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SOCIOECONOMIC DETERMINANTS OF THE INTENSITY OF MUSHROOM COMMERCIALISATION IN GREATER ACCRA REGION, GHANA

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Abstract: *Fungi, such as mushrooms, have the unique ability to decompose and convert obstinate organic substances into protein, thereby improving nutrition, increasing food security, fostering sustainable agricultural production, and generating income for farmers. Since the 1990s, the Ghanaian government, through the Mushroom Unit of the Food Research Institute of Ghana, has promoted the cultivation and commercialisation of oyster mushrooms in Ghana as an additional source of income for the urban poor. This study used a cross-sectional survey design, questionnaires, and validated structured interview schedule instruments to collect data from 153 mushroom farmers in the Ga East and Adentan Municipalities of the Greater Accra Region to determine the intensity, degree, characterisation, and factors that influence the intensity of oyster mushrooms. The crop commercialisation index, frequency, mean, standard deviation, two-stage least squares regression, and ordinary least squares regression were used to analyse the data. The results showed a low intensity (GHC 10202.20) but a high degree (75%) of oyster mushroom commercialisation in the study area. The vast majority of oyster mushroom farmers (95%) were highly commercialised, selling more than half of their oyster mushroom output. Except for age, farmers' level of formal education, land ownership, and production volume of oyster mushrooms all positively influenced the intensity of oyster mushroom commercialisation. The Food Research Institute, the Ministry of Food and Agriculture, and development organisations should step up efforts to increase oyster mushroom production and attract educated, young, and unemployed people to oyster mushroom ventures.*

Keywords: *Oyster mushroom commercialisation, Crop Commercialisation Index, intensity of oyster mushroom commercialisation, two-stage least square regression*
(JEL code: Q11)

INTRODUCTION

Ghana is an agrarian economy that highly promotes large-scale, commercial agricultural production as a top priority for the country's development (Abu, 2015). The agricultural industry of Ghana accounts for 15.3% of GDP as of the second quarter of 2019 and employs 44.7% of the country's workforce (Mzali, 2020). The agricultural sector of Ghana is dominated by the crop subsector, which comprises major cash crops such as cocoa, oil palm, rubber, and citrus. Also, maize, cassava, plantains, yam, cocoyam, rice, sorghum, and millet are the principal food crops, accounting for 3.40 million hectares (Mha) of total cultivated land (Adjei-Nsiah, 2012). However, the onset of climate change and its negative impact threaten the yield of traditional crops (maize, cassava, plantains, yam, cocoyam, rice, sorghum, and millet), jeopardising the sustainable livelihoods of the majority of Ghanaians whose livelihoods rely on the aforementioned crops (Antwi-Agyei, 2012). Mushrooms (Oyster) have been identified as an agribusiness enterprise with a high potential for livelihood in Ghana (Obodai, 2000).

Mushrooms are neither plant nor animal foods, but edible mushrooms are classified as vegetables (Fortune Business Insight, 2020; Harvard School of Public Health, 2020). A mushroom is a fungus' fleshy, spore-bearing fruiting body that grows above ground, on soil, or on its food source. It is considered a cash crop globally that contributes significantly to food security and the quality of human health due to its known medicinal, nutritional, and economic value (Zhang et al., 2014). Mushrooms are a good source of protein, amino

acids, and vitamins that are important nutrients for healthy human growth (Kortei et al., 2018a).

The global mushroom industry is comprised primarily of edible, medicinal, and wild varieties. Since 1978, the global production of cultivated edible mushrooms has expanded by more than 30 fold. In 2020, the global mushroom market was worth 14.5 million metric tonnes. The global mushroom market is expected to increase from 15.25 million tonnes in 2021 to 24.05 million tonnes in 2028 (Fortune Business Insight, 2020). China is the leading producer of edible, cultivated mushrooms. Lentinus edodes is currently the most widely produced edible mushroom, accounting for around 22% of the global supply. Lentinula and four other genera (Pleurotus, Auricularia, Agaricus, and Flammulina) comprise 85 percent of the world's cultivated edible mushroom supply. On average, consumers consume approximately 5 kilogrammes of mushrooms each year (Royse et al., 2017). Governments in many countries are investing in the production of high-quality varieties of edible fungi for both consumption and export due to the growing demand for food with low cholesterol and fat content for healthy human growth (Fortune Business Insight, 2020).

In Ghana, mushroom cultivation is a promising agribusiness venture and a good source of nutrients for healthy human development, as it is high in protein, amino acids, and vitamins. The mushroom commonly grown in Ghana in general and the Greater Accra region in particular is the Pleurotus oystreatus (oyster mushroom). This is because oyster mushrooms have a high nutritional value, a simple method of cultivation, and a tasty nature cherished by most Ghanaians (Kortei et al., 2018). The economic importance of mushrooms necessitated the establishment of the National Mushroom Development Project (NMDP) in Ghana in 1990 to promote the commercialisation of mushrooms in Ghana, which, through research, could systematically establish and encourage the intensive production, use, and export of mushrooms (Obodai, 2000). This initiative is consistent with Ghana's Food and Agriculture Sector Development Policy (FASDEP), which seeks to promote smallholder farmers' commercialisation (Martey et al., 2012).

In addition to the government's effort, other local and foreign development partners have been implementing a series of programmes to boost the commercial production of mushrooms in the country (Kubi, 2010). For example, in 2016, the Business Sector Advocacy Challenge (BUSAC) sponsored a skill development programme to equip the members of the Mushroom Growers and Exporters Association of Ghana (MUGREAG) with mushroom production, costing, marketing, and financial management skills (BUSAC Report, 2019). Again, in 2019, the European Union (EU) launched a four-year agricultural project (2019–2022) in the Nkoranza North District of the Bono East Region to help boost local economic growth and development, focusing on the production of mushrooms for job creation. The project entails the construction of a modern agribusiness incubation centre, a spawn laboratory, and commercial mushroom production villages (Adu-Gyamerah, 2019). Furthermore, ActionAid Ghana introduced a mushroom production training programme in two municipalities in the Greater Accra Region of Ghana to improve the informal sector's growth (Lomotey, 2019).

Despite the huge investments in Ghana's mushroom industry, small-scale mushroom producers in the country are predominantly subsistence-oriented (Shem, 2018; Adu-Gyamerah, 2019), with a low average annual production of 758 tonnes (687.65 metric ns) (Mu hroom-PO-Ghana, 20, 2017). According to Trigde (2021), a total of 28,470 metric tonnes and 28,690 metric tonnes of oyster mushrooms were imported into the country in 2018 and 2019, respectively, which corresponded to $78,460 and $64,520. This implies that the majority of local demand is met by imports, confirming Obodai et al.'s (2015) assertion that demand for mushrooms in Ghana surpasses supply. Given the current state of Ghana's mushroom industry, it is imperative to improve the commercialisation of mushroom production in Ghana, particularly in the Greater Accra Region, to meet demand.

The Greater Accra Region is the best place to gauge oyster mushroom commercialisation because it is the origin of mushroom production in Ghana (Obodai, 2000). It also serves as the home to major government institutions like the Food Research Institute (FRI), which is in charge of promoting mushroom production and development in Ghana. The region further contains the majority of the country's middle-class residents, who are the largest consumers of mushroom products, and constitutes a favourable source of market for mushrooms (Weatherspoon & Reardon, 2003).

Unfortunately, research on agricultural commercialisation in Ghana has focused mainly on the major staple crops (cassava, maize, rice, and groundnut) and a few cash crops, including cocoa and pineapple, but little or no work has been done to explore the determinants of mushroom commercialisation, conforming to the claim by Zhou (2013) that empirical studies on agricultural commercialisation have concentrated only on the staple crops and livestock. The intensity of oyster mushroom commercialisation and the factors influencing it, however, have received little scholarly attention. Against this backdrop, the question that arises is: What is the intensity of oyster mushroom commercialisation in the Greater Accra region of Ghana? The paper specifically addresses the research questions listed below: 1) What is the intensity of oyster mushroom commercialisation in the Greater Accra Region? 2) Are there degrees or variations in the intensity of oyster mushroom commercialisation? 3) What factors significantly influence the intensity of oyster mushroom commercialisation in the region?

THEORETICAL FRAMEWORK

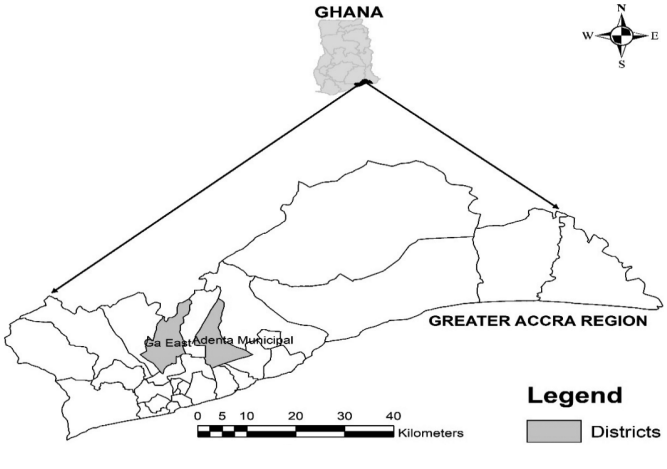
The current study is based on the trade theory proposed by David Ricardo (Maneschi, 1992). According to the theory, farmers produce goods for which they have a high comparative advantage and exchange them for goods for which they have a lesser comparative advantage (Siziba et al., 2011). However, the trade theory is unable to identify the specific determinants of agricultural commercialisation, which gave rise to numerous theoretical models. One of the models is the non-separable household agricultural commercialisation behaviour model posited by Barret (Barrett, 2008; Boughton et al., 2011). Barrett (2008) developed a non-separable household agricultural commercialisation behaviour model that assumes

that a farm household must choose between being a buyer, net seller, or autarchic to maximise utility. The model is shown in a simplified way as a function of five outside factors: A, G, W, P, and Z. These factors stand for private asset stock, public asset stock, household-specific characteristics, commodity price, and transaction costs, in that order (Abu, 2015). In other words, a farmer's comparative advantage in producing and commercialising a particular agricultural commodity is influenced by the variables mentioned above. The intensity of commercialisation, that is, the amount of output sold on the market, is influenced by several household and farm-related characteristics, market-related variables, and public asset variables (Baisa, 2009).

MATERIALS AND METHODS

This research was conducted in the Greater Accra Region, specifically in Ga East and Adentan municipalities, which are hubs of mushroom production in the region. The Ga East Municipal Assembly, with Abokobi as its capital, is located in the northern part of the region. The Akwapim South District borders it on the north, the Ga West Municipal on the west, the La Kwantanang Municipal on the east, and the Accra Metropolitan on the south. The Adentan Municipality is positioned at latitude 5° 43 north and longitude 0° 09 west, 10 kilometres northeast of Accra. The Ashaiman Municipal Assembly and Kpong Akatamanso District Assembly border the municipality's east and north; La Nkwantanang Municipal Assembly borders it on the west and south; and the municipality has a total land area of 928.4 square kilometers. Greater Accra was selected for the study because it is the origin of the mushroom commercialisation campaign in Ghana. It also houses the headquarters of the Mushroom Growers and Exporters Association of Ghana, which has a substantial number of mushroom farmers who were used for this study. The two municipalities were also chosen because they harbour the majority of the registered mushroom producers in the region, and they have been the location for most mushroom training programmes, thereby having the majority of trained mushroom producers. Moreover, the mushroom farmers in these areas are small-scale farmers.

Figure 1. Study area



The study used a cross-sectional survey design. The population of the study comprised all mushroom producers who produced and sold oyster mushrooms in the Ga East and Adentan municipalities of the Greater Region in the 2020 production year and were registered with the Mushroom Growers and Exporters Association of Ghana (MUGREAG) Greater Accra chapter. A sampling frame of 210 (135 and 75 mushroom farmers, respectively, from Adentan and Ga East Municipalities) oyster mushroom producers was developed from the records of the MUGREAG. A census of all the mushroom producers was taken. The farmers were located and surveyed with the help of the executives of the MUGREAG-Accra Chapter. However, an accessible population of 153 was used for the survey due to the non-availability of some of the farmers during the data collection period owing to the COVID-19 restrictions.

The data was collected using a structured, content-validated interview schedule and questionnaire. The researchers performed face-to-face interviews with 127 mushroom farmers and phone interviews with 12 mushroom farmers. Some of the farmers (17 in number) also completed questionnaires via email. The response rates for face-to-face, phone interviews, and email were 100%, 100%, and 82%, respectively. The overall response rate from the target population was 72.9 percent (153 responses), which was good for analysis following Baruch (1999), who recommended a minimum response rate of 60 percent for analysis to proceed.

Various indicators, such as the household commercialisation index, crop commercialisation index, and volume or value of output sold, have been used internationally to assess smallholder agricultural commercialisation (Poulton, 2018).

Using the value and volume of oyster mushrooms sold, the researchers measured the degree of mushroom commercialisation in this study based on the farmers' activities in the 12 months preceding the survey. The researchers considered all mushrooms sold by the producers during that period since all the smallholder mushroom producers in the study sold at least some of their harvest. This allowed the researchers to calculate the intensity of oyster mushroom commercialisation—rather than simply identifying commercialised and non-commercialised producers—as the monetary value of the volume of mushrooms sold during the last 12 months before the survey period (Saha et al., 2021). However, because the intensity of oyster mushroom commercialisation could not be calculated in the absence of a mean price, the researchers imputed price data for each farmer. The average value of oyster mushrooms sold was used as a proxy for the intensity of oyster mushroom commercialisation. This method of estimating the intensity of agricultural commercialisation is widely used (Baisa, 2009; Saha et al., 2021) because it is a reliable indicator of commercialisation, as the increase in the average value of sales of the same commodity over time indicates the increase in commercialisation of the commodity. The method is also less data-demanding than the CC1 and is less susceptible to distress sales (Poulton, 2018).

The researchers also computed the degree of oyster mushroom commercialisation using the Crop Commercialisation Index (CCI) to indicate the proportion of oyster mushroom output supplied to the market (Leavy et al., 2008; Poulton, 2018; Qaim

et al., 2020). The CCI is determined by dividing the ration of the total annual quantity of the crop sold by the total output of the crop as a percentage. A CCI value above 50% indicates a high degree of commercialisation, while a CCI value of 100% signifies full commercialisation. Farmers with a CCI of 50% are considered to be shifting production goals from consumption-focused to commercialisation-oriented, while farmers with 100% commercialisation value produce solely for the market (Gebremedhin & Jaleta, 2010; Gevereh et al., 1999). The commercialisation index is shown in equation 1:

$$CCI_{Produce} = \left[\frac{The\ gross\ value\ of\ produce\ sold\ fpyearn}{The\ gross\ value\ of\ produce\ fpyearn} \right] * 100 \quad (1)$$

This study determined the effect of socioeconomic, sociodemographic, and institutional factors on the intensity of mushroom commercialisation in the Ga East and Adentan Municipalities in the Greater Accra region of Ghana. The researchers assumed that there is an issue of endogeneity within the data, possibly from the correlation between one of the independent variables (value of oyster mushroom output sold) and the error term of the dependent variable (intensity of oyster mushroom commercialisation). To confirm or otherwise, the researchers used the two-stage least squares (2SLS) regression model to test this assumption.

In analysing the influence of socioeconomic, demographic, and institutional factors on the intensity of mushroom commercialisation, the intensity of mushroom commercialisation was modelled based on the mean value of mushroom sales per annum. However, the researchers were concerned that the model might have an endogeneity problem. Then, to deal with the possible breach of the third classical assumption of the OLS model, which specifies that the error term must not correlate with each regressor variable, we used the 2SLS regression model as an option (Bannor et al., 2022). The regression used in the model is the intensity of mushroom commercialisation (the value of mushrooms sold), measured as the mean income earned from mushroom sales. The exogenous variables, also known as regressors, were those that were categorised under sociodemographic, farm, and institutional characteristics (see Table 1). The value of the mushroom output was considered an endogenous variable, as revealed by Gebreselassie and Sharp (2007), who found that the value of the output of crop production is highly likely to correlate with the error term when the value of sales of the crop is used as a dependent variable in the modelling of the intensity of agricultural commercialisation. The assumed endogenous variable is justified by the fact that the output of the crop marketed is determined, along with many other factors, by the total crop output. Because the decision on how much crop to sell proceeds with the decision on how much crop to produce, the quantity of crop marketed is unlikely to affect the quantity produced at a given period. Notwithstanding, the portion of crop marketed in the past year (t-1) heavily influences the quantity produced in the present year (t) (Gebreselassie & Sharp, 2007). This implies that the causal association in time "t" runs from total output to the proportion of the output marketed, rather than the other way around. However, there is a strong probability of an opposite association at time t-1 (Gebreselassie & Sharp, 2007). As a result, the authors hypothesised that the cause of endogeneity could be attributable to a potential bidirectional causality between the value of oyster mushrooms produced and the intensity of mushroom commercialisation. Second, unobserved farmers' sociodemographic and institutional factors and heterogeneities may be the source of endogeneity, potentially impacting the value of oyster mushroom output sold. Consequently, to account for endogeneity, we used three instruments to determine the value of oyster mushroom output and its impact on commercialisation intensity. The instruments for the supposed endogenous variable were identified as farmers' annual income, price, and hired labor. It is noteworthy that the price of produce in the previous year and hired labour can positively influence the value of production (Gebreselassie & Sharp, 2007), while annual income can also positively influence the level of production (Baisa, 2009).

We modelled 2SLS regression as follows:

$$P = D0 + D1S + u \quad (2)$$

where P is the intensity of mushroom commercialisation, u is an estimated error term that contains a variable correlated with S; D0 and D1 are assumed to have consistent estimates when u and S are correlated, and S is the endogenous variable as a result. New variables designated as instrument variables are consequently needed.

Assume an unobservable variable M satisfies the assumptions:

1 M and U are uncorrelated, thus,
$Cov(M,U) = 0$

2 M and S are correlated, thus,
$Cov(M, S) \neq 0$

M is therefore a variable used to control S. It should be noted that the primary step in the 2SLS regression analysis is to compute the reduced version of Equation 2 using OLS to obtain P̂. After that, additional estimating is done using the first stage's estimates, and these estimates are known as 2SLS (Bannor et al., 2022). However, the 2SLS results (Table 3) showed that there was no issue of endogeneity in the variables. The researchers, therefore, employed the Ordinary Least Square (OLS) model to determine the socioeconomic, demographic and institutional factors that influence the intensity of oyster mushroom commercialisation in the study area.

OLS linear multiple regression model was used to estimate the effect of using sociodemographic characteristics of farmers, farm characteristics and institutional factors on the intensity of mushroom commercialisation. Because the dependent variable, the intensity of oyster mushroom commercialisation, is a continuous variable and is measured on the ratio level, the OLS regression model was appropriate for the estimation (Cohen et al., 2014). The OLS regression uses a minimum of two independent variables to predict the dependent variable. It further quantifies the magnitude of the relationship between these vari-

ables (Hutcheson, 2011). According to Williams et al. (2013), the OLS multiple linear regression requires a continuous dependent variable, multiple independent variables, and data that is normally distributed, free of autocorrelation and multicollinearity, homoscedastic, and most importantly, parametric. For this study, the OLS multiple regression is specified as:

$$Y= f(\beta, X, \varepsilon) \quad (3)$$

This is further expanded in equation (3) as

$$Yi = \beta 0 + \beta 1\ X1 + \beta 2\ X2 + \ldots + \beta 15\ X15 + \varepsilon i \quad (4)$$

The independent variables of 2SLS and OLS regression models have been specified in Table 1.

RESULTS AND DISCUSSION

This section presents the socio-economic characteristics of the mushroom farmers, the intensity and degree of mushroom commercialisation, categorisation of oyster mushroom commercialisation and the determinants of the intensity of oyster mushroom commercialisation.

About 68% of the mushroom producers were male, with a mean age of 38.37 years. The mean age of the farmers was 48.37 years. This implies that the farmers were young. Most (81.7%) of the mushroom producers were married with a household size of 1 to 5 people. The mean number of years of education for the farmers was 4.5 years. This implies that all the farmers were formally educated and can manage mushroom farms since mushroom farming is a science and art that requires the ability to access and interpret information (Martey, 2014). The average quantity of mushrooms produced was 717kg, with more than half (54.9%) of farmers producing between 101 kg and 500 kg of oyster mushrooms. Averagely, the mushroom farmers sold 514.80kg of mushrooms, with more than half (56.86%) selling between 101kg and 500kg of oyster mushrooms.

The average land size used for mushroom production was 0.49 acres, but the majority of the mushroom producers (86.9%) produced oyster mushrooms on land spaces of 0.9 acres and below. This confirms that mushroom production does not require a large amount of land for cultivation as compared to staple foods like maize or cassava. The mean years of mushroom production experience by the farmers were about 5 years (4.56 years). The mean price per kg of fresh oyster mushroom was GHC 20.00. The majority of the farmers (94.8%) hired between 1 and 5 people on their mushroom farms.

The majority of the mushroom producers (65%) owned land, while most of the farmers (84%) did not have access to credit, and more than 50% of them (57%) did not have access to extension services. Close to half (45.8%) of the producers had an annual income in the range of GHS 1,000.00 and GHS 10,000.00, while very few of them (1.3%) had an annual income above GHC 50,000.

Socioeconomic characteristics of surveyed farmers

Table 1. Description of variables used in the 2SLS and OLS Models

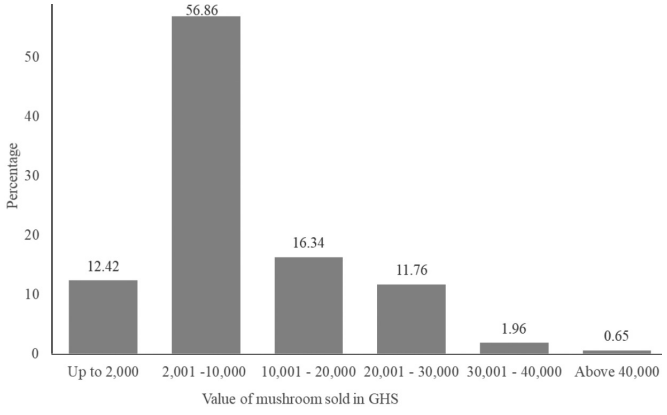
Variable	Description	Type	Measurement	Expected relationship
Dependent variable				
Intensity of mushroom commercialisation	Income earned from mushroom sold	Ratio	GHC 20/1kg of fresh mushroom	
Endogenous	/			
Value of mushroom produced	Total value of mushroom produced	ratio	GHC 20/1kg of fresh mushroom	+
Instruments				
Annual income	Farmers' annual income		GHC	+
Hired labor	People paid to work on the mushroom farm		Number	+
Price	Last price per kg of fresh mushroom	Ratio	GHC	+
Independent variables				
Socio-demographic factors				
Age	Age of farmers.	Ratio	Years	+/-
Hired labour	Number of people hired on the farm	Ratio	Number of people	+

Variable	Description	Type	Measurement	Expected relationship
Independent variables				
Educational level	Education level of farmers	Ratio	Years	+
Annual income	farmers annual income	Ratio	GHC	+
Marital status	Farmers' state of being married or not	Nominal	1 if married, and 0 if not married	+
Household size	Number of people in the farmers' household	Ratio	Number	+/-
Land ownership	State of having a legal entitlement to land	Nominal	1 if owns land, and 0 if does not own a land	+
Farm characteristics				
Value of mushroom produced	Total value of mushroom produced	Ratio	GHC 20/1kg (2020 price) of fresh mushroom	+
Price	Last years' price per kg of fresh mushroom in GHS	Ratio	GHC	+
Farming experience	Number of years of supplying mushroom to the market	Ratio	Number of years	+/-
Institutional factors				
Access to extension	Contact with extension agents	Nominal	1, has contact, 0 otherwise	+
Member of FBO	Member of a Farmer-based organization	Nominal	1 member, 0 otherwise	+
Credit access	Farmers' access to credit facility	Nominal	1, has access, 0 otherwise	+

Source: Authors' Construct, 2020

The intensity of oyster mushroom commercialisation

Figure 2. Value of oyster mushrooms sold in 2020



Mean = GHC 10202.29, SD = 9440.50

The result in Figure 2 shows that close to 60% of the mushroom farmers sold mushroom worth between GHC 2,020.00 and GHC 10,000.00. This is below the commercialisation threshold (GHC 300,000.00—equivalent to 15000 kg or 15 metric tonnes per annum estimated from the study. The mean value of mushroom sold in the 2020 production year was GHC 10,202.29. The result implies that all the surveyed mushroom farmers sold below the commercial level, and are therefore described as low commercial producers.

The degree of oyster mushroom commercialisation

Table 2. Degree of oyster mushroom commercialisation in the Greater Accra Region

Variables for comptuting the degree of oyster mushroom commercialisation	Mean	Std. Dev.
Average quantity of oyster mushroom sold (kg)	514.80	488.33
Average quantity of mushroom harvested per capita (kg)	717.00	713.76163
Total value of oyster mushroom sold (GHS)	10202.29	9440.50
Value of mushroom produced (GHS)	14179.12	13642.02
Intensity mushroom of commercialisation	75.123	15.89

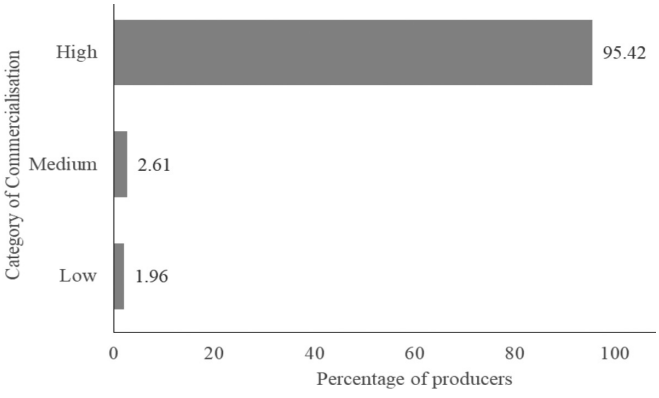
Source: Field Data, 2020

The result in Table 2 shows that, on average, 75% of oyster mushrooms produced were sold, while the rest (25%) were consumed. This indicates that mushroom farmers in the study

area are highly commercial. The most commercialised mushroom producer sold all (100%) of the mushrooms harvested, whereas the least commercialised mushroom producer sold only 6.67% of the mushrooms harvested. The result shows a high commercialisation index for oyster mushroom production and implies that mushrooms are produced as a cash crop in the study area. This indicates that the mushroom producers in the region are highly commercial, on average. The result agrees with Martey et al. (2012), who reported a high commercialisation index of 75% among cassava farmers in the Effutu Municipality. The World Bank (2007) indicates that farmers who sell more than 50 percent of their output are more market-oriented. Such market-orientedness is key to driving economic transformation and is important for fostering innovation and competitiveness (Kabiti et al., 2016). The result of the study implies that oyster mushroom production is a potential driving force for the economic development of Ghana and must be given more institutional support.

Characterisation of the intensity of mushroom commercialisation

Figure 3. Characterisation of the intensity of oyster mushroom commercialisation by producers



Low commercialisation = 25% and below,
Medium commercialisation = 26% - 50% and H
igh commercialisation = 51% and above (Baisa, 2009).

The mushroom producers were grouped into high, medium, and low commercial producers based on their commercialisation indices. According to Baisa (2009), farmers who market 25 percent or less of their crops are considered low commercial farmers; those who market between 26 percent and 50 percent are considered medium commercial farmers; and those who market more than 50 percent are considered high commercial farmers. Based on this categorization, the study revealed that about 2% of the mushroom producers were low commercial farmers, 3% medium, and about 95% high commercial mushroom producers, as displayed in Figure 3.

The distribution of mushroom commercialisation intensity is similar to Abu's (2015) findings that farmers in the Upper West region comprised 7.8 percent of low commercial farmers, 27.58 percent of medium commercial farmers, and 64.78 percent of high commercial farmers. The result also mimics Martey et al. (2012), who observed that the proportion of cassava sold by farmers in the Effutu Municipality ranged from 81% to 100%, indicating that most of the cassava farmers in the municipality were highly commercial. The results of the study confirm that crop commercialisation in Ghana is not uniformly low, medium, or high, and the majority of farmers participating in the output market are highly commercial, selling more than half of their produce.

The degree of oyster mushroom commercialisation

Table 3. Degree of oyster mushroom commercialisation in the Greater Accra Region

2SLS regression			
Variable	**Coefficient**	**Std error.**	**p-value**
Sociodemographic characteristics			
Sex	-7.997696	456.4476	0.986
Marital status	981.6477	691.7067	0.156
Age	-41.45001*	20.72701	0.046
Educational level	183.7063*	90.01438	0.041
Household size	-75.86139	144.536	0.600
Land ownership	1102.361*	456.0471	0.016
Farm characteristics			
Value of crop produced	0.6740399*	.0292015	0.000
Farming experience	-123.9998	115.257	0.282
Land size	-114.2715	710.1842	0.872
Institutional characteristics			
Access to extension	416.8426	435.6726	0.339
Member of FBO	-630.1563	941.5945	0.503
Constant	-207.7686	1832.618	0.910
Wald chi2(11)	638.54		
Prob > chi2	0.0000		
R-squared	0.9262		
Endogeneous variable	Value of mushroom produced		
Endogeneity test			
Ho: variables are exogenous			
No. of Observation	153		
Durbin (score) chi2(1)	0.06864 (p = 0.7933)		
Wu-Hausman F(1,144)	0.062836(p = 0.8024)		
Validity test of instruments			
Sargan (score) chi2(2)	0.2.34781(p = 0.3092)		
Basmann chi2(2)	0.2.16622(p = 0.3385)		

**p<0.05*

Source: Field Data, 2020

The 2SLS regression model shows that all the residuals were statistically insignificant (Durbin (score) chi2(1) test (0.06864 (p = 0.7933), Wu-Hausman F (1,144) test (0.062836 (p = 0.8024)). The instruments also did not correspond with the disturbance term, as the Sargan (score) chi2(2) was statistically insignificant (0.2.34781, p = 0.3092) (Table 3). Hence, we failed to reject the null hypothesis, which stated that the value of the oyster mushroom produced is not exogenous, and, therefore, proceeded with OLS regression (Anderson, 2018; Qaim et al., 2020). According to the results of the OLS regression, the independent variables together explained 92% (R-square = 0.92) of the variance in the intensity of mushroom commercialisation. The statistical significance level for the F statistic value of 117.95 was 1%. This suggests that the independent variables jointly explain the intensity of oyster mushroom commercialisation and that the linear model is fit for the data.

Table 4. Factors predicting the intensity of oyster mushroom commercialisation

Variable	Coefficient	Std error.	p-value
Sociodemographic characteristics			
Sex	10.26012	476.2892	0.983
Marital status	1109.186	730.0354	0.131
Age	-39.71751*	21.91402	0.072
Educational level	187.4811**	93.54359	0.047
Household size	-59.52011	152.7324	0.697
Land ownership	1249.249**	487.4574	0.011
Annual farmer income	231.2777	224.7343	0.305
Farm characteristics			
Value of crop produced	.6664862***	0.0194137	0.000
Farming experience	-141.0085	121.0437	0.246
Land size	-204.3461	715.6101	0.776
Hired labour	30.32684	181.9995	0.868
Price	136.1953	119.607	0.257
Institutional characteristics			
Access to extension	461.6571	453.7839	0.311
Access to credit	704.3018	590.595	0.235
Member of FBO	-371.7992	1009.025	0.713
Constant	-4213.801	3498.817	0.231
F(15, 137)	117.95***		
Prob > chi2	0.0000		
R-squared	0.9281		
Adj R-squared	0.9203		

**p<0.1; **p<0.05 and ***p<0.001*

Source: Field Data, 2020

Four (4) out of the fifteen independent variables significantly influenced the intensity of mushroom commercialisation: age, educational level, land ownership, and value of crop sold (quantity of mushrooms produced), as presented in Table 4.

The age of mushroom producers influenced the intensity of oyster mushroom commercialisation negatively at a statistical significance of 10%. This indicates that the younger the mushroom farmer, the higher the intensity of mushroom commercialisation, and young people who enter oyster mushroom production can increase their intensity of commercialisation by GHS 39.72. The findings are in line with those of Abu (2015) and Mariyono (2019), who found a negative relationship between farmers' age and the degree of commercialisation. However, the study's findings contradict those of Akinlade et al. (2016), who found a positive relationship between farmers' age and commercialisation, suggesting that older farmers are more likely than younger farmers to commercialise their outputs. Young farmers are more dynamic, open to new ideas, may have a better understanding of commercialisation issues, and view mushroom farming as a business, in contrast to the majority of older farmers who view farming as a way of life rather than a business and who may be less concerned with farming for profit (Randela et al., 2008). Young farmers may be more inclined than older farmers to experiment with, embrace, and implement agricultural technology, such as the use of ICT, to maximise access to market information and boost commercialisation (Lwanga, 2015). Additionally, young farmers may be reasonably diligent and own assets such as savings that can be used to improve production in order to generate market surplus (Yeboah et al., 2020). Young oyster mushroom growers may profit from business acumen, energy, and a willingness to utilise technology to boost mushroom commercialisation's intensity.

The level of formal education had a positive association with the intensity of mushroom commercialisation at a 5% statistical significance level. According to the result of the study, for every additional year of formal education, oyster mushroom farmers can increase the intensity of oyster mushroom commercialisation by GHS 187.48. The result confirms Martey (2014) and Abu (2015), who found a positive association between farmers' level of formal education and the degree of commercialisation. The level of formal education of farmers plays a significant role in commercialisation (Akinlade et al., 2016). According to Ofori (1973), formal education provides farmers with improved production and management skills that can be used to maximise profit. Additionally, formal education improves farmers' access to and interpretation of information, which allows them to make informed crop production and marketing decisions to maximise profit and increase commercialisation (Heierli & Gass, 2001). Based on the findings of the study, it can be said that mushroom farmers who are highly formally educated increase the intensity of oyster mushroom commercialisation to maximise profit. Formally educated farmers are, therefore, encouraged to go into mushroom production.

The findings of the study further revealed a positive association between land ownership and the intensity of oyster mushroom commercialisation at a statistically significant

level of 5%. According to the study, farmers' ownership of land increases the intensity of mushroom commercialisation by GHC 1249.249. The findings are consistent with those of Gebreselassie and Sharp (2007), who found a positive relationship between land ownership and the degree of commercialisation. Land ownership in this study refers to the right and control farmers have over the decision and use of land for producing mushrooms. For farm families to invest in their property, they must have a clear expectation that sacrifices, investments of labour, capital, and materials, and the benefits that result from those investments will pay off in the future (Lawry, 2015). One way to ensure this, according to Lawry, is through land certification or titling. Land certification, or titling, ensures the security of land tenure and property rights. Consequently, there appears to be a positive relationship between land ownership, farm productivity, and commercialisation (Lawry, 2015). For example, Lawry et al. (2017) found that secure land tenure leads to increased productivity and farm income. Farmers who certified and obtained legal titles to their lands recorded significant increases in their productivity, from 50 to 100% in Europe and around 10% in Africa (Lawry, 2015). Based on the findings of the study, mushroom farmers' ownership of land increases the intensity of oyster mushroom commercialisation.

At a 1% statistical significance level, the volume of oyster mushroom production (in monetary terms) showed a positive association with the intensity of commercialisation. According to the research, a GHS 1 increase in the value of mushroom output results in a GHS 0.67 increase in commercialisation intensity. The value of output influences the degree of commercialisation (Abu, 2015; Gebreselassie & Sharp, 2007). The result of the study supports the findings of Omiti et al. (2009) and Barrett (2008) that surplus production serves as a motivator for farmers to increase commercialisation. Based on the study, increasing oyster mushroom production can lead to the increased commercialisation of oyster mushrooms.

CONCLUSION

Mushroom cultivation is a non-traditional farming enterprise that is being promoted in Ghana due to its proven economic, medicinal, and nutritional value. The increased demand for oyster mushrooms in Ghana, particularly in the Greater Accra region, justifies the need for commercialisation. Commercialising mushrooms provides a means of generating income and reducing poverty while also improving food security. The mushroom commercialisation index showed that during the 2020 production season, all producers sold 75% of oyster mushrooms. This indicates that oyster mushroom is grown as a cash crop in the region, although the intensity of commercialisation (GHC 10202.29) was low. In terms of farmer characterization, the study found that the majority (94%) of the mushroom producers in the region were highly commercialised. Age, educational level, land ownership, and volume of output were significant determinants of the intensity of mushroom commercialisation. We recommend that stakeholders such as the Food Research Institute and the Ministry of Food and Agriculture of Ghana increase their efforts to improve oyster mushroom production to enhance the intensity of commercialisation. We also recommend that stakeholders in the mushroom industry launch programmes to attract young, educated people, especially recent graduates who are not formally unemployed, into oyster mushroom production. This will increase the supply and maximise producers' profits.

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Data Availability

The data used for the study can be provided upon request from the corresponding author.

Consent

All participants provided written informed consent before participation in this study.

Conflicts of Interest

All the authors declare that they have no conflicts of interest in this study.

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