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VALUE CHAIN ANALYSIS OF COCOYAM ENTERPRISE IN SOUTHWEST REGION, NIGERIA

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ABSTRACT— Cocoyam farming in Nigeria is mostly practiced at subsistence level. Farmers that produce cocoyam only produce in small quantity and hence, limit its value chain propensity. This study examines value chain processes of cocoyam, return on investment, and factors influencing its participation. Study was carried out in Ondo state and Ekiti state, South-west, Nigeria. Primary data was collected through multistage sampling technique. Pre- tested questionnaire was administered on 320 respondents. Descriptive statistics, gross-margin analysis, stochastic dominance, return-on-investment and logistic regression were used to analyze the data. Average age of cocoyam farmers is 45 years. Female cocoyam farmers (particularly married ones) engaged more on value chain than their male counterpart by 21.4%, although, male has a longer farming experience. A relative household size exists (mean of 6.6) and this has been used for family-labour on cocoyam production and processing. Education has been seen to influence participation in cocoyam value chain processes as 58.7% that had post-primary education, 70.1% participated in value chain processes. Majority of the respondents (55%) engaged in cocoyam value chain, particularly on flour and derivatives (30.9%), livestock feeds (24%) and into medicinal uses (11.3%). Cocoyam processed in all chain processes had positive ROI, while medicinal uses had a higher ROI indicating a strong viability of participation in cocoyam value chain activities particularly in Ondo State. Value addition to cocoyam is profitable and return on investment is more plausible for medicinal purposes and needs to be encouraged.

KEYWORDS: Cocoyam worth sequence, chain profitability analysis, stochastic ascendency, south-west, Nigeria

1. INTRODUCTION

Nigeria, with an estimated population of approximately 197 million people, is the largest black nation on earth, accounting for about 47% of West Africa's population [66]. It constitutes about one fifth of the total population of Sub-Saharan Africa. Agriculture constitutes about 75% of the rural economic activities, and contributes about 40 percent to the GDP [20]. In the seventies, when the oil boom era came into being, attention from agricultural development shifted to petrochemical development. Hence, petroleum exploration and exportation became the major source of government revenue [32]. However, despite the diversion of attention from agriculture as a source of government revenue to petroleum resources, agriculture still remained as the most important sector in Nigeria's economy. Petroleum export remained the exclusive preserve of government revenue while engagement in agriculture is still the livelihood of the majority [41], [32]. Nigeria's dependence on oil export alone, made the general economy open to shocks generated by international oil prices [32]. Prior to 1956, Nigeria was known for her prolificacy in agriculture. Today, less than half of Nigeria's arable land is being put to use; only a small percentage is being optimally utilized. [9]. Past studies revealed that the collapse of oil prices of the 1980s was the beginning of Nigeria's economic problems [32].

Revenue from oil export declined from $20 billion in 1980, to $10 billion in 1982. This led to Nigeria's inability to pay its 21 short-term debts and to purchase essential imports. The economy, which has already been weakened by corruption and mismanagement, sunk into severe recession [6]. At this period, Nigeria's food import bill rose steadily from N24 million in the mid-1950s to N47million, N126 million, N2 billion and N7 billion in 1960s, 1970s 1980s, 2000srespectively, by the year 2017, the import bill for Wheat, Rice, Sugar and Fish put together reached N1.31trillion [30], [21]. Past studies have documented various agricultural products that rural farmers used to augment food supply and meet nutrition needs of their respective households. These products include cassava, cocoyam, yam, potatoes among others. Several studies have documented the value of these agricultural products with the exception of cocoyam. Cocoyam is a perennial crop grown in Nigeria mainly for its edible roots. [27]. Nigeria is the highest producer of cocoyam in the world, with about 3,450,000 metric tonnes [17], accounting for over 40% of world production and over 70% of production in West Africa [18]. It ranks third in importance after cassava and yam, among the root and tuber crop cultivated and consumed in Nigeria [46]. [11] stated that cocoyam is a member of Araceae family and constitute one of the six most important root and tuber crops worldwide [13]. Cocoyam is rich in digestive starch, good quality protein, vitamin C, thiamine, riboflavin, niacin and high scores of protein and essential amino acids [55], [40]. In the Eastern part of Nigeria, it serves as staple food and is used as a thickener in food preparations especially the varieties Colocasiaesculenta and Xanthosoma cultivar. [33] emphasized that cocoyam can be processed into cocoyam flour and chips. Cocoyam can be used for the production of alcohol, medicines, flour and starch [28]. Stabilizing cocoyam tuber and adding value could greatly improve its utilization in cocoyam producing countries [61]. [59] deduced that the mechanisms for increasing efficiency of the crop is through value chain processes. Hence, this is a reference point for improvements in services and in the business environment. The value chain approach is being used to drive high-impact product for better productivity, competitiveness, entrepreneurship, and the growth of small and medium enterprises (SMEs) [32].

Value chain analysis looks at the effective utilization of resources to create competitive advantage in other to provide lower cost, attract quality market and improve profit margins. The number and conduct of the participants along the value chain determine its efficiency, pricing and returns accruing to each participant at every stage [25]. The value chain approach is designed to help policy makers and project planners on intervention strategies to improve welfare [26]. Value addition at various stages of the cocoyamchain would bring improvements in the cocoyam sector. The value addition starts from the input supply, and flows through the production, processing and marketing stages. Hence, this study wants to look at the chains along cocoyam production and its antecedent values that is attached along the chain. Cocoyam farming in Nigeria is mostly practiced at subsistence level. Farmers that produce cocoyam only produce in small quantity and hence, limits its value chain propensity. Cocoyam production has not been given much attention in most developing countries like Nigeria, probably because of its inability to earn foreign exchange. [60], [52]. Most of what is produced is consumed locally [43], [52] due to its low scale of production. Although, cocoyam is important and it has the ability to generate special benefits, none of these numerous benefits such as medicinal values and livestock feeds have been considered. Although, there is limited information on the value chain processes of cocoyam, which perhaps contributes to the less attraction of the product [49]. Also, resource allocation to cocoyam is significantly low when compared to crops such as yam and cassava [51]. Cocoyam farmers are generally found on a small scale and its production has been undermined, especially its medicinal values. Arising from the foregoing, the study examines value chain processes of cocoyam. Past study argued that cocoyam is one of the major roots and tuber crops in Nigeria which is fast becoming an underutilized crop [1]. It is therefore imperative to analyze the value chain processes of cocoyam and return on investment. This is to enhanceits productivity, competitiveness and entrepreneurship. Hence, the study examines the following objectives; identify the production chains of cocoyam in the study area; value-added along the production

chain; determine the costs and benefits incurred along the value chain and factors influencing participation in the identified value chain processes.

2. CONCEPTUAL FRAMEWORK

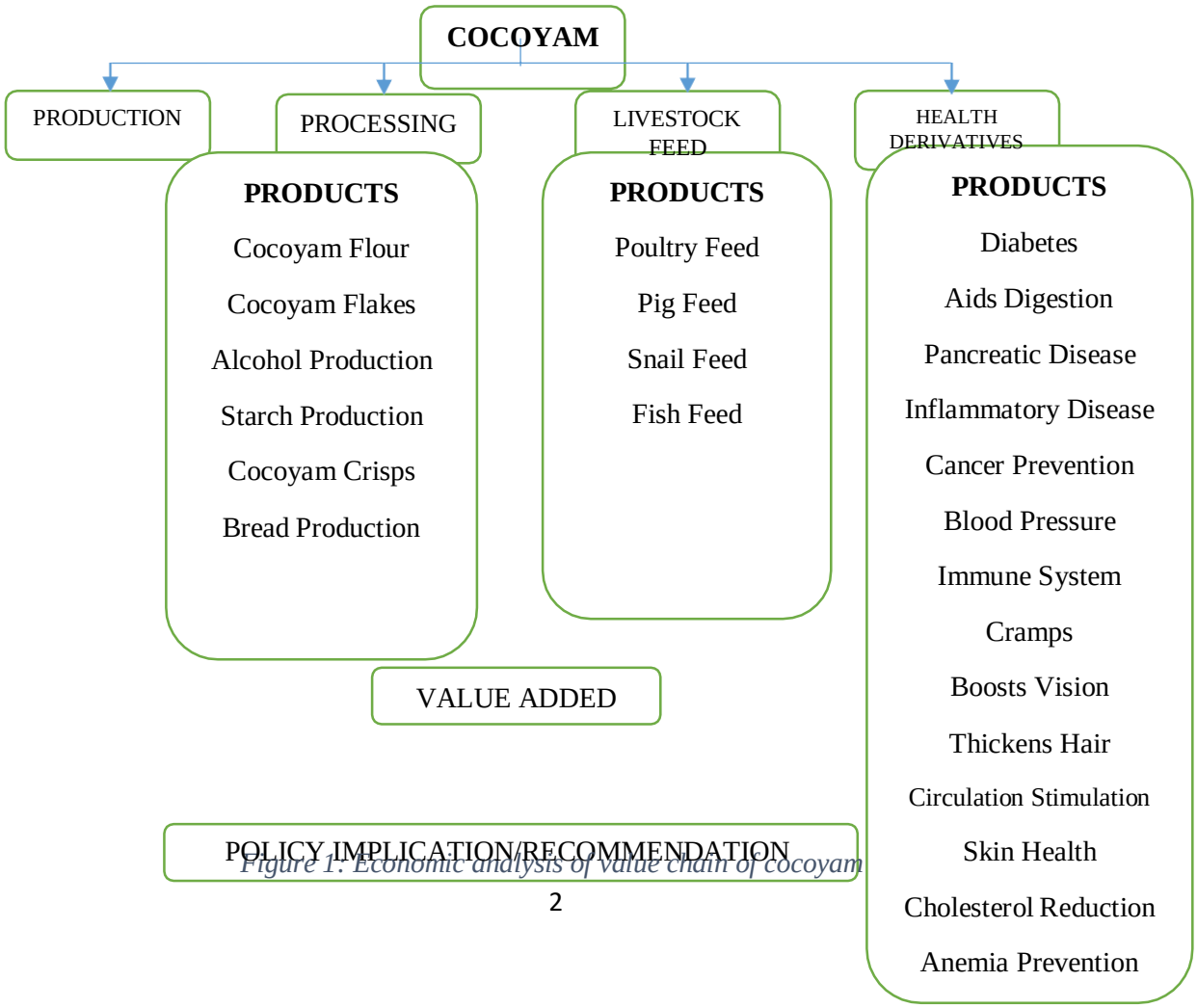

Figure 1: Economic analysis of value chain of cocoyam

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3. METHODOLOGY

3.1 Study area

The study was carried out in selected local Government Areas of Ekiti state and Ondo state of Nigeria. The two states are among the major areas where cocoyam is produced in South west of Nigeria. The choice of Ekiti state is because Ekiti is one of the largest producers of cocoyam, while Ondo state is the largest processor of cocoyam into various forms, particularly into livestock feeds and medicinal uses [44]. Figures 1&2 shows the map of Ondo state and Ekiti states. Ondo state has a land area of 14,788 square kilometers and a population of about 3,460,877. The state lies between longitudes 4”30 and 6” East of the Greenwich Meridian, 5”45” and 8”15” North of the Equator. [56]. Ekiti state is located between longitudes 40°51′ and 50°451′ East of the Greenwich meridian and latitudes 70°151′ and 80°51′ north of the Equator. Ekiti state has a population of about 2,384,212 (National Population Commission, 2006). Ondo state has 18 Local Government Areas while Ekiti state has 16 Local Government Areas. Ekiti State is one of the largest producers of Cocoyam in Nigeria with about 214,970 metric tonnes in 2006 while Ondo state is the largest processor of cocoyam into various forms with about 243,850 metric tonnes of cocoyam. [44].

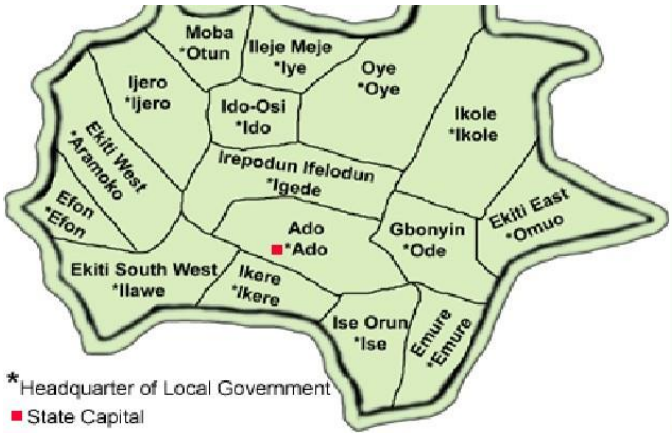

Figure 1: Map of Ondo State, Nigeria

Figure 2: Map of Ekiti state, Nigeria

Primary data was used for this study. This was collected with the aid of a pretested structured questionnaire. Information was collected on farmer's socio-economic characteristics such as age, household size, educational status, amount of credit received, production information; level of inputs used and output in cocoyam production, production value-chain, constraints faced by the farmers in cocoyam production, post-harvest processing (if any).

3.2 Sampling Procedure and Sample Size

A multistage sampling technique was employed in selecting respondents for this study. The first stage was selection of two (2) Local Government Areas from each state based on the predominance of cocoyam production and processing. Secondly, four villages were randomly selected in each of the local government areas. While, third stage was a random selection of twenty (22) cocoyam farmers from each of the towns/villages to give a sample size of three hundred and twenty (352) for the study. However, three hundred and twenty (320) respondents' (90.1% response rate) data were useful for data analysis. The remaining data contained missing information, inappropriate data entry, questionnaire loss in transit and unreturned questionnaire.

Table 1: Selected Local Government Areas and Towns/Villages

State	LGA	Towns/Villages
Ondo	Ondo West	Gbagegha, Gbongo, Ilunla, Araromi
	Owo	Ipele, Iyere, Emure, Ogbese
Ekiti	Emure	Okeseri, Owode, Emure, Odoba
	Gbonyin	Aisegba, Bolorunduro, Ilumoba, Agbado

Source: Field survey, 2020

3.3 Method of Data Analysis

Descriptive statistics, Gross Margin Analysis, return on Investment analysis, Stochastic Dominance Analysis and Logistic Regression Model were used to analyze the data.

3.4 Gross Margin Analysis

A gross margin for an enterprise is simply its financial output minus its variable costs [21]. For the purpose

of this study, gross margin analysis and profitability ratio were determined and calculated in order to determine the cost implications and benefits incurred along the value chain of cocoyam in Ekiti and Ondo states. Mathematically, gross margin is expressed as:

Gross Margin (GM) = Total Revenue (TR) – Total Variable Cost (TVC)
Profitability ratio (Pr) is expressed as the ratio of Gross Margin to Total Variable Cost.

3.5 Return on Investment Analysis

Return on investment (ROI) is a ratio between net profit and cost of investment. ROI is a performance measure used to evaluate the efficiency of an investment. The study used ROI, to evaluate the efficiency of engagement of cocoyam farmers in value chain activities.

$$ROI = \frac{Net\ return\ on\ value\ chain\ activities}{Cost\ of\ engagement\ in\ value\ chain\ activities}\ X\ 100$$

ROI is expressed as a percentage and calculated as net return.

3.6 Stochastic Dominance Analysis

Stochastic Dominance Analysis is used to know whether a random, variable is the dominant choice because it is preferred by all agents whose utility functions share certain general characteristics. It is used to compare and rank distributions of alternative risky outcomes according to their level and dispersion (riskiness) of returns. According to Wolfstetter (1996). Stochastic dominance theory has a bearing on the old issue whether one can judge a random variable as riskier than another, regardless of who is the judge, provided that utility functions belong to a class with certain common properties.

In statistical terms, if the cumulative probability of an alternative is greater than the cumulative probability for another alternative for all levels of outcome, the technology with the higher probabilities is dominated by the technology with the lower probabilities. This is referred to as "first degree stochastic dominance". The second rule is based on the observation that, in addition to preferring more to less, human beings usually prefer to avoid low value outcomes, that is to say they are risk averse. The alternative with the greatest area under the curve at any given outcome level has the highest probability of low value results. This is referred to as "second degree stochastic dominance". Hence, this study used a second-degree stochastic dominance to examine the likelihood dominant choice of cocoyam varieties.

Table 2: Stochastic Dominance Analysis

Items	Ondo State			Ekiti State		
	Red Variety (RAR)	White variety (RAR)	Both variety (RAR)	Red Variety (RAR)	White variety (RAR)	Both variety (RAR)
Yield Estimated	48 (29)	32 (18)	80 (42)	12 (5)	20 (6)	128 (101)
Maturity retro	42 (17)	38 (25)	105 (61)	17 (11)	35 (11)	136 (93)
Disease forbearance	51 (16)	49 (23)	95 (61)	25 (15)	33 (13)	162 (83)
Soil adaptableness	55 (32)	53 (35)	89 (37)	28 (17)	28 (13)	106 (82)
Intercropping type	62 (32)	61 (39)	91 (72)	31 (19)	36 (17)	113 (97)

Source: Field Survey, 2020. Where RAR is the Risk aversion ratio

3.7 The Logistics Regression Model

Logistic regression offers recognized approach to allow prediction of relevant dichotomous outcomes. Argued

that it presents several advantages over more traditional approaches to the analysis of such data and is better explored in this context than newer data analytic procedures. However, there are a number of important considerations that need to be taken into account when planning research that will be analyzed by logistic means. These considerations include: the use of a large sample size; the use of limited numbers of predictors; and an assessment of the likely ratio of positive and negative outcomes. In this paper, logistic regression was used to analyze the relationship between several predictors (independent variables) on an outcome that is dichotomous in nature (participation in value chain activities =1 and zero otherwise). This is stated as:

$$P_n(Y_n = 1) = \frac{1}{1+exp^{-(A+B_1X_1+B_2X_2+\cdots+B_nX_n+e_{i})}} \ldots\ldots\ldots(1)$$

where: A is a constant term; β is a vector of coefficients for the independent variables X1; Yn is the dependent variable, equal to 1, if the respondent participated in value chain activities and 0 otherwise; Pn is the estimated probability of the respondent participation Eq. (1) represents the cumulative logistic distribution function. For the purpose of interpretation, it is normal to write the model in terms of log-odds ratio. With a logit transformation, the estimated model becomes a linear function of the explanatory variables,

Which is expressed as follows?

$$Logit\,\{P_n(Y_n = 1)\} = Log\,\left\{\frac{P_n}{1-P_n}\right\} = b_0 + b_1 \ldots\ldots\ldots\ldots(2)$$

Where b1 is the amount of increase in the log odds of the outcome given by an increase in one unit of the predictor, and b0 is the intercept of the model.

$$Logit\,\{P_n(Y_n = 1)\} = Log\,\left\{\frac{P_n}{1-P_n}\right\} = \alpha + \beta X_n \ldots\ldots\ldots\ldots(3)$$

Where;$P_n(Y_n = 1)\beta X_n$
Y_n = Participation in value chain processes and Return on investment =1 and 0 otherwise also with Return on investment.
β = Coefficients of the independent variables
X_n= Set of independence variables
X_1 = Age of farmers (years)
X_2 = Education
X_3 = Marital Status X4 = Sex
X_5 = Farm experience X6 = Cost of farm inputs
X_7 = Cost of processing to flour and related products X8 = Cost of livestock feeds
X_9 = Cost of medicinal value added
X_{10} = Proportion of each to the whole chain
X_{11} = Contact with Extension Agent Visit
X_{12} = Access to productive inputs
X_{13}= Household sizes e = Error term

3.8 Description of the variables

Table 3: Description of variables used in the Logit Model

Variable name	Variable type	Variable Description
Age	Continuous	Age of household head (in years)
Educational attainment	Continuous	Educational level of household head (years
Marital status	Binary	1= married and 0= unmarried
Sex	Binary	1= male and 0= female
Farm experience (cocoyam)	Continuous	Measure in years.
Cost of farm inputs	Continuous	Measured in Naira (Nigerian currency)
Cost of processing to flour and related products	Continuous	Measured in Naira (Nigerian currency)
Cost of livestock feeds	Continuous	Measured in Naira (Nigerian currency)
Cost of medicinal value added	Continuous	Measured in Naira (Nigerian currency)
Proportion of each chain processes to whole chain	Continuous	Measured in Naira (Nigerian currency)
Contact with extension	Binary	1= contact with extension and 0, otherwise
Access to productive inputs like credit, fertilizers	Continuous	1= access to productive inputs and 0, otherwise
Household sizes	Continuous	Number

Source: Field survey, 2020

3.9 Estimation technique

To determine the statistical significance of the relationship between the predictor and outcome, logistic regression uses a maximum likelihood method, which discovers the precise form of theequation that maximizes the chances of predicting the outcome based on the predictor (Karp, 2009, King and Zeng, 2001). To achieve this end, the likelihood of observing the outcomes that were actually obtained based on the logistic model, and also based on no predictors, are calculated (Eqn., 4).

$$Log - likelihood = \sum_{i=1}^{n}\{Y_i In[P(Y_i)] + (1 - Y_i) In\big(1 - p(Y_i)\big)\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The Log-likelihood statistic is analogous to the residual sum of squares in multiple regression and it is an indicator of how much unexplained information there is after the model has been fitted. Wald statistic is used to indicate whether the B coefficient is significantly different from 0. If it is significantly different from 0, then we can assume that the predictor is making a significant contribution to the prediction of the outcome variable. Hence, the paper adopted the use of Maximum Likelihood Estimation (MLE) as estimation technique.

4. RESULTS AND DISCUSSION

Many characteristics concerning rural households in Nigeria can be drawn from Table 4. The first aspect that stands out is the high level of value chain in cocoyam production. The study revealed that the average age of cocoyam farmers in the study areas is 45 years (Table 4). This is an active population that can make good use of agricultural practices and adoption of effective technology. This outcome according to will influence farmer to bear risks and still be productive. Moreover, sex distribution of the cocoyam farmers revealed that male was more (50.9%) by 1.8%. Further analysis on gender indicated that female cocoyam farmers engaged more on value chain (60.7%) than their male counterpart by 21.4%. Farming experience of cocoyam farmers in the study indicated minimum of 8 years and maximum of 36 years with an average of 18.7 years with male having a longer farming experience (Table 4). The study deduced that majority (about 57.5%) of the entire cocoyam farmers had about 16-25 years farming experience, while cocoyam farmers in Ondo state have more farming experience than farmers in Ekiti state. A proportion of the study population (93.75%) had a modest farming experience (more than 10 years) which is expected to boost their productivity. The study revealed that 61.1% of cocoyam farmers were married, single 5% and the rest were widowed/separated 26.3%. Further analysis

indicated that married cocoyam farmers involved more in values chain (81.4%), widowed 65% and single 25%. These results show that larger percentage of the cocoyam farmers are married and engaged in value chain of cocoyam production. Hence, a stable relationship exists where spouses equally share responsibilities and expectations which boost productivity (Table 4).

The mean household size in the study area is 6.6. A relative household size, depending on the educational attainment and exposure of the household head will determine the usefulness or otherwise this relatively of the household size. The study revealed a positive relationship between household size and family labour. The study deduced that 60% of the labour used in cocoyam production came from family labour (Table 4).

The study revealed that 65% of the cocoyam farmer's had post-primary education, with 21.3% attained post-secondary education. Further analysis indicated that in Ondo State there are more cocoyam farmer with post-secondary education (42.5%) than their counterpart in Ekiti state by 20%. (Table 4). In addition, out 35% with no-formal education/primary education, 58% did not engaged in value chain of cocoyam. However, out of 58.7% that had post-primary education, 70.1% participated in value chain processes with more respondents from Ondo State (Table 4). The result showed that cocoyam farmers in the two states are fairly educated people which influence value chain and income generation. Hence, dissemination of new ideas and technology can easily be accepted.

The study showed that in Ondo State majority (55%) of the farmers had a farm size between 1.01-3ha, while in Ekiti State majority (45%) of the respondents cultivated 3.01-4ha of cocoyam farmland with mean farm size of 3.3 ha. Analysis of farm size and return on investment were carried out and the result revealed that out of 58.7% that had post-primary education had a positive Benefit Cost Ratio (BCR), moderate farm size (mean of 2.45ha) and sizeable percentage return on investment (ROI) (Table 4).

Table 4: Basic Statistics of Variables that influences Value Addition of Cocoyam Farmers

Characteristics	**Ondo State**		**Ekiti State**	
Selected Variables	Mean	Std. Deviation	Mean	Std. Deviation
Household Information				
1. Age (Years)	44.65	7.06	39.25	11.18
2. Sex	1.49	0.51	1.32	0.48
3. Marital Status	2.24	0.57	2.03	0.61
4. Educational level	3.67	1.01	4.02	0.83
5. Household Size (Number)	6.64	1.63	7.01	1.73
6. Years of Farming experience (Years)	13.40	3.05	23.0	5.03
7. Other livelihood activities	Farming		Public/civil servant	
8. Cost of Farm inputs (₦)	251,735	115,201	315.020	75,219
9. Corm cost Proportion in Total input cost (%)	10.27	0.91	11.23	1.62
10. Fertilizer cost Proportion in Total input cost (%)	13.85	2.27	11.73	3.81
11. Labor cost Proportion in Total input cost (%)	10.67	1.17	14.07	2.37
12. Agrochemical cost Proportion in Total input cost (%)	8.16	3-72	12.16	2.01
13. Land preparation cost Proportion in Total input cost (%)	5.28	1.19	7.82	3.37
14. Land clearing cost Proportion in Total input cost (%)	6.63	2.91	11.49	3.95
15. Planting cost Proportion in Total input cost (%)	7.35	1.83	8.01	2.47
16. Weeding cost Proportion in Total input cost (%)	7.15	2.61	10.85	3.24
17. Harvest cost Proportion in Total input cost (%)	0.02	0.01	0.03	0.01
18. Other cost Proportion in Total input cost (%)	30.39	7.15	33.11	8.03
19. Loan Volume (Annually) ₦	201,032.	53,091.0	31,226.06	43,642.96

20. Loan interest	15.91	6.35	20.08	7.25
21. Cocoyam Farm-size	4.18	1.64	2.42	0.82
22. Cocoyam breed (White) (%)	53	12.83	33	9.26
23. Cocoyam breed (Red) (%)	72	17.28	20	4.17
24. Fresh tuber consumption (%)	28	5.35	72	6.10
25. Processed flour (%)	67	6.10	33	8.27
26. Livestock feeds (%)	69	11. 08	31	9.08
27. Medicinal value (%)	67	8.05	33	7.83
28. Benefit cost ratio (BCR) (₦)	28,912.5	15,012.8	1,186.82	10,937.81
29. BCR Livestock (₦)	25,384.1	18,010.4	5,199.29	13,358.32
30. BCR Medicinal (₦)	17,703.2	12,003.3	11401.96	10,464.83
31. Return on Investment (ROI) Processed form No.	61.02	37.11	58.66	28.91
32. ROI Livestock No.	71.15	23.63	29.41	16.62
33. ROI Medicinal No.	67.26	28.16	4.21	2.17

Source: Field Survey, 2020

4.1 Assessment of farmers' involvement in Value Chain

Findings from this research indicated that cocoyam farmers in the selected areas were not only consuming their farm produce, they went as far as processing the tubers into flour/derivatives, livestock feeds and medicinal uses (Table 5). Table 5 revealed that 55% of the respondents engaged in cocoyam value chain and 26.1% do not, while 25% sold cocoyam tuber without processed it further. Value chain analysis results indicated that 30.9% of the respondents went into processing of cocoyam into flour and derivatives, 24% into livestock feeds and 11.3% into medicinal uses. There were 2 varieties of cocoyam cultivated by respondents in the area of study, type 1 (Colocasiaesculentum), and type 2 (Xanthosomasagittifolium).

Table 5 showed that for cocoyam variety 1 (Colocasiaesculentum), 64% of the farmers cultivated this variety while 36% cultivated type 2 (Xanthosomasagittifolium). For variety 2 (Xanthosomasagittifolium), 55% of the farmers in Ondo State processed their produce into flour, 65% processed into livestock feed, 27.5% used it for medical purposes. While in Ekiti state, variety 1, 90% of the farmers processed into flour, 67.5% processed into livestock feeds and 50% utilized it'sfor medicinal purposes. Also, for variety 2, only 5% of the farmers processed their produce into flour, 5% processed into livestock feed, 35% used it for medical purposes. The study revealed that in Ondo state, 24.17% of the respondents processed their produce into flour, 28.57% processed into livestock feeds while 12.08% utilized it'sfor medicinal purposes. However, in Ekiti state, majority (46.42%) consumed their produce, only 3.57% processed into flour, 25% into livestock feeds and 4% for medicinal purposes (Table 6).

Further analysis revealed that in Ondo State cocoyam farmers consumed cocoyam products by 28.5%, while in Ekiti, the consumption is 71.5%. Moreover, Ekiti cocoyam farmers sold cocoyam tubers more (67.1%) without processed by 34.2%. whereas there was more processed cocoyam into flour and derivatives in Ondo State (65.5%) than in Ekiti State by a margin of 28.1%. Furthermore, processed of cocoyam tubers into livestock feeds by cocoyam farmers in the two states were examined and the results presented in Table 6. The results revealed that in Ondo State, there are more cocoyam farmers (64.6%) that processed cocoyam into livestock feeds than their counterparts in Ekiti state by a margin of 29.2%. Similarly, cocoyam tubers processed for medicinal uses were examined and the results indicated that Ondo state cocoyam farmers processed cocoyam for medicinal uses (66.7%) more that their counterpart from Ekiti State by 33.4% (Table 6). This evidence testified to viability of participation in cocoyam value chain activities that add value to cocoyam production particularly in Ondo State.

Table 5: Cocoyam Farmers involvement in Value Chain activities

s/n	**Activities**	**Cocoyam Type 1**	**Cocoyam Type 2**	**Total**
	Consumption	45	20	65
	Sold (Cocoyam raw)	48	31	79
	Processing to flour and derivatives	59	40	99
	Livestock feed	31	10	41
	Medicinal uses	21	15	36
	Total	**204**	**116**	**320**

Source: Field Survey, 2020

Table 5. What did you do when you harvest cocoyam product from farm1 * State (Location) Cross tabulation

Count				
		State (Location)		
		Ekiti	Ondo	Total
What did you do when you harvest cocoyam product from farm1	Consumed the whole	47	18	65
	Consumed a little and sold much (about 75%)	25	13	38
	Consumed much and sold little (about 25%)	28	13	41
	Processed majority (75%) to flour and other products	18	36	54
	Processed a little (25%) to flour and consumed more	16	29	45
	Livestock feeds (75%)	8	18	26
	Livestock feeds (25%), Flour processed 45% and consumed the rest	6	9	15
	Medicinal uses (100%)	12	24	36
Total		160	160	320

Source: Computer analysis results (SPSS)

Evidence from the tables 5 and 6 revealed cocoyam farmer's engagement in cocoyam value chain activities. The study examines what are the factors influencing this decision. The results of these findings are presented from Table 7. Early maturity of the varieties prompts most cocoyam farmers into its production, consumer's preference, high yield and diseases resistance are factors influence their participation into value chain activities (Table 7). Also, processed cocoyam tubers into flour and derivatives, livestock feeds and medicinal uses add value and thereby increases income. Moreover, access to marketing information and extension services prompt motivation into cocoyam value chain activities (Table 7).

Table 7: Factors influencing value addition activities

s/n	Activities	Mean values	Percentage (%)	Sample (n)
1	Early Maturity	120	37.5	320
2	Easy to maintain	24	7.5	320
3	Disease resistance	32	10.0	320
4	High Yield	60	18.8	320
5	Consumers' preference	84	26.2	320
6	Prefer to sell cocoyam tuber raw	20	14.0	143
7	Processed into flour and derivatives improves income	69	48	143

8	Processed into Livestock feeds improves income	117	51	143
9	Cocoyam has Medicinal values	73	51	143
10	Access to information on Cocoyam processing and market	97	67.8	143

Source: Field survey, 2020.

Value Addition and Profitability Analysis Profitability analysis of cocoyam flour processing
The result in table 8 showed cocoyam farmers involvement in value chain activities. Results indicated that 20.3% consumed cocoyam, 24.t% sold cocoyam raw without processed while, 55% processed it further into flour and derivatives (31%), livestock feeds (12.8%) and medicinal purposes (11.2%).

Table 8: Cocoyam Farmers involvement in Value Chain activities

s/n	**Activities**	**Participation (%)**	**Participation* (%)**
	Consumption	65 (20.3)	73 (17.8)
	Sold (Cocoyam raw)	79 (24.7)	85 (20.1)
	Processing to flour and derivatives	99 (31%)	121 (29.4%)
	Livestock feed	41 (12.8%)	73 (17.8%)
	Medicinal uses	36 (11.2)	59 (14.9%)
	Total	**320**	**411***

Source: Field Survey, 2020
* = multiple responses

Participation = Number of actual farmers that participated majorly (if more than 60% focus mainly on that chain activity) in the value chain activities.

Participation* = Number of actual farmers that participated in more than one value chain activities either major or minor. (Note: number of cocoyam framers that participated in more than one chain processes are 91, 22%)

Table 9 indicated cocoyam farmers that are engaged in value addition and profit/loss attained. Results indicated that 15% of these categories of farmers made a loss with most feasible losses found in livestock feeds (8.2%). While 80% of these categories of farmer's profit were in different chain analysis. Evidence from Table 9 revealed that 69.8% of farmers that processed cocoyam further made profit in the category of N1 – N15, 000 Naira with more in cocoyam processed to flour and derivatives (43.8%). Similarly, 49% of the respondents engaged in processing and that earned N15000 – N50000 from value addition where mostly in Livestock feeds. In the category of the respondents that earned N50, 000 to N100, 000, from cocoyam value addition were 63.7% and mostly in Livestock feeds processing (24.7%). Similarly, the range of earners of above N100, 000 were 20.4% and mostly in the medicinal sector. This is a reflection of high income earning when cocoyam is processed for medicinal purposes (Table 9).

Table 9: Value addition and Profitability Analysis

Value Addition activities	Ondo State Frequency (%)	Ekiti State Frequency (%)	Total Frequency (%)	Difference (%)
Processed to Flour and other related products (n =121)				
Loss	3	3	6 (5%)	0
0 - 15000	32	21	53 (43.8)	11
15001 – 50,000	7	4	11 (9.1%)	3
50,000 – 100,000	12	15	27 (22.3%)	- 5
Above 100000	16	8	24 (19.8%)	8

Livestock feeds (n = 73)				
Loss	4	2	6 (8.2%)	2
0 - 15000	6	8	14 (19.2%)	- 2
15001 – 50,000	9	12	21 (28.8%)	-2
50,000 – 100,000	11	7	18 (24.7%)	4
Above 100000	10	4	14 (19.2%)	6
Medicinal products and uses (n = 59)				
Loss	1	3	4 (6.8%)	-2
0 - 15000	6	10	16 (27.1%)	-4
15001 – 50,000	7	10	17 (28.8%)	-3
50,000 – 100,000	8	2	10 (16.9%)	6
Above 100000	8	4	12 (20.4%)	4

Source: Field Survey, 2020

4.2 Cocoyam farmer's involvement in value chain and Returns on Investment (ROI)

Table 10 showed the distribution of cocoyam farmers engaged in value chain activities as well as return on investment (ROI). The study used ROI to evaluate the efficiency of engagement of cocoyam farmers in value chain activities. There were return on investment at every level of value chain activity. Results indicated that 24.7% of cocoyam farmers that sold cocoyam raw without processed further made the least (ROI of 10-15%) (Table 10). Similarly, those that processed further to flour and derivatives were 31% (ROI of 10-15%). Also, those processed into Livestock feeds were 12.9% (ROI of 20 -25%) and medicinal uses were 11.1% (ROI or 10- 55%). These results revealed that processed cocoyam to medicinal purposes attracted more ROI (Table 10). Investment in cocoyam processing to medicinal purposes is more profitable. This evidence testified to viability of participation in cocoyam value chain activities as value addition to cocoyam is profitable and return on investment is more plausible for medicinal purposes and needs to be encouraged.

Table 10: Cocoyam Farmers involvement in Value Chain and Returns on Investment (ROI)

s/n	**Activities**	**ROI (%) Ondo State**	**ROI (%) Ekiti**	**ROI (%) Total**
	Consumption	0 (16.9%)	0 (23/8%)	0 (20.3%)
	Sold (Cocoyam raw)	10-15%(18.1%)	10-15% (31.3%)	10-15% (24.7%)
	Processing to flour and derivatives	20-35% (36.3%)	10-40% (25.6%)	10-40% (31%)
	Livestock feed	20-30% (16.3%)	20-45% (9.4%)	20-45% (12.9%)
	Medicinal uses	10-55% (12.4%)	10-25% (9.9%)	10-55% (11.1%)
	Total	**160**	**160**	**320**

Source: Field survey, 2020

4.3 Stochastic Dominance

Stochastic dominance is generally used in decision theory to refer to situations where one outcome can be ranked as superior to another [64]. It is a form of stochastic ordering. The idea is to examine factors influencing the varieties of the cocoyam cultivated and processing forms adopted in the study area.

Table 11: Descriptive statistics of the Value Addition to Cocoyam

Descriptive indicator	Processed value	Livestock feeds	Medicinal values
Mean (%)	0.043	0.0301	0.295
Standard deviation (%)	0.081	0.044	0.072
Maximum (%)	0.51	0.48	0.42

Minimum (%)	0.21	0.28	0.21
Skewness	-0.192	-0.028	-0.218
Kurtosis	-1.038	-1.014	-1.137

Source: Field Survey, 2020

Table 12: P-values of stochastic dominance tests of Cocoyam preference (Class interactions)

Type		Class interaction	
		A (SD1)	B (SD 2)
Cocoyam Type	A	0.0851	0.1032
	B	0.0135	0.3101

Source: Field Survey, 2020

Stochastic dominance was used to examine the factors influencing the choice (preference) of the cocoyam variety adopted for production in both states. From table 12, it can be deduced that the farmers in the study area chose white cocoyam (Colocasiaesculenta) over red cocoyam (Xanthosomasagittifolium) due to taste and market demand. The study examined indicators of dominance and their relation to decision theory. Results from Table 12 revealed five indicators of dominance prevalence, they are yield estimated (YE), maturity retro (MR), disease forbearance (DF), soil adaptableness (SA) and intercropping type (IT). These indicators are in line with the works of that indicated evidence of relationship between these indicators of dominance and decision theory. Evidence from Table 12 revealed that in terms of yield estimated, farmers involved in the cultivation of the two varieties dominates both the red and white varieties respectfully. Similarly, red variety dominate red varieties in Ondo state, while in Ekiti, white dominates. The risk aversion ratio (RAR) indicated that in Ondo state, red variety preferred, while in Ekiti, white preferred. Evidence of preferences were further substantiated from the qualitative analysis that indicated what influences their dominance as; early maturity, easy to maintain, disease resistance, high yield and consumer preference. These outcomes are applicable to all other indicators as specified. On the indicators of soil adaptableness and intercropping type among respondents. The results indicated that the RAR, farmers involved in the cultivation of the two varieties dominates both the red and white varieties respectfully. Similarly, red variety dominate white varieties in Ondo state, while in Ekiti, both red and white preferred on the same plain. The risk aversion ratio (RAR) indicated that in Ondo state, concerning the intercropping type, red variety preferred, while in Ekiti, white preferred.

4.4 Logistics regression results

Overall model evaluation section of the regression results provides the good-fit, soundness and robustness of the model to the study hypothesis. These evaluations are Likelihood ratio test and Wald test. The results provide a better fit to the data. Also, the goodness of fit test of Cox and Snell R^2andNagel KerkeR^2resultssuggesting that the model fit to the data well. Statistical tests of individual predictors examined the significance of individual regression coefficients (i.e., βs) istested using the Wald chi-square (Wald$^{\chi 2}$) statistic. The results revealed that Cost of processing to flour and related products, cost of livestock feeds, sex, education, cost of medicinal value added, Contact with Extension Agent Visit and Access to productive inputs were all significant and positive. However, Household sizes is significant but negative (Table 13). Result indicated that, the independent variables explained the dependent variable (Return on investment in the engagements in value chain activities) by 63%. According to the model in equation 3, the log of the odds of a cocoyam farmer's participation in value chain activities was positively related to improve return on investment ($p < .05$) (Table 13). In other words, the higher the variables, the likely will the participation of cocoyam farmers in value chain activities. For each point increase on the participation of cocoyam farmers in value chain processes, the odds of being recommended by these predictors is to influence participation which is positively correlated. If the increase on the participation score was 10 points, then the odds (education)

increase from 1.0 to 4.42, 0.95, 4.0 and 4.1 for Cost of processing to flour and related products, sex, education, and Contact with Extension Agent respectively.

Table 13: Logistic Regression results of 320 Cocoyam farmer's participation in value chain

S/N	Predictor	*B*	*S.E β*	Wald χ^2	df	*P*	e^{β} (odd-ratio)
1.	Constant	2.002	0.573	7.162	1	0.000	0.000
2.	Age	0.609	0.304	5.047	1	0.535	1.838
3.	Educational attainment	1.052	0.952	6.117	1	0.603	2.863
4.	Marital Status	0.642	0.125	3.919	1	0.763	1.902
5.	Sex	1.279	0.400	6.417	1	0.024	3.593
6.	Farm experience	0.280	0.270	1.125	1	0.287	1.323
7	Cost of farm inputs	0.641	0.325	2.109	1	0.031	1.898
8.	Cost of processing to flour and related products	0.327	0.042	6.308	1	0.000	1.386
9	Household sizes	-0.026	0.024	4.738	1	0.526	1.027
10	Cost of livestock feeds	0.098	0.025	5.193	1	0.000	1.103
11	Cost of medicinal value added	0.066	0.027	5.862	1	0.015	1.068
12	Proportion of each chain to the whole chain	0.058	0.532	1.012	1	0.913	1.060
13	Contact with Extension Agent Visit	0.013	0.441	5.212	1	0.022	0.363
14	Access to productive inputs	0.561	0.664	3.116	1	0.000	0.000
	Test(value chain activities)			χ^2	**df**	***P***	
	Processed flour and derivatives						
	Livestock feeds						
	Medicinal uses						
	Overall Model evaluation						
	Likelihood ratio test			19.094	2	0.052	
	Wald test			11.015	2	0.002	
	Goodness of fit test						
	Cox and Snell R^2			0.584	8		
	Nagel Kerke R^2			0.672	8		

Source: Computer results of Log regression analysis (SPSS 16.0)

4.5 Policy Implications of Major Findings

The study examined economic analysis of value chain of cocoyam in Ondo state and Ekiti state. Average age of cocoyam farmers is 45 years, an active population that can make good use of agricultural practices and adoption of effective technology. Female cocoyam farmers engaged more on value chain than their male counterpart by 21.4%, although, male has a longer farming experience, particularly married cocoyam female farmers. Hence policy that will streamline female cocoyam farmers to have access to productive inputs and credit can go a long way to boost cocoyam value chain processes. A relative household size exists (mean of 6.6) and this has been used for family labour on cocoyam production and processing. Education has been seen to influence participation in cocoyam value chain processes as 58.7% that had post- primary education, 70.1% participated in value chain processes. Policy that will make relevant new ideas and technology and marketing information will influence cocoyam value chain better. Farm size, education and return on investment were correlated, as respondents that had post-primary education had a positive Benefit Cost Ratio (BCR), moderate farm size (mean of 2.45ha) and sizeable percentage of Return on investment (ROI) among the majority. Majority of the respondents (55%) engaged in cocoyam value chain, particularly on flour and derivatives (30.9%), livestock feeds (24%) and into medicinal purposes (11.3%). Cocoyam processed in all chain

processes had positive ROI, while medicinal uses had a higher ROI indicating a strong viability of participation in cocoyam value chain activities particularly in Ondo State. Factors influencing this outcome are early maturity of the varieties prompt most cocoyam farmers into its production, consumer's preference, high yield and diseases resistance. Also, varieties of cocoyam planted as evidenced by stochastic dominanceresults revealed white cocoyam variety over red cocoyam variety due to taste and market. Hence policy that will facilitate timely access to marketing information and prompt extension services can increase motivation and productivity in cocoyam value chain activities. This indicated that value addition to cocoyam is profitable and return on investment is more plausible for medicinal purposes and needs to be encouraged.

Logistic regression model provides good fit, soundness and robustness of the model to the study hypothesis, where cost of processing to flour and related products, cost of livestock feeds, sex, education, cost of medicinal value added, contact with extension Agent visit and access to productive inputs were all significant and positive. These variables motivated cocoyam farmer's participation in value chain activities and thus positively related toquality return on investment.

5. Conclusion

The study revealed that female engaged more on value chain than their male counterpart, particularly married cocoyam female farmers. Hence policy that will streamline female cocoyam farmers to have access to productive inputs and credit can go a long way to boost cocoyam value chain processes. Cocoyam processing indicated substantial ROI, while medicinal purposes had a higher ROI indicating a strong viability of participation in cocoyam value chain activities particularly in Ondo State. Hence, this study provides evidence that cocoyam processing is highly profitable especially when processed to medicinal purposes. Value addition to cocoyam is profitable and return on investment is more plausible for medicinal purposes and needs to be encouraged. The cocoyam farmers are ageing with time, so the youth should be encouraged to take up cocoyam production as the study has provided enterprising livelihood evidence in cocoyam value chain, while existing cocoyam farmers should be motivated to go into cocoyam value chain and not just stop in tuber production. It can be further processed into products like flour, livestock feeds etc. this would lead to value addition to the produce and sizeable return on investment as evidenced by the study.

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