



Review Article

Cashew trees cultivation and management practices in Nigeria

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Abstract

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Management practices are the key determinants of the quality and quantity of agricultural products. This article discusses the management practices undertaken by Nigerian cashew farmers in the production of raw cashew nuts (RCN). It aims to foster the development of RCN production in the country. The paper reported the background of cashew production quality and quantity in Nigeria States where cashew is being cultivated, and trends in cashew production in the country. It also examined seed selection and other agronomical practices that are being carried out by the farmers in the country. This is to proffer solutions to the challenges in the quality and quantity of Nigerian RCN. Also, challenges on the adoption of improved cashew varieties were discussed as well. It was concluded that the majority of smallholder farmers in Nigeria carried out cashew nuts seed recycling in the establishment of new plantations and/or gapping (resupplying), and basic management practices are implemented for the establishment of cashew farms. Therefore, to ensure the production of quality and internationally acceptable raw cashew nuts in Nigeria, rigorous awareness campaign be conducted to promote the adoption of improved cashew varieties and the renovation of farms among farmers. Good agricultural practices (GAP) training should be organized by the stakeholders in the cashew value chain for the cashew farmers.

Introduction

Cashew (*Anacardium occidentale* L.) is a perennial crop that originated from eastern Brazil and was cultivated and turned into international trade by India (Agada & Sule, 2020). It found its way to Nigeria through Portuguese traders during the 15th and 16th centuries. The crop remains an important economic tree to Nigeria and other tropical countries in the world (Agada & Sule, 2020). Cashew thrives in well-drained areas and has the ability to survive in less fertile soil and in the savannah part of the country (Aminu et al., 2021). The performance of the crop is subject to the local environmental conditions and the management practices adopted by farmers. Additionally, cashew cultivation can be influenced by tropical storms and seasonal Harmattan winds (Agada & Sule, 2020).

An increase in the global demand for raw cashew nuts (RCN) and other cashew products (Ton et al., 2018) has made cashew cultivation one of the most relevant among the cash crops in Nigeria. Field observations showed that a significant number of cashew farms or plantations were established not due to economic motivations but for socio-cultural purposes; such as to secure or demarcate lands, or to deter farm workers from sourcing

cashew apples from the wild (non-cultivated trees) at the expense of their farm work (Baale, personal communication, November 20, 2021). Similarly, Kakwagh et al. (2023) observed that most of the cashew nuts harvested in Nigeria were collected from the wild and not from active plantations. However, the current market opportunities and economic benefits ensue from the sales of raw cashew nuts (RCN) have instigated a shift in cultivation patterns and management practices. Unlike in earlier times when greater attention was placed on cocoa cultivation in the southwest and palm oil in the southeast of Nigeria (Agboola-Adedjoja et al., 2022), the economic potentials of RCN have propelled many communities in the country to engage in cashew cultivation. Notably, Dendena and Corsi (2014) reported a 40% increase in cashew production in Nigeria from 2009 to 2014.

Nigeria stands as a major global player in the production of RCN. In the recent ranking by Nigeria Export Promotion Council (NEPC, 2021), the country ranked 6th worldwide in RCN production and holds the third spot in Africa. In 2022, the country exported 315,677 metric tons of RCN valued at \$252 million, accounting for over 5% of Nigeria's non-oil revenue (NEPC, 2023). Although cashew trees thrive throughout Nigeria, Ogbomoso in Oyo State is particularly renowned for producing high-quality cashew nuts (Adeniyi & Nduka, 2022; NEPC, 2021). However, the overall increase in cashew production in Nigeria is primarily attributed to the expansion of cultivated areas rather than a significant rise in yield per hectare as a result of prevalent suboptimal farming practices throughout the country and the absence of improved planting materials (Adeigbe et al., 2015).

Cashew is mainly propagated from seeds or recycle of the seeds (sowing of harvested nuts), (Adesanya et al., 2021) with relatively little attention given to the planting materials and/or seed selection by farmers. Classification and characterization of cashew primarily revolve around biotypes, nut forms, shapes, lengths, and sizes which determine the outputs and out-turns of the cashew nuts kernels (Adeniyi & Nduka, 2022). Hammed et al. (2008) and Adeigbe et al. (2016) enumerated six different types of RCN sizes in Nigeria: jumbo, extra-large, large, medium, small and madras.

The Indian and Brazilian biotypes are the two main cashew biotypes cultivated by Nigerian farmers. The Indian biotype, which was naturalized in the country, is referred to as the indigenous type by the local farmers. On the other hand, the Brazilian biotype was introduced to the country by the Cocoa Research Institute of Nigeria (CRIN) (Agada & Sule, 2020), and takes different sizes including Brazilian jumbo and medium size. Brazilian biotypes offer desirable characteristics such as heavier nut weight and larger sizes. However, they tend to yield fewer nuts compared with the Indian biotypes, which are renowned for its high yields but associated with less weight and smaller sizes (Hammed et al., 2008). For instance, Jumbo cashew trees produce approximately 8 to 10 kg yield per tree, while the local varieties yield considerably more, ranging from 30 to 250 kg per tree (Hammed et al., 2008).

It is necessary to examine cashew cultivation techniques and management practices adopted by farmers in Nigeria to ensure continuous and sustainable production practices. The study used both primary and secondary information. The primary information was obtained through field observations, focus group discussions, and personal communication from 2021 to 2023. The field observation involved visitation to cashew farming communities and inspection of purposively selected old and newly established cashew farms. Discussions were held with cashew farmers in groups or on an individual basis across eight states in Nigeria (Edo, Ekiti, Kwara, Kogi, Oyo, Ogun, Ondo, and Nasarawa). Further, focus group discussions (FGD) with key informants in 2021 under the Procashew project in Nigeria were conducted in about 54 cashew-producing communities in four states of the federation (Ekiti, Kogi, Kwara, and Oyo). Personal communication was also carried out with key

informants at the University of Ilorin and the community head of an Oyo State farm settlement at Otiri village.

Secondary information was obtained from relevant literature. We conducted an extensive literature review covering articles published from January 2023 to June 2023, with an extension to October 2023, primarily focusing on subjects related to cashew cultivation, management practices, marketing of raw cashew nuts, and other relevant areas. These articles were sourced from the internet using the Google search engine within the specified timeframe. The inclusion criteria for article selection were based on their relevance to the research theme.

Cashew producing states in Nigeria

Out of Nigeria's 36 states and the federal capital territory, more than 20 of them were engaged in cashew cultivation in commercial quantity (Ezeagu, 2002; Lawal & Uwagboe, 2017). According to Agbongiarhuoyi et al. (2008), cashew thrives effectively in all the agro-ecological zones of the country including the semi-arid regions, though the middle belt area is known for its high concentration. The cashew-cultivating states are divided into major and minor producers. Ezeagu (2002) identified the major cashew-producing states in Nigeria, representing regions where commercial cultivation of cashew started in the early 1950s. These states are Enugu, Abia, Imo, Anambra, Ebonyi, and Cross River at the eastern part of Nigeria, and Oyo, Osun, Ondo, Ekiti and Ogun in the western part. These areas are also the source of most of the country's exported cashew (Ezeagu, 2002). Other cashew-growing areas identified by Ezeagu (2002) are Kwara, Kogi, Nasarawa, Benue, Taraba, Niger, and the federal capital territory in the north central region, and Sokoto and Kebbie states in the northwest region.

Trends of cashew production in Nigeria

There is scant information on the actual production rate of RCN in Nigeria per year as well as data on actual land areas under cashew cultivation (Kakwagh et al., 2023). Nevertheless, it is on record that cashew production in commercial quantity started in the 1950s by the defunct corporations such as Eastern Nigeria Development Corporation (ENDC) and Western Nigeria Development Corporation (WNDC) at Oghe, Oji, Mbala, and Iwo, Eruwa, Upper Ogun, respectively. Cashew production spread to other locations from these places (Asogwa et al., 2008). As of 1995, the total land area under cashew cultivation in Nigeria was estimated to be 40,000 ha, about 60% of which was owned by smallholders' farmers, while about 30% were from the wild cashew trees and 10% from commercial farms and plantations (Onuchi & Aiyelabowo, 2006). However, Crusoe (2006) stated that by the year 2000, the total land area under cashew cultivation had increased to about 100,000 ha with an estimated annual production of 70,000 MT as a result of some state governments' intervention in cashew production. The interventions were anchored by Agricultural Development Programmes, National Land Development Authority and States Ministries Tree Crops Development Units. In 2006, Nigeria was ranked 4th in Africa after Tanzania, Cote d'Ivoire and Guinea Bissau in the production of cashew from an estimated 100,000 ha and annual production of 80,000 MT. This accounted for about 16% of Africa and 5% of the total world production (Agbongiarhuoyi et al., 2008).

According to consultative committee on agricultural export commodity statistics ([CCAECs], 2005), as of 2005, the estimated total land area under cashew cultivation in Nigeria was 144,570 ha with estimated output of 94,140 tonnes. Edo state had the largest areas followed by Imo then Kwara with 37,850 ha, 27,170 ha and 16,77 ha, respectively. Subsequently, RCN production increased geometrically in Nigeria. It was estimated to be 791,726 tons in 2010; 982,539 tons in 2017 (Eze et al., 2022), and 315,677MT in 2022 (NEPC, 2023).

Interplay of agroforestry practices and cashew cultivation in Nigeria

Agroforestry is a multiple land use integration technique employed by farmers in many parts of the country. Basically, it is a deliberate incorporation of the tree (crops) and/or animal husbandry into farmland. It is a means of providing solutions to land shortage, poverty, food security, and environmental degradation challenges being experienced in the country (Karshie et al., 2017). Similarly, Idumah et al. (2021) stated that agroforestry was introduced to ensure sustainability of food production system through soil erosion and degradation protection. Agroforestry was described by Nair (2008), as land use mechanism that satisfies the need of various stakeholders including crop farmers, foresters and livestock keepers. According to King (2007), the integration of trees, crops and animals could be done simultaneously or sequentially on the same plot of land (farm) in conformity with the cultural practices of the people.

There are different forms of agroforestry being practiced in Nigeria, these include – agrisilviculture (crops and trees cultivation), silvopasture (trees and animal rearing), agro-silvopasture (crops, trees cultivation, and animal husbandry), agro-pisciculture (crops and fish farming), aqua-silviculture (fish farming and trees cultivation), apiculture (beekeeping) and sericulture (silkworms raising) (Nair, 2008). Agrisilviculture (crops and tree cultivation) is the most common practice of establishing cashew plantations following agroforestry techniques. Cashew farmers practice intercropping by planting annual crops (maize, sorghum, millet, melon, soybean, cowpea, etc.) and roots crops or tubers (yam, cassava among others) into cashew plantation during the first five years of establishment (Aremu-Dele et al., 2021; Lawal et al., 2017). Also, in some places bee hives were installed (placed) in matured cashew farms (Azeez, 2019). According to Aremu-Dele et al. (2021), intercropping practices in cashew plantations have been shown to improve weed management. This, in turn, leads to better growth performance of cashew in the field compared to situations where cashew is planted in isolation. Thus, there are huge benefits associated with the practices of agroforestry in cashew farming. Other benefits include the provision of fire woods from cut trees and the provision of medicinal plants' parts (Azeez, 2019; Aremu-Dele et al., 2021).

Agronomic Practices

Planting materials – seeds and seedlings selection

Small-scale cashew farmers are the main players in the cashew farming industry primarily use seeds sourced from existing cashew farms and/or plantations as their main planting materials (Adeigbe et al., 2015). They rarely pay attention to the seed selection process other than the yield performance of the mother trees. Seeds were picked mostly at random from different trees, and planted directly on the farm after sun-drying to reduce moisture content of the nuts/seeds. This is a result of lack of awareness of the determinants of high-graded and good-performing cashew trees among the majority of farmers (Hammed et al., 2008). According to Amanoudo et al. (2022), the yield gap associated with West Africa cashew is due mainly to poor performance planting material. Commercial farm managers and investors also pay little attention to the seed selection process. According to Adeigbe et al. (2015), openly pollinated and unimproved planting materials that usually do not give true-to-type are being used to establish cashew farms in Nigeria.

Field observations revealed that some farmers used wild seedlings germinated from the fall-off or left-over from previously harvested nuts but they were small in number. Further, observations showed that a significant number of commercial farms were established using seedlings obtained from government institutions like Cocoa Research Institute of Nigeria (CRIN), National Horticultural Research Institute (NIHORT), Moor Plantation, etc. or

private nurseries. Hammed et al. (2008) affirmed that CRIN distributes Brazilian jumbo to all the willing farmers who visited their institution. Although the seeds came from the same source, the enhanced selection process ensures a greater level of uniformity. Similar observations were made by Agbongiarhuoyi et al. in 2015. They noted that planting materials were mainly obtained from established farms, with only 1.3% and 11% planting materials acquired from CRIN and Ministry of Agriculture, respectively. They reported that old varieties of cashew were mostly replicated by farmers in the study area. That is, un-recommended genotypes were planted by farmers resulting in low cashew productivity.

Vegetative propagation of cashew trees is almost unknown to the majority of farmers in Nigeria. Instead, vegetative propagation of cashew is mostly planted in experimental fields of institutions (Adekola, personal communication, January 22, 2022). The establishment of cashew plantations with grafted cashew seedlings (wedge method) is relatively new in the country. This method was introduced in 2022 to four states in Nigeria (Ekiti, Kogi, Kwara, and Oyo) through the ongoing Procashew project intervention sponsored by the United States Department of Agriculture (USDA). This was implemented in Nigeria by Cultivating New Frontiers in Agriculture (CNFA) in collaboration with McGeorge Consulting Limited, the company in charge of the distribution of the seedlings. The objective of the intervention was to address issues contributing to the lower prices of Nigerian cashew nuts in the global market (CNFA, 2021), which include small size, poor quality and reliability, and the laborious process of peeling the testa of cashew nuts.

Cashew seeds viability test

A seed viability test is used to determine the viability of cashew planting materials. It was observed that farmers in Nigeria do not practice this test. Amanoudo et al. (2022) argued that cashew cultivation in West Africa is still being done in a primitive way, thus, modern seeds germination and viability test were not being practiced. A study showed that floater seeds can germinate; however, it is recommended and preferable to plant these after soaking (Makale et al., 2020).

Site selection

Farmers often overlook the soil requirements for cashew cultivation in the country, leading to the planting of trees in a wide range of soil types. This is in line with the findings of Agbongiarhuoyi et al. (2015) where soil testing was noted as part of factors contributing to low yield of cashew but was not considered a serious factor by farmers. This practice may not be too detrimental because cashew adapts and grows virtually in all ecological zones. According to the Ministry of Agriculture and the Farmers' Welfare of India (n.d), cashew is commonly perceived to have moderate soil requirements and able to tolerate diverse soil conditions with minimal impact on productivity. However, cashew performance is subject to edaphic and climatic factors. Successful cashew production depends greatly on factors such as seed quality, pests, and disease management, and soil fertility (Jadid et al., n.d). Cashews flourish better on deep, well-drained, sandy-loamy, and slightly acidic soil while its growth and development are poor in flooded and clay soil.

Cashew farms establishment

Cashew seeds or seedlings are mostly planted on existing farmlands in Nigeria. In most cases, these farmlands may have been utilized for cultivating other arable crops (groundnut, maize, cowpea, millet, melon, etc.) before cashew seeds/seedlings are planted on the farm (field). The cashew planting materials are subsequently introduced as intercrops on the farms, especially in the first year of the establishment. Seeds are planted directly on farms, arbitrarily with 2 to 3 seeds in a hole. Planting density and spacing are randomly chosen by traditional or small-scale farmers, while spacing(s) of 10 m by 10 m, 9 m by 9 m, and 8 m by 8 m are commonly used by commercial farms. As earlier stated, propagation is mostly through direct seeds. In planting of seedlings, farmers have received little training on hole-

digging techniques which require the separation of topsoil and subsoil. In contrast, cashew seeds or seedlings are planted on the already tilled or plowed soil which made the soil turning and separation almost unnecessary. Amanoudo et al. (2022) corroborated these findings by affirming that reforestation was the primary reason for the introduction of cashew tree in West Africa, hence, farmers are struggling to implement fruit production requirement of cashew production. They further mentioned that farms were mainly established through seeds, plant spacing were not adherent to recommendations, and the yield gap of cashew in West Africa is associated to weak or poor application of good agricultural practices, particularly regarding weeding, pruning and thinning, phytosanitary application, and the lack of fertilization.

Weeding

Despite the fact that weeds compete for nutrients and sunlight with the cashew seedlings/trees, our observation revealed that farmers pay slight attention to the weeding of cashew farms because of their limited knowledge of the effects and the economic situation. Weeding is typically conducted once or twice a year, especially as the cashew trees begin to bear fruit. Slashing, a form of manual weeding, is the most commonly adopted method. This has negatively impacted cashew production in Nigeria. Agada & Sule, (2020) stated that farmers were aware of some improved management practices including weeding. It was determined that adoption of improved management practices such as weeding and the application of agrochemicals, among others, was low, which were attributed to lack of awareness, limited accessibility, and financial constraints. Similarly, Kakwagh et al. (2023) stated that farmers in the study area generally do not apply agrochemicals, fertilizers, and pesticides on their cashew farms, opting instead for manual weeding with the use of machete as the predominant method. These were attributed to the high cost of agrochemicals, herbicides, and other inputs.

Fertilizer application

According to Dendena and Corsi (2014), responses of cashew to fertilizer applications have been proven in numerous studies. Aminu et al. (2021) noted that nitrogen (N), phosphorous (P), and potassium (K) have been reported to have positively impacted the vegetative growth and nut production of the cashew trees. They further stated that cashew plants applied with organic fertilizers (such as poultry drops, cow dung, etc.) have been noted to perform well compared to those applied with inorganic fertilizers. Ipinmoroti et al. (2011) claimed that since nitrogen is slowly released from the manure, leaching and acidification are limited. Hence, soil structure and water content are improved. However, only very few cashew farmers in Nigeria apply either organic or inorganic fertilizers on their farms (Aminu et al., 2021). Factors that are probably responsible for these include—lack of awareness of the importance of fertilizer application, financial incapacity of the farmers, and/or farmers' interest in organic farming. This finding is in line with the observation of Akanbi et al. (2013), where it was noted that part of the challenges of cashew production in Nigeria is the incapability of the farmers to meet the expenses of application of inorganic fertilizer on their cashew farms, and the negative impact of the inorganic fertilizer application. More so, Amanoudo et al. (2022) affirmed that the non-use of fertilizer is one of the elements that is negatively affecting cashew production. Also, Lawal et al. (2017) posited that farmers do not use fertilizers based on the notion that the crop is woody in nature, but it is more so because of farmers' economic situation.

Meanwhile, Adejumo (2010) observed that fertilizer application in cashew farms reduced the influence of diseases, such as inflorescence blight and increased yields. Fertilizer application rate and time are subject to soil fertility and nutrients deficiency, while application time depends on the types of fertilizers being used and the purposes. According to Aikpokpodion et al. (2010) nutrient deficiency levels and fertilizer recommended rates are

to be based on soil tests. Hence, Amanoudo et al. (2022) recommended that fertilization policies should be carried out for cultivable lands.

Pruning and side shoot removal

Pruning is one of the management practices carried out on cashew plantations. Asogwa et al. (2008) asserted that it is commonly practiced in Africa. It is carried out to ensure uniform growth of tree canopy as well as in the reduction of overcrowding which can lead to reduction in yield performance of cashew plantations (Dendena & Corsi, 2014). Similarly, pruning is done to shape cashew trees into a single stem. Moreso, pruning is carried out as a pest and disease control mechanism. The infected parts of the trees are removed to stop the infection to healthy branches (Nathaniels et al., 2003). Pruning is supposed to be carried out two years after planting of cashew, and once a year between May and July. All the side trunks are removed up to a height of at least 1m from the ground (CNFA, 2023). The removal of side shoots, on the other hand, is a common practice in grafted seedlings and constitutes a standard procedure in nursery routine management. The rootstock typically produces numerous side shoots, which are expected to be removed to facilitate the proper development of the scion (ICAR, 2015).

Field observations revealed that only very few farmers practice pruning while the removal of side shoots is still unknown to the majority of the farmers, despite the benefits of this management practice. More so, farmers often use machetes on pruning, inadvertently causing injuries to many plants, instead of employing pruning saws which offer a higher level of precision in the pruning process. According to research conducted in Ghana by Wongnaa (2013), 52.9% of farmers pruned their farms. However, our findings are in contrary to the findings of Agada & Sule (2020) who reported that 89.5% of farmers practiced pruning in Kogi State Nigeria but the technique was not mentioned.

Pests and disease management

Cashew production is greatly affected by pests and diseases infestation in Nigeria. According to Hammed et al. (2008), over 286 species of cashew pests have been reported within 20 years. Some of the commonly found cashew pests include *Analeptes trifasciata* (stem girdler), *Selenothrips rubrocinctus* (red-banded thrips), *Pachnoda cordata* (fruit scraper), sap-sucking bugs, leaf-chewing, caterpillars, beetles, aphids, scales, and mites. They mostly attack the foliar and fruit parts of the plant. Ojelade (1998), asserted that these insects' species cause up to 52% to 75% economic losses to the cashew production level. Hammed et al. (2008) and Adeigbe et al. (2015) posited that there were three highly notable diseases common in cashew, which are floral shoot die-back (*Lasiodiplodia theobromae*), twig die-back (caused by *L. theobromae*) and root rot of cashew seedlings caused by *Pythium ultimum* Trow. Floral shoot die-back reduces total nuts yield by an average of 38-70%. Twig die-back causes more than 50% of deaths of vegetative shoots of cashew. The loss due to root rot of cashew seedlings was estimated at 10-15% in the nursery (Hammed et al., 2008). It was observed that despite the prodigious economic losses associated with insect and pest infestation in Nigeria, cashew farmers' disease management practices are almost non-existent. Although farmers are quite aware of the economic losses and diseases implications, they do not have adequate technical knowledge to identify, manage, and treat the infestations. They just leave the infestations to take natural causes, mostly due to unaffordability and unavailability of the agrochemicals required for the phytosanitary treatment of the infestation. More so, farmers who are aware of organic farming are deterred from using agrochemicals. Alternative means of preventing diseases through organic treatment and soil fertility are yet to be fully harnessed. This finding is in line with the observation of Agada & Sule (2020), where it was stated that practices such as pesticide, fertilizer, herbicide applications were not practiced by farmers in Kogi State of the country. They further attributed the non-use of improved practices to lack of needed information and finance among farmers. Furthermore, Amanoudo et al. (2022) affirmed that cashew nut production

is still being practiced in the traditional way in West Africa deprived of the disease and pest management practices. Control measures were either systemic or not the priority of the farmers. It was concluded that lack of disease and pest management caused considerable losses to cashew production in the West Africa. Similarly, Okogbaa et al. (2018) observed that majority (44%) of their respondents do not apply any disease management practices on the cashew farms. This was applicable to weeding too.

Posts-harvest handling

Harvesting techniques and post-harvest handling determine to a large extent the quality of the cashew and the economic benefits that would be accrued from cashew farming. It takes about four months (October to January) for most cashew to ripen and mature, from flowering to maturity. Ripe and matured cashew apples are allowed to naturally fall from the trees to the ground, and the primary method of harvesting involves collecting the dropped cashew apples. The nuts are separated from the apple mostly through manual process primarily by rural women and children (Azam-Ali & Judge, 2001). However, our field observations revealed that security threats compel some farmers to harvest the cashew from the plants rather than wait for them to drop. This affected the quality of Nigerian RCN in the international market. The peel-ability and the overall kernel out-turn ratio of induced cashew apples are usually poor. This is in line with the findings of Adeigbe et al. (2015), that poor quality of Nigeria RCN was associated with the complex effect of poor harvest and post-harvest handling of RCN, and the inherent genetic composition of the Nigerian cashew.

Also, in most instances, farmers sell the nuts right from the farm gate, and drying is left for the buyers to carry out. Raw cashew nuts normally take two to three days for the moisture content to be reduced. It is usually from 25% to 7% after sun-drying. Farmers have argued that drying the RCN doesn't bring any economic value to them, since wet or dried RCN acquire the same price from the buyers in Nigeria. In some areas, dried RCN even acquires less economic value compared with wet nuts, particularly, if farmers store the nuts for some time before selling them to the local buying agents (LBA). Ezeagu (2002) emphasized that harvesting is a serious problem in Nigeria. He further noted that large quantities of RCNs are lost due to poor post-harvest handling, insufficient packaging, storage, and drying methods.

Adoption of vegetative propagation of cashew nuts trees

Following the Procashew project intervention, over 40,000 grafted seedlings were distributed across the country in 2022. However, maintaining grafted seedlings posed challenges to the farmers, despite the series of trainings held to ensure adequate maintenance on the farm. Amanouido et al. (2022) posited that vegetative propagation is the only means by which genetic characteristics of the mother trees can be maintained and plants produced will be homogeneous. It was further stated that grafting method is what is widely used in West Africa for vegetative propagation.

Cashew growers' socio-economic characteristics

Cashew farming was observed to be a male-dominated enterprise in all the regions in Nigeria (Adebayo et al., 2022; Akinpelu et al., 2021; Competence Centre Agribusiness, 2023; Pelemo, 2020). Also, the average age of cashew farmers was observed to differ across regions and across sampled populations. The average age of cashew farmers in Kogi State was reported to be 49-55 years (Agada & Sule, 2020; Pelemo et al., 2020), whereas Falaye and Ojo (2020) reported that 32.7% of cashew farmers in Kogi were between 41 and 50 years. Adebayo et al. (2022) reported that 73.3% of cashew farmers in Kwara State were over 61 years of age while, those in Oyo State were 53 years (Akinpelu et al., 2021). In 2008, Agbongiarhuoyi et al. stated that the average age of cashew farmers in Nigeria was 49 years

old, the same age reported by Lawal and Uwagboe in 2017. However, Oluyole et al. (2017) reported a much older age between 60-70 years. Reported in Competence Centre Agribusiness (2023), the average age of cashew farmers in Nigeria was 55 years. In summary, cashew is being cultivated by people in their fifties and sixties in Nigeria. This may be due to land tenure system in the country. It is easier for the elderly ones to acquire land while the younger ones acquired land commonly through inheritance. Agada & Sule (2020) observed that 93.3% of cashew farmlands were acquired through family or inheritance.

According to Agbongiarhuoyi et al. (2008), the major cashew producers are the small-holder farmers. Studies reported that majority of the cashew farmers cultivate an average of 5 acres of land dedicated for cashew farming (Pelemo et al., 2020; Akinpelu et al., 2021; Adebayo et al., 2022). Majority of these farmers had at most secondary education and they were highly experienced individuals in cashew farming with average yearly income of N150,000 (\$200 USD) from 5 acres (Adebayo et al., 2022; Pelemo et al., 2020).

Gender involvement in cashew production

The tediousness associated with agriculture has made it a male-dominated sector in Nigeria. Only 21.7% of cashew farmers were females (Adebayo et al., 2022). They stated further that the involvement of women in cashew production cut across fruit collection and picking, apple and nuts separation, and marketing.

Youth participation in cashew production

In most places in Nigeria, youth are involved as plots or farm managers. Whereas some youth own their farms especially in communities where there are enough lands available and in case of inherited farms. In a study conducted in Osun state in Nigeria by Ayinde et al. (2022), it was concluded that majority of youth involved in cashew production were male (83.3%) and 64.4% were single. They were mostly secondary school leavers (59.3%). The main reason for the involvement of youth was revealed to be unemployment in non-agricultural sectors (Ayinde et al., 2022).

Constraints to the adoption of improved cashew variety

According to Amanoudo et al. (2022), non-adoption of improved management practices is responsible for yield gap in cashew production. As earlier mentioned, majority of the cashew farmers completed up to primary education or no formal education (Oluyole et al., 2017; Agada & Sule, 2020; Adebayo et al., 2022). This greatly affects the adoption of improved varieties which is needed to boost cashew production in Nigeria. Adebayo et al. (2022), asserted that education plays significant role in the management practices among farmers, and its absence or inadequacy will negatively affect the adoption of innovations or improved varieties. Our field observation and reports of experts (Competence Centre Agribusiness, 2023) revealed the constraints hindering the adoption of improved variety in Nigeria. Farmers are yet to be convinced about the low quality of Nigerian cashews in the international market. There is inadequate awareness of the constituents and the determinants of good and quality raw cashew nuts among farmers. Ezeagu (2002) posited that RCNs from Nigeria crashed in 1997 due to low-quality nuts emanating from poor farm management practices, inadequate knowledge of post-harvest handling, and lack of quality control mechanisms. This emanated from the practice of LBAs buying directly at the farm gate without conducting kernel out-turn ratio test (KOR) to assess the quality of the nuts or encouraging the farmers to harvest nuts following good agricultural practices (GAP). The main interest of the LBA is to maximize profits and transport nuts to aggregators, without minding or testing for quality. These findings are in line with the observations of Agbongiarhuoyi (2020), who observed that majority (72%) of farmers sold RCN to LBA at farm gate and the interest of LBAs most of the time is to maximize profits. Similarly, Ezeagu (2002) stated that LBAs penetrate villages to acquire supplies of RCN. Agbongiarhuoyi (2020) further established that LBA is the major source of market information for farmers,

but this may not provide farmers with the needed information to maximize their gains. More so, Ezeagu (2002) asserted that the greatest problem of cashew nuts in Nigeria is the quality of the produce. This led to reduction in the price of RCN from Nigeria in international market which was 30% below what RCN from Tanzania acquired.

Also, level of awareness on improved varieties of cashew is low among the farmers in Nigeria, which hinders the adoption of improved varieties by the small-scale farmers. Similarly, Kakwagh et al. (2023), in their study in Kogi State mentioned that majority of farmers did not have knowledge of high-yielding varieties of cashew nuts, and that the farmers depend mostly on wild cashew trees that yield small nuts which were sold for little amount. Furthermore, Okogbaa et al. (2018) asserted that farmers in Lafia-Nigeria lack awareness of cashew production, potential uses, economic value, and post-harvest handling, as well as preservation of cashew apples.

However, the Procashew project intervention is currently working on this to change the narrative by ensuring that farmers are adequately aware of improved varieties and get trained on GAP. Similarly, most farmers believe in the result demonstration, that is, they prefer to first see the improved varieties planted and yielded before they can be adopted. More so, most farmers are used to avail free seeds (either sourced from their farms or relative farms) because buying improved variety at an average of N200 (\$0.137) per seedling is a bit difficult for them. Land availability is also another constraint to planting new varieties. Sequel to the economic benefits associated with cashew production, farmers have utilized almost all the available lands within their communities for cashew production. In some communities, farmers have been prevented from cultivating cashew to have land available for arable crops cultivation and other uses. Ezeagu (2002) posited that land acquisition is one of the constraints of cashew production in Nigeria. Furthermore, theft and vandalism also pose challenges to the adoption of improved varieties in some areas. In many communities, cashew nuts are stolen at night. Likewise, cattle headers either set the farm on blaze or left the farm to be eaten up by cattle, especially during the dry season. According to Ewetola et al. (2022), 57.6% of the farmers considered theft as part of factors limiting the production of quality RCN in the study area.

Conclusion

Nigeria has good edaphic and ecological factors that favor raw cashew nuts production in most states of the federation, however, crude management practices are still being used by farmers in the establishment of the cashew farms. Most of the farms were established with the use of harvested cashew nuts which limit the production rate of the cashew nuts in the country. Vegetative propagation is yet to be adopted by most farmers in the country. Majority of cashew farmers are in their fifties and experienced in cashew cultivation. It is therefore recommended that awareness and training should be organized by relevant stakeholders in the cashew industry for the farmers to foster the adoption of improved management practices, and the youths should be motivated to engage in cashew cultivation.

Disclosure Statement

No potential conflict of interest was declared by the authors.

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