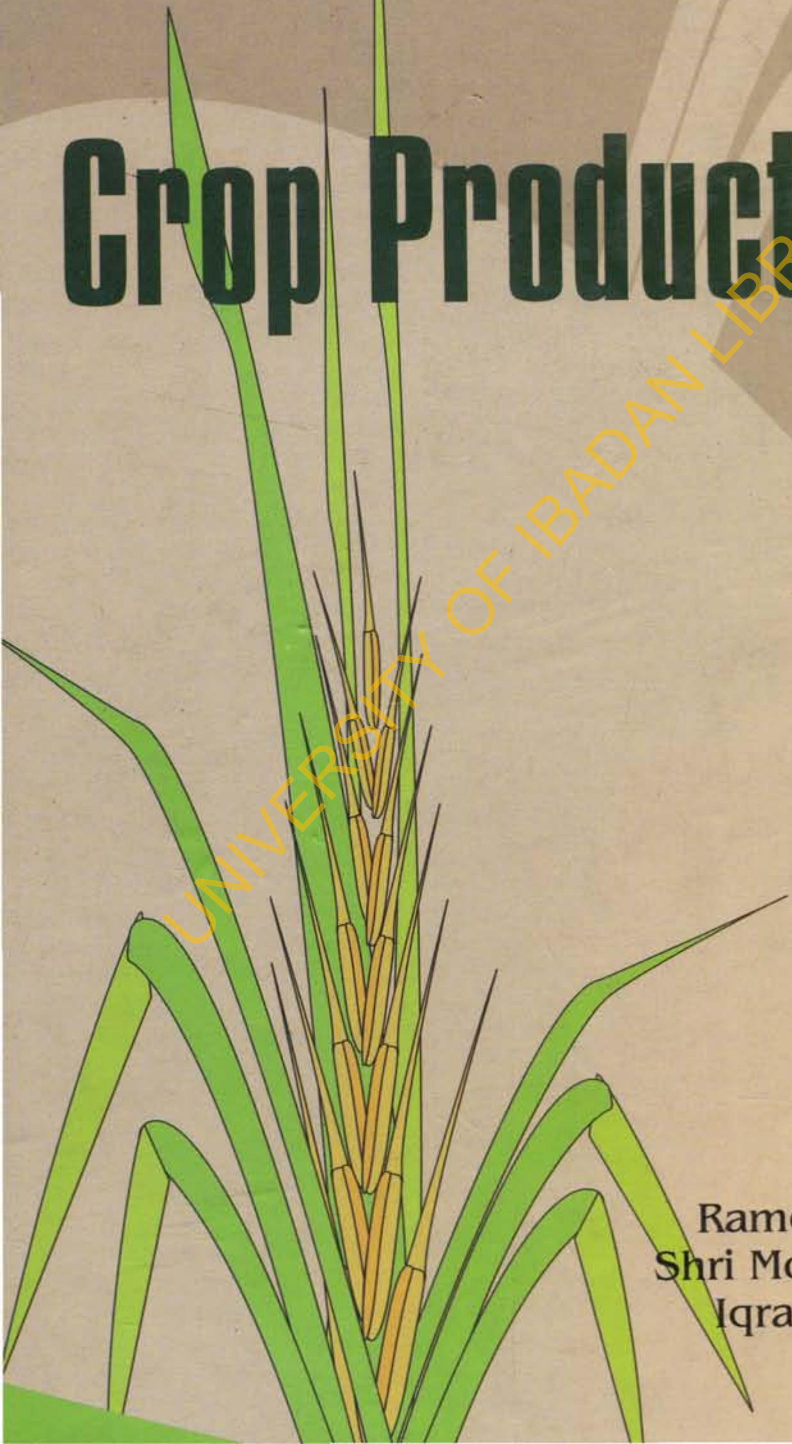
Environment and Crop Production



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RESOURCE USE EFFICIENCY OF *COCHORUS, CELOSIA* AND *AMARANTHUS* AMONG FARMERS IN OYO STATE, NIGERIA

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INTRODUCTION

Vegetables are plants consumed in relatively small quantities as a side dish or a relish with staple food. Most vegetables are the leaves, roots or stems of herbaceous plants, although flowers, calyces, immature seeds or fruits may also be eaten as vegetables. Vegetables constitute a rich and comparatively cheap source of fibre, protein, minerals, vitamins and calories for a large sector of mankind.

On the other hand, Rice and Colleagues (1993) have described vegetables as plants that provide a source of food often low in calories and dry matter content, eaten along with a basic starch food to make it more palatable. Three major classes of vegetables are consumed in Nigeria: a) those gathered from the wild such as leaves of purslane (*Portulaca*); b) indigenous vegetables, often gathered but also cultivated such as *Amaranthus* and *Celosia*; and c) imported vegetable species that are also cultivated.

According to FAO (1998), the basic daily per capita requirement for vegetables is 157 g, consisting of 47 g obtained from leaves and 110 g from fruit vegetables, pulses, roots and tubers. However, there is a wide gap between the required (157 g) quantity of vegetables and their availability (87.9 g) according to the Sri Lanka Department of Census and Statistics (1982). Leafy vegetables in particular are nutritionally important. They contain protein, minerals and vitamins (A in particular) and provide roughage. According to an annual report of the International Institute of Tropical Agriculture, a study of 150 urban households showed that for the poorer people, leafy green vegetables generally supply the protein not affordable in meat; they are the greatest source of calcium, iron, thiamine, riboflavin and vitamin C for both the poor and better off.

Vegetables are also a source of roughage, providing an indigestible matrix, stimulating muscles and preventing constipation through their laxative effect. Some vegetables have a curative action. All play a vital role in the health and nutrition of people throughout the world while providing employment and income that contribute to a higher standard of living. Nigeria is no exception.

Because they are short-duration crops, vegetables fit well into any cropping system and it is not uncommon in Nigeria to harvest 3-4 crops in the same field annually. Vegetables give higher tonnage per unit area in less time than cereal and offer better food value. Due to its labour intensiveness, vegetable production also offers better employment opportunities and increases farmer income. A certain quantity of bulky food is necessary for good health and leafy vegetables serve this function well when taken in sufficient quantity.

Sources other than the FAO have recommended per capita consumption per day of leafy vegetables ranging from 85 to 114 g and of non-leafy from 57 to 113 g. In other words, between 142 and 227 g of vegetables are thought to be needed every day. Further, an additional 57 g of vegetables daily has been recommended when fruit cannot be included in the diet.

The site for vegetable production is determined mainly by physical (climate and soil), economic and sociological factors. The physical factors play a major role in determining which species of vegetables can be grown and the potential productivity of a particular site.

Socio-economic factors can modify decisions regarding site choice, in densely populated areas for instance, or limit selection in other ways of a suitable site for growing vegetables.

Nonetheless, vegetables remain the primary source of protein, minerals and vitamins in developing countries, especially for the lower income groups. It is therefore important to seriously encourage their production and consumption, in particular those familiar to the community. Concomitantly the stages of development and growth and the various forms of vegetable preparation for optimum consumption benefit should be investigated and popularized.

Inadequate supply of seeds of improved crop cultivars is a major obstacle to horticultural development in Nigeria and underscores the importance of obtaining information on potential seed yields and cost of production on plots of commercial size. Vegetable production in Nigeria is largely unmechanized and carried out by small farming families in plots less than 0.4 ha.

The process of modernization, urbanization and diversification has led to accelerated change from primitive to relatively sophisticated market garden systems (Grubeen, 1992). Commercial vegetables, often grown more extensively—similar to arable crop production—require 100-250 mandays per ha from establishment to maturity.

Available statistics show that production costs of vegetables (both exotic and indigenous) have been rising and profit margins decreasing due to increased labour costs (although family labour is still utilized), cost of implements, seeds, fertilizers, agrochemicals and packaging materials. Farmers also have to absorb heavy losses due to the high perishability of vegetables and volatile market forces. The size of plots under vegetables is generally small but varies widely in different agroecological zones. In the low country dry zone, the average farm size varies from 0.09 to 0.37 ha. This poses an important production constraint that has to be rapidly alleviated if the economic well-being of farmers is to be improved.

This study examines the resource use efficiency of *Amaranthus*, *Celosia* and *Cochorus* in Oyo state, Nigeria.

MATERIAL AND METHODS

The study area was Ibadan North-west Local Government area of Oyo State, sharing a common boundary with Ibadan North-east Local Government area in northern Ibadan, Ibadan South-west and South-east Local Governments in the south, Ibadan North Local Government to the east and Ido Local Government area to the west.

The area is characterized by two rainy seasons and hence commonly two growing seasons. As an urban centre, there is little land available for agricultural activities. Backyard farming and cultivation along stream banks or the inland valley predominate in the study area. Primary data were obtained through well-structured questionnaires passed out to randomly selected leafy vegetable farmers in the study area and analyzed using descriptive statistics in presenting the responses to certain variables.

RESULTS

Land area allocated to the cultivation of *Amaranthus, Celosia* and *Cochorus* (Table 31.1).

Table 31.1 Land area allocated to vegetables

Land area (ha)	*Frequency*	*Percentage*
Amaranthus		
0.001–0.009	17	22.67
0.01–0.0375	44	58.67
0.04–0.2	14	18.67
Total	75	
Celosia		
Land Area		
0.001–0.009	6	16.23
0.01–0.0375	28	75.68
0.04–0.2	3	8.1
Total	37	
Cochorus		
Land area		
0.001–0.009	8	12.8%
0.01–0.0375	51	72%
0.04–0.2	11	11.42%

Amaranthus: About 58.6% of the respondents place between 0.01 and 0.0375 ha under cultivation of this crop, 22.67%—0.001 to 0.009 ha and 18.67%—0.04 to 0.2 ha.

Celosia: Of the 37 farmers who cultivate this crop in the study area, 75.68% plant between 0.01 and 0.0375 ha, 16.23%—0.001 to 0.009 ha and 8.1%—0.04 to 0.2 ha.

Cochorus: Of the 70 farmers in the study area involved in the production of Cochorus, 72% cultivate between 0.01 and 0.0375 ha, 12.86%—0.001 to 0.009 ha and 11.42%—0.04 to 0.2 ha.

RESOURCE USE EFFICIENCY

Analysis of the productivity of the three leafy vegetables selected for study was carried out. Estimates of the production function coefficients were the direct measures of the input transformation ratios. Four production functions were then fitted into the data, namely Linear, Semilog, Double-log and Exponential for *Amaranthus* (Table 31.2), *Celosia* (Table 31.3) and *Cochorus* (Table 31.4) and a lead function selected for each vegetable.

From a critical look at the four functional forms based on R^2 coefficients and F values and their levels of significance, it can be inferred that double-log is the lead production function that best fits the model.

The lead equation selected has the highest R^2 (0.62), which is significant at 1%; this means that 62% of the explanatory variables (i.e., land, capital, seed and fertilizer) determined the output of *Amaranthus* while 38% (X_{11}, X_{21}, X_{41}) due to error term were not explained. The chosen lead functional form also has the highest F value of 28.55 (sig. at 1%), which means that 1% of the explanatory variables explain the error term of variation in output of *Amaranthus*. Hence an increase in all the explanatory variables in production, except fertilizer, due to their positive beta coefficients would bring about an increase in total output of this crop, while the negative beta coefficient of fertilizer indicates excessive use and any further increase in usage would reduce production of this vegetable.

Table 31.2 Regression analysis of *Amaranthus* output based on four functional forms

Functional form	*Constant term*	*Land* X_{11}	*Capital* X_{21}	*Seed* X_{31}	*Fertilizer* X_{41}	R^2	*F*
Linear	–538.45 (552.59)	–0.90503 (4.1493)	5.9966 (1.6604) ***	1.5858 (0.58781) ***	1.4427 (1.6830)	0.41	12.29***
Exponential	5.9991 (0.23775)	0.4311E-03 (0.17852E-03)	0.28652E-02*** (0.71436-E03)***	0.73965E-03 (0.25280E 03)	0.91316E-03 (0.72411E-03)	0.47	15.67***
Semilog	–12979 (3316.6)	203.05 (126.87)	2070.4 (548.40)***	624.20 (351.38)*	124.00 (312.76)	0.43	13.04***
Double-log	0.3411E-01 (1.2263)	0.13145*** (0.46910E-01)***	0.85652 (0.20277)***	0.52549 (0.12992)	0.20994-E-01(0.11-564)	0.62	28.55***

***Mean significant at 1% level.
**Mean significant at 5% level.
*Mean significant at 10% level.

Table 31.3 Regression analysis of *Celosia* output based on four functional forms

Functional form	*Constant term*	*Land* X_{11}	*Capital* X_{21}	*Seed* X_{31}	*Fertilizer* X_{41}	R^2	*F*
Linear	–555.05 (342.19)	–2.1347 (0.72226)	0.19639 (0.25749) E-01	0.49179 (0.24133)***	0.55396 (1.3883)	0.72	20.92***
Exponential	6.5002 (0.15411)	0.7531E-03 (0.32528E-03)***	0.86088E-04 (0.11597E-04)***	0.25191-E-03 (0.10869E-03)***	0.35926E-03 (0.62527E-03)	0.72	19.96***
Semilog	–17298 (2490.6)	–2.4385 (0.74602)	1768.2 (247.93)***	628.16 (238.86)***	–131.47 (248.15)	0.71	19.41***
Double-log	–1.5961 (1.0417)	0.86896E-03 (0.31202E-03)***	0.81368 (0.10370)***	0.29316 (0.99904E-01)***	–2.5268E-01 (0.10379)	0.74	22.72***

Table 31.4 Regression analysis of *Cochorus* output based on four functional forms

Functional form	*Constant term*	*Land* X_{11}	*Capital* X_{21}	*Seed* X_{31}	*Fertilizer* X_{41}	R^2	*F*
Linear	47.880 (1541.6)	-8180 (11332)	0.18595 (3.6953)	1.9633 (1.1718)*	5.5587 (3.9075)	0.079	1.39
Exponential	5.8362 (0.39872)	-0.15142 (2.9308)	0.23929E-03 (0.95574E-03)	0.75940E-03 90.30308E-03)	0.48327E-03 (0.10106E-02)	0.23	4.79
Semilog	-5865.3 (124.82)	163.41 (564.40)	-372.46 (1511.6)	1019.5 (803.23)	892.17 (716.55)	0.084	1.50
Double-log	4.6216 (2.8130)	0.39896*** (0.12719)	0.31474 (0.34065)	0.31315* (0.18102)	0.10105 (0.16148)	0.42	11.64***

From a critical look at the four functional forms based on their R^2 coefficient and F values with their levels of significance, it can be inferred that double-log is indeed the lead production function that fits the model. A lead equation with a coefficient of multiple determination (R^2) of 0.74 means that 74% of the total variations in aggregate value of output (Y_{12}) of *Celosia* were attributable to the four explanatory variables—land (X_{12}), capital (X_{22}), seed (X_{14}) and fertilizer (X_{42})—included in the production function analysis. The lead equation is also significant at 1% with an F value of 22.72, which is the highest of the four functional forms.

As mentioned above, a critical look at the four functional forms based on their R^2 coefficient and F values together with their level of significance showed that double-log should be selected as the lead production function best fitting the model. The R^2 (0.42) of the lead equation, the highest of all the functional forms, indicates that 42% of the total variations in aggregate value of output (Y_{13}) of all *Cochorus* were attributable to the four explanatory variables included in production function analysis.

The lead equation is also significant at 1% with the highest F value of 11.64 over the other functional forms. The positive values of the beta coefficient of all the explanatory variables of *Cochorus* means that an increase in land, capital, fertilizer and seeds would bring about an increase in its total output.

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