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Research Article

The Economic Value of an Okra Plant

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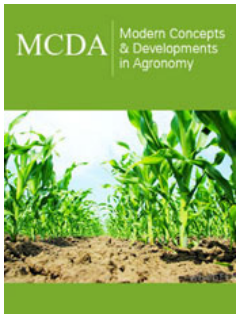

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Abstract

Okra cultivation is a prominent practice in Ghana due to its lucrative economic prospects. This study aimed to assess the cost and returns associated with okra cultivation. Results revealed that each okra plant yields profits of 4, 3, and 2 Ghana Cedis during lean, intermediate, and glut seasons, respectively. The average cost of cultivating okra was found to be GH 11,870 per hectare, with labor costs comprising the largest share at 56%, followed by seed costs at 5%. Variations in okra varieties did not significantly affect yield or revenue, as retailers commonly trade them based on quantity rather than weight. Okra production and marketing proved highly profitable for both farmers and stakeholders, contributing to tax revenues and employment opportunities. At the end of the value chain, each okra plant contributed 27.6 Ghana Cedis. On average, seasonal production yielded a net return of GH 180,424.7 per hectare for farmers and GH 333,306.8 for traders, with a notable Benefit-Cost ratio of 1:14. Returns could be realized within 10 to 12 weeks after harvest initiation. Mechanized seeding was recommended to ensure optimal plant population and sustained profitability. These economic insights into okra cultivation provide valuable information for farmers considering alternative crop choices. Additionally, the government can leverage okra production as a pro-poor policy initiative to alleviate poverty..

Keywords: Okra; Yield; Profit; Price; Economic; Value

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is widely cultivated in tropical and sub-tropical regions of the world due to its high yield and short cropping cycle, making it economically appealing to farmers, including new entrants and investors [1]. It offers a promising income with minimal capital investment and a short turnaround time. According to the FAO of the UN, global okra production has shown significant growth, reaching 9.87 million tons in 2018, with India leading as the largest producer followed by Nigeria, Sudan, Mali, Pakistan, Côte d'Ivoire, Cameroon, and Ghana in the eighth position [2,3]. In certain parts of Africa, the fruit is commonly referred to as Gombo or Gumbo [4].

In Ghana, okra production has seen substantial increases over the years, rising from 50,000 tons in 2010 to 66,458 tons in 2017, indicating a growing trend [5]. The total yield and growth of okra are influenced by factors such as seed quality, climatic conditions, and cultural practices. The FAO reports a rise in the total area under okra cultivation from 1.89 million hectares in 2016 to 2.02 million hectares in 2018. The profitability associated with okra cultivation, coupled with its short growth duration, has led to increased demand for okra seeds, thereby boosting sales [6-8].

However, the relatively high price of hybrid okra seeds may impede market growth in the coming years [9]. Additionally, unexpected events like the COVID-19 pandemic can disrupt the export and import of seeds, including okra [10,11]. Hybrid okra seeds are preferred by growers due to their ability to produce plants with high-quality fruits and disease-resistant traits, despite their higher costs.

The okra plant serves various purposes, including food, feed, fuel, and diverse industrial and medicinal applications. As food, the young okra pods can be consumed in different forms such as boiled, fried or cooked/baked [12]. In Western Africa, the fruit is sliced, sun-dried and ground to powder and stored which can easily be rendered edible by boiling [13]. In Turkey, the young pods are strung together and allowed to dry for winter use [14]. In Thailand, okra is usually boiled resulting in slimy soups and sauces, as well as served as soup thickeners [15]. In India and other parts of Central America, Africa and Malaysia, the ripped seeds are dried and used to prepare vegetable curds or roasted and ground to be used as coffee additive or substitute [6,12]. The seeds which contain high unsaturated fatty acids (70%) can also be used as margarine when hydrogenated into solids [16,17].

Industrially, okra mucilage is mostly used as a spreading agent for glace paper production and as a confectionery use [18,19]. That is, the long fibre extracted from its stem is a suitable material for making paper. Dried okra stems which burn rapidly producing considerable heat can also be used as cheap fuel [20]. In addition to its use for paper making, biogas and fuel, the stems could serve as sacks and ropes. The roots and stems are used for clarification of sugarcane juice before it is converted into jaggery and brown sugar [21,22]. Medicinally, okra is used as a plasma replacement or blood volume expander in humans [12,23]. Soluble fibre from the okra helps to reduce serum cholesterol, thus reducing the risk of heart disease and other diseases such as type 2 Diabetes, gastroenteritis and even cancers [12,24]. Das et al. [25] reported that okra fibre also helps in stabilizing blood sugar and prevent constipation. It has been found that the slippery characteristics of the okra, which some people dislike, rather facilitates the elimination of excess cholesterol and toxins from the body (ARAJILINE, 2019). Tests conducted in China has suggested that an alcohol extract of okra leaves can eliminate oxygen free radicals, alleviate renal tubular-interstitial diseases, improve renal function and alleviate renal tubular-interstitial diseases [26,12]. Also, the tender leaves of okra are often consumed as a vegetable mostly in some parts of Western Africa and South-eastern Asia [27]. These leaves are also considered to be good cattle feed other than the primary use of the plant [27,28].

In Ghana, okra is one of the frequently and commonly consumed traditional vegetables due to its robust nature, dietary fibres and nutritional benefits. Okra is planted alloccurround in Ghana, but major farming activities usually occurs between the months of March to November depending on rainfall. Cultivation between the periods of December to March is mainly dependent upon the availability of irrigation facilities. Several varieties of okra are classified according to their height (tall, medium and dwarf), quality of the pod, and colour of fruit (deep green and light green) and these differ according to country. For example, varieties that are commercially grown and important in Ghana include: Fetri, Pora, Muomi, Ason-Wen, Dikaba. DA/08/004 Agbodro, KNUST/SL1/07 Nkrumanhene Sheo mana, Wun mana and Atuogya Asontem, Odumase, Ogye abatan, Antado, Tuaghya, Avalavi, Kakumdo, Pɜbrɜnkruma, and Krotetenye [29]. Fruits with characteristics such as smooth, spineless, slender with green (light or dark) skin are the most desired in the Ghanaian local and export markets [30]. Varieties such as DA/08/004 Agbodro, Asontem and KNUST/SL1/07, Nkrumanhene are among the landraces that display such traits. Other varieties such as Sheo mana, Wun mana and Atuogya are reported to comparatively have high yielding with longer harvest duration and highly resistant to environmental stresses such as disease, pest and drought [31].

Although the okra plant bears high economic importance, most farmers are unaware of its production economics [32-34]. Okra is an economically important vegetable crop with a potential to increase farm incomes of small producers. This is because okra is popular, easy to grow, and valuable with attractive retail prices. Research has shown that diversification of farm operations with okra cultivation boosts income and farm sustainability [35-37]. Hence exposing farmers to the economics of okra crops that are typically grown is necessary. However, the economic value of an okra plant is yet to be determined. Knowing this, farmers can make an informed decision on size to cultivate to generate a particular income. As a result, the objective of this study was to evaluate the economic value of one okra plant to support farmers in economic decision and scale of production and profitability.

Research Approach

The study was conducted in the Greater Accra Region of Ghana. Data were collected from a purposely set up okra farm on the research fields of the Ghana Atomic Energy commission as well as okra farmers in the Greater Accra region. Vegetable farmers cultivating on the GAEC lands were purposely involved in the study to validate results obtained from the research fields as well to fortify the data. Over 250 vegetable farmers are registered on the GAEC land, and these farmers grow vegetables commercially. A survey was conducted among some selected okra farmers within the surrounding catchment. Ten (10) active okra farmers were purposely selected from the constituency cultivating at least a hectare of okra farm. Farmers were interviewed individually using both closed and open-ended questionnaires. Socio-demographic characteristics, production performance and production constraints and awareness of economic value of their produce were collected. Personal observations from individual farms were also conducted. The study was based on both primary and secondary data. Primary data were collected from experimental fields and also from personal interview methods with the help of pre-tested questionnaires from vegetable farmers who cultivated okra. The research method used in this study includes the cultivation of okra plants on the research farm of the Biotechnology and Nuclear Agriculture Research Institute (BNARI) of the Ghana Atomic Energy Commission (GAEC) as a benchmark study for examining the economic value of okra production and marketing. This was done to model the economic yield and performance of okra on the livelihood of farmers in

Ghana. Data from the research farm was collected twice a week. Observations and harvesting of the randomly selected 100 plants were made at four (4) days intervals. Fruit height, fruit weight, fruit width and total number of fruits per plant, yield (yield per plant and % marketable fruit per plot), and economic profit were analyzed. Average values were used for the analysis. Secondary sources such as surveys through literature review were also carried out. Okro buyers and market women were also selected at random with the sample size 30 from the market. The study was conducted in the central part of the greater Accra region.

Analytical procedure: The following logical procedure was adopted from Tegar [38] to analyze the data obtained.

Plant Population

$$\text{Plant population} = \frac{\text{Total Area of a hactare}}{\text{Plant Spacing} \times \text{Row Spacing}}$$

Cost of cultivation: To work out the cost of cultivation simple math and statistics and statistical techniques of analysis such as average, percentage and standard method of cost of cultivation were adopted to fulfill the objectives of the study. The study worked out the cost of okra production as follows.

Cost of Inputs =Value of purchased material inputs (seed, insecticides and pesticides, manure, fertilizer), hired human labour (hired and owned), hired farm machinery, depreciation on farm implements and farm buildings, irrigation charges, land revenue and other taxes, and interest on working capital.

Cost of fixed Assets = Cost of rent paid for leased-in land.

Capital Cost = cost of inputs + interest on value of owned capital assets (excluding land).

Marketing Cost, Margins and Price Spread:

$$TC = CI + CL1 + CL2 + CL3 + CLn \quad \text{.....(1)}$$

$$QTGO = \frac{ANFP \times PP}{NFG} \quad \text{..... (2)}$$

$$NI = QTGO \times FGP \quad \text{.....(3)}$$

$$PF = NI - TC \quad \text{.....(4)}$$

$$PFP = AP / PP \quad \text{.....(5)}$$

Where,

TC = Total cost of producing commodity

CI = Cost paid by the farmer for input during cultivation of the commodity

CLi = Cost incurred by the Farmer for labour in the process of cultivating the commodity.

NI = Net Income

FGP = farm Gate Price

ANFP = Average number of Fruits per plant

PP = Plant Population

NFG = Number of Okra Fingers in groups

QTGO = Quantity of Grouped Okra

PF = Profit

AP = Average Profit

PF/P = Profit per Plant

Result and Discussion

Climatic condition required for growing Okra

The optimum time of seeding varies greatly depending upon climate, varieties and their temperature requirement for growth. The major season for okra cultivation in Ghana fall under three seasons: the lean season (November to February), the rainy or glut season (March to June) and intermediate season (July to October). Okra grows best within a temperature range of 22-35 ℃. The greater Accra Region have an average temperature of 32 ℃ and heavy rainfall (787mm/year) resulting in good okra yield. Okra does well in all kinds of soil but sandy loam and clay. Loam soils are the best for its cultivation. The optimum PH range is between 6 and 6.8. Soils with high organic matter are preferred and most farmers involved in the study used both matured farmyard manure which is plough into the land during land preparation and fertilizer to enhance yield.

Economic parameters

The economic profit was calculated in Ghana Cedi currency (Gh₵). The weight of okra harvested ranges from 9.38g to 19.95g with an average weight of harvested fruit being 17.69g, average length was 6.67cm and average width was 1.6cm. However, these attributes decline in figures at the later age of the plants. The study found that each okra plant was able to give an average of 22 fruits or fingers in its lifetime totaling an average of 389.2grams valuing GH₵3.3/plant. The results obtained from the study as well as discussion have been summarized under the following heads.

Cost of okra production

Cost of okra production involved expenditure on land rent, tillage, labour, fertilizers, seeds, plant protection, irrigation, and capital cost as shown in Table 1. Irrigation cost varies during the different seasons, in the major rainy season, irrigation cost is 1/3 of the amount spent during the dry season which is 1891.5Gh₵ bringing absolute irrigation cost to 5291.5 and in the minor season, fuel and labour cost is 50% less than that of the lean season cost, which is 2550 Gh₵ bringing irrigation cost to 2741.5 Gh₵.

Average cost per hectare

The cost of cultivation of okra in different planting season amounted from Gh₡11,199.22/hectare to Gh₡9377.10/hectare in lean and rainy or glut season respectively. Table 1 reveals that the average cost of cultivation a hectare of okra turned out to be Gh₡10,136.30. The major cost components were expenditure on hired labour with 39.96% followed by irrigation with 28.53%. Apart from this, expenditure on chemical inputs and seeds were next major as 11.6% and 5.92% respectively.

Cost of land: On rental basis, the cost of leasing 1 hectare of farming land is GH₡500/year. From the date of sowing to the last date of harvesting, the duration of okra farming is 80 to 100 days.

Table 1: Cost involved in okra cultivation.

Activity Log and Cost Implication for 1 Hectare Okra Production			
Activities	**Frequency**	**Unit Cost**	**Total Cost**
Rent on land/Season		500	500
Ploughing and harrowing	1	500	500
Cost of Stomp Weedicide	1	90	90
Cost of okra seeds	1	600	600
Pesticides			
Golan/litter	1	120	120
Attack/litter	9	35	315
Fertilizers			
NPK ()	1	400	400
Fruit Master	5	75	357
Foliar fertilizer	5	44	220
Manure	1	200	200
Labour Cost			
Planting cost	2	150	300
Weedicide application	1	150	150
Cost of irrigation	39	100	3900
Manual weeding	2	300	600
Cost of NPK Application	1	200	200
Cost of Fruit Master Application	5	150	750
Cost of Foliar fertilizer Application	5	150	750
Cost of Manure application	1	0	
Irrigation cost in the dry season			
Fuel cost First 2 weeks	2	50	100
Fuel cost Other 11 weeks	11	100	1100
Pump depreciation	13	12.5	163.5
Irrigation pipes depreciation	14	2	28
Farm supervisor salary	3	500	1500
		Total cost (Lean Season)	12,843.50
		Total cost (glut Season)	9,443.50
		Total cost (intermediate Season)	10,293.50
With monetary policy rate of 28% (March 2023)		Total cost (Lean Season)	14,037.95
		Total cost (glut Season)	10,321.75
		Total cost (intermediate Season)	11,250.80

Land clearing and preparation

Manual labour has drifted from the agricultural sector to illegal mining popularly known as galamsey as a result of higher wages which has resulted in expensive and inadequate labour for horticultural activities. As a result of this more farmers have resulted in decreased cultivation and or mechanisation where tractors are accessible. The mechanized operator charges operation such as land clearing, ploughing, harrowing, seeding, harvesting, etc. per hectare/acre basis. Selective weedicide was used a week or two after tractor operation before planting the seeds. The cost of plowing and leveling with ridges and furrows is GH₵ 500 per hectare (Table 1).

Cost of planting okra seed

The cost of the okra seed depends on the region and the origin of seeds or source of purchase and its variety. However, on average we require 4-5kg of seed/hectare. The seed rate generally varies with germination percentage, spacing and season. Before sowing the seeds are soaked in a solution of Bavistin (0.2%) for 6 hours. The seeds are then dried in shade. The seeds are dibbled on either side of the furrows at a spacing of 60 x 30cm in the rainy season. The cost of 5kg seed is GH₵ 600 at the rate of Gh120 perkg packed of okra seed (Table 1). Planting cost per hectare is 300GH₵ including replanting to fill in ungerminated seeds after 5 days. Planting is normally done by women and in groups of three to five ladies giving a plant population of 55,556.

Pest and diseases in okra farming

The insect, pest, and disease control measures depend upon type and intensity of the attacks. Flea beetles, which are major insects that attacks okra, was controlled using applications of Golan or Attack. Golan insecticide at a cost of 75Gh/250mil was applied 1 and ½ weeks after plant emergence until the first flower. This was later changed to Attack which is a biopesticide at a cost of 35Gh per liter, applied at 7 days interval. Okro is susceptible to diseases such as verticillium, Fusarium and several other fungal diseases in the rainy season. These diseases can be controlled by proper crop rotation and good farm sanitation practices.

Weed control in okra farm

Weedicide application is normally done a week or 10 days after harrowing before seeding using glyphosate. The cost of weedicide and its application amounted to a cost of 240GH₵ (Table 1). Application is often done with a knapsack sprayer by an experienced sprayer. Hoe weeding is done twice during the life cycle of the okra and each at a cost 300Gh₵ per hectare especially during harvesting period.

Cost of manures and fertilizers application in okra farming

Okra plants were fertilized at 1 and ½ weeks after germination with a starter solution of Polyfeed 19:19:19 fertilizer as foliar application. NPK (23:5:10) at a rate of 5g/plant applied two weeks afterwards. The cost of the NPK is 400Gh₵ (Table 1). Subsequent Potassium nitrate (KNO3 10:10:40) fertilizer or fruit master and polyfeed which is a foliar fertilizer was applied and repeated every two weeks to induce flowering and good pod formation at cost of 75Gh and 44Gh₵ respectively. Compost application during the dry seasons increases okra seed yields [39,40].

Irrigation or watering okro farm

Watering was done when necessary, using sprinklers throughout the growing stage of the okra plant. The okra crop requires adequate moisture in the soil during the dry season months for faster growth. In the dry season, watering is done thrice a week. And zero to once during the rainy season. The water source for irrigation is from the Onyasia River. The main cost of irrigation comes from the fuel used to power the pumping machine. The daily water requirement of okra plants is 2.4 Liters/Day/4 plants during the early growth stage and 7.6 liters/day/4 plants during the peak growth stage. The irrigation system should be operated daily for 75 minutes during the initial growth stage, which will consumed about 3.5 liters of petrol at a cost of 50Gh₵ per week for two weeks and 4 hours during peak growth requiring about 7 liters of petrol at a cost of 100Gh₵ per week.

Harvesting of okra fruits

Harvesting was made at an interval of every 4 days after 4 weeks of initial planting for 10 weeks till plant productivity declined. 100 plants were randomly sampled from a hectare of land for fruit count, weight, and vigour. The prices of okra at farm gate vary depending on the season. Okra is in full glut between the months of August to October of which the price for 5 fingers of okra is 0.50 Gh₵. In the lean season, which is the dry season period between November and February, the farm gate price of 5 fingers of okra is 2Gh₵ and between the months of April to July, 5 fingers of okra at farm gate price are 1Gh₵.

Labour cost involved in a hectare of okra farm

Labour is required during the date of sowing, once in 4 weeks for manual weeding for 2 months, for irrigation at the rate of initially twice a week and later after every 7 days interval. Labour is required for 12 times of two labourers for irrigation as shown in Table 2. Harvesting starts after 30 days of sowing to 90 days after sowing. Harvesting is mainly done by the buyer at an interval of every 4 days.

Table 2: Labour cost in a hectare of okra production.

Planting cost	2	150	300
Weedicide application	1	150	150
Cost of irrigation	13	100	1300
Manual weeding	2	300	600
Cost of NPK Application	1	200	200
Cost of Fruit Master Application	5	150	750
Cost of Foliar fertilizer Application	5	150	750
Cost of Manure application	1	0	

Benefit of 1 hectare okra farming

The cost of production and income varies per planting season and ranges from 14,037.95, 11250.8 to 10,321.75 during the lean, intermediate and glut season respectively as shown in Table 3. Average income per cropping season is 180,424.7.

The Value chain of okra

The value chain analysis was based on the value each stakeholder gets as a result of one hectare of okra cultivation within the year as shown in Table 4 below. The cost of land rent was paid to landowners, the cost of fuel going to the petroleum industry, the value of agro chemicals going to the input suppliers, the cost of wages/labour going youth employed, the cost of transportation going to transport operators, the cost of carting going to women headgears, and the selling price going to traders and purchasing cost paid for by consumers in terms of satisfaction in utility.

Table 3: Yield benefit of a hectare okra farm.

Okra Yield Per Hectare									
Particulars	**Number of Okra Plants**	**Average Number of Fruits per Plant**	**Market Season**	**Okro Finger Grouped**	**Quantity of Grouped Okra**	**Price per Grouped Fingers**	**Income per Hectare**	**Cost per Hectare**	**Profit per Hectare**
Yield	55,556	22	Lean	5	244446.4	1	244446.4	14,037.85	230,408.55
Yield	55,556	22	intermediated	7	174,604.60	1	174,604.60	11,250.80	163,353.80
Yield	55,556	22	Glut	5	244446.4	0.50	122,223.2	10,321.75	111,901.45
						Total	541,274.2	35,610.4	505,663.80
						Average per plant	3.3	0.2	3.1

Note: Average income per plant is 3.3

Average cost of production per plant is 0.2

Average Profit per plant is 3.0

Average Profit per hectare is 168,554.6

Table 4: Valued contributed by a hectare of okra farm.

Particulars	Value in Gh₵/year	Percentage	Outflow Source
Landowners	500	0.03%	Farmer
Petroleum industry	2,200	0.14%	Farmer
Input suppliers Seed Weedicides Pesticides fertilizers	4552 1,800 270 1,305 1,177	0.30%	Farmer
Employment/wages Income for Farmer Income from planting Income from weeding Income from fertilizing Income from watering Income from Harvesting	13,150 + 505663.8 505663.8 900 2250 2850 7150 1620	33.93% 0.11%	Farmer Okra sales Trader / Okra buyer
Transport Industry	540	0.04%	Trader / Okra buyer
Head porters/carters	162	0.01%	Trader / Okra buyer
Traders/retailers Lean season Intermediate season Glut season	999,920.3 568,052.93 311,966.2 119,901.2	65.43%	Okra retails
Total	1,533,510	100%	

Several factors are involved in the production and marketing of okra, e.g. input suppliers, traders, and exporters. In general, the supply chains mainly consisted of selling at farm-gate to collectors, traders, commission agents and wholesalers who are mainly women. Harvesting, transporting and carting costs are borne by the buyer. Produce is transported to the district markets within and outside of the Greater Accra regions for retailing.

Conclusion

Although potential earnings from growing okra vary by season, growing okra can increase the revenue of farmers within the shortest possible period. This is due to the fact that, each okra plant can give a profit of 4, 3 and 2Gh₵ during the lean, intermediate and glut season respective within the year. The average cost of cultivation of okra turned out to be GH 11,870/ hectare. The total labour cost i.e. Gh₵6650/ hectare was the major component (56%) in cost in terms of cultivation. In material cost, the least expense was on seed with a share of 5 % of the total cost of production. Based on our findings, yield and revenue were not different for the okra varieties evaluated since retailers buy them in numbers and not by weight. The findings indicate that okra production and marketing was highly remunerative for both farmers and stakeholders. The

country as a whole also benefited in terms of income tax and levy earnings from the market women as well as creating jobs for the less privileged through the production and marketing of okra. An okra plant valued about 27.6 Ghana Cedis at the end of the value chain.

The average net return observed within seasonal production was GH 180,424.7/ hectare for the farmer and 333,306.8 for traders or retailers. However, farmer profit was greater than that of retailers or traders after cost. Researcher farmers or farmers who have access to information about prices turn to record higher farm gate prices than those whose received prices are dictated by middlemen. The okra production has a Benefit-Cost ratio of 1:14. It can return an income within the 10- to 12- week period after harvest starts. The study recommended the use of mechanized seeding to minimize error in planting population density and thereby ensuring steady profitability. Encouragement to farmers markets should be given for fetching better prices. Most importantly, the results also show that farmers and traders still have better market access in both lean and non-lean seasons, thus income is assured. Ants popularly known as "Charles Taylor" was the major hurdle in Okro production therefore some strategies should be implemented to save okra crops in study areas. An understanding of the economics of okra cultivation is vital to help farmers and government develop an appropriate agricultural policy to maximize yield and profits. An important policy implication of these results is that the government can use okra production as a pro poor policy measure to help elevate poverty.

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