



ORIGINAL ARTICLE

Profitability of various cropping patterns among arable crop farmers in Niger State, NigeriaBabatunde Stephen OJETUNDE¹, Emmanuel Egbodo Boheje ODUM^{2*}

Abstract - Descriptive Statistics and Net Farm Income model was used to analyze data collected from 120 Arable Farmers who adopted various cropping patterns in Niger State, Nigeria. The study specifically examined the socio-economic characteristics of arable farmers, profile the cropping patterns adopted, examined the profitability and highlighted the constraints to crop production among arable farmers in the study area. Results obtained from the study show that crop farming in the area is a male dominated. The mean age of farmers was 33years, 98.3% were married, 80.8% had one form of education or the other and 68.4% adopted a three-crop mix pattern in their crop production. Two and three crop mixes enterprise were profitable than sole cropping when gross income per ha was used as an index of profitability. Profitability was higher in single crop enterprise when returns/man day was used as an index but was higher in a two and three crop mix enterprise when net returns per ha was used as a measure of profitability. Bad roads, drought, theft of farm produce, poor extension per farm advisory services and lack of credit facilities respectively were the constraint to crop production. The study concludes that mixed cropping enterprises was more profitable than sole cropping. We recommend the promotion of mixed cropping among arable farmers for increased profitability and income to farm households, that the constraints identified be addressed by all concerned authorities so as to sustain crop production, reduce food insecurity and eradicate hunger and poverty among arable farmers in the area and Nigeria as a whole.

Keywords: Farm income. Cropping patterns. Arable crops.

Rentabilidade de vários padrões de cultivo entre agricultores de culturas arvenses no estado de Níger, Nigéria

Resumo - O modelo de Estatísticas Descritivas e Renda Agrícola Líquida foi usado para analisar dados de 120 agricultores no Estado do Níger, na Nigéria. O estudo examinou características socioeconômicas dos agricultores, traçou o perfil dos padrões de cultivo adotados, examinou a lucratividade e destacou as restrições à produção agrícola na área de estudo. Os resultados mostram que a agricultura na área é dominada por homens, com idade média de 33 anos, 98,3% casados, 80,8% possuíam educação formal e 68,4% adotavam o padrão de três culturas em sua produção. O sistema de produção de duas e três culturas foi mais lucrativo do que a monocultura quando a receita bruta por hectare foi usada como um índice de lucratividade. A lucratividade foi mais alta em sistemas de monocultura quando retornos por dia de trabalho por pessoa foram usados como índice, mas foi maior em sistemas de duas e três culturas quando considerados os retornos líquidos por hectare. Estradas ruins, seca, roubo de produtos agrícolas, serviços inadequados de extensão e consultoria agrícola e baixo acesso a crédito, respectivamente, foram os fatores restritivos para a produção agrícola. O estudo conclui que os sistemas de cultivo misto foram mais lucrativos do que o cultivo individual. Recomendamos a promoção de culturas mistas entre os agricultores para aumentar a lucratividade e a renda das famílias agrícolas, que as restrições identificadas sejam abordadas por todas as autoridades de modo a sustentar a produção agrícola, reduzir a insegurança alimentar e erradicar a fome e a pobreza entre os agricultores da área e da Nigéria como um todo.

Palavras-chave: Renda na propriedade agrícola. Sistema de cultivo. Culturas arvenses.

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Introduction

Farmers manage their crops and field through sequences of technical acts, which are interdependent. These acts have multiple and prolonged effects on the agroecosystem dynamics. Any given crop is selected and managed in relation to the preceding and subsequent crops, and a given technical operation is decided and implemented in relation to other techniques involved in the crop management (BISWAS, 2015). A well-managed cropping system has the potential to contribute towards sustainable land use while preserving biodiversity. A major type of cropping system is mixed cropping also referred to as intercropping (BONKE; MUSSHOF, 2020). Gaba *et al.* (2015) define mixed cropping as a practice of growing more than one type of crop on the same piece of land at the same time optimal for crop production. It may be defined as a sustainable farming practice that entails two or more crops growing in the same field side by side in the same or overlapping growing season (MARTIN-GUAY *et al.*, 2018).

Paudel (2016) asserted that mixed cropping is an agriculture system was long adopted by marginalized small holder farmers especially in hills and mountains and that the practice favors efficient utilization of resources like air, water, light, space, and nutrients by companion crops in both temporal and spatial dimensions due to their differential growth habits and seasonality. The ultimate outcome of mixed cropping is increased agriculture production, livelihood and income in an adverse or harsh environment. Isiaka and Familusi (2018), stated that farmers intercropped for varied reasons, including insurance against crop pests, yield increment, weed control and high monetary returns. Intercropping encourages a higher nutrient uptake than in sole cropping and water use efficiency is high because of the inter-cooperative interaction between the intercrops and was supported by. Ju *et al.* (2013) and Zhang (2019), opined that mixed cropping play a vital role for securing the food supply while, Fung *et al.* (2019) considered mixed crop cropping as a sustainable agricultural practice that can reduce the environmental impacts of agriculture. Similarly, Obayelu *et al.* (2015) and Aminu and Okeowo (2016), reported that farming households who practiced crop combinations were found to be profitable evident with high net margins when compared with that of single crop farmers and was supported by Tsoho and Salau (2012) and Ibrahim *et al.* (2019), who posited that crop mixture in a farm was more rewarding and profitable due to the fact they ensure optimal utilization of farm inputs in comparison with a single crop enterprise and recommended that quite a substantial proportion of land should be devoted to the cultivation of these crops in addition to promoting mixed crop farming.

In comparing profitability of maize and sorghum in Nigeria State, Nigeria, Yisa *et al.* (2018), found that the returns from sole maize cropping was lowest when compared to that of maize with another crop. Their study recommended that farmers should be enlightened on the higher returns to investment and profitability of cultivating maize in combination and with other crops instead of sorghum combinations, appropriate production technologies that reduce labour cost in maize and sorghum production should be adopted by farmers to enhance farmers' incomes and livelihoods.

These reviews are in consonance with Chidiebere-Mark *et al.* (2019), who posited that farmers adopt a





particular production system based on the topography, input, expected output and returns and hence this study seeks to find out what are the socio-economic characteristics of the small scale arable crop producers in the study area; what are the cropping patterns they adopted; which cropping pattern is more profitable to undertake in the study area and what are the major constraints faced by the respondents in their crop production activities? The main objective of this study was to analyze the profitability of various cropping patterns among Arable Crop farmers in Niger State, Nigeria. The specific objectives are to describe the socio-economic characteristics of the small-scale farmers; identify cropping patterns adopted by the respondents in the study area; estimate and compare the profitability of sole and mixed cropping enterprises in the study area and profile the major constraints to production by small holder arable crop farmers in the study area.

Material and Methods

Area of study

The study was conducted in Niger state, Nigeria. The state was created in the year 1976 and lies between latitude 3^o20 and 7^o40 North and Longitudes 8^o and 11.3^o east. It is located in the guinea savannah vegetation of the country with favorable climatic condition for crops and livestock production. It shares boundary with Zamfara State to the North, Kebbi State and Federal Capital Territory to the North-East and South-East respectively. It shares a common boundary with the Republic of Benin at Abbanna in Borgue Local Government Area. The state also share boundary with Kwara and Kaduna States. About 85% of the State's population are farmers, but some of them also engage in the rearing of livestock as well as cultivation of arable crops which helps in complementing other products and thereby improve their standard of living. The population of the state, according to the 2006 census figure was 5,556,247 (NPC, 2016).

Method of data collection and sampling technique and method of data analysis

Data used for this study was elicited using questionnaire and interview schedules from 120 respondents using a two-stage random sampling method involving the selection of three villages were from the 4 Local Government Areas (LGA's) and 10 respondents selected from each of the three villages during the 2019/2020 farming season in Nigeria. Data was analyzed using descriptive statistics and profitability analysis ratio (Net Farm Income Model).

Model Specification

Net farm income

Gross return per hectare, gross return per man-day and Net return per hectare are the three parameters measured to examine the profitability of both Sole and mixed cropping enterprises.

The net farm income is represented as:

$$\text{Profit} = \text{Total Revenue} - \text{Total Cost} \text{ ----- (1).}$$





It can also be represented as; $\pi = TR - TC$ ----- (2).

Where, Profit is denoted by π .

Total Revenue is denoted by TR, and

Total Cost by TC.

Where Total revenue (TR) = TPP * Py.

Total Cost (TC) = Total Variable cost + Total Fixed Cost.

Results and Discussion

Results in Table 1 show that 97.5% of respondents are male while 2.5% are females. This indicates that production is a male dominated activity. However, women are usually very active during harvesting period which may be attributed to the fact that Gwari culture which is the predominant culture in the study area discourages women participating in farming activities other than harvesting. The modal age of respondents is between 31 – 40 years and above with a mean age of 33years. This shows that younger farmers of working age dominated the farming population and at the same time adopted the various cropping patterns respectively. A total of 98.3% are married while about 1.7% of the respondents in the study area are single. The respondents in the study area said that they are into farming in other to find a source of livelihood for themselves and feed their younger children. About 80.8% of respondents had one form of education or the other while 19.1% had no form of education at all. This agrees with Odum and Fakayode (2018). The high level of education in the study area will have a direct impact in facilitating the adoption of technologies, raises the technical competence of small holder farmers by enabling them to cope with the complexities associated with the cropping patterns adopted in the study area.

Table 1. Socio-economic characteristics of respondents.

Variable	Frequency (N = 120)	Percentage (%)
Gender		
Male	117	97.5
Female	3	2.5
Age Distribution (years)		
<31	22	18.4
31- 40	49	40.8
>40	49	40.8
Marital Status		
Single	2	1.7
Married	118	98.3
Level of Education		





Primary	11	9.2
Secondary	27	22.5
Tertiary	30	25
Quaternary	18	15
Adult Education	12	10
None of the above	22	18.3
Farming Experience(years)		
< 10	59	49.16
10 – 20	56	46.67
> 20	5	4.17
Household Size(No. of persons)		
< 6	24	20
6 – 10	31	25.8
11 – 15	41	34.2
>15	24	20
Farm Size (ha)		
< 2	4	3.3
2 – 4	100	83.3
> 4	16	3.4
Land Ownership Status		
Owned/Inherited	114	95
Rented/Borrowed/Lease/Purchase	6	5
Total Gross household income (NGN)		
< 100,000	6	6.67
100,001 – 200,000	49	40.83
200,001 – 300,000	40	33.33
300,001 – 400,000	10	8.33
400,001 – 500,000	10	8.33
> 500,000	3	2.50
Cropping Patterns		
Sole cropping	22	18.3
Two Crop combination	16	13.3
Three Crop combination	82	68.4

Source: Field Survey (2020).





Table 1 shows that about 49.5% respondents had been farming for less than 10 years, 46.7% are between 10-20 years and about 4.2% are above 20 years. As the number of years of farming experience increase, there is an increase in the respondents' exposure, professionalism, and prospect for better coping but contrary to the assertions made by Asiakaba, Morse and Kenyon (2001), that the ability of farmers to adopt new innovations decrease with age, further stating that the reason for this is that the younger farmers are more willing to adopt new innovation than the older farmers. On household size, respondent with 11 – 15 persons per household was the modal size (34.2%), while the mean household size is 8 persons. Larger households are believed to provide a readily source of cheap agricultural labour. A total of 83.3% have farm size between 2 – 4 hectares while 3.3% of respondents have a farm size of below 2 hectares and supports the findings of Awoke and Okorji (2004), that small farmers are those farmers that operate on small scale basis with farm holding usually small. About 5% of the respondents do not own the land they are cultivating, while about 95% of the respondents in the study area own the land they are cultivating. Through this result, it shows that most of the land cultivated is owned by family which implies that most of the cultivated lands in the area are through inheritance.

The results in Table 1 also show that 6.67% of the respondents realized gross income of below NGN100, 000 from both agricultural and non-agricultural sources during the production year, 40.83% of the respondents realized output between NGN 100, 000 and NGN 200, 000 which have the highest. Also, 33.3% of the respondents i.e., about 40 farmers had their total income between NGN 200,000 and NGN 300,000, while about 8.3% of the respondents realized a gross income of between NGN 300,000 and NGN 400,000. Only 2.5% of the respondents realized a total gross income of above NGN 500,000. This is in accordance with Thilagavathi and Chandrasekaran (2009), which carried out a study on crop productivity losses, activity diversification & Livelihood security stated that in most of rural farm households, under the problem situation (reduction in income from agriculture) family members have been diverted to other activities to earn for meeting consumption expenditure.

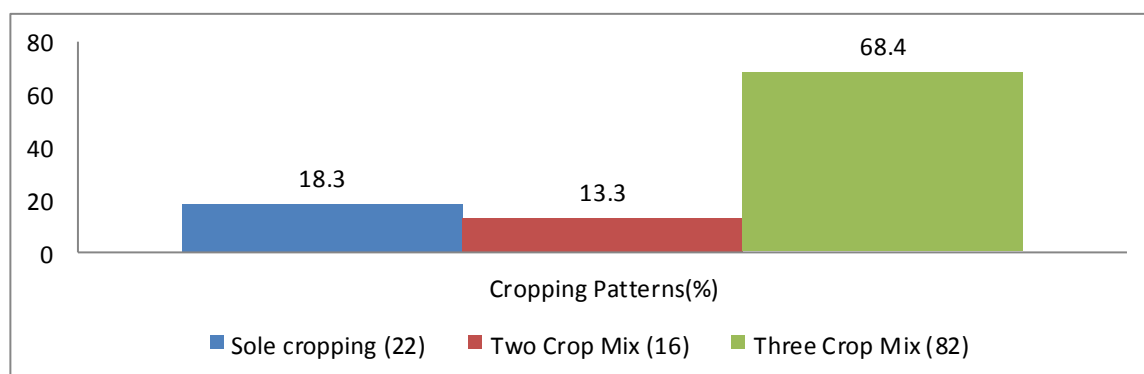


Fig. 1. Cropping patterns adopted by respondents in the study area. Source: Computed from field data (2020); Values in parenthesis are frequency counts.



Figure 1 shows that the percentage of the respondents Practicing both sole and mixed cropping are very high, accounting for 68.3%, while 13.3% of the respondents are Practicing only mixed cropping and 18.3% of the respondents in the study area practiced sole cropping and supported by Odum and Fakayode (2018). The result showed that the higher percentage of the respondents practice growing mixed enterprises. This could be attributed to the fact that most farmers are afraid of the risks involved in Practicing only sole cropping, because they believe practicing mixed cropping will help to supplement most of the loses on the farm. Moreso, the result also showed that most farmers believed that mixed cropping is more profitable than sole cropping respectively. The result from the findings also supports Akinbile and Adekunle (2000), in the study of land administration in Nigeria, stated that over the years now most small-scale holder arable crop farmers in Nigeria adopted mixed cropping pattern because of their low level of income earning capacity while little practice sole cropping which is mostly done by commercial farmers.

Profitability of sole and mixed cropping enterprises

Gross Return per Hectare is the monetary value per hectare of the entire farm produce, without deducting the cost of labour or the costs of other inputs such as seeds, chemicals and fertilizers without allowing for depreciation on tools and equipment. Farm products were valued at the various average prices worked out from bi-weekly market prices collected throughout the production season. Gross income is a parameter that might interest the peasant farmers more than net profit since peasant farmers often disregards the cost of other farming input used in the farm operations.

Table 2 indicates that return is generally higher for crop mixture than for sole crop. Considering these crops, income per hectare is higher for Yam/Sorghum, (NGN 88,666.67), Cowpea/Sorghum (NGN 79,483.87), Yam/Maize (NGN 77,846.15), Yam/Okra (NGN 77,076.92), than for Yam (NGN 31,236.00), Melon (NGN 30,000.00), Maize (NGN 25,916.67) and other crops planted as sole respectively. It is also relevant to note that income per hectare fell when Maize is intercropped with Groundnut. Gross income per hectare is higher for Maize (NGN 25,916.67) than for Maize/Sorghum (NGN 8,600). This implies that the extra return resulting from inter-planting Maize with Groundnut has failed to compensate the loss due to the depression of the yield of Groundnut.

Among the crop mixture, the gross income per hectare is generally higher for the three-crop mixtures than for the two-crop mixtures. For instance, the gross returns per hectare is generally higher for Yam/Maize/Sorghum mixture (NGN 118, 444.44) than for Yam/Maize mixture (NGN 77, 846.15), and it is higher for Yam/Maize/Cowpea mixture (NGN 98, 545.45) than for Yam/Cowpea mixture (NGN 73,800). Furthermore, it is higher for Maize/Millet/Sorghum mixture (NGN 82, 666.67) than for Maize/Melon mixture (NGN 54, 166.67). Moreso, the gross income per hectare is also higher for Yam/Okra/Pepper mixture (NGN 81, 853.66) than for Okra/Pepper mixture (NGN 67, 250.00). It is also important to note that gross income per hectare is higher for Cowpea/Sorghum mixture (NGN 79,483.87) than for Cowpea/Sorghum/Pepper mixture





(NGN 78,909.09) which also implies that the extra returns resulting from inter-planting Cowpea/Sorghum/Pepper failed to compensate for the loss due to the depression in the yield of Cowpea/Sorghum respectively.

Table 2. Gross returns per hectare (NGN per hectare) for some crop enterprises.

Crop	Sole Cropping		Two Mixed Cropping		Three Mixed Cropping	
	NGN	Crop Mix	NGN	Crop Mix	NGN	Crop Mix
Maize	25,916.67	Yam/Maize	77,846.15	Yam/Maize/Millet	63,066.67	
Yam	31,236.00	Yam/Cowpea	73,800.00	Maize/Millet/Sg.	82,666.67	
Rice	5,722.58	Maize/Gn.	8,600.00	Yam/Okra/Pepper	81,853.66	
Okra	18,500.00	Okra/Pepper	67,250.00	Cowpea/Maize/Ca.	31,400.00	
Pepper	4,263.41	Cowpea/Sg.	79,483.87	Yam/Maize/Sorghum	118,444.44	
Tomatoes	5,400.00	Millet/Maize	51,250.00	Cowpea/Sorghum/Pp.	78,909.09	
Cassava	11,500.00	Cassava/Melon	58,333.33	Yam/Maize/Cowpea	98,545.45	
Melon	30,000.00	Pepper/Tm.	57,714.29			
Cowpea	16,000.00	Yam/Sorghum	88,666.67			
Sorghum	13,200.00	Maize/Melon	54,166.67			
Groundnut	1,944.44	Yam/Okra	77,076.92			
Millet	15,151.51	Sorghum/Gn	51,360.10			

Source: Field Survey, 2020; Gn. = Groundnut, Tm. = Tomatoes; Sg. = Sorghum; Ca = Cassava; Pp = Pepper

Gross income per Man day

Results from Table 3 revealed that the average gross income per man day is higher for sole crops was NGN 1, 234.13 than for crop mixtures of NGN 1, 122.11. This implies that the higher average gross return per hectare reported for crop mixtures has failed to match the extra labour requirement associated with crop mixtures. The contrasting results obtained here in this section dealing with the gross return per hectare, make it rather difficult for one to state categorically that sole cropping is superior to mixed cropping or vice versa. It is also necessary to investigate the net income per hectare as a rather crude way of determining overall resource-use efficiency.

Therefore, it is important to note that among the sole cropping Maize has the highest gross income per man day (NGN 1, 234.13) and Tomato has the least (NGN 270.00) which was supported by Yisa *et al.* (2018), who studied the comparative analysis of the profitability of maize and sorghum as sole cropping enterprises in Niger State, Nigeria. Also, in two-crop mixture, Yam/Sorghum mixture has the highest gross return per man day (NGN 997.50) and Millet/Maize mixture has the least (NGN 630.77). Also, for the three-crop mixture, Yam/Sorghum/Maize has the highest gross income per man day (NGN 1, 122.11) and Cowpea/Maize/Cassava





has the least gross income per man day. Generally, Maize based on crop mixtures has the highest gross return per man day.

Table 3. Gross returns per Man day (NGN per Man day) for some crop enterprises.

Sole Cropping		Two Mixed Cropping		Three Mixed Cropping	
Crop	NGN	Crop Mix	NGN	Crop Mix	NGN
Maize	1,234.13	Yam/Maize	816.13	Yam/Maize/Millet	955.56
Yam	1,205.09	Yam/Cowpea	802.00	Maize/Millet/Sorghum	953.85
Rice	492.78	Maize/Sorghum	666.05	Yam/Okra/Pepper	987.06
Okra	961.04	Okra/Pepper	717.33	Cowpea/Maize/Cassava	348.89
Pepper	218.50	Cowpea/Sorghum	892.75	Yam/Maize/Sorghum	1122.11
Tomatoes	270.00	Millet/Maize	630.77	Cowpea/Sorghum/Pepper	876.76
Cassava	920.00	Cassava/Melon	767.54	Yam/Maize/Cowpea	903.33
Melon	1,000.00	Pepper/Tomatoes	812.50		
Cowpea	1,000.00	Yam/Sorghum	997.50		
Sorghum	1,178.57	Maize/Melon	812.50		
Groundnut	940.86	Yam/Okra	759.09		
Millet	675.68	Sorghum/Groundnut	896.34		

Source: Field Survey, 2020.

Net income per hectare

This indicates the relative profitability of sole cropping and mixed cropping enterprises. Table 4 shows the relevant data on the net return per hectare. Calculations based on the data in Table 5 gives the average net return per hectare for sole crops, two-crop mixture and three-crop mixtures as NGN 23,496.00, NGN 69,692.31 and NGN 99,000.00 respectively. These averages attest to the superiority in the use of resources of crop mixtures generally and three-crop mixtures in particular. It is important to note that among the sole crop Yam offers the highest return per hectare (NGN 23,496.00) while Pepper had the least net income per hectare (NGN 3, 678.05). For the two crop mixes Yam/ Okra has the highest net returns per hectare with NGN 69,692.31 while Maize/Sorghum had the least returns of NGN 7,419.35. Also, for the three crop enterprises, Yam/Maize/Sorghum had the highest net income per hectare of NGN 99, 000 while the mix of Cowpea/Maize/Cassava had the least return/Ha of NGN 27, 900.00.

Therefore generally, in considering profitability of both sole cropping and mixed cropping enterprise, the evidence from this study shows that resources-use efficiency in on the average, higher for crop mixtures than for sole crops, that is using profitability as a measure of efficiency which was supported by Waha *et al.* (2020), who worked on multiple cropping systems of the world and the potential for increasing cropping





intensity. The results also indicate that, on the average the three-crop mixture is more profitable than the two-crop mixture. If one may project the result slightly further, one could say that the greater the number of crops in the mixture the more profitable. Yet there could be the danger of crop diversification beyond the point of maximum efficiency. It is probably in recognition of this possibility that the peasant farmers permit the number of crop enterprises devoted to four-crops and five-crop mixture.

Table 4. Net income per hectare (NGN per hectare) for some crop enterprises.

Sole Cropping		Two Mixed Cropping		Three Mixed Cropping	
Crop	NGN	Crop Mix	NGN	Crop Mix	NGN
Maize	16,916.67	Yam/Maize	66,307.69	Yam/Maize/Melon	59,000.00
Yam	23,496.00	Yam/Cowpea	47,800.00	Maize/Melon/Sg.	77,355.56
Rice	4,432.26	Maize/Sg.	7,419.35	Yam/Okra/Pepper	69,135.80
Okra	10,000.00	Okra/Pepper	61,000.00	Cowpea/Maize/Ca.	27,900.00
Pepper	3,678.05	Cowpea/Sg.	69,419.35	Yam/Maize/Sg.	99,000.00
Tomatoes	4,566.67	Millet/Maize	47,500.00	Cowpea/Sorghum/Pp.	67,090.91
Cassava	6,555.00	Cassava/Melon	55,8333.33	Yam/Maize/Cowpea	86,545.45
Melon	18,000.00	Pepper/Tm.	48,071.43		
Cowpea	9,000.00	Yam/Sorghum	48,666.67		
Sorghum	11,090.08	Maize/Melon	49,375.00		
Groundnut	16,944.44	Yam/Okra	69,692.31		
Millet	20,944.24	Sorghum/Gn.	24,660.00		

Source: Field Survey, 2020 Gn. = Groundnut, Tm. = Tomatoes; Sg. = Sorghum; Ca = Cassava; Pp = Pepper.

Table 5. Constraints to Crop production in the study area.

Constraint	Frequency (N = 120)	Percentage
Insufficient Rainfall	14	11.7
Incidence of Pest and diseases	10	8.3
Lack of credit facilities	12	10.0
Pilfering and theft of farm produce	14	11.7
Poor market prices	8	6.6
Bad roads and poor transport facilities	48	40.0
Poor extension and farm advisory Services	14	11.7

Source: Field survey 2020.





The result from Table 5 which revealed crop production constraints encountered by the farmers in the study area signifies that insufficient rainfall contributed to about 11.7%, incidence of pest and diseases was 8.3%, lack of credit facilities was 10%, pilfering and theft of farm produce was 11.7%, poor market prices was 6.6%, bad roads and poor transport facilities was 40% while poor extension and farm advisory services was 11.7% respectively.

General recommendation

This research results concludes that the arable cropping in the study area is profitable. However, the profitability of the enterprise could be enhanced if the existing resources are allocated more efficiently to optimize the production goal of profit maximization. In conclusion, mixed cropping enterprise is more profitable when compared with sole cropping enterprise. We, therefore, recommend the promotion of mixed cropping among arable farmers through the provision of extension services to famers and the subsidization of agricultural inputs by the government and other donors in the area and other farming sites for increased profitability and income to farm households. We also recommend that the government or farmers association set up a regulatory board which will help to regulate the various prices of farm produce or commodities so as not to eliminate a particular system of production but to strengthen all the farm production systems as complimentary to each other. The farm production systems not performing at optimum should be reviewed so as not to go into extinction due to farmers exiting them for a better and profitable system but should be upgraded to contribute to food security and improvement of farmers' welfare. From the findings of the study, it is recommended that arable crop farmers form formidable and join cooperative groups to help the pull together resources to tackle some of the constraints they face such as emergency repairs of roads and other infrastructures while waiting for response from the government and other donors. Protection of farm's properties should be made paramount by the owners of respective farms so as not to lose their farm produce to thieves. Finally, it is recommended that all other constraints from the study be addressed by all the relevant and concerned authorities to sustain crop production in the area, reduce food insecurity and eradicate hunger and poverty among arable farmers in the area and Nigeria as a whole.

Conflict of interests

The authors declare that the research was conducted in the absence of any potential conflicts of interest.

Ethical statements

The authors confirm that the ethical guidelines adopted by the journal were followed by this work, and all authors agree with the submission, content and transfer of the publication rights of the article to the journal. They also declare that the work has not been previously published nor is it being considered for publication in another journal. The authors assume full responsibility for the originality of the article, and may incur on





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