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Full Length Research Paper

Economics of sustainable vegetable farming under Fadama condition in Dass Local Government Area of Bauchi State, Nigeria

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The study examined the sustainable vegetable farming under fadama condition in Dass Local Government Area of Bauchi using the following selected crops: onion, tomato, pepper, okro, carrot, cabbage and garden-egg. A total of ninety-six (96) farmers were randomly selected from twelve- (12) Fadama users' association arranged in strata. Three (3) categories of farmers were formed, namely, below 1, 2 to 3.99, and 3 to 4.99 ha consisting of 37, 39 and 20 farmers, respectively. The specific objective of the study was to determine the categories of farm sizes within which the sampled farmers operated; resource use and return pattern on the various categories of sampled farmers in the study area. Benefit-cost analysis was employed to analyze the results of the study. The findings below 1 ha farm size revealed higher benefit-cost ratios for onion (4.22), tomato (4.08) and pepper (3.43) even though the surplus over cost A_1 (N32,285.52) and surplus over cost C (N29,463.52) were highest for tomato, followed by onion at surplus over cost A_1 (N30,863.43) and surplus over cost C (N27,883.43). Similarly the benefit-cost on 1 to 2.99 ha farm size shows that the benefit-cost ratio for onion (N4.08) was highest followed by tomato (N3.99), even though surplus over cost A_1 (N31,978.67) and surplus over cost C (N28,978.67) were both highest in tomato than onion. Also, the results on 3 to 4.99 ha farm size disclosed that even though the benefit-cost ratio was highest in onion (4.10) and tomato (3.94), pepper, lettuce and okro were competitive crops. This implies that the benefit-cost ratios for the major vegetable crops showed a consistently increasing trend for all categories of the sampled farmers due to joint family labor. It was therefore recommended that the Government should play supportive roles of enabling environment for the sustainability to be achieved.

Key words: Sustainability, cost, returns, vegetable crops, gini concentration ratio, economics, surplus.

INTRODUCTION

Agriculture constitutes a very important sector of the Nigerian economy and was the dominant sector prior to the oil boom of the 1970s. The primary concern of it, therefore, is to feed the ever-growing population from available resource base. Economics of crop farming deal with the costs and returns per unit area for the crops practiced in vegetable farming under Fadama agriculture. Agricultural costs are measured in terms of variable cost (cost A) and total cost of production (cost C). This also encompass gross returns along with the returns over variable cost, cost and benefit-cost (b/c) ratio for the various crops on different categories of farm sizes that the farmer may intended to maintain.

World Development Report (2008) reported that an estimated 2.5 billion of the 3 billion rural inhabitants are involved in agriculture: 1.5 billion of them living in smallholder households and 800 million of them working

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in smallholder households. It was further revealed that the size of the rural population is expected to grow continually until 2020 and decline thereafter, due to slower population growth and rapid urbanization in most countries.

Ramalan (1993) revealed that Fadamas are mainly low laying flood plains composed of alluvial deposits and containing extensive exploitable aquifers seasonally flooded for re-charge during the next season floods. Irrigation is one of the sources of Fadama season farming under the natural fadama condition and it is the application of water by human agency to assist the growth of crops and grass. Water for irrigation may be, firstly, pumped from underground sources by means of wells, secondly, drawn from the natural flow of streams, and thirdly, obtained by damming or otherwise regulating the flow of streams. It may be applied to crops by flooding, by channels, by spraying or by drips from nozzles.

Diouf (1997) reported that returns over costs or net returns played an important role in making decision regarding area allocation to crops. Though the benefit-cost ratio and net returns for the various competing crops may be high, with time, it may continue to shift in favour of other crops due to uncertainty and natural factors.

Jodha (1991) examined the nature of Fadama agriculture in the marginal resource areas. In these areas,it was reported that prospects of vegetable agricultural sustainability were severely constrained by the specific creatures of their natural resource endowments. The author analyzed indicators of unsustainability relating to resource base and productivity. The negative changes are consequences of current patterns of resource use that over exploit the resources. To reap economies of farming, therefore, requires application of modern science and technology along with the rationale of indigenous practices.

Working conditions in agriculture can be hazardous. Agriculture is one of the three most dangerous occupations, along with mining and construction. About half the estimated 355,000 annual on-the-job fatalities occur in agriculture. Agricultural wage workers face exposure to toxic pesticides, livestock-transmitted diseases, and dangerous machinery, but they lack adequate training and protective equipment. The exposure to pesticides extends beyond work to the rest of the household, (Hruske and Corriols, 2002; Valdes and Foster, 2006).

Anderson and Hardakar (2003) emphasized that agricultural productivity has grown rapidly where modern varieties and fertilizers have been widely adopted, but not where adoption has been lagged. The demand for fertilizer used on noncommercial crops is generally weak and unstable, for many of the same reasons: lack of knowledge, information asymmetries, and liquidity constraints, risk and uncertainty, and high opportunity costs. The author further stressed that on supply of fertilizers, seasonality variable and geographically dispersed demand discourages potential suppliers because markets are small, making low-cost procurement difficult.

According to Singh et al. (1991), technological changes in agriculture had led to significant changes in the pattern of farm investment and had widened income disparities. Lorenz Curve and Gini Concentration Ratio (GCR) were used as tools to measure inequalities. The study revealed a direct relationship between the percentage of investment and size of holdings. The investment on farm implements and machinery increased as size of holding increases. This analysis has direct bearing on economies of crop production.

Nkonya et al. (2007) reported that farmer user groups were key to the success of Nigeria's Second National Fadama Development Project, which invested in irrigation equipment, other farm assets, rural infrastructure, and advisory services. The author further revealed that incomes of the participants of this community-driven project have increased by more than 50% on the average between 2004 and 2006. In the dry savanna zone, where farmers invested mainly in small-scale irrigation, average income increased by nearly 80%.

Dillon (1992) concluded an economic analysis on hypothetical agronomic research on new crop cultivars for Arkansas dry land soya-bean and wheat producers. In relation to farmers' attitudes towards risk, the micro-economic effects and level of adoption of yield variability reducing cultivar was analyzed using a production management decision making model, which was formulated with mathematical programming techniques. The study indicated that negative covariance between crops continue to be an effective means of reducing production risk associated with yield variability. However, agronomic research on the breeding of new soya-bean and wheat cultivars with reduced yield variability is worthwhile.

Grewal (1992) revealed that disquieting features of the Green Revolution was intensive use of modern inputs, which has multiplier effects on economies of crop production. It was noted that farmers were making use of pesticides, which were banned, long ago in advanced countries. The insecticides recommended for particular crops were being used on the other crops resulting in making the insects immune to their application and reduction in expected yields. There were other environmental hazards by way of destruction of natural enemies of insect, pest and loss of human life by water pollution. The author emphasized stress on application of organic manure along with the chemical based farming practices in order to ensure sustainable economies of crop farming.

Rockström and Barron (2007) maintained that agricultural development in less-favored regions is constrained to varying degrees by fragile, sloped, and already-degraded soils; erratic and low rainfall; poor market access; and high transport costs. Investments in water

harvesting and small-scale irrigation are in many circumstances catalytic, reducing the barriers to adoption of otherwise costly soil and crop management practices by increasing their profitability.

Selvarajan et al. (1992) assessed the impact of watershed development on selected economic indicators, appraises its economic feasibility and locates constraints inhibiting the optimum utilization of resources. Farm level, input-output and time s-series data were used to demonstrate that there has been a significant shift in cropping pattern from cereals to oilseeds and towards plantation and cash crops which gave more than doubled their share of cultivated land use. Gross cropped area under improved varieties and fertilizer consumption has increased. Cost-benefit analysis proves the programs economic worthiness and a further sensitivity analysis supported this assertion.

Kushwaha (1992) revealed that for farmers to adopt new agricultural technologies in order to achieve economies of crop farming there is a need to develop fair-related business and rural development strategies linked to sustainable agriculture. There is also a need to develop infrastructures and markets, develop innovative extension programs to assist farmers in meeting the technical and managerial challenges of economies of crop farming. Strategies to promote sustainable farming should simultaneously alleviate economic problems and encourage the use of technologies that increases productivity while sustaining the environment. The author concluded that gaining a better understanding of the interrelationship between agricultural sustainability and rural development will ensure solutions that will themselves be economical and sustainable.

Kushwaha (1994) explained that sustainable agricultural system is one that can continue to function over some defined time period and sustainability is the capacity of a system to continue to function over time. It, therefore, enhances environmental quality and resource base on which agriculture depends, provides most economical human needs and enhances the quality of life for farmers. The author further emphasized that alternative agricultural farming systems must be able to survive adversity. The new concepts of 5 Rs of alternative agricultural systems are resistance, resilience, regenerative, redesign and replenishment. Shocks and associated threats to survivals are an inescapable aspect of the ecology and economies of crop farming. Alternative agricultural systems may resist, absorb, recover, adjust or be restored but somehow they must be able to persist under conditions of periodic ecological and economic adversity. Alternative farming systems must be able to survive drought, floods, pest outbreaks and other physical shocks to ecological systems.It must also be able to survive short run economic losses due to periodic crop failures, depressed markets and rising input costs that characterize the agricultural sectors of most economies.

Diouf (1997) stressed that if the goal of food security for all is to be reached, there must be significant increase in food production and improved access to food. It was also noted that much of the investment in food security in poorer countries would continue to be private with three quarter coming from millions of small farmers, traders, village artisans, businessmen and others engaged in the production and distribution of food in the poorer countries.

The primary concern of sustainable agriculture systems in developing countries like Nigeria is to feed ever-growing population from available scarce resource base. The present strategy of high cost of agricultural inputs will definitely lead us towards a stage of possible trap of un-sustainability. Hence, the reason why the study was carried out on sustainability within the context of Nigerian agriculture in general and vegetable farming systems especially in Dass Local Government Area of Bauchi State, Nigeria. We are confident that from the findings of the study, the government should be able and willing to see the true situation the Fadama farming in the study area and come up with policy issues that will enhance and transform agricultural resource potentials in the study area. Taking into consideration this scenario, the broad objective of the study was to examine economics of sustainable vegetable farming under Fadama condition in Dass Local Government Area of Bauchi State, Nigeria while the specific objectives were to determine the categories of farm sizes within which the sampled farmers operated; resource use and return pattern on the various categories of sampled farmers in the study area.

MATERIALS AND METHODS

Sample size and sampling procedure

The study was carried out in Dass Local Government Area of Bauchi State, Nigeria. Five (5) districts out of eleven (11) were selected for the study. Twelve (12) villages belonging to Fadama Users' Associations (FUAS') were selected purposively. Each Fadama users' association has twenty-five (25) members thereby bringing the total number of respondents to three hundred (300). Eight (8) farmers in each Fadama users' association that practiced small-scale farming system under Fadama conditions were selected using a five (5) digit random sampling technique thereby finally bringing the number of sampled farmers to ninety- six (96). The vegetable Fadama crops used in this study included onion, tomato, pepper, okro, potato, carrot, cabbage, lettuce and garden- egg. Three categories of farmers were formed, namely: below 1, 1 to 2.99 and 3 to 4.99 ha, consisting of 37, 39 and 20 farmers, respectively (Sani, 2000).

Model specification

Regarding crop cultivation, four costs namely: Cost A_1, Cost A_2, Cost B, and Cost C was widely used in farm management and other cost studies. Consequently, benefit-cost analysis (cost concepts and returns) was employed to analyze the results of the study. The constituents of cost concepts included the follows:

Table 1. Distribution of selected farmers according to farm size.

S/N	Village/FUAS'	Below 1 ha		1 to 2.99 ha		3 to 4.99 ha		Total	
		No. of farmers	No. selected	No. of farmers	No. selected	No. of farmers	No. selected	No. of farmers	No. selected
1	Alunta	12	4	8	3	5	1	25	8
2.	Bunjang	6	3	18	4	1	1	25	8
3.	Bakin-Kogi	5	2	4	2	16	4	25	8
4.	Dass I	10	3	8	3	7	2	25	8
5.	Dass II	7	1	10	4	8	3	25	8
6.	Dass III	11	6	9	2	5	0	25	8
7.	Dabardak	13	4	8	3	4	1	25	8
8.	Shallgwanta	8	2	14	6	3	0	25	8
9.	Kwafa	7	1	15	6	3	1	25	8
10.	Manda	14	6	6	1	5	1	25	8
11.	Wandi	6	1	9	3	10	4	25	8
12.	Wandi	11	4	7	2	7	2	25	8
Total		110	37	116	39	74	20	300	96

Source: Updated field data, 2009.

COSTS A_1

i. wage for hiring human labor (both casual and permanent);
ii. bullock labor charges(both owned and hired);
iii. hired machinery charges, repairs and maintenance charges of owned machines;
iv. cost of seeds(both home produced and purchased) and fertilizer;
v. cost of manure(both home produced and purchased);
vi. cost of insecticides and pesticides;
vii. irrigation charges(both owned and hired);
viii. interest on working capital;
ix. land revenue and taxes;
x. depreciation on farm implements and machinery;
xi. Miscellaneous expenses.

COST A_2

Cost A_1 + Rent paid for leased land.

This is because cost A_2 takes into consideration the rent paid for leased land in addition to the Cost A_1.

$$\text{COST } B = \frac{\text{Cost } A_1}{\text{Cost } A_2} + \text{Rental value of owned land + interest on fixed capital.}$$

COST C = Cost B + imputed value of family labor.

$$\text{COST } D = \frac{\text{Cost } A_1}{\text{Cost } A_2} + \text{imputed value of family labor - Revenue.}$$

Designated as the prime cost, cost D is a useful measure to compare the farm situations without taking into consideration the rental value of land (owned or leased in), interest on fixed farm assets and land revenue and taxes.

For the purpose of this study, while cost A_1 and cost C were used to compute different farm situations in the study area, cost A_2, B, and D have been ignored because the study does not regard farm situations under tenancy.

RETURN MEASURES

Return measures used in the study were as follows:

Surplus over cost A_1 = Gross Income minus cost A_1.
Surplus over cost B = Gross Income minus cost B.
Surplus over cost C = Gross Income minus cost C.

Surplus in the context of this study refers to the difference between the gross income and the various costs used in the study. Income and surplus over different costs are regarded as return or return over different costs. Surplus over cost C was regarded as net returns.

RESULTS AND DISCUSSION

Table 1 shows the distribution of selected farmers according to farm size in the study area. Three categories of farmers were formed based on the results obtained from the field namely: below 1, 1 to 2.99, and 3 to 4.99 ha consisting of 37, 39 and 20 farmers, respectively. Twelve-village Fadama users' associations were selected for the study. This operational holding is in conformity with the BSADP (1997) and Okigbo (1978) classification of farm holdings. The categorization was to enable the study obtain the farmers' operational holdings in each of the selected villages.

Table 2 disclosed the costs, returns and benefit-cost ratios for different crop enterprises on below 1 ha farm size, which was calculated in naira per hectare. The implication of this finding was that the area allocation will

Table 2. Costs, returns and benefit-cost ratios of different crop enterprises on below 1 ha farm size (N/ha).

Crops	Working capital	Cost		Gross income	Returns		B/C ratio
		Cost A1	Cost C		Surplus over cost A1	Surplus over cost C	
Onion	2,518	5,680	8,660	36,543.43	30,863. 43	27,883.43	4. 22
Tomato	1,150	6,744	9,566	39,029.52	32,285.52	29,463.52	4. 08
Pepper	2,990	5,684	9,692	33,243.48	27,559.48	23,551.48	3.43
Okro	770	680	3,266	9,438.60	8,758.60	6,172.60	2. 89
Potato	000	0. 00	0.00	0.00	0.00	0.00	0. 00
Carrot	2,996	5,946	9,737	24,051.00	18,105. 00	14,314.00	2. 47
Cabbage	1,250	4,020	7,024	24,583.33	20,563.33	17,559.33	3..50
Lettuce	690	1,324	4,324	12,798.40	11,474.40	8,474.40	2. 96
Garden-egg	980	9,001	12,000	26,279.87	17,278.87	14,279.87	2. 19

Source: Updated field data, 2009.

Table 3. Costs, returns and benefit-cost ratios of different crop enterprises on 1 to 2.99 ha farm size (N/ha).

Crops	Working capital	Cost		Gross income	Returns		B/C ratio
		Cost A1	Cost C		Surplus over cost A1	Surplus over cost C	
Onion	2,547	5,764	8,659	35,321.56	29,557.56	26,662.56	4.08
Tomato	1,894	6,692	9,692	38,670.67	31,978.67	28,978.67	3.99
Pepper	1,998	5,444	8,130	30,117.92	24,673.92	21,987.92	3.70
Okro	1,594	3,759	6,759	22,162.00	18,403.00	15,403.00	3.27
Potato	2,494	19,299	22,124	35,178.00	15,879.00	13,054.00	1.59
Carrot	2,944	9,241	11,780	28,732.86	19,491.86	16,952.86	2.44
Cabbage	989	2,704	5,552	20,819.58	18,115.58	15,267.58	3.75
Lettuce	943	608	3,171	10,401.00	9,793.00	7,230.00	3.28
Garden-egg	782	8,117	12,053	28,686.43	20,569.43	16,633.43	2.38

Source: Updated field data, 2009.

continue to shift in favour of these crops than the other crops with lesser benefit-cost ratios The result shows higher benefit-cost ratios for onion (4.22), tomato (4.08) and pepper (3.43) even though the surplus over cost A_1 (N32,285.52) and surplus over cost C (N29,463.52) were highest for tomato, followed by onion at surplus over cost A_1 (N30,863.43) and surplus over cost C (N27,883.43) grown on this category of farm. This result is in accordance with Kushwaha (1994) that since areas under vegetable crops with higher benefit-cost ratios has increased, there is the need to develop new modern processing plants to take care of the surplus from these crops.

Table 3 revealed the result of the benefit-cost on 1 to 2.99 ha farm size. Similarly, as in Table 2, the benefit-cost ratio for onion (N4.08) was highest followed by tomato (N3.99), even though surplus over cost A_1 (N31,978.67) and surplus over cost C (N28,978.67) were both highest in tomato than onion. Marginal area was allocated to the production of potato that has the lowest benefit-cost of 1.59. This implies that the farmers were using high variety seeds and improved agricultural mechanization. This is in agreement with Kushwaha (1992) that cost C serves the very useful measure to compare situations on different category of the farm. In this case, income and surplus over different costs are regarded also as return or return over different costs.

Table 4 reveals the result of the benefit-cost ratios on 3 to 4.99 ha farms. Similarly, the result shows that even though the benefit-cost ratio was highest in onion (4.10) and tomato (3.94) cultivation, pepper, lettuce and okro were also competitive crops This is in agreement withGrossi (1993), which asserted that crop yields have increased dramatically as capital, technology and energy have been substituted for labor and land as farm inputs.

CONCLUSION AND POLICY IMPLICATIONS

From the findings of this study, it was concluded that the

Table 4. Costs, returns and benefit-cost ratios of different crop enterprises on 3 to 4.99 ha farm size (N/ha).

Crops	Working capital	Cost		Gross income	Returns		B/C ratio
		Cost A1	Cost C		Surplus over cost A1	Surplus over cost C	
Onion	2,252	5,108	8,108	33,244.62	28,136.62	25,136.62	4.10
Tomato	1,988	7,187	10,185	40,128.83	32,941.832	29,943.83	3.94
Pepper	2,200	4,774	7,775	28,767.47	23,993.47	20,992.47	3.70
Okro	1,800	2,526	5,526	20,116.00	17,590.00	14,590.00	3.64
Potato	1,986	20,196	23,194	33,168.00	12,972.00	9,974.00	1.43
Carrot	2,899	5,074	7,963	28,667.00	23,593.00	20,704.00	3.60
Cabbage	1,420	1,898	3,898	14,694.00	12,796.00	10,796.00	3.77
Lettuce	1,000	1,369	4,369	16,123.00	14,754.00	11,754.00	3.69
Garden-egg	1,900	5,297	8,297	29,785.00	24,488.00	21,488.00	3.59

Source: Updated field data, 2009.

entire area under Fadama crops in the study area have shifted from traditional varieties to high yielding varieties showing that the sampled farmers were more progressive in the adoption of high yielding varieties reflecting in high application of fertilizers, pesticides, irrigation, farm mechanization and changes in cultural practices that gave them good farm yield and returns. Profitability tends to weigh heavily on the farmers' decisions, because the cost of fertilizers and other farm inputs often represents a large share of irrigated crop production. The implications of this findings shows that the results of the study were achieved due to easy contact of the farmers with the extension agents, timely dissemination of institutional information and fair level of education and enlightenment of farmers. It was therefore recommended that the need to develop new modern processing plants in the study area to take care of the surplus from these vegetable crops in the postharvest period cannot be overemphasized considering the challenges of food security in the ever growing population declining food production due to climate change, rising demand for food, land and water, higher energy prices and droughts and increasing farmers doubts about future adoption rates of new agricultural technology and above all lack of political will of the government.

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