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CROP COMBINATION PATTERNS IN YAM-BASED CROPPING SYSTEMS AMONG FARMERS IN SOUTHERN ADAMAWA STATE, NIGERIA

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ABSTRACT

The study analyzed the crop combination patterns and profitability in yam-based cropping systems among farmers in southern Adamawa State, Nigeria. The specific objectives were to; identify the crop combination types and to estimate the profitability of yam-based cropping systems, Primary data were obtained from two hundred and ninety-eight (298) respondents using a simple random sampling procedure. Data were analyzed using mean, frequency counts, gross margin, and net profit analysis. Cropping systems revealed that sole yam accounted for 22.82% of the cropping system and 22.72% of the total hectares allocation, while, mixed cropping accounted for 77.18% of the cropping systems and 77.28% of the total hectares allocation. The total hectares allocation for the yam-based cropping system was 603 ha, with sole yam and mixed cropping covering 137 ha and 466 ha respectively. A total of five mixed cropping systems; yam/cowpea (22.15%), yam/maize (13.76%), yam/maize/cowpea (17.11%), yam/maize/groundnut (13.09%) and yam/sorghum/cowpea (11.07%) were identified. The result of the gross margin analysis revealed that the yam/cowpea enterprise had the highest gross margin per hectare of ₦409,735.39, while the Yam/maize/cowpea enterprise had the least gross margin per hectare of ₦254,007.44. The gross margin per hectare (GM/ha) in all six enterprises was positive, and the operating ratio was less than one. More farmers should be encouraged by Government and non-governmental organizations to go into yam production enterprise because it is profitable.

Keywords: Crop combination, profitability, yam-based, farmers.

INTRODUCTION

Intercropping is a farming practice involving two or more crop species, or genotypes, growing together and coexisting for a time (Rob *et al.*, 2017). Intercropping is advocated due to its benefits for yield increase on a given piece of land by making use of resources that would otherwise not be utilized by a single crop (Gana, 2017). Careful planning is required for the practice of intercropping arable crops. This includes taking into account the soil, climate, crops, and varieties. It is particularly important not to have crops competing with each other for physical space, nutrients, water, or light, Examples of intercropping strategies are planting a deep-rooted crop with a shallow-rooted crop or planting a tall crop with a shorter one that requires partial shade. Mixed and intercropping have more advantages in terms of resource output and profitability than sole cropping (Majeke *et al.,* 2018). The mixed cropping system provides food for today and will impact broad future issues such as poverty and hunger, and small farm families find the labour needs in mixed cropping to be both rewarding in food production and limiting as the attempt to scale up commercial activity (Francis and Porter, 2017).

Cropping systems according to Bathon *et al.* (2018) are the yearly sequence and spatial arrangement of crops on a farm during a given period of time with the objective of obtaining maximum return from each crop without compromising the soil fertility. The objective of any cropping system is efficient allocation of all production resources, maintaining stability in production and obtaining higher net returns. Selecting the appropriate cropping pattern is essential for maintaining agricultural sustainability and productivity.

Yam is grown under different cropping systems most commonly as mixed-cropping or mono-cropping. Yam-based crop mixture (YBCM) is a common crop mixture system practiced in farming communities in Nigeria (FAO, 2019). The crops in the Yam-based crop mixture are arable crops which are food crops planted and harvested at maturity within one production cycle or season. The practice of intercropping is popular because of its several advantages over sole cropping which include yield stability, security and profitability due to combined returns per unit area of land. The practice of intercropping helps to control erosion and weeds and allows for a more even distribution of farm labour compared to sole cropping and serves as an enterprise combination which is a security against crop failure (FAO, 2019). Yam-based cropping systems still pose a problem to farmers in determining the appropriate crop combinations for efficient yam business enterprise. This study therefore, analyzed the crop combination patterns in yam-based cropping systems among farmers' in southern Adamawa State. The specific objectives were to: identify the crop combination types in yam-based cropping systems in the study area; and estimate the costs and returns of yam-based cropping systems.

METHODOLOGY

The Study Area

The study was conducted in Adamawa State of Nigeria. It has an international boundary with the Cameroun Republic along its eastern border. By 2016, the state had a projected population of about 4,248,436 people (NPC, 2016). It has twenty-one (21) Local Government Areas. It is divided into three Senatorial Districts: North, South and Central. It has a distinct wet season which begins in April and ends in October and a dry season which begins in November and ends in April. The mean monthly temperature in the state ranges from 26.7^0C in the south to 27.8^0C in the northern part of the State. The mean annual rainfall pattern ranges from 700mm in the northern part of the state, to 1600mm in the southern part (National Agricultural Extension Research Laison Services (NAERLS), 2018). The major vegetation formations in the state are the Southern Guinea Savannah, Northern Guinea Savannah and Sudan Savannah.

Within each formation is an interspersion of thickets, tree savannah, open grass savannah and fringing forests in the river valleys. The major economic activities in the zone are agriculture. Major food crops of the zone are cereals, legumes and root crops. The food crops grown in the state are maize, sorghum, millet, cassava and potatoes, while cash crops such as groundnuts, cowpea, rice, yam, and sugarcane are produced in large quantities. Major livestock reared in the zone are cattle, sheep, goats, pigs and poultry (Adebayo *et al.,* 2020).

Sampling Method

Multistage and purposive sampling procedures were used in selecting the respondents. In the first stage, three Local Government Areas (LGAs) were purposively selected because they are high yam-producing areas. The selected LGAs were; Ganye, Toungo and Jada in the southern zone. In the second stage, three wards were purposively selected from each of the Local Government Areas selected because of the predominance of yam cultivation giving a total of nine wards. In the third stage, two villages from each of the wards were purposively sampled from the lists of yam-producing villages in each of the LGAs, making a total of 18 villages. Finally, a total of three hundred and thirty-nine (339) respondents were selected using a simple random sampling technique, out of which two hundred and ninety-eight (298) questionnaires were retrieved and used for the study.

Analytical Technique

Descriptive statistics such as frequency counts, mean, percentages and gross margin were used to achieve the stated objectives. The gross margin and net profit analysis were used to determine the profitability of yam–based cropping systems in Adamawa State. Gross margin was calculated for each of the enterprises. It is obtained as:

$$GM = GI - TVC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where:

$GM =$ Gross margin from yam-based production (₦/ha)

$GI =$ Gross farm income (₦/ha)

$TVC =$ Total variable cost (₦/ha)

The net farm income (NFI) is the difference between gross margin and total fixed cost of production. It is obtained as;

$$NFI = GM - TFC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:

$NFI =$ Net farm income (₦/ha)

$GM =$ Gross margin (₦/ha)

$TFC =$ Total fixed cost (₦/ha)

Fixed inputs such as machetes, hoes, cutlass, axes, sprayers, and spades in yam-based cropping systems were not normally used up in a production cycle. Therefore, the depreciation values of the assets were calculated as follows;

$$D = \frac{P_v - S_v}{N_y} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where;

D = Depreciation (₦)

P_v = Purchase value of fixed input (₦)

S_v = Salvage value of input (₦)

N_y = Number of years of life of asset (years)

Operating Ratio: The operating ratio (OR) is the total operating cost (TOC) divided by the gross income (GI).

$$OR = TOC/GI \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

RESULTS AND DISCUSSION

Crop Combination Patterns of Yam-Based Crop Framers

Table 1 shows the distribution of respondents by cropping systems. The result showed six (6) yam-based cropping systems namely; sole yam, yam/cowpea, yam/maize, yam/maize/cowpea, yam/maize/groundnut and yam/sorghum/cowpea. The study revealed that the farmers practice both sole yam and mixed cropping system. The sole yam accounted for 22.82% of the cropping system and 22.72% of the total hectares (ha) allocation, while the mixed cropping system accounted for 77.18% of the cropping system and 77.28 of the total hectares (ha) allocation. The result implied that the respondents were more into mixed cropping than sole yam, this might be due to its security against risks, should one crop fail, another may succeed in mixed cropping.

The result further revealed that yam/cowpea accounted for 22.15% of the crop combination with 19.40% of the total hectares allocation. Yam/maize/cowpea combination had 17.11% of the crop combination and 18.74% of the hectares allocation. Similarly, yam/maize/groundnut and yam/sorghum/cowpea accounted for 13.09% and 11.07% of the crop combinations with 12.94% and 12.44% of the total hectares allocation respectively.

The total hectares allocation for the yam-based cropping system was 603 ha, with sole yam and mixed cropping covering 137ha and 466ha respectively. Unlike sole yam production, mixed cropping increases yield on a given piece of land by making use of resources that would otherwise be utilized by a single crop. Mixed cropping guarantees effective management of available resources through efficient resource allocation, leading to increase in yield and income (Igwe *et al.*, 2015). Any cropping system's goal is to allocate production resources as efficiently as possible, keep production stable, and increase net returns (Bathon *et al*., 2018).

Table 1: Distribution of Respondents by Cropping Systems

Cropping systems (Enterprise)	Frequency	%	Total Area (ha)	%	Average Farm Size (ha)
Sole yam	68	22.82	137	22.72	2.01
Yam/cowpea	66	22.15	117	19.40	1.77
Yam/maize	41	13.76	83	13.76	2.02
Yam/maize/cowpea	51	17.11	113	18.74	2.22
Yam/maize/groundnut	39	13.09	78	12.94	2.00
Yam/sorghum/cowpea	33	11.07	75	12.44	2.27
Total	**298**	**100**	**603**	**100**	

Source: Field Survey, 2020

Profitability of Yam-Based Cropping Systems

Profit is the difference between the monetary value of goods produced and the cost of the resources used in their production. The amount of revenue realized and the operating cost of a business venture determines the gain or loss of an enterprise within a certain period. The trend in profitability analysis in Nigeria is usually to determine the economic viability of a particular crop or cropping system in a given region (Asala and Ebukiba, 2016).

The results of the costs and returns associated with the yam-based cropping system from where the gross margin per hectare (GM/ha) was obtained for the various cropping enterprises are presented in Table 2. The Table revealed the gross margin/ha of six (6) enterprises. Yam/cowpea had the highest GM/ha of ₦409,735.39, while yam/maize had the second highest GM/ha ₦403,533.66, followed by yam/maize/groundnut with GM/ha of ₦402,496.93. Sole

yam had GM/ha of ₦335,339.70, while yam/sorghum/cowpea and yam/maize/cowpea had GM/ha of ₦317,783.94 and ₦254,007.44 respectively.

The total variable cost per hectare (TVC/ha) in all six (6) enterprises ranged from ₦236,542.65 in sole yam to ₦293,257.27 in yam/maize/cowpea. The variable cost used for the study includes seed, fertilizer, labour, and agro-chemicals. Labour constituted the highest production cost ranging from 48.09% of the total cost of production (TC)/ha in yam/maize/groundnut to 53.95% of (TC)/ha in sole yam enterprise. The GM/ha in all six (6) enterprises was positive and the operating ratio was less than 1, which shows that there is higher returns per naira invested. An operating ratio of one means the gross income barely covers the expenses of the variable inputs used on the farm. In other words, such a business could survive only in the short run and could fold up if correct adjustments are not made to improve the usage of variable resources in terms of reducing costs or increasing gross income. The result agreed with the findings of Adeyemo *et al.* (2017) who reported that yam production enterprise is profitable.

Table 2: Result of Costs and Returns Associated with Yam-Based Cropping Systems

Cropping Enterprises	Costs in (₦/ha)						
	Total Variable Cost (TVC)	Total Fixed Cost (TFC)	Total Cost (TC)	Gross Income (GI/ha)	Gross Margin (GM/ha)	Net Farm Income (NFI/ha)	Operating Ratio (OR)
Sole Yam	236,542.65	23,206.20	259,748.85	571,882.35	335,339.70	312,133.50	0.41
Yam/Cowpea	264,522.19	21,655.03	286,177.22	674,257.58	409,735.39	388,080.36	0.39
Yam/Maize	247,466.34	17,810.54	265,276.88	651,000.00	403,533.66	385,723.12	0.38
Yam/Maize/Cowpea	293,257.27	23,147.96	316,405.23	547,264.71	254,007.44	230,859.48	0.54
Yam/Maize/Groundnut	240,464.61	21,174.18	261,638.79	642,961.54	402,496.93	381,322.75	0.37
Yam/Sorghum/Cowpea	289,000.91	22,602.73	311,603.64	606,784.85	317,784.85	295,181.21	0.48

Source: Field Survey, 2020

CONCLUSION AND RECOMMENDATIONS

The yam-based cropping system was found to be a profitable venture among the farmers in southern Adamawa. State. The farmers practiced both sole yam and mixed cropping systems. Farmers' combination patterns in yam-based cropping systems in the area were yam/cowpea, yam/maize, yam/maize/cowpea, yam/maize/groundnut, and yam/sorghum/cowpea. Mixed cropping dominated the cropping system. The study recommended that a prototype combination of crops should be fashioned out and integrated into the extension education package of Agricultural Development Programmes (ADPs) for dissemination to farmers. More farmers should be encouraged by Government and non-governmental organizations to go into yam production enterprise because it is profitable.

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