**THE SUSTAINABILITY OF AGRICULTURE IN NIGERIA USING RUBBER AS A CASE STUDY**

**ABSTRACT**

The study is an investigation of the sustainability of agriculture in Nigeria using Rubber as case study. Edo and Abia states were sampled for the study with 300 questionnaires administered in 10 communities among rubber farmers. The study is an investigation of the socio-demographic distribution of the rubber farmers, perception of rubber farmers, and influence of government activities. Sources of information and the data were cumulated for Nigeria as a whole. The data were analyzed using statistical analysis. Findings indicated the distribution of rubber farmers on socio-demographic distribution, sources of funds, and the effects on agricultural sustainability in Nigeria. Farmers’ reaction to government activities and recommendations were stated alongside the challenges encountered by the farmers and were analyzed. I concluded that provision of funds, basic infrastructural facilities, government increased participation, restructuring laws and policies relating to agriculture and provision of information on improved agricultural technology are needed for agricultural sustainability in Nigeria.

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CHAPTER 1

INTRODUCTION

The history of natural rubber production in Nigeria began in 1894 with the exploitation of Funtumia elastic, indigenous wild rubber. The wild trees that yielded rubber were, however, ruined by poor tapping systems, and the export of wild rubber dropped sharply. In a search for sources of natural rubber to supply the demand of a rapidly expanding automobile industry, Heavea brasiliensis (Muell Arg.) was found to be the best source of the plant because of its singular ability to renew its bark and thus ensure a sustained harvest. It was introduced into Nigeria from Kew Gardens, England around 1895 with the first rubber estate planted at Sapele in 1903 and a second one at Nkisi in the then eastern region in 1912. By 1925, some 1,000 hectares of European owned estates existed in Southwestern Nigeria (Uraih, 1980).

Rubber is grown in Edo, Delta, Ondo, Ogun, Abia, Anambra, Akwa Ibom, Cross River, Rivers, Ebonyi, and Bayelsa States where the amount of rainfall is between 1,800 mm and 2,000

1. per annum (Aigbekaen, Imarhiagbe, & Omokhafe, 2000). Natural rubber performs three main functions in the national economy of Nigeria: it provides raw materials for the agro- based industries and foreign exchange earnings as in Table 1, places Nigeria in the world map as a net exporter of rubber, and lastly, it offers employment to a sizeable segment of the Nigerian farming population (Abolagba, 2003). In 1990 Nigeria overtook Liberia as the largest rubber producer in Africa. Production rose from 60,000 tons in 1986 to 147,000 tons in 1990. It dropped to 125,000 tons in 1995 and 107,000 tons in 2,000 but went up again in 2003 to 142,000 tons and remained at 142,000 in 2004. (Table 2).

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The Nigerian rubber industry has enormous potential for its sustainable growth and development, and the neglect it has suffered creates a need to conduct research that will help address the situation and help the sustainability of the agricultural industry through rubber production.

Table 1.

*World Price of Natural Rubber 1988 – 2003*

|  |  |
| --- | --- |
| **Year** | **World market price** |
|  | **(N /kg)** |
| 1988 | 1.50 |
| 1989 | 2.00 |
| 1990 | 1.40 |
| 1991 | 5.30 |
| 1992 | 12.52 |
| 1993 | 24.10 |
| 1994 | 34.40 |
| 1995 | 34.78 |
| 1996 | 59.92 |
| 1997 | 56.72 |
| 1998 | NA |
| 1999 | 57.89 |
| 2000 | 59.40 |
| 2001 | 69.80 |
| 2002 | 95.67 |
| 2003 | 113.89 |

**Source:** Abolagba et al., (2003), CBN Annual Reports and Statement of Account (Various issues).

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Table 2.

*Major Cash Crops Production Outputs (1,000 tons)*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Crops** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Oil palm fruit | 7,800 | 7,750 | 7,750 | 7,800 | 8,000 | 8,220 | 8,500 | 8,500 | 8,600 | 8,700 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Palm kernels | 543 | 548 | 545 | 545 | 562 | 577 | 579 | 608 | 610 | 610 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Palm oil | 860 | 776 | 810 | 845 | 896 | 899 | 903 | 908 | 910 | 910 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Cocoa beans | 203 | 323 | 318 | 370 | 225 | 338 | 340 | 340 | 361 | 366 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Coffee | 3,090 | 3,780 | 3,700 | 3,700 | 3,750 | 3,830 | 3,850 | 3,910 | 3,320 | 3,520 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Rubber | 125 | 130 | 120 | 120 | 107 | 107 | 108 | 112 | 142 | 142 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Seed cotton | 251 | 301 | 341 | 348 | 381 | 399 | 402 | 403 | 397 | 417 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Cotton lint | 95 | 116 | 130 | 135 | 145 | 147 | 148 | 150 | 140 | 140 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Cotton seed | 153 | 183 | 208 | 212 | 236 | 247 | 248 | 250 | 250 | 250 |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| Sugar cane | 589 | 615 | 675 | 675 | 682 | 695 | 705 | 747 | 739 | 776 |
|  |  |  |  |  |  |  |  |  |  |  |

Source: [FAOSTAT data 2005.](http://faostat.fao.org/faostat/collections?version=int&hasbulk=1&subset=agriculture) (Accessed June 26, 2005)

It can be said from the above table that the price of rubber is steadily increasing and that this trend will continue to make rubber a huge source of income. This is why it is important to sustain it as an agricultural commodity.

**Aims and Objectives**

The primary objective of this study is to evaluate the sustainability of agriculture in

Nigeria when considering rubber and the challenges encountered and proffer solutions on how

this can be tackled by both the government and the public and international bodies to meet the

desires of Nigerian agricultural industry. My aim is to identify any positive or negative impacts

of the policies of trade liberalization with a view of coming up with policy proposals that will:

1. Enhance the positive impacts
2. Mitigate the negative impacts
3. Promote coherence and sustainability of agricultural trade policy

This would be achieved by considering the following secondary objectives:

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1. To examine the inputs and outputs that will boost the Nigerian agricultural industry
2. To study and proffer solutions to enhance the growth of the Nigerian agricultural industry
3. To create awareness in the government and relevant agencies about the merits of rubber production in Nigeria
4. To evaluate the effect on socioeconomic characteristics by rubber
5. To know the constraints of rubber production in Nigeria and provide useful information that will boost its sustainability.

The information obtained from this research will be of great benefit to the country of Nigeria because of the many important uses of rubber. Rubber helps the country’s economy because it is a source of income, which is especially important in a country such as Nigeria where the agricultural sector, which should be generating a huge amount of income for the government, is in a state of neglect. This research will highlight the need to sustain and empower the agricultural sector. Rubber is one major crop found in abundance in Nigeria that could help achieve a much-needed alternative source of funding.

**Method and Research Design**

This project involves quantitative means of research. For the purpose of this study, the following methodology is employed:

1. Secondary and primary data on yield, domestic and world prices, gross margin, net income, prices of agrochemicals, levels of use of fertilizers, pesticides, and herbicides were collected as these help stress the importance of its sustainability.

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1. A structured questionnaire was administered to farmers in rubber producing states in Nigeria. Sampling method and oral interview was used to get data from government and related agencies, rubber farmers, and the public.
2. Frequency counts and percentages were used to analyze the data collected.
3. Evaluation of government policies relating to the agricultural sector was accomplished.

**Justification of Study**

Agriculture is the principal source of food and livelihood in Nigeria and employs nearly two quarters of the nation’s workforce. Rubber has the potential to be a major source of finance to Nigeria. Over the past 2 decades, agricultural yields with reference to rubber have stayed the same or declined. In spite of the predominance of the petroleum subsector in Nigeria’s economic growth and development, agriculture remains a major source of economic resilience. Increasing and sustaining agricultural productivity should be a critical component of programs that seek to reduce poverty and attain food security in Nigeria. Considering this, this study helps enlighten on the present trends and practices of rubber in Nigeria with regards to the selected study area, shortcomings of rubber production, marketing and sustainability in Nigeria. This study help explains the socio-demographic characteristics of the rubber in Nigeria with regards to the study area, the effects of various government activities and rural- urban migration on sustainability of rubber as perceived by the rubber farmers, the level of awareness of the rubber farmers of the various advances in rubber technical practices and materials, and the effects and level of awareness of various sources of information about rubber as the availability and awareness of all these are very essential for sustainability. This study is essential considering sustainability of rubber as an agricultural produce is vital to the Nigerian economy.

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CHAPTER 2

HISTORY OF RUBBER

Pará rubber tree initially grew only in the [Amazon Rainforest.](http://en.wikipedia.org/wiki/Amazon_Rainforest) Increasing demand and the discovery of the [vulcanization](http://en.wikipedia.org/wiki/Vulcanization) procedure in 1839 gave a rise to rubber in the region. The name of the tree derives from [Pará,](http://en.wikipedia.org/wiki/Par%C3%A1) the second largest Brazilian state, the capital of which is Belém.

These trees were used to obtain rubber by the natives who lived within its geographical distribution. The [Olmec](http://en.wikipedia.org/wiki/Olmec) people of [Mesoamerica](http://en.wikipedia.org/wiki/Mesoamerica) extracted and produced similar forms of primitive rubber from analogous latex-producing trees such as Castilla elastica as early as 3,600 years ago. The rubber was used to make the balls used in the [Mesoamerican ballgame.](http://en.wikipedia.org/wiki/Mesoamerican_ballgame) Early attempts were made in 1873 to grow hevea brasilensis around Brazil. Twelve seedlings were germinated at the [Royal Botanic Gardens, Kew.](http://en.wikipedia.org/wiki/Royal_Botanic_Gardens,_Kew) These were sent to [India](http://en.wikipedia.org/wiki/India) for cultivation, but died. A second attempt was then made, some 70,000 seeds being smuggled to Kew in 1875, by [Henry Wickham,](http://en.wikipedia.org/wiki/Henry_Wickham) at the service of the British Empire. About 4% of these germinated, and in 1876 about 2,000 seedlings were sent in Wardian cases to [Ceylon,](http://en.wikipedia.org/wiki/Ceylon) and 22 were sent to the Botanic Gardens in [Singapore.](http://en.wikipedia.org/wiki/Singapore) Once established outside its native country, rubber was extensively propagated in the British colonies (Horn, 2013). Rubber trees were brought to the botanical gardens at Java in 1883. By 1898 a rubber plantation had been established in [Malaya,](http://en.wikipedia.org/wiki/British_Malaya) and today, most rubber tree plantations are in [South](http://en.wikipedia.org/wiki/South_Asia) and [Southeast Asia,](http://en.wikipedia.org/wiki/Southeast_Asia) with some also in tropical [West Africa](http://en.wikipedia.org/wiki/West_Africa) with Nigeria included.

Efforts to cultivate the tree in South America (Amazon) were unsatisfactory because of blight. The blight, called "South American Leaf Blight", is caused by the Asxomycota, Microcyclus urei.The gap between the forecasted production of natural rubber (12.5 million tons)

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and forecasted consumption (13.6 million tons) will be 1.1 million tons. And to meet this anticipated increase in demand for the commodity, the group recommended increase in the hectares under new cultivation and yield particularly under small holding farmers. They revealed that current major rubber producers mainly Malaysia and Thailand are facing land constraints for natural rubber due to severe competition for land by other crops mainly palm oil, the same with Vietnam, China, and India. For the needed increased hectares and yield, therefore, Africa (West and Central) are among the subregions to be targeted with an estimated production capacity of 680,000 tons by 2020. Steady increases are expected from countries like Liberia, Cote d’Ivoire, and Cameroon. The forecast for Nigeria is that production would remain static unless the natural rubber industry particularly in the small holder sector is revived. Because of its elasticity, resilience, and toughness, natural rubber (NR) is the basic constituent of many products used in the transportation, industrial, consumer, hygienic, and medical sectors. Of these major end-use markets for rubber, transportation is by far the largest single sector, with tires and tire products accounting alone for over 50% of NR consumption. Truck and bus tires would represent the largest single outlet for NR, followed by automobile tires. General rubber goods for commercial and industrial use account for the balance. These nontire rubber items include industrial products (for example, transmission and elevator belts, hoses and tubes, industrial lining, and bridge bearings); consumer products (like golf or football balls and other recreational and sports goods, erasers, footwear and other apparel); and articles for use in the medical and health sector (notably, condoms, catheters, and surgical gloves) as well as seismic materials (for instance, over 500 and 2,500 buildings are respectively fitted with seismic rubber bearings in China and Japan). Latex articles (typically condoms, gloves, threads, adhesives, and molded foams) could be included in different categories in terms of end-use.

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**Agriculture Sector in Nigeria**

Agriculture is the principal source of food and livelihood in Nigeria and employs nearly three quarters of the nation’s workforce. Over the past 2 decades agricultural yields have stayed the same or declined. Nigeria has experienced an increase in agricultural productivity in recent times due to different reasons among which are intervention by foreign organizations and marketing plans. Increasing and sustaining agricultural productivity should be of major importance as it helps to reduce poverty and attain food security in Nigeria. Primary and secondary data were used as source information. Results indicate that agricultural sustainability efficiency in Nigeria is dismally low. Transport costs are high due to poor road conditions, limiting access to inputs, credit and output markets, and reducing the transmission of key market information. In order to ensure agricultural productivity, it is recommended that strategic agricultural sustainability program be made a critical component of the agricultural policy in Nigeria.

Agriculture remains the leading non oil sector of the Nigerian economy supporting about 65% of the population and providing nearly 70% of the nonpetroleum export. Nigeria’s agricultural scene has been dominated by peasant farmers characterized by the use of traditional hand tools, unimproved planning, applying little or no fertilizer or other modern inputs, and poor sustainability that has not helped Nigerian agricultural yield to increase. The average Nigerian farmer faces a number of challenges ranging from resource problems such as land, water, labor and management, availability of farm capital in terms of physical, mechanical, chemical, biological, and financial bottlenecks. Also there exists the problem of government inefficiency. Inefficient integration of inputs, farm production, and products processing in rural agribusiness is another challenging problem. It is increasingly evident that improved agricultural development

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and growth can offer a pathway from poverty. Nigeria’s agricultural policies have been inconsistent, uncoordinated, and ad hoc. Such agricultural policies have limited the full realization of the sector’s potential. A paradigm shift towards formulating sound sustainability strategies is needed to promote a more equitable and environmentally sustainable growth in the agricultural sector. The recent food price increase has made this paradigm shift even more important. This shift has brought about the new Nigerian agricultural policy in Nigeria. Agriculture remains a major sector for the Nigerian economy. The majority of Nigerians rely on agriculture for their livelihood. Despite the importance of this sector, many problems plague it. These problems range from inefficient integration of inputs, farm production, and products processing to preservation and sustainability. Before Nigeria attained independence, agriculture was the most important sector of the economy and accounted for more than 50% of GDP and more than 75% of export earnings. Consequently, with the rapid expansion of the petroleum industry, agricultural development was neglected, and the sector entered a relative decline. Thus, between the mid-1960s and the mid-1980s Nigeria moved from a position of self-sufficiency in basic foodstuffs to one of heavy dependence on imports. Under-investment, a steady drift away from the land to urban areas (cities), increased consumer preference for imported foodstuffs (particularly rice and wheat), and outdated farming techniques continued to keep the level of food production well behind the rate of population growth (Olomola, 2007). In 1990 Nigeria overtook Liberia as the largest rubber producer in Africa. Production rose from 60,000 tons in 1986 to 147,000 tons in 1990. It dropped to 125,000 tons in 1995 and 107,000 tons in 2000 but went up again in 2003 to 142,000 tons and remained at 142,000 in 2004. Benefits from a replanting program in the western states, Edo and Delta, have yet to materialize, and local demand from tire and footwear industries continues to outstrip domestic supply. A program to increase output of rubber and palm kernels, with financial assistance from the World Bank, is

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being implemented. Also various state governments are encouraging farmers to increase rubber production by providing interested farmers with subsidies (FMEN, 2001).

**Importance of Agriculture in Nigeria**

The agricultural sector of Nigeria is as important as the oil and gas sector is today because it still employs about 70% of the general population in the small, medium, and large scale levels, which helps to boost the economy. Most of the major crops found in Nigeria include maize, cassava, rubber, plantains, yam, beans, kola nut, cocoa, groundnuts, palm oil, and rice.

Nigeria has a total land mass of about 91 million hectares but 82 million is said to be arable but only 42% has been farmed. As of 1990 the bush fallow system was the practice by most of the farmers. In the bush fallow system the farmland is left to regenerate its natural soil fertility by not farming on it for a given period of time. The 18 million hectares were pastures that were permanent but potentially could support the growth of crops. The other 20 million hectares consist of forest and woodlands with agricultural potential.

Before the civil war in Nigeria, agriculture was a major source of income and foreign exchange which made us autonomous in food. By 2001, 32% of our GDP was derived through agricultural products which are mainly cash crops for export and perennial crops for home consumption. The southern parts of Nigeria made up of the rainforest contains fertile soil yielding crops such as cassava and yam. While the northern parts where you have more of dry lands and Sahara desert with low rain falls produce millet and sorghum as the major crops.

According to Adubi, Nigeria produced 145,000 tons of cocoa beans but has the potential of producing over 300,000 tons per year, making cocoa the largest nonoil foreign exchange, while rubber is the second largest earner (Adubi, 2002).

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**Land Use, Soils, and Land Tenure**

The soil was rated from low to medium in productivity in Nigeria. However, a study conducted by the Food and Agricultural Organization of the United Nations (FAO) concluded that proper soil management would increase agricultural productivity.

Land tenure all over Nigeria was created on customary laws under which land was considered community property. Every individual had official rights to the land he farmed in his family or community area. He has the right to land as long as he used it for his family’s or community’s benefits and could make the land beneficiary to inheritor and vow its use to satisfy a debt, but could not sell or mortgage it. The community only has the right to dispose the land in accordance with the customary law going to the traditional authorities (Country Reports, 2013).

During the Early 1800s the Fulani destruction of northern Nigeria caused an alteration in the land tenure in areas control by the Fulani. The Fulani gave out lands freely to some individuals who assigned trustees to distribute these lands without considering local community interest. This caused increase in nonrepayable loans to unknown people, therefore, increasing the revenue from their landlords' holdings. In late 1900s this practise resulted in reduction of bush land, which led to the farmers moving to urban areas.

In the early 1900s the British confirmed leadership over the Fulani and ordered all land in the former Fulani area to be public property. Subsequently, when compared to southern Nigeria where lands are owned by the community, the government required habitation permits in the north. However, it was the right of the northern authorities to monitor and guard the indigenous population's traditional rights, and change to usual land-tenure practices occurred. Most parts of Muslim areas, traditional land bequest laws were accepted to exist. Due to the government's

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support of local customary law, invasion by outsiders seems to have been stopped to a great extent, and the government’s landholding restricted nonindigenes of the northern community in 1962.

Individuals were encouraged to own private lands in southern part, though they must register the land with the appropriate authority before full ownership was transferred to them. Various laws and ordinances gave government the power to take statutory landholdings in return for compensation. As a result of the increase in the sales of agricultural products, which were exported, many farmers sought individual or private ownership of lands for farming. Notwithstanding this, traditional rulers and cabinets remained the principal landholders throughout Nigeria prior to 1970s. However, during the 1970s private individuals and entrepreneurs inflated the prices of lands especially in urban areas, which were still developing by investing heavily in real estate. Rural area owners of lands in the south turned from sale of land to more profitable high-rent leasing arrangements. In the north, land was owned only by the approval from the appropriate authorities, and farmers in the rural areas became victims of developmental rezoning. These approvals were cancelled, and the owners were compensated with little or nothing, and so they moved to other areas of the northern part of the country. The land was then divided into parts and disposed of at expensive prices.

As a result of the land crises arising from the distribution of land, the Federal Military Government enacted the Land Use Decree of March 1978, establishing a central tenure system for all of Nigeria and incorporated the constitution of 1979. The decree successfully made all land legal by demanding certificates of occupancy from the government for land held under customary and statutory rights and the payment of rent to the government. This law stipulated that anyone in a rural or urban area who occupied and developed their land would continue to

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enjoy the right of occupancy and could dispose or transfer his earnings in the development of the land. Individuals, entrepreneurs, corporations, institutions, and governments were encouraged to develop lands as a result of the 1978 decree. This decree gave state and local government authority to possess and assign any undeveloped land. Ownership and occupancy of undeveloped land by individuals were limited and restricted. Statutory right of occupancy were allowed be passed on only to one person or heir. This was to avoid fragmentation (Photius, 2002).

**Challenges Facing Agriculture in Nigeria**

Agriculture has suffered from years of mismanagement, inconsistent and poorly conceived government policies, and the lack of basic infrastructure. Still, the sector accounts for over 26.8% of Nigeria’s GDP and two thirds of employment. Nigeria is no longer a major exporter of cocoa, groundnuts (peanuts), rubber, and palm oil. Cocoa production, mostly from obsolete varieties and overage trees, is stagnant at around 180,000 tons annually; 25 years ago it was 300,000 tons. An even more dramatic decline in groundnut and palm oil production also has taken place. Once the biggest poultry producer in Africa, corporate poultry output has been slashed from 40 million birds annually to about 18 million. Import constraints limit the availability of many agricultural and food processing inputs for poultry and other sectors. Most critical for the country's future, Nigeria's land tenure system does not encourage long-term investment in technology or modern production methods and does not inspire the availability of rural credit. The Nigerian agricultural sector suffers from extremely low productivity, reflecting reliance on antiquated methods. Although overall agricultural production rose by 28% during the 1990s, per capita output rose by only 8.5% during the same decade. Agriculture has failed to keep pace with Nigeria’s rapid population growth, so that the country, which once exported food, now relies on imports to sustain itself.

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The challenge facing agriculture today in Nigeria is the infertility of our soil that is caused by soil and wind erosion that has led to the damage and low to medium productivity, according to Food and Agriculture Organization of the United Nations (FAO). Proper management of the soil can achieve medium to good productivity. The effect of wind erosion is so detrimental that it causes the exposure of seedlings, crop roots, and fine grain soil particles in drifts that can cover crops. While soil erosion destroys the soil texture and causes the loss of all the organic matters in the soil. All this can be reduced by the planting of trees adjacent to farmlands (Ewash, 2011). The trees tend to absorb most of the wind effects that will thereby help to ensure that soil is not lost. Water erosion also affects soil fertility in Nigeria. Two types of water erosion exist: splash erosion and rill erosion. Splash erosion occurs when rain drops impact the soil, and rill erosion occurs when channels of water carry soil downstream. Water erosion is reduced when the soil is covered with a canopy. Also, improving the soil structure by adding organic matter that greatly reduces water erosion.

Irrigation problems also affect agriculture sustainability in Nigeria. The low-lying flood plains are very fertile during the rainy season, but the lack of rain during the dry season hinders agricultural development. The lack of water management systems in these areas is a concern for many farmers. By adding irrigation canals and access roads to these areas, yearly production yields are expected to increase.

Lack of investment is also a major challenge faced in Nigeria’s agricultural sector. The government budget for agriculture is not enough to meet the challenges. International aid groups have supplemented the funding of the government, but most of the funds don’t reach the local farmer.

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**Rubber**

Natural rubber, known as Hevea Brasiliensis, is a commercial tree economically grown in plantations. The natural rubber plant is useful for the latex that bleeds from the stem in the event of wounding. The product of the coagulated latex is rubber. Rubber is used in the manufacture a number of industrial products that range from tires, balls, containers, shoes, to bands and a lot of other items. Rubber is important in the socioeconomic life of many tropical developing nations, such as Nigeria and Brazil. Prior to the 60s, before the oil boom, rubber was one of the agricultural commodities that were the major generators of income for Nigeria. The cultivation of rubber provided bulk employment for the people of the then Mid-West now known as the Edo and Delta states. However, rubber is not native to Nigeria. As the name suggests, it is an introduction from Brazil. Harvesters make incisions across the latex vessel, deep enough to tap the vessels without harming the growth of the tree. The latex is then collected in small containers. This process is known as [rubber tapping.](http://en.wikipedia.org/wiki/Rubber_tapping)

A recent report by the International Trade Centre indicated that Nigeria rubber export for 2006 stood at $7.4 million, placing her at a distant 16th position in world ranking of exporters of the commodity, while Liberia and Malaysia, who are later entrants into rubber production, raked in $134.8 million from the nearly $2 billion global rubber exports for that year.

Natural rubber production peaked to about 236,000ha in 1990s and gradually declined to the current level of 154,000ha. While some countries of the far east like Thailand, Indonesia, and Malaysia account for over 70% of world production, Nigeria with her enormous potentials and one-time Africa leading producer now account for just 1.4% of the world output. The decline in natural rubber can be attributed to the following- the marginalization of rubber as an economic and strategic crop due to the discovery of crude oil, the increase in production aftermath of the

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dissolution of the Natural Rubber Board that gave rise to transient glut in the mid-1990s and a drastic drop in the price of the commodity. Others are the low yield due to uneconomic size of farmer’s holdings, old age of plantations leading to reduced stands per hectare, little or no agricultural inputs like fertilizer, availability of credit facilities, and pesticides.

Only about 40% of Nigeria rubber potential is currently being exploited. This is as a result of the abandonment and felling of trees, particularly by smallholders for seemingly more lucrative annual food crop production. Also the gestation period for rubber, which is 7 years during which period the farmer earns no income from the trees, shortage and high cost of labor in many rubber producing areas where the industry is forced to compete for labor with the oil sector as well as scant federal and state governments attention to the sector. Over time, stakeholders has always urged the federal government to take advantage of an expected production glut predicted by the International Study Group on Rubber (IRSG) and motivate farmers to invest more in the cash crop. They said there was need to give renewed effort to the presidential initiative on rubber that was launched in 2006 in order to motivate the small holder rubber farmers in both the traditional rubber cultivating areas and the non-traditional areas, particularly in Southern Kaduna zone of Kaduna State and Taraba State.

The stakeholders also believe the greatest motivation farmers need to expand production of natural rubber will come from the Presidential Initiative on rubber. The federal government must of necessity come to the assistance of rubber farmers in view of the fact that the industry is currently witnessing continued increase in rubber prices in the last 3 years, making rubber cultivation an economically viable enterprise. There is need for government at all levels to support the development of seed garden and nurseries to produce more improved and quality budded materials. They also advised farmers to desist from the use of local unselected seedlings

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but to go for planting materials given out at highly subsidized rates to farmers under the Presidential Initiative.

**Botanic Description of Rubber**

Hevea brasiliensis is a quick-growing tree that rarely exceeds 25 m in height in plantations, but wild trees of over 40 m have existed. In the Amazon, the trees are called ‘heve’ the native word for rubber. Bole is usually straight or tapered and branchless for 10 m or more. It can be up to at least 50 cm in diameter, without buttresses with smooth bark surface, hoop marked, grey to pale brown, inner bark pale brown and abundant white latex, crown conical slender branches. The root system has a well developed taproot and far spreading laterals. Leaves are palmate shaped and each one has three leaflets. It features leaflets elliptic etiolated, with a basal gland, pointed at the tip with lengths varying up to 45 cm; glabrous, with entire margin and pinnate venation. Inflorescence in the form of pyramidal-shaped axillary panicles produces simultaneously with new leaves and are arranged in cymose form. Flowers are small, greenish-white, dioeciously. Female flowers usually larger than the male ones. In the female flower, gynoecium is composed of three united carpels forming a three-lobed, three-celled ovary with a single ovule in each cell. Seeds are large, ovoid, and slightly compressed. They are shiny, 2-3.5 x 1.5-3 cm, grey or pale brown with irregular dark brown dots, lines, and blotches. It is possible to identify the female parent of any seed by its markings and shape.

**Types of Rubber**

The two types of rubber in common use today are natural and synthetic. Natural rubber comes from the rubber tree (Hevea brasiliensis). When a tree matures at the age of 6 or 7 years, the latex is collected from a diagonal incision in the tree trunk. The tapping process does not

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affect the health of the tree and the tree wound later heals itself. Synthetic rubber is made by man from petrochemical feedstock. Crude oil is the principal raw material.

**Natural Rubber.** Hevea brasiliensis can only be grown in areas with similar conditions to the Amazon rain forests, which effectively restricts production to regions 15 to 20 degrees latitude north or south of the equator. It takes 5 to 8 years for a rubber tree to mature to the girth at which it can be tapped, and its economic life will then be 20 to 30 years. At the end of its life rubber wood provides a valuable end product as a medium density tropical hardwood.

The rubber is extracted in the form of latex, a white, milky fluid that is held in cells found in the inner layers of the bark of the trees, using a method known as ‘tapping’, which involves paring away a thin slice of bark without damaging the growing layer in a series of half-spiral cuts, usually on alternate days, using a special knife. The latex then oozes from the cut and flows into a collecting cup for a period of several hours or more until it begins to coagulate and the flow ceases as shown in Figure 1 below. After collection the latex, which at this point is about 70% water, may be taken to a processing plant, where it may be sieved to remove extraneous matter, blended, coagulated, rolled into sheets, and then dried in ‘smokehouses’ to produce ‘ribbed smoked sheets’ (RSS). Alternatively, after coagulation, it may be washed, shredded, and granulated under controlled conditions before being dried in deep-bed driers to form a ‘block’ rubber known as Technically Specified Rubber (TSR). Whichever process is used, the rubber is then pressed into bales and wrapped into polythene bags for dispatch. Finally, a small proportion of natural rubber is also processed and sold as latex concentrate; water is removed by centrifuging, creaming, or evaporation to give a product containing around 60% rubber.

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Regardless of these, there was still a major problem to be overcome: in warm weather rubber would soon become sticky and in cold weather it became brittle. It is observed that by heat treating rubber with sulphur the resultant material was no longer affected by temperature.



*Figure 1:* Typical Rubber Plantation. (Field Survey, 2013)

**Synthetic Rubber.** There are over 200 types of synthetic rubber, each having its own constituents and qualities. However, all involve the polymerization process, which is the bringing together chemically of monomers to form a polymer. Physically, polymerization converts the monomer, usually a liquid or a gas, into a rubber, plastic or fiber, depending on the chemical nature of the monomer. For simplicity, the production of styrene butadiene rubber (SBR), which is the major general purpose synthetic rubber accounting for around 37% of world

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solid synthetic rubber capacity, is illustrated. SBR is made from two monomers – styrene, a liquid, and butadiene, a gas. The majority of monomers are derived from oil. Styrene is generally made from ethyl benzene. Although ethyl benzene can be extracted from petroleum ‘streams’ it can also be synthesized from ethylene and benzene. Butadiene can be obtained in many ways from the refinery streams. These streams may be either naturally occurring refinery gases or gases obtained by ‘cracking’, i.e. breaking up larger molecules by heat, usually in the presence of a catalyst. The polymerization of styrene and butadiene is also conducted in the presence of a catalyst. Polymerization can be carried out by the traditional method, which is dispersion of monomers in water as an emulsion, or in solution in an organic solvent. Any monomers that are not converted into the polymer are recovered, whilst the polymer in a latex form is coagulated into crumb, screened, washed, and filtered. The crumb is dried in a hot air drier, after which the dry rubber is baled and wrapped into polythene bags for dispatch.

**Specifications**

Naturally coagulated rubber (cup lump) is used in the manufacture of TSR10 and TSR20 grade rubbers. The processing of the rubber for these grades is basically a size reduction and cleaning process to remove contamination and prepare the material for the final stage, drying. The dried material is then baled and palletized for shipment. Typical technical specifications of Nigeria standard rubber are shown in Table 3.

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Table 3.

*A Typical Technical Specification of NSR (Nigeria Standard Rubber)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | NSR10 |  | NSR20 |  |
|  |  |  |  |  |
| Dirt% weight |  | 0.1 |  | 0.2 |
|  |  |  |  |  |
| Ash % weight |  | 0.75 |  | 1.00 |
|  |  |  |  |  |
| Nitrogen % weight |  | 0.60 |  | 0.60 |
|  |  |  |  |  |
| Volatile matter % weight |  | 0.80 |  | 0.80 |
|  |  |  |  |  |
| Po (plasticity) |  | 30.00 |  | 30.00 |
|  |  |  |  |  |
| PRI % |  | 50.00 |  | 40.00 |
|  |  |  |  |  |

**The Harvest of Rubber**

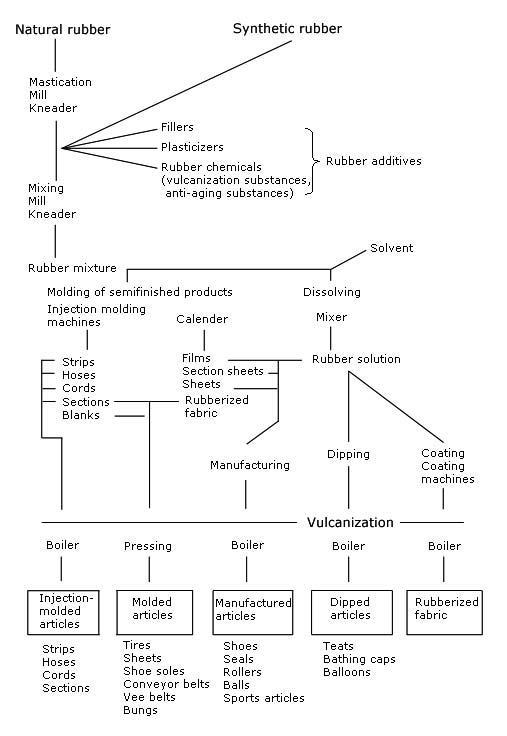
The harvesting (tapping) or rubber is done during the dry season. Tapping normally takes place early in the morning, when the internal pressure of the tree is highest. A good tapper can tap a tree every 20 seconds on a standard half-spiral system, and a common daily "task" size is between 450 and 650 trees. Trees are usually tapped on third day, although there are many variations in timing, length, and number of cuts.

**Processing of Natural Rubber to Form Rubber Products**

Natural rubber is mixed with various additives designed to give the end product the required properties, shaped, and then vulcanized.

The stages of processing natural rubber into rubber products are shown in Figure 2.

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*Figure 2:* Diagram Showing the Processing of Rubber. Source: Verischerungswirtschaft, 2013

Mastication is a preliminary stage to processing the raw rubber. This process involves the use of special mechanical equipment and additives (e.g. aromatic mercaptans - sulfur-containing compounds) at low temperatures to shred the rubber molecules into smaller units. This improves the plasticity and reduces the viscosity. After mastication, the rubber is mixed together with fillers, plasticizers, and rubber chemicals to form a homogeneous mass in mills or closed kneaders. The subsequent end product is produced by compression molding, injection molding, or calendaring. Compression molding machines, for example, are used to produce car tires, soles and heels for shoes, and bungs. Thin, seamless rubber products, for example, are produced by dipping.

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The final processing step involves the molded rubber mixture to be vulcanized. The most important vulcanization medium is sulfur, which is added to the rubber mixture before the mixture is heated. The tire-manufacturing industry is the world's largest consumer of natural rubber. Tires are used for cars, bicycles, and aircraft. Seals, hoses, drive belts, floor coverings, conveyor belts, foam rubber, and medical equipment are all products of rubber.

**Uses of Rubber**

Due of its elasticity, resilience, and toughness among other properties, natural rubber is the basic constituent of many products used in the transportation, industrial, consumer, hygienic, and medical sectors. Tires and tire products account for more than 50% of natural rubber usage, making transportation the leading single sector of the major uses of rubber. Automobile tires follow truck and bus tires, which make up the prime outlet for natural rubber. Industrial products such as hoses and tubes, industrial lining, transmission and elevator belts, bridge bearings, and consumer products such as golf balls, erasers, footballs, footwear, and other apparel account for the remaining usage of rubber (Howstuffworks, 2013). Articles for use in the medical and health sector (notably, condoms, catheters, and surgical gloves) as well as seismic materials (for instance, over 500 and 2,500 buildings are respectively fitted with seismic rubber bearings in China and Japan). Latex articles (typically condoms, gloves, threads, adhesives, and molded foams) could be included in different categories in terms of end-use.

Hevea or Para rubber is obtained by tapping the trunks of the trees. The latex coagulates with the aid of acetic acid, formic acid, and alum. Cured rubber is used for all types of rubber products. Seeds are source of Para rubber seed oil, recommended for manufacture of soap. Although poisonous, seeds can be eaten as a famine food after processing. Boiling removes the poison and releases the oil that can be used for illumination. Seeds are sometimes eaten off the ground by cattle. Kernels (50%–60% of the seed) contain 40%–50% of a semidrying pale yellow

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oil, used in soap making, paints, varnishes, and is effective against houseflies and lice. Press cake or extracted meal can be cautiously used as fertilizer or feed for stock (Reed, 1976).

Rubber is made into articles as diverse as raincoats and sponges, bowling balls and pillows, electrical insulation and erasers. People ride on rubber tires and walk on rubber heels. Rubber is also used in toys, balls, rafts, elastic bandages, adhesives, paints, hoses, and a multitude of other products.

The essential use of rubber is for tires. Most commonly, tires consist of several types of rubber including both natural and synthetic. Natural rubber has a greater resistance to heat compared to synthetic rubber, making its use vital in some types of tires. For example, as a result of the flexible sidewalls found in radial tires that produce a buildup of heat, radial automobile tires are composed of an increased percentage of natural rubber compared to other types of automobile tires (Egwuatu, 2013). Either natural or synthetic rubber is suitable for most uses, and price determines which is used.

**Potentials of Rubber Sustainability in Economic Development of Nigeria**

The potentials of rubber sustainability to agricultural sector and overall economic development are immense (Rural Sector Enhancement Program, 2002). These include:

i. Guaranteed supply of rubber products to the firms may stimulate expansion in farm production activities.

1. Value addition to primary commodities through domestic processing is given a dynamic rationale on the basis of the paper that postulates a structural tendency for the net better terms of trade to deteriorate relatives to manufacturers.

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1. Processing activities that are initially labor intensive can in the long-term conform to the dynamic comparative advantage of most developed nations; small holder farmers will escape from the syndrome of producing low value and poor quality products.
2. Value addition to agriculture produce may lead to export-oriented industrialization through chain upgrading.
3. Diversification in terms of the products, technology as well as the size firms in the produce subsectors.
4. Improved postharvest system with strong linkages between crop producer and end users not only generate added value but also create employment opportunities in rural areas, thereby contributing to economic growth and poverty reduction.
5. Employment generation in all spheres of product marketing. The indirect advantage of reward able employment in farming activities is the reduction in rural-urban migration.
6. Development of entrepreneurship in order to create a vacuum for individual creativity and innovations that can accelerate sustainable industrial growth.
7. Generate a vacuum for wealth creation and improvement in socioeconomic welfare of the citizenry.
8. Contributing to economic and social development through the reduction of inefficiencies including friction between trading partners, wasted effort by the producers and others and food waste, thereby leading to more efficient production and marketing of existing and new food products.

As articulate and logical as these contributions are, the expected targets of agricultural sustainability reforms have not been met.

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**Exportation of Rubber**

**Export Market.** About 48% of the global demand for natural rubber comes from China, India, and Malaysia, which are three major natural rubber consuming countries within the ANRPC (Association of Natural Rubber Producing Countries) However, the major buyers of rubber from Nigeria include Canada, France, China, Netherlands, Italy, Germany, Malaysia, South Africa, Spain, and United Kingdom.

**Export Price.** In general the FOB prices range from USD2,500-3,000 /MT depending on

quality and time of year as shown in Table 4.

Table 4.

*World Price of Natural Rubber 1988 – 2003*

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** |  | **World market price( N /kg)** | |
|  |  |  | |
| 1988 |  | 1.50 | |
|  |  |  | |
| 1989 |  | 2.00 | |
|  |  |  | |
| 1990 |  | 1.40 | |
|  |  |  | |
| 1991 |  | 5.30 | |
|  |  |  | |
| 1992 |  | 12.52 | |
|  |  |  | |
| 1993 |  | 24.10 | |
|  |  |  | |
| 1994 |  | 34.40 | |
|  |  |  | |
| 1995 |  | 34.78 | |
|  |  |  | |
| 1996 |  | 59.92 | |
|  |  |  | |
| 1997 |  | 56.72 | |
|  |  |  | |
| 1998 |  | NA | |
|  |  |  | |
| 1999 |  | 57.89 | |
|  |  |  | |
|  | 34 | |

Table 4 (continued)

|  |  |
| --- | --- |
| 2000 | 59.40 |
|  |  |
| 2001 | 69.80 |
|  |  |
| 2002 | 95.67 |
|  |  |
| 2003 | 113.89 |
|  |  |

**Source:** Abolagba et al., (2003), CBN Annual Reports and Statement of Accounts ( various issues)

**Rubber Exportation Forecasting.** Agricultural commodities export forecasting provides efficient price discovery mechanism and a hedge against risk of price instability. The volatility of natural rubber prices was a significant risk to producers, traders, consumers, and others involved in the production and marketing of this produce. Efficient forecasting of the future movement of rubber (*Hevea brasiliensis*) can help policy makers in proper planning to develop the sector. For efficient forecasting, adequate mathematical models such as Autoregressive Integrated Moving Averages (ARIMA) models are necessary (Haque, Imam, & Awal, 2006). However, ARIMA model is quite a difficult model to develop and apply as it involves transformation of the variable, identification of the model, estimation through nonlinear method, verification of the model, and derivation of forecast. In situation of considerable uncertainty and high risk, export volume and price forecast were necessary to help in decision making (Mesike, 2011). Accurate export volume and price forecasts were particularly important to facilitate efficient decision making as there was a considerable time lag between making output decisions and the actual output of the commodity in the market (Samsudin & Arshad, 2009). Hence, forecasting mechanism is necessary for the market participants as guide to their production, consumption, and financial decisions. Furthermore, hedging or futures is another effective risk strategy

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available to reduce the associated risks that producers and traders are exposed to. Efficient forecasting of the future movement of rubber export can help policy makers in proper planning to develop the sector. ARIMA models are very powerful and popular as they can successfully describe the observed data and can make forecast with minimum forecast error. ARIMA process developed by Box and Jenkins (1978) can be defined as:



(B) (Δdyt – μ ) = θ (B)εt …………………………………..…..(1)

Where;

yt denotes natural rubber exports,

μ is mean of Δdyt,



(B) is 1 – 1B – --- – pBp,

θB is 1 – θ1B – --- – θqBq,

θi is the ith moving average parameter,



i is the ith autoregressive parameter,

p, q and d are auto-regressive, moving average and difference orders of the process respectively, Δ and B are the difference and back shift operators respectively.

The estimation of the model above consists of three steps: identification, estimation of parameters, and diagnostic checking.

For identification purpose the values of p, d, and q were determined by using Auto-Correlation Function (ACF), Partial Auto- Correlation Function (PACF), and Augmented Dickey Fuller (ADF) test. The method of maximum likelihood was used for estimation purpose. The third step is to check if there is white noise. The ACF of residuals and Ljung and Box (1978) chi-square statistic was used.

In case of two or more competing models passing the diagnostic checks, the best model was selected using the criteria of multiple R2, Root Mean Square Error (RMSE), Akaike

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Information Criterion (AIC), Mean Absolute Error (MAE), Mean Absolute Percent Error (MAPE), and Thiel Inequality Coefficient (TIC).

Four deterministic types of growth models were also considered in this study for comparing the forecasting efficiency of stochastic models. These models are as follows: yt = a + bt + ε (linear)

yt = a + bt + ct2 + ε (quadratic) ……………………………………. (2)

yt = a + bt + ct2 + dt3 + ε (polynomial of cubic expression)

yt = aebtε (exponential)

where;

y is the time series considered,

t represents time taking integer values starting from 1,

* is the regression residual and a, b, c, and d are the coefficient of the models

**Government Agencies in Nigeria Charged With Rubber Sustainability**

**Rubber Research Institute of Nigeria (RRIN).** established in 1961 at Iyanomo as Rubber Research Station of the then Western Region, was taken over by the federal government of Nigeria in 1973 with a merger of the Demonstration Centre of then Eastern Nigeria located at Akwete. The Institute assumed the name Rubber Research Institute of Nigeria (RRIN) with headquarters at Iyanomo. RRIN is the only government agency in the country mandated to conduct research into production and development of Natural Rubber (NR), gum arabic, and other latex-producing plants of economic importance. Below are the following mandates:

1. Genetic improvement of natural rubber, gum arabic, and other latex producing plants;
2. Improvement of agronomic practices including cultivation and exploitation techniques;

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1. Processing, preservation, storage, and use of rubber, gum arabic, and their derivatives;
2. Development of control measures against pests and diseases of rubber, gum arabic, and other latex producing plants;
3. Design and fabrication of simple processing implements and equipment for rubber, gum arabic, and other latex producing plants;
4. Farming systems in relation to rubber, gum arabic, and other latex- producing plants;
5. Socioeconomic problems of the cultivation and use of rubber, gum arabic, and other latex producing plants;
6. Extension research liaison services;
7. Organizing technical and vocational courses in areas relevant to the above
8. Providing laboratory and other technical services to farmers, agro-based industries, and others needing these services;
9. Any other problems relating to the production, processing, and use of rubber, gum arabic, and other latex producing plants of economic importance.

**The Raw Materials Research and Development Council (RMRDC).** The Raw Materials Research and Development Council (RMRDC) is an agency of the federal government of Nigeria vested with the mandate to promote the development and use of Nigeria’s industrial raw materials.

It originated from the recommendations of a Workshop on Industrial Matters organized by the Manufacturers Association of Nigeria (MAN) and the Nigerian Institute of Social and Economic Research (NISER) in July 1983. It was established by Decree (Now Act) No.39 of 1987 but commenced operation on February 10, 1988. It is today Nigeria’s focal point for the development and use of the nation’s vast industrial raw materials.

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The Raw Materials Research and Development Council (RMRDC) was established at a time when dwindling foreign exchange earnings from petroleum was expended to import raw materials and products that were available or could be competitively produced in Nigeria.

Other Nigerian government agencies that are involved with Rubber and Agricultural Research and Sustainability include:

1. Institute for Agricultural Research (IAR)
2. Institute of Agricultural Research & Training (IAR&T)
3. National Agricultural Extension and Research Liaison Services (NAERLS)
4. Nigerian Institute of Social and Economic Research (NISER)
5. Agricultural Research Council of Nigeria (ARCN)

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CHAPTER 3

METHODOLOGY

**Materials and Methods**

I sought to study the sustainability of agriculture in Nigeria using rubber as the case study. To achieve this, I among other things investigated the perception of rubber farmers on the factors militating against rubber production in their respective area and cumulating this for Nigeria as a whole. I sought to cover the three pillars of sustainability which are: development, social equity, and the environment.

**Study Area**

Nigeria was the focus of the study. It has an area of 923,769 km2 and a population of over 140 million people. It is bounded on the West by the Republic of Benin and the Republic of Niger; on the East by the Republic of Cameroon; on the North by Niger and Chad Republic, and on the South by the Gulf of Guinea. The climate is equatorial and semiequatorial. There are two seasons, the wet and dry season, and agriculture is a major employer of labour and the mainstay of the economy despite her dependence on oil.

The study was conducted in the southern part of Nigeria. Edo and Abia states were purposively sampled for the study due to their predominant activities in rubber industry in Nigeria. The states also represent different cultural background of southern people of Nigeria.

They fall within Latitude 6 and 7oN of the Equator and Longitude 5 and 6oE of the Greenwich Meridian, the data obtained permutated for the country, as a whole as they are the major and highest rubber production areas of the country. The total land area of the two states is about 35,502km2 with food and tree crops. They are within the humid rainforest zone with mean

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annual rainfall of 2,000 mm. Rainfall has two peaks in the month of July and September but highest in July and there is drought in August. The soils of this humid forest belts are mainly ultisols with pH range between 4 and 5.5. The soils have been described as the “acid sand belt” derived from unconsolidated grits and stones containing clay beds in varying proportions (Vine, 1956).

There were 300 structured questionnaire administered in 10 communities among rubber tappers. Of these 300 questionnaires, only 230 were used for the purpose of these study due to errors and wrong inputs by the respondents on the other questionnaires. The communities were Iyanomo, Obaretin, Obayator, Uhie, Ogbekpen in Edo state, while Akwete, Umunteke, Obohia, Umuebulungwu, and Obegu were considered in Abia state.

**Data Collection**

Data for this study were obtained from primary sources. I analyzed my primary data using descriptive statistics and other quantitative methods. The primary data were obtained through the use of structured questionnaires administered as an interview scheduled due to low educational level of the respondents. Random sampling technique was adopted in eliciting information from respondents for the study. Information on the population of tappers was obtained. A total of 300 respondents were presented with the structured questionnaires, but a sample of 230 tappers was eventually used. The following were used in data collection; food and agricultural organization (FAO), reputable journals, and the Internet. This was supplemented with primary data collected from the Rubber Research Institute of Nigeria (RRIN) and Cocoa Research Institute of Nigeria (CRIN).

The quantitative approach was used in a manner whereby constructing questions was sent few days prior to the day of interview for the interviewee to have a broad idea of what the

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interview will entail in order for a comprehensive and actual fact be to extracted. The tappers provided adequate information required for the study. Data were analyzed using descriptive statistics such as frequency counts, percentages, means, and standard deviations.

The context of the questionnaire reflects the United Nations parameters for the assessment of sustainability of agriculture. The style of questionnaire design allowed respondents to assert and express their personal opinion of the conditions in the rural setting and the empirically local means of sustainable agricultural and economic developments. Information was sought on age, household size, farming experience, farm size of the rubber farmers, sources of finance for farming operation, sources of farm labor, farm input use and output, level of exposure to improved production technology, influence of rural – urban migration on the sustainability of agricultural activities. Quantitative research was based on interviews that enabled social interaction that enabled the respondents to provide their knowledge, understanding, roles, beliefs, and attitudes on sustainability of agriculture in Nigeria using rubber as case study. It also enabled the studied topic to get richer and clearer response and as well help to complement other questions from quantitative research method. Natural rubber production output in kg dry rubber and mean prices from 1993 to 2003 was obtained.

Perceived factors affecting rubber production was measured using a 4-point Likert-type rating scale of: strongly agree (4 point), agree (3 point), disagree (2 point), and strongly disagree (1 point) on a list of 16 production factors. Respondent’s adoption of recommended improved rubber production technologies was ascertained using a 4-point rating scale of: Using (4 points), Aware (3 points), Interest (2 point), and Unaware (1 point) on a list of 11 recommended practices. Respondents sources of information on rubber (production, market, technological advancement, access to funds, etc.) were ascertained using a 4-point scale of: Regularly (4points), occasionally (3 point), rarely (2 point), and never (1 point) on a list of seven plausible

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solutions to the problems. These constitute major means by which sustainability of rubber can be

enhanced within the Nigerian Agricultural sector.

Data were analyzed using frequency counts, percentages, means, standard deviations, and

univariate analysis method.

**Hypotheses**

1. If urgent measures are not taken to control the socio-demographic pattern in Nigeria’s rubber production, then sustainability of agriculture cannot be achieved.
2. If more funds and support are made available to rubber farmers, this will aid the sustainability of rubber and agriculture as a whole in Nigeria.
3. Scarcity of availability and knowledge about various agro-chemicals that aid rubber production are among the major factors affecting sustainability of rubber in Nigerian agricultural sector.
4. If the present government laws, policies, and attitudes towards agriculture remain the same, then the continued production of rubber and agriculture as a whole cannot be sustained in Nigeria.
5. Sources of information about rubber production activities have an effect on the sustainability of agriculture among rubber farmers in Nigeria.

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CHAPTER 4

DATA ANALYSIS AND PRESENTATION OF RESULTS

The overview of this section is to present the univariate analysis of data. It presents the frequency distribution of respondents by socio-demographic features and the resultant effect this will have on the sustainability of rubber in Nigeria. Two hundred thirty respondents were interviewed.

**Results and Discussion**

**Socio-Demographic Characteristics**

**Farming Characteristics of Respondents Gender and Marital Status.** Data in Table 5 shows that 161 respondents of the 230 respondents are males representing 70% percent of the respondents while 69 respondents representing female is 30%. The marital status shows that

69.1% of the respondents were married and 30.9% are single. Also, it is discovered from the level of education 39.6% of the respondents had primary education.

**Farming Characteristics of Respondents Age.** Data in Table 5 show that 14.3% of the respondents were less than 30 years of age, 17.8% of them were within the age range of 31 and 40 years, 44.3% were within the age range of 41 and 50 years, while 17.4% were in the age range of 51 and 60 years. The remaining 6.1% were 61 years and above. The mean age of the respondents was approximately 47 years, which shows that the respondents were relatively middle-aged farmers. This calls for concerted efforts that should aim at encouraging younger farmers to embark on rubber production activities.

**Educational Attainment.** Entries in Table 5 show that 26.1% of the respondents had no formal education, 39.6% completed primary school, while 23.5% had secondary school education. The remaining 10.9% had postsecondary education. It could be deduced therefore

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from the study, that the rubber farmers in the area were predominantly literate at least to the primary education level. This could be a disadvantage that will affect the sustainability of rubber as they might not the positive effect of education on the adoption of new technologies and trends to aid sustainability of rubber.

**Primary Occupation.** Entries in Table 5 displays that the study indicated 34.3% of the respondents were engaged in handcrafts alongside rubber farming, 10.9% also engaged in teaching, 32.6% did petty trading, 2.2% were involved in driving, while 3.9% were also students being involved in rubber farming on secondary basis is probably a risk for the sustainability of rubber and the trees because the farmers might feel less committed to using protective and good tapping techniques because they could fall back on other occupations when the trees are endangered.

**Sources of Rubber Farmland.** Entries in Table 5 also indicate that majority (46.5%) of the respondents acquired their farm land through rent, 34.3% of the respondents acquired their farm land through inheritance, while the remaining 19.1% acquired their farmland through purchase. According to Shaib, Aliyu, and Bakshi (1997) land tenure in the zone is a combination of communal and individual ownership. Traditionally, land is heritable through the family, with succession. The fact that majority of the respondents acquired their farmland through rent might make them feel less committed to the land because it’s not really their own, also because majority also acquired their land through inheritance, it could constitute hindrance to the expansion of the size of rubber farm land, as such tenure does not allow for ownership of large area of land by an individual.

**Size of Rubber Holdings in Hectares.** Data in Table 5 further show that 81.3% of the respondents had less than 1.99 hectares of rubber plantation, 12.6% had between 2 and 3.99 hectares, while the remaining 6.1% of the respondents had between 4 and 5.99 hectares of rubber

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plantation. The average rubber holding of the respondents was 1.32 hectares indicating that majority of the farmers were smallholder farmers.

**Sources of Financing Rubber-Farming Activities.** Table 5 also indicates that 46.5% of the respondents financed their rubber farming activities through personal savings, 22.2% financed their farming activities through borrowing from friends and relatives, while 20.0% percent of the respondents also sourced for loans from cooperative societies to finance their farming activities. Also, 11.3% of the respondents asserted that they financed their farming activities through loans obtained from community banks. This implies that personal saving is a major source of finance for carrying out farming activities, which could have resulted from inability to secure loan from cooperative societies and banks, and suggests the need to boost bank lending to farmers through deliberate government policy.

**Major Sources of Farm Labor on Rubber Farmers.** A higher proportion (51.3 percent) of the respondents use family labor to carry out their farming activities on rubber farms (Table 5), 31.7 percent of the respondents use a combination of family and hired labor in the performance of the various farm operations, while 17.0% f the respondents use family labor to perform the various farm tasks on rubber farms. Data from the study also show that 23.9% of the respondents had fewer than 3 people per household, 35.2% had 4-6 people, 32.6% had 7-10 people, and 8.3% had above 10 people. The average family in the area consists of 6 people. The number of people could actually be of great help in the rubber farm.

**Membership of Farmers’/Social Organization.** Table 5 also shows that majority

(53.9%) of the respondents belonged to no farmers’/social organizations, 42.2 % belonged to 1 to 2 farmers’/social organizations. The remaining 3.9% of the respondents did belong to 3-4 farmer/social organization. According to Swanson (1984), participation in various farmer/social

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organizations is important in enhancing farmer’s adoption of new practices due to the effect of

group dynamics.

Table 5.

*Distribution Based on Demographic Characteristics*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **DEMOGRAPHIC VARIABLE** | **FREQUENCY** | **PERCENTAGE** |
|  |  | **N=230** | **(%)** |
|  |  |  |  |
|  | **GENDER** |  |  |
|  | Male | 161 | 70 |
|  | Female | 69 | 30 |
|  |  |  |  |
|  | **AGE** |  |  |
|  | Below 30 years | 33 | 14.3 |
|  | 31-40 years | 41 | 17.8 |
|  | 41-50 years | 102 | 44.3 |
|  | 51-60 years | 40 | 17.3 |
|  | 61 years and above | 14 | 6.1 |
|  |  |  |  |
|  | **MARITAL STATUS** |  |  |
|  | Single | 71 | 30.9 |
|  | Married | 159 | 69.1 |
|  |  |  |  |
|  | **LEVEL OF EDUCATION** |  |  |
|  | No Formal Education | 60 | 26.1 |
|  | Primary Education | 91 | 39.6 |
|  | Secondary Education | 54 | 23.5 |
|  | Post-Secondary Education | 25 | 10.9 |
|  |  |  |  |
|  | **HOUSEHOLD SIZE** |  |  |
|  | Less than 3 person | 55 | 23.9 |
|  | 4-6 persons | 81 | 35.2 |
|  | 7-10 persons | 75 | 32.6 |
|  | Above 10 person | 19 | 8.3 |
|  |  |  |  |

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Table 5 (continued)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **NONFARM OCCUPATION** |  |  |  |
|  | Handicraft |  | 79 | 34.3 |
|  | Teaching |  | 25 | 10.9 |
|  | No Response |  | 37 | 16.1 |
|  | Petty trading |  | 75 | 32.6 |
|  | Driving |  | 5 | 2.2 |
|  | Student |  | 9 | 3.9 |
|  |  | |  |  |
|  | **SOURCES OF RUBBER FARMLANDS** | |  |  |
|  | Inherited |  | 79 | 34.3 |
|  | Rented |  | 107 | 46.5 |
|  | Purchased |  | 44 | 19.1 |
|  |  | |  |  |
|  | **SIZE OF RUBBER HOLDINGS (HECTARES)** | |  |  |
|  | Less than 1.99 |  | 187 | 81.3 |
|  | 2.0 – 3.99 |  | 29 | 12.6 |
|  | 4.0 – 5.99 |  | 13 | 5.7 |
|  | 5.99 and above |  | 1 | 0.4 |
|  |  |  |  |  |
|  | **SOURCESOF FINANCING** | **RUBBER** |  |  |
|  | **FARMING ACTIVITIES** |  |  |  |
|  | Personal savings |  | 107 | 46.5 |
|  | Loans from community banks |  | 26 | 11.3 |
|  | Cooperative societies |  | 46 | 20.0 |
|  | Friends and relatives |  | 51 | 22.2 |
|  |  | |  |  |
|  | **MAJOR SOURCES OF FARM LABOUR** | |  |  |
|  | Family labor |  | 118 | 51.3 |
|  | Hired labor |  | 39 | 17.0 |
|  | Family /hired labor |  | 73 | 31.7 |
|  |  | |  |  |
|  | **FARMERS’/SOCIAL ORGANIZATION** | |  |  |
|  | None |  | 124 | 53.9 |
|  | 1-2 |  | 97 | 42.2 |
|  | 3-4 |  | 9 | 3.9 |
|  |  |  |  |  |
|  | Source: Field Survey, 2013 |  |  |  |
|  |  | 48 |  |  |

**Measure of Influence of Government and Rural-Urban Migration on the Sustainability of Rubber**

This section of the study helps to understand factors militating against or otherwise to the sustainability of agriculture with regards to rubber considering various factors such as government input, land ownership patterns, urban-rural migration especially among the youths, availability of funds, old age of rubber trees and the late planting of new ones among other things. The study helps to get feedback from the farmers to know their take on the various influencing factors.

From the study with details as presented in Table 6, it was discovered that 108 respondents (47.0%) strongly agree that government effort in rubber sustainability is not enough, 77 respondents (33.5%) agree, 32 respondents (13.9%) were neutral, 11 respondents (4.8%) disagree, while 2 respondents (0.9%) strongly disagree that government effort in rubber sustainability is not enough.

The study showed that134 respondents (58.3%) strongly agree that capital and funding to farmers is limited, 76 respondents (33%) agree, 17 respondents (7.4%) were neutral, while 3 respondents disagree. Also, 134 respondents (58.3%) strongly agree that cost of labor was on the increase, 65 respondents (28.3%) agree the cost of labor is on the increase, 20 respondents

(8.7%) were neutral, 9 respondents (3.9%) disagree, and 2 respondents (0.9%) strongly disagree on the increase in the cost of labor.

From the study with details as presented in Table 6, it was discovered that 144 respondents (62.2%) strongly agree that increased government support will boost rubber production , 60 respondents (26.1%) agree, 23 respondents (10%) were neutral, 3 respondents (1.3%) disagree that increased government support in rubber sustainability will boost rubber production.

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The study showed that 78 respondents (33.9%) strongly agree that storage facilities is a major challenge to sustainability of rubber, 95 respondents (41.3%) agree, 20 respondents (8.7%) were neutral, 36 respondents (15.7%) disagree, and 1 respondent (0.4%) strongly disagree that storage facilities pose a major challenge to sustainability of rubber.

Land ownership is a major factor that is crucial in sustainability of rubber in agricultural sector. The result of this study shows that 158 respondents representing 68.7% strongly agree that there is need for policies to restructure land ownership pattern, 53 respondents (23%) agree, 5 respondents representing 2.2% were neutral, while 14 respondents (6.1%) disagree. Also, the study shows that 165 respondents representing 71.7% strongly agree that there is need for basic infrastructural facilities such as good roads, electricity, water and housing available to farmers to aid sustainability, 54 respondents (23.5%) agree, and 11 respondents representing 4.8% were neutral on the need for basic infrastructural facilities.

Provision of extension service and information to rubber farmers was also evaluated and the result showed that 147 respondents representing 63.9% strongly agree for the need for provision of extension services and information to rubber farmers, 73 respondents (31.7%) agree, 10 respondents (4.3%) were neutral. On evaluation of the ability of Nigerian rubber farmers to be a major in the world market on provision of all relevant facilities and policies, 117 respondents (50.9%) strongly agree, 67 respondents (29.1%) agree, and 46 respondents (20%) were neutral.

Availability of rubber farmers plays a major role in the sustainability of agriculture. I sought to find out from the farmers if the populations of farmers were on the increase or decrease. 147 respondents (63.9%) strongly agree that rubber farmers were on the decline in the country, 62 respondents (27%) agree, 20 respondents (8.7%) were neutral, while 1 respondent (0.4%) disagreed on the decline of rubber farmers in Nigeria.

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The study shows that 170 respondents (73.9%) strongly agree that there is scarcity of agro – chemicals, 43 respondents (18.7%) agree, and 17 respondents representing 7.4% were neutral on the scarcity of agro – chemicals. This study shows that 162 respondents representing 70.4% strongly agree incidences of pest, diseases, wind, and fire have a major effect on sustainability of rubber, 64 respondents (27.8%) agree, and 4 respondents were neutral on the effect these would have on sustainability of rubber.

The availability of market for rubber was evaluated and 122 respondents (53%) strongly agree it will boost rubber production hence sustainability, 71 respondents (30.9%) agree, 24 respondents (10.4%) were neutral, while 13 respondents (5.7%) disagree. Also, study on old age of rubber trees and the decline in the planting of new ones and how this affects yield shows that 124 respondents (53.9%) strongly agree it does, 74 respondents (32.2%) agree, 15 respondents (6.5%) were neutral, 16 respondents (7%) disagree, while 1 respondent (0.4%) strongly disagrees.

I also evaluated the effect of the cost and unavailability of latex preservatives as it affects sustainability. Of the respondents 122 representing 53.1% strongly agree they play a role, 61 respondents (26.5%) agree, while 47 respondents (20.4%) were neutral. Evaluation of the respondents response on the role urban – rural migration plays on sustainability of agriculture with reference to rubber shows that 131 respondents (57%) strongly agree it’s on the increase, 72 respondents (31.3%) agree, 21 respondents (9.1%) were neutral, 6 respondents (2.6%) disagree that there has been an increase in rural – urban migration especially among the youths.

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Table 6.

*Measure of Influence of Government and Rural-Urban Migration on the Sustainability of Rubber*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **VARIABLE** | | | |  | **N= 230** | **PERCENTAGE** |
|  |  |  |  |  |  |  | **(%)** |
|  |  |  |  | |  |  |  |
|  | **Government effort in Rubber sustainability is not enough** | | |  |  |  |  |
|  | Strongly agree | | | |  | 108 | 47.0 |
|  | Agree | | | |  | 77 | 33.5 |
|  | Neutral | | | |  | 32 | 13.9 |
|  | Disagree | | | |  | 11 | 4.8 |
|  | Strongly disagree | | | |  | 2 | 0.9 |
|  |  |  | | |  |  |  |
|  | **Capital and funding is limited to farmers** | |  | |  |  |  |
|  | Strongly agree | | | |  | 134 | 58.3 |
|  | Agree | | | |  | 76 | 33.0 |
|  | Neutral | | | |  | 17 | 7.4 |
|  | Disagree | | | |  | 3 | 1.3 |
|  | Strongly disagree | | | |  | 0 | 0 |
|  |  | | | |  |  |  |
|  | **Cost of labor is on the increase** | | | |  |  |  |
|  | Strongly agree |  | | |  | 134 | 58.3 |
|  | Agree | | | |  | 65 | 28.3 |
|  | Neutral | | | |  | 20 | 8.7 |
|  | Disagree | | | |  | 9 | 3.9 |
|  | Strongly disagree | | | |  | 2 | 0.9 |
|  |  | | | |  |  |  |
|  | **Increased government support will boost rubber production** | | | |  |  |  |
|  | Strongly agree | | | |  | 144 | 62.2 |
|  | Agree | | | |  | 60 | 26.1 |
|  | Neutral | | | |  | 23 | 10.0 |
|  | Disagree | | | |  | 3 | 1.3 |
|  | Strongly disagree | | | |  | 0 | 0.0 |
|  |  |  |  |  |  |  |  |

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Table 6 (continued)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Storage facilities pose a major challenge to rubber farmers** | | | | |  |  |  |
|  | Strongly agree | | | | |  | 78 | 33.9 |
|  | Agree | | | | |  | 95 | 41.3 |
|  | Neutral | | | | |  | 20 | 8.7 |
|  | Disagree | | | | |  | 36 | 15.7 |
|  | Strongly disagree | | | | |  | 1 | 0.4 |
|  |  |  | |  |  |  |  |  |
|  | **Policies on Land ownership pattern is essential** | | | | |  |  |  |
|  | Strongly agree | |  | | |  | 158 | 68.7 |
|  | Agree | | | | |  | 53 | 23.0 |
|  | Neutral | | | | |  | 5 | 2.2 |
|  | Disagree | | | | |  | 14 | 6.1 |
|  | Strongly disagree | | | | |  | 0 | 0.0 |
|  |  |  | |  | |  |  |  |
|  | **Provision of basic infrastructural facilities is essential** | | | | |  |  |  |
|  | Strongly agree | | | |  |  | 165 | 71.7 |
|  | Agree | | | | |  | 54 | 23.5 |
|  | Neutral | | | | |  | 11 | 4.8 |
|  | Disagree | | | | |  | 0 | 0 |
|  | Strongly disagree | | | | |  | 0 | 0 |
|  |  | | | | |  |  |  |
|  | **Provision of extension services and other sources of** | | | | |  |  |  |
|  | **information is essential** |  | |  | |  |  |  |
|  | Strongly agree | | | | |  | 147 | 63.9 |
|  | Agree | | | | |  | 73 | 31.7 |
|  | Neutral | | | | |  | 10 | 4.3 |
|  | Disagree | | | | |  | 0 | 0.0 |
|  | Strongly disagree | | | | |  | 0 | 0.0 |
|  |  |  |  |  |  |  |  |  |

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Table 6 (continued)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Nigeria has the human resources to be a major player in the** | | | | | | |  |  |
|  | **global market** | | | | | |  |  |  |
|  | Strongly agree |  | | | | | | 117 | 50.9 |
|  | Agree | | | | | | | 67 | 29.1 |
|  | Neutral | | | | | | | 46 | 20.0 |
|  | Disagree | | | | | | | 0 | 0.0 |
|  | Strongly disagree | | | | | | | 0 | 0.0 |
|  |  | |  |  | |  | |  |  |
|  | **Rubber farmers in Nigeria are on the decline** | | | |  | | |  |  |
|  | Strongly agree | | | | | | | 147 | 63.9 |
|  | Agree | | | | | | | 62 | 27.0 |
|  | Neutral | | | | | | | 20 | 8.7 |
|  | Disagree | | | | | | | 1 | 0.4 |
|  | Strongly disagree | | | | | | | 0 | 0.0 |
|  |  | |  | | |  | |  |  |
|  | **Agro- chemicals are not readily available** | | | | | | |  |  |
|  | Strongly agree | | |  | | | | 170 | 73.9 |
|  | Agree | | | | | | | 43 | 18.7 |
|  | Neutral | | | | | | | 17 | 7.4 |
|  | Disagree | | | | | | | 0 | 0.0 |
|  | Strongly disagree | | | | | | | 0 | 0.0 |
|  |  | | | | | | |  |  |
|  | **Pest and disease attack, fire outbreak and wind hazards** | | | | |  | |  |  |
|  | **affect rubber yield** | | | | | | |  |  |
|  | Strongly agree | |  | | | | | 162 | 70.4 |
|  | Agree | | | | | | | 64 | 27.8 |
|  | Neutral | | | | | | | 4 | 1.7 |
|  | Disagree | | | | | | | 0 | 0.0 |
|  | Strongly disagree | | | | | | | 0 | 0.0 |
|  |  |  |  |  |  |  |  |  |  |

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Table 6 (continued)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Market for primary produce will encourage rubber** | | | | | |  |  |  |  |
|  | **production** |  | | | | | |  |  |  |
|  | Strongly agree | | | | | | |  | 122 | 53.0 |
|  | Agree | | | | | | |  | 71 | 30.9 |
|  | Neutral | | | | | | |  | 24 | 10.4 |
|  | Disagree | | | | | | |  | 13 | 5.7 |
|  | Strongly disagree | | | | | | |  | 0 | 0 |
|  |  | |  | | |  | |  |  |  |
|  | **Old age and late planting of new ones is affecting** | | | | | | |  |  |  |
|  | **Rubber yield** | | |  |  | | |  |  |  |
|  | Strongly agree | | | | | | |  | 124 | 53.9 |
|  | Agree | | | | | | |  | 74 | 32.2 |
|  | Neutral | | | | | | |  | 15 | 6.5 |
|  | Disagree | | | | | | |  | 16 | 7.0 |
|  | Strongly disagree | | | | | | |  | 1 | 0.4 |
|  |  | | | | | | |  |  |  |
|  | **Cost and unavailability of Latex preservatives is on** | | | | | | |  |  |  |
|  | **the increase** | |  | | |  | |  |  |  |
|  | Strongly agree | | | | | | |  | 122 | 53.0 |
|  | Agree | | | | | | |  | 61 | 26.5 |
|  | Neutral | | | | | | |  | 47 | 20.4 |
|  | Disagree | | | | | | |  | 0 | 0.0 |
|  | Strongly disagree | | | | | | |  | 0 | 0.0 |
|  |  | | | | | | |  |  |  |
|  | **Rural - Urban migration especially of youth affects rubber** | | | | | | |  |  |  |
|  | **production** |  | | | | | |  |  |  |
|  | Strongly agree | | | | | | |  | 131 | 57.0 |
|  | Agree | | | | | | |  | 72 | 31.3 |
|  | Neutral | | | | | | |  | 21 | 9.1 |
|  | Disagree | | | | | | |  | 6 | 2.6 |
|  | Strongly disagree | | | | | | |  | 0 | 0.0 |
|  | | | | | | | |  |  |  |
| Source: Field study 2013 | | | | | | | |  |  |  |

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**Percentage Distribution of Respondents by Stages of Adoption of Improved Rubber**

**Production Technology**

This section is designed to show the distribution of respondents based on the stages of the adoption of improved rubber production technology. From the field study (Table7), it is observed that 65 respondents representing 28.3% were unaware about the use of Ethel to stimulate rubber yield, 77 respondents were interested in using Ethel but it was not available and this represents 33.5%, 55 respondents representing 23.9% were aware about the use of Ethel but they were not using, while 33 respondents representing 14.3% were using Ethel, and it represents the least of the number of respondents.

It was also observed that 50 respondents were found to be using the improved techniques representing 21.7%, while 46 respondents representing 16.1% were found to be unaware about the importance and use of improved techniques and materials.

Studies from the use of Nigerian developed rubber clone RRIN 500 showed that 108 respondents representing 47% were interested in the use of RRIN 500, 52 respondents representing 22.6% were using it, 45 respondents representing 19.6% were aware of RRIN 500 but were not using it due to several constraints, 25 respondents (10.9%) were found to be unaware of RRIN 500.

It was discovered that the respondents using Nigerian developed rubber clone RRIN 600 was 26 respondents representing 11.3%, 68 respondents representing 29.6% were interested in the use but were neither aware of it and not using and if given the opportunity will use, 62 respondents (27%) were observed to be aware of RRIN 600 but were not using, and it was observed that the highest number of 74 respondents representing 32.2% were using RRIN 600.

Nigerian developed rubber clone NIG 800 had the highest number of 100 respondents using representing 43.5%, study indicated that 62 respondents representing 27% were aware of

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NIG 800, 53 respondents representing 23% were interested in the use of NIG 800, and 15 respondents representing 6.5% were found to be unaware of NIG 800.

Nigerian developed rubber clone NIG 801 had the highest number of 110 respondents using representing 47.8%, study indicated that 68 respondents representing 29.6% were aware of NIG 801, 40 respondents representing 17.4% were interested in the use of NIG 801, and 12 respondents representing 5.2% were found to be unaware of NIG 801.

Nigerian developed rubber clone NIG 805 had the highest number of 117 respondents using representing 50.9%, study indicated that 61 respondents representing 26.9% were aware of NIG 805, 37 respondents representing 16.1% were interested in the use of NIG 805, and 15 respondents representing 6.5% were found to be unaware of NIG 805.

I find it hard to understand the effect of the use Agro-chemicals as been reflected by the level of its awareness among the rubber farmers as this is essential to its sustainability. It was discovered that 25 respondents (10.9%) were unaware of the importance and uses of agro-chemicals, 57 respondents (24.8%) were interested in the use of the agro-chemicals, also, 86 respondents representing 37.4% were aware of the use, while 62 respondents representing 27% were making use of agro-chemicals.

The study showed that majority of the respondents was unaware of the recommended planting time. This represents 65 respondents (28.3%), 54 respondents (23.5%) were interested in the use of the recommended planting time, 63 respondents (27.4%) were aware of the recommended planting time, 48 respondents representing 20.9% are using the recommended planting time.

The study showed that majority of the respondents was interested in employing the recommended tapping time. This represents 70 respondents (30.4%), 65 respondents (28.3%) were aware of the use of the recommended tapping time, 50 respondents (21.7%) were unaware

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of the recommended planting time, and 45 respondents representing 19.6% are using the recommended tapping time.

The study showed many of the respondents were interested in intercropping with food crops. This represents 88 respondents (38.3%), 72 respondents (31.3%) were aware of the use of intercropping with food crops, 40 respondents (17.4%) were unaware of the recommended planting time, and 30 respondents representing 13% are using the recommended tapping time.

From the study, it was found that 46 respondents (20%) are unaware of the recommended planting space, 63 respondents representing 27.4% are interested, 59 respondents representing

25.7% are found to be aware, and 59 respondents representing 25.7% are found to be using the recommended planting space.

From the study, it was found that 46 respondents (20%) are unaware of the recommended fertilizer type and dosage, 86 respondents representing 37.4% are interested, 59 respondents representing 25.7% are found to be aware, and 39 respondents representing 17% are found to be using the recommended planting space.

From the study, it was found that 55 respondents (23.9%) are unaware of the recommended pest diseases and disease control measures, 51 respondents representing 22.2% are interested, 56 respondents representing 24.3% are found to be aware, and 68 respondents representing 29.5% are found to be using the recommended pest and disease control measures.

Figure 3 shows the adoption of improved rubber production technology.

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Table 7.

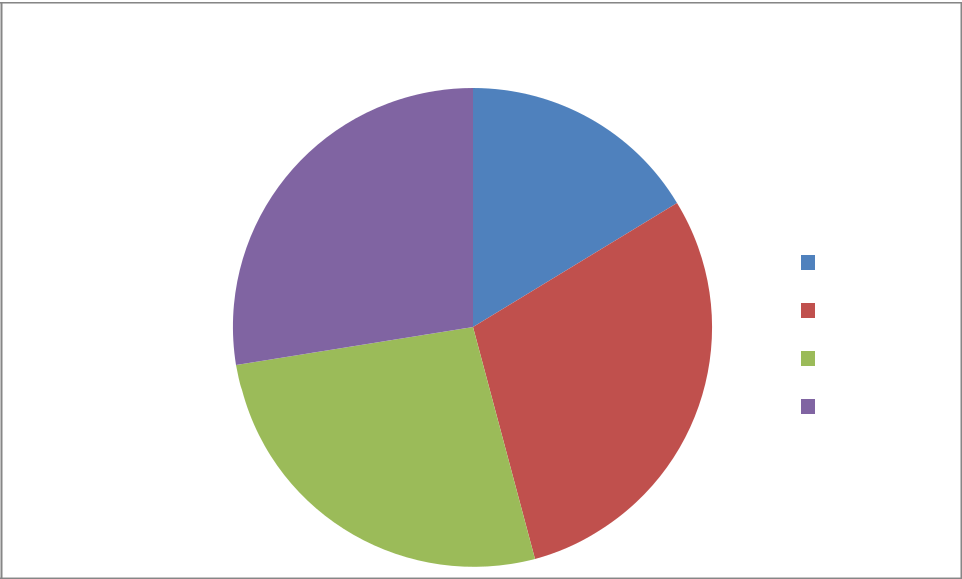
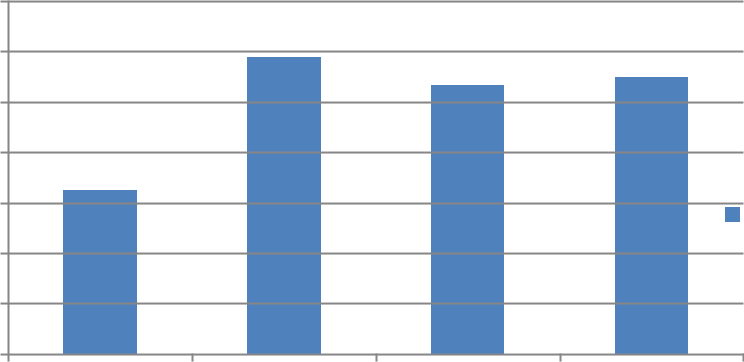
*Percentage Distribution of Respondents by Stages of Adoption of Improved Rubber Production Technology*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **IMPROVED TECHNOLOGY** | **UNAWARE** |  | **INTERESTED** | **AWARE** | **USING** | **TOTAL** |
|  |  |  |  |  |  |  |
| Use of Ethel to stimulate | 65 |  | 77 | 55 | 33 | 230 |
| rubber yield |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Improved technique and | 37 |  | 97 | 46 | 50 | 230 |
| materials |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| RRIN 500 | 25 |  | 108 | 45 | 52 | 230 |
|  |  |  |  |  |  |  |
| RRIN 600 | 26 |  | 68 | 62 | 74 | 230 |
|  |  |  |  |  |  |  |
| NIG 800 | 15 |  | 53 | 62 | 100 | 230 |
|  |  |  |  |  |  |  |
| NIG 801 | 12 |  | 40 | 68 | 110 | 230 |
|  |  |  |  |  |  |  |
| NIG 805 | 15 |  | 37 | 61 | 117 | 230 |
|  |  |  |  |  |  |  |
| Use of Agro-chemicals | 25 |  | 57 | 86 | 62 | 230 |
|  |  |  |  |  |  |  |
| Recommended planting time | 65 |  | 54 | 63 | 48 | 230 |
|  |  |  |  |  |  |  |
| Recommended tapping time | 50 |  | 70 | 65 | 45 | 230 |
|  |  |  |  |  |  |  |
| Intercrop with food crops | 40 |  | 88 | 72 | 30 | 230 |
|  |  |  |  |  |  |  |
| Recommended planting space | 49 |  | 63 | 59 | 59 | 230 |
|  |  |  |  |  |  |  |
| Recommended fertilizer type | 46 |  | 86 | 59 | 39 | 230 |
| and dosage |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Recommended pest and | 55 |  | 51 | 56 | 68 | 230 |
| Disease control measures |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| SOURCE: Field Survey 2013 |  |  |  |  |  |  |
|  |  | 59 | |  |  |  |

|  |  |
| --- | --- |
| **Variable** | **Percent (100)** |
|  |  |
| Unaware | 16.31 |
|  |  |
| Interested | 29.48 |
|  |  |
| Aware | 26.69 |
|  |  |
| Using | 27.52 |
|  |  |



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Chart showing Percentage distribution of respondents by stages of** | | | |  | |
|  | **adoption of improved rubber production technology** | | | |  | |
|  | 35 |  |  |  | |  | |
|  | 30 |  |  |  | |  | |
| **Frequency** | 25 |  |  |  | |  | |
| 20 |  |  |  | |  | |
| 15 |  |  | Series1 | |  | |
|  |  |  |  | |
|  |  |  |  | |  | |
|  | 10 |  |  |  | |  | |
|  | 5 |  |  |  | |  | |
|  | 0 |  |  |  | |  | |
|  | Unaware | Interested | Aware | Using | |  | |
|  |  | **Level of Awareness** | |  | |  | |
|  | **Chart showing Percentage distribution of respondents by stages of** | | | |  | |
|  | **adoption of improved rubber production technology** | | | |  | |
|  |  |  | 16% |  | |  | |
|  |  | 28% |  |  | |  | |
|  |  |  |  | Unaware | |  | |
|  |  |  |  | Interested | |  | |
|  |  |  |  | Aware | |  | |
|  |  |  | 29% | Using | |  | |
|  |  | 27% |  |  | |  | |



*Figure 3:* Bar Chart and Pie Chart Showing Percentage Distribution of Adoption

SOURCE: Field Survey 2013

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From Figure 4 above, it is discovered that 29% of the respondents are interested in adopting new stages of improved rubber production technology, 28% of the respondents are using the new stages of improved rubber production technology, 27% are aware of the new stages of improved rubber production technology, while 16% being the least indicates the percentage of the respondents unaware of the new planting institute.

**Sources of Information About Rubber (Production, Market, Technological Advancement,**

**and Access to Funds)**

Table 8 below shows the result of data and information based on the response from the rubber farmers regarding the frequency and level of exposure to various sources of information regarding rubber. The information covers a wide range of information ranging from production of rubber, market for the rubber, and technological approaches to harnessing and processing the rubber, Access to funds for various rubber sustainability operations among other things. These sources of information are very essential to the sustainability of agriculture and rubber being our case study.

It was discovered from the study that many of the respondents (83 respondents) representing 36.1% source of information occasionally comes from friends and family, 76 respondents (33%) regularly get information from friends and family, 64 respondents (27.8%) rarely get information, while 7 respondents (3%) never have their source of information from family and friends.

The study revealed that 113 respondents representing 49.1% never got information from their radios and television, 113 respondents (49.1%) rarely source information from the radio and television, and 4 respondents (1.7%) occasionally source information from the radios and

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television(media). Also, 158 respondents representing 67.8% never get information from the newspaper, 74 respondents (32.2%) rarely source information from newspapers.

The study revealed that 9 respondents representing 3.9% never got information from Agricultural Development Programs (ADP), 38 respondents (16.5%) rarely source information through Agricultural Development Programs (ADP), 94 respondents (40.9%) occasionally source information from Agricultural Development Programs (ADP), while 89 respondents (38.7%) regularly have information through Agricultural Development Programs (ADP).

The study showed that many of the respondent’s occasionally sourced information from the Rubber Research Institute of Nigeria (RRIN). This represents 101 respondents (43.9%), 49 respondents (21.3%) rarely source information from Rubber Research Institute of Nigeria (RRIN)., 40 respondents (17.4%) never get information from the Rubber Research Institute of Nigeria (RRIN), and 40 respondents representing 17.4% also regularly get information from the Rubber Research Institute of Nigeria (RRIN).

The respondents having their source of information from Michelin Plc are as follows. 80 respondents (34.8%) do get information from them, 115 respondents (50%) do get information from them, 30 respondents have their source from Michelin Plc, while the least number of 5 respondents representing 2.2% source information from Michelin Plc.

The study showed that many of the respondents’ sourcing information from buyers of the rubber produce were 100 respondents (43.5%) who regularly get information from them. 90 respondents (39.1%) occasionally get information from buyers, 29 respondents (12.6%) rarely source information from buyers, and 11 respondents (4.8%) never get information from the buyers. All these as shown in Figure 4 below.

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Table 8.

*Sources of Information about Rubber (Production, Market, Technological*

*Advancement, and Access to Funds)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SOURCE OF** | **NEVER** | **RARELY** | **OCCASIONALLY** | **REGULARLY** | **TOTAL** |
| **INFORMATION** |  |  |  |  |  |
|  |  |  |  |  |  |
| Friends / Relatives | 7 | 64 | 83 | 76 | 230 |
|  |  |  |  |  |  |
| Radio / Television | 113 | 113 | 4 | 0 | 230 |
|  |  |  |  |  |  |
| Agricultural | 9 | 38 | 94 | 89 | 230 |
| Development |  |  |  |  |  |
| Programs (ADP) |  |  |  |  |  |
| Newspaper | 156 | 74 | 0 | 0 | 230 |
|  |  |  |  |  |  |
| Rubber Research | 40 | 49 | 101 | 40 | 230 |
| Institute of Nigeria |  |  |  |  |  |
| Michelin Plc | 80 | 115 | 30 | 5 | 230 |
|  |  |  |  |  |  |
| Buyers | 11 | 29 | 90 | 100 | 230 |
|  |  |  |  |  |  |

SOURCE: Field Survey 2013

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|  |  |
| --- | --- |
| **Variable** | **Percent (100)** |
|  |  |
| Never | 25.84 |
|  |  |
| Rarely | 29.94 |
|  |  |
| Occasionally | 24.96 |
|  |  |
| Regularly | 19.26 |
|  |  |



|  |
| --- |
| **Frequency** |

35

30

25

20

15

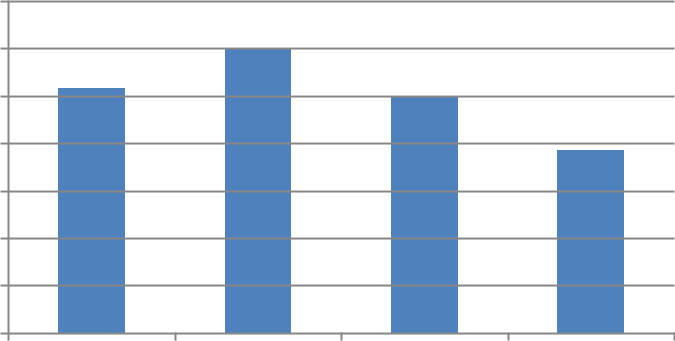
10

5

0

**Chart showing distribution of source of information to**

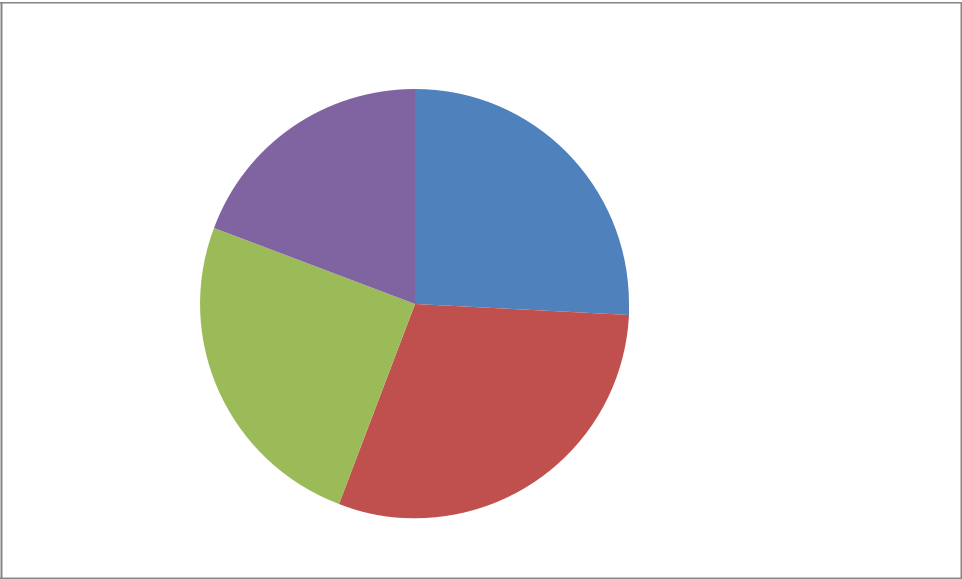
**farmers.**



 Series1

Never Rarely Occasionally Regularly

**Level of Usage**



**Chart showing distribution of source of information to**

**farmers.**

19%

26%

 Never

 Rarely

 Occasionally

25%

 Regularly

30%

*Figure 4:* Bar Chart and Pie Chart Showing Distribution of Sources of Information

SOURCE: Field Survey 2013

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From Figure 5 above, it is discovered that 30% of the respondents rarely get information from the required/relevant sources, 26% never get information from these sources, and 25% occasionally get information from these sources, while 19% being the least regularly gets information from the required/relevant sources.

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CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATION

**Summary**

From the research study, it is clear that the sustainability of rubber production in the Nigeria agriculture economy has a doubting future. Making inference from the contributions from varying age group and the discouraging attempt of the government support to rubber production, we could deduce that there is a falling wiliness/enthusiasms from the older generation who are noted to be larger contributor to rubber production in Nigeria.

The survey presented the larger percentage of the contributor to be people of age group of 40 and above with the negligence youthful population having lesser participation in rubber production. Male farmers are the dominant operators of the rubber farm. The result showed that most of the respondents had little or no formal education. This will definitely have a bad effect on sustainability due to adoption of improved technology. Respondent’s household size was found to be six on the average. The majority of the farmers had nonfarm operations and there is a tendency to abandon rubber farming activities if there is boom in the nonfarm activity. The source of farm land was majorly rented and this might not make the farmers totally committed to the farmland. The size of the rubber holdings was discovered to be less the 1.99 hectares for majority of the respondents and this is very low.

Farmers’ major source of financing is through their personal savings with little or no input from the government, and with the constant increase in cost of farm labor these can lead to impediments for farmers that will not boost sustainability of agriculture. It is discovered that majority of the farmers strongly agree various government activities such as provision of funds, support, provision of storage facilities, policies restructuring land ownership, provision of infrastructural facilities such as good roads, water, electricity and housing, extension services

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and increase information sources, agrochemicals, pest, diseases, fire, and wind outbreak control devices, availability of market, early planting of new rubber, preservatives, improved techniques and materials that are majorly lacking among the farmers if provided to them will help lead to sustainability of rubber and agriculture as a whole.

With this justification, we can postulate a there will be discouraging future for the sustainability of rubber production in the Nigeria agricultural economy. Unless government makes an encouraging effort through positive contributions to support the willing population of rubber farmers and equal interest the younger generation, rubber production may not be sustained. It is therefore imperative that government make available resources to funding farmers to assure a huge production of rubber. This in turn will not only generate income to the participating farmers but will equally provide the nation an avenue to generate foreign exchange and income.

**Conclusions**

Though from the investigation gathered from various respondents regarding the survey, it was noted that government contributions were very low. However, government can take up responsibility to measure out modality to assist rubber production technology to further encourage it sustainability. Government could therefore put in place effort like generating loans for farmers who are willing to venture into huge plantation production but who lack capital for investment. Irrespective of the enormous challenges hampering the achievement of sustainable development in Nigeria agricultural sector with reference to rubber as an agricultural produce, it can be employed at a level high enough to address the various problems (economic: poverty, unemployment, environmental degradation; deforestation) while at the same time leading to sustainable development of agriculture.

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The government can provide other assistance such as storage facilities, basic infrastructural facilities, agro chemicals to boost production, policies on land use pattern to support farmers, and create awareness through extension services. All these if employed by the authorities will no doubt aid and equally proffer a sustainable rubber production in the agricultural economy of Nigeria.

**Recommendations**

1. All stakeholders in the Natural rubber industry should contribute towards funding of research activities on natural rubber.
2. Regular trainings and workshops for rubber farmers through collaborative efforts in funding of research by government, nongovernmental organizations, and users of research results on natural rubber should be provided.
3. Provision of basic infrastructural facilities, capital, and funding should be provided for the farmers.
4. The policies guiding the interest of rubber farmers and various forms of awareness should be provided for the farmers and all other produce in the agricultural sector as a whole.

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APPENDICES

APPENDIX A: Questionnaire

EAST TENNESSEE STATE UNIVERSITY

ENGINEERING TECHONOLOGY DEPARTMENT

Good day sir/ma, I am a postgraduate student of the above named institution doing my master’s degree project on'' The Sustainability of Agriculture in Nigeria Using Rubber as a Case Study”. Please, I kindly require your help in filling this questionnaire. The purpose of this questionnaire is to provide feedback for the progressive improvement and sustainability of Agriculture in Nigeria. Thank you for your help.

**SECTION A**

**Sex:**

Male

**(**

**)**

Female

**(**

**)**

**Age:**

Below 30 years **(** years and above

**(**

**)**

31-40 years **( )**

**)**

41-50 years

**(**

**)** 51-60 years,

61

**Marital status:**

Single

**(**

**)**

Married

**(**

**)**

**Level of education:**

No Formal Education

**(**

**)**

Primary Education

**(**

**)**

Secondary Education

**(**

**)**

Post-Secondary Education

**(**

**)**

**Household size:**

Less than 3 person **(**

**)**

, 4-6 persons **(**

**)**

,

7-10 persons (

**)**

,

Above 10 person (

**)**

**Non-farm occupation:**

Handicraft

,

Teaching

, No Response

Petty trading **(**

**)**

, Driving

**(**

**)**

, Student **(**

**)**

73

**Sources of rubber farmlands:**

Inherited **(**

**)**

, Rented **(**

**)**

, Purchased

**(**

**)**

**Size of rubber holdings (hectares):**

Less than 1.99 **(** 4.0 – 5.99 **( )**

**)**

, 2.0 – 3.99 **(**

**)**

**Sources of financing rubber farming activities:** Personal savings **(** **),** Loans from

community banks **(** **),** Cooperative societies **(** **),** Friends and relatives **(**

**)**

**Major sources of farm labour:**

Family labour **(** **)**, Hired labour

Family /hired labour **(** **)**

**(**

**),**

**Farmers’/social organization:**

None

**(**

**)**

, 1-2

**(**

**)**

,

3-4 (

**)**

**SECTION B**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S/N** | **Item** | **Strongly** | **Agree** | **Neutral** | **Disagree** | **Strongly** |
|  |  | **Agree** |  |  |  | **Disagree** |
|  |  |  |  |  |  |  |
| 1 | Government is not doing enough |  |  |  |  |  |
|  | to support Rubber production in |  |  |  |  |  |
|  | Nigeria |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 2 | Capital and funding are not |  |  |  |  |  |
|  | readily available to the farmers |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 3 | There is an increase in the cost of |  |  |  |  |  |
|  | labour |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 4 | With increased funding and |  |  |  |  |  |
|  | government support, rubber |  |  |  |  |  |
|  | production will increase |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 5 | Storage facilities are a major |  |  |  |  |  |
|  | challenge faced by rubber |  |  |  |  |  |
|  | farmers in Nigeria |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 6 | There is a need to make policies |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  | 74 |  |  |  |  |

to restructure land ownership

pattern

1. There is a need for provision of basic infrastructural facilities (good roads, good water and electricity)
2. There is a need for provision of extension services and other sources of information
3. Nigerian Rubber farmers have what it takes to make Nigeria a major player in Rubber production in the world
4. Rubber farmers in Nigeria are on the decline
5. There is a Scarcity of agro-chemicals (pesticides and herbicides)
6. Incidence of pest and disease attack, fire outbreak and wind hazards affect yield
7. Provision of adequate market for primary produce (latex and rubber lump) will encourage rubber production
8. Old age of Rubber and the decline in the planting of new ones is affecting Rubber production
9. There has been an increase in the cost and unavailability of Latex

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preservatives

1. Increase in Urban-Rural migration especially of youth has led to decrease in rubber production

**Percentage distribution of respondents by stages of adoption of improved rubber production technology**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Improved Technology** | **Using** | **Aware** | **Interest** | **Unaware** |
|  |  |  |  |  |  |
| 17 | Use of Ethel to stimulate rubber |  |  |  |  |
|  | yield |  |  |  |  |
|  |  |  |  |  |  |
| 18 | Improved technique |  |  |  |  |
|  |  |  |  |  |  |
|  | Improved materials |  |  |  |  |
|  |  |  |  |  |  |
| 19 | -RRIN 500 |  |  |  |  |
|  |  |  |  |  |  |
| 20 | -RRIN 600 |  |  |  |  |
|  |  |  |  |  |  |
| 21 | -NIG 800 |  |  |  |  |
|  |  |  |  |  |  |
| 22 | -NIG 801 |  |  |  |  |
|  |  |  |  |  |  |
| 23 | -NIG 805 |  |  |  |  |
|  |  |  |  |  |  |
| 24 | Use of Agro-chemicals |  |  |  |  |
|  |  |  |  |  |  |
| **S/N** | **Improved Technology** | **Using** | **Aware** | **Interest** | **Unaware** |
|  |  |  |  |  |  |
| 25 | Recommended planting time |  |  |  |  |
|  |  |  |  |  |  |
| 26 | Recommended tapping time |  |  |  |  |
|  |  |  |  |  |  |
| 27 | Intercrop with food crops |  |  |  |  |
|  |  |  |  |  |  |
| 28 | Recommended planting space |  |  |  |  |
|  |  |  |  |  |  |
| 29 | Recommended fertilizer type and |  |  |  |  |
|  | dosage |  |  |  |  |
|  |  |  |  |  |  |
| 30 | Recommended pest and |  |  |  |  |
|  | Disease control measures |  |  |  |  |
|  |  |  |  |  |  |

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**Sources of Information about Rubber (Production, Market, Technological advancement, Access to Funds.etc)**

1. Friends / Relatives
2. Radio / Television
3. Agricultural Development Programmes (ADP)
4. Newspaper
5. Rubber Research Institute of Nigeria
6. Michelin Plc
7. Buyers

Scale: Regularly = 4, Occasionally = 3, Rarely = 2, Never= 1

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APPENDIX B: Pictures



*Figure 5*: At Rubber Research Institute of Nigeria (RRIN) main root stock nursery – Nigeria. (Field Survey, 2013)



*Figure 6:* In a Rubber Plantation Nigeria while Carrying out the Field Study (Field Survey, 2013)

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*Figure 7*: Thanking one of the Respondents for Sharing his Time and Knowledge with me. (Field Survey, 2013)



*Figure 8:* At the Rubber Research Institute of Nigeria during the Field Study. (Field Survey, 2013)

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*Figure 9*: In a Rubber Processing Factory Inspecting Some Creep Rubber. (Field Survey, 2013)



*Figure 10:* At a Rubber Plantation Understanding the Tapping Process of the Natural Rubber (Field Survey, 2013)

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VITA

OWEN O. OGEBOR

Personal Data:

Date of Birth: September 4, 1985

Place of Birth: Benin City, Nigeria

Martial Status: Single

Education:

Public Schools: Greater Tomorrow Primary & Secondary School, Benin

City, Nigeria, 2002

B.S.C., Business Admin.,

University of Lagos, Lagos State, Nigeria, 2008

M.S., Technology, East Tennessee State University, Johnson City,

Tennessee, 2013

Professional Experience:

Executive Assistant (NYSC), Access Plus Protocol Service, Isin, Kwara, Nigeria, 2009- 2010.

Accountant, Ogbebor Concrete Industry, Idu, Abuja Nigeria, 2010-2011

CEO, Mula Synergy, Ltd., Lifecamp, Abuja Nigeria, 2011-present

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