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FACTORS INFLUENCING IRRIGATED CABBAGE (*BRASSICA OLERACEAE*) PRODUCTION IN TORO LOCAL GOVERNMENT AREA OF BAUCHI STATE, NIGERIA

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ABSTRACT
The study was conducted to examine the factors influencing irrigated cabbage production in Toro Local Government Area of Bauchi State, Nigeria. Multistage sampling technique was used to select a total of 100 farmers for the study. The data collected was analyzed using descriptive and inferential statistics. The result shows that all (100%) of the farmers were male and 35.7% of cabbage farmers were youth with average age of 35.6 years. The result further reveals that all (100%) of the respondents were male and majority (69.4%) of the farmers were literate who obtained various form of formal education. The average farm land cultivated was 1.5 hectares and 74.5% of the farmers acquired their inputs from the market. Majority (80.6%) of the farmers sourced water from the river/stream and used pumping machine for the irrigation. The result also shows that most (93.9%) of the farmers adopted treated and improved seeds technology. The result revealed that quantity of seeds, labour, fertilizer and farm size had positive coefficients and significantly influenced cabbage output. The R^2 was estimated at 0.398 which implies about 40% of the variation in output of cabbage production was explained by explanatory factors included in the model. The R^2 was estimated at 0.398 which implies about 40% of the variation in output of cabbage production was explained by explanatory factors included in the model. This is not by chance as justify by F-value of 10.027 and significant at $P<0.001$, indicating combine effect of independent variables on the total output. The study recommends that farmers should be encouraged to form cooperative societies to obtain input resources collectively and enjoy group marketing of cabbage. The use of more improved irrigation technologies is also recommended in order to boast cabbage production for high income.

Keywords: Cabbage, Influencing Factors, Irrigation, Nigeria, Production.

INTRODUCTION
Cabbage (Brassica Oleraceae) is a leafy green or purple biennial plant, grown as annual vegetable crop for its dense leaved head. Cabbage is one of the most popular vegetables in the world because of its adaptability to a wide range of climatic conditions and soil types, ease of production and storage, and its food value (AsiaFarming, 2015). In Nigeria, production of this important vegetable is mostly carried out in the north especially Plateau State (Ogedegbe and Law-Ogbomo, 2013). Plateau state is the home of exotic vegetables including cabbage because of its cool weather condition. Other exotic vegetables cultivated on the Plateau include; lettuce, cucumber, carrot, etc. They are termed exotic because these are species of vegetables that are not indigenous to Nigeria. They are primarily cultivated in the temperate regions of the world. Cabbage does well in in Toro Local government Areas (LGAs) in Bauchi State; Jos North; Jos South; and Riyom LGAs of Plateau State (Ebojei, 2016). The local government areas are

Cabbage is predominantly cultivated in these areas because of their high altitude which result in the areas having cool climate. Since it is not a common vegetable that can be cultivated in any part of the country, the demand then outweighs the supply. This ordinarily will enrich the producers of this commodity thereby financially empowering the farmers in this part of the country.

Irrigation is the artificial application of water to the soil to sustain plant growth. Irrigation has been identified to be a key part in optimizing agricultural production for self-sufficiency in food production and poverty reduction in most developing countries in the world (Hassan *et al.,* 2017). Irrigation contributes to livelihood improvement through increased income, food security, employment opportunity, social needs fulfillment and poverty reduction. Increase in agricultural production through diversification and intensification of crops grown, increased household income because of on/off/non-farm employment, source of animal feed, improving human health due to balanced diet and easy access and utilization for medication, soil and ecology degradation prevention and asset ownership are contributions of irrigation (Asayehegn, 2012). According to Diana (2014), the health benefits of cabbage include the followings;

i. Ideal weight loss: It has only 33 calories in cup of cooked cabbage is low in fat and high fibre. It is definitely a smart carb.
ii. It is brain food: It is full of vitamin K and *anthocymins* that help with mental function and concentration. This nutrient also prevents nerve damage improving your defense against alzheimers disease dementia.
iii. High sulphur, the beautifying mineral: Cabbage helps dry up oily and acre skin. Internally sulphur is essential for keratin, a protein substance necessary for healthy hair nails and skin. All vegetables are good for the skin, but cabbage is one of the best.
iv. Helps detoxity the body: The high content of vitamin C and sulphur in cabbage removes toxins (free radicals and uric acid) these are the main causes of arthritis, skin diseases, rheumatism and gout.
v. Helps keep blood pressure from getting high. The high potassium content helps by opening up blood and it has well-known cancer preventive compounds *lupeol, sinignin* and *sulforphane*.
vi. They stimulate enzyme activity and inhibit the growth of cancer tumors. A study on women should a reduction in breast cancer when cruciferous vegetables like cabbage were added to their diet.
vii. A warm compress made with cabbage leaves can help relieve the pain of a headache and drink for chronic headaches.
viii. Anti-inflammatory and blood sugar regulator: The natural red pigments of red cabbage (betalains) is said to lower blood sugar levels and boost insulin production.

The research work will also serve as a reference for students and other researchers of similar research work in the future. The work can be used by stakeholders to enlighten farmers in the area on factors influencing cabbage production and as a source of nutrition and income for better living standard. The study specific objectives of the study were to:

i. describe the socio-economic characteristics of small scale irrigation farmers of cabbage in the study area;
ii. identify the sources of inputs used in irrigated cabbage production;
iii. identify technologies/practices adopted by the farmers in cabbage production; and
iv. examine the production factors influencing total output of cabbage in the study area.

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The hypothesis of the study was; Ho_1: Production factors such as seeds/seedlings, labour, farm size, fertilizer, agrochemicals and depreciation of assets does not influence cabbage output.

MATERIALS AND METHODS

The Study Area

The Study area was Toro Local Government Area of Bauchi State, Nigeria located between latitude $9^0\ 3^1$ and $12^0\ 3^1$ North and longitude $8^0\ 50^1$ and 11^0 East. The local government share boundary with Plateau State to the West, Kano State to the North and Kaduna State to West-North.

Toro local government covered an area of 2400 squares miles; with a population of 346,000 person as of 2006 and projected population of 483,016 in 2017 based on growth rate of 3.6% of the State (NPC, 2006). The climatic condition of the area like other parts of the tropics has two main seasons i.e., the rainy season and dry season. Rainfall start from early April and ends by November while dry season is from December to end by March. The average temperature is 27^0C due to its hilly and rocky nature; it is very cold like Jos, in Plateau State. The local government is located in the Guinea Savannah region; generally Toro LGA has a fertile soil mostly loamy, clay loam and sandy loam which is used to produce food crops and cash crops such as guinea corn, maize, millet cotton, soya beans, cassava, cowpea, rice, groundnut, and beniseed (sesame). The farmers also engage in dry season farming (irrigation) because of the many rivers/streams and earth dam found in the Local Government Area. The crops grown during the dry season include; carrot, tomatoes, cabbage, green beans, cucumber, onions, maize, garden egg, and pepper (hot and sweet). The local government comprise of different ethnic group and main occupations are farming, hunting, black smith and petty trading in the area.

Sampling Techniques and Sample size

Multistage sampling technique was used, at the first stage four districts were purposively selected out of the eight districts of the Local Government Area because of large production of cabbage by Irrigation. As presented in Table 1, the districts selected were Tilde, Toro, Lame and Ribina. At the second stage, one village was selected from each of the district namely; Tilden-Fulani, Toro, Gokin-Sallah and Girjule, from the respective districts. At the final stage, 15% of the farmers were randomly selected from each town/village (sampling frame) making a total sample of 100 cabbage farmers in the study area. However, information of 98 farmers was analyzed due incomplete responses from the two farmers. Thus, important data were not provided in the case of those two farmers.

Table 1: Sampling Procedure and Sampling Size

Districts	Town/Villages	Sampling frame	Sample size (15%)
Toro	Toro	225	34
Tilde	Tilde-Fulani	184	27
Lame	Gokin-Sallah	135	20
Ribina	Girjule	127	19
Total		**671**	**100**

Source: Author computation

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Data Collection

Primary data were collected using structures questionnaires. Types of information that were collected include socio-economic characteristics, cabbage production processes and costs and returns, in the study area.

Method of Data Analysis

The data were analyzed using descriptive and inferential statistics. Descriptive statistics such as frequency, percentage and mean were used in analyzing objective one, two and three. Multiple regression was used in achieving objective four.

Depreciation of Farm Assets

Assets loss value at different rate, the average annual depreciation cost of all fixed inputs was used to calculate total fixed cost. Depreciation is the loss in value of an asset over a period of time. It is a function of time and use (Bose *et al.,* 2017) the straight-line method of depreciation was used in calculating the depreciation of equipment's.

$$D = \frac{P - S}{N} \quad \ldots (1)$$

where;
D = Depreciation
P = Price of assets
S = Salvage value
N = Number of useful years of assets

Multiple Regression Analysis

Multiple regression analysis is also used to determine factors that influence output of cabbage in the study area. This was used in the estimation of the value of the dependent variable from the value of the independent variables. The value of Y for a given value of X was used to estimate the influence of some factors on output (kg) of cabbage production. The production function was estimated as:

$$Y = F(X_1, X_2, X_3, X_4, X_5 \ldots X_6 + e \quad \ldots (2)$$

$$Y = b_o + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e \quad \ldots (3)$$

where;
Y = Cabbage output (kg)
X_1 = Seed/seedlings (kg)
X_2 = Labour (man days)
X_3 = Fertilizer (kg)
X_4 = Farm size (ha)
X_5 = Pesticide and herbicide (litre)
X_6 = Depreciation (₦)
e = Error term
b_0 = Constant
b_1 - b_6 = Regression coefficients.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

The result in Table 2 shows that 39.8% of the irrigated were within the age group of 31-40 years and 35.7% of them were between age ranges of 20-30 years with an average age of 35.6 years. This implies that cabbage farmers were youth and productive. This was not

surprising been irrigated cabbage production requires a lot of energy and strenuous in nature. However, age is an important variable influencing the decision of a farmer to adopt improved technology (Abdulhamid *et al.,* 2018). The result also reveals that all 100% of the farmers were male. This finding conform Olubunmi *et al.* (2017) who reported that all the respondents were male in the study area. In addition, majority of the farmers obtained one form of formal education or the other, implying that the farmers were literate and literacy may help them in decision-making as well as adopting improve practices. The indicates that 48% of the farmers engaged in full time cabbage production only and cultivating average farm land of 1.5 hectares.

Sources of Inputs

The result in Table 3 revealed that 74.5% of the farmers obtained their inputs from the market. This was followed by 62.2% of them sourced their inputs from BSADP. This implies that majority of the farmers procured inputs from markets. This may be due to the fact that inputs are readily available in the market for purchase compare to the other source with surrounded by formalities and delay in supply of the inputs. This result is in line with Abdulhamid *et al.* (2016) who reported that majority of small scale farmers sourced their inputs from market in the study area.

Source of Irrigation Water

The result in Table 4 shows that majority (80.6%) of the farmers sourced water from the river/stream for the irrigation. These were followed by 45.9% and 37.8 of the farmers obtained water for irrigation from borehole/tube well and well/shallow well, respectively. This implies that most of water used by the farmers for irrigation was from river/stream, hence less cost, easily accessible and very much available. This result disagrees with the finding of Bose (2018) who reported that majority of the used borehole/tube well as a source of water for vegetable irrigation in Northern Agricultural Zone of Bauchi State.

Technologies/Practices Adopted in the Study Area

The result in Table 5 shows that most (93.9%) of the farmers adopted treated and improved seeds for cabbage production. The result also reveals that 86.7% of the farmers adopted watering techniques and 81.6% of them adopted planting spacing. This implies that all the farmers adopted one form of technology or the other in production of irrigated cabbage. Thus, farmers in the study area adopted to use of treated seeds as they cannot produce seeds on their own except from companies or research institute. This finding is line with Bose (2018) who reported that irrigated vegetable farmers adopted improved seed due to high yield and early maturity. Farmers tend to use a technology or practice to the extent that they derive benefits from it, while they reject or discontinue the use of a technology when they feel that the package is no longer performing as it used to be or is not what it is expected (Idrisa and Ogunbameru 2008; Abdulhamid *et al.*, 2018).

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Table 2: Socio-economic Characteristics of the Respondents

Variables	Frequency	Percentage
20 – 30	39	39.8
31 – 40	35	35.7
41 – 50	11	11.2
51 – 60	08	8.2
61 – 70	05	5.1
X = 35.6 years		
Sex		
Male	98	100.0
Educational Level		
Non-formal education	30	30.6
Primary	16	16.3
Secondary	33	33.7
Tertiary	19	19.4
Occupation		
Cabbage production only	47	48.0
Mixed farming	26	26.5
Civil service and cabbage production	12	12.2
Trading and cabbage production	13	13.3
Farm Size		
0.5 – 1.4	50	51.0
1.5 – 2.4	30	30.6
2.5 – 3. 4	11	11.2
3.5 – 4. 4	05	5.1
4.5 – 5. 4	02	2.0
X = 1.5 hectares		

Source: Field survey 2015

Table 3: Distribution of Respondents according to Sources of Inputs

Sources of input	Frequency	Percentage
Market	73	74.5
BSADP	61	62.2
Research Institution	11	11.2
Total	**145***	**162.2***

* Multiple responses were obtained.
Source: Field survey 2015

Table 4: Sources of Water for Irrigation used by the Farmers

Sources of water	Frequency	Percentage
Borehole/Tube well	45	45.9
River/Stream	79	80.6
Well/shallow well	37	37.8
Total	**159***	**164.3***

* Multiple responses were obtained. Source: Field survey, 2015

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Table 5: Technologies/Practices adopted by the Respondents

Technology/Practices	Frequency	Percentage
Treated and improved seeds	92	93.9
Fertilizer application techniques	67	68.4
Agro-chemical application techniques	69	70.4
Planting spacing	80	81.6
Watering techniques	85	86.7
Total	**393***	**162.2***

* Multiple responses were obtained.
Source: Field survey 2015

Factors influencing Cabbage Output in the Study Area

The result in Table 6 shows that quantity of seed had positive coefficient (3339.171) and significant at P<0.05implying that the more the quantity of seeds planted the higher the output all other factors held constant. The result further reveals that labour had positive coefficient (36584.207) and significant at P<0.05, which implies the more the labour applied the higher the output obtained. The coefficients of fertilizer (49.292) and farm size (5547.980) had positive coefficient and significant at P<0.05 and P<0.001, respectively, implying that increase in quantity of fertilizer and farm size the higher the output that will be obtained. This finding is in agreement with Petros and Yishak (2017) who reported that farm size and labour had significant influence on cabbage production at P<0.05 and P<0.01, respectively. Olubunmi *et al.* (2017) also reported that farm size and fertilizer had positive coefficient and significant influence on garden egg production at P<0.001 and P<0.05, respectively in Edu Local Government Area, Kwara State, Nigeria. The coefficient of agrochemicals and depreciation on assets had negative signs and not significant implying that increase in those variables may leads to decrease in output. The R^2 was estimated at 0.398 which implies about 40% of the variation in output of cabbage production was explained by explanatory factors included in the model. The F-value was 10.027 and significant at P<0.001 and it implies that all factors of production (explanatory variables) considered in the model influenced the total output of cabbage in the study area.

Table 6: Factors influencing Total Yield of Cabbage in the Study Area

Variables	Coefficient	T-value	Prob. Level
Constant	1689.084	0.211	0.833
Quantity of seed (X_1)	3339.171	1.713**	0.011
Labour (X_2)	36584.207	1.926**	0.047
Fertilizer (X_3)	49.292	4.009**	0.033
Farm size (X_4)	5547.980	1.074***	0.001
Agrochemicals (X_5)	-159.070	-0.245^{NS}	0.807
Depreciation (X_6)	-0.070	-0.207^{NS}	0.836
R^2	0.398		
R adjusted	0.358		
F-value	10.027^{***}		

***P<0.001, **P<0.01, NS = Not Significant
Source: Field survey, 2015

CONCLUSION AND RECOMMENDATIONS

The study revealed factors influencing cabbage yield in Toro Local Government Area of Bauchi State. The production inputs such as quantity of seeds, labour, fertilizer and farm size were found positive and contributed significantly to total yield of cabbage in the study area. All the farmers were male and majority of them were youth, and operating on small scale production. Majority of the farmers obtained inputs from markets. Thus, the study recommends that farmers be encouraged to form cooperative societies in order to procure inputs collectively and sell their output through group marketing. In addition, the farmers should be encouraged to use improve irrigation technologies and practices in order boast production for high income.

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