International Scholars Journals

International Journal of Agricultural Extension and Rural Development ISSN: 3254-5428 Vol. 2 (8), pp. 141-148, September, 2015. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Evaluation of Land utilization and sustainability for food crop production in Southern Guinea Savanna

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Accepted 26 August, 2015

An assessment of the sustainability of food crop production in the *fadamas* of Southern Guinea Savanna of Niger State, Nigeria was carried out within the framework of small-scale farming households utilizing *fadama* for the cultivation of food crops. The study determined profitability of food crop production in the *fadama* and identified the pattern of land use and management and its effects on sustainability of *fadama*. A two- stage simple random sampling technique was used to obtain 149 food crop farming households interviewed for the study. The data were analyzed by using descriptive statistics such as frequency distribution, mean, standard deviation, in addition estimates of crop diversification index (CDI), nutrient intake index (NII), Ruthberg index, farm budgeting model was made. A typical household hectared seventeen persons and planted an average of 3.44 ha scattered in three plots. The major enterprises were sole crop rice and maize – based mixtures in about 0.70 and 2.59 ha respectively. Estimated mean CDI was 0.651 implying stability of income and sustainability of mixed crop enterprises while mean NII was 1.89 showing that combined crops hectareve low tendency to deplete soil nutrient. The Ruthberg index value of 0.393 implied that a six years fallow period alone may not be adequate to restore natural fertility. The farm budget analysis showed thectaret the sampled *fadama* food crop farming household hectared positive net return for all enterprises. Maize/cowpea enterprise hectared the highest gross margin of ₦25, 663/ ha while leafy vegetables (for example spinach) hectared the highest return on investment (2.39). The average return on investment for all the farms studied was 1.89. Mixed cropping the dominant cropping system generally adopted by the *fadama* farming households gave higher gross margin per hectare. The study concluded that production of food crop in the *fadama* of the Guinea Savanna of Niger State, Nigeria is sustainable. Mixed cropping, consolidation of household resources, increased use of animal traction and organic fertilizer as well as integrated pest management is recommended. In order for the foregoing to be effective, they must be accompanied by improved extension service delivery, aggressive adult education programme, regulated use of agro-chemical, improved access to credit and availability of subsidized inputs.

Keywords: *Fadama*, sustainability, mixed cropping, land use and management.

INTRODUCTION

Background to the study

Fadama are seasonally flooded plains along major rivers or depressions on adjacent low terraces. They are fertile, reduce the risk of crop failure and hectareve potentials for longer period of agricultural activities in a year. They present a unique opportunity towards reversing the declining per capita food production in Nigeria. However, development intervention, changing land tenureship and population pressure have been identified as threats to this valuable but delicate land resource The *fadama* size of Nigeria is estimated at about 4.6 million ha. Out of this, Niger State hectares an estimated 495,000 ha. This is second to Adamawa State with 625,000 ha, the largest in

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the country (Ingawa, 1998). If the potential of the inland valleys for intensive crop production could be realized, they might serve as a kind of safety valve for relieving pressure in other agro ecosystem particularly the humid forest and moist savanna (World Bank, 1992).

Research problem

The quest for harnessing the benefit of *fadama* land hectares ushered in technological innovations such as development of small irrigation pumps, small earthen dams and shallow tube wells. These hectares led to intensification in the use and management of *fadama* for agricultural activities. By and large, the inland valleys are cultivated by small holders whose land utilization and management with limited resources are aimed at achieving farm level objectives in terms of food security and economic viability. Their land use practices have a short term planning horizon with little attention to the status and management of agricultural land (Krusemen et al., 1996; Pannell and Glenn, 2000; Adewumi and Omotesho, 2002) . Production objectives of short term food security and income that guarantees economic production by the farmer might be achieved. However, the achievement may hectareve come at the expense of long-term sustainability of land resources and development. Sustainable development is consistent with increasing environmental assets or development without destroying the future of natural capital stock.

The most critical issue that this paper addresses is whether *fadama* land utilization is consistent with sustainable development in view of some factors threatening sustainability around the *fadama* of Northern Nigeria. Kolawole (1991) reported that development intervention, changing land tenureship and population pressure were among the factors threatening sustainability of *fadama* in Nigeria. Lawal (2001) also reported that the construction of hydroelectricity Dams at Jebba and Shiroro hectareve hectared adverse effect on socio-economic lives of the riparian communities. This hectare led to the loss of crop and farm land to flooding as a result of flash-flood occasioned by opening of the dams. The potential of fadama area will remain elusive until the sustainability of this agro-ecosystem can be assessed which is the focus of this study. Therefore, some questions become fundamental in the assessment of *fadama* land use; Are the farming practices adequate to improve soil fertility, nutrient recycling and enhance sustainable production? (2) Can the present cropping practices enhance economic benefits? (3) Is food crop production in the *fadama* sustainable*?*

A work that assesses sustainability of food crop production in *fadama* at the small holder farm level is relevant in determining the extent to which the low external input agriculture (LEIA) farming households in the *fadama* allocate, use and manage this delicate land resource. The work is necessary to provide information to policy makers in assessing the economic rationale of different land management options in order to maintain the bio-physical condition of the land. It is against this background that the study on which this paper is based was undertaken.

Objective of the study

The objective of the study is to determine costs and return to food crop production in the *fadama,* identify the patterns of land use and evaluate its effects on the sustainability of *fadama* in food crop production in the Southern Guinea Savanna of Nigeria.

Economic concept of sustainability

The unpriced outputs of agricultural system both positive and negative have become of increased importance as compared with conventional marketed outputs. There is concern that, while technical changes have brought major benefits to consumers in terms of reduced food prices, some developments hectareve taken us into unsheltered waters.

Nix (1990) pointed out that the idea of sustainability is central to attempts to define farm income. He quoted Hicks (1946) who defined income as that which could be consumed in a given period leaving the consumer as well off at the end of the period as at start. Recent theories of economic growth have built upon neoclassical foundation (Solow, 1992) and recognize that aggregate capital (K) consists of man made capital (K_m), natural capital (K_n), human capital (K_h) and social capital (K_s), such that;

$$K = Km + Kn + Kh + Ks \quad (1)$$

The quantity and quality of this capital determines the level of provision of utility for mankind on a year by year basis (Pearce, 1999). The notion of sustainability arises when it is required that the capacity of K to produce utility from one period to the next does not decline. Important modifiers to K include technological change, which may be regarded as endogenous or exogenous and population growth, which may hectareve positive or negative impacts on the component of capital (Webster, 1999).

The distinction between weak sustainability and strong sustainability hinges upon whether substitution is permitted between the components of K. Weak sustainability implies that substitution may take place in order to maintain K. In other words, rates of substitution or elasticity's are assumed to exist. In contrast, strong sustainability does not permit substitution between components of K and the emphasis is placed on conserving K_n (and each of its separate sub-components) at all costs. Arguments for such an approach include irreversi-

bility of some changes in natural capital for example species extinction (Tversky and Kahneman, 1981) . It is further argued that natural capital is impossible to value by whatever means and that no trade-offs could be made within K_n or any level of subdivision of K_n. However, Vander Hectaremsfort and Latacz-Lohnman (1998) have argued for strong sustainability on the basis of the second law of thermodynamics (the entropy law), which implies a limit to the stock of energy available to mankind for transforming low entropy natural capital through manufactured capital to high entropy waste products. It is argued that that K_m and K_n should be complements rather than substitutes.

METHODOLOGY

Area of study

The study was carried out in the *fadama* areas of Niger State, in the Southern Guinea Savanna of Nigeria. The *fadama* along river Niger and river Kaduna and other minor rivers and floodable plains in Niger State were used for the study. Niger State lies between longitude 8°11' and 11°20' north of the equator and between 4°30' east of the equator. It covers an estimated land area of 4240 km sq. The vegetation of the state is mainly Southern Guinea Savanna. The mean annual rainfall ranges between 1110 mm in the north and 1600 mm in the south. The average annual number of raining days ranges between 187 and 220 days. The rain starts in late April and ends in October with the peak being in July. The average minimum temperature is about 26°C while the average maximum temperature is about 36°C. The mean humidity ranges between 60 (January to February) and 80% (June to September). The vege-tation supports the cultivation of root crops and grains. The predominant crops are; rice, sorghum, millet, yam, groundnut and cotton.

Method of data collection

Data used for this study were from both primary and secondary sources. The relevant primary data were obtained through a farm management survey of *fadama* food crops farming households conducted between August 2004 and September 2005. The main instrument for data collection was structured interview schedule. These were administered on head of *fadama* food crop farming households by trained enumerators under the supervision of the researcher. The data covers farming activities for the 2004 cropping season. Data collected covers information on *fadama* food crop farming households head characteristics (age, level of education, family size etc), land use and management practices, input and output data, as well as their prices, crop combination and diversification etc.

Sampling procedure

The target population for this study is the *fadama* food crops farming households in Niger State, Southern Guinea Savanna, Nigeria. A two stage simple random sampling technique was used to select sample for the study. The first stage involved the random selection of *fadama* farming villages in the three ADP zones of the State. The 1991 *fadama* village and households listing of Niger State Agricultural Development Project (NSADP) served as the sampling frame for the selections. About five percent of the total *fadama* farming villages were randomly selected for the study. The second stage of sampling involved the random selection of *fadama* farming households. About 10% of the *fadama* farming households in each of the selected villages were sampled for the study. The villages and households selection was based on the proportion of *fadama* food crop farming households in the NSADP zones and the villages respectively. A cross sectional data from 149 *fadama* food crop farming households were collected for study.

Analytical techniques

Combinations of analytical techniques were employed in this study. Descriptive statistics such as mean, standard deviation, frequency distribution were used to capture the socio economics characteristics and pattern of land use management. In addition to descriptive statistics the following indices were calculated to further investigate the influence of pattern of land use and management on sustainability of fadama land.

Crop diversification index (CDI)

Stability of yield and revenue from crop planted are indicators of sustainable farm practice, this was captured with crop diversification index. The crop diversification variable was measured in this study by the Herfidahl index given as;

$$CDI_j = \sum_{i=1}^{n} Pi_j^2 \quad (1)$$

Where; CD1j is the crop diversification index for the j^{th} household. Pi_J = Proportion of total income from each crop in a particular enterprise.

A value approaching 1.0 indicates specialization whereas smaller values reflect increasing diversification, stability of income and sustainability of land use pattern (Spio, 1996; Udoh, 2000).

Nutrient intake index (NII)

Following Udoh (2000) the NII was estimated to reflect how crop diversity pattern can affect nutrient depletion and sustainability of farmland. This was measured as a ratio of crop configuration to number of crops in combination. Crop configuration was derived by assigning different weights to different classes of crop in combination and summing the weighted value for each farm and then dividing the value by the number of crops in such combination. The assigned weights to the respective classes were based on nutrient depletion ability of crops in an environment where nutrient augmenting input like fertilizer is inadequate (Fageria and Baligar, 1993). It is expected that the yield of crops in combination would be affected if the combined crops were mostly of the same class of crops. For instance, a combination of melon/maize/yam would not deplete soil nutrient as the case of cassava/yam/cocoyam mixture. Therefore, combining crops that would deplete soil nutrients heavily do not show sustainable land use practice.

The nutrient intake Index is given as

$$NII_j = \frac{W_i}{N} \quad i = (2 \text{ ----, } n) \quad (2)$$

Where; NIIj = Nutrient intake index for j^{th} households. n = Number of crop in combination.
w_i = Particular weight attached to type of class of crop planted (Legume = 1, vegetable/cereal = 2, root tuber = 3, stem tuber = 4).

Nutrient intake index is meant to capture the vulnerability of farm total output to different crop combination. The index value ranges between 1 and 4. The higher the NII the more the likelihood that crop combinations can affect nutrient depletion, land degradation and sustainability of farmland (Fageria and Baligar, 1993; Ali, 1996; Udoh, 2000).

Ruthenberg -value

The Ruthberg -Value shows the land use intensity for an area. It shows if the length of fallow may be adequate for soils to restore natural fertility. It is given as;

$$R - \text{value} = \frac{c}{c+f} \quad (3)$$

Where; c = Number of cropping years. This was obtained as the average number of years a land was used before fallow. f = Number of fallow years. This was obtained as average number of years a land was allowed to fallow before further cultivation.
R – Value = 1 for permanent cultivation.

The further the value is from one the more the likelihood that fallow would be adequate to restore natural fertility and improve sustainability (Udoh, 2000).

Degrees of soil erosion, flooding and drainage were also part of variables used to measure extent of likely land degradation, the level of nutrient depletion and *fadama* sustainability.

Farm budget model

Olukosi et al. (2006) stated that farm budget is a detailed physical and financial plan for operation of a farm for a certain period. Farm budget model enables the estimation of the total expenses (costs) as well as various receipts (revenue or returns) within a production period. Musa et al. (2006) stated that thectaret farm budget model gives a measure of profitability. Following Olukosi and Erhectarebor (1988), farm budget was estimated on per hectare basis in this study and specified as

$$NFI = GI - TVC - TF \quad (4)$$

$$GM = GI - VC \quad (5)$$

Where; NFI= Net farm income, GM= Gross Margin per Hectare.

The fixed inputs used during the survey consist of inputs such as baskets, hoes, cutlasses and rain boot. The depreciated values of these assets were negligible, therefore GM/ha was used for profitability analysis.

GM/ha was calculated for all the enterprises that the *fadama* farming households were engaged in during the survey period. GM allowed for comparison of the profit of the different enterprises cropped by the sampled households during the survey.

Return on a Naira Investment (RNI) which provides a measure of economic performance of each enterprise in terms of revenue accruing to the households and cost of inputs employed was determined as;

$$\text{Return on a Naira Investment (RNI)} = \frac{GI}{TVC} \quad (6)$$

RNI > 1 for enterprise to be sustainable (Alamu and Coker, 2005). Return on a Naira Investment was used to rank the enterprises of the sampled fadama food crop farming household.

RESULTS AND DISCUSSION

This section presents the results of the analysis of data collected and discussion on it.

Socio-economic characteristics of *fadama* food crops farm household heads

Table 1 shows the summary of farm inputs and socio-economics characteristics of *fadama* food crop farming households during the 2004 cropping season. On the average the farm size cultivated was 3.44 ha in about 3 plots. Hired labour was about 32% of total labour used for production. One of the probable reasons for hiring little labour could be the fact that an average *fadama* farming household head is still young (about 44 years), active and married with about 17 family members who provided the needed manpower for farm operations. On the average, the cost of labour used constitutes about 73.17% of total expenditure on farm inputs. This phenomenon clearly demonstrates the dominance of labour in food crop production in the *fadama* area. Labour is the most important factor of production because farming activities in the area are mostly labour intensive.

Table 2 reveals that an average household head was about 44 years, males (97.32) and married (98%) with a household size of 17 persons. An appreciable high level of literacy was recorded among household heads (54%). They are likely to hectare good potentials to acquire and interpret messages relating to their farming operation. The mean *fadama* farming experience was about 17.5 years. About 59.06% of the sampled farming households hectared no extensions contact. The mean extension contact was 1.5 visits per household per annum.

Analysis of cropping pattern and index of diversity

Land use pattern

The study reveals that the *fadama* farming household adopted different agricultural diversification strategies to fully utilize the *fadama* land and cope with risks and uncertainties. The strategies include: (i) An act of cultivating flood tolerant crop such as rice and sugarcane during the early wet season (ii) Cultivation of drought resistant crops: millet, cowpea, sorghum, cassava later in the season at the drier part of *fadama* area. (iii) Cultivation of crops with short gestation period: Okra, leafy vegetable, late sorghum and cowpea to utilize moist land during the early part of dry season. These strategies assure adequate utilization of the *fadama* land, which satisfy the food security and income generation objectives of the households.

Tables 3 and 4 reveals that mixed cropping was the

Table 1. Summary statistics of farm inputs and socio-economic characteristics of average *fadama* food crop farming household.

Description	Sample mean	Standard deviation	Minimum value	Maximum value
Farm size (Hectare)	3.44	2.68	0.10	6.30
Number of plots	3.00	9.56	1.00	6.00
Family labour (man-days)	118.74	38.99	7.00	220.00
Hired labour (man-day)	55.71	11.63	2.00	70.00
Family labour (₦)	32,524.00	43.68	37.00	290.00
Hired labour (₦)	15,320.00	37.80	1750.00	55,000.00
Total labour	47,845.00	218.54	50.00	17,500.00
Pesticide (litres)	1.84	1.57	0.00	7.00
Pesticide (₦)	2,870.00	53.43	9250.00	72,500.00
Capital (₦)	2,275.00	9.53	0.00	12,000.00
Fertilizer (kg)	78.00	2.76	0.00	8.00
Fertilizer (₦)	3,978.00	2.76	850.00	9,000.00
Other operating cost (₦)	6,624.00	204.30	0.00	38,500.00
Age(years)	44..50	11.52	21.00	68.00
Household size(No of people)	17.00	9.65	1.00	32.00
Fadama farming experience(yrs)	17..50	8.65	6.00	45.00
Extension contact (No of visits/yrs)	1.50	1.35	0.00	12.00
Credit (₦)	3,250.00	192.40	0.00	35,500.00

* Hired labour cost average ₦275 per man-day during the survey. Source: Field survey (2004/2005).

Table 2. Demographic characteristics of the f*adama f*ood crops farming household.

Characteristics	Frequency	Percentage
Gender		
Male	145	97.32
Female	4	2.68
Total	149	100.00
Age group		
20 - 50	125	83.89
>51	24	16.11
Total	149	100.00
Highest educational level	149	100.00
No formal education	17	11.41
Quranic	54	34.89
Adult	24	16.11
Primary	43	28.86
Secondary	9	6.04
Tertiary	3	2.01
Total	149	100.00
Household size		
1 - 5	15	10.07
6 - 10	27	18.12
11 - 15	42	28.18
16 - 20	51	34.23
21 - 25	9	6.04
> 26	5	3.36
Total	149	100.00

Table 2. Contd.

Characteristics	Frequency	Percentage
Source of seed		
Personal stock	88	59.06
Local market	33	22.15
ADP and other agencies.	28	18.79
Total	149	100.00
Experience in years		
0 - 5	11	7.38
6 - 10	23	15.44
11 - 15	51	14.22
16 - 20	33	22.15
21 - 25	13	18.13
26 - 30	9	6.04
> 31	9	6.04
Total	149	100.00
Source of credit		
No credit	99	66.44
Family and friend	30	20.13
Money lenders	9	6.05
Cooperative society	7	4.70
Community bank	4	2.68
Total	149	100.00
No of extension visits.		
0	88	59.06
1 - 2	22	14.76
3 - 5	18	12.08
6 - 8	16	10.74
9 - 11	-	-
> 12	5	3.36
Total	149	100.00

Source: Field survey (2004/2005).

most common farming system. The sampled households cultivated thirteen (13) types of crops as sole enterprises and eleven (11) types of mixed crops enterprises during the survey. 209. 11 ha (36.70%) and 360.72 ha (63.30%) of the cultivated land area during the survey were used for sole crop enterprises and mixed crops enterprises respectively. Results show that farming households use more of their own stock of local varieties, which inherently possess low yield potentials as planting material. Rice is the dominant and most preferred crop planted as sole crop, it was the only crop planted by all the sampled households. It was planted in 17.14% (104.3 Ha) of the land area utilized for crops production during the survey. Maize/cowpea mixture was the most preferred enterprises among the mixed crop farms accounting for 10.36% (63.05 ha) of the total area cultivated by sampled households. The cropping pattern clearly reveals preference for rice, maize, sorghum, yam and cowpea as the most important food crops grown by the households. Under crops combination, cowpea is the predominant second crop grown in association with cereal crop such as maize and sorghum. This result is similar to that of Amaza (2000) which reported mixed cropping as the dominant cropping system of farmers in Gombe State of Nigeria.

Index of crop diversification

The pattern of land use as regards stability of yield and revenue from crops planted are indicators of sustainable farm practice (Webster, 1999). This is measured with the

Table 3. Distribution of area cultivated (ha) to sole crop enterprises.

	No. of households	Area cultivated (ha)	% of area cultivated	Mean area cultivated (ha)	Minimum area cultivated (ha)	Maximum area cultivated (ha)	Standard deviation
Cowpea	8	6.4	1.12	0.80	0.20	3.00	2.37
Groundnut	8	16.00	2.81	2.00	0.50	2.50	1.89
Maize	10	22.30	3.91	2.23	0.80	3.5	2.45
Okra	12	7.20	1.26	0.60	0.20	2.00	0.89
Onion	2	1.50	0.26	0.75	0.50	1.00	2.74
Pepper	6	4.80	0.84	0.80	0.20	3.50	1.25
Rice	149	104.3	18.32	0.70	0.30	4.50	0.96
Sugarcane	7	5.6	0.98	0.80	0.30	3.00	0.58
Sorghum	5	8.25	1.45	1.65	0.60	2.80	1.33
Soybean	3	3.00	0.53	1.00	0.50	1.50	1.28
Tomato	14	11.90	2.09	0.85	0.30	1.75	0.45
Vegetables	14	12.46	2.19	0.89	0.25	1.00	0.33
Yam	6	5.40	0.95	0.90	0.50	1.50	0.53
	244	209.11	36. 70	0.86			

Source: Field survey, (2004/2005).

Table 4. Distribution of area cultivated (Ha) to mixed crop enterprises.

Enterprise	No. of households	Area of land cultivated (ha)	% of area of land cultivated	Mean area cropped (ha)	Minimum area cropped (ha)	Maximum area cropped (ha)	Standard deviation
Maize/sorghum	29	30.72	5. 39	1.28	0.20	4.00	2.46
Mellon/maize/sorghum	28	46.94	8.24	1.68	1.0	6.50	2.58
Maize/sorghum/cowpea	36	66.96	11.75	1.86	1.0	4.50	2.74
G/nut/sorghum/cowpea	12	16.80	2. 95	1.40	0.5	7.00	1.85
Sorghum/cowpea	29	43.84	7. 69	1.56	0.2	3.50	2.25
Sorghum/Bambara	1	1.30	0. 23	1.30	1.30	1.30	0.00
Maize/cowpea	58	71.34	12. 52	1.23	0.5	4.00	2.35
Maize/cassava	10	8.64	1. 52	0.86	0.4	2.50	1.67
Maize/yam	32	27.52	4.83	0.86	0.3	3.00	3.98
Millet/groundnut	20	28.20	4. 95	1.41	1.0	2.00	2.11
Millet/cowpea	13	18.46	3. 24	1.42	0.6	3.50	2.64
	263	360.72	63.30	1.37			

Source: Field survey, (2004/2005).

Table 5. Herfidahl index of crop diversification.

Description of cropping pattern	Mean Herfidahl index	SD	Minimum value	Maximum value	CV %
Sole	1	1	1	1	100
Two-crops combination	0.625	0.189	0.384	0.946	30
Three-crops combination	0.462	0.106	0.264	0.753	23
Whole farm	0.651	0.302	0.264	1	47

Source: Field survey (2004/2005).

indices of crop diversification. The index used in this study is Herfidahl index. This is modeled in terms of proportion of net income from the various crops in each combination (see equation 1).

Table 5 shows that the estimated mean diversification index was 0.651. This implies increasing diversification among majority of *fadama* food crops farming households which could ensure stability of yield, income and sustainability of *fadama* land. These crop combinations could be regarded as environmentally and economically sound practice. It is environmentally friendly because when two or more crops are planted under low use of land augmenting material like fertilizers as observed during the survey, the negative effect of such material on the environment is reduced. The cultivated crop depended mostly on the available soil nutrient for their growth and development. Each crop uses the fertility of the soil in its own peculiar way especially when the rooting systems of the crops differ. Mixed cropping planted this way during the survey generally gives more revenue and higher gross margin per hectare than mono cropping. This finding is similar to the work of Spio (1996); Alamu and Coker (2005) who reported thectaret mixed cropping in Ghana and Nigeria gave higher yields and revenue per hectare respectively.

Index of soil nutrient intake

To achieve the maximum advantage of inter cropping or mixed cropping, combined crops must be grown in such a way that each crop in mixture uses the nutrient of the soil in different ways as to eliminate the risk of competition for the available soil nutrients. Table 6 shows the distribution of the *fadama* farming households based on how their crop diversity pattern can affect nutrient depletion and sustainability of farmland. This was calculated using equation 2.

The mean Nutrient intake Index (NII) was 1.89. This index measured the intensity of likely nutrient depletion by the combined crop. This result implies that the combined crops hectareve very low tendency to deplete soil nutrient. These may not be unconnected to the fact that eight of the crop combinations hectared a leguminous crop in addition to the cereal in the combination. So the cropping pattern is such thectaret could not adversely affect soil nutrient and crop nutrition. These could translate to consistently good yield of *fadama* farm land which is an indication of sustainability of the cropping pattern of the *fadama* food crops farming households. Udoh (2000) reported NII of 3.25 among farmers in eastern Nigeria, most of these farmers planted root/tuber crops in combination with other crops.

Table 6. Distribution of nutrient intake index among sampled households.

Nutrient intake index	Frequency	Percentage
1 - 1.5	23	15.44
1.6 - 2.0	99	66.44
2.1 - 2.5	27	18.12
Total	149	100

Source: Field survey, (2004/2005).

Ruthberg- value

The Ruthberg-Value shows the land use intensity for the sampled households. It was estimated as 0.983 during the survey. This implies thectaret cultivation is nearly on a continuous basis in the fadama. These may not be unconnected with the high value attached to the fertility of fadama and probably the difficulty in land clearing. Depending on the agronomic practices adopted by the households, the land use may be unsustainable. About 65% of the farms sampled hectared different levels of soil erosion symptoms indicating incidence of soil degradation and subsequent nutrient loss. The farmlands were not adequately covered with crop canopies. In the long run, without adequate remedial and preventive measures, soil fertility may be affected which could affect the sustainability of *fadama* land of Niger State in Nigerian Southern Guinea Savanna.

Cost and returns in food crop production in fadama of Southern Guinea Savanna of Niger State, Nigeria.

From the results in Table 7, the production cost and revenue per hectare varies across the households and it did not necessarily depend on the type of crop planted in the enterprises. Gross margin analysis shows thectaret maize/cowpea enterprise with ₦25, 663/ha hectares the

Table 7. Gross margin per hectare by enterprises for food crops planted by sampled *fadama* farming Households.

Enterprises	Mean farm Revenue/ha	Mean variable cost per hectare	Gross margin per hectare	Ranked based on GM//ha	Return on naira investment	Ranked by return on naira investment
Maize/Cowpea	57,500	31,837	25,663	1st	1.81	10th
Sorghum/Cowpea	40,100.	17,886	22,214	2nd	2.25	3rd
Maize//sorghum/Cowpea	42,700	22,122	20,578	3rd	1.85	7th
Maize / Yam	56,250	36,684	19,566	4th	1.53	21st
Sugarcane	41,250	27,550	18,700	5th	1.68	17th
Sorghum / Bambara	35,600	17,850	17,550	6th	1.89	6th
Millet /Cowpea	36,400	19,750	16,650	7th	1.84	8th
Soybean	41,593	24,946	16,627	8th	1.57	19th
G/Nut / Sorghum Cowpea	39,700	23,283	16,417	9th	1.71	15th
Okra	28,850	12,502	15,950	10th	2..30	2nd
Mellon / Maize /Cowpea	36,585	20,670	15,915	11th	1.73	14th
Maize / Cassava	39,600	23,755	15,845	12th	1.68	17th
Maize / Sorghum	38,631	22,2716	15,684	13th	1.61	18th
Rice	50,600	25,650	14,950	14th	1.42	22nd
Yam	34,200	19,461	14,739	15th	1.76	13th
Pepper	32,487	18,195	14,292	16th	1.79	11th
Sorghum	31,767	17,413	14,267	17th	1..82	9th
Tomatoes	28,850	14,650	13,850	18th	1..95	4th
Cowpea	31,500	17,685	13,815	19th	1.78	12th
Millet /G/nut	28,300	14,595	13,705	20th	1.94	4th
Vegetables	23,500	9,850	13,650	21st	2.39	1st
Maize	29,592	16.250	13,342	22nd	1.70	16th
Onion	21,600	14,000	7,660	23rd	1.54	20stt
Bambara	14412	8,461	5,951	24th	1.70	16th
Whole farm	33, 623	18, 486	15, 137		1.89	

Source: Field survey, (2004/2006).

highest GM/ha during the survey. Based on the profitability ratio leafy vegetable (spinach), okra and sorghum/cowpea ranked first, second and third respectively. These enterprises returns N2.39k, N2.30k and N2.25k on every N1 invested in the enterprises respectively. The average gross margin per hectare for a representative farm was N 15,137 while average net farm-income was N52, 071. The average return on a Naira investment ratio for all farms was 1.89 showing thectaret on financial consideration the farm operation of food crop farming households in the *Fadama* of Southern Guinea Savanna, Niger State, Nigeria was profitable and therefore sustainable.

Conclusion

The general conclusion drawn from the study is that production of food crops in the *fadama* of Niger State, Nigeria is sustainable. All the food crop enterprises produced hectareve positive net farm income, profitability the and return on Naira

investment ratio than is greater than one. The levels of diversification of the enterprises do not impact negatively on the nutrient intake index (NII) of the crops. The Ruthberg index value, erosion and drainage situation shows thectaret remedial and preventive measure is required to ensure sustainability of *fadama* land in the Southern Guinea Savanna of Niger State, Nigeria.

Recommendations

Government should provide adequate and assessable inputs such as work oxen, improve seeds, herbicides and fertilizers to *fadama* food crop farming households. The inputs should be provided at subsidized rate to encourage their usage. Vigorous effort should also be made to encourage the farm households to employ animal traction involving oxen or camel with appropriate implements. The use of improved seeds varieties with high yield potentials together with packages of required crop husbandry is also recommended. Extension workers should be properly motivated through provision of appropriate vehicle for their movement and prompt payment of their salary and allowances. The activities of the extension agents should also be monitored to ensure that they carried out their duty diligently. Mixed cropping is recommended for food crop production in the *fadama* of Southern Guinea Savanna Niger State, Nigeria. This would ensure stability of output and income.

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