)	np	np
	Wu-Hausman F	0.03020 (p=0.0836)	np	np
	Validity tests of instruments			
	Sargan (score) chi 2 (2)	0.02077 (p=0.150)	np	np
	Basman chi 2	0.02005 (p = 0.157)	np	np
Greater Accra region	Socioeconomic characteristics			
	Age	0.00047	29.2	87.2
	Gender	0.09049	405.1	**2.5
	Educational level	0.13589	350.6	***0.000
	Experience	-0.0011	114	***0.000
	Household size	-0.06092	13.4	93.6
	Main occupation	0.0399	597.9	0.505
	HFIAS	-0.01928	45.5	***0.000
	Agrobusiness			
	Commercialization	0.01928	853.8	82.1
	Institutional			
	Extension contacts	0.22912	583.1	***0.000
	Constant	0.47294	1497.9	***0.2
	Insigma 2	0.07258	21.4	***0.000
	Prob>chi2=0.000 Wald chi2(9) =55.72 Log pseudo likelihood= -1206.43			

Np= not provided, NB: 10%= *, 5%= ** and 1%= ***

The table shows the impact of socioeconomic characteristics on poverty among urban agriculture farmers in the Bono regions. The two-stage least square regression was employed for the analysis [30]. After realizing that commercialization is an endogenous variable in the OLS regression, the authors chose the two-stage least square regression (2SLS). The regression instrument variables in urban crop production were grading and the rate of fear of pesticide use. The p-value of less than 10% in the Hausman and Durbin tests for endogeneity confirms that commercialization is endogenous in the model. This implies that the OLS could not be used for the analysis; thus, the 2SLS is a suitable fit model. All five factors were shown to have a substantial impact on poverty. A one-year rise in age raises a household's per capita expenditure (poverty proxy) by 1.1 units. Thus, age significantly reduces poverty by 1% ($p < 0.01$). Age, on the other hand, was hypothesized to link



adversely with per capita spending (that is, a growth in poverty) since increasing age reduces the energy to labour and amass adequate wealth for family needs [30,35]. This is because the elderly in Ghana are typically landowners and have access to land for agricultural output to earn money [36]. Their capacity to earn a living through agricultural pursuits is expected to improve household spending. This is consistent with past studies indicating age is inversely connected to the likelihood of being impoverished [30,37]. Furthermore, a male urban farmer is more likely than a female to see a rise in per capita expenditure. The assumption is that a male urban farmer is less likely than a female urban farmer to be impoverished. One probable explanation for this phenomenon is that male-headed families may have different revenue sources and resource advantages than female-headed households. Females are often overburdened with housework, leaving them with insufficient time to spend on the field. As a result, guys are more productive and create more revenue than females.

In addition, if the farmer's educational level advances by a year, the odds of being poor reduce by 10.8 units (higher per capita spending). As a farmer's educational level rises, it is known that they are better positioned to accept new methods and technology [38,39]. Furthermore, education enhances human capital (labour) by increasing skills and knowledge, which increases agricultural production, farm revenue, and household expenditure [39]. Furthermore, being educated enhances the likelihood of getting off-farm employment as a complement to farm revenue [40]. Similarly, it is said that increasing farmers' educational levels reduce their chances of becoming impoverished [41]. As family size grows by one person, the per capita spending of the household drops [42,43]. There are two competing opinions on household size. First, increasing family size is projected to increase available labour for farm operations, improving productivity and boosting farm revenue and spending. In contrast, increasing household size puts pressure on household income and limits the ability to invest in human capital (e.g., education and health), rendering available household labour useless. Furthermore, this conclusion might be linked to the fact that as household membership rises, so does their consumption of farm proceedings, leaving little output for sale to generate money and other expenses. The experience of urban farming was adversely associated with household per capita spending. Thus, for every one-year increase in urban farming experience, the likelihood of a household being poor rises (per capita spending falls) by 0.7 units.

Furthermore, expertise in urban farming was thought to have a detrimental impact on poverty, but actual data proved otherwise. One possible explanation is that as farmers gain more urban farming experience and get more comfortable with their traditional methods of production, they become more resistant to new and emerging technology [44,45]. This inhibits them from boosting agricultural output, lowers farm income, and reduces household expenditure. This conclusion, however, contradicts the previous results. A unit rise in the commercialization of an urban farmer raises a household's per capita spending by 72 units. The outcomes might be attributable to revenue generated via commercialization. Farmers join the market to earn money for household expenses; thus, they will be eager to participate in the market if the chances of earning more money are great. Similarly, various research has suggested that when commercialization or market engagement grows, household poverty diminishes. The findings imply that the commercialization of urban agriculture might be one of the tactics utilized to alleviate poverty in Ghana and other West African cities. Incorporating urban agricultural marketing and cultivation into the urban development plans of West African nations such as Ghana is so critical [41,46].

5. CONCLUSION

Agricultural commercialization entails shifting from husbandry to more market-oriented output. In principle, it is calculated as a proportion of the value of a marketable crop to add up to farm production. Commercialization refers to the transition from farming to meeting the basic requirements of the family to expanded market-set production. West Africa's agriculture is certainly seeing growing commercialization. As part of commercialization, the market plays an important role in agricultural change. Smallholder farmers are encouraged to increase production and transition from subsistence farming to commercial agriculture by providing proactive and profitable market channels, which aid in poverty alleviation. Furthermore, market involvement, largely used as a proxy for commercialization, was viewed as the solution to improving farmers' family welfare and lifting them out of poverty, but this has proven to be a substantial difficulty in most developing nations, particularly in west Africa. This is because many African smallholder farmers continue to produce mainly for their use, with very few marketable surpluses and limited market prospects. Due to crises, market knowledge, and low demand, farmers generally sell their products on-site, according to some of these statistics.

Acknowledgements

The listed author(s) are thankful to their representative universities for providing the literature services.



Conflicts of Interest

The authors declare no competing interests.

Compliance with ethical standards

Research involving human participants and/or animals

No human participants or animals were involved in this research.

Competing interest

The authors declare that there are no competing financial interests.

Author contributions

Denzel Eshwanu Ulric Strasser-King: Conceptualization, Investigation, Formal analysis, Writing-Original Draft; Writing-Review and Editing; **Augustine Sarfo:** Writing-Original Draft, Formal analysis, Writing-Review and Editing; **Essah Paulina Adobea:** Resources, Methodology, Data Curation, Writing-Review and Editing; **Eliasu Issaka:** Data Curation, Resources, Methodology, Validation, Writing-Review and Editing, Supervision.

REFERENCES

1. Issaka E, Agyeman F, Wariboko A M, Johnson N A N, Agyeman K S, Gyimah E, Anagbo M S, IMPACTS OF AGRICULTURAL MECHANIZATION ON FOOD SECURITY AND POVERTY ALLEVIATION IN GHANA, *Asian Journal of Advances in Research*. (2022) 1–13. <https://www.mbimph.com/index.php/AJOAIR/article/view/3098> (accessed January 22, 2023).
2. Y. Kassouri, K.Y.T. Kacou, Does the structure of credit markets affect agricultural development in West African countries?, *Econ Anal Policy*. 73 (2022) 588–601. <https://doi.org/10.1016/j.eap.2021.12.015>.
3. J.M. Alston, Reflections on Agricultural R&D, Productivity, and the Data Constraint: Unfinished Business, *Unsettled Issues, Am J Agric Econ*. 100 (2018) 392–413. <https://doi.org/10.1093/AJAE/AAX094>.
4. Y. Bambio, A. Deb, H. Kazianga, Exposure to agricultural technologies and adoption: The West Africa agricultural productivity program in Ghana, Senegal and Mali, *Food Policy*. 113 (2022) 102288. <https://doi.org/10.1016/J.FOODPOL.2022.102288>.
5. N. Ashraf, X. Giné, D. Karlan, Finding missing markets (and a disturbing epilogue): Evidence from an export crop adoption and marketing intervention in Kenya, *Am J Agric Econ*. 91 (2009) 973–990. <https://doi.org/10.1111/J.1467-8276.2009.01319.X>.
6. P. Bustos, B. Caprettini, J. Ponticelli, Agricultural productivity and structural transformation: Evidence from Brazil, *American Economic Review*. 106 (2016) 1320–1365. <https://doi.org/10.1257/AER.20131061>.
7. M. Julius Chegere, M. Sebastian Kauky, Agriculture commercialisation, household dietary diversity and nutrition in Tanzania, *Food Policy*. 113 (2022) 102341. <https://doi.org/10.1016/J.FOODPOL.2022.102341>.
8. A.D. Alene, O. Coulbaly, The impact of agricultural research on productivity and poverty in sub-Saharan Africa, *Food Policy*. 34 (2009) 198–209. <https://doi.org/10.1016/J.FOODPOL.2008.10.014>.
9. E. Etuk, J.A.- Heliyon, undefined 2021, Agricultural commercialisation, poverty reduction and pro-poor growth: evidence from commercial agricultural development project in Nigeria, Elsevier. (n.d.). <https://www.sciencedirect.com/science/article/pii/S240584402100921X> (accessed January 22, 2023).
10. E. Duncan, L. Ashton, A.R. Abdulai, T. Sawadogo-Lewis, S.E. King, E.D.G. Fraser, S. Vosti, J. Haines, F. Knight, T. Robertson, Connecting the food and agriculture sector to nutrition interventions for improved health outcomes, *Food Secur*. 14 (2022) 657–675. <https://doi.org/10.1007/S12571-022-01262-3>.
11. G.M. Diiro, M. Fisher, M. Kassie, B.W. Muriithi, G. Muricho, How does adoption of labor saving agricultural technologies affect intrahousehold resource allocations? The case of push-pull technology in Western Kenya, *Food Policy*. 102 (2021). <https://doi.org/10.1016/j.foodpol.2021.102114>.
12. S. Stahn, C. Wickert, D. Katamba, C. Tindiwensi, A. Serum, Value Chain Upgrading in the Informal Agricultural Economy of Uganda: Networks among Small Business Owners as a Solution to Institutional Voids, (2017). <https://nru.uncst.go.ug/handle/123456789/6947> (accessed January 22, 2023).
13. S. Stahn, C. Wickert, D. Katamba, C. Tindiwensi, AGRI-QUEST, Knowledge4food.Net. (n.d.). https://knowledge4food.net/wp-content/uploads/2017/08/agri-quest_Research-Paper_No9_2017_Stahn-et-al.pdf (accessed January 22, 2023).
14. J. Olwande, M. Smale, M. Mathenge, F.P.-F. policy, undefined 2015, Agricultural marketing by smallholders in Kenya: A comparison of maize, kale and dairy, Elsevier. (n.d.). <https://www.sciencedirect.com/science/article/pii/S0306919215000196> (accessed January 22, 2023).
15. S. Fan, J. Brzeska, M. Keyzer, A. Halsema, From subsistence to profit: Transforming smallholder farms, 2013. https://books.google.com/books?hl=en&lr=&id=MX8JAQAAQBAJ&oi=fnd&pg=PR4&dq=Agricultural+commercialization+implies+a+gradual+transition+from+subsistence+to+modernized+farming,+with+production+and+input+decisions+based+on+profit+maximization+and+reinforcing+vertical+linkages+between+input+and+output+markets.+&ots=wzK64pJ_Ay&sig=kQI3M6wjC4ebNksdYUeMlpK2SY (accessed January 22, 2023).
16. D. Karlan, R. Osei, I. Osei-Akoto, C. Udry, Agricultural decisions after relaxing credit and risk constraints, *Quarterly Journal of Economics*. 129 (2014) 597–652. <https://doi.org/10.1093/QJE/QJU002>.



17. D.C. North, *Location Theory and Regional Economic Growth*, *Journal of Political Economy*. 63 (1955) 243–258. <https://doi.org/10.1086/257668>.
18. M. Paul, J.T. Ojong, M. Hauser, K. Mausch, *Does Agricultural Commercialisation Increase Asset and Livestock Accumulation on Smallholder Farms in Ethiopia?*, Taylor & Francis. 58 (2022) 524–544. <https://doi.org/10.1080/00220388.2021.1983170>.
19. M. Jaleta, B. Gebremedhin, D.H.-I.D. Paper, *undefined* 2009, *Smallholder commercialization: Processes, determinants and impact*, Cgspace.Cgiar.Org. (n.d.). <https://cgspace.cgiar.org/handle/10568/27> (accessed January 22, 2023).
20. N.T.B. Zondi, M.S.C. Ngidi, T.O. Ojo, S.I. Hlatshwayo, *Factors Influencing the Extent of the Commercialization of Indigenous Crops Among Smallholder Farmers in the Limpopo and Mpumalanga Provinces of South Africa*, *Front Sustain Food Syst*. 5 (2022). <https://doi.org/10.3389/FSUFS.2021.777790/FULL>.
21. K.T. Sibhatu, V. v. Krishna, M. Qaim, *Production diversity and dietary diversity in smallholder farm households*, *Proc Natl Acad Sci U S A*. 112 (2015) 10657–10662. <https://doi.org/10.1073/PNAS.1510982112>.
22. J. Mariyono, *Profitability and Determinants of Smallholder Commercial Vegetable Production*, *International Journal of Vegetable Science*. 24 (2018) 274–288. <https://doi.org/10.1080/19315260.2017.1413698>.
23. P. Moyo, *Urban Agriculture and Poverty Mitigation in Zimbabwe: Prospects and Obstacles in Bulawayo Townships*, *Journal of Human Ecology*. 42 (2013) 125–133. <https://doi.org/10.1080/09709274.2013.11906586>.
24. B.Z. Gulyas, J.L. Edmondson, *Increasing city resilience through urban agriculture: Challenges and solutions in the global north*, *Sustainability (Switzerland)*. 13 (2021) 1–19. <https://doi.org/10.3390/SU13031465>.
25. R.E. Evenson, C.E. Pray, G.M. Scobie, *The Influence of International Research on the Size of National Research Systems*, *Am J Agric Econ*. 67 (1985) 1074–1079. <https://doi.org/10.2307/1241375>.
26. A. de Janvry, E. Sadoulet, *World poverty and the role of agricultural technology: Direct and indirect effects*, *Journal of Development Studies*. 38 (2002) 1–26. <https://doi.org/10.1080/00220380412331322401>.
27. T.J. Coelli, D.S.P. Rao, *Total factor productivity growth in agriculture: A Malmquist index analysis of 93 countries, 1980-2000*, *Agricultural Economics*. 32 (2005) 115–134. <https://doi.org/10.1111/J.0169-5150.2004.00018.X>.
28. D. Byerlee, G. Traxler, *National and International Wheat Improvement Research in the Post-Green Revolution Period: Evolution and Impacts*, *Am J Agric Econ*. 77 (1995) 268–278. <https://doi.org/10.2307/1243537>.
29. S.A. Block, *A New View of Agricultural Productivity in Sub-Saharan Africa*, *Am J Agric Econ*. 76 (1994) 619–624. <https://doi.org/10.2307/1243676>.
30. R.K. Bannor, H. Oppong-Kyeremeh, S.K.C. Kyire, H.N.A. Aryee, H. Amponsah, *Market participation of urban agriculture producers and its impact on poverty: Evidence from Ghana*, *Sustainable Futures*. 4 (2022) 100099. <https://doi.org/10.1016/J.SFTR.2022.100099>.
31. J. Omiti, E. McCullough, ... D.O.-K.I. for, *undefined* 2006, *Participatory prioritization of issues in smallholder agricultural commercialization in Kenya*, *Researchgate.Net*. (n.d.). https://www.researchgate.net/profile/Alice-Murage-2/publication/265024365_Participatory_Prioritization_of_Issues_in_Smallholder_Agricultural_Commercialization_in_Kenya/links/54fff6830cf2741b69fa30d1/Participatory-Prioritization-of-Issues-in-Smallholder-Agricultural-Commercialization-in-Kenya.pdf (accessed January 22, 2023).
32. D.N.-J. of political economy, *undefined* 1955, *Location theory and regional economic growth*, *Journals.Uchicago.Edu*. (n.d.). <https://www.journals.uchicago.edu/doi/abs/10.1086/257668> (accessed January 22, 2023).
33. K. Otsuka, Y. Nakano, K.T.-A.R. of R. Economics, *undefined* 2016, *Contract farming in developed and developing countries*, *JSTOR*. (n.d.). <https://www.jstor.org/stable/26773370> (accessed January 22, 2023).
34. J.S. Crush, G.B. Frayne, *Urban food insecurity and the new international food security agenda*, *Dev South Afr*. 28 (2011) 527–544. <https://doi.org/10.1080/0376835X.2011.605571>.
35. R.K. Bannor, N. Ibrahim, E.C. Amrago, *Examining the influence of commercialisation and postharvest losses on the choice of marketing outlet among poultry farmers*, *Sci Afr*. 12 (2021). <https://doi.org/10.1016/j.sciaf.2021.e00792>.
36. J. Sward, *In-migration, customary land tenure, and complexity: exploring the relationship between changing land tenure norms and differentiated migrant livelihoods in Brong Ahafo, Ghana*, *Popul Environ*. 39 (2017) 87–106. <https://doi.org/10.1007/S11111-017-0277-Z>.
37. R. Hall, I. Scoones, D. Tsikata, *Plantations, outgrowers and commercial farming in Africa: agricultural commercialisation and implications for agrarian change*, *Journal of Peasant Studies*. 44 (2017) 515–537. <https://doi.org/10.1080/03066150.2016.1263187>.
38. Y.A. Yigezu, A. Mugeru, T. El-Shater, A. Aw-Hassan, C. Piggan, A. Haddad, Y. Khalil, S. Loss, *Enhancing adoption of agricultural technologies requiring high initial investment among smallholders*, *Technol Forecast Soc Change*. 134 (2018) 199–206. <https://doi.org/10.1016/j.techfore.2018.06.006>.
39. R. Stewart, L. Langer, N.R. da Silva, E. Muchiri, H. Zaranyika, Y. Erasmus, N. Randall, S. Rafferty, M. Korth, N. Madinga, T. Wet, *The Effects of Training, Innovation and New Technology on African Smallholder Farmers' Economic Outcomes and Food Security: A Systematic Review*, *Campbell Systematic Reviews*. 11 (2015) 1–224. <https://doi.org/10.4073/CSR.2015.16>.
40. W. Morris, A. Henley, D. Dowell, *Farm diversification, entrepreneurship and technology adoption: Analysis of upland farmers in Wales*, *J Rural Stud*. 53 (2017) 132–143. <https://doi.org/10.1016/j.jrurstud.2017.05.014>.
41. F. Noack, A. Larsen, *The contrasting effects of farm size on farm incomes and food production*, *Environmental Research Letters*. 14 (2019). <https://doi.org/10.1088/1748-9326/AB2DBF>.



42. M. Mutisya, M.W. Ngware, C.W. Kabiru, N. bakwin Kandala, *The effect of education on household food security in two informal urban settlements in Kenya: a longitudinal analysis*, *Food Secur.* 8 (2016) 743–756. <https://doi.org/10.1007/S12571-016-0589-3>.
43. M.E. Wagner, H.J.P. Schubert, D.S.P. Schubert, *Family Size Effects: A Review*, *Journal of Genetic Psychology.* 146 (1985) 65–78. <https://doi.org/10.1080/00221325.1985.9923449>.
44. C. Grebitus, L. Chenarides, R. Muenich, A. Mahalov, *Consumers' Perception of Urban Farming—An Exploratory Study*, *Front Sustain Food Syst.* 4 (2020). <https://doi.org/10.3389/FSUFS.2020.00079/FULL>.
45. D. Satterthwaite, G. McGranahan, C. Tacoli, *Urbanization and its implications for food and farming*, *Philosophical Transactions of the Royal Society B: Biological Sciences.* 365 (2010) 2809–2820. <https://doi.org/10.1098/RSTB.2010.0136>.
46. R. McDougall, P. Kristiansen, R. Rader, *Small-scale urban agriculture results in high yields but requires judicious management of inputs to achieve sustainability*, *Proc Natl Acad Sci U S A.* 116 (2019) 129–134. <https://doi.org/10.1073/PNAS.1809707115>.