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FOREST LIQUIDATION, RURAL AGRARIAN POVERTY AND GROWTH IN NIGERIA

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Abstract

This paper assesses forest resource liquidation within the context of rural agrarian poverty and growth in Nigeria, using annual and quarterly data from 1990 to 2016, and 2001 to 2019. Descriptive statistics and correlation analysis were employed to examine how forest resource utilisation is associated with rural agrarian poverty and economic growth. Findings revealed that forest resources have consistently been exploited in an unrestrained manner in the last 26 years, with shifting agriculture and urbanisation as major drivers. In addition, efforts to replenish these resources have not been sufficient enough to ensure their sustainability; thus the share of the forestry subsector has been extremely low. However, as forest depletion took place over time, rural agrarian poverty in Nigeria declined, due to the release of additional land that became available for crop and livestock production, thereby signifying the prevalence of

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a deep-rooted dichotomy between forest and agriculture in the country. The study recommends the replenishment of lost forest cover across the country, discouraging the primitive practice of shifting agriculture, ensuring balanced development to check rural-urban drift, and the development of a national accounting system for the efficient management of forest resources.

Keywords: Forest; Growth; Nigeria; Poverty; Environment; Natural Capital

INTRODUCTION

An increased interest in forestry-livelihood-economy interactions has emerged in recent times[1]. In the past, the discussion centred on the establishment of forest reserves and how to enhance conservation efforts through various domestic and external interventions[2] (Olujobi and Olajuyigbe, 2020). In developing countries, forests were viewed as a nuisance that limited agricultural expansion; hence they were usually cleared to make extra land available for crop production (Aju, 2014). However, recent events have shown that the usefulness of forest sustainability in developing countries goes far beyond ecological protection to how these natural resources can improve the livelihood of rural forested communities (Ibrahim, *et al*., 2020). The forestry sector has been described as a critical determinant of welfare levels in developing countries. This is because it provides multiple benefits to humankind as it contributes to livelihood, both directly and indirectly. As a rich source of raw materials for industries, it generates employment, thereby providing incomes, which could significantly contribute to poverty eradication. In the same manner, forests have also been described as a vital resource that can help to achieve some of the United Nations (UN) Sustainable Development Goals (SDG)[3] (United Nations, 2015; Swamy, *et al*., 2018).

Global forest cover has been estimated to be approximately around four (4) billion hectares, which translates to about 30 per cent of worldwide land use. Furthermore, according to Food and Agriculture Organization (FAO), approximately about 1.6 billion people globally, which represents about 22 per cent of the population, depend on forest and forest resources to support their livelihood in form of building materials, food and water (FAO, 2016). It is estimated that about 400 million people who live near forests rely heavily, on a daily basis, on forests for subsistence (OECD, 2008). In sub-Saharan African communities, where alternative income sources do not exist, forest liquidation and utilisation are gradually becoming the major activities for survival and economic advancement.

As a result of this huge dependence on forests, global forest cover has been reported to have declined from 4,128 million ha in 1990 to 3,999 million ha in 2015. This represents a deforestation rate of 0.13% due to changing land use and societal demands which are put to various uses (Food and Agriculture Organization: FAO, 2015). Countries situated in the tropical rain forest belt have accounted for massive levels of global deforestation figures. The case of Nigeria is not different from the global scenario. In fact, it appears to be worse. For instance, according to Ibrahim, *et al*. (2020), both the quantity and quality of forest resources in the country were on the decrease. They noted that Nigeria's initial estimated forest cover which was 10% as at 1960, during the British colonial rule, fell to 6% as at 2010. Similarly, based on a recent FAO report, Nigeria was identified as one of the countries with a large expanse of forest, which has contributed significantly to the share of net forest loss in West Africa, in particular, and, generally, in Africa between the year 2000 and 2010 (FAO, 2011). These trends of shrinking forest are worrisome and have become a source of concern among environmentalists, as it poses a threat to rural, regional and global biodiversity and climate change.

In the light of the massive forest depletion discussed above, it is expected that the economic potentials of the resource should have growth-enhancing, as well as poverty alleviating effects. However, the poverty situation appears to be adverse in some developing countries. This has led to the generalisation that the poorer the population or community, the more they

tend to depend on natural capital; thus massive deforestation will threaten the sustainability of forest resources as more and more forests are liquidated. Consequently, the number of poor people will continue to increase, and a vicious cycle between poverty and degradation will arise. Therefore, most conservationists and government officials often view the poor as part of the natural resources' problems and as the cause of deforestation, degraded landscapes, and decreasing wildlife populations. This has been referred to in the environmental literature as the "downward spiral thesis". This notion assumes that poverty leads to cycles of further environmental degradation and ever-increasing poverty as a result of long-term reduction in food consumption, human health, and food security (USAID, 2006).

However, the recent positive pieces of evidence from South Asia, Latin America and Africa appear to contradict the above-noted verdict, by showing how forests have supported pro-poor growth[4]. For instance, according to the World Bank (2004) and Lebedys (2004), forest-related activities have accounted for a minimum of 10 per cent to the GDP of 19 African countries which amounted to USD 8 Billion. This is also corroborated by some recent studies[5] which suggest that forest ecosystems are viable sources of employment and household income for the rural poor in Africa and globally. In a more specific manner, these studies report that while environmental income generally constitutes about 28-45 per cent of aggregate household income, 77 per cent share of this amount is derived from natural forests and wood products. However, in Nigeria, recent data show that while there has been massive liquidation of forest resources, the contribution of the subsector has largely remained very minimal and insignificant. The data show that as GDP was increasing, the contribution of the forestry sub-sector declined progressively. This indicates that while the demand for forest resources was high, it appears the contribution of the subsector has not been properly accounted for over time.

The conflicting views presented above on the potential of forests to alleviate poverty and contribute to economic growth point to obvious gaps in the linkages between the forest and socio-economic development in Nigeria. These gaps have been further widened by the difficulty to quantify

the real value of forest resources and their contributions. Also, it has been attributed to an unclear connection between the mechanisms that connect forest utilisation to poverty alleviation (Cheng, *et al*., 2019). This undefined pattern has also been made complex by the multi-dimensional nature of poverty, which further compounds the difficulty of relating how forest product incomes may determine the livelihood of rural economies in Nigeria[6]. Other factors that account for the above-noted gaps include unsustainable management of these resources and a general paucity of adequate data from official sources.

Thus, in the light of the above, relatively little is understood about the contributions of forests to the rural and national economies of Nigeria due to a dearth of relevant studies on the multi-functional linkages between resource utilisation and poverty alleviation. Therefore, there is an urgent need to fill the gaps identified above so as to provide information on the factors that account for the substantial exploitation of forest resources in Nigeria. Secondly, it is relevant to show the share of the subsector in total output. Thirdly, it is also pertinent to explore the role of forest liquidation on the well-being of rural dwellers in agrarian communities vis-a-vis the position of previous studies on the subject. Hence, the justification for this study stems from the need to fill the gaps identified above and contribute to the existing literature by providing a detailed account of the interaction between forest liquidation, growth and rural agrarian poverty in Nigeria. Consequently, in the course of the study, the following questions were considered.

a. What are the determinants of forest liquidation in Nigeria?

b. How significant is the share of the forestry sub-sector in total output (GDP)?

c. Does liquidation of forest resources affect rural agrarian poverty levels?

The paper is organised into six sections. As a follow-up to the introduction, Section Two lays a foundation for the various perspectives in the literature by elaborating on forest resources, poverty and growth nexus. Section Three dwells on the theoretical framework, in order to provide

clear perspectives on theoretical issues relevant to the study, while Section Four presents the methodology of the study. Section Five focuses on discussions of findings, while Section Six provides the summary, recommendations, conclusion and suggestions for further studies.

Literature Review

Despite the growing awareness of the role of forests and their potential for economic transformation, the subject has been largely overlooked in Nigeria as few studies have been directed toward human activities in the forestry sub-sector, (Ibrahim, *et al*., 2020). However, this section presents a theoretical and empirical review of the relevant issues in the literature considered appropriate for this study.

Theoretical Issues

In our discourse on the theoretical issues associated with environment-poverty- growth nexus, four major views in the literature that have fuelled the debate on the role of forests, the impact of liquidation and its implication on the economy and environment over time are examined. Various theories have been put forward to explain the dynamics of forest cover variations and how these could enhance the welfare of individuals and communities. The four major views of interest are as follows: the theoretical expositions of the Von Thunen model; forest transition theory; Malthusian theories, and the Environmental Kuznets Curve.

Firstly, Von Thunen was the foremost scholar to elaborate on the drivers of forest cover changes. His theory opines that the use to which land is put is assumed to be influenced by activities that yield the greatest surplus (rent) (Angelson, 2007). On the other hand, the surplus that accrues to land arises from variables such as prevailing crop prices, agro-ecological conditions, available technologies, input cost and welfare levels of economic agents in the economy. Of the factors identified, elements that have both direct and indirect linkages with the location of land to be utilised for agricultural purposes were considered to be the most critical (Angelson, 2007). It, therefore, follows that, if forest resources deliver enormous value to people living in forested economies or those outside these com-

munities, it implies that more and more land will be devoted to investment in forest-related activities.

Secondly, with the passage of time, available evidence from the north and southern countries revealed that land, which was previously cleared for various uses, experienced reforestation naturally over time. This led to the emergence of the forest transition theory. This theory explains the factors that bring out the resurgence of forests, which have previously been felled, due to increasing human activities. According to the forest transition theory, fields revert to forest lands due to shifts in human activities as the economy transits from agricultural to an industrially driven economy (Mather, *et al*., 1999). This is similar to Lewis' two-sector model of the structural transformation theories, where the economy evolves from a predominately agrarian/traditional economy to a modern industrial sector. On the other hand, the forest transition theory largely emphasises the role of economically motivated incentives as responsible for a significant amount of trees felled, which results in deforestation. The theory is more optimistic relative to the Malthusian idea.

Thirdly, Malthus explained the land-economy-poverty nexus by providing an understanding of the role of population growth. He argued that an ever-increasing population would continually strain society's ability to provide for itself. To him, the power of the population was considered infinitely, greater than the ability of the environment[7] to provide sustenance. Therefore, mankind was doomed to live a life of poverty. While he correctly assumed that the world's population would increase exponentially, which has indeed risen, about six times over the last two centuries, economic growth has reduced chronic hunger, as standards of living are currently higher than in Malthus' days (Mankiw and Taylor, 2019).

The average growth in output across countries has been attributed to the scientific discoveries and technological innovations around the turn of the 20th century. These developments consequently resulted in a clear relegation of natural constraints on economic growth, decades after the thesis of Malthus, as can be gleaned from the literature. For instance, this is very conspicuous in the Solow growth model which completely ignores natural capital from the aggregate production function that explains the determinants of output in the economy. However, Naidoo (2004) has advanced a

twice-augmented growth function that incorporates natural capital, where he specifically measures forest resources as a proxy for natural capital. Fourthly, the Environmental Kuznets Curve (EKC) is a more recent premise that provides a link between environmental quality and development. Earlier ideas have focused on the implications of the utilisation of natural resources, such as forests for economic reasons on the environment and the devastating effects of the human footprint on the continent. Consequently, two broad views became prominent; these arose from the debates of the pessimists and optimists. The pessimists argue that human activities have resulted in severe environmental degradation and, thus, they contend that a linear relationship exists between economic growth and environmental pressures (Opshoor, 2007). On the other hand, the optimists[8] agree that an inverted U relationship exists between the utilisation of environmental resources and output/income. In other words, they uphold that growth will lead to less ecological pressures such as deforestation and degradation of natural resources. This conclusion is in agreement with the position of Kuznets which he first advanced about five decades ago.

Surprisingly, modern environmental literature appears to oppose the inverted U EKC hypothesis put forward by optimists. In fact, they advanced the argument that the quest for economic development across regions and countries would lead to massive environmental decline which could take the form of natural resource depletion, pollution, and degradation. These environmentalists generally believed that efforts to encourage regenerative processes in the environment would not yield the desired results as long as the ecosystem is constantly converted to land in a bid to secure economic advancement through agriculture. They also noted that trade would introduce an external dimension to environmental degradation, as developing countries that are naturally endowed are less capable to resist the offers in terms of incomes from trans-border trade deals of advanced countries. Therefore, environmental decline through consistent degradation arising from economic incentives will become detrimental to the welfare of direct communities from which these resources are derived, which will in the long run have adverse effects on the next generation.

In a nutshell, it is evident from the theoretical discussion that the emphasis on the role of forests has evolved over time, from the views of Von Thunen to the postulation of the Environmental Kuznets Curve. Thus, it is interesting to note that earlier thoughts, such as that of Von Thunen and the forest transition theories, have explicitly shown that forests are vital resources which could contribute to better socio-economic outcomes. Conversely, the theory of Malthus and the proponents of the linear version of EKC have presented a pessimistic view. They argued that constant environmental pressures as a result of increased population and unsustainable practices will have an adverse effect on the welfare of communities from which the forest resources are derived. This is the view upheld by modern environmentalists who focus on the forest-agriculture dichotomy, that as long as forests are converted to land, regenerative efforts on the environment will continue to be frustrated, as well as the sustainability of the environment.

Empirical Issues

Empirical studies on evidence of the nexus between forest liquidation, poverty and national output of countries document mixed results based on the focus of their research. However, the results can be broadly classified under four main issues in relation to the objectives of this study.

Forest Liquidation by Rural Agrarian Communities (The Poor)

The first group of studies evaluates the factors of forest liquidation and benefits that accrue from forest resources to the poor who are mostly dependent on these resources, although the empirical linkages between the environment and how they relate to poverty have been generally described as complex and not well understood. Indeed, existing research has shown that the poor depend on the environment, and they consider it their primary responsibility to preserve it (Cheng *et al*., 2019). This is confirmed by Opschoor (2007), who shows that the pressure imposed on the environment by the poor is mainly for subsistence which is usually very low.

Shively (2004) subscribed to the view that the poor rely on the environment for survival and then assessed the causes of degradation in Latin

American and Asian countries, like Indonesia and Malaysia. He found that the poor exploit forest resources as a means of sustaining their livelihood, enriching themselves and protecting themselves against shocks and other uncertainties. He concluded that while the poor people had limited resources, they were found to be responsive agents due to their sensitivity to the effects of degradation as clearly expressed by their attempts to rehabilitate lost environmental resources. However, in a single incident, the poor have been reported to engage in degradation. This was observed by Bennagen *et al*. (2006) who employed dynamic equilibrium models calibrated based on real-life situations in rural Kenyan communities. He found that the rural poor will continue to engage in unsustainable and illegal logging as a result of a lack of alternative sources of income to sustain their livelihood.

Other studies have gone further to empirically highlight some of the specific drivers of forest liquidation in agrarian societies. For instance, Olujobi and Olajuyigbe (2020) investigated the contribution of the Aramoko forest (in Ekiti State) to the well-being of local dwellers in five communities surrounding the forest[9]. The study revealed that the products mostly derived from the forests were often used as timber, food, herbal plants, fuel wood and for cultural purposes[10]. They noted that majority of the respondents sold these products at the local markets to derive income, which was used to support their livelihood and for other various purposes. They further observed that collectors of forest products that take their items to city markets, due to the attendant challenge of inadequate storage facilities, sell their commodities faster and at a higher price relative to those who sold in smaller village markets. The study also reported that village dwellers that depend on the *Aramoko* forest were conscious of the need to conserve the forest to sustain their means of livelihood. However, negative activities, such as indiscriminate bush burning, illegal felling, Fulani herdsmen cattle grazing and the planning of illegal crops, such as Indian hemp were observed within the forest.

Similarly, Ibrahim, *et al*. (2020) found that the forestry sector provides several economic and employment opportunities, such as trading, investment and processing of forest products. However, the desire for these

forest incomes consequently resulted in overexploitation of forest resources in an unprecedented manner, particularly due to the growth of the rural population, which tends to continually extend agricultural land. They identified overgrazing, high demand for fuel wood[11], attacks by pests and diseases, and bush burning as factors that have contributed to the unsustainable use of forest resources in Nigeria. They concluded that despite of the drivers of unsustainable use of forest resources, the potential multiplier effects that could accrue from the forestry sub-sector are enormous.

Forest Liquidation and External Individuals (The Rich)

The second category of works focuses on the benefits of forests for the rich who live outside forested areas. In this regard, Ekbom and Bojo (2001) found that while the poor are more dependent on forest products mainly as a means of subsistence, the rich consume relatively more of these resources, as they liquidate forests on a large commercial scale. The rich consume forest resources by taking them to the timber industries and sawmills for the production of particle boards, sawn wood, industrial round wood, and face veneers, among others. Other aspects of the economic importance of forest resources for the rich include timber exports, electric poles, planks for buildings, furnitures and pulp and paper.

Thus, Markandya (2001) noted that unrestrained felling of trees by the rich individuals outside forested communities creates pressures that eventually lead to environmental decline, which negatively affects the rural dwellers more than these external individuals. His evidence was based on the investigation of forest resource utilisation in developing countries. He thereafter suggested that any policy targeted at improving the availability of environmental resources will eventually favour the rich in the long run. This assertion was also validated by Adhikari (2004), based on a study that targeted the forested communities of Nepal. He concluded that forest management policies portend the risk of only addressing the needs of the elites, while simultaneously reducing the welfare and available opportunities for the poor. Consequently, he considered the inverted U-EKC misleading and inappropriate for policy formulation. This view is also expressed by Opschoor (2007), who observed that the inverted U-EKC is unreliable to address environmental/poverty issues and challenges.

According to Opschoor (2007), as the external forces continue to have greater access to natural resources like forests, as well as other available products, to the detriment of the dwellers, it may give rise to conflicts over the distribution and control of ecological resources. If these conflicts are not well managed, they could stimulate claims for compensation or justice in the equitable use of resources, which in extreme cases could trigger a social change, such as a revolution. These attempts have been observed in the *Chico Mendez* struggles of Amazonia, *Chipko* movements in India and the *Ogoni* and *Ijaw* movement for resource control in Nigeria. Therefore, he recommended that environmental policies should be made to be pro-poor, by adopting an inclusive framework that is responsive to the plight of the poor and how they can continually improve their wellbeing through the sustainable use of natural resources (forest inclusive). This is what Martinez-Alier (2002) referred to as the environmentalism of the poor, which has been described as livelihood-based environmentalism that ensures both market and non-market access and security of natural resources.

Forest Liquidation and Poverty

Studies in the third category have investigated the relationship between forest liquidation and poverty. According to Byron and Arnold (1999), Sunderlin *et al*., (2005) and Wunder *et al*. (2014), forests clearly offer a way out of poverty. This is achieved by the provision of a substantial contribution to the livelihood of both rural and urban communities, such as the offer of incomes and consumption which support welfare and subsistence (World Bank, 2001, 2016; Bryon and Arnold 1999). While estimates of dependence on forests may vary widely based on location and other factors[12], Angelsen *et al.* (2014) estimate that forests may contribute between a quarter and a fifth of incomes among households living near forests.

Similarly, as observed by USAID (2006), small-scale activities in the forest, fishing, agriculture, livestock, and mining sectors can contribute 15 to 70 per cent of rural households' cash incomes. Also, according to the World Bank (2002), 90 per cent of the world's 1.1 billion poor, living on less than one dollar per day, depended on forests for at least some parts

of their income. In South Africa, out-grower schemes of about 43,000 hectares which started in the 1980s as a partnership venture engaged 19,000 households in the production of small-scale timber. This project which was situated in the KwaZulu-Natal Province was reported to have brought a contribution of between 12 and 45 per cent of the incomes needed for the benefitting communities to remain above the abject poverty line (Mayers and Vermeulen, 2002). Lastly, by developing a systematic map analysis from 242 articles, which focused on 14 forest-based interventions on 11 poverty indicators, Cheng *et al*. (2019) found evidence of a growing link between forest-based human activities and poverty alleviation.

Forest Liquidation and Economic Growth

The last class of studies provides empirical views on the relationship between forest liquidation and growth. Several studies have reported that forest resources are highly significant in every economy as they serve as the engine of growth. One of these studies by Andrew *et.al* (2015) noted that timber and other forest resources have largely fuelled economic growth in China and the scarcity of timber has been associated with population growth. Similarly, as indicated earlier, 19 developing countries in Africa have attributed a 10-per cent increase in their GDP which amounted to 8 billion US dollars to forest output and trade in forest products (World Bank, 2004; Lebedys 2004). It has also been substantiated in the empirical literature that forest-related activities have supported growth in the developing countries around Asia and Latin America.

Other studies that have verified the role of forests in stimulating economic growth include Cavendish, 2000; Campbell and Luckert, 2002; Mamo *et al*., 2007; Babulo *et al*., 2008; Illukpitiya and Yanagida, 2008, and Appiah *et al*., 2009. These authors have documented cases where the contributions from the forestry sub-sector either matched or exceeded the contributions of the agricultural sector in the countries that were assessed. They also found that these generated individual incomes ranging from 6 to 45 per cent to households that took part in the planting, tending, harvesting, processing and trading of forest related products. Finally, Ibrahim, *et.al* (2020) using a series of methods, including Ordinary Least

Squares (OLS) for Nigeria covering the period 1970 to 2015, found that the forestry sub-sector contributed 2.44 percent to the GDP per capita in the period under review.

Based on the pool of pieces of evidence emerging from empirical studies, it is evident that forest resources could play a special role in the life of the poor, given the economic characteristics of the poor that make forest resources attractive as a source of income in rural communities. Furthermore, it is also clear that as external forces from outside rural communities begin to encroach on forests for commercial purposes, the level of degradation intensifies and may indeed result in conflicts between the communities. In summary, the pieces of evidence gleaned from the studies reviewed generally indicate that forest liquidation has improved community incomes, through trade in forest resources, enhanced food availability and lifted individuals out of poverty in several countries. Also, it has contributed significantly to the national output of developing countries in Africa, Asia and Latin America.

3. Theoretical Framework and Methodology

This section establishes a theoretical nexus between forest resources and growth and also provides a basis for evaluating the effects of natural capital on poverty. To achieve this, we employ an augmented growth model based on the neoclassical approach within a Cobb-Douglas aggregate production function. Also, the idea of weak sustainability of natural capital is upheld based on Neumayer (2003) and (2012) to explain the correlation between natural capital and poverty.

The Solow-Swan (1956) neoclassical growth model in an attempt to explain some of the variables that account for economic growth specifies that the interactive influence of physical capital and labour determines the changes in output within a closed economy. They showed this relation using a Cobb-Douglas production function that is characterised by constant returns to scale, where the increases in capital and labour are subject to diminishing marginal product. This is shown in equation (1) below:

$$Y = K^{\alpha}(AL)^{1-\alpha} \quad \text{..... (1)}$$

where K is physical capital; A is the level of technology, which enters multiplicatively into the model, with labour (L), and á is the output elasticity of capital. They also identified human capital apart from technology as an additional determinant of productivity. This is consistent with the Von Thunen[13] model that connects several variables to the output, such as input costs and technologies available for production. Nevertheless, Mankiw and Taylor (2019) made a quick distinction between technology and human capital. To them, while technological knowledge is concerned with the technical understanding of how systems work, human capital refers to the resources expended to acquire and transmit this understanding to the labour force. By including the human capital (H) into the model, our equation (1) becomes:

$$Y = K^{\alpha} H^{\beta} (AL)^{1-\alpha} \quad \text{..... (2)}$$

Since our focus is on forest resources which are a form of renewable natural capital[14], we toe the line of Naidoo (2004), who augmented the theory with natural capital. The role of natural capital assumed importance since the advent of the Environmental Kuznet Curve. According to Aronson *et al*. (2007), natural capital refers to the stock of physical and biological natural resources. They can be broadly classified into renewable, non-renewable, replenishable and cultivated natural capital. Examples of renewable capital comprise living species and ecosystems; non-renewable natural capital consists of subsoil assets like petroleum, coal, and diamonds. Examples of replenishable natural capital are the atmosphere, potable water, fand ertile soils, while cultivated natural capitals include crops and forest plantations. Natural capital in the form of ecosystems provides abundant ecological services both for production and consumption, such as raw materials, food, fresh water etc. In addition to natural resources, ecosystems also provide genetic materials, regulatory[15], cultural, spiritual, inspirational, and aesthetic benefits (Costanza, *et al.* 1997). Thus, the augmented model becomes:

$$Y = K^{\alpha} H^{\beta} N^{\gamma} (AL)^{1-\alpha-\gamma} \quad \text{..... (3)}$$

Equation 3 above which says that output growth is dependent on physical, human and natural capital, becomes our framework to show how

natural capital, in this case forest resources, are related to growth[16]. This is consistent with the Von Thunen model and the inverted U-shaped EKC that explicitly shows the relationship between output growth as a function of resources, such as land and other natural capitals.

The nexus between natural capital and poverty is clearly expressed in the notion of weak sustainability which is defined as the substitutability of natural capital that is derived from production theory. Natural capital can either be substitutable or a complement. When it is substitutable, it can be converted. However, natural capital that is a complement cannot be replaced without a corresponding loss in productivity or human welfare. The theory of substitutability of natural capital focuses on the degree to which natural capital can be replaced by man-made capital in the production process while maintaining economic output and wealth in the long run.

Although the concept of weak sustainability has been highly contested in an attempt to address emerging issues around the management of natural capital, the conceptual debate by environmental economists has been broadly classified into strong and weak sustainability. The strong version strictly requires that both physical and natural capital stocks are maintained over time. In other words, the proponents of this view argued that because natural capital is critical and irreversible, any attempt to substitute it with other types of capital will bring about an inevitable loss. To them, this loss could take the form of complete destruction of the ecosystem, which will, in turn, result in a substantial reduction in economic activities, production and human welfare. Incidentally, this is the same view expressed by environmentalists who contest the hypothesis of the inverted U-EKC and emphasise the devastating effects of the human footprint on the earth. According to Adams (2001), this is the basis for the position of environmentalists who are opposed to development and who also seek to create superfluous problems for government and businesses.

It is pertinent to note that the weak notion of sustainability allows for trade-offs to natural capital in a project or activity and also allows for the substitution of human-made capital for natural capital (Adams, 2001). Weak sustainability implies that as natural capital is destroyed, to further

drive economic activities, as long as it is substituted with sufficient quantities of man-made capital, human welfare will be maintained or enhanced at a constant level or even increased. In other words, the weak notion of sustainability will ultimately support the existing level of welfare or may even result in higher welfare which will lead to higher living standards. This notion is also expressed in the Hartwick rule which states that the ease at which substitutability is possible and the speed of technological progress are proportional to the rate at which natural capital would be replaced. This sufficiently captures the views of optimists that agree with the inverted U relation of the EKC. They believe that natural capital will continue to sustain growth to a point where growth will no longer result in environmental pressures, due to the substitution of natural capital with human-made capital.

4. Methodology of the Study

The methodology for this study is largely driven by data availability. Since our data are inadequate for standard regression analysis, we employed a descriptive approach and bivariate correlation analysis. Data for our analysis were sourced from the Global Forest Watch Open Database[17] and the Nigerian Bureau of Statistics, covering the period from 2001 to 2019.

Data Analysis

This section presents the trend analysis of relevant data on forest liquidation, rural agrarian poverty and output in Nigeria. The descriptive data shows the trend of forest cover, drivers of forest loss, the share of the forestry sector, forest liquidation and rural agrarian poverty in the country.

Figure 1: Trend of Forest Cover per Square Kilometre in Nigeria

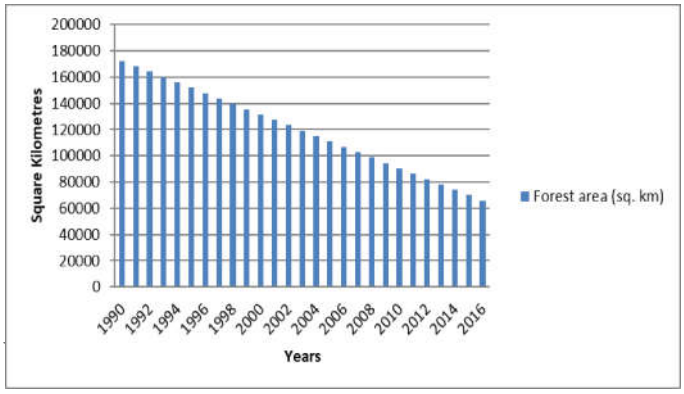
Source: 

Figure 1 presents the data trend on forest cover per square kilometre in Nigeria from 1990 to 2016. The maximum forest area value of 17,234 square kilometres was recorded in 1990; the minimum was 65,834 in 2016, and the average was 119,084, which was the value for 2003. From the graph, it is clear that forest resources have declined steadily over time, since 1990. This implies that as forests are being liquidated, efforts to realize additional forest cover have not yielded the desired results, as the data seem to suggest that forest depletion rates are higher than attempts to replenish these resources.

Figure 2a: Forest Cover Relative to State Area

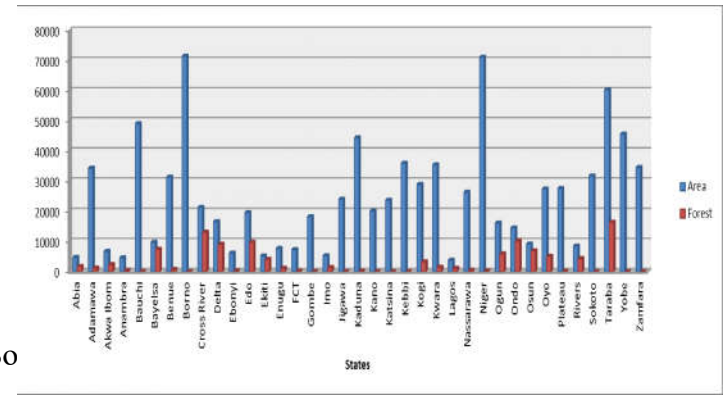
So 

Figure 2b: Forest Cover by State

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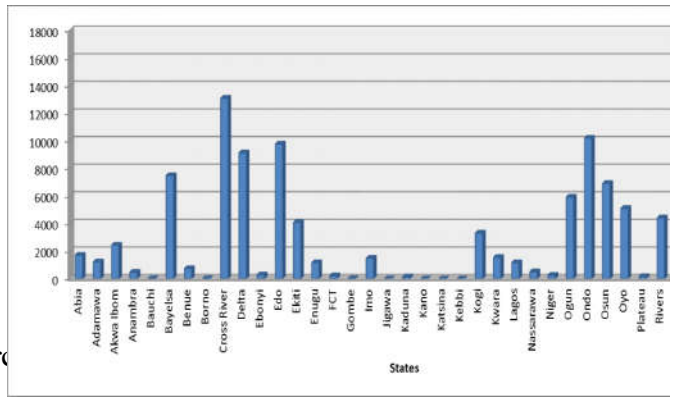

Figures 2a and 2b above show the forest cover in the thirty-six states and the Federal Capital Territory (FCT) compared with the total area in hectares (ha) in the respective states[18]. The trend shows that Borno State has the largest land mass, while Taraba State has the largest forest cover, with 71,440,743.2 and 1,639,749.2 ha, respectively. Similarly, the states with the lowest area and forest cover are Lagos and Katsina with 378,463.7 and 1 ha respectively. The subsequent figures (3-7) below depict the determinants of forest liquidation in Nigeria for selected years between 2001 and 2019[19].

Figure 3: Forest Loss Drivers by Type 2001

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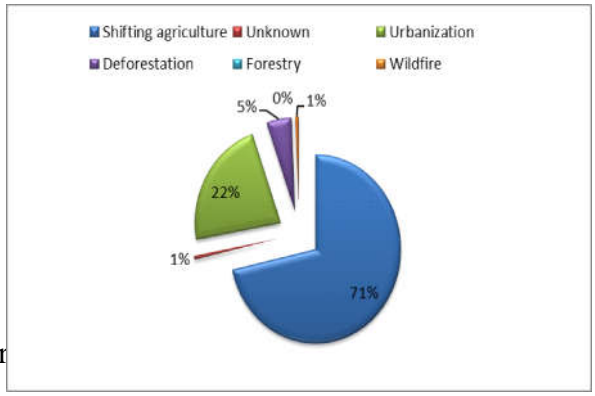
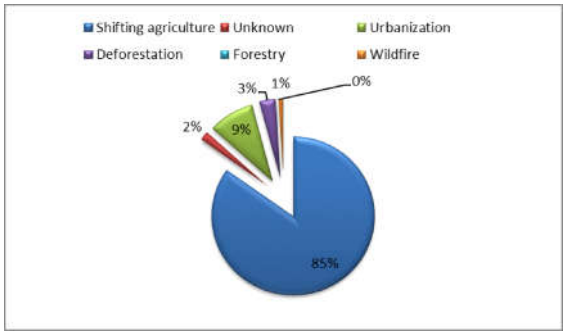


Figure 3 shows the respective pie slices of various forest loss drivers in Nigeria in 2001. The pie charts show that in the year under review, the largest contributor to forest loss in Nigeria was shifting agriculture with 71 percent. This was followed by urbanisation with 22 percent. Other activities, such as community-driven deforestation, were 5 percent, while unknown causes and wildfire accounted for 1 percent each.

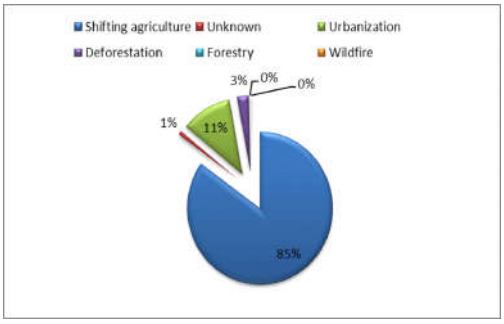
Figure 4: Forest Loss Drivers by Type 2005



Source: Forest Watch Data

Figure 4 also represents the causes of forest liquidation in the year 2005. The largest share for the pie chart is shifting agriculture, while the second largest driver of forest loss was urbanisation, with 85 per cent and 9 per cent, respectively. Similarly, community-driven deforestation led to 3 per cent of forest loss, while unknown factors and wildfire accounted for 2 and 1 per cent each.

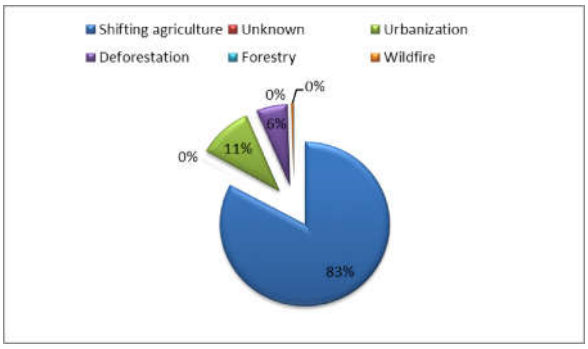
Figure 5: Forest Loss Drivers by Type 2010



Source: Forest Watch Data

In the year 2010, figure 5 provides the proportion of forest loss drivers by activity type. The largest share of forest loss was from shifting agriculture with 85 per cent, while urbanisation was 11 percent as the next highest determinant of forest liquidation. Accordingly, community-driven deforestation and unknown causes resulted in 3 per cent and 1 per cent loss of forest cover in Nigeria.

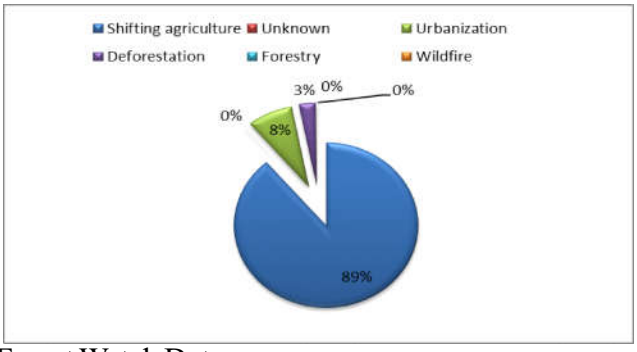
Figure 6: Forest Loss Drivers by Type 2015



Source: Forest Watch Data

Figure 6 indicates the factors that led to forest loss in the year 2015 in the country. The largest activity from the pie-chart was shifting agriculture which was followed by urbanisation, with 83 and 11 per cent, respectively. Also, community- driven deforestation led to 3 per cent of tree cover loss in 2015.

Figure 7: Forest Loss Drivers by Type 2019

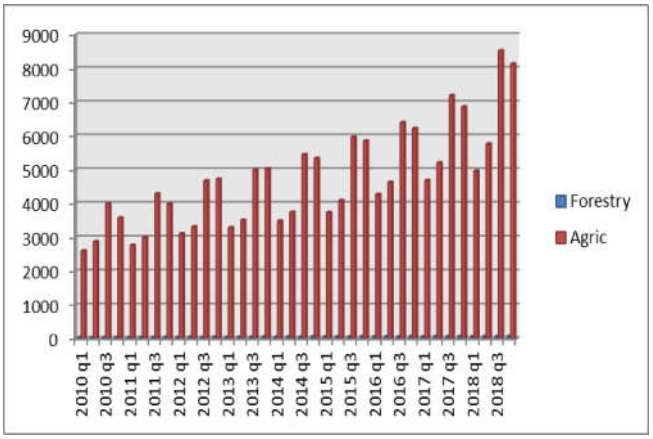


Source: Forest Watch Data

In 2019, as shown in figure 7 above, shifting agriculture was responsible for 89 per cent of forest cover loss in Nigeria, while only 8 per cent was attributed to urbanisation. Similarly, community-driven deforestation accounted for only 3 per cent of tree cover loss in Nigeria as of 2019. The pie charts presented in figures 3 to 7 therefore clearly reveal that the largest drivers of forest liquidation in Nigeria based on our sample data from 2001 to 2019 were shifting agriculture and urbanisation.

Figure 8 below presents the contribution of the forestry sub-sector to growth by showing the trend of forestry GDP from 2010 Quarter 1 to 2018 Quarter 3 based on data from the NBS (2018).

Figure 8: Contribution of Forestry to Output

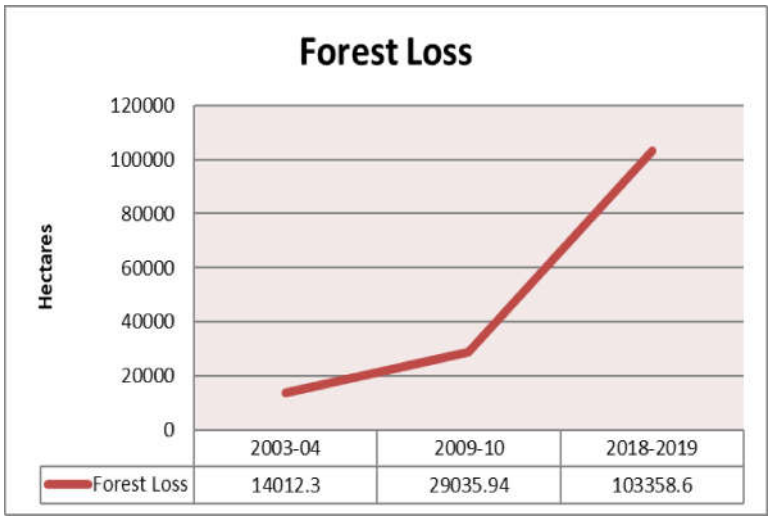


Source: Nigerian Bureau of Statistics (NBS 2018)

Figure 8 represents the share of forestry output in the agricultural sector GDP in Nigeria. The share ranges between 1 per cent and 3 per cent, with the maximum value of 3 per cent recorded only 6 times in the entire period covered. Similarly, a cursory look at the data shows that, of the four subsectors that constitute the total share of agricultural GDP, namely crop production, livestock, forestry, and fishing, the forestry sector is the least contributor to agricultural growth in Nigeria. This implies that the share of the forestry sector in agricultural growth is very insignificant and grossly inadequate as a sustainable source of economic growth in the country.

Figures 9a and 9b focus on the empirical relationship between forest liquidation and rural agrarian poverty over time using a sample of selected data from 2003/2004 to 2018/2019.

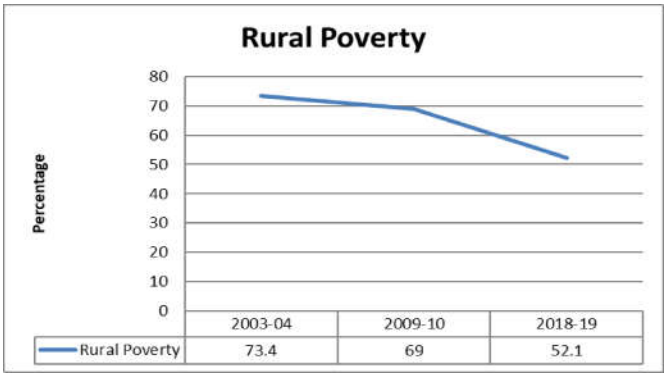
Figure 9a: Forest Liquidation and Rural Agrarian Poverty Levels



Source: Forest Watch Data

Figure 9a provides the trend of forest losses for selected years in hectares in the country. Between 2003 and 2004, the forest cover loss was estimated to be 14,012.3 hectares. By 2009/2010, the figure for forest cover loss has risen to 29,035.94 hectares, and by the year 2019, it was put at 103,358.6 hectares. The graph shows an upward movement which was initially rising at a slow and steady pace. However, it began to witness a more accelerated and steeper ascent between 2009 and 2010. This suggests that more forest resources are being depleted in an uncontrollable manner to fuel various human domestic and developmental needs.

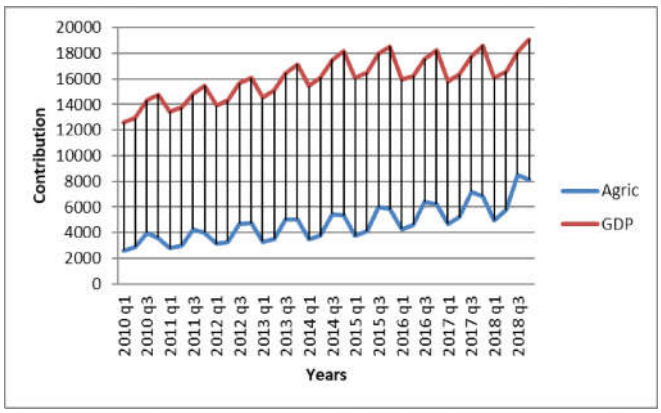
Figure 9b: Forest Liquidation and Rural Agrarian Poverty Levels



Source: Nigerian Bureau of Statistics (NBS, 2018)

In the same way, figure 9b shows that the initial rural poverty estimated in percentage was 73 per cent between 2003 and 2004, which fell to 69 per cent between 2009 and 2010, and again witnessed a further decline in 2019. This indicates that in the period under review, as more and more forest resources were being depleted annually, rural agrarian poverty levels fell considerably in Nigeria. In order to find out whether there is a correlation between agricultural share and growth in Nigeria, a correlation analysis was carried out with a view to showing the trend of the two variables as presented in Figure 10.

Figure 10: Correlation between Agricultural Share and Output Growth



Source: NBS (2018)

Figure 10 presents the interaction between agricultural contribution and growth measured by GDP from 2010 Quarter 1 to 2018 Quarter 3. The trend depicts that the two series move in the same direction. This is confirmed by the value of the correlation coefficient of 0.89, suggesting a near-perfect positive correlation between agricultural contribution and growth. Thus, it can be concluded that forest liquidation indirectly contributes to growth as deforestation makes available additional land for crop and livestock production. In other words, as forest cover losses are intensified, welfare in rural agrarian communities is improved upon and sustained through expanded crop production. It is plausible that this explains the rationale behind the inverse relation between forest utilisation and a sharp and proportionate reduction in the poverty levels of rural agrarian communities in Nigeria.

Discussion of Findings

The results from findings in the previous section indicate that the trend of forest cover per square kilometre has been declining continuously from 1990 till 2016. This implies that while forest resources have consistently been exploited, efforts to replenish these resources have not been sufficient enough to ensure sustainability in the last 26 years. The results also revealed that from the data on forest liquidation available from 2001 to 2019, the largest contributors to forest cover losses in Nigeria were shifting agriculture and urbanisation with an average of 83 and 12 per cent, respectively. In addition, shifting agriculture recorded a maximum percentage value of 89 per cent in 2019 and a minimum value of 71 per cent in 2001. Also, urbanisation had a maximum value of 22 per cent in 2001 and a minimum value of 8 per cent in 2019. While this is largely consistent with the postulations of the Von Thunen model and the views of the proponents of the linear version of the EKC, the finding fails to support the forest transition theory and the views of the optimists that advanced the argument of the inverted U-EKC as discussed in the theoretical section of this study.

In the light of the above major findings, it is difficult to rule out the influence and the activities of external forces outside rural agrarian communities in the harvesting and depletion of forests in Nigeria. Again, as pointed out by

Ibrahim *et al.* (2020), the forestry sub-sector in Nigeria has gone through intense pressure as a result of overgrazing, overharvesting of fuel wood, outbreak of pests, diseases and bush fires, which greatly threaten its sustainability. In the same manner, increasing population has continued to put environmental pressures arising from increasing requirements for agricultural land and expansion of cities. In addition, a study by Faleyimu, *et al*. (2013) has also attributed the over-exploitation of forests in the country in the 90s to the role of trade. They observed that as more and more quality timbers were being exported, without the planting of secondary species, trade declined abruptly afterwards. This consequently resulted in a huge deficit of forest products due to a lack of replacement of products felled in the period of boom. Incidentally, this validated the prediction of environmentalists that oppose the U-inverted EKC. In addition, Larinde and Chima, (2014) have shown that the activities of bandits, terrorists and insurgents who illegally occupy forests, which appear to have a long history in certain parts of the country, also account for the destruction of forests. This, therefore, is contrary to the views expressed in the empirical literature (Ekbom and Bojo 2001; Opschoor 2007; Shively 2004, and Cheng *et al*. 2019) that the rural dwellers see the preservation of forest as a duty. Unfortunately, the reality seems to suggest that the poor in rural agrarian forested communities clearly lack the capacity to protect their forests due to the risks associated with such attempts.

This study also found that the share of forestry contribution to agricultural growth in Nigeria was deplorably insignificant. Indeed, the maximum contribution of 3 per cent was achieved only 6 times throughout the whole sample period (2001 to 2019). This authenticates the findings of Ibrahim, *et al.* (2020) who reported a gross contribution of 2.44 per cent to GDP per capita between 1970 and 2015. With this finding, the contribution of the forestry subsector is grossly inadequate to directly drive growth in Nigeria. Surprisingly, while the data showed an abysmally low contribution of the forestry sector in the aggregate, our findings suggest that as more and more forest resources were being liquidated, particularly from 2010, rural agrarian poverty levels declined considerably. This strongly suggests an inverse association between forest depletion and rural agrarian poverty in Nigeria. This is supported by our bivariate correlation coef-

ficient of 0.89, which signifies that the medium through which deforestation fuels growth and enhances welfare is not direct. The result indicates that it is transmitted through agricultural output, as it augments crop and livestock production as more and more land is released for such activities. Thus, the finding substantiates the existence of an inherent forest-agriculture dichotomy in Nigeria.

Summary, Recommendations, Conclusions and Suggestions for Further Studies

This study was motivated by the need to understand the determinants of forest liquidation, the effects of forestry contributions on growth and the association between forest depletion and rural agrarian poverty in Nigeria. This is particularly important in the face of global increased dependence on forests that has resulted in forest cover losses and vulnerability of the rural population.

Our results suggest that the major factors that influenced forest liquidation in Nigeria were the practice of cultivating a portion of cleared forest for a few years, which is abandoned for a new area until its fertility has been naturally restored, and the demand for urbanisation. The demands for urbanisation include infrastructural extension (settlements, pipelines, roads, mining and hydroelectric dams) and unsustainable wood extractions (timber and fuel wood). Urbanisation is sometimes induced by migration from security concerns[20], leading to unplanned urban expansion, with an influx of several homeless people in the urban areas.

Data analysed also alluded to a disparity between massive forest cover losses due to consistent liquidation and the contribution to growth from the forestry subsector which has been found to be very low. This could imply that the contribution of forests is yet to be properly documented. Therefore, there is room to suspect that forest statistics in Nigeria are appallingly unreliable as indicated by the paucity of data. This reasoning is in line with the observation by the UN-REDD+ (2017) that deforestation in Nigeria has coincided with a period of high economic growth and a significant trade-off between economic and social developmental goals and forest depletion and degradation.

On the relationship between rural agrarian poverty levels and deforestation, our analysis points to an inverse correlation between forest liquidation and rural agrarian poverty levels in Nigeria. This implies that as forest resources were increasingly extracted, particularly from 2001, the level of agrarian poverty in the country witnessed a substantial decline. This again agreed with the study by UN-REDD^{21}+ (2017) which focused on the Forestry Resource Account (FRA) and the conduct of Eco-Services Valuation (ESV) for Nigeria. They agreed that as rural agrarian communities are often compromised by large-scale timber extractors, whose activities negatively reduce forest cover, agriculture often becomes the alternative to supporting welfare within such local communities.

The study has shown that lots need to be done to harness the potentials inherent in the forestry sector in Nigeria. To achieve this, it is recommended that more attention should be devoted to the replenishment of lost forest cover across the country. In the same manner, efforts should be made towards the replacement of species that are about to be extinct to ensure the sustainability of the sub-sector and also boost its capacity to contribute more to growth. Urbanisation due to rural-urban drift should be resolved by ensuring a balanced development that caters for the needs of people in rural areas. Governments should also ensure that rural dwellers have adequate access to essential social services like security, education, health, sanitation, electricity and clean water. It is of paramount importance to develop a national forest resource accounting system for forest resources. This accounting system shall allow for proper quantification of the real value of forest ecosystems and the tracking of the welfare effect on the immediate residents of forested communities, as well as overall effects on growth in the Nigerian economy. Finally, further studies are required for micro-level research that relies on surveys, in particular, primary and regenerated forests and their surrounding communities to capture the peculiarities of those locations. This will help to provide more understanding of the complex interactions that seemingly exist between forest liquidation, poverty and growth.

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