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Natural Rubber value chains: A game changer for smallholders

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Abstract:

ABSTRACT The study analyzed the value chain of natural rubber in Nigeria. The study specifically mapped the natural rubber value chain and identify the functions performed by the respondents in the chain; identified the existing marketing channels and estimated the marketing margin at each value addition point. Data for the study were collected using a well-structured questionnaire administered to 425 respondents selected using a two-stage sampling process involving random and purposive sampling techniques. Data collected were analyzed using descriptive statistics, flow chat, marketing margins, marketing efficiency The findings showed a mean age of 53 years for farmers and 44 years for marketers, with males (97.86%) dominating. Most were married and majority had at least primary education. The main value chain agencies were input suppliers/nursery farmers, rubber farmers, marketers/collectors, processor and manufacturers, while the key product points along the chain were seeds, seedlings, budded stump, lump, latex concentrates, sheet, and crumbs. Marketing margin analysis showed crumb having the highest margin (N234.01) with processing cost having the major component. Value added by processing were N14.36k, N115.16, N136.14 and N124.38 per budded stump, latex concentrate, crumb and sheet respectively. The nursery was the most efficient and it was more profitable to process into crumb rubber. It was therefore recommendations that farmers may integrate backward to produce their own budded stumps and process their latex before selling for profit

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INTRODUCTION

Nigeria is the second largest producer of natural rubber in Africa after Cote d'Ivoire and the eleventh in the world, with a land area of 345,000 hectares under rubber, ranking seventh in the world, having yield (hectogram/ha) of 4,159 which ranks twenty-fifth in the world (Food and Agriculture Organization Statistics, 2015). About 68% of rubber producers in Nigeria are smallholder farmers living in the rural areas (Aigbekaen, Imarhiagbe, and Omokhafe, 2000; Giroh and Adebayo, 2007; Giroh, Umar and Yakub, 2010).

Natural Rubber, *Hevea Brasiliensis*, is the world's number one source for natural rubber (Abolagba and Giroh, 2006). The Nigerian rubber industry has enormous potentials for sustainable growth and development. Rubber performs basically three main functions in the Nigerian economy in terms of providing raw materials for agro-based industries, foreign exchange earnings and in the provision of employment (Aigbekaen, *et al*, 2000) having several points whereby value is added to the product.

The Nigerian natural rubber industry, which is dominated by smallholders, suffered a significant decline (70-80%) in output, despite the potentials of the crop as a major foreign exchange earner (Rubber Research Institute of Nigeria, 2010). This decline in the production of rubber in Nigeria has been described as alarming and worrisome especially to the nation's economy (Umar, Giroh, Agbonkpolor, and Mesike 2011). The fluctuation in production of rubber in Nigeria has been attributed mainly to the decline in natural rubber prices particularly

between 1996 and 2002, which got to a historic low in 2000 and affected the global rubber industry to the point that farmers in many producing countries including Nigeria shifted away from the industry (Aigbekaen, *et al*, 2000). It is encouraging that local and world market prices of rubber have increased such that the glut and low prices of the 1990s have transformed into current deficit and hence high prices (FAOSTAT 2014). With the increase in prices it would be expected that a corresponding increase in production and hectareage cultivation would follow, rather it fell from 247,000ha in the 1970s to 154,000ha in 2006 and recently a slight increased to 200,900ha in 2012 (Central Bank of Nigeria, 2013). This reduction in hectareage is mainly due to withdrawal of small scale rubber farmers from rubber production (Umar and Ugwa, 2006). With favorable market prices of natural rubber, which is predicted to remain for a long time (FAO, 2014) due to the indispensable nature of natural rubber in the manufacturing industry, there ought to be a renewed interest in rubber cultivation, yet production has not increased greatly. Therefore, this failure cannot be attributed to fluctuation in prices alone. What then could the problem be?

Rubber has the potential to help in poverty reduction, but the current production, processing, and marketing techniques being used, do not maximize the potential gains to be realized by farmers who cultivate and market rubber products. Nigeria smallholder rubber farmers sell about 98% of their total production as raw unprocessed rubber lump and in doing so, profit margins are slim. Adding value to natural rubber could generate higher profits, decrease unemployment rate for the country citizens and contribute as income generation for poor population. What then are ways farmers/marketers can add value to rubber to make good profit?

Natural rubber marketing, unlike other agricultural products, is unique for several reasons; it is purely an industrial product hence it is highly technical, involving specifications and quality of

the product, which everyone involved in the marketing system, must abide with. Absence of organized marketing has been felt as one of the major bottlenecks in accelerating the growth of rubber production. The Farmers have to depend on various marketing agencies to get a remunerative price for their produce, who in turn depend on rubber processors/manufactures for affecting their sales. It is obvious that the natural rubber sector needs a good marketing system. It is important to know how much marketing margin is earned in rubber marketing. What proportion of this margin is earned by the different marketing organizations and how profitable and sustainable is the value addition at each stage of the marketing channel for natural rubber?

This study, therefore, sought to provide answers to the following research questions:

1. Who are the agencies and what functions do they perform along the marketing channels for natural rubber?
2. What are the existing value addition points and marketing channels for Natural Rubber in Nigeria?
3. What proportion of the marketing margin is earned by each enterprise in the marketing chain and how sustainable are these enterprises?

RESEARCH METHODOLOGY

Area and Scope of the Study: The study was conducted in south-south, Nigeria. The zone was chosen because of its status as the major natural rubber growing areas in the country. The zone is characterized by a tropical climate with distinct dry season between November and March and a wet season between April and October.

Sources and types of data: The Primary data were collected with the aid of a set of well-structured questionnaire which was used to gather the information from the farmers, tappers, local collectors, wholesalers, processors and manufacturers.

Sampling procedure and Sampling size: A two-stage sampling procedure involving purposive and random sampling techniques was used in selecting 452 respondents study. Stage one was the purposive selection of Edo, Delta and Akwa-Ibom States being the major rubber- producing States in Nigeria. About 62.34% of the total rubber area planted in the country is owned by small-holder farmers, out of which, 75% are located in Study Area. (RRIN, 2010).

The second stage was the random selection of respondents-

- 20 small-holder nursery farmers from each State, that were involved in raising rubber seedlings and budded- stump cultivation, from the 2013 list of rubber nursery farmers obtained from the Rubber Research Institute of Nigeria (RRIN).
- 50 smallholder farmers involved in rubber cultivation in each of the three States from the 2007 list of rubber farmers obtained from the Rubber Research Institute of Nigeria and the tree crop units of the Ministry of Agriculture and Natural Resources in Edo, Delta and Akwa Ibom States. (The 2007 list comprises of farmers whose plantation would have attained tapping age; gestation period for rubber is 7years).
- 60 tappers. (20 tappers from each state)
- 120 marketers (40 from each State).
- the processing of wet coagulants into ribbed smoked sheet and blocked rubber and the processing of latex into concentrates, crepe and crumb rubber was done by about 47 rubber processing factories in Edo, Delta, and Akwa- Ibom states (RRIN 2010). Out of

the 47 processing factories, only 20 were processing fully and the 20 were purposively selected.

- 12 manufacturers were randomly selected, 4 from each State.

A total of 452 respondents, 60 input suppliers/nursery farmers, 150 farmers, 90 tappers, 120 marketers, 20 processors and 12 manufacturers were interviewed for the study.

Analytical Techniques; Data collected were analyzed using descriptive statistics which were frequency counts, pie chart, percentages, means and mode. Value Chain mapping was done using functional approach. The core processes, enterprises involved, flow and quantity of product at each node of the value chain were determined and represented by a flow chart. Value added is the amount of wealth created by a respondent in the chain; it is measured from net sales less the costs of bought-in goods and services (Iyabo, Omobowale, Sulaiman and Kemisola, 2013).

Value added = (Total sales value) – (Value of intermediate goods)

Total sales value = price x volume of final product sold.

Value Added is mathematically expressed as:

$$VA = P_i Q_i - \sum_{i=1}^n r_i X_i \dots\dots\dots (1).$$

(Oni, 2013)

Where VA - value added (in terms of net profits)
 PQ - value of output
 rX - cost of raw materials and intermediate goods/services

$$\text{Marketing Margin} = \text{Selling Price} - \text{Purchase Price} \dots\dots\dots (2)$$

Computing the total marketing margin is always related to the final price paid by the end buyer and is expressed as percentage.

$$\text{Total Gross Marketing Margin (TMM)} = \frac{\text{End buyer price} - \text{First seller price}}{\text{End buyer price}} \times 100 \quad \dots\dots\dots(3)$$

(Mussema,2006)

Statistics of Respondents Sampled: 452 respondents were sampled for the study, a total of 425 were found useful for the study. These represent about 94% response rate. Manufacturers' response rate was 33% and the products manufactured differed greatly- ranging from rubber bands, balloons, tries, carpet underlay, foot wears, hence marketing margin, profit and other financial calculations was not computed for this category expect their constraints.

Table 1: Distribution of Respondents Sampled

| | | Number of sampled respondents | Number valid for the study | Response Rate % |
|-------------------|------------|-------------------------------|----------------------------|-----------------|
| Nursery Farmers | Study Area | 60 | 60 | 100 |
| Rubber Producers | Edo | 50 | 50 | 100 |
| | Delta | 50 | 46 | 92 |
| | Akwa-Ibom | 50 | 44 | 88 |
| | | 150 | 140 | 93 |
| Tappers Marketers | Study Area | 90 | 90 | 100 |
| | Edo | 40 | 38 | 95 |
| | Delta | 40 | 38 | 95 |
| | Akwa-Ibom | 40 | 35 | 88 |
| | | 120 | 111 | 93 |
| Processors | Study Area | 20 | 20 | 100 |
| Manufacturers | Study Area | 12 | 4 | 33.33 |
| TOTAL | | 452 | 425 | 94.03 |

Source: Computed from Survey Data, 2017

RESULTS AND DISCUSSION

Socio – Economic Characteristics of Rubber Farmers in the study area.

Table 2 presents the socio-economic characteristics of the rubber farmers. The modal class was the age bracket of 51-60 and a mean value of 53 years. Generally there were a higher proportion of old farmers from each State than young farmers. This mean age suggests that rubber farmers in the study area were not young. The low representation of youth and middle aged in the sample might be due to their unfavorable attitude towards agriculture. This is consistent with findings of Balogun, Esekade, and Omo-Ikeroda (2011) and Abolagba, , Aigbeaen, and Omokhafa (2003) who noted that rubber farmers consisted mainly of the aged category. Findings were, however not in agreement with Bameke and Omoregbee (2009) their findings indicates that many of the respondents were in their active age of 36 to 45 years, in their Study Of Farmers' Perception of the Factors Militating against Rubber Production in Edo and Delta States of Nigeria

Results from the pooled data indicate that majority of the respondents were males, indicating that the sector is male dominated. This suggests that men were more involved in the production of natural rubber in the study area than women. This may be attributable to the enormous labour involved in rubber production.

The pooled data indicated that 86.43% of the respondents were married. The high percentage of married respondents may imply the importance attached to the marriage institution in Nigeria and family labour is still very important for many small-scale farmers.

Being educated may help the farmers adopt new and improved techniques without much difficulty, as they are likely to learn with ease and disseminate innovations. Results from the pooled data indicate that respondents from Edo State having higher literacy level compared to

Delta and Akwa-Ibom Farmers. Respondents in Akwa-Ibom were least educated. This could be due to value and interest placed on education in these areas.

The pooled data showed that majority of the respondents engaged in rubber farming on part-time basis. 10.71% of the respondents were full-time rubber farmers. This suggests that very few hands are full time rubber farmers, which might not be healthy for the growth and development of the rubber industry. Being involved in farming on secondary basis is probably a risk for latex-producing rubber trees because the farmers might feel less committed to using good tapping techniques and other practices that could endanger the trees.

Experience in farming had a mean value of 18.57 years. This implies that most of the farmers have been into farming for reasonable number of years. The long years of experience may indicate that most of the farmers started the farming at a young age (say 35 years). These years of experience could help in rubber development.

Results from the pooled data showed a mean household size of 9 persons. The large family size could be a valuable source of labour for rubber production and other agricultural and nonagricultural activities.

Table 2: Socio-Economic Characteristics of Respondents (Farmers)

| Variables | Description | Edo (N =50) | | Delta (N = 46) | | Akwa-Ibom (N = 44) | | Total (N=140) | |
|----------------------------------|------------------|-----------------|-----|--------------------|-------|------------------------|-------|------------------|-------|
| | | N | % | N | % | N | % | N | % |
| Age range (years) | < 30 | - | | 2 | 4.35 | 1 | 2.27 | 3 | 2.14 |
| | 31 -40 | 6 | 12 | 1 | 2.17 | 3 | 6.82 | 10 | 7.14 |
| | 41-50 | 9 | 18 | 13 | 28.26 | 12 | 27.27 | 34 | 24.29 |
| | 51-60 | 25 | 50 | 20 | 43.48 | 20 | 45.45 | 65 | 46.43 |
| | >61 | 10 | 20 | 10 | 21.74 | 8 | 18.18 | 28 | 20 |
| | Mean | 53.3 | | 53.11 | | 52.53 | | 53 | |
| Sex | Female | - | - | 2 | 4.35 | 1 | 2.27 | 3 | 2.14 |
| | Male | 50 | 100 | 44 | 95.65 | 43 | 97.73 | 137 | 97.86 |
| Marital Status | Married | 44 | 88 | 38 | 82.61 | 39 | 88.64 | 121 | 86.43 |
| | Single | 4 | 8 | 4 | 8.70 | 1 | 2.72 | 9 | 6.43 |
| | Divorce | - | | 1 | 2.17 | - | - | 1 | 0.71 |
| | Widow(er) | 2 | 4 | 3 | 6.52 | 4 | 9.09 | 9 | 6.43 |
| Education | None | 2 | 4 | 7 | 15.22 | 12 | 27.27 | 21 | 15 |
| | Primary school | 8 | 16 | 21 | 45.65 | 10 | 22.73 | 39 | 27.86 |
| | Secondary school | 25 | 50 | 10 | 21.74 | 14 | 31.82 | 49 | 35 |
| | Tertiary | 15 | 30 | 8 | 17.39 | 8 | 18.18 | 31 | 22.14 |
| Major occupation | Farming | 5 | 10 | 7 | 15.22 | 3 | 6.82 | 15 | 10.71 |
| | Trading | 8 | 16 | 11 | 23.91 | 22 | 50 | 41 | 29.29 |
| | Civil servant | 35 | 70 | 15 | 32.61 | 17 | 38.64 | 67 | 47.86 |
| | Others | 2 | 4 | 13 | 28.26 | 2 | 4.55 | 17 | 12.14 |
| Farming Experience (years) | < 10 | 5 | 10 | 6 | 13.03 | 5 | 11.36 | 16 | 11.43 |
| | 11- 15 | 6 | 12 | 10 | 21.74 | 10 | 22.73 | 26 | 18.57 |
| | 16-20 | 15 | 30 | 13 | 28.26 | 13 | 29.55 | 41 | 29.29 |
| | 21- 25 | 16 | 32 | 12 | 26.09 | 12 | 27.27 | 40 | 28.57 |
| | >25 | 8 | 16 | 5 | 10.87 | 4 | 9.09 | 17 | 12.14 |
| | Mean | 19.6 | | 18 | | 18 | | 18.57 | |
| Household size | 1-4 | 8 | 16 | 2 | 4.54 | 1 | 2.27 | 11 | 7.86 |
| | 5-8 | 25 | 50 | 21 | 45.65 | 17 | 38.64 | 63 | 45 |
| | 9-12 | 10 | 20 | 13 | 28.26 | 22 | 50 | 45 | 32.14 |
| | 13-16 | 7 | 14 | 10 | 21.74 | 4 | 9.09 | 21 | 15 |
| | Mean | 8 | | 9 | | 9 | | 9 | |

Source: Computed from Survey Data, 2017

Socio –Economic Characteristics of Rubber Marketers.

Table 3 shows the socio-economic characteristics of the rubber marketers. The modal class was the age bracket of 41-50 with a mean value of 43.88 years. This age mean suggests that the

rubber marketers are in their active age and that younger people were more involved in the marketing of rubber compared to those in production. Delta State recorded the lowest mean-age of 42.6 years as compared to Edo and Akwa-Ibom States. Rubber marketing involves a lot of travelling and activities; this could be the reason for the younger age mean.

The results also showed that majority (89.84%) of the respondents in Edo State was males and only two were females. About 95% and 91% were recorded as males in Delta and Akwa-Ibom states respectively. Results from the pooled data indicate 6.31% of the respondents were females, while record for males was about 94%. This suggests that rubber marketing in the study area was male dominated. This could be attributed to the numerous travelling and activities involved in rubber marketing, which might be cumbersome for female.

Most of the respondents were married. This suggests that rubber marketing in the study area was dominated by married people.

Majority had formal education. The literacy level is higher than that of their counterpart in the rubber production. This suggests that the marketers had the required basic knowledge and skill to enhance their marketing performance which will help in the efficient performance of all the marketing functions like effective communication, record keeping and devising strategies on how to enhance efficient marketing activities.

As regards occupation, about 68% was fully involved in the marketing of natural rubber, few of the marketers were involved in farming. This suggests that rubber marketing might be a profitable and sustainable business.

Results for marketing experience suggests that, on average, rubber marketers have been in the business for at least 17 years. This implies that most of the marketers in the study area have been

in the rubber marketing business for a long time. They were thus assumed to be experienced to know the right decisions to take and ought to have been contributing to source of income to many families.

Table 3: Socio –Economic Characteristics of Rubber Marketers

| Variables | Description | Edo (N = 38) | | Delta (N = 38) | | Akwa-Ibom (N =35) | | Pooled (N=111) | |
|---------------------------------|------------------|------------------|-------|-------------------|-------|-----------------------|-------|-------------------|-------|
| | | N | % | N | % | N | % | N | % |
| Age range (years) | < 30 | 1 | 2.63 | 3 | 7.89 | 1 | 2.86 | 5 | 4.5 |
| | 31 -40 | 12 | 31.58 | 15 | 39.47 | 6 | 17.14 | 33 | 29.73 |
| | 41-50 | 19 | 50 | 14 | 36.84 | 21 | 60 | 54 | 48.65 |
| | 51-60 | 5 | 13.16 | 2 | 5.26 | 6 | 17.14 | 13 | 11.71 |
| | >60 | 1 | 2.63 | 4 | 10.53 | 1 | 2.86 | 6 | 5.41 |
| | Mean | 43.66 | | 42.61 | | 45.5 | | 43.88 | |
| Sex | Female | 2 | 5.26 | 2 | 5.26 | 3 | 8.57 | 7 | 6.31 |
| | Male | 34 | 89.47 | 36 | 94.74 | 32 | 91.43 | 104 | 93.69 |
| Marital Status | Married | 33 | 86.84 | 30 | 78.94 | 30 | 85.71 | 93 | 83.78 |
| | Single | 2 | 5.26 | 4 | 10.53 | 1 | 2.86 | 7 | 6.31 |
| | Divorced | 2 | 5.26 | 1 | 2.63 | - | | 3 | 2.70 |
| | Widow (er) | 1 | 2.63 | 1 | 2.63 | 4 | 11.43 | 6 | 5.41 |
| Education | No formal | - | | 1 | 2.63 | - | | 1 | 0.9 |
| | Primary school | 8 | 21.05 | 11 | 28.95 | 10 | 28.57 | 29 | 26.13 |
| | Secondary school | 22 | 57.89 | 23 | 60.53 | 12 | 34.29 | 57 | 51.35 |
| | Tertiary | 8 | 21.05 | 3 | 7.89 | 13 | 37.14 | 24 | 21.62 |
| Major occupation | Farming | 5 | 13.16 | 6 | 15.79 | 3 | 8.57 | 14 | 12.61 |
| | Trading | 28 | 73.68 | 22 | 57.89 | 25 | 71.43 | 75 | 67.57 |
| | Civil servant | 5 | 13.16 | 2 | 5.26 | 5 | 14.29 | 12 | 10.81 |
| | Others | 2 | 5.26 | 8 | 21.05 | 2 | 5.71 | 12 | 10.81 |
| Marketing Experience (years) | < 10 | 5 | 13.16 | 3 | 7.89 | 5 | 14.29 | 13 | 11.71 |
| | 11- 15 | 10 | 26.32 | 9 | 23.68 | 5 | 14.29 | 24 | 21.62 |
| | 16-20 | 15 | 39.47 | 11 | 28.95 | 18 | 51.43 | 44 | 39.64 |
| | 21- 25 | 6 | 15.79 | 7 | 18.42 | 6 | 17.14 | 19 | 17.12 |
| | >25 | 2 | 5.26 | 8 | 21.05 | 1 | 2.86 | 11 | 9.91 |
| | Mean | 16.68 | | 19.05 | | 17 | | 17.59 | |

Source: Computed from Survey Data, 2017

Socio-Economic Characteristics of Tappers in the Study Area.

Table 4 shows the socio-economic characteristics of the tappers. The modal class was 41-50 age brackets with a mean value of 43.6. This implies that many of the respondents were young, (compared to the mean ages of rubber farmers and marketers in the study area) and in their active age, especially given the task of rubber tapping.

Majority of the respondents were males. This suggests that rubber tapping in the study area was mostly undertaken by men and that the task might be too tedious for females.

Majority of the tappers had formal education, which will positively predispose them to willingly accept innovations and practices that will enhance rubber tapping and their tapping skills.

Tapping experience results revealed a modal class of less than ten years and mean value was 11.5 years. This suggests that the tappers had experience and will be expected to tap well.

Table 4.: Socio-Economic Characteristics of the Rubber Tappers

| Variables | Description | Edo (N = 30) | | Delta (N = 30) | | Akwa-Ibom (N =30) | | Pooled (N=90) | |
|-----------------------|------------------|------------------|-------|-------------------|-------|-----------------------|-------|------------------|-------|
| | | N | % | N | % | N | % | N | % |
| Age range (years) | < 30 | 1 | 3.33 | 3 | 10 | - | - | 4 | 4.44 |
| | 31 -40 | 14 | 46.67 | 15 | 50 | 8 | 26.67 | 37 | 41.11 |
| | 41-50 | 15 | 50.00 | 12 | 40 | 21 | 70.00 | 48 | 53.33 |
| | 51-60 | - | - | - | - | 1 | 3.33 | 1 | 1.11 |
| Sex | Female | 3 | 10 | 2 | 6.67 | 5 | 16.67 | 10 | 11.11 |
| | Male | 27 | 90 | 28 | 93.33 | 25 | 83.33 | 80 | 88.89 |
| Education | No formal | 1 | 3.33 | 1 | 3.33 | 5 | 16.67 | 7 | 7.78 |
| | Primary school | 8 | 26.67 | 11 | 36.67 | 15 | 50.00 | 34 | 37.78 |
| | Secondary school | 21 | 70 | 18 | 60.00 | 10 | 33.33 | 49 | 54.44 |
| Tapping Experience | < 10 | 15 | 50 | 21 | 70.00 | 13 | 43.33 | 49 | 54.44 |
| | 11-15 | 12 | 40 | 9 | 30.00 | 10 | 33.33 | 31 | 34.44 |
| | 16- 20 | 3 | 10 | - | - | 6 | 20.00 | 9 | 10.00 |
| | 21- 25 | - | - | - | - | 1 | 3.33 | 1 | 1.11 |

Source: Computed from Survey Data, 2017

Natural Rubber Value Chain in the Study Area

The value chain mapping highlights the involvement of different respondents/agencies who participate directly or indirectly in the natural rubber value chain.

Direct Agencies /Respondents and their Functions in the Value Chain

The results of the analysis indicates that the key processes in natural rubber Value Chain in the study area are input supplies, Production, marketing, Processing, Consumption and Export, while the key respondents/agencies are input suppliers, producers, marketers, processors, manufacturers, exporters and consumers. Similar processes were also found by Hoang (2008) in Upgrading Strategy for Rubber Value Chain in Bo Trach. The direct agencies included co-operatives, farmer groups, processors, local manufacturers, and exporters. The indirect agencies included financial institution, Rubber Research Institute of Nigeria, Agricultural Development Programme - tree crop unit and the Raw Materials Research and Development Council (RMRDC). The value chain map for natural rubber is in Figure 1, and it was the same for the three States studied. Each of these respondents added value to the product along the chain. Some functions were performed by more than one respondent and some respondents performed more than one function.

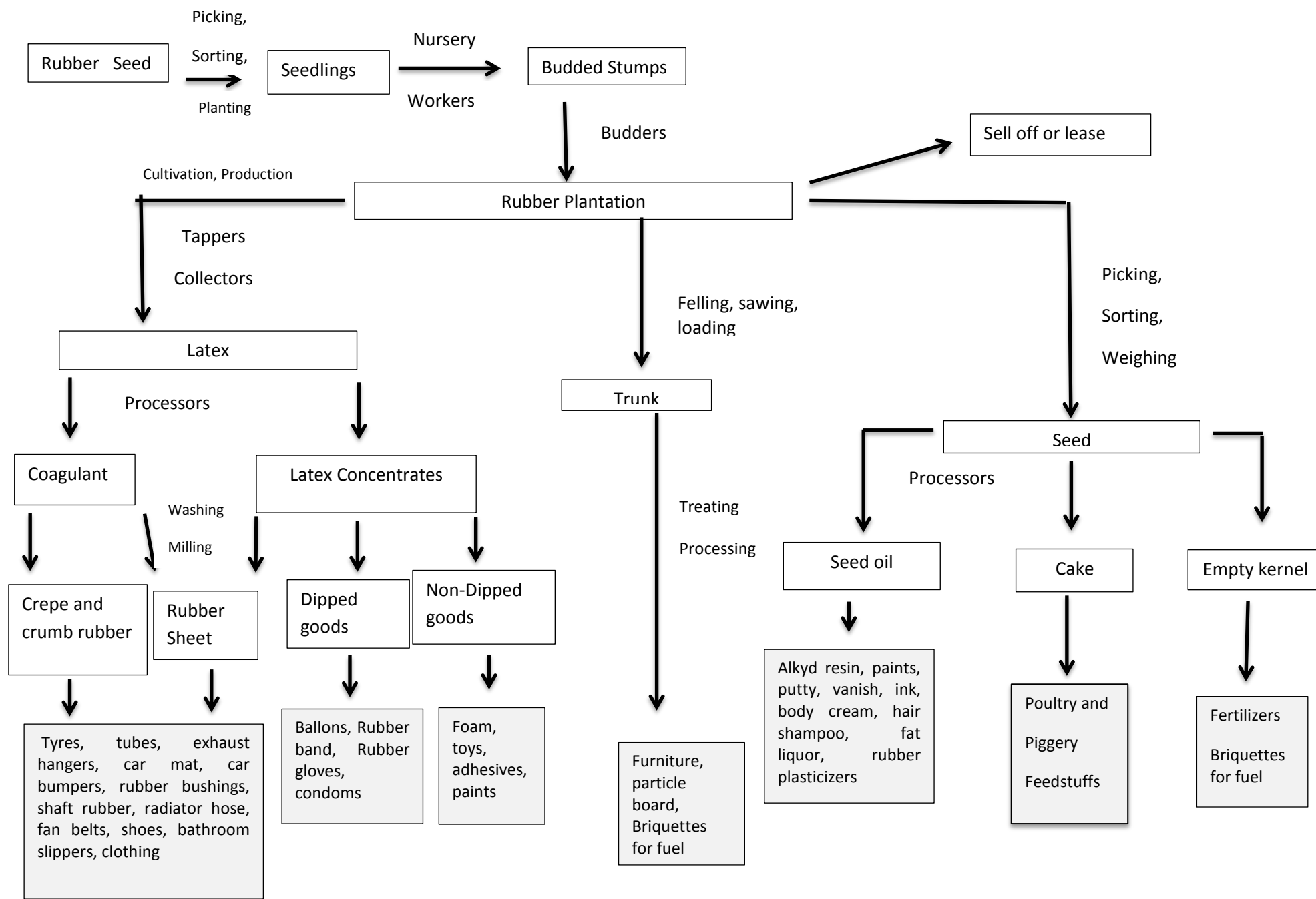


Figure 1. Natural Rubber Value Chain Mapping for the study area

Source: Mapped from Survey, 2017

Input Suppliers in the Rubber Value Chain

At this stage of the value chain, there were many agencies that were involved directly or indirectly in input supply in the study area. The input suppliers were responsible for providing seeds, seedlings, budded stumps and procuring inputs from manufacturer's representatives and selling to farmers. Such inputs included herbicides, pesticides, fertilizers, and farm tools such as budding tools, cutlasses and hoes. They also render advisory services to the farmers on the type of clone to plant, cropping system/pattern, type and method of application of the various inputs.

The major source of seed among of the nursery producers was nearby rubber plantations (94.29% of nursery producers). Major clones used as rootstock among nursery producers included, NIG 800 series (71.43%), GTI (22.86%) and RRIM 600 (5.71%). Majority of the respondents (85%) sourced these inputs (seeds, agrochemicals and tools) within their locality, while 15% sourced their inputs from urban centers such as Benin, Asaba, Warri and Calabar. Most farmers (65%) did not applying fertilizers of any kind. Results revealed that Input suppliers were vertically/forwardly integrated with about 35% of the nursery owners having their own rubber plantation.

Producers/Farmers in the Rubber Value Chain

Natural Rubber producers owned rubber farms of various sizes in smallholdings. The mean farm size was computed to be 3.5, 3.2 and 3.6 hectares in Edo, Delta and Akwa-Ibom State respectively. The producers were responsible for the production of naturally coagulated rubber (cup lump), rubber latex and rubber seeds. Their functions/activities included establishment, cultivation and management of the rubber farm. They added value right from farm preparation, procurement of the inputs, tapping and marketing. Other functions include ploughing, planting, fertilization application, weeding, pest/disease control and post-harvest handling. The budded

stumps were mainly supplied by the Rubber Research Institute of Nigeria (RRIN) private nurseries, and Michelin farms. Rubber production in the study area was rain fed. Some farmers sell-off or lease out their farms when the plantation attains tapping age for some period. The lessee is responsible for the plantation maintainers, tapping and sells of products depending on the agreement, which is usually on yearly basics. Most of the respondents enhanced the value chain by engaging in different cropping system. Table 5 showed that only 6% of the respondents in Edo practiced sole farming, while 11.9% was recorded in Delta and Akwa-Ibom States respectively. In Edo State 70% of the respondents practiced intercropping, while Delta and Akwa-Ibom States had 78.26% and 65.91% respectively. This mean that the respondents are adding value to the farms by engaging in intercropping which serves to protective crops, reduce weeding cost and source of addition food/revenue to the farmers. Mixed farming was practiced by 23.18% of the respondents. Results from the pooled data indicates that 5.71% of the respondents practiced sole rubber farming, 71.43% practiced intercropping, while 22.86% practiced mixed farming. Major intercropping systems identified were with cassava/Plantain/maize (about 26%), cassava/plantain/pineapple about 25% and (about 22%) Cassava/pawpaw/cocoyam. About 94% of the respondents claimed that intercropping and mixed farming was a means to ensure additional returns and reduce cost of slashing in the rubber farms. This suggests that most of the respondents were involved in either mixed farming or intercropping at one stage or the other in their rubber plantation. This production system created opportunities for income enhancement through the integration of arable crops on the inter-rows during the immature stages of rubber or high value agro –forestry crops at the periphraasis and mini-livestock in matured plantations.

This system which is known as rubber agroforestry system, may have contributed immensely to the farmers' food security and income opportunities. This is similar to the findings of Ogwuche, Umar, Esekhide and Francis (2012) on the economics of intercropping natural rubber. They found out that rubber farms intercropped with arable crops will reach tapping stage earlier which means a quicker return is expected from rubber intercropped compared with a sole rubber plantation and guaranteed annual income flow.

The farmers in the study area were utilizing rudimentary implements in their production activities. Post-harvest handling, which included packing, storing, transportation, loading and unloading were carried out by the producers. Where rubber lump is sold at the farm gate, all aforementioned activities were performed by the collector/traders. The means of transportation varied but predominantly producers made use of motorcycles and pick-up vans. Results revealed that 15% of the producers tap their rubber themselves and about 30% market their products themselves.

Table 5 Natural Rubber Cropping System in the Study Area

| Variables | Description | <u>Edo</u> (N = 50) | | <u>Delta</u> (N = 46) | | <u>Akwa-Ibom</u> (N =44) | | <u>Total</u> (N=140) | |
|---------------|-----------------------------|-------------------------|-----------|---------------------------|--------------|------------------------------|--------------|-------------------------|--------------|
| | | N | % | N | % | N | % | N | % |
| Sole | | 3 | 6 | - | - | 5 | 11.9 | 8 | 5.71 |
| Intercrop | Cassava/plantain /maize | 24 | 48 | 9 | 19.56 | 3 | 6.82 | 36 | 25.71 |
| | Cassava/plantain /pineapple | 7 | 14 | 25 | 54.35 | 2 | 4.76 | 34 | 24.64 |
| | Cassava/telferia /cocoyam | 4 | 8 | 2 | 4.35 | 24 | 57.14 | 30 | 21.74 |
| | Total | 35 | 70 | 36 | 78.26 | 29 | 65.91 | 100 | 71.43 |
| Mixed farming | Bee keeping | 4 | 8 | 4 | 8.7 | 2 | 4.76 | 10 | 7.14 |
| | rabbit | 4 | 8 | 6 | 13.04 | 7 | 16.67 | 17 | 12.14 |
| | snail | 4 | 8 | - | - | 1 | 2.38 | 5 | 3.57 |
| | Total | 12 | 24 | 10 | 21.74 | 10 | 23.81 | 32 | 22.86 |

Source: Computed from Survey Data, 2017

Tappers in the Rubber Value Chain

Their functions include tapping, collection of latex, addition of acid (coagulant or anti-coagulant) and transportation to farm gate. It was also found out that a mean of 396 trees were tapped per day as against the 450 to 500 trees recommended by Schroth *et al.* (2004). Several factors have been identified for low number of trees tapped and include the following: weedy plantations and wind damages to rubber trees. Results also revealed that 4.44% of the tappers own their plantation, while 11.11% on lease plantation. 10% of the tappers, market their products themselves. This implies forward and backward market integration, which is necessary for sustainable development for the small holders.

Collectors/Marketers in the Rubber Value Chain

Their functions include collection, transportation, sorting, grading, quality control and distribution. Their socio-economic characteristics had earlier been presented in Table 4. It was discovered that there were two major types of collectors in the rubber value chain in the study area: Farm-Gate/Village Assemblers and Wholesaler marketers. The Village marketers collect and bulk rubber lump from individual farmers, and most times sell to the wholesalers. They handle 58% of total marketed rubber. This is similar to the findings of Iyabo *et al* (2013) on Plantain Value Chain Mapping in Southwestern Nigeria. Selling at the Farm Gate prevent producers from bargaining for higher prices compared to when the commodity is taken to markets. Results revealed that the marketers were vertically integrated with about 41% of the respondents processing lump/latex into different products.

Processors in the Rubber Value Chain

They process Primary products (latex concentrates and lump) into different types of products such as into crepe, crumb, ribbed smoked sheet and blocked rubber. Latex in the study area is processed into different types of products such as rubber sheet. The coagulant is processed into crumbs and crepe for export and for local manufacturing of tires. Results revealed that 40% of the processed products were sold locally to manufacturers, while 60% was exported. 10% of the respondents (processor) had their own manufacturing industries.

Manufacturers in the Rubber Value Chain

Manufacturers of rubber-based products can be classified into two according to the raw materials they use (dry rubber and liquid rubber).

Manufacturers using dry rubber produce tires, tubes, belts, hoses, mats, floor coverings, slippers, gaskets, caster wheels, hot water bottles, jar rings, exercise components, automotive components, and other similar products.

Latex-based or liquid rubber based manufacturers produce dipped products including different types of gloves (examination, surgical, household, cotton supported industrial and agricultural gloves), balloons, foam rubber mattresses and other articles of foams, rubber bands and threads, toys and masks, cot sheets.

Supporting agencies in the Rubber Value Chain

Financial institutions were the banks and insurance companies that granted credit and assists farmers and marketers in their rubber business.

RRIN was the main source of training in the study area. The survey results revealed that majority of respondents participated in training that were organized in the last three years. The results show that most of the trainings were given on tapping, disease control and management, and the other trainings

such as intercropping-arable and perennial; mixed framing-mini livestock and post-harvest handling were given. Trainings were not given on rubber marketing. The supporting agencies have never organized any training on marketing of rubber.

Table 6: Access to Services by Respondents

| Variables | Items | Edo N=50 | | Delta N=46 | | Akwa-Ibom N=44 | | Total N=140 | |
|-----------|---|-------------|----|---------------|-------|----------------|-------|----------------|-------|
| | | N | % | N | % | N | % | N | % |
| Training | Participated in Training Programme | 45 | 90 | 40 | 86.96 | 40 | 90.91 | 125 | 89.29 |
| | Did not Participate in Training Programme | 5 | 10 | 6 | 13.04 | 4 | 9.09 | 15 | 10.71 |
| Extension | Access to Extension services | 10 | 20 | 13 | 28.26 | 14 | 31.81 | 37 | 26.42 |
| | No Access to Extension services | 40 | 80 | 33 | 71.74 | 30 | 68.18 | 103 | 73.57 |

Source: Computed from Survey Data, 2017

Marketing Channels for Natural Rubber in the Study Area

The diagrammatic representations of the marketing channels in the study area are contained in Figures 2. Natural rubber in the study area had a long marketing chain because lump/latex passes through many market participants and different form of processing before reaching the final consumers. The major agencies in the channeling of natural rubber in the study area included the producers, the marketers, the processors, manufacturers, exporter, the retailers and the consumers. the main receivers from producers were marketers/collectors. The channels was however the same for the three States. The majority of farmers (86.43%) sold their produce to marketers. The marketers consisted of village marketers, wholesalers and co-operative societies or fellow farmers. About 46% of farmers sold their produce to village marketer and wholesalers, 35% to co-operative society and

5.0% to fellow farmers. Marketers are the major buyers of rubber produce from producers because they are accessible and available all the time. Most farmers in Edo State sold to the co-operative societies, the co-operative in turn sold to the processors (Michelin Company). Farmers (13.57%) also sold produce to processors and manufacturers. Five major marketing channels were identified. Study also revealed that this is one product where the final consumer could not buy directly from the producers. The volume of natural rubber (lump and latex) flow through the channel reflected efforts by producers to sell their products through channels that provided more profit and also marketers strive to buy through channels where they had a higher chance of making profit. It is clear that the major value-added activity by the marketers was the transfer of latex or lump from one location to the other as the trade was based mainly on raw materials. The major marketing functions carried out in all five marketing channels are storage, packaging, grading and processing.

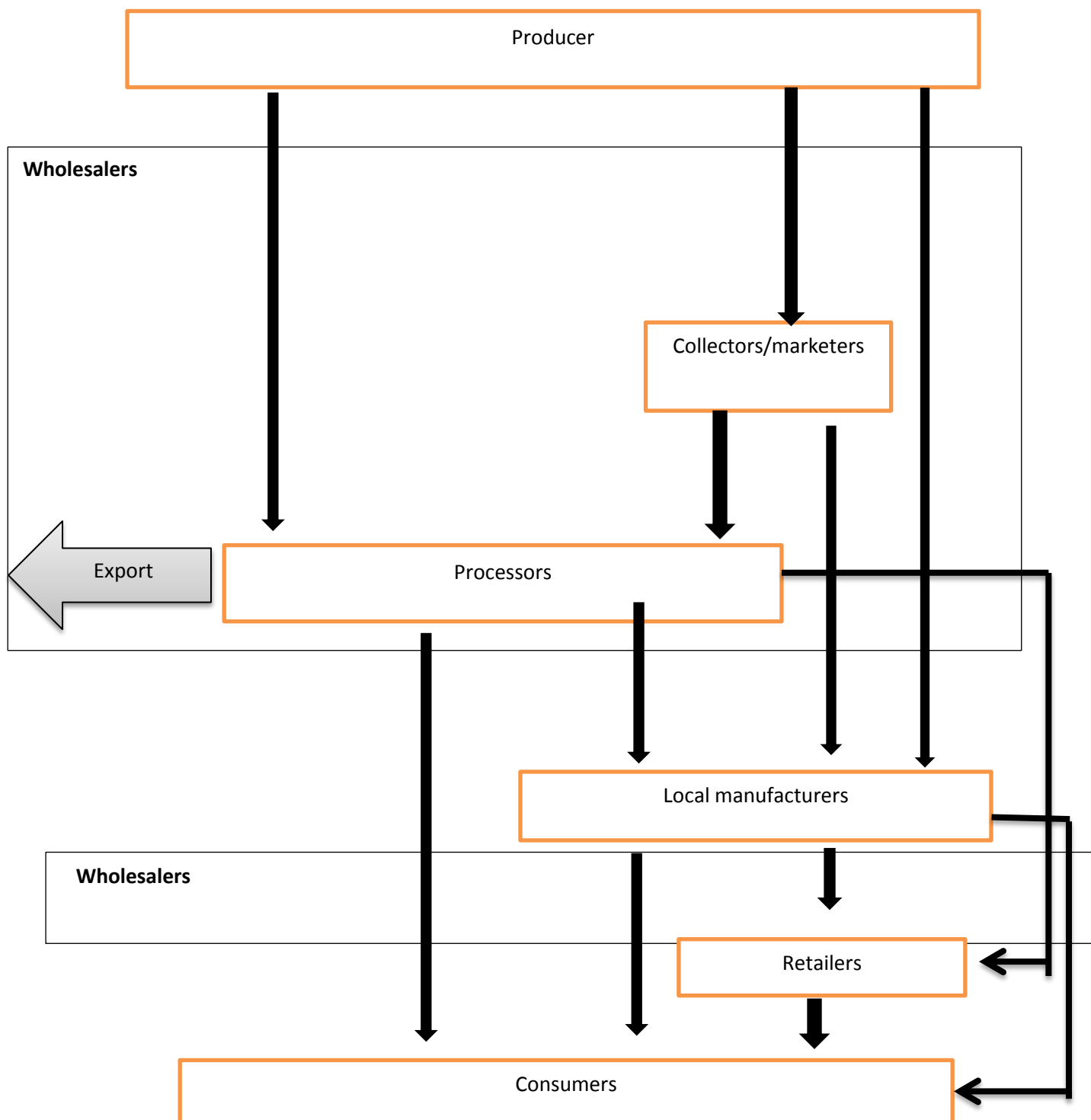


Figure 2: Marketing Channel for Natural Rubber Lump and Latex Concentrates in the Study Area.
Source: Computed from Survey Data, 2017

Marketing Margin at each Value Addition Point for Key Products

The identified functions included transportation, processing, storage, packaging and distribution which formed the major components of the marketing margin. Table 7 shows the average marketing margins for key products in the study area. Findings show that marketing margin percentage for dry rubber crumb was the highest accounting for 60% of selling price, followed closely by latex concentrates and sheet which recorded 59.20% and 50% respectively.

In Table 8, the mark-up/profit for the seedlings marketers accounted for 67.59% of the total margin while the cost of marketing functions accounted for 32.43% with transportation cost taking the greater proportion (24.32%) of the total margin. This is in conformity with the findings of Achike and Anzaku (2010) that transportation accounted for the greater share of the cost in the marketing of benniseed. The results also show that marketers who process into latex concentrate, crumb and sheet had mark-up that accounted for 89.80%, 77.12% and 80.33% of their total margin respectively which shows that the marketers and processors were more exploitative in their prices relative to the marketers of seedlings and rubber lump. The marketing functions for those that process into latex concentrate, crumb and sheet accounted for 10.20%, 22.88% and 19.67% of their total margins respectively with processing cost taking the lion share. This also supports the findings by Folayan and Bifarin (2011) who found out that processing cost was high relative to the other cost components in the business of plantain processing in Ondo State.

Likewise the major components of marketing margin for seedlings and budded stump were identified to be middlemen's mark-up and transportation cost, which also corroborates Alufohai and Abiola (2003) who found mark-up and transportation to be the major components in the

processing of plantain flour in Edo State. Likewise the major components of the marketing margin for the processors of latex concentrates, rubber crumb and rubber sheet were middlemen's mark-up and processing cost. The mark-up for the budded stump marketers was highest, which was closely followed by latex, sheets and crumb, while that of lump and seedling were the least among the product in the study.

Table 7: Average Marketing Margins for key products

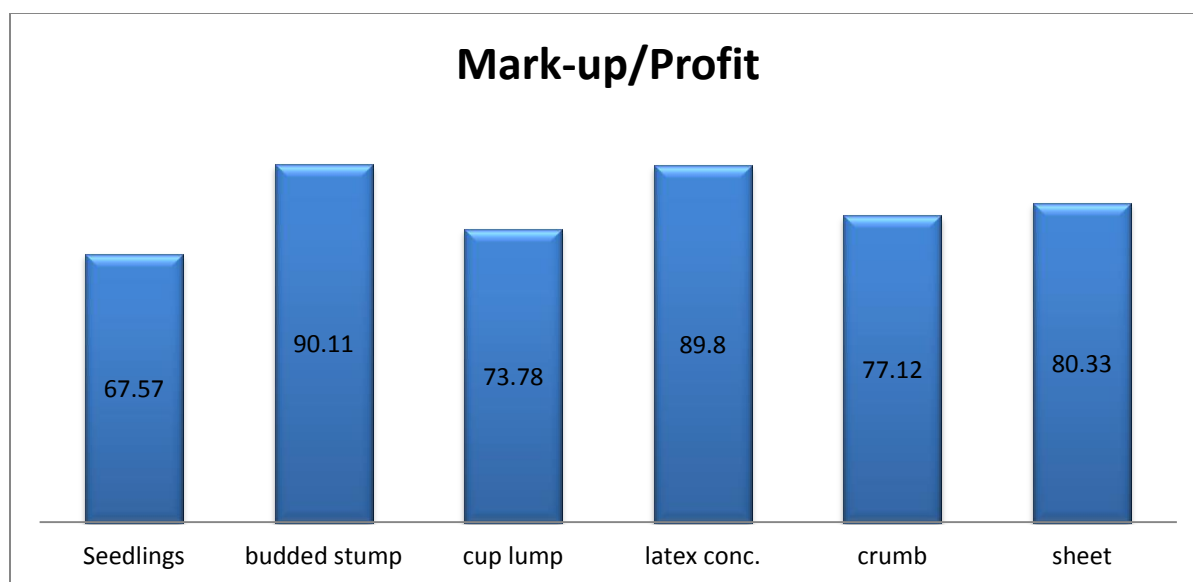
| Products /one/kg | Purchase price (₦) | Selling Price(₦) | Market Margin | Marketing margin% |
|---------------------|--------------------|------------------|--------------------|-------------------|
| | 1 | 2 | 3 = (2 - 1) | 4=3/2*100 |
| Seedlings | 10 | 13.7 | 3.7 | 27.01 |
| Budded Stump | 41.29 | 60 | 18.71 | 31.18 |
| Cup Lump | 95.92 | 155.99 | 60.07 | 38.51 |
| Latex Conc. | 122.41 | 300 | 177.59 | 59.20 |
| Crumb | 155.99 | 390 | 234.01 | 60.00 |
| Sheet | 210 | 420 | 210 | 50.00 |

Source: Computed from Survey Data, 2017

Table 8 Identified Components of the Marketing Margin for Cup Lump and processed Products

| Component cost | Seedlings | | Budded stump | | Cup lump | | Latex Conc. | | Crumb | | Sheet | |
|-----------------------|------------|--------------|--------------|--------------|--------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|
| | Mean ₦ | Percentage | Mean ₦ | Percentage | Mean ₦ | Percentage | Mean ₦ | Percentage | Mean ₦ | Percentage | Mean ₦ | Percentage |
| Standardization | | | | | 1.1 | 1.83 | 1.9 | 1.07 | | 0.00 | - | - |
| Transportation | 0.9 | 24.32 | 1.2 | 6.41 | 8.44 | 14.05 | 2.56 | 1.44 | 1 | 0.43 | 2.00 | 0.95 |
| Packaging | 0.2 | 5.41 | 0.1 | 0.53 | 0.07 | 0.12 | 1.11 | 0.63 | 1 | 0.43 | 2.00 | 0.95 |
| Storage | - | | 0.2 | 1.07 | 1.12 | 1.86 | 0.56 | 0.32 | 1 | 0.43 | 3.00 | 1.43 |
| Processing | 0 | 0.00 | | 0.00 | | 0.00 | 8.03 | 4.52 | 50 | 21.37 | 33.00 | 15.71 |
| Losses | 0.1 | 2.70 | 0.15 | 0.80 | 1.02 | 1.70 | 2.15 | 1.21 | 0.05 | 0.02 | 0.80 | 0.38 |
| Other levies | 0 | 0.00 | 0.2 | 1.07 | 4.00 | 6.66 | 1.8 | 1.01 | 0.5 | 0.21 | 0.50 | 0.24 |
| Mark-up/Profit | 2.5 | 67.57 | 16.86 | 90.11 | 44.32 | 73.78 | 159.48 | 89.80 | 180.46 | 77.12 | 168.70 | 80.33 |
| Total Margin | 3.7 | 100 | 18.71 | 100 | 60.07 | 100 | 177.59 | 100 | 234.01 | 100 | 210 | 100 |

Source: Computed from Survey Data, 2017



Source: Computed from Survey Data, 2017

Figure 3: Bar Chart showing profit for different value addition points of Rubber

Value Addition through Processing

Results in Table 9 show value addition to natural rubber from seedlings to processing. Value addition per unit of budded stump was ₦14.36. Value addition per 1kg of rubber was ₦115.16 for latex concentrates, ₦136.14 for crumb rubber and ₦124.38 for sheet rubber. This means that the value of the products could increase by a ratio of about 3:1 for all products. Findings also show that crumb rubber had the highest value addition, which means it is more profitable to process into crumb rubber followed by rubber sheet followed by latex concentrates. However it is profitable to process into any of the three products when compared with the profit from rubber lump (coagula). The differences were however significant at 5% level.

Table 9 Value Added by Processing and Marketing Efficiency

| Products | Profit (₹) | Value Added (₹) | Cost of Value added (₹) | Marketing Efficiency |
|--------------|---------------|--------------------|----------------------------|-------------------------|
| Seedlings | 2.5 | | 1.2 | |
| Budded Stump | 16.86 | 14.36 | 1.85 | 7.76 |
| Cup Lump | 44.32 | | 15.75 | |
| Latex Conc. | 159.48 | 115.16 | 18.11 | 6.36 |
| Crumb | 180.46 | 136.14 | 53.55 | 2.54 |
| Sheet | 168.7 | 124.38 | 41.30 | 3.01 |

Source: Computed from Survey Data, 2017

Conclusion and Recommendation

The study established numerous enterprises and products derivable from natural rubber value chain. The rubber marketing system also gave a unique result as the marketing systems were the consumer does not buy directing from the producer. The rubber value addition points all appeared efficient and sustainable.

Based on the findings of this study the following recommendations have been made:

- i. Nursery had the highest value add, farmers should be encouraged to venture into nursery enterprise.
- ii. Farmers should endeavor to integrate backwards to produce budded stumps and also process rubber latex into its different products since they were all profitable.
- iii. Farmers should be encouraged to form cooperatives/Commodity Associations/SMEs such as: Use of lohashilpi sheeting battery for production of sheet rubber; Production of latex concentrate; Production of dipped goods such as hand gloves, rubber band, balloons; Information dissemination on production of industrial goods.

- iv. The mean age of the farmers was approximately 53 years, which shows that the respondents were relatively old; this call for concerted efforts that should aim at encouraging younger farmers to embark on rubber production activities by the Government and the Supporting agencies.
- v. Training should be organized for marketers and other relevant agencies by the Government and the Supporting agencies
- vi. Market and processing infrastructure should be improved upon (by the Federal Government and the Supporting agencies) by investing in advance technology/facilities in order to improve the production, marketing and processing of natural rubber as it was indicated as a major constraint.

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APPENDIX



Rootstock nursery



Bud wood garden of RRIN developed natural rubber clones



Rubber + cassava



Rubber + pineapple



Rubber + yam

Natural rubber intercropping



Rubber + Snailery



Rubber + Bee hive

Mixed farming in rubber plantation



Showing Rubber Latex, Cup Lump, Sheet and Crumb Rubber

