PROFITABILITY AND CONSTRAINTS TO DRY-SEASON CUCUMBER CULTIVATION BY SMALL-HOLDER FARMERS IN THE KADAWA IRRIGATION PROJECT, KANO STATE, NIGERIA

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ABSTRACT
Cucumber is one of the most important exotic vegetables in Nigeria and it is gaining increasing attention for its inherent health benefits. This study examined the profitability and constraints to cucumber production in the Kadawa Irrigation Project, Kano State, Nigeria. Multi-stage technique was adopted for sample selection while questionnaire was used for data collection. A total of 153 cucumber farmers were used for the study. Data were analyzed using descriptive statistics, gross margin analysis, linear profit function regression and Garret ranking technique. Majority of the farmers were male (98.69%) with an average age of 39 years. An average of 0.38 ha farm size was devoted to cucumber production which was 28.15% of the total irrigable land available to the average farmers. Gross margin analysis revealed a gross profit of ₦438,970.74/ha being 89.67% gross profit margin. The linear profit function analysis indicated that cost of weeding (1%), cost of seed (5%), cost of pesticides (5%), and cost of transportation (5%) amongst others were statistically significant. The study further revealed the major constraints faced by cucumber farmers to include pest and diseases, high cost of hybrid seeds and unfavourable climatic condition causing plant wilt. Consequently, awareness campaign for cucumber producers by extension workers is necessary in order to train them in the best farming practices to deal with pest and diseases as well as cope with changing climatic conditions. In addition, for the farmers to attract higher profit, the spatial value addition to cucumber should be encouraged through facilitation of transportation means to consumer markets.
Keywords: Profitability, Constraints, Cucumber Cultivation, Small-holder Farmers, Irrigation, Kano State.

INTRODUCTION

Cucumber, Cucumis sativus, is one of the most popularly cultivated plant of the gourd family Cucurbitaceae. It is believed to have originated from ancient India in about 4,000 years ago (Aziza et al., 2018). Over the years, cucumber has spread beyond Indian borders, moving through Ancient Greece, Rome, Europe, New World, China, and eventually becoming fourth most widely cultivate vegetable in the world (Adeoye and Balogun, 2016; Aziza et al., 2018). Cucumbers are long, cylindrical green fruits that contain about 95% water and are for this reason often recommended as natural diuretics. They are accessory fruits but are often perceived, prepared and eaten as vegetables. Cucumbers are very rich source of conventional antioxidant nutrients including beta-carotene, and manganese. Being used as a cooling food in summer (Maurya et al., 2015), a fresh cucumber provides vitamin C, niacin, iron, calcium, thiamine, fibers and phosphorus (Khan et al., 2015).

Vegetable production in general has been an ongoing practice in Nigeria, but a relatively recent addition to the diet of Nigerians with the increasing awareness of the health benefits associated with their consumption. Consequently, the ability to increase cucumber production in Nigeria is of great

importance. Cucumber is widely cultivated in Nigeria and is available almost in every market (Okelola et al., 2018). Dry season cucumber farming is however only possible by irrigation. Cucumber demands high temperatures and soil moisture for satisfactory yield, and under unfavorable climatic conditions, several problems may occur that can cause delay in fruit growth (Marcelis and Hofman-Eijer 1993; Medany, Wadid and Ayman 1999) and mineral disorders. Cultivation during dry season allows for favourable weather conditions suitable for plants growth and high yield even on small farmland (Pozderec, Pazek and Bavec 2010).

Cultivation of cucumbers in the dry season is expected to be very profitable as only few farmers have access to and practice irrigation in Nigeria. The low number of cucumber farmers in Nigeria during the dry season makes cucumbers scarce in the market, causing a hike in the prices of cucumbers and increased profitability for farmers, as observed by Veggie Grow, (2021). However, vegetable producers in Nigeria are generally faced with debilitating challenges that could be grouped into agronomic and socio-economic factors (Sabo and Zira, 2009), that make them fall short of expectations. For instance, many farmers are smallholders who are unable to adopt mechanized farming and therefore experience low farm productivity. Mrema and Rolle (2002) identified, amongst others, a high level of wastage in the production and marketing of vegetables due to inadequate cold storage facilities and lack of processing facilities. Consequently, these constraints can result in unstable supply and economic inefficiencies for both farmers and consumers.

With the dearth of studies on cucumber production profitability and constraints especially during the dry season, this study would provide useful information to the cucumber farmers and other stakeholders interested in cucumber business. Researchers will find the study useful for further research on economics of cucumber production, marketing and profitability. It will also be a source of reference to students and policy makers. More so, the findings will add to existing literature on the economics of cucumber production.

The overall objective of the study is to investigate the profitability and constraints to dry season cucumber production in the Kadawa Irrigation Project, Kano. The specific objectives are as follows:

i. To estimate cost and return of producing cucumber;
ii. Determine factors influencing profitability of cucumber production in the dry season;
iii. Identify the constraints associated with the production of the crop in the study area.

RESEARCH METHODOLOGY

The study was conducted in the Kadawa Irrigation Project Area, which is part of the Kano River Project, Kano State. The project, founded over five decades ago began as a pilot project and was one of the three original modern irrigation projects in the country. Others are the Bakolori Irrigation Project in Zamfara State and the South-Chad Irrigation Project in Borno State. The Kano River Project is under the Hadejia Valley and Jama'a River Basin Development Authority covering an area of about 62,000 hectares of irrigable land (Sangari, 2006), has a number communities namely Dawaki kudu, Kura, Bunkure, Garun Malam,

Chiromawa, Kulluwa, to mention but a few, populated by farmers and migrant labourers. It is located between latitude 11°32'N and 11°51'N North of the equator and longitude 8°20'E and 8°40'E East of the Greenwich Meridian.

A multistage sampling technique was adopted for this study. The first stage involved random selection of villages within the project site namely, Chiromawa, Yantomu, Kupa, Ungwan kudu, Kadawa and Yadakwa. The second stage involved a snowball sampling of cucumber farmers within the villages as no list of such farmer existed, giving a sample size of 153 respondents. Primary data were collected from cucumber farmers using structured questionnaires, while descriptive statistic, gross margin analysis, linear profit function and Garret ranking technique were used in the analysis of data.

For classical competitive firms assumed to face exogenously determined technological possibilities and can chose variable inputs and outputs, to maximize profit at exogenous competitive market price, a restricted profit function is applicable (Diewert, 1971; McFadden, 1978; Fuss, McFadden and Mundlak, 1978). The general linear profit function explains the underlying parameters of production process, making it possible to estimate the net supply system by multivariate linear regression techniques and formulate economic hypotheses as linear restriction in the industry (McFadden, 1978).

The profit function model is given by;

$$Y_i = f(X_i; \beta) + e_i \text{.....(1)}$$

Where: Y_1 is the monetary value of net returns in naira, Xi is the vector of input costs, β is the vector of unknown parameters to be estimated, f is a notation for the functional form of the model. The production function f (Xi; β) is a measure of maximum potential profit for any particular input cost vector Xi. e_i is the error term and is the farm specific composite residual term comprising of a random error term.

Explicitly, the profit function model is specified as;

$$Y_{ij} = \alpha_0 + \alpha_1 X_{1ij} + \alpha_2 X_{2ij} + \alpha_3 X_{3ij} + \ ... \ + \alpha_{15} X_{15ij} + U_{ij} \text{.....(2)}$$

Where:

The subscription i and j refer to i^{th} farmer and j^{th} farm respectively. Y is the net profit of cucumber (₦), X_1 is the cost of land preparation (₦), X_2 is the cost of planting (₦), X_3 is cost of seeds planted (₦), X_4 is the cost of weeding (₦), X_5 is cost of renting farmland (₦), X_6 is cost of renting water pump (₦), X_7 is cost of fuelling water pump (₦), X_8 is cost of water (₦), X_9 is cost of irrigating field (₦), X_{10} is the cost of fertilizer used (₦), X_{11} is cost of fertilizer application (₦), X_{12} is cost of pesticides/chemical (₦), X_{13} is cost of spraying chemicals (₦), X_{14} is cost of harvesting (₦), X_{15} cost of transportation (₦), U_{ij} is a random error term with normal distribution N (0, δ^2), while $\alpha_o - \alpha_{15}$ are the parameters estimated.

Garret Ranking Technique was used to analyze the constraints in cucumber production. As identified in reviewed literature, farmers were presented with a number of constraints for ranking in the order of importance. The ranks provided by the farmers were scored using the formula:

$$\text{PercentagePosition} = \frac{100(R_{ij} - 0.5)}{n_j} \text{.....(3)}$$

where, R_{ij} is the rank given to i^{th} constraint by the j^{th} farmer, and n_j is number of constraints ranked by the j^{th} farmer.

RESULTS AND DISCUSSION

Table 1: Distribution of socio-economic attributes of cucumber farmers in the study area

Characteristics	Mean/Mode	Min.	Max.	St. Dev.	Frequency	Percentage
Gender	Male			0.08		
Male					151	98.69
Female					2	1.31
Level of education				1.83		
No formal education					24	15.69
Arabic education					40	26.14
Adult education					7	4.58
Primary education					5	3.27
Secondary educ.	Secondary educ.				53	34.64
Post-secondary education					24	15.69
Age of respond.	38.7	18	75	11.9		
< 20					11	7.19
21-40	29				96	62.75
41-60					40	26.14
> 60					6	3.92
Total irrigable land size (Ha)	1.35	0.1	10.1	1.11		
< 0.50					27	17.65
0.51-1.00	1				72	47.06
1.10-1.50					2	1.31
1.51-2.00					32	20.92
2.10-2.50					12	7.84
2.51-3.00					4	2.61
> 3.00					4	2.61
Total No of plots	2	1	10	1.69		
< 2					85	55.56
3-5					57	37.25
6-8					10	6.54
> 8					1	0.65
Cucumber farm size (Ha)	0.38	0.1	1	0.026		
< 0.20	0.2				76	49.67
0.21-0.40					45	29.41
0.41-0.60					5	3.27
0.61-0.80					16	10.46
> 0.80					11	7.19

It can be seen from Table 1 that cucumber production in the study area was male dominated by a sweeping 98.7%. This is in line with the findings of Adeoye and Balogun (2016), Oyediran, Sodiya and Omoare (2014) and Tambo and Gbemu (2010), whose findings indicated that men were majorly involved in cucumber, melon and tomato production in their respective study areas. The study also revealed that only about 35% of the cucumber farmers attained secondary school education with about 26% having Arabic education literacy. About 16% of the respondents had no formal education. Education is vital as it could enable quick capacity building in cucumber production. This view is in accordance with the findings of Uwagboe et al. (2010) and Elum, Etowa and Ogonda (2016), that the farmers' level of education could enhance their farming activities, level of awareness and level of receptivity of improved technologies. In addition, an educated labour force can easily adapt to the dynamic needs of a changing economy.

The average cucumber farm size is indicated in Table 1 as 0.38ha which is 28.15% of the total irrigable land available to the average farmer. With the possibility of cultivation of other crops like maize, water melon, green pepper, wheat, tomato and other popularly grown crops under irrigation in the study area, the share of cucumber in the available irrigable land can be said to be substantial. It could possible mean that cucumber is seen as a cash crop grown by farmers whose cultivation can boost significantly, the income opportunities of small-scale farmers.

Costs and returns in cucumber production

Table 2: Gross margin analysis of profit level in cucumber production

Items in naira (₦)	Amount at average farm size of 0.38ha	Amount at equivalent 1ha farm size	Percentage of Cost
Average sale	355,259.57	934,893.61	
Rental costs	35,045.75	92,225.66	18.84
Cost of Seed	27,356.09	71,989.71	14.71
Cost of hired labour	76,874.39	202,301.03	41.33
Cost of fertilizers	20,577.25	54,150.66	11.06
Cost of pesticides	13,023.69	34,272.87	7.00
Cost of fuel	11,274.61	29,670.03	6.06
Cost of water	4,298.91	11,312.92	2.31
Cost of transportation	6,319.49	16,630.24	3.40
Total variable cost (TVC)	186,020.17	489,526.76	100.00
Total revenue	188,450.69	495,922.87	
Gross profit (TR-TVC)	166,808.88	438,970.74	
Gross profit margin (%)	89.67	89.67	

The results of gross margin analysis are as presented in Table 2, showing that the gross profit from cucumber production in the study area is ₦166,808.88 per 0.38ha average farm size and ₦438,970.74 1ha equivalent. Based on the gross profit margin

(89.67%), similar to the findings of Elum, Etowa and Ogonda (2016), about ₦0.90 is retained as gross profit on every naira invested. This gross profit which was realized after accounting for the costs of operating the business in a production season, indicated that cucumber production is highly profitable in the study area and this is in line with studies on cucumber production in various parts of Nigeria (Okelola, et al. 2018; Elum, Etowa and Ogonda 2016; and Adeoye and Balogun 2016). The cost of hired labour (41.33%) constituted the highest percentage of cost. It is followed by rental cost (18.84%) which includes land, water pump, pipes rentals when applicable, and cost of hybrid seed (14.71%). The least cost of production is the cost of water (2.31%), which is the paltry sum charged for the use of water for irrigation by the estate

Cucumber linear profit determinants

Table 3: Determinants of cucumber profitability in the study area

Variable	Coefficients	Standard Error	t Stat	P-value
Intercept	0	#N/A	#N/A	#N/A
Cost of land preparation	5.424	3.137	1.729	0.086***
Cost of seed	3.451	1.442	2.393	0.018**
Cost of planting	2.202	2.409	0.914	0.362
Cost of weeding	16.526	4.336	3.811	0.000*
Cost of renting farmlands	0.885	1.372	0.645	0.520
Cost of renting water pump	-9.995	6.697	-1.492	0.138
Cost of fueling	4.929	2.867	1.719	0.088***
Cost of water	22.446	12.151	1.847	0.067***
Cost of irrigating field	5.085	2.867	1.773	0.078***
Cost of fertilizers	-1.877	2.056	-0.913	0.363
Cost of fertilizer application	6.512	5.541	1.175	0.242
Cost of pesticides	-12.706	4.958	-2.563	0.011**
Cost of pesticides application	4.656	4.646	1.002	0.318
Cost of harvesting	2.692	1.945	1.384	0.169
Cost of transportation	8.961	3.548	2.525	0.013**

The results of the multivariate linear profit regression analysis for the determinants of cucumber profitability are presented in Table 3. The R^2 was found to be 0.81, adjusted R^2 0.78 and F-calculated 38.85 ($p < 0.01$) The cost of seed (5%), cost of weeding (1%), cost of pesticides (5%), and cost of transportation (5%) were found statistically significant. Note that the intercept to the function is zero, meaning with zero cost in cucumber production, no revenue let alone profit is realized. From signs on the coefficients of the result presented, it can be noted in particular that the cost of pesticides negatively affect profit, pointing to a likely misuse of pesticides in cucumber production. Also, the positive relationship between cost of transportation and profit might be indicative of the fact that with increasing transportation

(distance) of farm product from area of cultivation to location of consumption, the higher the profit that would be realized by the farmer. The result is in agreement with the submission of Elum, Etowa and Ogonda (2016) and Badmus and Yekini (2011), who found that the value of output of cucumber farmers is significantly influenced by their socio-economic characteristics.

Major constraints faced by cucumber producers in the study area

Table 4: Garret ranking distribution of constraints to cucumber production in the study area

Constraints	Total score	Percentage position	Rank
Pest and diseases	896	73.20	1
Unavailability and high cost of hybrid seed	427	39.87	2
Wilting occasioned by high temperature	354	38.56	3
Fruit decay problem	215	28.10	4
Low and inconsistent market price	148	24.18	5
Low yield	75	16.34	6
Water shortages	6	1.96	7
Inadequate farmland	1	0.65	8

The results from the Garret Ranking Technique are presented in Table 4. The technique identified eight constraints ordered from highest to lowest according to their limiting effects on cucumber production in the study areas. Pest and disease attacks were ranked as the first major constraints faced by the cucumber farmers with a garret score of 896 points and a percentage position of 73.2%. Further, unavailability and high cost of hybrid seed was ranked as the second major constraint with garret score of 427 points and a percentage position of 39.87, closely followed by harsh climatic condition warranting wilting of crop. These findings were similar to that of Okelola, et al. (2018), Elum, Etowa and Ogonda (2016) and Adeoye and Balogun, (2016). The least constraint was the issue of land unavailability/inadequacy. It had a Garret score of 1 and a percentage position of 0.65%.

CONCLUSION AND RECOMMENDATIONS

This study sought to estimate the profitability and identify the constraints to cucumber production in Kadawa Irrigation Project, Kano State, Nigeria. The findings showed that cucumber business was highly profitable with a gross profit of ₦443,051.51 per hectare. It could be inferred from the study that, there is likely to be an increase in the production level of cucumber in the future, as more persons would engage in cucumber production because of its high profitability. The major costs of production that affected profit were cost of weeding, cost of seed, cost of pesticides, and cost of transportation to mention but a few. The study further revealed that the major constraints faced by cucumber farmers in the study area include pest and diseases, high cost and unavailability of hybrid seeds, fruit decay problem, amongst others, with varying levels of importance. Consequently,

farmers need to be encouraged to cultivate cucumber as cultivation can boost their income opportunities. More so, awareness campaign for cucumber producers by extension workers is necessary in order to train them in the best farming practices to deal with pest and diseases as well as cope with changing climatic conditions. In addition, for farmers to attract higher profit, the spatial value addition to cucumber should be encouraged among farmers through facilitation of transportation means to consumer markets.

REFERENCES

Adeoye, I. B. and Balogun, O. L. (2016). Profitability and Efficiency of Cucumber Production Among Smallholder Farmers in Oyo State, Nigeria. Journal of Agricultural Sciences 61(4): 387-398.

Aziza, L., Fardous, A.H., Farjana, Y., Hasibur, R. H. (2018). Production and Marketing of Cucumber in Some Selected Areas of Mymensingh District. Agricultural Research and Technology 15(5): 141-148.

Badmus, M.A. and Yekini O.T. (2011). Economic Analysis of Exotic Vegetable Production Among Urban Fadama Women Farmers in Akinyele Local Government Area Oyo State, Nigeria. International Journal of Agricultural Economics and Rural Development 4(1): 19-24

Diewert, W.E. (1971). An Application of the Shephard Duality Theorem: A Generalized Leontief Production Function. Journal of Political Economy, 79: 481-507.

Elum, Z.A., Etowa, E.B. and Ogonda, A.U. (2016). Economics of cucumber production in Rivers State, Nigeria. Agro-Science 15(2):48-53.

Fuss, M., McFadden, D. and Mundlak, Y. (1978). A Survey of Functional Forms in the Economic Analysis of Production. Production Economics: A Dual Approach to Theory and Applications, (ed). M. Fuss and D. McFadden,. Amsterdam: North-Holland Publishing Co. pp. 219-268.

Khan, Z., Shah, A.H., Gul, R., Majid, A., and Khan, U, (2015). Morphoagronomic Characterization of Cucumber Germplasm for Yield and Yield Associated Traits. International Journal of Agronomy and Agricultural Research 6: 1-6.

Marcelis, L.F.M. and Hofman-Eijer, L.R.B. (1993). Effect of Temperature on the Growth of Individual Cucumber Fruits. Physiologia Plantarum 87(3): 321-328.

Maurya, G.P., Pal, V., Singh, G.P. and Meena, L.K. (2015) An Economic Analysis of Cucumber Cultivation in Sultanpur District of Uttar Pradesh (India). International Journal of Agricultural Science and Research, 5(1): 23-28.

McFadden, D. (1978). The General Linear Profit Function: History of Economic Thought. In: Fuss, Melvyn & McFadden, Daniel (ed.), Production Economics: A Dual Approach to Theory and Applications, volume 1, chapter 5, McMaster University Archive for the History of Economic Thought.

Medany, M., Wadid, M.M. and Ayman, F.A.H. (1999). Cucumber Fruit Growth Rate in Relation to Climate.

Acta Horticulturae 491(491): 107-112.

Mrema, C.G. and Rolle, S.R. (2002). Status of the Port Harcourt sector and its Contribution to Agricultural Development and Economic Growth. Japan International Research Center for Agricultural Sciences, JIRCAS Proc. 9th: 13-20.

Okedola, O.E., Korie, B.N., Ariyo, O.C. and Korie, C.I. (2018). Profitability of Cucumber (Cucumis sativus) Production in Udi LGA of Enugu, State, Nigeria. 19th Annual National Conference. Nigerian Association of Agricultural Economists (NAAE) held 15th to 18th October, 2018.

Oyediran, W.O., Sodiya, C.I. and Omoare, A.M. (2014). Determinants of Melon Production in Iseyin Local Government Area of Oyo State, Nigeria. Scholars Journal of Agriculture and Veterinary Sciences 1 (2): 42-49.

Pozderec, S., Pazek, K. and Bavec, M. (2010). Economics of Pepper and Salad Cucumbers Production on an Open Land and in a Protected Place. Agriculturae Conspectus Scientificus 75(3): 127-132.

Sabo, E. and Zira, Y.D. (2009). Awareness and Effectiveness of Vegetable Technology Information Packages by Vegetable Farmers in Adamawa State, Nigeria. African Journal of Agricultural Research. 4(2): 065-070.

Sangari, D.U. (2006). An Evaluation of Water and Land Uses in the Kano River Project, Phase I, Kano State. Journal of Applied Science and Environmental Management 11(2): 105 - 111

Tambo, J.A. & Gbemu, I. (2010). Resource Use Efficiency in Tomato Production in the Dangme West District, Ghana. Conference on International Research on Food Security, National Resource Management and Rural Development, ETH Zutith, Sept. 14-16.

Uwagboe, E.O., Ndagi, I., Agbongiarhuoyi, A.E., Adebiyi, S. and Aigbekaen, E.O. (2010). Assessment of Insect Pest and Disease Control by Cocoa Farmers in Relation to their Income in Kwara State, Nigeria, Middle East Journal of Scientific Research, 6(2): 147-151.

Veggie Grow (2021). Make ₦3 Million from Cucumber Farming in 3 Months in 2021. An Online Publication by Veggie Grow Limited. Available at a