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Production Risk And Level Of Output In Internal And External Inputs Use Among Cassava Farmers In Bayelsa State, Nigeria

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ABSTRACT

This study investigated production risk and output levels in using internal and external inputs among cassava farmers in Bayelsa State, Nigeria. It aimed to assess risk sources and output levels associated with internal and external inputs. A multistage sampling technique was used to select 173 internal input users and 161 external input users. Data collection involved validated questionnaires, and analyses were conducted using descriptive and inferential statistics. The results of the risks across input users showed that Internal input users faced higher risks from theft, animal destruction, and insecurity, followed by pest/disease attacks and poor infrastructure, while external input users were pests and diseases, theft/insecurity, high costs of inputs, lack of credit, and poor access to storage and markets. The results of Output levels were higher among external input users (22.37 t/ha) than internal input users (18.38 t/ha), though both groups experienced low yield rates (26.59% and 21.74%, respectively).

1. Introduction

Nigeria, like other developing countries, is principally an agrarian nation that still faces an ever-increasing food crisis, as the level of food production is yet to keep pace with demand (Maarten *et al*., 2016). Though endowed with a large expanse of land for crop production, reports still show that Nigeria cannot produce the food her population requires and has thus been depending on food importation to meet her domestic demands (Ibrahim *et al*, 2021). The agricultural sector has the potential to be the industrial and economic springboard from which a country's development can take off. Indeed, often, agricultural activities are usually concentrated in the rural areas where there is a critical need for rural transformation, redistribution, poverty alleviation and socio-economic development (Metu*et al*., 2016 and FAO, 2019). Agriculture is the largest non-oil export earner and largest employer of labour, accounting for about 88% of the non-oil foreign exchange earnings and over 70% of the active labour force of the population (Anyanwu and Ezedinma, 2006; CBN, 2012; and National Bureau of Statistics (NBS), 2017). Sustainable growth rates of the Nigerian economy cannot be achieved in the absence of increased agricultural output, such as cassava and other staples. Cassava, a perennial woody shrub with an edible root, was first cultivated in South America and introduced to Nigeria in the sixteenth century (Adeniji*et al*., 2005). However, Cassava is considered food for the poor and has a widely criticized crop for its propensity to deplete soil nutrients and open the farmland to erosion (Hershey *et.al*, 2001).

Given this, a large proportion of Cassava crops are grown on marginal lands (bad topography) that are usually not competitive (not too good for other crops), and some others are not tractor-friendly. Another complication around Cassava production is that the type of land tenure system in Nigeria and other countries in Sub-Saharan Africa does not allow for large farm holdings suitable for mechanization. Most Cassava farmers cultivate small farm areas, which are not conducive or economical for mechanization. Yet Abass*et.al* (2014) have argued that without mechanization, using improved inputs alone will not sufficiently boost cassava production in Nigeria. Despite these challenges, Cassava is one of the fastest

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expanding staple food crops in consuming countries and has continued to gain prominence among farmers, while the industrial demand is also rising consistently (FAO, 2018). Globally, world Cassava production as of 2018 stood at about 278 million tones ;Africa's total production was about 170 million tonnes (about 56% of world production) (FAOSTAT, 2019). At the same period, Nigeria produced about 60milli0n tonnes (FAOSTAT, 2019). Nigeria, the largest producer in the world, but a trend in yield performance (production per hectare) that remains low.

This low yield may be linked to inefficient agronomic practices and inefficient management of production resources (Tadele and Assefa, 2012; and Fakayode*et al,* 2008). According to Moyo (2016). Poor management of agricultural lands has consistently affected the sustainable production of food in Sub-Saharan Africa. Cassava products are a dietary staple food in Nigeria and other countries in Sub-Saharan Africa. These products include: Cassava flakes (gari), Cassava flour (*pupuru* and *lafun*), and cassava paste (fufu), which are derived from Cassava roots. It is a widely accepted energy food source for over 600 million consumers of Cassava across the globe (FAO 2015). Cassava is produced by farmers in Bayelsa State of Nigeria. These farmers use internal inputs such as residues, animal manure, legumes, green manure, off-farm organic wastes and biological pest control measures. In contrast, some others use external inputs such as synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. Production risk derives from the uncertain natural growth processes of crops and livestock. Weather, disease, pest, technological change and other factors affect both the quantity and quality of commodities produced. The agricultural producers or farmers face a series of risks that may impact the income and welfare of their business and household (Diaz-Canja et *al,* 2008). Risk is highlighted as a present aspect of agricultural business, and it is a priority area for agricultural producers to manage risk effectively (Vasvari 2015).

Recent studies have advanced the understanding of cassava production efficiency in Nigeria.These studies have explored various factors influencing efficiency, including farm size, labour, fertilizer use, and socio-economic characteristics.Akinola *et al*. (2020) analyzed production efficiency in Ogun State, revealing that farm size, fertilizer quantity, and cassava stem cuttings significantly influenced output, while household size and educational status affected technical inefficiency. Similarly, Zubairu*et al*. (2020) assessed technical efficiency in Taraba State, finding that farm size, family labour, and fertilizer use were positively related to cassava output. In Imo State, Nwosu and Gbolagun (2021) examined allocative efficiency, identifying factors such as age, farm size, education, and cooperative membership as significant determinants. Additionally, Onu and Echebiri (2020) studied technical efficiency among smallholder cassava farmers in Owerri West, highlighting the importance of cassava cuttings and herbicides in enhancing productivity. Despite these contributions, there remains a research gap concerning the modelling of production risk and output levels about internal and external input use among cassava farmers in Bayelsa State. Addressing this gap is crucial for developing targeted interventions to improve cassava production efficiency in the region.

To address these issues, the study considered the following objectives;
i. identify all the risk sources associated with the internal and external inputs use among cassava farmers in the study area,
ii. determine and compare the level of output associated with internal and external inputs use among cassava farmers in the study area,

2. Materials and Methods

The study was conducted in Bayelsa State, Nigeria. Bayelsa State is in the South–South part of Nigeria, with an area of about 10,773 square kilometres and a population of 1,950,000 people (NPC, 2015). The state is geographically located between Latitudes 04° 15' North and 05° 23' North and Longitudes 05° 22' East and 06 ° 45' East. It shares boundaries with Delta State on the North, Rivers State on the East, and the Atlantic Ocean on the West and South. Bayelsa State is a picturesque tropical rain forest, and more than three-quarters of its area is covered by water, with a moderately low land stretching from Ekeremor to Nembe. The area lies almost entirely below sea level, with a maze of meandering creeks and mangrove swamps. The network of several creeks and rivers in the South flows into the Atlantic Ocean via the major rivers such as San Bartholomew, Brass, Nun, Ramos, Santa Barbara, St. Nicholas, Sangana, Fishtown, Ikebiri Creek, Middleton, Digatoro Creek, Pennington and Dobo. The vegetation is characterized by the mangrove forest. It has a thick forest with arable lands for cultivation of various food and cash crops. The State is endowed with rich and diversified marine life and an abundant forestry. Some of the agricultural resources include Food Crops, Timber Trees and Non-timber Forest Products. The food crops include; Rice, Bananas, Plantain, Yam, Cassava, Cocoyam, Sweet Potatoes, and Maize. Most of the agricultural land in the state has the problem of Oil Pollution and gas flares pollution that affects agricultural productivity. Cassava, maize, cocoyam, and plantain are the major food crops engaged in by farmers in the area, while many others engage in fishery, timber trees, and non-timber forest products. Some cassava farmers use organic inputs such as animal manure, kitchen wastes, compost, poultry droppings, etc, while others use external inputs such as inorganic fertilizers, pesticides, herbicides, etc. Multi-stage sampling procedure was used in this study. In the first stage, two (2) LGAs were purposively selected in each of the three Agricultural Zones of Bayelsa State based on some farmlands that were not seriously affected by oil spillages and pollution. In the second stage, three (3) communities were randomly selected from the two LGAs, making a total of six (6) communities. In the third stage, four (4) villages were selected randomly from the six communities, making a total of twenty-four (24) villages. In the fourth stage, the list of registered cassava farmers was used to stratify the farmers into external input and internal input users, and a random sampling technique was used to select 173 internal input users of cassava farmers and 161 external input users of cassava farmers. making a total of 334 cassava farmers, which was used as the sample size for the study. The internal inputs are the organic manure, poultry droppings, and many more, and the external inputs are the inorganic fertilizer and pesticides, and many more. primary data were collected through a well-structured questionnaire, interview, and focal group discussion. Practical field measurement of plots was done through the global positioning system (GPS). A combination of analytical tools, including descriptive statistical and econometric procedures, was utilized in data analyses. A 5-point Likert scale was used to capture farmers' perceptions of specific risk factors. Respondents were asked to indicate their level of agreement with a series of risk-related statements, using the following Likert scale: Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1). Each identified risk source was rated by the farmers, and the mean score for each risk was computed across all respondents. The mean Likert scores served as an index for ranking the perceived risk source. A higher mean score indicated a stronger perception of that risk among the farmers. Based on these scores, the risks were ranked in descending order to determine which factors were considered most critical. This approach enabled a comparative analysis between internal and external input users in terms of the intensity and frequency of the risks they faced. The model is specified as follows;

$$\bar{X} = \frac{\sum_{i=1}^{n} x_i}{n} \quad \text{- - - Equation (3.1)}$$

Where
$\bar{X}$= is the mean Likert score for that risk source
n = is the total number of respondents
xi = is the score given by each farmer
mean value of the responses was used to rank the risks.
The output level of output associated with internal and external inputs among cassava farmers in the study area, was achieved using descriptive statistical tools such as frequency counts, percentages, and mean. The mean value was used to categorizing the level of output associated with internal and external inputs used by the farmers.

Decision rule
Mean value, less than 7 t/ha = Very Low Output (VLO)
Mean Value, 7 – 12 t/ha = Low Output (LO)
Mean Value, 13 – 20 t/ha = Moderate Output (MO)
Mean Value, 21 – 30 = High Output (HO)
Mean Value, 31 above = Very High Output (VHO)

3. Results and Discussions

Risk Sources Associated with External and Internal Input Use in Cassava Farming
Tables 1 (a) and 1 (b) present the results of the sources of risks associated with external and internal inputs to users.

Table 1(a): Distribution According to Risk Sources Associated with Internal Input Use

Risk sources	Strongly agree (5)		Agree (4)		Undecided (3)		Disagree (2)		Strongly disagree (1)		Mean	Rank
	F	%	F	%	F	%	F	%	F	%		
Disease/pest	111	64.2	50	28.9	5	2.9	5	2.9	2	1.2	**4.53***	**2nd**
Climate change	50	28.9	20	11.6	50	28.9	40	23.1	13	7.5	**2.85**	**14th**
Price instability	100	57.8	45	26.0	10	5.8	15	8.7	3	1.7	**4.29***	**3rd**
Interest rate	50	28.9	30	17.3	70	40.5	20	11.6	3	1.7	**3.68***	**11th**
Late access to inputs	25	14.5	30	17.3	10	5.8	75	43.4	33	19.1	**1.94**	**16th**
Credit unavailability	20	11.6	20	11.6	55	31.8	76	43.9	2	1.2	**2.88**	**12th**
Tax regime	20	11.6	20	11.6	50	28.9	70	40.5	13	7.5	**2.87**	**13th**
Theft from humans/Animal destruction	140	80.9	30	17.3	2	1.1	1	0.5	0	0.0	**4.78***	**1st**
Health/death	80	46.2	50	28.9	40	23.1	2	1.1	1	0.5	**4.19***	**7th**
Post-harvest losses	75	43.4	65	37.6	30	17.3	2	1.1	1	0.5	**4.20***	**6th**
Lack of improved technologies	50	28.9	62	35.9	40	23.1	20	11.6	1	0.5	**3.81***	**9th**
Poor transportation	70	40.5	85	49.1	11	6.3	3	1.7	4	2.3	**4.23***	**4th**
Fragmented land holdings	59	34.1	48	27.8	57	32.9	3	1.7	6	3.4	**3.89***	**8th**
Lack of storage facilities	72	41.6	84	48.6	7	4.1	2	1.1	8	4.6	**4.21***	**5th**
High cost of land	10	5.7	25	14.5	17	9.8	75	43.4	46	26.6	**2.27**	**15th**
High cost of fertilizers/manure	62	35.9	57	32.9	20	11.6	21	12.1	13	7.5	**3.78***	**10th**

*Field survey Data, 2024 *Significant factors F = (Frequency)*

Table 1 (a) shows that the most significant risks encountered by cassava farmers who rely on internal inputs include theft (particularly by humans), destruction of crops by roaming animals such as cattle, and general insecurity in farming communities. These are followed, in order of severity, by the prevalence of pests and diseases, price instability, poor transportation infrastructure, and the lack of adequate storage facilities. Additionally, post-harvest losses, as well as health challenges and eventual mortality among farmers, were identified as substantial risk factors.

These findings are consistent with previous studies by Emenyonu *et al*. (2020) and Ajah *et al.* (2022), which also highlighted pests, diseases, and inadequate transportation systems as key risks affecting cassava production in Nigeria. Such risks critically undermine the efficiency of farm operations, emphasizing the urgent need for proactive and context-specific risk mitigation strategies. Farmers dependent on internal inputs, often constrained by limited capital and rudimentary technologies, are particularly vulnerable. Unlike their counterparts who utilize external inputs and may have access to more sophisticated tools or institutional support, internal input users face heightened exposure to production risks, further exacerbating their challenges and threatening their livelihoods.

Table 1 (b): Risk Sources Associated with External Input Use in Cassava Farming

Risk sources	Strongly agree (5)		Agree (4)		Undecided (3)		Disagree (2)		Strongly disagree (1)		Mean	Rank
	F	%	F	%	F	%	F	%	F	%		
Disease/pest	42	26.1	40	24.8	40	24.8	20	12.4	19	11.8	**3.41***	**12th**
Climate change	70	43.5	50	31.1	19	11.8	10	6.2	12	7.5	**3.95***	**10th**
Price variation	85	52.8	42	26.1	15	9.3	11	6.8	8	5.0	**4.15***	**8th**
Interest rate	40	24.8	28	17.4	20	12.4	50	31.1	23	14.3	**3.07***	
Late access to inputs	75	46.6	60	37.2	10	6.2	15	9.3	1	0.6	**4.21***	**6th**
Credit unavailability	90	55.9	50	31.1	15	9.3	3	1.9	3	1.9	**4.37***	**3rd**
Tax regime	70	43.5	50	31.1	30	18.6	10	6.2	1	0.6	**4.10***	**9th**
Theft from humans/insecurity	130	80.7	31	19.3	0	0.0	0	0.0	0	0.0	**4.81***	**1st**
Health/death	80	49.7	50	31.1	20	12.4	5	3.1	6	3.7	**4.18***	**7th**
Post-harvest losses	45	28.0	25	15.5	50	31.1	30	18.6	11	6.8	**3.38***	**13th**
Lack of improved technologies	30	18.6	42	26.1	50	31.1	30	18.6	9	5.5	**3.51***	**11th**
Poor transportation	80	49.7	56	34.8	14	8.6	7	4.3	4	2.5	**4.28***	**5th**
Fragmented land holdings	40	24.8	30	18.6	50	31.1	30	18.6	11	6.8	**3.35***	**14th**
Lack of storage facilities	90	55.9	54	33.5	10	6.2	6	3.7	1	0.6	**4.41***	**2nd**
High cost of land	96	59.6	35	21.7	15	9.3	13	8.1	2	1.2	**4.30***	**4th**
High cost of fertilizers/manure	85	52.8	48	29.8	18	11.1	9	5.6	1	0.6	**4.28***	**5th**

*Field survey Data, 2024 *Significant factors F = (Frequency)*

Table 1(b) highlights the key risks associated with the use of external inputs among cassava farmers. Unlike their counterparts, who rely on internal inputs whose major concerns were pest infestations, crop diseases, and threats from theft or insecurity, external input users identified a lack of storage facilities and theft/insecurity as their most pressing challenges. Other significant risks reported include lack of access to credit, high cost of land, rising prices of fertilizers, poor transportation infrastructure, and health-related risks, including the eventual death of farmers. Supporting these findings, Olowogbon *et al.* (2021) observed that the use of agrochemicals, while effective in enhancing productivity, poses serious health hazards to farmers, particularly when applied without proper protective measures. This aligns with the work of Aktar *et al*. (2009), who also emphasized the toxicological risks of pesticide exposure. Interestingly, while external input users may have experienced fewer pest- and disease-related losses, likely due to their use of pesticides and chemical treatments, they face a trade-off in terms of heightened health risks. The increased productivity associated with external input usage creates an additional burden: the urgent need for adequate storage facilities to prevent post-harvest losses. Without these, much of the benefit from higher yields is negated. This underscores the dynamic nature of risk in agricultural systems, where solving one problem can inadvertently introduce another, making adaptability a core requirement for sustainability in cassava production. A further constraint faced by external input users is the limited availability of accessible credit. Given the capital-intensive nature of external inputs, such as tractors, agrochemicals, hired labour, and mechanized land preparation, many farmers are unable to fund operations solely through personal savings. This makes financial support from banks, cooperatives, and both governmental and non-governmental organizations crucial. Enhancing access to credit and input subsidies could help mitigate these risks and ensure more equitable access to modern farming tools. Additionally, while the use of external inputs offers clear advantages in terms of output, it introduces its own set of risks, particularly those tied to capital, infrastructure, and health. Estimated Output of Cassava and the Levels of Output Associated with Internal and External Inputs Use among Cassava Farmers. The result of the estimated output in tons per hectare and the levels of output associated with internal and external inputs used among the cassava farmers are presented in Table 2

Table 2: Distribution of respondents according to output and their levels of output

Internal Input User			External Input User			Pooled Sample		
Output of cassava (Tons/Ha)	**F**	**%**	**Output of cassava (Tons/Ha)**	**F**	**%**	**Output of cassava (Tons/Ha)**	**F**	**%**
5.1 – 10	25	14.45	5.1 – 10	*3*	*1.86*	5.1 – 10	72	8.38
10.1 -15	46	26.59	10.1 -15	35	21.74	10.1 -15	81	24.25
15.1-20	34	19.65	15.1-20	31	19.25	15.1-20	65	19.46
20.1 -25	28	16.18	20.1 -25	30	18.63	20.1 -25	58	17.37
25.1 -30	25	14.45	25.1 -30	33	20.50	25.1 -30	58	17.37
30.1-35	13	7.51	30.1-35	18	11.10	30.1-35	31	9.28
35.5 – 40	2	1.14	35.5 – 40	11	6.83	35.5 – 40	13	3.89
Total	**173**	**100**		**161**	**100**		**334**	**100**
Meanvalue	**18.38/ha**			**22.37/ha**			**20.26/ha**	
		Categorization	**of Levels of**	**Output**				
Internal Input User			**External Input User**			**Pooled Sample**		
Output Level	**F**	**%**	**Output Level**	**F**	**%**	**Output Level**	**F**	**%**
Very Low Output	40	23.12	Very Low Output	*32*	*19.88*	Very Low Output	72	21.56
Low Output	46	26.59	Low Output	35	21.74	Low Output	81	24.25
Moderate Output	34	19.65	Moderate Output	31	19.25	Moderate Output	65	20.36
High Output	28	16.18	High Output	30	18.63	High Output	58	17.37
Very High Output	25	14.45	Very High Output	33	20.50	Very High Output	58	17.37
Total	**173**			**161**			**334**	

Source: Field survey Data, 2024. F (Frequency), Mean Value < 7 tons/ha (Very Low Output), Mean Value 7 – 12 tons/ha (Low Output), Mean Value 13 -20 (Moderate Output), Mean Value 21 – 30 tons/ha (High Output), Mean Value 31 – 40 and above tons/ha (Very High Output)

Table 2 presents the cassava output levels among farmers utilizing internal and external inputs in Bayelsa State. The mean output for internal input users was 18.38 tons/ha, while external input users achieved a higher mean output of 22.37 tons/ha. The pooled sample across both groups yielded an average of 20.26 tons/ha. These figures indicate that external input usage correlates with increased cassava productivity, aligning with findings from Srivastava et al. (2023), who emphasized the role of improved agronomic practices in enhancing yields. Despite the observed differences in mean outputs, statistical analysis revealed no significant difference between the two groups. The calculated t-value ($t_{cal} = 0.11$) was less than the critical t-value ($t_{tab} = 1.96$) at a 5% significance level, suggesting that while external inputs may boost yields, the variation is not statistically significant within the study's context. Further categorization of output levels showed that 26.59% of internal input users and 21.74% of external input users experienced low output levels, with the pooled sample reflecting a 24.25% incidence of low yields. This underscores the persistent challenges in achieving optimal cassava production, regardless of input type. Meanwhile, despite Nigeria being the world's largest cassava producer, it grapples with a low yield per hectare, averaging around 8 tons/ha, significantly lower. However, the lack of significant statistical difference between input types suggests that merely increasing input usage may not suffice. Factors such as access to credit, improved cassava varieties, and extension services play crucial roles in optimizing yields. For instance, Olugbenga *et al*. (2022) highlighted the importance of farm size and fertilizer input in influencing cassava output.

4.Conclusion

This study concludes with the interplay between production risks and the level of output in the use of internal and external inputs among cassava farmers in Bayelsa State, Nigeria. The findings revealed that risk factors were diverse and input-specific. Internal input users were more vulnerable to theft, animal destruction, and general insecurity, whereas external input users contended with pest/disease pressure, high input costs, and access-related issues. These findings underscore the need for tailored risk management strategies, improved extension services, and input policy reforms.

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