



Impact of agribusiness empowerment interventions on youth livelihoods: Insight from Africa

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ABSTRACT

This study generates evidence to understand the impact of agribusiness empowerment programmes on youth livelihoods in developing countries based on the ENABLE-TAAT programme implemented in Kenya, Nigeria, and Uganda. A multistage sampling technique was used in obtaining primary agribusiness-level data from a sample of 1435 young agripreneurs from the study countries. An Endogenous Treatment Effect Regression (ETER) model was used to assess the impact of programme participation on youth livelihoods (income and food security). Results show that participation significantly increased youth's agripreneurship income by 7% and improved food security by 75% for the pooled analysis. The country disaggregation results show that participation led to a 54% and 37% increase in the income of participants in Nigeria and Uganda, respectively. Also, positive and significant impacts were obtained for food security in the two East African countries. These findings suggest policy interventions or programmes focusing on youth agribusiness empowerment, particularly those that target young actors along different agricultural value chains. The study also suggests interventions geared towards mitigating constraints to credit access and productive resources by young agripreneurs to ease barriers to working capital and business innovation.

1. Introduction

Africa has the youngest population in the World, with between 60 and 70% of its population below 30 years old [1]. While this could be an economic asset in terms of human resources, many scholars have described it as a ticking time bomb waiting to explode [2, 3]. This is because if Africa fails to generate appropriate economic possibilities for youths to earn a modest living, surging unemployment rates will continue to fuel criminality, insurgency, violent conflicts, religious radicalization, and sexual exploitation, among others [4].

Youth bulge and unemployment are two terms that must not go hand in hand because a continuous increase in the youth population must be accompanied by sufficient employment opportunities for nation-building and economic development. However, like in every

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other part of the world, the narrative is sardonic in Africa. According to the International Labor Organization (ILO) [5], the estimated 440 million youths expected to join the labour market by 2030 may pose a significant development challenge in Africa due to declining and limited economic and livelihood opportunities for the youths [6].

In tackling the issue of unemployment and its accordant undesirable outcomes, scholars and development partners have highlighted the importance of youth entrepreneurship in agriculture, otherwise known as agripreneurship [7,8]. Agripreneurship is described as a profitable linkage between agriculture and entrepreneurship [9], whereby a farmer, regarded as an agripreneur, applies innovative and creative methods to agricultural activities while constantly taking calculated risks and looking for ways to improve farm business to generate more income and maximize profits [10]. The potential of agripreneurship in generating sustainable employment opportunities for young people, alleviating youth poverty, preserving the agricultural labour force, and contributing to food security has been widely discussed in the literature [9,11–13].

While the concept of youth agripreneurship is emerging, African governments have shown their commitment to harnessing youth agripreneurship intention and improving the performance of youth-owned agro-enterprises [14]. These commitments are evident in various interventions implemented in recent years to expose youth to various agribusiness value chains and profitability mechanisms. Examples include the Youth Inspiring Youth in Agriculture (YIYA) Initiative in Uganda [15], the Kenya Youth Agribusiness Strategy [16], and the Empowering Novel Agribusiness-Led Employment (ENABLE) programmes implemented in 19 African countries. These interventions have included skills development, facilitating youth access to productive resources, and training on modern technologies [14].

As a result of these efforts, some young people have realized the benefits of agripreneurship as a sustainable means of livelihood [17] and stepped off the long unemployment queue to pursue agripreneurship careers, either as a necessity due to the inability to secure gainful employment in other sectors or out of passion [14]. For instance, in Uganda, approximately 55% of the youths in rural areas engage in agriculture as a sole means of livelihood [15]. This has fueled continued interest in interventions that can improve the performance and productivity of those involved in agricultural value chains.

Specifically, the relevance of agribusiness empowerment programmes to youth engagement in agripreneurship has received significant attention in the global agenda and literature in recent years [18–20]. For instance, Adeyanju et al. [21] found that participation in the Fadama Graduate Unemployed Youth Women Support (FGUYS) programme in Nigeria improved the performance of youth-owned agribusinesses. Similarly, Moore [22] argued that training on the efficient use of financial resources helps youth manage funds, while entrepreneurship training helps young people better understand their business environment and create bankable business plans.

Overall, the theoretical implications of these programmes for policymaking have been well studied, with primarily descriptive, classificatory, and often historical literature [12,14,23,24]. Additionally, the majority of existing literature on agribusiness programmes is preoccupied with the factors influencing participation, intention to engage in agribusiness, and youth perception of agriculture [13,17,25,26]. Those that addressed the impacts of agricultural-related programmes primarily focused on farming households with little reference to youth who face more severe labour market challenges [27–29].

Thus, despite the importance of youth agribusiness empowerment programmes for host countries and development partners, the impact of such efforts remains poorly understood, both at national and regional levels [18,30]. There is, in particular, little evidence to support debates on the implications of youth agripreneurship programmes for local and regional policymaking. It is worth noting that there have been few country-specific attempts to assess agribusiness programmes and performance in different contexts [18,20,21,31]. However, most evaluations focus on the impact of hard skills, while studies considering programmes that combine hard and soft skills are limited. Without sufficient practical evidence, policymakers and development partners involved in programme implementation may be caught between making informed decisions about scaling programmes or truncating them altogether. This study, therefore, addresses some of the identified research gaps by empirically assessing the impact of agribusiness empowerment programmes on the livelihoods of young agripreneurs taking evidence from the ENABLE-TAAT programme in Kenya, Nigeria, and Uganda.

The rest of the paper is structured as follows: The next section presents a review of empirical studies relevant to the research objective. Section 3 describes the data, variable operationalization, and estimation strategy. The results and discussions are presented in section 4. Finally, the paper concludes with the highlights, relevant policy implications, and recommendations for further studies in section 5.

2. Materials and method

2.1. The ENABLE-TAAT programme

The ENABLE-TAAT programme was initiated to involve youth, aged 18–35 years, in the process of agricultural transformation and help tackle the issue of youth unemployment in Africa. The programme was funded by the African Development Bank (AfDB) and implemented by the International Institute of Tropical Agriculture (IITA) through its youth in agribusiness initiative [32]. The primary goal was to engage more youth in agribusiness and help them generate better economic and livelihood outcomes including income and food security.

The 3-year programme was conducted across 19 African countries: DR Congo, Kenya, Nigeria, Tanzania, Uganda, and Zambia between 2018 and 2021. The programme provided an intensive 6-week training, mentorship, and technical assistance and facilitated the creation and expansion of youth-led agribusiness enterprises along the TAAT value chains to 4398 youths, the majority of whom resided in rural areas [32]. With regards to our study locations, a total of 1384 youths, 344, 440, and 600 beneficiaries from Kenya, Nigeria, and Uganda, respectively participated in the programme in 2018. A sub-sample of these youths participated in the current

study (see section 2.2).

2.2. Data, sampling, and variable definition

The data used in this study was obtained under the ENABLE-TAAT programme funded by the African Development Bank (AfDB) and facilitated by the International Institute of Tropical Agriculture (IITA). The survey was conducted in Kenya, Nigeria, and Uganda between August and December 2021. These countries were purposively selected based on three criteria. First, they were three of the pioneering countries in which the ENABLE-TAAT programme was conducted in 2018. The second criterion was related to the severity of unemployment and underemployment, while the third criterion was based on the relatively high number of programme participants compared to the other countries.

A multistage sampling technique was adopted in selecting the respondents. Following the purposive selection of the three countries, the study population was stratified into programme participants and non-participants in the second stage. Participants were those who participated in the ENABLE-TAAT programme in 2018, and non-participants were other agripreneurs in the community who did not participate in the programme. The list of participants and non-participants was obtained from the repository of the ENABLE-TAAT programme in each country's coordinating office. Based on the sample size determination formula proposed by Yamane [33], the third stage involves the random selection of 1463 respondents, comprising 747 participants and 716 non-participants, across the three countries. The selection of respondents was based on random numbers generated via Microsoft Excel.

The sample size was proportionately shared between the three countries based on the sampling frames. A total of 407 youths (186 participants and 221 non-participants) were selected in Kenya, 440 youths (238 participants and 202 non-participants) from Nigeria, and 617 youths (324 participants and 293 non-participants) from Uganda. However, out of those selected, 400 respondents (183 participants and 217 non-participants) participated in Kenya, 429 respondents (230 participants and 199 non-participants) participated in Nigeria, and 606 respondents (324 participants and 282 non-participants), participated in Uganda, summing up to 1435 respondents in total. This gives a 98% response rate. The 2% excluded was due to the unavailability and refusal of some respondents to participate. The survey instrument which captured socioeconomic and demographic information, programme participation, agribusiness attributes and performance, food security, and other relevant variables was programmed on an Open Data Kit (ODK). The key variables included in the questionnaire are described in Table 1.

2.3. Ethical approval

This study was approved by the School of Post-Graduate Studies of the University of Nairobi, Kenya. Written informed consent was obtained from all the participants. The questionnaires were anonymized, and respondents were free to opt out of participation whenever they were uncomfortable.

2.4. Empirical framework

The Endogenous Treatment Effect Regression (ETER) model was used to identify factors that influenced programme participation

Table 1
Definition of Key Variables Included in the ETER Model and their Expected Signs.

Variable	Measurement	Hypothesized sign (Participation)	Hypothesized sign (Income and FCS)
(ln)Income	Natural log of total annual income from agribusiness activities (in naira)		
(ln)FCS	Natural log of food consumption score		
Participation	Participation in the ENABLE-TAAT programme (Participant = 1, non-participant = 0)		+
Age	Age of respondents in years	+	+/-
Education	Years of formal education	-	+
Gender	Dummy (Male = 1, Female = 0)	+	+/-
Marital status	Dummy (Married = 1, otherwise = 0)	-	+
Household size	Number of household members (headcount)	+	+
Experience	Years of agribusiness experience	+/-	+
Land size	Hectares of land owned	+	+
Value of asset	The total value of agribusiness assets	+/-	+
Credit	Borrowed money in the last 12 months Dummy (Yes = 1, No = 0)	+	+/-
Extension	Access to extension services Dummy (Yes = 1, No = 0)	+	+
Residence	Current residence (Rural = 1, Urban and others = 0)	-	-
Partnership	Involved in business partnership (Yes = 1, No)	+/-	+
Perception	General perceptions of agribusiness empowerment interventions/programmes (Positive = 1, otherwise = 0)	+	
Awareness	Awareness of ENABLE TAAT programme (Aware = 1, unaware = 0)	+	
Covid-19	Did the pandemic affect major agribusiness activities (Yes = 1, No = 0)		-

Source: Authors' compilation (2022).

decisions and assess the impact on youth livelihood [21,34,35]. The model is unique for its ability to account for endogeneity resulting from observable and unobservable factors and equally provide the Average Treatment Effect (ATE) of the endogenous dummy variable on the dependent variable. The ETER model is a two-stage estimation method that combines a binary selection equation to assess participation decisions in the first stage with a linear regression model in the second stage to evaluate the outcome. In this study, participation decision was modelled as a dichotomous variable, which takes the value of 1 for participants and 0 for non-participants. Consider a rational young agripreneur, i , confronted with two decisions of either to participate in the ENABLE-TAAT programme or not, based on the expected utility from participation. The participation decision can then be expressed as presented in Equation (1):

$$T_i^* = \alpha X_i + \epsilon_i, \text{ where } T_i = \begin{cases} 1 & \text{if } T_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

Where T_i^* is the latent variable that specifies whether a young agripreneur participated in the programme or not. Hence, T_i is a dichotomous variable that equals 1 for programme participants and 0 for non-participants. α represents the vector parameter to be estimated, X_i denotes the covariates that determine participation decisions, and ϵ_i is the disturbance term.

To identify the selection equation, it is required to include at least a variable, otherwise known as an exclusive restriction, which affects participation but does not directly influence the outcome variables, otherwise, through the selection variable. The restrictive exclusions included in the equation are discussed under the model identification strategy.

After accounting for endogeneity, the second stage or outcome equation is expressed in Equation (2):

$$Y_i = \mu W_i + \eta T_i + u_i \tag{2}$$

Where Y_i is the outcome variables (agribusiness income and food security), W_i represents the covariates/controls which influence income and food security; T_i as previously defined as an indicator of participation status; η and μ are vectors of parameters to be estimated; and u_i is the disturbance term.

The conditional expectation of the outcome variables and expected value of the two error terms are computed as in Equations (3) and (4):

$$E(Y_i/T_i = 1) = \mu W_i + E(u_i / X_i, \epsilon_i) = \mu W_i + E(u_i / \epsilon_i), \text{ with } E(u_i / \epsilon_i) = 0 \tag{3}$$

$$E(u_i / \epsilon_i) = E(u_i \epsilon_i \leq \alpha X_i) = E(\sigma_u, \rho / \epsilon_i) = \rho \sigma_u \phi(\alpha X_i) / \Phi(\alpha X_i) \tag{4}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ represent the standard normal density and cumulative distribution functions, respectively. The ETER model was estimated using the Full Information Maximum Likelihood (FIML) method.

2.5. Outcome measures

This study focused on two outcome measures, agribusiness income and food security, which align with the objectives of the ENABLE-TAAT programme.

Agribusiness income was measured as the log of total income from agribusiness-related activities, which is the summation of total earnings from crop production, sales of livestock, and processed agricultural products produced by each respondent.

As a measure of general nutrient intake, *food security* was measured using the Food Consumption Score (FCS). The FCS also referred to as a “food frequency indicator,” is a frequency-weighted diet diversity score calculated using the consumption frequency of eight food groups, including main staples, pulses, vegetables, fruit, meat and fish, milk, sugar, and oil, over a 7-day recall period [36]. It indicates the dietary diversity, consumption frequency, and sources of these food items. In this study, the FCS was constructed using information on food consumption gathered from a country-specific list of food items.

The relevance of these food items to food security has been widely discussed in the literature. While some food items such as cereal grains are common staples that are easily accessible and affordable by many Africans [37–39], other items such as exotic fruits and dairy products are quite expensive and rarely found in the African diet. For instance, Fukagawa and Ziska [38] document that over

Table 2
Food groups and weight used in constructing the FCS.

Food Items	Food Groups	Weight
Maize, rice, pasta, bread, and other cereals	Cereals and Tubers	2
Cassava, Yam, Arrow roots/Cocoyam, and potatoes		
Vegetables and leaves	Vegetables	1
Fruits	Fruit	1
Beef, goat meat, poultry, pork, eggs, fish, other meat, and seafood	Animal protein	4
Beans, peas, lentils, peanuts, and others	Pulses	3
Milk and other milk products	Milk	4
Sugar, honey, and sugar products	Sugar	0.5
Edible oils, fats, and butter	Oil	0.5

Source: United Nations World Food Programme

20% of the world's calories come from rice while cereal grains provide the world's population with the most accessible and affordable macronutrients (energy and protein). However, sustainable food security cannot be achieved by relying on a few crops such as rice, maize, wheat, and soybeans, which account for a small portion of the global food supply [40].

In this study, respondents were asked how many days they had consumed different food items in the week preceding the survey. These food items were grouped into eight categories, as presented in Table 2. The consumption frequency of the eight groups was summed, and any frequency value above seven was capped at seven. Next, the frequency obtained for each food group was multiplied by an assigned weight based on its nutrient content (Table 2). Finally, the FCS was computed as the sum of the weighted values of all the food groups. This method of assessing food consumption has been adopted to compute individual and household food consumption by many studies in developing countries [41–43].

The formula used in computing the food consumption score is presented in Equation (5):

$$FCS = \sum F_i X_i \quad (5)$$

where F_i represents the food groups, and i represents the food items. X_i denotes the consumption frequency of each food group over a seven-day recall period. Finally, the continuous FCS was categorized into appropriate thresholds of food consumption groups as follows: poor food consumption (FCS = 0–28), borderline (FCS = 28.5–42), and acceptable food consumption (FCS >42) following United Nations World Food Programme [44].

2.6. Identification strategy

Two instrumental variables, perception of agribusiness empowerment programmes and awareness of the ENABLE-TAAT programme, were identified as factors that may likely influence participation decisions but may not directly influence income and food security, except through participation.

The *perception variable*, as identified by other literature, is a strong determinant of programme participation [21,45,46]. Several studies have found a positive link between perception and participation in business empowerment programmes or interventions. For instance, Adeyanju et al. [21] emphasized the relevance of improving youth perception of agricultural-related programmes to increase participation and ensure that many young people remain in agricultural careers. The authors also stressed the need for programme restructuring to entice the younger generation since increased participation has stern implications for food security and youth employment.

This study, therefore, hypothesized that positive perceptions of agribusiness empowerment programmes could lead to increased participation and vice versa. However, while programme perception may directly influence an individual's participation decision, it does not have a direct link to the outcome variables, except through participation. Perception was measured as a binary variable that equals 1 if a respondent holds a positive perception (i.e., perceiving empowerment programmes as generally beneficial) and 0 otherwise.

Prior *awareness of the ENABLE-TAAT programme* before its implementation is expected to influence youth participation decisions directly, but not their livelihood outcomes. This is because those who have prior information about the programme, such as the objectives of the programme, its location, and so on, may find it more worthy to attend than those who are unaware. However, programme awareness is not directly linked to income and food security, except through participation. Awareness was measured as a binary variable that equals 1 for those who had information about the programme before its implementation in 2018 and 0 otherwise.

3. Results and discussion

3.1. Food consumption score

Table 3 presents the average food consumption scores (FCS) and the percentage of respondents that had acceptable food consumption scores by country and participation status.

The results show that more participants (51%) than non-participants had acceptable food consumption scores across the three countries, suggesting that participants are more food secure than their counterparts who did not participate in the programme. While this could suggest a positive impact of the programme, further enquiry and an in-depth assessment are required to validate these results.

Table 3
Food consumption of youths in Kenya, Nigeria, and Uganda.

Food Consumption profile	Pooled n = 1435		Kenya n = 400		Nigeria n = 429		Uganda N = 606	
	P	NP	P	NP	P	NP	P	NP
Average food consumption score (mean)	46.37	43.87	54.44	48.69	48.76	46.34	40.11	38.41
Acceptable Food Consumption (%)	50.75	45.13	67.21	55.75	54.78	45.73	58.53	36.52

Source: Survey data (2021).

Notes: P stands for participants; NP for non-participants.

The country disaggregation shows that over two-thirds of the participants in Kenya had acceptable FCS while more than half had acceptable scores in Nigeria and Uganda (55% and 59%, respectively). Also, participants had higher FCS than non-participants. The pooled average FCS for participants was about 46 points compared to 43 points for non-participants. By country, Kenyan participants had the highest score of about 54 points, followed by Nigeria and Uganda with 49 and 40 points, respectively. This implies that overall, food consumption was highest among the participants in Kenya.

Even though the results indicate that, with an exemption of Uganda, non-participants had acceptable scores based on the threshold defined by the United Nations World Food Programme, the higher scores recorded for participants could suggest the positive impact of programme participation on food consumption. This high FCS obtained by respondents could be attributed to their engagement in agripreneurship since they have an increased capacity to produce what they consume [47,48].

This further supports the claims of several studies that recommend agripreneurship as a means of improving youth livelihoods in Africa [21,25,49,50]. The food consumption disparity between the two East African countries is surprising but, could be attributed to differences in food choices (for instance, high milk and dairy product consumption in Kenya) and Kenya being the hub of East Africa's economic activities. Generally, despite being food producers, the non-participants in Uganda had an average which falls within the non-acceptable food consumption group.

3.2. ETER model results-impact estimates (income and food security)

Table 4 presents the impact estimates obtained for income and food security using the ETER model. The two instrumental variables included to identify the models were statistically significant at $p < 0.01$ (Table 4), indicating that the basic condition for the exclusive restriction was met. The significance of rho, which is the correlation coefficient between the error terms of the selection (participation) and outcome (agribusiness income and food security) equations, indicates sample selection bias and endogeneity. This implies that unobserved characteristics influenced the participation decision. Also, the significance (Prob > chi2 = 0.01 for both income and FCS) of the likelihood ratio tests for joint independence confirms a correlation between the selection and outcome equations. This further justifies the fitness of the ETER model for the analysis.

The results show that programme participation led to an approximately 33% increase in agripreneurship income, indicating a positive and significant (at $p < 0.01$) impact on youth income. The increased income could be a result of the better business practices learned from the programme. Beneficiaries received practical training on how to run and manage their agribusinesses. Also, they were exposed to innovative methods of farming and received continuous mentorship from experts. These results agree with Lachaud et al. [18], who found that an agri-business skills training programme improved the labour market outcomes of young Zimbabwean farmers four years after it was implemented largely because programmes expose participants to a broad range of innovative support services aimed at enhancing both technical and managerial skills for sustainable and profitable production and marketing [51,52].

Disaggregated by country, a positive and significant impact was found in Nigeria and Uganda while no significant impact was found in Kenya. This implies that the result should be interpreted with caution as there may be potential heterogeneity, such as location in this case, which may affect the estimated ATT conditional on programme participation.

Also, a positive, and significant result was obtained for food consumption (at $p < 0.01$) for the pooled sample, where participation led to about a 75% increase in the FCS of participants. This could be attributed to the food security component of the programme which includes sensitization on healthy diets and exposure to crop diversification strategies. This result corroborates Garbero and Jäckering [53], who found that agricultural programmes improve the food security status of beneficiaries, especially for those residing in food-insecure countries. According to Ouko et al. [16], efforts to support youth agripreneurship will drive better livelihoods among youths in developing countries. The country analysis shows positive and significant impacts in the two East African countries while no significant impact was found for Nigeria. This could be attributed to the different food groups consumed in these countries.

Overall, these findings show that agribusiness empowerment interventions have a positive and significant impact on youth livelihoods. While the pathway through which this occurs was not assessed, these programmes could fill the experience gap faced by many young people and equip them with the necessary skills for better agribusiness performance [21]. Better performance in turn could contribute to wealth creation and facilitate the acquisition of productive resources, which could result in increased productivity,

Table 4

Impact of the ENABLE-TAAT programme on youths' income and food security in Kenya, Nigeria, and Uganda.

Treatment effect	Income				Food security (FCS)			
	Pooled	Kenya	Nigeria	Uganda	Pooled	Kenya	Nigeria	Uganda
ATT	0.330*** (0.076)	-0.236 (0.145)	0.544*** (0.152)	0.369*** (0.064)	0.753*** (0.081)	0.901*** (0.087)	-0.092 (0.266)	0.772*** (0.126)
Instruments								
Perception	0.382*** (0.081)	0.500*** (0.140)	0.262 (0.160)	0.600*** (0.192)	0.261*** (0.071)	0.111 (0.076)	-0.023 (0.161)	0.442** (0.187)
Awareness	0.401*** (0.778)	0.377** (0.171)	0.086 (0.137)	0.640*** (0.171)	0.404*** (0.069)	0.328*** (0.105)	-0.122 (0.156)	0.741*** (0.157)
LR test of indep. eqns. (rho = 0):								
chi2 (1)	6.12***	2.84*	1.58	5.31**	25.60***	14.28***	0.22	14.30***
Rho	-0.385***	0.500*	-0.584***	-0.438	-0.721***	-0.974***	0.266	-0.645***

Source: Field survey (2021). Standard error in parenthesis; ***p < 0.01, **p < 0.05, *p < 0.1.

higher income, and food security.

The results further address the concerns of Ouko et al. [16] on the effectiveness of programmes in generating better livelihood outcomes for youth. As evident in this study, agribusiness empowerment programmes such as ENABLE-TAAT offer positive economic outcomes for young agripreneurs and more importantly, could guide them during the start-up stage of their agribusiness life cycle. This is particularly relevant, considering that respondents have barely 4 years of agribusiness experience. This corroborates other studies that have found a positive relationship between programme participation and labour market outcomes [54,55].

With the growth of youth agripreneurship in Africa, it is expedient to increase the returns from agricultural activities to meet the expectations of young people to retain them in agripreneurship. According to Babu et al. [24], youth continue to face several constraints, including limited technical know-how and resources, when venturing into agriculture which deters their performance. While these constraints have been well discussed in the literature [15,16,20], there is a consensus that agribusiness empowerment programmes can potentially guide young agripreneurs and help them maximize the limited resources available to them [2,14,17,19,24].

The positive link between income, food security and agribusiness empowerment programmes found in this study supports this notion, suggesting that young agripreneurs could contribute to African agricultural transformation agendas through increased production. Also, better performance has different positive implications for the economy. First, it can put young people at the forefront of job creation, employment stability, and ensuring the well-being of their families [31]. Second, it can promote peer-to-peer mentoring, in which successful agripreneurs mentor aspiring agripreneurs in their communities. While this is not the focus of the current study, evidence abounds that peer-to-peer mentorship generates better results for intending agripreneurs and can also help successful agripreneurs contribute to community development [31].

3.3. Factors influencing agripreneurship income

Table 5 presents the factors influencing agripreneurship income in the three study countries.

The results show a positive and significant correlation between gender and income, suggesting that male agripreneurs earn higher incomes than females. Past studies document similar findings in that men have access to and greater control over productive resources and are engaged in high-income and high-profit enterprises [56–59]. However, gender was not significant when disaggregated by country.

The results show a positive and significant correlation between experience and income, suggesting that more experienced agripreneurs earn higher incomes than less experienced ones. This is not surprising given the significance of experience to technical know-how and performance. While experience was a significant determinant of income in Kenya and Nigeria, it was not significant in Uganda. These results suggest that interventions aimed at improving youth agripreneurship income should target those with little or no experience. This is because technical training and mentorship offered by these programmes can help to fill the experience gap and improve their agripreneurship performance in general.

The heterogeneous effect of income based on the value of agribusiness assets could be a result of more productive resources, which could aid productivity and income. This corroborates Quisumbing et al. [60], who reported a positive linkage between tangible/intangible assets and livelihood strategies contributing to income generation and food security. Thus, asset-rich individuals are more likely to generate higher income than their counterparts. This is also supported by Tabe et al. [61], who found that asset-rich households usually have sufficient resources to invest in economic activities that can potentially yield higher income. While asset was a strong determinant of income in the East African countries, it was not significant for Nigeria.

The positive correlation between credit and income is expected since credit facilitates business expansion which could increase production and economic returns. Also, access to extension services was correlated with higher agribusiness income. This could be because extension contact facilitates access to information on emerging innovations and modern production practices that could help enhance productivity and agribusiness income.

Table 5
Factors influencing Youth Agripreneurship Income in Kenya, Nigeria, and Uganda.

Variables	Income			
	Pooled	Kenya	Nigeria	Uganda
Age (years)	0.005	−0.005	−0.008	0.007***
Education (years)	0.013	0.072	0.814***	−0.031
Gender (Male = 1)	0.037***	0.011	−0.008	0.036
Household size (#)	−0.032	−0.068	0.030	−0.009
Experience (years)	0.062***	0.099***	0.191***	−0.047
Land size (Hectare)	0.009***	−0.007	0.057***	0.019***
(ln)Asset value (#)	0.024***	0.050***	0.006	0.029***
Credit (Yes = 1)	0.039***	0.122***	0.100*	0.227***
Extension (#)	0.047***	0.003***	0.000	0.000
Residence (Rural = 1)	0.111***	0.155***	0.001	0.054
Covid19 (=1)	−0.010	0.006	0.001	0.008
Partnership	−0.006	0.154***	−0.009	0.073***
_cons	7.750***	7.647***	5.507***	7.555***

Sources: Field survey (2021). ***p < 0.01, **p < 0.05, *p < 0.1.

Also, extension contact encourages the adoption of innovations that could positively impact production. This corroborates Bowe and van der Horst [62], who found that the best practice agronomic advice given by corporate farm extension to smallholder farmers in Rajasthan led to yield improvement, which significantly increased farm income. This result also agrees with Danso-Abbeam et al. [63], who reported a positive relationship between access to extension and the income of maize farmers in the Tolon District of northern Ghana. Access to extension was only significant for Kenya when disaggregated by country. Another factor correlated with increased income and peculiar to the two East African countries is partnership, suggesting that those in agripreneurship partnerships earn higher income than their counterparts. This could be because partnership facilitates resources aggregation which could lead to business expansion.

3.4. Factors influencing food security

Table 6 presents other factors influencing food security among the participants in the three study countries.

Market access had a positive and significant correlation with food security across the three countries. This could be because having market access, particularly the input market, may aid the adoption of improved inputs and better services that could contribute to increased production. Also, it could facilitate access to diversified food items which could influence food consumption. This corroborates Ogunniyi et al. [64] who attributed improved food security to the positive effect of market information. This, however, contradicts Usman and Callo-Concha [65] who found that market access encouraged smallholder households to rely less on their own production to improve household consumption diversity.

Having access to credit was positively and significantly correlated with food security for the pooled analysis, suggesting that having access to credit could improve food security. This could be because access to credit could facilitate business expansion, raise agricultural output, and increase income. Increased production and income could contribute to both individual and household food security. Also, credit could facilitate greater caloric intake through larger meal portions and improve meal quality and consumption diversity patterns. This corroborates other studies that have highlighted credit as a crucial factor which promotes household food security [66,67].

As expected, food security was negatively influenced by the Covid-19 pandemic. According to the results, the pandemic reduced food consumption by 9%, 7%, and 13%, respectively for the pooled, Kenyan, and Ugandan groups. This is in line with several studies that have discussed the negative effects of the pandemic on farming households. The significance of this variable suggests that the East African respondents could be attributed to the COVID-19 restrictions and lockdown measures implemented to curb the pandemic.

4. Conclusions and recommendations

The importance of agripreneurship as a link between youth, agriculture, and rural employment cannot be overstated. The declining job opportunities in the formal sector necessitate the development of a vibrant agribusiness sector that supports young people. While young people are yielding to the call and engaging in agripreneurship, it is essential to implement programmes to help them sustain their businesses and, invariably, improve their livelihoods. Also, based on their limited agribusiness experience, it is evident that young agripreneurs could benefit more from such programmes.

The main question addressed in this study is whether participation in agribusiness empowerment programmes can generate better livelihood outcomes for young agripreneurs. The findings established that those who participated in the ENABLE-TAAT programme earned higher agribusiness incomes and had higher food consumption scores than non-participants, implying a positive impact of the programme on young agripreneurs' livelihoods. While this is a more direct impact, increased income is fundamental to business expansion, better economic status, and poverty reduction among rural youths.

As a strategy to continue to promote youth agripreneurship, the findings suggest the relevance of rigorous empowerment/training

Table 6
Factors influencing youth food consumption in Kenya, Nigeria, and Uganda.

Variables	FCS			
	Pooled	Kenya	Nigeria	Uganda
Age (years)	0.180**	0.032	0.067	-0.026
Education (years)	0.125	0.136	0.059	0.066
Gender (Male = 1)	0.047	0.035	0.042	0.038
Household size (#)	0.020	-0.005	-0.028	0.030
Experience (years)	-0.043	-0.054	0.005	0.009
Business level	-0.023	0.012	-0.041	-0.015
Credit (Yes = 1)	0.161***	0.108***	0.095**	0.051
Access to market	0.146***	0.148***	0.154***	0.108**
Asset	0.175***	0.105	0.075	0.173**
Residence (Rural = 1)	0.015	-0.019	0.012	0.110
Access to land (Yes = 1)	-0.017	0.034	-0.003	0.202**
Covid19 (=1)	-0.093***	-0.072**	-0.042	-0.126**
_cons	2.572***	3.280***	3.297***	3.006***

Sources: Field survey (2021). ***p < 0.01, **p < 0.05, *p < 0.1.

programmes such as the case study in helping young agripreneurs develop the technical competencies required for better business performance. This is particularly important, considering that many young agripreneurs are low-skilled and inexperienced. Thus, modalities should be drawn by the government and development partners to increase investment in agripreneurship empowerment programmes and scale existing programmes beyond the regular one-time period.

Also, the significance of the awareness variable on participation suggests that more awareness of agribusiness empowerment programmes that could benefit young people should be created. Given this, information on relevant programmes could be disseminated using innovative platforms such as social media that appeal to young people. In addition, youth perceptions of these programmes should be improved such that programmes offer attractive incentives that could motivate participation.

Furthermore, efforts should include facilitating increased access to credit facilities and support for young agripreneurs who are just starting their ventures to ease off the various socio-economic hardships they face, particularly at the inception of their agripreneurship careers. The government could establish developmental funds/grants targeting young agripreneurs. Also, empowerment programmes could incorporate strategies to improve the creditworthiness of youths in their structure. Additionally, there is a need to develop approaches that support and facilitate youth access to credit facilities and extension services that promote agriculture as a business.

To the best of our knowledge, this is the first study to assess the impact of a regional programme- ENABLE-TAAT- on youths' livelihood in Kenya, Nigeria, and Uganda. Despite its significance, the study had limitations. The study is skewed toward young rural agripreneurs. As a result, the findings favour rural youth over peri-urban and urban youths. Future research should broaden the scope of the study to include more young agripreneurs in peri-urban and urban areas. Such studies should also consider evaluating the performance of young agripreneurs by location. Also, it would be beneficial to assess the impact from a gender perspective. This is because there are notable differences between male and female agripreneurs regarding access to productive resources. Since agripreneurship is a male-dominated sector, female agripreneurs may face tougher work challenges than their male counterparts.

Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Dolapo Adeyanju: Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **John Mburu:** Writing – review & editing, Supervision, Methodology, Investigation, Conceptualization. **Wainaina Gituro:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Chepchumba Chumo:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Djana Mignouna:** Writing – review & editing, Supervision, Methodology. **Noel Mulinganya:** Conceptualization, Investigation, Writing – review & editing.

Declaration of competing interest

The authors declare no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] Development (OECD), African Development Bank (AfDB). United Nations Development Program (UNDP), African Economic Outlook 2017: Entrepreneurship and Industrialization, OECD Publishing, Paris, Franc, 2017, p. 317.
- [2] D. Adeyanju, J. Mburu, D. Mignouna, Impact of agricultural programs on youth engagement in agribusiness in Nigeria: a case study, *J. Agric. Sci.* 12 (2020) 145, <https://doi.org/10.5539/jas.v12n5p145>.
- [3] W. Baah-Boateng, The youth unemployment challenge in Africa: what are the drivers? *Econ. Lab. Relat. Rev.* 27 (4) (2016) 413–431, <https://doi.org/10.1177/1035304616645030>.
- [4] M. Williams, Youth, peace, and security: a new agenda for the Middle East and north Africa, *J. Int. Aff.* 69 (2) (2016) 103–104.
- [5] International Labour Organization, Global Employment Trends for Youth 2020: Africa, 2020.
- [6] A. De Pinto, J.M. Ulimwengu, A Thriving Agricultural Sector in a Changing Climate: Meeting Malabo Declaration Goals through Climate-Smart Agriculture ReSAKSS an, International Food Policy Research Institute, Washington, DC, 2017.
- [7] D. Filmer, L. Fox, Youth Employment in Sub-saharan Africa, International Bank for Reconstruction and Development/The World Bank, Washington DC, USA, 2014.
- [8] World Bank, Growing Africa: Unlocking the Potential of Agribusiness, 2013, <https://doi.org/10.1596/26082>. Washington, DC, USA.
- [9] S.L. Bairwa, K. Lakra, S. Kushwaha, L.K. Meena, P. Kumar, Agripreneurship development as a tool to upliftment of agriculture, *Int. J. Sci. Res. Publ.* 4 (3) (2014) 1–4.
- [10] S.M. Njagi, Enhancing climate change awareness and food security without donor support, Available at: <https://cgspace.cgiar.org/bitstream/handle/10568/110580/Scaling-up-youth-agripreneurship-Vijabiz.pdf?sequence=1#page=32>, 2020.
- [11] A.A. Barau, M.S.I. Afrad, Potentials of rural youth agripreneurship in achieving zero hunger, *World Rural Observ.* 9 (2) (2017) 1–11.
- [12] R. Akrong, B.H. Kotu, Economic analysis of youth participation in agripreneurship in Benin, *Heliyon* 8 (2022), e08738.
- [13] B. Magagula, C.Z. Tsvakirai, Youth perceptions of agriculture: influence of cognitive processes on participation in agripreneurship, *Dev. Pract.* 30 (2020) 234–243.
- [14] M. Yami, S. Feleke, T. Abdoulaye, A. Alene, Z. Bamba, V. Manyong, African rural youth engagement in agribusiness: achievements, limitations, and lessons, *Sustainability* 11 (2019) 185, <https://doi.org/10.3390/su11010185>.
- [15] Y. Ose, Solutions to Youth Agripreneurship Challenges – Lessons Learned from Youth Agripreneur Champions in Uganda, 2021. Rome.
- [16] K.O. Ouko, J.R.O. Ogola, C.A. Ng'on'ga, J.R. Wairimu, Youth involvement in agripreneurship as Nexus for poverty reduction and rural employment in Kenya, *Cogent Soc. Sci.* 8 (2022), 2078527.

- [17] J. Mulema, I. Mugambi, M. Kansime, H.T. Chan, M. Chimalizeni, T.X. Pham, G. Oduor, Barriers and opportunities for the youth engagement in agribusiness: empirical evidence from Zambia and Vietnam, *Dev. Pract.* 31 (2021) 690–706.
- [18] M.A. Lachaud, B.E. Bravo-Ureta, N. Fiala, S.P. Gonzalez, The impact of agri-business skills training in Zimbabwe: an evaluation of the Training for Rural Economic Empowerment (TREE) programme, *J. Dev. Effect.* 10 (2018) 373–391.
- [19] A.M. Ogunmodede, M.O. Ogunsanwo, V. Manyong, Unlocking the potential of agribusiness in Africa through youth participation: an impact evaluation of N-power agro empowerment program in Nigeria, *Sustainability* 12 (2020) 5737.
- [20] L.O. Bello, L.J.S. Baiyegunhi, D. Mignouna, R. Adeoti, P.M. Dontsop-Nguezet, T. Abdoulaye, V. Manyong, Z. Bamba, B.A. Awotide, Impact of youth-in-agribusiness program on employment creation in Nigeria, *Sustain. Times* 13 (2021) 1–20, <https://doi.org/10.3390/su13147801>.
- [21] D. Adeyanju, J. Mburu, D. Mignouna, Youth agricultural entrepreneurship: assessing the impact of agricultural training programmes on performance, *Sustainability* 13 (2021) 1697.
- [22] K. Moore, Fostering economic opportunities for youth in Africa: a comprehensive approach, *Enterp. Dev. Microfinance* 26 (2015) 195–209.
- [23] R. Akrong, S.G. Mbogoh, P. Irungu, Youth agribusiness in the horticultural value-chain: the case of small-scale mango farmers in Southern Ghana, *Afr. Dev. Rev.* 32 (2020) S68–S77, <https://doi.org/10.1111/1467-8268.12483>.
- [24] S. Babu, Y. Zhou, L. Koeber, N. Srivastava, Youth Entrepreneurship in Agribusiness. Niger. Ctry. Report, Int. Food Policy Res. Inst. Abuja, Niger, 2020.
- [25] D. Adeyanju, J. Mburu, D. Mignouna, K.J. Akomolafe, Determinants of youth participation in agricultural training programs: the case of Fadama program in Nigeria, *Int. J. Train. Res.* 1–25 (2021).
- [26] I. Scoones, K. Amanor, A. Favaretto, G. Qi, A new politics of development cooperation? Chinese and Brazilian engagements in African agriculture, *World Dev.* 81 (2016) 1–12, <https://doi.org/10.1016/j.worlddev.2015.11.020>.
- [27] Y. Todo, R. Takahashi, Impact of farmer field schools on agricultural income and skills: evidence from an aid-funded project in rural Ethiopia, *J. Int. Dev.* 25 (2013) 362–381.
- [28] M.M. Sikwela, A. Mushunje, The impact of farmer support programmes on household income and sustainability in smallholder production: a case study of the Eastern Cape and KwaZulu Natal farmers, South Africa, *Afr. J. Agric. Res.* 8 (2013) 2502–2511.
- [29] M. Korth, R. Stewart, L. Langer, N. Madinga, N. Rebelo Da Silva, H. Zaranyika, C. van Rooyen, T. de Wet, What are the impacts of urban agriculture programs on food security in low and middle-income countries: a systematic review, *Environ. Evid.* 3 (2014) 1–10.
- [30] R. Stewart, L. Langer, N.R. Da Silva, E. Muchiri, H. Zaranyika, Y. Erasmus, N. Randall, S. Rafferty, M. Korth, N. Madinga, The effects of training, innovation and new technology on African smallholder farmers' economic outcomes and food security: a systematic review, *Campbell Syst. Rev.* 11 (2015) 1–224.
- [31] M.M. Ramushu, Role of Agribusiness in Creating Youth Employment in the Sekhukhune District Municipality, 2021. Limpopo Province, South Africa.
- [32] IITA, ENABLE TAAT compact, Available at: <https://youthagribusiness.org/enable-taat/>, 2020.
- [33] T. Yamane, Elementary Sampling Theory, Prentice Inc, Englewood Cliffs, 1967, pp. 371–390. NS, USA 1.
- [34] B.S. Balde, M. Diawara, C.M. Rossignoli, A. Gasparatos, Smallholder-based oil palm and rubber production in the forest region of Guinea: an exploratory analysis of household food security outcomes, *J. Agric.* 9 (2019) 41.
- [35] O. Adebayo, O. Bolarin, A. Oyewale, O. Kehinde, Impact of irrigation technology use on crop yield, crop income and household food security in Nigeria: a treatment effect approach, *AIMS Agric. Food* 3 (2018) 154–171, <https://doi.org/10.3934/agrfood.2018.2.154>.
- [36] D. Wiesmann, L. Bassett, T. Benson, J. Hoddinott, Validation of the World Food Programme's Food Consumption Score and Alternative Indicators of Household Food Security, *Int'l Food Policy Res Inst.*, 2009.
- [37] F. Brouns, G. van Rooy, P. Shewry, S. Rustgi, D. Jonkers, Adverse reactions to wheat or wheat components, *Compr. Rev. Food Sci. Food Saf.* 18 (2019) 1437–1452.
- [38] N.K. Fukagawa, L.H. Ziska, Rice: importance for global nutrition, *J. Nutr. Sci. Vitaminol.* 65 (2019) S2–S3.
- [39] A. Pople, R. Hill, S. Dercon, B. Brunckhorst, Anticipatory Cash Transfers in Climate Disaster Response, Working paper 6 (2021) 1–67.
- [40] O.C. Awoorh, African Traditional Foods and Sustainable Food Security, *Food Control*, 2022, 109393.
- [41] C.S. Aweke, J.Y. Hassen, M.G. Wordofa, D.K. Moges, G.S. Endris, D.T. Rorisa, Impact assessment of agricultural technologies on household food consumption and dietary diversity in eastern Ethiopia, *J. Agric. Food Res.* 4 (2021), 100141.
- [42] L.A.A. de Menezes-Júnior, A.C. de Souza Andrade, H.N. Coletro, R. de Deus Mendonça, M.C. de Menezes, G.L.L. Machado-Coelho, A.L. Meireles, Food consumption according to the level of processing and sleep quality during the COVID-19 pandemic, *Clin. Nutr. ESPEN.* 49 (2022) 348–356.
- [43] M.B. Fite, A.K. Tura, T.A. Yadeta, L. Oljira, K.T. Roba, Factors associated with food consumption score among pregnant women in Eastern Ethiopia: a community-based study, *J. Health Popul. Nutr.* 41 (2022) 1–9.
- [44] United Nations World Food Program, Food Consumption Score: Construction of the FCS, World Food Program, 2008, pp. 1–102.
- [45] D. May, S. Arancibia, K. Behrendt, J. Adams, Preventing young farmers from leaving the farm: investigating the effectiveness of the young farmer payment using a behavioural approach, *Land Use Pol.* 82 (2019) 317–327.
- [46] A.K. Mishra, A. Kumar, P.K. Joshi, A. D'souza, Production risks, risk preference and contract farming: impact on food security in India, *Appl. Econ. Perspect. Pol.* 40 (2018) 353–378.
- [47] M. Jaleta, M. Kassie, P. Marenja, C. Yirga, O. Erenstein, Impact of improved maize adoption on household food security of maize producing smallholder farmers in Ethiopia, *Food Secur.* 10 (2018) 81–93.
- [48] K.T. Sibhatu, M. Qaim, Meta-analysis of the association between production diversity, diets, and nutrition in smallholder farm households, *Food Pol.* 77 (2018) 1–18.
- [49] L.K. Addo, Factors influencing agribusiness and their role in agribusiness performance among young graduate agribusiness, *Int. J. Environ. Agric. Biotechnol.* 3 (2018).
- [50] P. Ray, R.S. Panigrahi, S. Shasani, Determinants of skill levels of farm youth with regard to agribusiness: a multinomial regression approach, *Indian J. Ext. Educ.* 58 (2022) 58–62.
- [51] C.W. Kilelu, J. van der Lee, J. Koge, L. Klerkx, Emerging advisory service agri-enterprises: a dual perspective on technical and business performance, *J. Agric. Educ. Ext.* 28 (2022) 45–65.
- [52] A. Koutsouris, E. Zarokosta, Supporting bottom-up innovative initiatives throughout the spiral of innovations: lessons from rural Greece, *J. Rural Stud.* 73 (2020) 176–185.
- [53] A. Garbero, L. Jäckering, The potential of agricultural programs for improving food security: a multi-country perspective, *Glob. Food Secur.* 29 (2021), 100529.
- [54] T.O. Ojo, L.J.S. Baiyegunhi, Determinants of climate change adaptation strategies and its impact on the net farm income of rice farmers in south-west Nigeria, *Land Use Pol.* 95 (2020), 103946.
- [55] L.J.S. Baiyegunhi, Z.P. Majokweni, S.R.D. Ferrer, Impact of outsourced agricultural extension program on smallholder farmers' net farm income in Msinga, KwaZulu-Natal, South Africa, *Technol. Soc.* 57 (2019) 1–7.
- [56] T. Dietz, A. Estrella Chong, P. Font Gilabert, J. Grabs, Women's empowerment in rural Honduras and its determinants: insights from coffee communities in Ocotepeque and Copan, *Dev. Pract.* 28 (2018) 33–50.
- [57] M.K. Kansime, J.A. Tambo, I. Mugambi, M. Bundi, A. Kara, C. Owuor, COVID-19 implications on household income and food security in Kenya and Uganda: findings from a rapid assessment, *World Dev.* 137 (2021), 105199.
- [58] M. Owusu, M. Nursey-Bray, D. Rudd, Gendered perception and vulnerability to climate change in urban slum communities in Accra, Ghana, *Reg. Environ. Chang.* 19 (2019) 13–25.
- [59] C. Ragasa, N.-L. Aberman, C.A. Mingote, Does providing agricultural and nutrition information to both men and women improve household food security? Evidence from Malawi, *Glob. Food Sec.* 20 (2019) 45–59.
- [60] A.R. Quisumbing, D. Rubin, C. Manfre, E. Waitanji, M. Van den Bold, D. Olney, N. Johnson, R. Meinzen-Dick, Gender, assets, and market-oriented agriculture: learning from high-value crop and livestock projects in Africa and Asia, *Agric. Hum. Val.* 32 (2015) 705–725.

- [61] M.P.J.R. Tabe Ojong, M. Hauser, K. Mausch, Does agricultural commercialisation increase asset and livestock accumulation on smallholder farms in Ethiopia? *J. Dev. Stud.* 58 (2022) 524–544.
- [62] C. Bowe, D. van der Horst, Positive externalities, knowledge exchange and corporate farm extension services; a case study on creating shared value in a water scarce area, *Ecosyst. Serv.* 15 (2015) 1–10.
- [63] G. Danso-Abbeam, D.S. Ehiakpor, R. Aidoo, Agricultural extension and its effects on farm productivity and income: insight from Northern Ghana, *Agric. Food Secur.* 7 (2018) 1–10.
- [64] A.I. Ogunniyi, S.O. Omotoso, K.K. Salman, A.O. Omotayo, K.O. Olagunju, A.O. Aremu, Socio-economic Drivers of food security among rural households in Nigeria: evidence from Smallholder maize farmers, *Soc. Indic. Res.* 155 (2021) 583–599.
- [65] M.A. Usman, D. Callo-Concha, Does market access improve dietary diversity and food security? Evidence from Southwestern Ethiopian smallholder coffee producers, *Agric. Food Econ.* 9 (2021) 1–21.
- [66] R. Aidoo, J.O. Mensah, T. Tuffour, Determinants of household food security in the Sekyere-Afram plains district of Ghana, *Eur. Sci. J.* 9 (2013).
- [67] S. Iftikhar, H.Z. Mahmood, Ranking and relationship of agricultural credit with food security: a district level analysis, *Cogent Food Agric.* 3 (2017), 1333242.