

Unraveling Market Structure and Conduct of Cocoyam Industry in South East, Nigeria

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Abstract: Cocoyam market structure and conduct are the focus of this study carried out in South East, Nigeria. Cocoyam is a common staple crop produce and consume in South East Nigeria. The study involved collection of primary information about market structure and their conduct of cocoyam farmers, wholesalers and retailers. The study was guided with the null hypothesis that the mean income of farmers, wholesalers and retailers did not significantly differ. A total of 260 questionnaires were administered from September 2012 to August 2013 to farmers, wholesalers and retailers selected through stratified multi-staged random sampling techniques. Descriptive statistics, concentration ratios, Gini coefficient, Herfindahl Hirschman index were used to analyze the data. Only 7% of marketers obtained loan from formal financial institution indicating financial market failure. The Herfindahl Hirschman index calculated for farmer, wholesalers, and retailers were 119.49, 193.98 and 196.69 respectively. These measures did not indicate oligopolistic market behavior. However the Gini coefficient and Lorenz curve plotted from the data were 0.55, 0.56 and 0.70 implies inequitable distribution of market shares and income of marketers. This is a reflection of inefficiencies of market structure in cocoyam industry.

Key ward: market-structure, post-harvest techniques, cocoyam, Nigeria

I. Introduction

Cocoyam (*Colocasia* spp and *Xanthosoma sagittifolium*) originated from Southeast Asia. It was introduced into Nigeria and other West Africa countries in 16th and 17th centuries [1]. It is the third largest root and tubers in South-east Nigeria after cassava and yam in terms of production and acreage [2, 3, 4, 5]. Cocoyam is grown for its edible starchy corm and leaves. [6] estimated the production of cocoyam in Nigeria in 2008 as 5,387,000 metric tons out of a total of 11.77million metric tons of world output of cocoyam. West Africa accounts for 90% of the global output with Nigeria accounting for 50% of this [6].

Agriculture employed approximately 70% of the country's total labor force and contributed 40 percent to Nigeria's GDP. Nigeria is the world's largest producer of cassava, yam, cocoyam, and cowpea. However, Nigeria is still a food-deficit nation and depends on imports of grains, livestock products, and fish [7]. Hence efforts towards improved agricultural marketing are an indispensable investment towards increased incomes for farmers, poverty alleviation and household welfare [8, 9, 10, 11]. Nigeria is presently focusing on development of the industrial and export sector for the economic development of the nation and creation of more employment. Cocoyam thrives well in warm, humid forest areas where high annual rainfall and long wet season are conducive for its optimum yield. Considering that this climate makes up about 80% of land mass in South-east Nigeria, there is need for empirical work on market structure and conduct of cocoyam which will provide evidence for policy intervention. Market structure is defined in terms of the organization of a market which seems to influence strategically the nature of competition and pricing within the market [12]. Market conduct studies either in the area of competitive behaviour by market participants or price fixing and price stabilization have focused on crops such as cassava, yam, cereals, grain seed, rubber and vegetables [13, 14, 15, 16, 17]. However none of these studies examined the question of the market structure and conduct in the cocoyam industry. The question that therefore arises is whether the cocoyam marketing system in Nigeria is effectively competitive? In providing answer to the above question, the broad objective of the paper will be based on examining structure and conducts of the cocoyam marketing system. Specifically, the objectives of the study were to:

1. describe the socio-economic and institutional factors of the marketers;
2. access the degree of concentration of the cocoyam marketers (producers, wholesalers and retailers);
3. access product differentiation, market knowledge and barrier to entry and exit;
4. analyze market conduct with respect to post harvest technologies (grading, packaging, pre-cooling and storage)

II. Methodology

The states in the South-east geopolitical zone are Abia, Anambra, Ebonyi, Enugu, and Imo states. Southeastern Nigeria lies between latitude 4° 50'N to 7° 10'N and longitudes 6° 40'E to 8° 30'E. It spreads over a total area of 78,618 km², representing 8.5% of the nation's total land area. The area has a total population of 16,381,729 million [18].

2.1 Sampling Procedure

The multi-stage sampling technique was employed for the study. The respondents were sampled from market participants in supply and demand regions. There are three stages that involve the selection of sites and respondents and these are: stages (1) States (2) markets (3) respondents stratified into producers, wholesalers and retailers who market raw cocoyam in surplus and deficit regions. In stage one, stratified random sampling techniques was used. States in supply region that formed strata A are: Enugu, Ebonyi and Imo states while states in deficit region that formed strata B are: Abia and Anambra (Reported flow by market participants). One state in each stratum was selected through simple random sampling technique. These gave a total of two states which constituted the sample. The sampled states were Enugu and Anambra. The second stage involves the selection of the sites to use. Purposive sampling technique was used to obtain six markets comprising three urban and three rural markets from the two sampled states. The selection was based on sites that had a preponderance of cocoyam so as to enable the researcher collect necessary data. The third stage sampling constituted selection of respondents. The respondents were stratified into farmers, wholesalers and retailers. Then a total of 100 producers from a frame of 2000, 60 wholesalers from 1260 and 100 retailers from 2400 were randomly sampled to give a sample of 260 respondents. The urban markets were: Timber shed/Nsukka main market, Enugu main market and Onitsha main market while the rural markets were: Nkwo Ibagwa market, Ori/Nkwo Opanda market, and Nkwo Adazi Nnukwu.

2.2 Data Collection

Primary data collection involved administration of three sets of structured and pre-tested questionnaire to two hundred and sixty selected respondents using trained enumerators to obtain information that was used to realize the objectives of the research and focus group discussion. Secondary data were collected from, journals, Food and Agricultural Organization, International Food Policy Research Institutes, United Nations and World Bank publications, National Root Crop Research Institute, Umudike, proceedings, etc.

2.3 Analytical Techniques

Descriptive statistics such as frequencies, percentages, tables and mean were used to achieve objective one, three and four. The degree of concentration of the cocoyam marketers in objective two was accessed using Herfindahl-Hirschman Index (HHI), Gini coefficient and Lorenz curve. [19] suggest that, as a rule of thumb, a four enterprise concentration ratios of 50 percent or more is indicative of strongly oligopolistic industry, of 33-50 percent a weak oligopoly, and less than that, an un-concentrated industry. The Herfindahl-Hirschman Index (HHI) was computed by dividing the total volume of cocoyam sales of each of the producers or traders by the total volume of cocoyam sale of all the producers/sellers in the industry and its square. The value of HHI ranges from 0 to 1/N or 0-1, where N is the number of firms in the market. However, in this study percentage market share were used and in this case the index can range up to 100², or 10,000 if only one person is involved. A HHI index below 0.01 (or 100) indicates a highly competitive index and it means that there are infinity firms in the industry or it is a competitive market. A HHI index below 0.1 (or 1,000) indicates an un-concentrated index. A HHI index between 0.1 to 0.18 (or 1,000 to 1,800) indicates moderate concentration. A HHI index above 0.18 (above 1,800) indicates high concentration. An advantage of HHI is that it can be used to measure changes in the market share because it takes into account all firms in the market [17]. The Gini coefficient measures the departure of the Lorenz curve actually observed and the curve which would appear if all cocoyam producers have equal market shares. It varies from zero (where every person in the society has the same market share indicating absence of inequality, which is a condition of perfect equality) to unity (where one gets all the share and the rest receive nothing indicating a presence of complete inequality), [13]. When the Gini coefficient is zero, this implies a characteristic of a purely competitive market.

2.4 Specifications of Measures of Degrees of Concentration

i. Herfindahl- Hirschman Index (HHI) It is expressed as follows:

$$HHI = \frac{\sum_i^n P_i^2}{n} \dots \dots \dots (1)$$

Where: HHI = Herfindahl-Hirschman Index; n = Total number of classes in the industry

Pi = total market shares of those i class of cocoyam producers or traders.

ii. Gini Coefficient (GC). The Gini coefficient was computed as follows:

$$GC = 1 - \sum P_i C_i \dots\dots\dots(2)$$

Where: GC = Gini coefficient in percent
 C_i = cumulative proportion of market share in a given quintile group
 P_i = proportion of cocoyam actors in a quintile group
 Both P_i and C_i were arranged from the highest to the smallest

III. Results And Discussion

3.1 Socio-Economic Characteristics of the Respondents

This section examines the socio-economic profile of marketers. Socio-economic profile refers to the personal characteristics and conditions, which influenced the decisions-making behaviour of respondents in their market conducts.

Table 1 Socio-Economic Characteristics Of Market Participants.

Characteristics	Producers (n = 100)	Wholesalers (n = 60)	Retailers (n = 100)	Total (n = 260)
Age of Players				
21- 30 years	7 (7)	0(0)	2(2)	9(3.46)
31- 40 years	4(4)	5(8.3)	22(22)	31(11.93)
41- 50 years	48(48)	47(78.4)	55(55)	150(57.69)
51- 60 years	36(36)	8(13.3)	19(19)	63(24.23)
>60 years	(5)	0(0)	2(2)	7(2.69)
Educational Level				
No formal Education	28(28)	10(16.7)	25(25)	63(24.23)
Primary education	24(24)	23(38.3)	46(46)	93(35.76)
Secondary Education	38(38)	24(40)	24(24)	86(33.07)
Tertiary Education	10(10)	3(5)	5(5)	18(6.92)
Gender				
Male	88(88)	5(8.3)	4(4)	97(37.3)
Female	12(12)	55(91.7)	96(96)	163(62.7)
Household size				
1-3	14(14)	2(3.3)	4(4)	20(7.69)
4-6	59(59)	18(30)	30(30)	107(41.16)
7-9	24(24)	37(61.7)	63(63)	124(47.69)
>9	3(3)	3(5)	3(3)	9(3.46)
Marital status				
Single	19(19)	3(5)	10(10)	32(12.31)
Married	81(81)	57(95)	90(90)	228(87.69)

Source: Field survey 2011/12

The age distribution of the sample was skewed towards the upper age group of 40 and above indicating that there were relatively high proportions of middle age respondents participating in the cocoyam markets. Less than 16% of players were below 40 years. The farmers below 40 years were 11%; that of wholesalers were 5% and retailers 24%. This implies that the younger ones were less involved in marketing. It also gives an indication of an aging labour force involved in production and distribution of cocoyam. It is an important factor in agriculture because it determines experience of participants.

Acquisition of formal education enables one to communicate more than those who have less education or no education at all. Thus education levels also affect the level of participation in cocoyam markets. From Table 1, 24% of respondents had no formal education starting from 10% of wholesalers to 28% of producers. On the other hand 33, 35 and 6 percent of the respondents attended primary, secondary and tertiary education, respectively.

With respect to gender Table 1 shows that 37% of the interviewed participants were male while 63% were female involved in minimizing losses of cocoyam and its products between production and consumption. This implies that any development strategy targeted at post harvest technologies will benefit both males and females.

Household sizes are generally larger among the retailers where 63% have between 7 and 9 people in their family. The percentage of wholesalers with household size of between 7 and 9 people were 37% while that of farmers were 24%. The majority of the heads of households among the producers, wholesalers, retailers were married (87%) while 13% were single.

3.2 Institutional Factors Of The Market Participants

Institutional factors relate to the institutional conditions under which market participants operate. Understanding the conditions under which they operate is useful in understanding whether these environments influence their market conducts.

3.2.1 Extension Service

Only about 67% of farmers, 3.3% of wholesalers and 15% of retailers have access to extension agents (Table 2). This results shows that the majority of marketers, especially wholesalers and retailers, have no proper linkages with the extension services. Thus marketers did not use improved packaging, pre-cooling, and storage and there are of post harvest losses.

Table 2 Institutional Conditions Of Respondents.

Socio-economic variables	Producers (n=100)	Wholesalers (n=60)	Retailers (n=100)	Total (n=260)
Extension service				
Access to extension services	67(67)	2(3.3)	15(15)	84(32.3)
No access to extension services	33(33)	58(96.7)	85(85)	176(67.7)
Storage methods				
basket in storage house	3(3)	0(0)	100(100)	101(39)
on the floor in storage house	5(5)	60(60)	0(0)	26(10)
shelf in storage house	4(4)	0(0)	0(0)	92(35.38)
storage in raised platform in the barn	8(8)	0(0)	0(0)	23(8.84)
heaped in the barn	40(40)	0(0)	0(0)	40(15)
bury in the barn	18(18)	0(0)	0(0)	18(6.9)
Membership of co-operatives				
Member	42(42)	5(8.3)	1(1)	18(46)
Not a member	34(34)	11(18.4)	0(0)	45(17.30)
Credit access				
Need for credit	78(78)	49(81.7)	69(69)	196(75.38)
No need for credit	22(22)	11(18.3)	31(31)	64(24.62)
Sources of finance				
Personal savings	61(61)	17(28.3)	80(80)	158(60.77)
NGO	28(28)	33(55)	7(7)	68(26.16)
Friends and relatives	7(7)	4(6.7)	4(4)	15(5.77)
Microfinance institution	4(4)	6(10)	9(9)	19(7.30)

Source: Field survey, 2011/2012. Figure in parentheses are percentages.

3.2.2 Storage Methods

There were no modern storage facilities such as goring storage, ventilator or refrigerator in the study areas. None of the respondents followed proper post harvest technologies such as grading, packaging and pre-cooling. About 30% of the respondents and 78% of farmers stored cocoyam between 30 and 180 days after harvesting by either storing it in the basket in the storage house or on the floor in the storage house or by heaping on the floor on the barn or on raised platform in the barn or bury it in the barn. Others mostly wholesalers and retailers usually stored cocoyam in open storage house by heaping it on the floor or in the baskets which offered little security against theft and other risks. Storage costs can easily add up per bag in the source market as well as in the deficit market for wholesalers and retailers so they preferred to distribute as many as possible to their clients. Good storage facilities and post harvest technologies are necessary for producers, wholesalers and retailers as they maintain quality and safety minimizes losses of cocoyam between production and consumption.

3.2.3 Membership of Co-Operatives

Most farmers, wholesalers and retailers belonged to a co-operative and this enabled them to access market information as well as lowered transaction costs, pool transport, insure members.

3.2.4 Credit Access

Credit is one of the business support services, especially for adopting cultivars with more employment prospects. Table 1 shows the major players among formal and informal financial institutions. Microfinance institution is weak in south east Nigeria and that is why their role in lending to 7% respondents which is smaller compare to Non Governmental Organization that lend to 26% of players, as shown in Table 2.

3.3 Accessing the Degrees Concentration Ratios

The degree of producers, wholesalers and retailers concentration was assessed using Herfindahl-Hirschman index (HHI), Gini coefficient (GC) and Lorenz curve. Gini coefficient also shows the market shares of marketers.

3.3.1 Herfindahl Hirschman Index (HHI)

Herfindahl Hirschman Index (HHI) is a more comprehensive measure of market concentration than the four-firm concentration ratio. The calculation gives higher weight to larger firms but also allows firms outside of the top four largest to factor into the equation. As stated before in literature review, the lower the Herfindahl Hirschman Index, the more spread out the market share with many large firms. An advantage of HHI is that it can be used to measure changes in the market share because it takes into account all firms in the market [17].

3.3.2 Herfindahl Hirschman Index (HHI) Of Farmers

The Herfindahl Hirschman Index (HHI) of farmers is shown in Table 6.

Table 6 The Herfindahl Hirschman Index For Farmers.

List of farmers	Volume of cocoyam in kg per yr	% market share and HHI (index)	Cumulative HHI
F1- F2	5500 (2)	16.82	16.82
F3-F4	4500 (2)	10.58	27.40
F5-F6	4000 (2)	8.82	36.22
F7-F8	3600 (2)	7.22	43.44
F9-11	3400 (2)	5.78	49.22
F12-F13	3000 (2)	4.5	53.72
F14-F15	2600 (2)	3.38	57.10
F15-F16	2500 (2)	2.6	59.70
F17-F20	2400 (4)	5.76	62.86
F21-F24	2300 (4)	5.76	68.62
F24-F29	2000 (6)	6	74.60
F30-F41	1900 (12)	12	86.60
F42-F71	1800 (30)	24.3	110.90
F72-F73	1700 (2)	1.28	113.18
F74-F77	1600 (4)	2.56	115.74
F78-F81	1500(4)	2.56	118.20
F82-F85	700(4)	0.64	118.84
F86-F89	600(4)	0.36	119.20
F90-F95	400(6)	0.24	119.44
F96-97	300(2)	0.02	119.46
F97-98	200(2)	0.02	119.48
F99-F100	100(2)	0.005	119.49
	189,000	119.49	

Source: Field survey 2010/2011

It shows that the Herfindahl Hirschman Index of the 100 sampled farmers is, 119.49. The calculated index shows that cocoyam industry was not concentrated and thus competitive. The index allows the farmers with the largest market share ($2.9^2 = 8.41$) as well as the farmers with the lowest market share (0.0025) to account for it. The sum of market share squared of each of the farmers' share in the industry is 119.49. Thus, using the stated criteria for concentrated or spread out of the market share, the computed index is less than 1000. The industry is therefore said to be unconcentrated.

3.3.3 Herfindahl Hirschman Index (HHI) Of Wholesalers

A table 7 show that the Herfindahl Hirschman Index of the 60 sampled wholesalers was 193.98, indicating that cocoyam industry was not concentrated. The Herfindahl Hirschman index of the largest wholesalers' market share in cocoyam industry was (9) while that of the lowest market share was (0.16). The sum of square of the market share of all the wholesalers in the industry was 193.98. Thus using the stated criteria for concentrated market share, the computed index was more than 100 but less than 1000 and the wholesalers' market share in the industry is said to be unconcentrated and competitive. These indexes are consistent, indicating that the farmers and wholesalers are competitive.

Table 7 Herfindahl-Hirschman Index of Wholesalers.

List of wholesalers	Volumes of sales in kg	Sq of % market share	Summary	Cumulative index
W1	90,000	9	9.00	9.00
W2	89,000	8.41	8.41	17.41
W3	86000	7.84	7.84	25.25
W4	84000	7.84	7.84	32.09
W5	83000	7.84	7.84	39.93
W6	82000	7.29	7.29	47.22
W7	81000	7.29	7.29	54.51
W8	80000	6.76	6.76	61.27

W9-W13	78000(5)	6.76x5	33.80	94.27
W14	75000	6.25	6.25	100.52
W15	70000	5.29	5.29	105.81
W16	68000	5.29	5.29	111.10
W17-W19	65000(3)	4.84x3	14.52	125.62
W20	60,000	4.0	4.0	129.62
W21-22	56000(2)	3.61x2	7.22	136.84
W23	55000	3.61	3.61	140.45
W24-W25	54000(2)	3.25x2	3.25	143.70
W26	53000	3.25	3.25	146.95
W27	51000	3.25	3.25	150.20
W28	50000	2.81	2.81	153.01
W29-W30	47000(2)	2.56x2	5.12	158.13
W31-W32	46000(2)	2.25x2	4.50	162.62
W33	45000	2.25	2.25	164.86
W34-W36	43000(3)	1.96x3	5.88	170.74
W37	42000	1.96	1.96	172.70
W38	41000	1.96	1.96	174.66
W39-W40	39000(2)	1.69x2	3.38	178.04
W41	37000	1.44	1.44	179.48
W42	36000	1.44	1.44	180.92
W43	35000	1.44	1.44	182.36
W44-W45	34000(2)	1.21x2	2.42	184.78
W46-W48	32000(3)	1.21x3	3.63	188.41
W49	29000	1.0	1.0	189.41
W50	25000	0.64	0.64	190.05
W51	24000	0.64	0.64	190.71
W52-W53	23000(2)	0.64x2	1.28	191.99
W54-W55	20000(2)	0.36x2	0.72	192.71
W56	19000	0.36	0.36	193.07
W57	16000	0.25	0.25	193.32
W58	15000	0.25	0.25	193.57
W59	14000	0.25	0.25	193.82
W60	13000	0.16	0.16	193.98
	3000000			193.98

Source: Field survey 2011/2012

Herfindahl Hirschman Index (HHI) Of Retailers

Table 8 Herfindahl-Hirschman Index of Retailers.

List of retailers	Volume of sale	Square of % market share	Summary	Cumulative
R1-R6	75,000(6)	8.64 x 6	51.86	51.86
R7	70,000	7.53	7.53	59.39
R8	67,000	6.90	6.90	66.29
R9-R11	65,000(3)	6.45 x 3	19.35	85.64
R12	63,000	6.10	6.10	91.74
R13-R14	60,000(2)	5.53 x 2	11.06	102.80
R15	58,000	5.17	5.17	107.97
R16-R17	56000(2)	4.79 x 2	9.59	117.56
R18-R19	55,000(2)	4.65 x 2	9.30	126.86
R20-R21	54,000(2)	4.48 x 2	8.96	135.82
R22	53,000	4.31	4.32	140.14
R23-R24	52,000(2)	4.16 x 2	8.32	148.32
R25-R26	50,000(2)	3.84 x 2	7.68	156.14
R27	46000	3.25	3.25	159.39
R28-R32	45000(5)	3.11 x 5	15.57	174.96
R33	42000	2.71	2.71	177.67
R34	39000	2.23	2.23	175.48
R35	37000	2.10	2.10	179.90
R36-R38	35000(3)	1.88 x 3	5.65	185.55
R39	32000	1.57	1.57	186.80
R40	20,000	0.62	0.62	187.42
R41-R43	19,000(3)	0.55 x 3	1.66	189.49
R44-R47	18,000(4)	0.49 x 4	1.99	191.07
R48-R50	17,000(3)	0.44 x 3	1.33	192.40
R51-R53	16000(3)	0.39 x 3	1.18	193.58
R54	15000	0.34	0.34	193.92
R55	14000	0.30	0.30	194.22
R56-R57	12000(2)	0.22 x 2	0.44	194.66
R57	6500	0.06	0.06	194.72
R58	6000	0.05	0.05	194.77
R59-R60	5500(2)	0.04 x 2	0.08	194.85

R61-R63	5000(3)	0.04 x 3	0.12	195.97
R64-71	4500(8)	0.03 x 8	0.24	196.21
R72-R77	4000(6)	0.03 x 6	0.18	196.39
R78-R88	3500(11)	0.02 x 11	0.22	196.61
R89-R90	3000(2)	0.01 x 2	0.02	196.63
R91-R92	2500(2)	0.008 x 2	0.016	196.64
R93-R100	2000(8)	0.006 x 8	0.048	196.69
2,550,000 kg				196.69

Source: Field survey, 2010/2011

Table 8 shows that the Herfindahl Hirschman Index of the 100 sampled retailers was 196.66. This calculated index shows that the retailers in cocoyam industry were competitive and not concentrated. The Herfindahl Hirschman index of the largest wholesalers' market share in cocoyam industry was (7.84) while that of the lowest market share was (0.006). Thus using the stated criteria for spread out of the market share, the computed index was more than 100 but less than 1000 while the retailers' market share in the industry is moderately concentrated.

HHI for wholesalers and retailers were 193.98 and 196.69 respectively. Thus this measure showed consistency in the nature of concentration as well as competition for farmers, wholesalers and retailers market shares in cocoyam industry. Herfindahl Hirschman index calculated for farmer, wholesalers, and retailers which were 119.49, 193.98 and 196.69 respectively and did not indicate oligopolistic market behaviour although the market conduct is characterized by unethical practices of cheating and information collusion that led to uncompetitive market behaviour.

3.3.4 Gini Coefficient (GC) and Lorenz Curve.

Gini Coefficient was also used to measure variation in sales' share as well as income distribution among the farmers, wholesalers and retailers. The interpretation of Gini coefficient (GC) was based on Lorenz Curve and was one minus the sum of the product of the proportion of market participants and the cumulative proportion of their sales earnings arranged in class intervals from the lowest to the highest [20]. The value of Gini Coefficient ranges between 0 and 1. [21] Noted that Gini coefficient greater than 0.35 indicates inequality in distribution of sales as well as income earned per year.

The Gini coefficient (GC) was given as $1 - \sum PC = 1 - 0.45 = 0.55$. Thus as already indicated this value was higher than 0.35 implying high inequality in sale distribution and income among farmers. This was noted before as some farmers were producing for subsistence while others were producing for commercial reasons. The distribution of cocoyam farmers by yearly sales in kg and the number of sellers in each category were presented in Table 9

Table 9 Distributions Of Farmers By Yearly Sales In Kg.

Sales range	No of sellers	Proportion of sellers (P)	Cumulative proportion	Total value of sales	Proportion of total sales	Cumulative proportion (c)	PC
1-1000	18	0.18	0.18	7400	0.039	0.039	0.007
1001-1600	08	0.08	0.26	12400	0.066	0.104	0.008
1601-1800	32	0.32	0.58	57400	0.303	0.407	0.130
1801-2000	18	0.18	0.76	34800	0.184	0.592	0.106
2001-3000	14	0.14	0.90	35000	0.185	0.777	0.109
3001-4000	06	0.06	0.96	22000	0.116	0.893	0.053
4001-5000	02	0.02	0.98	9000	0.048	0.942	0.019
5001-6000	02	0.02	1.00	11000	0.058	1.000	0.02
		1.00		189000	1.000		0.45

PC = proportion of seller X cumulative proportion of total sale. Source: Field survey 2010/2011

3.3.5 Wholesales

Table 9 shows the distribution of wholesalers by yearly sales and the number of wholesalers in each category. The Gini coefficient (GC) was given as $1 - \sum PC = 1 - 0.44 = 0.56$. This implies that there was inequality in the distribution of sales as well as income and greater concentration among wholesalers. This was also noted before since wholesalers in Onitsha and Enugu markets were selling significantly higher volumes than those in other areas. The Gini coefficient higher than 0.35 implies inequality of the wholesalers' market share and purely competitive market; thus farmers which had GC of 0.55 is very close to wholesalers with 0.56.

Table 10: Distribution Of Wholesalers By Yearly Sales In Kg.

Sale range	No of seller	Proportio of sellers (P)	Cumulatvpr opoirtn	Total value of sale	Proporn of total sales	Cumulativ Proportion (c)	PC
10001-20000	7	0.117	0.117	117,000	.039	0.039	.0046
20001-30000	5	0.083	0.200	124,000	.041	0.080	.0064
30001-40000	10	0.167	0.367	350,000	.120	0.200	.0334
40001-50000	11	0.183	0.550	493,000	.160	0.360	.0658
50001-60000	8	0.133	0.683	439,000	.150	0.510	.0673
60001-70000	5	0.083	0.766	333,000	.111	0.621	.0514
70001-80000	7	0.117	0.883	545,000	.181	0.802	.0933
80001-90000	7	0.117	1.000	595,000	.198	1.000	.117
Total	60	1.000		3000,000	1.000		0.44

PC = proportion of seller X cumulative proportion of total sale

Source: Field survey, 2011/12

The Gini coefficient (GC) computed was given as $1 - \sum PC = 1 - 0.298 = 0.70$. This indicate that the sale distribution was away from 0 where there was totally equitable distribution and implies departure from 45-degree line and significant inequality in the distribution of sales as well as income among the retailers. The distribution of retailers by yearly sale is shown on Table 11.

Table 11 Distribution of Retailers by Yearly Sale in Kg

Sale range	No of sellers	Proportion of sellers (P)	Cumulative proportion	Total value of sale	Proportion of total sales	Cumulative proportion (c)	PC
1001-10000	44	0.44	0.44	164000	0.064	0.064	0.028
10001-0000	18	0.18	0.62	301000	0.118	0.182	0.033
20001-0000	0	0	0.62	0	0	0.182	0
30001-0000	6	0.06	0.68	213000	0.083	0.265	0.0159
40001-0000	8	0.08	0.76	363000	0.142	0.407	0.0325
50001-0000	12	0.12	0.88	665000	0.261	0.668	0.080
60001-0000	6	0.06	0.94	395000	0.155	0.823	0.049
70001-0000	6	0.06	1.00	450,000	0.177	1.000	0.06
Total	100	1.00		2551000	1.00		0.298

PC = proportion of seller X cumulative proportion of total sale

Source: Field survey, 2011/2012.

Thus the results of Gini coefficient of farmers, wholesalers and retailers of 0.55, 0.56 and 0.70 respectively implies that there is significant inequality in the distribution of income among the cocoyam sellers and hence, inefficiency of cocoyam market's structure.

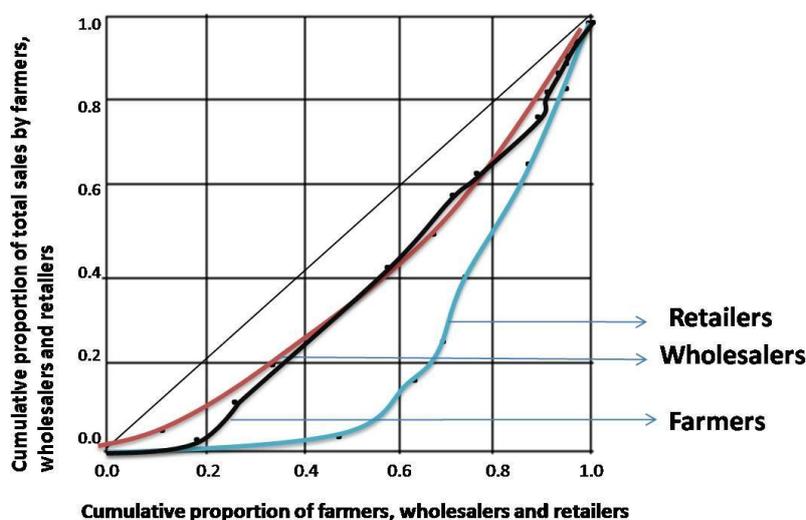


Figure 1 Lorenz Curves For Farmers, Wholesalers and Retailers and Equidistribution Line

Source: Field survey 2011/12

Lorenz curves were also obtained from Tables 9, 10 and 11. The curves relate the cumulative proportion of total sale by farmers, wholesalers and retailers to the cumulative proportion of the farmers, wholesalers and retailers, after ordering the population according to increasing level of sales. It is obtained by

plotting the cumulative proportion of cocoyam sellers from the smallest to the largest against the cumulative proportion of their sale earnings. The 45⁰ line represents the perfect equality of sales by households. The black line represents the Lorenz curve of farmers; the red line represents that of wholesalers while the blue line represents that of retailers. The Lorenz curve of retailers showed the greatest departure from the 45 degree and this is also consistent with the value of Gini coefficient 0.70 and significant inequality distribution.

Gini-coefficients provide useful information based on Lorenz curve shapes. However, the Lorenz curve for farmers with Gini coefficient of 0.55 showed almost the same departure from the 45⁰ as that of wholesalers which was 0.56. Gini-coefficient favors equality of the market shares without regard to the number of equalized firms. [22] Stated that the discrepancy obtained using Gini-coefficient appears to be a consequence of various functional forms.

3.4 Product Differentiation, Market Knowledge And Barrier To Entry And Exit

3.4.1 Product Differentiation

There are three types of cultivars in cocoyam industry are *colocasia antiquorum*, *Xanthosoma sagittifolium* and *Colocasia esculenta*. However 100 percent of the respondents participated in marketing *colocasia antiquorum* popularly known as *ede ofe* in Igbo language. Only 8.5 percent were engaged in marketing *Xanthosoma sagittifolium* while 13 percent marketed *Colocasia esculenta*. Thus there were multiple responses and 8.5 percent of the respondents marketed all the cultivars while 4.5 percent of all the respondents marketed two cultivars. The implication is that there is underutilization of *Xanthosoma sagittifolium* and *Colocasia esculenta* which is presently used in the rural areas as a substitute for yam in preparing many dishes while *colocasia antiquorum* is more marketable.

3.4.2 Market Knowledge

Market information specifically included information on price, product demand, product supply, market place and buyers and sellers. About 48% of farmers, 91% of wholesalers and 90% of retailers had access to market information on price and buyers. The sources were co-traders for all the respondents. Respondent farmers evaluated the price trend of the last five years to indicate whether it had increased or decreased. Accordingly, all the farmers, wholesalers and retailers responded that in the last five years, prices of cocoyam were increasing. The reason for this price growth could be attributed to increased demand and leaf blight diseases that reduced the supply of cocoyam. Market information supply was not transparent between levels that created high price variability and difference among selling farmers especially in Ibagwa market. Prospecting wholesalers got information from their partners far in Onitsha and Enugu while farmers could not. This created the information asymmetry expressed by low prices. The main market information lines that farmers used were the product selling price, input price and number of buyers coming to the area.

3.4.3 Condition of Entry and Exit from Cocoyam Markets

Barriers to enter into and exit from a given marketing system influence the structure of the marketing system. Licensing procedure, capital, skills and risks are entry and exit barriers to cocoyam marketing in the study area.

3.4.4 Licensing Procedure

All the respondents, including farmers, wholesalers and retailers reported that they had no license at all. However most commercial farmers paid check point fees when transporting cocoyam from their farms to collecting centres. Most wholesalers and commercial farmers also joined informal groups as a condition for starting the business.

3.4.5 Capital

Large investment was the main barrier to entry into the cocoyam industry particularly for wholesalers. Most wholesalers were of the opinion that cocoyam trading was constrained by low or virtually nonexistent credit access and this was an entry barrier. Capital at retail level was not a serious problem. The credit from wholesalers solved their cash credit demand. In Table 4.2, about 28% of farmers, 55% of wholesalers and 7% of retailers obtained loan from Non Governmental Organizations. However, very few households, about 4 percent of farmers, 10% of wholesalers and 9% of retailers obtained loan from microfinance banks. A capital sum ranging from ₦200, 000 to ₦500,000 was suggested by respondents as a sine qua non for the business and for being a strong wholesaler.

3.4.6 Skills

Almost all the interviewed farmers, wholesalers and retailers from all levels strictly underlined the importance of experience. The skill to manage customers, skill of lobbying and buying customers are needed to enter the business.

3.4.7 Risk

The common risk types prevailing were spoilage, unsold left over, and defaulting (cheating). A question was raised whether there was unsold cocoyam from the total amount produced. Few respondents claimed the presence of unsold produce in the last 3 years when there was no leaf blight disease. Respondents were asked what they did when they failed to sale their cocoyam. Some farmers claimed that they sold to some wholesalers on credit when there was excess supply while others left cocoyam to rot in the field during that period. However, few wholesalers defaulted.

3.5 Conduct In Post Harvest Technologies (Grading, Packaging, Pre-Cooling And Storage)

Market conduct refers to the patterns of behavior of firms. This implies analysis of human behavioral patterns that are not readily identifiable, obtainable, or quantifiable [23]. There are no agreed upon procedures for analyzing the elements of market conduct. However, in this report market conduct was analyzed in terms post harvest technologies used in grading, packaging, pre-cooling and storage.

3.5.1 Grading

Cocoyam sold in modern markets are graded and sized. Sophisticated marketing systems require precise grading and standard. No clear set grading and quality standards were found in cocoyam in south east Nigeria. *Colocasia antiquarium* are distinguished as *Ede-Nsukka*, *Ede-Nachi*, *Ede-Anambra*. Most buyers sorted cocoyam in every instance of purchasing. Characteristics considered in sorting were size, firmness, free from pest, taste, sprout free.

3.5.2 Packaging

There are different modes of packaging. Generally, container-packaging is considered ideal cocoyam because these are easy to handle, provide protection from mechanical damage, have adequate ventilation and convenient for marketing. Fancy containers such as palm frond baskets or sacs could be used for packaging. Majority of the respondents used different sizes of sacs to pack cocoyam or pack all the cocoyam behind the truck without sacs. Sacs used by farmers were different from those used by wholesalers. The size of the sacs also depends on the destination market.

3.5.3 Pre-cooling

Temperature plays a vital role in maintaining good health of cocoyam. Good temperature management is the most effective way to reduce post harvest losses and preserve the quality of fruits or vegetables. The pre-cooling methods currently used include; room cooling, forced air cooling, water cooling, vacuum cooling and package icing. Similarly desirable storage and transportation temperatures for cocoyam were identified by [24, 25 26]. Storage in well ventilated stores (~26°C and 76% rh), cocoyam had 1% weight loss per week but sprouting occurred after 6 weeks [26]. Other studies showed that cocoyam may be stored in well-ventilated conditions for up to 6 months [25]. Factors such as corm maturity, environmental condition, agro-climatology, degree of physical damage, and a host of pre-harvest factors contribute to the variability of results reported. However, none of the respondents practiced pre-cooling method.

3.5.4 Storage

Storage is needed to extend the shelf life of cocoyam. Air cooled storage houses are needed in this regards. [24] Noted that cocoyam can be stored for six months in the gocing barn. The structure of the gocing barn consists of a dwarf wall of about 1-1.5 m high, made up with a wire mesh to the roof. The dwarf wall and the wire mesh guarantee adequate ventilation. The wall could be of cement or brick with asbestos roofing and cemented floor. Its wall could also be made of mud with thatch or mat roofing and rammed earthen floor for the low technology type. There is no direct rain or sunlight into the store. The floor is spread (mulched) with wood shavings to a depth of 10 cm thick and watered adequately to about 50-70% moisture content. Consequently, a relative humidity of 60-80 % and temperature of about 20-28 °C is maintained in the store. The cocoyam corms and cormels are spread on the mulched floor. However, none of the respondents practiced improved storage. According to the survey, only few commercial farmers, about 30 of the 100 farmers, stored products from 30 up to 120 days. None of the wholesalers and retailers stored cocoyam for up to 30 days during the survey. Among the types of storage were: by storing it in the basket in the storage house or on the shelf in the storage house or on the floor in the storage house or by heaping on the floor on the barn or on raised platform in the barn or bury

it in the barn or by leaving it on the field without harvesting. This implies that only 30% of farmers added time utility to cocoyam and were able to sell at maximum price during scarcity.

IV. Summary And Conclusion

Results have shown that cocoyam is a popular crop in Nigeria as it thrives well in warm and humid forest areas where high annual rainfall and long wet season are conducive for its optimum yield. The personal characteristics of the respondents and their access to various factors of production are clear indications of their poor resource situation which constrained their conduct in cocoyam enterprises, leading to economic losses. Only 7% of marketers obtained loan from formal finance. Herfindahl Hirschman index calculated for farmer, wholesalers, and retailers were 119.49, 193.98 and 196.69 respectively and did not indicate oligopolistic market behavior. However the Gini coefficient and Lorenz curve plotted from the data were 0.55, 0.56 and 0.70 implies inequitable distribution of market shares as well as income of market participants. This is a reflection of inefficiency of the cocoyam industry market structure. Types of cocoyam cultivars were the main indicator of product differentiation. Producers have less market information than other marketers. High capital investment was the main barrier to entry. Producers, wholesalers and retailers were not following improved post harvest technology available in the research institutes including grading, packaging, pre-colling goring storage and transportation. About 78% of the producers stored cocoyam between 30 and 180 days after harvesting by either storing it in the basket in the storage house or on the floor in the storage house or by heaping on the floor on the barn or on raised platform in the barn or bury it in the barn. These methods offered little protection against sprout, rot and loss in fresh weight. Others mostly wholesalers and retailers usually stored cocoyam in open storage house by heaping it on the floor or in the baskets which also offered little security against theft and other physiological changes. Policy measures that will improve credit advancement and extension access to producers, wholesalers and retailers to improve structural efficiency and encourage the use of improved post-harvest are advocated.

References

- [1]. Bown, D. (2000). *Aroids. Plants of the Arum Family*. (2nd Editio). Portland, Oregon, USA.: Press., Timber.
- [2]. Ajala, A. A., & Obiechina, C. O. . (1987). An investigation into the economics of production and storage of cocoyam in the farming system of Nsukka Agricultural Zones of Anambra State: implication for extension service. In O. B. Arene, L. S. . Ene, S. O. Odurukwe, & N. O. A. Ezeh (Eds.), *Proceedings of the 1st National Workshop on Cocoyajm'* August (pp. 131–137). Umudike: National Root Crop Research Institute.
- [3]. Njoku, J. E., & Obiefuna, J. C. (1987). Problems in production and marketing of cocoyam in Imo State of Nigeria". In O. O. Arene, L. S. O. Ene, S. O. Odurukwe, & N. O. A. Ezeh (Eds.), *1st National Workshop on Cocoyam'* August (pp. 101–107).
- [4]. Nwagbo, E. C., Okorji, E. C., & Ugwu, D. (1987). Cocoyam and food economy of Anambra state, a case study of two major production area of Anambra State. In O. B. Arene, L. S. O. Ene, S. O. Odurukwe, & N. O. A. Ezeh (Eds.), *1st National Workshop on Cocoyam* (pp. 101–107). National Root Crop Research Institute, Umudike, Nigeria.
- [5]. Okoye, B. ., Asumugha, G. ., & Mbanaso, E. N. . (2007). Cost Return Analysis of CocoyamProduction at NRCRI, Umudike National Root Crops Research Institute, Umudike, AbiaState. In *Agricultural society of Nigeria* (Vol. 41, pp. 511–513).
- [6]. FAOSTAT. (2010). *Food and Agricultural Organization: Agricultural Statistics*. Rome, Italy.
- [7]. IFPRI (International Food Policy Research Institute). (2012). *Global hunger index the challenge of hunger ensuring sustainable food security under land, water and energy stress*. Bonn / Washington, DC / Dublin.
- [8]. Dorward, A., Kydd, J., & C., P. (2008). Traditional domestic markets and marketing systems for agricultural products.
- [9]. Greig, L. (2009). An analysis of the key factors influencing farmer's choice of crop, Kibamba ward, Tanzania. *Journal of Agricultural Economics*, 60(3), 699 – 715. <http://doi.org/10.1111/j.1477.2009.002215.x>
- [10]. Kostov, P., & Davidova, S. (2013). A quantile regression analysis of the effect of farmers' attitude and perceptions on market participation. *Journal of Agricultural Economics*, 64(1), 112–132. <http://doi.org/10.1111/j.1477-9552.2012.00366.x>
- [11]. Zanello, G. (2012). Mobile phone and radios: effects on transactions costs and market participation for households in Northern Ghana. *Journal of Agricultural Economics*, 63(3), 694–714. <http://doi.org/10.1111/j.1477-9552.2012.00352.x>
- [12]. Bain, J. (1968). *Industrial Organization*. New York. United States of America.: John Wiley and Sons Inc.
- [13]. Afolabi, J. A. (2009). An Assessment of Gari Marketing in South-Western Nigeria. *Journal of Social Science*, Vol. 21(1), 33–38.
- [14]. Giroh, D. Y., Umar, H. Y., & Yakubu, W. (2010). Structure, conduct and performance of farm gate marketing of natural rubber in Edo and Delta States, Nigeria *African Journal of Agricultural Research*, 5(14), 1780–1783.
- [15]. Mari, F. M. (2009). Structure and efficiency analysis of vegetable production and marketing in sindh, Pakistan. *Sindh agriculture university Tando jam*.
- [16]. Onu, J. ., & Iliyasu, H. A. (2008). An Economic Analysis of the Food Grain Market in Adamawa State, Nigeria. *World Journal of Agricultural Sciences*, 4(5), 617–622.
- [17]. Sayaka, B. (2006). Market structure of the corn seed industry in East Java. *Journal Agro Ekonomi*, 24(2), 133–156.
- [18]. National Population Commission. *Nigerian population, state by state analysis*. (2007). Nigeria.
- [19]. Kohls, R. L., & Uhl, J. N. (1985). *Marketing of Agricultural Products*. (5th ed.). New York: Macmillan Publishing Company.
- [20]. Ike, P. C., & Chukwuji, C. O. (2005). Efficiency measurement of cashew nut marketing in Enugu State, Nigeria". *Journal of Agriculture, Food Environment and Extension.*, 4(1), 44–49.
- [21]. Dillion, J. L., & B., H. J. (1993). *Farm management research for small farmer development*. Rome: FAO.
- [22]. Chotikapanich, D., & E., G. W. (2002). Estimating Lorenz curves using Dirichlet distribution. *Journal of Business and Economic Statistics*, X, 20(2), 290–295.
- [23]. Pomeroy, R. S., & Trinidad, A. C. (1995). *Industrial organization and market analysis*. In: *Prices, products, and people: analyzing agricultural markets in developing countries*. (G.J.Scott., Ed.). Boulder, London: Lynne Rienner.
- [24]. Chukwu G. O. C., Nwosu, K. I., Madu, T. U., Chinaka, C., O. B. C. (2008). Development of goring storage method for cocoyam.

- Munich Personnel RePEc Archives (MPRA), 25(17444:), 5.
[25]. Kay, D. E. (1987). Crop and product digest. (2nd ed.). London: Tropical Development and Research.
[26]. Thompson, A. K. (1996). Postharvest technology of fruit and vegetables. Oxford: Blackwell Science Ltd.