FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 8 No. 6, December, 2024, pp 196 - 204
DOI: https://doi.org/10.33003/fjs-2024-0806-2909

ECONOMIC AND ECOLOGICAL SUSTAINABILITY OF NON-TIMBER FOREST PRODUCTS (NTFPS) IN NIGERIA: A REVIEW

***[1]Adaaja, B. O., [2]Akemien, N. N., [3]Alawiye, M. A., [4]Zaman, E. Y., [5]Yahaya, U. and [1]Khidir H. Y.**

[1]Trial Afforestation Research Station (TARS) Kaduna, Forestry Research Institute of Nigeria,(FRIN) Ibadan
[2] Moist forest Research Station, Utagban, Benin city (FRIN)
[3]Federal college of Forest Resources Management, Fugar, Edo State (FRIN)
[4]Federal College of Forestry, Jos (FRIN)
[5]Federal College of Forest Resources Management Maiduguri, Borno State (FRIN)

*Corresponding authors' email: blessing.adaaja2@gmail.com Phone: +2348035988405

ABSTRACT

This study reviews the economic and ecological roles of Non-timber forest products (NTFPs) sustainability in Nigeria. Systematic review method was adopted for the study. The relationship between NTFPs trade, ecological conversation, socioeconomic benefits, poverty alleviation and sustainable forest management practice was carefully assessed. It was revealed that the NTFPs' huge prospect and potential impact on the Nigeria economy largely depends on the ecological conditions, access to market, commercialization, value addition, its collection methods and utilization within and outside Nigeria. In addition, the review indicated that rural areas remain the hub for NTFPs trade and forest communities largely depend on it for their household income and livelihood. However, NTFPs could serve as a poverty trap for locals if the commercialization and value addition are not prioritized. In conclusion, this review underscores that the extent to which NTFPs can impact the economy cannot be fully studied unless those in the informal sector are well captured. In essence, NTFPs could serve as the key to unlock the economic growth of Nigeria through its huge revenue potential. Hence, the need for organizational, institutional and legal reforms that addresses the concerns of sustainable forest and NTFPs management within the ecosystem to achieve economic growth.

Keywords: NTFPs, Economic growth, Ecosystem, Sustainable Forest Management

INTRODUCTION

Non-timber forest Products (NTFPs) are those resources or products obtained from forests that are completely different from timber or wood products (Shrestha *et al.*, 2020; Pandey *et al.*,2016). These products include those collected from plants and trees as well as those derived from animals and fungi that are distinct from wood (Shackleton and Pullanikkatil, 2019; Shackleton and Pandey, 2014).

Globally, NTFPs have been recognized for their huge contributions to the economy via income generation and improvements in environment and human livelihoods, translating to rural development (Peerzada *et al.*, 2022). This significant contribution to global economy is estimated to worth around USD 90 billion yearly, with approximately a-third of this value being consumed within local economies, by passing market transactions (Mahapatra and Tewari, 2005). Arguably, the role of Non-Timber Forest Products (NTFPs) in bolstering the income of rural households cannot be over-emphasized across the globe.

The earnings made from the NTFPs trade by the locals serve as means to cater for their health needs, provide foods on their table, procure farm inputs and other necessities as well as support for their financial independence through saving (Schaafsma *et al.*, 2014; Adam *et al.*, 2013; Heubach *et al.*, 2011). Rural dwellers across countries of the world convert income from NTFPs trade as additional capital stream to enhance their financial stability during hardship (Kurniasih *et al.*, 2021; Harbi *et al.*, 2018; Zivojinovic *et al.*, 2017; Shackleton and Pandey 2014). For instance, in West and Central Africa, the minimum wage of a civil servant or other professional workers is at times equal or even surpasses the income shares derived from NTFPs (Shackleton *et al.*, 2007). More noteworthy, is the fact that rural households in Nigeria obtain a substantial proportion of their earnings, reaching as high as 80%, from the sale of NTFPs (Jimoh *et al.*, 2013). Similarly, in nigeria, about 70% of households is estimated to rely directly on fuelwood as their primary energy source, with a daily consumption estimated to reach about 27.5 million kilogram per day. This has reduced the dependence of people on expensive source of energy. Across many regions, the extraction and processing of NTFPs has evolved from subsistence use and local market sales to include international cross-border trade (Zaku *et al.*, 2013). The transformations in the high forest regions of Eastern and Western Nigeria are the current realities, where the collection and the trade of game meat and snails have become increasingly significant source of earnings for locals (Onuche, 2011). Likewise, in the Central and Northern regions of Nigeria, specifically within the Savannah zone, rural households derive a significant amount of their income from different activities which include honey production, fuelwood gathering, locust bean seed collection, gum arabic harvesting, and fuelwood/charcoal production (Jimoh *et al.*, 2013) with earnings from the trade of these resources are used to cater for family issues such as school fees payments and hospital bills.

In the same vein, local medicine also utilizes NTFPs to enhance healthcare accessibility and affordability, particularly among the local communities (Asamoah *et al.*, 2023; Lindberg *et al.*, 2023; Mipun *et al.*, 2019). Significant number of the traditional medicine are derived from plants and herbs found in forests and have been used to cure varying health challenges for generations. These plants and herbs play a vital role in proper health maintenance, provision of remedies for different ailments, and provide significant contributions to the well-being of the entire populace. More so, the knowledge and practices related with the use of NTFPs for medicinal purposes are often transferred through cultural and traditional teachings, for the enrichment of the cultural heritage of healthcare practices within the residents living together in communities (Mohd Salim *et al.*, 2023).

Meanwhile, to help reduce the dependence on a mono economy for any country, this could be achieved through the adoption of NTFPs while diversifying the economy (Lebmeister *et al.*, 2018; Verma and Paul, 2016). This diversification is vital to the enhancement of economic resilience, especially during economic and financial shocks in other sectors or fluctuations in the market (De Roest *et al.*, 2018; Sedita *et al.*, 2017). Furthermore, diversification helps individual traders, markets and communities to generate multiple streams of income via the collection, processing, and trading of NTFPs. By and large, the multidimensional approach to income-generation provides a buffer against economic instability caused by shocks or changes in demand, prices, or other unforeseen circumstances in traditional markets (Suleiman *et al.*, 2017; Ahenkan and Boo, 2011). In addition, economic diversification through NTFPs can serve as a safety net during challenging economic times (David *et al.*, 2019; Wahlén, 2017). For instance, agriculture as a primary source of income could experience a downturn. In the case, income earned from NTFPs can be used to offset financial losses and keep the standard of living in shape. Moreover, individuals and communities across the country can have a more resilient financial structure that helps them to reduce their vulnerability to economic shocks. In addition to bolstering financial stability, economic diversification through NTFPs gives room to sustainable practices such as the harvest and ecological management of forest resources to ensure long-term availability and economic viability.

An Overview of Nigeria's Forest Estate

Nigeria's population is estimated at over 216 million people enriched with a land mass of about 923,768km^2 (NPC, 2022). The vegetative zones spread across a diverse range of habitats from tropical rain and swamp forests in the south to desert zones (Arid region) in the northeast. According to FAO (2015), Nigeria's current forest estate of 7.7% of the land mass is significantly below the 25% recommended minimum requirement. The reason for this is attributable to the frequent and continuous forest depletion through deforestation without commensurate reforestation and afforestation. Nigeria currently has the highest rate of deforestation globally having given up an estimated 450,000-600,000 hectares of its forest cover to human related activities which includes urbanization, agriculture, overgrazing, bush burning, and indiscriminate logging. The total amount of carbon stock in forested areas is estimated to be around 1,292 million metric tons (FAO, 2015). Worst still, is the insignificant investment into the forest sector by the public sectors such as various governments (federal and state) and also the inadequate involvement of the private sector (organizations and individuals) in forest development (Gbadebo *et al.*, 2022).

NTFPs trade in Nigeria

Globally, in terms of research and development NTFPs has evolved due to the efforts of Centre for International Forestry Research (CIFOR). Efforts such as collecting and utilization of relevant data by CIFOR for NTFPs development for production sustainability. According to Sunderland *et al.*, (2004), the primary roles of middlemen in NTFPs trade includes serving as a distributor of high-volume trade between the producers and sellers, the export services, as well as contact persons by the marketers, for the purpose of matching the prospective sellers and buyers while receiving their sales commissions after each transaction. Historically, the British establishment of trading stations in Nigeria were key to trade and colonial expansion across Africa (Packenham, 1991; Iliffe 1995). During this period, NTFPs such as rubber, tea, cocoa and coffee were traded (Hobhouse, 1999) and their commercialization gave rise to the conversion of a sizeable forest lands to plantation agriculture in the tropic region, which has contributed significantly to countries economic diversification and GDP growth (Ndoye *et al.*, 1997).

However, NTFPs availability are usually determined based on the harvested product and the quantity stored during the off-seasons. Similarly, there are few NTFPs markets in Nigeria such that low production or harvest of NTFPs greatly impacts the available quantities for storage and sales (Ndoye *et al.*, 1997; 1999). By and large, NTFPs value chain deficit requires contribution from the different stakeholders involved in the value chain such as planting, harvesting up on till market, this is to minimize trade data fragmentation and scarcity in the entire value chain.

Table 1: List of products derived from Non-Timber Forest Resources

Category	Products Derived (lists not exhaustive)
Food products	Nuts (Brazilian nuts, pine nuts, malva nut, walnuts, chestnuts), Fruits. (Jujube, sapodilla, ginkgo, bush mango) Edible fungi (Morels, truffles and other mushrooms) Vegetables (Bamboo shoots, reindeer moss, various "green" leaves, palm hearts, wild onions (ramps), Starches (Sago) Birds' nests, Oils (Shea butter, babassu oil, illipe oil) Sap and resin (Maple syrup, Birch syrup).
Spices, condiments and culinary herbs	Nutmeg and mace, cinnamon, cassia, cardamom, bay leaves, oregano, etc.
Industrial plant oils and waxes	Tung oil, neem oil, jojoba oil, kemiri oil, akarwangi, babassu, oiticica and kapok oils. Carnauba wax.
Plant gums	Gums for food uses. Arabic, tragacanth, karaya and carob gums. Technological grade gums. Talha and Combretum gums.
Natural plant pigments	Annatto seeds, logwood, indigo
Fibres and flosses	Fibres. Bamboo, rattan, xateattap, aren, osier, raffia, toquilla straw products, cork, esparto, Erica and other broom grasses, Flosses. Kapok
Vegetable tanning materials	Oak, mimosa, chestnut and catha/cutch.
Latex	Natural rubber, guttapercha, jelutong, sorva and chicle.
Insect products	Natural honey, beeswax, lac and lac-dye, mulberry and non-mulberry silks, cochineal, aleppo galls, kermes
Incense woods	Sandalwood, gaharu.
Essential oils	Eucalyptus, CanagaOil (ylang-ylang), Aniba, Sandal oil
Plant insecticides	Pyrethrum, Derris, Medang and Peuak Bong.
Animals and animals' products	Ivory, trophies, bones, feathers, butterflies, live animals and birds, bushmeat, etc

Source: Secretariat of the Convention on Biological Diversity (SCBD), 2001;David *et al.*, 2019.

Importance of forest resources and ecological conservation in Nigeria

The role of forests and forest resources to Nigeria economy cannot be over emphasized, due to their contributions to livelihood sustenance and income generation among others hitherto (Adeniyi, 2016). However, ineffective forest resources management and over utilization have led to the significant loss of forest and environmental degradation of many Nigeria's forest resources (Ayanlade and Drake, 2015). For instance, the tropical rainforest in Nigeria is known for a high biodiversity which inadvertently provides a different form of ecological, economic and social services. These range of services such as conservation of biological diversity; carbon storage; soil and water conservation; timber and non-timber production that in turn provide employment and enhanced livelihoods to the local population provided could be both beneficial and detrimental to man and its environment (FAO, 2018). Meanwhile, inspite of this ecological importance, the forest resource in Nigeria particularly in the tropical region has deteriorated as a result of pressure from Nigerian rising population. (Ayanlade and Drake, 2015).

In the same vein, substantial protected areas of conservative values were lost largely due to activities such as commercial logging, firewood collection by local people and farming (Phileze and Okoro 2008). According to Bown et al., (2011); Morakinyo and Tooze (2007) over 56 % of forests in Nigeria have been lost with about 3.5 % rate of deforestation annually. Similarly, from the findings of Ayanlade and Drake (2015) over utilization of forest resource in the past three decades was responsible for degradation depending on the forest types, patterns or intensity. The majority of the forest reserves in lowland rainforests have lost over 40 % of their area, freshwater swamp forest reserves have lost about 30 %, whilst the reserves in mangrove forests have lost just 11 %. Deforestation is high in the lowland rainforest because the land is good for agriculture, but lower in freshwater swamp and mangrove forest because the land is covered in swamps and subjected to seasonal flooding, both of which limit accessibility.

Nevertheless, it is believed that a well conserved forests will bring economic, social, ecological, and aesthetic benefits that guarantee sound and qualitative health of inhabitants. Hence, efforts on biodiversity conservation must be sustained due to its numerous ecological, scientific and economic values of Nigeria forest (Olalekan *et al.,* 2019).

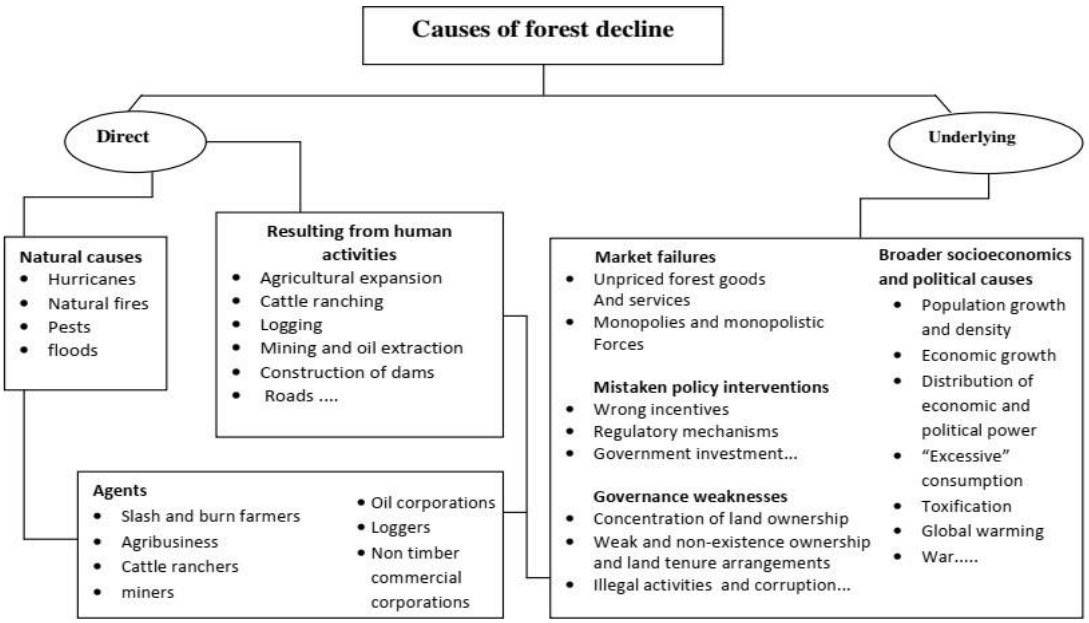

Figure 1: Causes of Forest Decline in Nigeria
Source: (Sambe *et al.,* 2018)

Ecological Values of NTFPs in Nigeria

Forest trees have ability to mitigate the effect of climate change in Nigeria. Trees serve as a cheaper alternative solution to environment degradation with its capacity to store considerable amounts of carbon that would otherwise contribute significantly to climate change. It is important to note that forest trees act as environmental buffers by absorbing and inhibiting the formation of secondary pollutants in the ecosystem and keeping the ozone concentration safer on a level that has no hazardous effect on human existence thus, contributing to the biosphere stability. Similarly, trees provide shade or over which helps in regulating the atmospheric temperature and also gives immense contribution to the aesthetics of the environment. There are many other ecological contributions of forest trees which include prevention of soil erosion, conservation of soil nutrient, detoxification of the environment to maintain balanced levels of oxygen and conservation of ground water (Adedayo, 2018).

Socio-economic Values of NTFPs in Nigeria

Essentially, food and livelihood security are constituted by the forest products for the benefit and survival of man. This helps in improving the ecosystem quality and as a result confers socio-economic benefits to human society. Every part of a tree whether its leaves, branches, stem, bark, fruits, seeds or roots are all beneficial to man and its environment. In other words, the extraction of non-timber forest products for both subsistence and trade remain common and widespread today because it is highly significant to the rural and national economies in provision of food, material, construction, energy, cash income, employment, and other benefits. NTFPs extraction also protects the poorest from falling into deeper poverty, and medium-income households from becoming poor. Therefore, NTFPs serve as a conventional strategy to

respond to shocks such as lack of human capital, low savings, rising food prices, and natural disasters (Chou, 2018).

In Nigeria, people make use of NTFPs and the increase in demand for these products has enhanced the income and livelihoods of those in the rural areas and also encouraged the expansion of domestic markets, particularly in urban areas where fuel wood and other forest resources are scarce. Furthermore, forest based industries in Nigeria such as wood crafts, cane furniture, and fabrication of tools handles also creates employment for a large number of people especially those in the rural setting who are involved in harvesting, processing or marketing of these products. This has placed forests in the limelight as an integral part of national development.

Non-Timber Forest Products as a panacea to Poverty alleviation in Nigeria

Efforts to curb poverty problem in forest communities could be achieved through the integration of NTFPs for economic impact (Issaka, 2018). With their huge potential to provide income and improve livelihoods, these products have received recognition and attention from policymakers, researchers, and development practitioners (Jaffee *et al.,* 2018; Mukul *et al.,* 2016; Scoones, 2015). Studies have shown that one of the critical benefits of NTFPs is their ability to provide income generating opportunities for rural communities, especially those living in or near forest areas (Rahman *et al.,* 2021; Verma and Paul, 2016). Many of the dwellers in these communities heavily rely on forest resources for their sustenance. The collection, processing, and sale of NTFPs offer them opportunities to make ends meet and improve their living conditions. Additionally, NTFPs have a relatively low entry barrier compared to other income-generating activities (Chakravarty *et al.,* 2015; Meinhold and Darr, 2019). This makes them particularly suitable for marginalised groups, such as women, youth, and indigenous communities, who may face limited access to resources and opportunities. By engaging in NTFP activities, these groups can enhance their economic empowerment and reduce their vulnerability to poverty (Djoudi *et al.,* 2015; Kassa andYigezu, 2015). NTFPs-related activities significantly generate employment opportunities, especially in rural and forest fringe areas (Talukdar *et al.,* 2021). This impact is particularly pronounced in regions with scarce or limited formal job opportunities. NTFP-related activities encompass a range of tasks from harvesting, processing, packaging, and transportation to marketing and sales. These activities require a diverse range of skills and labour (Vega *et al.,* 2023; Chakravarty *et al.,* 2015). Local community members often engage in these activities, providing them with direct employment opportunities within their vicinity.

Moreover, since NTFPs harvesting and processing often align with seasonal patterns of resource availability. This brings about a predictable employment patterns that guarantees stability and consistent income during specific times of the year when these resources are surplus (Vaughan *et al.,* 2023; Saxena and Güneralp, 2022). In the same vein, engaging with NTFPs can foster entrepreneurship and the development of small enterprises which offers individuals or smaller groups opportunities to start businesses especially on NTFPs value addition, such as processing NTFPs into marketable products like herbal medicines, handicrafts, or food items (Harbi *et al.,* 2023; Bannor *et al.,* 2021). This entrepreneurial spirit effectively contributes to local and national economic development. The nature of NTFPs activities often promotes community collaboration. Communities may come together to harvest, process, or market these products collectively, encouraging a sense of unity and shared responsibility while distributing the benefits of the enterprise (Dentoni *et al.,* 2018; Paudel, 2016). Similarly, engaging with NTFPs helps to provide an additional income source for farmers in rural and forest fringe areas. This extra income helps buffer against the fluctuating returns from agricultural activities and provides a safety net during challenging times. For farmers residing in rural and forest fringe areas, involvement in NTFP-related activities can function as an extra source of earnings. This added revenue helps cushion the unpredictable earnings from agricultural endeavour and offers a safety net during challenging periods.

Significance of NTFPs to poverty reduction in forest communities

For those living in the forest areas in rural communities, poverty alleviation remains their primary objective thereby impacting various aspects of their society, the economy, and the overall well-being of its people indirectly fulfilling the goal one (1) of the sustainable development goal (SDG). Hence, combating poverty is synonymous to enhancing human capital. This is achieved through measures such as poverty alleviation programs, access to education, healthcare, and broadening of skill development opportunities, nurturing a skilled and healthy workforce essentially for national gains (Council, 2015; World Bank, 2019). Clearly, poverty alleviation is directly linked to economic growth (Boukhatem, 2016). By raising individuals and communities out of poverty, rural dwellers can harness a more productive workforce. As people have increased access to resources and opportunities, they contribute to the nation's economy, fostering entrepreneurship, innovation, and overall economic progress. Poverty alleviation necessitates investing in human capital. When lifted from poverty, individuals can access education, healthcare, and skill development (Hoque *et al.,* 2015).

This investment in human potential enhances the skills and capabilities of the workforce, paving the way for a more knowledgeable and skilled society. Poverty alleviation efforts work towards reducing income inequality (Adekoya, 2018; Hassanain, 2015). Similarly, the income gap narrows as individuals move out of poverty, creating a more equitable society. This reduction in income disparity enhances social harmony and inclusiveness, critical components of sustainable socioeconomic development (van Niekerk, 2020; Zauro *et al.,* 2020). Poverty alleviation ensures that individuals can access necessities such as food, clean water, housing, and healthcare. When people's basic needs are met, they can focus on selfimprovement, education, and economic activities, ultimately contributing to the nation's development (Hizi, 2019). Poverty alleviation is instrumental in ensuring social and political stability. When communities experience improved living standards and economic well-being, they are more likely to engage positively in the democratic process and contribute to a stable and peaceful society (Gilchrist and Taylor, 2016; Werhane *et al.,* 2020). Poverty alleviation is at the core of the United Nations' Sustainable Development Goals. Poverty alleviation entails investment in infrastructure and public services. Building roads, schools, hospitals, and other essential facilities create jobs and enhance access to vital services, stimulating economic growth and overall societal development. A nation making strides in poverty alleviation enhances its global competitiveness and reputation. More efforts are required from all stakeholders in ensuring that Nigeria aligns itself with the sustainable development objectives on poverty alleviation via NTFPs-based enterprises and investment. For instance, a study conducted by (Muhammad, 2017) in the Kano state revealed

that 45% of the surveyed households received a portion of their total incomes, ranging from 20.5% to 40.5%, from Non-Timber Forest Products (NTFPs). About 22% of these households derived a higher share, ranging from 41% to 60.5% of their total household incomes from NTFP sales. On the other hand, only 2% of all the households interviewed reported that a significant portion, exceeding 80.5% of their incomes, was generated through NTFPs-based enterprises. The fight against poverty through economy diversification would be better achieved with more attention given to NTFPs-based enterprises.

NTFPs Prospect and Underutilized income generating opportunities

Besides fuel and timber resources, the forest offers diverse products that can enhance the livelihoods of rural dwellers and help reduce poverty (Djoudi *et al.,* 2015; Shackleton and Pandey, 2014). Nevertheless, in numerous areas, accurately documenting the role of NTFPs remains challenging, mainly because a substantial portion of the trade takes place in informal markets. Consequently, the true contribution of NTFPs has yet to be formally integrated into the national economy (Djoudi *et al.,* 2015). Nonetheless, in Nigeria and some other developing countries NTFPs such as honey, mushrooms, wood fuel fruits, leaves, among others contributed between 4-60% to the income to local dwellers (Nandi and Sarkar, 2021; Mulenga *et al.,* 2012; Tincani, 2012). In essence, medicinal herbs, honey, mushrooms, and fruits and other products extracted from the forest hold significant importance as marketable commodities.

Review Appraisal

Though most of the previous studies shown NTFPs has a great potential of boasting the income of farmers, reducing the poverty rate in the country and meaningfully contributing to the country's economy. Yet, the extent to which NTFPs can impact the economy is not fully studied especially with those in the informal sector not well captured in a host of these analysis. This paper provides a review of the potentials of contributions of NTFPs to the economy and the ecosystem. Meanwhile, some of the previous studies portrayed NTFPs as mainly a safety net and an end to income generation to only the locals (María Castro *et al.,* 2023; Shackleton and Gumbo, 2010). Also, some findings review the NTFPs as a poverty trap and categorized NTFPs farmers as the highest among households living poor in communities (Shackleton *et al.,* 2024).

Inspite of the aforementioned, it is important to note that NTFPs would not make a sustainable contribution to the economy or reduce the poverty rate at households' levels unless a clear and all-encompassing strategy is designed and implemented on the potentials of NTFPs in rural development plan (Adam *et al.,* 2013). According to the findings done by (Neumann and Hirsch, 2000), income derived from the trade of NTFPs is so meagre and contributes very little to the socioeconomic growth and poverty alleviation especially in most of the economically challenged communities despite their proximity to the forest areas. In the same vein, (Shackleton *et al.,* 2024; Angelsen and Wunder, 2003; FAO, 2003) had presented low returns as the major factor behind the eventuality of NTFPs as poverty trap even though the locals largely depend on it for their household's utilization.

Opportunities and challenges

Despite the myriads of challenges, opportunities abound in NTFPs trade in Nigeria. If properly harnessed, NTFPs has the potential of contributing significantly to the livelihoods of rural dwellers and the economy at large. Also, it could serve as a means of employment to locals while also contributing to food and nutritional security of households across board. Globally, approximately a billion people rely on NTFPs for their income and nutritional uptake through its trade which is estimated to generate revenue of about $90 billion annually (Mahapatra and Tewari, 2005). Similarly, harvest from the NTFPs can improve and enhance the economy of Nigeria with a population of over 200million. Consequently, Nigeria Government at all levels (national, state, local levels) through their relevant institutions, agencies and policies should explore the yet untapped opportunities in the utilization of NTFPs especially on value addition to help the country achieve a GDP target of $1trillion by 2030. This would help the Government in their bid to reduce the poverty rate in the country. Nevertheless, deforestation and environmental temperature changes and rural poverty reduction remain a difficult menace confronting sustainable forest management, hence a need for lasting solutions on sustainable forest use. In other words, part of the long-term economic benefits proposed to prevent forest degradation is the sustainable and ecological use of forest products thereby reducing deforestation in the tropics.

Consequently, advocacy and timely implementation policy makers on the ecological use of NTFPs to achieve economic growth and biodiversity conservation must be placed as priority as its utilization has no harm on the forest environment **(**David *et al.,* 2019).

CONCLUSION

The review on economic and ecological impact of NTFPs was done using systemic review approach. Even more that NTFPs contribute to households' food security and income in the local communities, its potential impact on the economy depends largely on the ecological conditions, access to market, commercialization, value addition, collection and utilization. In line with the outcome of the review, it is clearly evident that NTFPs have the potential to contribute significantly to the country's economy while also reducing the poverty rate especially among the local dwellers that are closer to the forest areas if well managed and commercialized by value addition.

Similarly, through effective and sustainable utilization, NTFPs have the capacity to benefit the traders and the environment in a way that support both forest conservation and revenue generation. Rural areas remain the home for NTFPs hence majority of the locals largely depend on it for household income and livelihood. It is noteworthy to say, harnessing the benefits of NTFPs directly translate to protection of timber and wood resources from destruction such as deforestation as well as their habitat. By and large, these sustainable approaches would guarantee proper ecosystem management and biodiversity preservation. Nevertheless, harnessing the huge potential of NTFPs as an instrument for economic growth and diversification calls for a concerted effort and attention such as a well laid economic and fiscal policy that addresses local and international trade of NTFPs in ensuring its long-term benefit and sustainability. Also, conducive environment should be provided for investments in value addition, good harvest practices and ease of trade for NTFPs.

In reality, the locals remain a big stakeholder in NTFPs, hence their capacity must be well key into overall planning through proper engagement and empowerment while strengthening efforts in NTFPs activities through provision of inputs and funding. With a functioning organizational, institutional and legal framework in place NTFPs has the attributes of a game

changer for economy diversification plan in Nigeria and also the well being of forest dependent communities as well as the ecosystem.

In conclusion, NTFPs could serve as the key to unlock the economic growth of Nigeria through its huge revenue potential. However, all hands must be on desk to fully harness these potentials through the right interventions and approaches that prioritize the diversity of the Nigerian community and its ecosystem.

REFERENCES

Adam, Y. O., Pretzsch, J., and Pettenella, D. (2013). Contribution of Non-Timber Forest Products livelihood strategies to rural development in drylands of Sudan: Potentials and failures. *Agricultural Systems, 117*, 90–97. https://doi.org/10.1016/j.agsy.2012.12.008

Adedayo, A.G. (2018): Harnessing the potentials of NTFPs for National Development in Nigerian. *Journal of Experimental Agriculture International, 24* (4) 1 -10.

Adekoya, O.D. (2018). Impact of human capital development on poverty alleviation in Nigeria. *International Journal of Economics Management Sciences, 7*(4), 1–8.

Adeniyi, P.A. (2016). Environmental Sustainability and Conservation of Nigeria Forest Reserves. *Journal of Geography, Environment and Earth Science International. Vol. 6(1): 1-9, 2016; Article no. JGEESI.25958*

Ahenkan, A., and Boo, E. (2011). Improving the Supply Chain of Non-Timber Forest Products in Ghana. In S. Renko (Ed.), Supply Chain Management—New Perspectives. InTech. https://doi.org/10.5772/19253

Angelsen, A., and Wunder, S. (2003). Exploring the forest-poverty link. CIFOR Occasional Paper, 40, 1–20.

Asamoah, O., Danquah, J. A., Bamsiegwe, D., Verter, N., Acheampong, E., Boateng, C. M., Kuittinen, S., Appiah, M., and Pappinen, A. (2023). The perception of locals on commercialisation and value addition of non-Timber Forest products in forest adjacent communities in Ghana.

Ayanlade, A. and Drake, N. (2015). Forest loss in different ecological zones of the Niger Delta, Nigeria: evidence from remote sensing. *Geography Journal* (2016) 81:717–735. https://doi.org/10.1007/s10708-015-9658-y

Bannor, R. K., Ros-Tonen, M. A., Mensah, P. O., Derkyi, M., and Nassah, V. F. (2021). Entrepreneurial behaviour among non-timber forest product-growing farmers in Ghana: An analysis in support of a reforestation policy. *Forest Policy and Economics*, 122, 102331

Boukhatem, J. (2016). Assessing the direct effect of financial development on poverty reduction in a panel of low-and middle-income countries. *Research in International Business and Finance*, 37, 214–230.

Bown, D., Olasupo, O., and Peacock, J. (2011). Conservation of the IITA forest and its resources. *The Nigerian Field*, 76, 19–78.

Cavalcanti, M., Ramos, M. A., Araújo, E. L., and Albuquerque, U. P. (2015). Implications from the use of non-timber forest products on the consumption of wood as a fuel source in human-dominated semiarid landscapes. *Environmental Management, 56, 389-401*.

Chakravarty, S., Puri, A., Subba, M., Dey, T., Rai, P., Shukla, G., and Pala, N. A. (2015). Value addition of non-timber forest products: Prospects, constraints, and mitigation. Value Addition of Horticultural Crops: *Recent Trends and Future Directions*, 213– 244.

Chamberlain, J.L., Small, C.J., and Baumflek, M. (2019a). Sustainable productionof temperate and boreal nontimber forest products: examples fromNorth America. In: Stanturf J, editor. Achieving sustainable forestry: Vol. 1 Boreal and temperate forests. Cambridge: Burleigh Dodds Science Publishing.

Chamberlain, J.L., Small, C.J., and Baumflek, M. (2019b). Sustainable forest management for non-timber products. Sustainability.11:2670 https://doi.org/10.3390/su11092670 .

Chou, P. (2018). The Utilization and Institutional Management of Non-timber Forest Products in Phnom Prich Wildlife Sanctuary, Cambodia. *Environ. Dev. Sustain., 1– 16*.

Council, N.R. (2015). Transforming the workforce for children birth through age 8: A unifying foundation.

David, E.O., Jimoh, K.A., Oyewole, S.O. and Ayeni, A.E. (2019*)*. Non-Timber Forest Products (NTFPs) as a Means of Livelihood and Safety Net Among the Rurals in Nigeria: A Review. *American Journal of Service Science and Management*. 6, (1) 27-31.

De Roest, K., Ferrari, P., and Knickel, K. (2018). Specialisation and economies of scale or diversification and economies of scope? Assessing different agricultural development pathways. *Journal of Rural Studies*, 59, 222–231.

Dentoni, D., Pascucci, S., Poldner, K., and Gartner, W. B. (2018). Learning "who we are" by doing: Processes of coconstructing prosocial identities in community-based enterprises. *Journal of Business Venturing*, 33(5), 603–622.

Djoudi, H., Vergles, E., Blackie, R.R., Koame, C.K., and Gautier, D. (2015). Dry forests, livelihoods and poverty alleviation: Understanding current trends. *International Forestry Review*, 17(2), 54–69.

Dramé, A., and Berti, F. (2008).*Les enjeux socio-économiquesautour de l'agroforesterievillageoise ā Aguié (Niger).*Tropicultura, 26(3).

Dwivedi, S.L., Van Bueren, E.T.L., Ceccarelli, S., Grando, S., Upadhyaya, H.D., and Ortiz, R. (2017). Diversifying food systems in the pursuit of sustainable food production and healthy diets. Trends in Plant Science, 22(10), 842– 856.

Food and Agricultural Organization *(*FAO*)* (2003). State of the world's forests 2003. Part II. Selected current issues in the forest sector. Food and Agricultural Organisation (FAO) Rome.

Food and Agricultural Organization *(*FAO*)* (2010). Global Forest Resources Assessment 2010. Main Report, FAO Forestry Paper163, pp 378.

Food and Agricultural Organization *(*FAO*)* (2015). State of the World's Forest 2015. Main Report, FAO Forestry Paper. pp. 46.

Gadzama, N. M. (2017). Attenuation of the effects of desertification through sustainable development of Great Green Wall in the Sahel of Africa.*World Journal of Science, Technology and Sustainable Development.*

Gbadebo, O.V., Oyewole, A.L. and Adegbayi, O.R. (2022). Sustainable forest management practices: a viable panacea to the challenges of Climate change in Nigeria. Proceedings of the 8th Biennial Conference of the Forests & Forest Products Society, Held at the Forestry Research Institute of Nigeria, Ibadan, Nigeria. Pp 259-262.

Gilchrist, A., and Taylor, M. (2016). The short guide to community development. Policy Press.

Harbi, J., Cao, Y., Milantara, N., and Mustafa, A.B. (2023). Assessing the Sustainability of NTFP-Based Community Enterprises: A Viable Business Model for Indonesian Rural Forested Areas. *Forests*, 14(6): 1251. https://doi.org/10.3390/f14061251

Harbi, J., Erbaugh, J.T., Sidiq, M., Haasler, B. and Nurrochmat, D.R. (2018). Making a bridge between livelihoods and forest conservation: lessons from non timber forest products' utilization in South Sumatera, Indonesia. *Forest Policy and Economics. 94*:1–10. https://doi.org/10.1016/j.forpol.2018.05.011

Hassanain, K.M. (2015). Integrating Zakah, Awqaf and IMF for poverty alleviation: Three models of Islamıc micro finance. *Journal of Economic and Social Thought, 2*(3), 193–211.

Hegde, R., and Bull, G. (2008). Economic shocks and Miombo woodland resource use: A household level study in Mozambique. Department of Forest Resource Management, University of British Columbia, 80–105.

Heubach, K., Wittig, R., Nuppenau, E-A. and Hahn, K. (2011). The economic importance of non-timber forest products (NTFPs) for livelihood maintenance of rural West African communities: a case study from northern Benin. *Ecol Econ. 70*(11):1991– 2001. https://doi.org/10.1016/j.ecolecon.2011.05.015

Hizi, G. (2019). Marketised "educational desire" and the impetus for self-improvement: The shifting and reproduced meanings of higher education in contemporary China. Asian Studies Review, 43(3), 493–511

Hobhouse, H. (1999). Seeds of change: six plants that transformed mankind. Papermac Press. 381p. *IOSR Journal of Humanities and Social Science* (IOSR-JHSS).

Hoque, N., Khan, M. A., and Mohammad, K. D. (2015). Poverty alleviation by Zakah in a transitional economy: A small business entrepreneurial framework. *Journal of Global Entrepreneurship Research*, 5, 1–20.

Iliffe, J. (1995). Africans: the history of a continent, 81–90. Cambridge University Press.

Jaffee, S., Henson, S., Unnevehr, L., Grace, D., and Cassou, E. (2018). The safe food imperative: Accelerating progress in low-and middle-income countries. World Bank Publications.

Jimoh, S. O., Amusa, T. O., and Azeez, I. O. (2013). Population distribution and threats to sustainable management of selected non-timber forest products in tropical lowland rainforests of south western Nigeria. *Journal of Forestry Research,* 24, 75–82.

Kassa, G., and Yigezu, E. (2015). Women economic empowerment through non timber forest products in Gimbo District, south west Ethiopia. *American Journal of Agriculture and Forestry*, 3(3), 99–104.

Kurniasih, H., Ford, R.M., Keenan, R.J. and King B. (2021). The evolution of community forestry through the growth of interlinked community institutions in Java, Indonesia. *World Develop*. 139:105319. https://doi.org/10.1016/j.worlddev.2020.105319 .

Kusters, K., Belcher, B., Ruiz-Pérez, M., and Achdiawan, R. (2005).*A method to assess the outcomes of forest product trade on livelihoods and the environment. JSTOR.*

Lepcha, L. D., Shukla, G., Moonis, M., Vineeta, Bhat, J. A., Kumar, M., and Chakravarty, S. (2022). Seasonal relation of NTFPs and socio-economic indicators to the household income of the forest-fringe communities of Jaldapara National Park. Acta EcologicaSinica, 42(3), 180–187. https://doi.org/10.1016/j.chnaes.2021.03.002

S. S. (2023). Herbal medicine promotion for a restorative bio economy in tropical forests: A reality check on the Brazilian Amazon. Forest Policy and Economics, 155, 103058. https://doi.org/10.1016/j.forpol.2023.103058

Maes, J., Paracchini, M.L., and Zulian, G.A.(2011). European assessment of the provision of ecosystem services: towards an atlas of ecosystem services. Luxembourg: Publications Office.

Mahapatra, A. K., and Tewari, D. D. (2005). Importance of non-timber forest products in the economic valuation of dry deciduous forests of India. *Forest Policy and Economics, 7(3), 455–467*. https://doi.org/10.1016/j.forpol.2004.02.002

Mango, N., Makate, C., Mapemba, L., and Sopo, M. (2018). The role of crop diversification in improving household food security in central Malawi. Agriculture & Food Security, 7(1), 1–10.

María Castro, L., Encalada, D., and Rodrigo Saa, L. (2023). Non-Timber Forest Products as an Alternative to Reduce Income Uncertainty in Rural Households. In O. Özçatalbaş (Ed.), Sustainable Rural Development Perspective and Global Challenges. IntechOpen. https://doi.org/10.5772/intechopen.102970

Meinhold and Darr. (2019). The Processing of Non-Timber Forest Products through Small and Medium Enterprises— A Review of Enabling and Constraining Factors. Forests, 10(11), 1026. https://doi.org/10.3390/f10111026

Melese, S.M. (2016). Importance of non-timber forest production in sustainable forest management, and its implication on carbon storage and biodiversity conservation

in Ethiopia. International Journal of Biodiversity and Conservation, 8(11), 269–277.

Mipun, P., Bhat, N. A., Borah, D., and Kumar, Y. (2019). Non-timber forest products and their contribution to healthcare and livelihood security among the Karbi tribe in Northeast India. *Ecological Processes*, 8(1), 1–21.

Mohd Salim, J., Anuar, S. N., Omar, K., Tengku Mohamad, T. R., and Sanusi, N. A. (2023). The Impacts of Traditional Ecological Knowledge towards Indigenous Peoples: A Systematic Literature Review. *Sustainability*, 15(1), 824.

Morakinyo, T. and Tooze, Z. (2007). conservation of community forest and primates in the Cross-river state, Nigeria. *The Nigerian Field*, 72, 126–138.

Muhammad, S.S. (2017). Analysis of Economic Value, Utilization and Conservation of Selected Non-timber Forest Products in the Falgore Game Reserve in Kano, Nigeria. University of Nairobi.

Mukul, S.A., Rashid, A. Z. M. M., Uddin, M. B., and Khan, N.A. (2016). Role of non-timber forest products in sustaining forest-based livelihoods and rural households' resilience capacity in and around protected area: A Bangladesh study. *Journal of Environmental Planning and Management*, 59(4), 628–642. https://doi.org/10.1080/09640568.2015.1035774

Mulenga, B. P., Richardson, R. B., and Tembo, G. (2012). Non-timber forest products and rural poverty alleviation in Zambia

Mutke, S., Bonet, J.A., Calado, N., Calvo, J., Taghouti, I., Redondo, C., et al. (2019). Innovation networks on Mediterranean non-wood forest products. *Journal of Innovative Science and Engineering*. *3*:1–10.

Nandi, D., and Sarkar, S. (2021). Non-Timber Forest Products Based Household Industries and Rural Economy—A Case Study of Jaypur Block in Bankura District, West Bengal (India). In P. K. Shit, H. R. Pourghasemi, P. Das, & G. S. Bhunia (Eds.), *Spatial Modeling in Forest Resources Management* pp. 505–528. Springer International Publishing. https://doi.org/10.1007/978-3-030-56542-8_21

National Population Commission (2022). Nigeria Population Growth Rate 1950-2022.

Ndoye, O. Ruiz-Perez, M., and Eyebe, A. (1997). *The markets of non-timber forest products in the Humid Forest Zone of Cameroon*. Rural Development. Forestry Network, Network Paper 22c. ODI, London.

Ndoye, O. Ruiz-Perez, M., and Eyebe, A. (1999). Non-wood forest products markets and potential degradation of the forest resource in Central Africa: The role of research in providing a balance between welfare improvement and forest conservation.

Neumann, R. P., and Hirsch, E. (2000). Commercialisation of non-timber forest products: Review and analysis of research.

Olalekan, R.M., Omidiji A.O., Williams, E.A., Christianah, M.B. and Modupe, O. (2019). The roles of all tiers of government and development partners in environmental conservation of natural resource: a case study in Nigeria. *MOJ Ecology and Environmental Science Vol.* 4(3):114–121.

Onuche, P. (2011). Non-timber forest products (NTFPs): A pathway for rural poverty reduction in Nigeria. *International Journal of Economic Development Research and Investment, 2*(2), 28–37.

Packenham, T. (1991). The scramble for Africa, 1876-1912. Abacus Press. 738p.

Pandey, Tripathi, and Kumar, A. (2016). *Non-Timber Forest Products (NTFPs) for Sustained Livelihood*: Challenges and Strategies. https://doi.org/10.3923/rjf.2016 .

Paudel, D. (2016). Re-inventing the commons: Community forestry as accumulation without dispossession in Nepal. *The Journal of Peasant Studies*, 43(5), 989–1009.

Peerzada, I. A., Islam, M. A., Chamberlain, J., Dhyani, S., Reddy, M., and Saha, S. (2022). Potential of NTFP Based Bioeconomy in Livelihood Security and Income Inequality Mitigation in Kashmir Himalayas. *Sustainability, 14*(4), 2281. https://doi.org/10.3390/su14042281

Peters, C.M., and Mundial, B. (1996). *The ecology and management of non-timber forest resources*. World Bank Washington, DC.

Phil-Eze, P. O. and Okoro, I. C. (2008). Sustainable biodiversity conservation in the Niger Delta: A practical approach to conservation site selection. *Biodiversity and Conservation*, 18(5), 1247–1257.

Rahman, Md. H., Roy, B., and Islam, Md. S. (2021). Contribution of non-timber forest products to the livelihoods of the forest-dependent communities around the Khadimnagar National Park in northeastern Bangladesh. *Regional Sustainability*, *2*(3), 280–295. https://doi.org/10.1016/j.regsus.2021.11.001

Sambe, L. N. Adeofun, C. O. and Dachung, G. (2018). The Economic and Ecological Effects of Deforestation on the Nigerian Environment. *Asian Journal of Advanced Research and Reports Vol. 1(2): 1-25, 2018; Article no. AJARR.41750*

Sardeshpande, M., and Shackleton, C. (2019). Wild edible fruits: A systematic review of an under-researched multifunctional NTFP (non-timber forest product). *Forests*, 10(6), 467.

Saxena, A., and Güneralp, B. (2022). Understanding the Dynamics Between Forest Landscapes and Rural Livelihoods: A Case Study from Central India. In Forests as Complex Social and Ecological Systems: A Festschrift for Chadwick D. Oliver (pp. 295–320). Springer.

Schaafsma, M., Morse-Jones, S., Posen, P., Swetnam, R.D., Balmford, A., Bateman, I.J., Burgess, N.D., Chamshama, S.A.O., Fisher, B., Freeman, T., et al. (2014). The importance of local forest benefits: economic valuation of non-timber forest products in the Eastern Arc Mountains in Tanzania. *Global Environ Change*. 24:295–305. 2013.08.018 https://doi.org/10.1016/j.gloenvcha .

Scoones, I. (2015). Sustainable livelihoods and rural development. Practical Action Publishing Rugby.

Secretariat of the Convention on Biological Diversity (SCBD) (2001). Sustainable management of non-timber forestresources. Montreal, 30p. (CBD Technical Series no. 6).

Sedita, S. R., De Noni, I., and Pilotti, L. (2017). Out of the crisis: An empirical investigation of place-specific determinants of economic resilience. *European Planning Studies*, *25*(2), 155–180.

Shackleton, C. M., Shackleton, S. E., Buiten, E., and Bird, N. (2007). The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa. *Forest Policy and Economics*, *9*(5), 558–577.

Shackleton, S., and Gumbo, D. (2010). Contribution of non-wood forest products to livelihoods and poverty alleviation. The Dry Forests and Woodlands of Africa: *Managing for Products and Services*, 63–91.

Shackleton, C.M., and Pandey, A. K. (2014). Positioning non-timber forest products on the development agenda. *Forest Policy and Economics*, *38*, 1–7. https://doi.org/10.1016/j.forpol.2013.07.004.

Shackleton, C. M., and Pullanikkatil, D. (2019). *Considering the links between non-timber forest products and poverty alleviation*. In Poverty Reduction Through Non-Timber Forest Products (pp. 15–28). Springer.

Shackleton, C. M., Garekae, H., Sardeshpande, M., Sinasson Sanni, G., and Twine, W. C. (2024). Non-timber forest products as poverty traps: Fact or fiction? *Forest Policy and Economics*, 158, 103114. https://doi.org/10.1016/j.forpol.2023.103114

Shrestha, S., Shrestha, J., and Shah, K. K. (2020). Non-timber forest products and their role in the livelihoods of people of Nepal: A critical review. *Grassroots Journal of Natural Resources*, *3*(2), 42–56.

Suleiman, M. S., Wasonga, V. O., Mbau, J. S., Suleiman, A., and Elhadi, Y. A. (2017). Nontimber forest products and their contribution to households' income around Falgore Game Reserve in Kano, Nigeria. *Ecological Processes*, *6*(1), 23. https://doi.org/10.1186/s13717-017-0090-8

Sunderland, T.C.H. Harrison, S.T. and Ndoye, O. (2004). Forest products, livelihood and conservation. Case studies of Non-timber Forest Product Systems. Chapter 1: Commercialisation of non-timber forest products in Africa: history, context and prospects. Volume 2 – Africa. ISBN 979- 3361-25-5.

Talukdar, N. R., Choudhury, P., Barbhuiya, R. A., and Singh, B. (2021). Importance of NonTimber Forest Products (NTFPs) in rural livelihood: A study in Patharia Hills Reserve Forest, northeast India. Trees, Forests and People, 3, 100042. https://doi.org/10.1016/j.tfp.2020.100042

Tata Ngome, P. I., Shackleton, C., Degrande, A., and Tieguhong, J. C. (2017). Addressing constraints in promoting wild edible plants' utilization in household nutrition: Case of the Congo Basin Forest area. *Agriculture & Food Security*, *6*(1), 1–10.

Tchatat, M., and Ndoye, O. (2006). *Etude des produitsforestiers non ligneuxd'Afrique Centrale: Reality and prospects.* Bois &Forets Des Tropiques, 289, 27-39.

Tincani, L. S. (2012). *Resilient livelihoods: Adaptation, food security and wild foods in rural Burkina Faso*. SOAS, University of London.

Uprety, Y., Poudel, R. C., Gurung, J., Chettri, N., and Chaudhary, R. P. (2016). Traditional use and management of NTFPs in Kangchenjunga Landscape: Implications for conservation and livelihoods. Journal of Ethnobiology and Ethnomedicine, 12(1), 19. https://doi.org/10.1186/s13002-016-0089-8

van Niekerk, A. J. (2020). Inclusive economic sustainability: SDGs and global inequality. *Sustainability*, 12(13), 5427.
Vaughan, B., Gunson, B., and Murphy, B. (2023). Non-Timber Forest Products: Potential for Sustainable and Equitable Development In Ontario, Canada. *Journal of Rural and Community Development*, *18*(1).

Vega, D. C., Page, T., and Ota, L. (2023). Challenges and opportunities for inclusive value chains of niche forest products in small island developing states: Canarium nuts, sandalwood, and whitewood in Vanuatu. *Journal of Rural Studies*, *100*, 103036.

Verma, S. K., and Paul, S.K. (2016). Sustaining the non-timber forest products (NTFPs) based rural livelihood of tribal's in Jharkhand: Issues and challenges. *Jharkhand Journal of Development and Management Studies*, *14*(1), 6865–6883.

Wahlén, C. B. (2017). Opportunities for making the invisible visible: Towards an improved understanding of the economic contributions of NTFPs. *Forest Policy and Economics*, *84*, 11–19.

Werhane, P. H., Newton, L. H., and Wolfe, R. (2020). Alleviating poverty through profitable partnerships: Globalization, markets, and economic well-being. Routledge.

World Bank. (2019). World Development Report 2019: The Changing Nature of Work. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1328-3

Zaku, S. G., Kabir, A., Tukur, A.A., and Jimento, I. G. (2013). Wood fuel consumption in Nigeria and the energy ladder: A review of fuel wood use in Kaduna State. *Journal of Petroleum Technology and Alternative Fuels*, 4(5), 85–89.

Zauro, N. A., Zauro, N. A., Saad, R. A. J., and Sawandi, N. (2020). Enhancing socioeconomic justice and financial inclusion in Nigeria: The role of zakat, Sadaqah and Qardhul Hassan. *Journal of Islamic Accounting and Business Research*, *11*(3), 555– 572.

Zhao, H., Wang, J., Meng, Y., Li, Z., Fei, B., Das, M., and Jiang, Z. (2022). Bamboo and rattan: Nature-based solutions for sustainable development. The Innovation, 3(6).

Zivojinovic, I., Nedeljkovic, J., Stojanovski, V., Japelj, A., Nonic, D., Weiss, G. and Ludvig, A. (2017). Non-timber forest products in transition economies: innovation cases in selected SEE countries. *Forest Pol Econ. 81*:18–29. https://doi.org/10.1016/j.forpol.2017.04.003 .