Research Article

Potentials and Challenges of Kolanut Production in Niger State, Nigeria

I. Ndagi, F. D. Babalola, I. U. Mokwunye, C. F. Anagbogu, I. A. Aderolu, O. Ugioro, E. U. Asogwa, M. Idrisu, and F. C. Mokwunye

1 Cocoa Research Institute of Nigeria, Ibadan, Nigeria
2 Department of Forest Resources Management, University of Ilorin, Ilorin 240003, Nigeria

Correspondence should be addressed to F. D. Babalola, folababs2000@yahoo.com

Received 2 April 2012; Accepted 22 April 2012

Academic Editors: S. Thompson and S. Tsushima

Niger State has unique history of kolanut production in northern part of Nigeria. Unfortunately, the potentials of kolanut production in the state are not duly recognized. Lavun and Mokwa Local Government Areas, where kolanut is widely produced were selected for the study. Kolanut farmers were randomly selected for administration of structured questionnaire. Cola nitida was the dominant species planted by the farmers. More than two thirds of the kolanut plantations were 60 years and above. Kolanut farms were mainly owned through inheritance. Farmers at Lavun adopted more cultural practices than the farmers at Mokwa; such practices included application of organic manure and mulching to the kolanut trees, felling of unproductive kolanut trees to coppice, and adoption of multiple land practice. Due to this, the farmers at Lavun got more harvest from their kolanut plantations than those at Mokwa. Stored nuts were mainly attacked by weevils and rot disease. Challenges of kolanut production are low yield, lack of information on improved technology, pest and disease infestation, lack of intervention from the government, and transportation. Farmers in the study areas still hold kolanut production in high esteem, and there is vast area of land which could be used for kolanut production.

1. Introduction

About 40 Cola species have been described in West Africa; however, the Cola species of economic importance in Nigeria are C. acuminata and C. nitida [1–4]. Both species are important economic crops in the forest areas of West and Central Africa, Carribean Islands, Mauritius, Sri Lanka, and Malaysia [5]. Kolanut is an important economic cash crop to a significant proportion of Nigerian population who are involved in kolanut farming, trading, and industrial utilization. Kolanut has for hundreds of years served as an important article of internal trade in Nigeria and other parts of Africa [6]. It has been an item of trade in West Africa and in the trans-Saharan trade routes for many centuries [7]. Nigeria accounts for about 70 percent of the total world production of kolanuts [1, 8, 9].

While the demand is rising, the production remains low because many of the trees in Nigeria are unfruitful or have very low yield due to self-and-cross incompatibility among trees, partial and total sterility, inefficient natural pollination, old age, field and storage pests, and diseases [2, 9–11]. About 90% of the kolanut produced in Nigeria is consumed within the country while 10% is exported [1]. The cultivation of kolanut in Nigeria is ecologically limited to the rain forest zones of the southern and riverine areas of the Savannah region.

Kolanut is used as a masticatory stimulant by Africans and has numerous uses in social, religious, ritual, and ceremonial functions by the natives in the forest region of Africa [12]. It is used during ceremonies related to marriage, child naming, installation of Chiefs, funeral, and sacrifices made to the various gods of African mythology [2, 6, 13]. There is also increasing demand for its usage in pharmaceutical industries and for production of soft drinks, wines, and candles [14, 15]. Its uses have inevitably created a high demand in excess of its production [16].

According to Asogwa et al. [12] there is an abundance of soils of high, medium, and low fertility that can be...
strategically exploited for kolanut cultivation in an effective land utilization policy in Nigeria. Such suitable soils have long been identified in the following parts of the country: (1) southwestern states, (2) Edo State (most of the southern part), (3) Delta State (most of the non-riverine areas), (4) southeastern states, (5) Cross River State (most parts of the state), (6) Akwa Ibom State (most parts of the state), (7) Rivers State (the non-riverine areas), (8) Kwara State (Ilorin area), (9) Kaduna State (Zaria area), (10) Adamawa State (the southern parts of the state), (11) Kano State (areas around rivers and streams if irrigation is provided, especially during establishment stages), (12) Niger State (Mokwa and large areas of the upper part of River Niger, provided irrigation is available), (13) Benue/Plateau/Kogi States (Oturkpo and Kabba areas, and (14) Nassarawa State (Lafia area) [12, 13]. These suitable soils scattered all over the country should be utilized for new plantings of improved kolanut seedlings to ensure high production of kolanuts for export.

Despite its endowment in soil resources suitable for kolanut production, as well as long history of kolanut production in Nigeria, Niger State has not been given due recognition. Kolanut farmers in the state have also been facing a number of challenges in term of production and marketing of kolanuts. This study therefore evaluates the potentials and challenges of kolanut in Niger State, Nigeria.

2. Methodology

2.1. Description of the Study Area. Niger State is located in North Western part of Nigeria between latitudes 8°20′N and 11°30′N and longitudes 3°30′E and 7°20′E. Currently, the state covers a total land area of 76,000 sq-km or about 9 percent of Nigeria's total land area. This makes the state the largest in the country. By reason of its location and its climate, soil, and hydrology, Niger State has the capacity to produce most of Nigeria's stable crops. The state experiences two distinct seasons: the dry and wet seasons. The annual rainfall varies from about 1,600 mm in the south to 1,200 mm in the north. The duration of the rainy season ranges from 150–210 days or more from the north to the south. Mean maximum temperature remains high throughout the year, hovering about 32°F, particularly in March and June. However, the lowest minimum temperatures occur usually between December and January when most parts of the state come under the influence of the tropical continental air mass which blows from the north. Dry season in Niger State commences in October [17].

Agriculture is the back bone of the economy of Niger State as nearly 90 percent of the population depends either directly or indirectly on it for their livelihood. With only about 10 percent of the state's arable land being cultivated, in addition to the favourable climatic conditions, unique opportunities exist in the state for the establishment of large scale farms [17].

2.2. Sampling Technique and Population. Multistage random sampling technique was used for the study. Two local government areas (LGAs) where kolanut is produced were selected; they include Lavun and Mokwa. Five communities were randomly selected in each of the LGAs. The communities selected in Lavun include Edogi, Emi-Kuta, Pategi, Shesi, and Tswasun, while those selected in Mokwa are Ezhi, Kpaki, Labozhi, Nakupa, and Takuma. The respondents for the study were mainly kolanut farmers. Ten farmers were randomly selected in each of the communities, but response gotten in Lavun and Mokwa are 48 (96%) and 47 (94 %), respectively (Table 1).

2.3. Data Collection. Primary data was mainly used for the study. Data was collected through the use of structured questionnaire, interviews, and focus group discussion. Prior to commencement of the study, contacts to farmers were made through phone calls and dates were fixed for meeting and visitation. All the respondents had kolanut farms, with many years of kolanut production and marketing. To be able to analyze the data as efficient as possible and with the least bias, structured questionnaire was developed for data collection. Farm visits were embarked upon to form the questionnaire administration and assess the composition of the kolanut farms as well as the cultural practices employed by the farmers in their operations. Personal interview was organized for selected key informants. Tape recording of conversation during the interviews was also made. Focus group discussions were also organized for some group of farmers on the farmers.

2.4. Data Analysis. Data collected through the questionnaire was coded and analysed using descriptive statistics. Information collected through tape recording was properly transcribed.

2.5. Demographic Information on Kolanut Farms. As presented in Table 2, the demographic characteristics of the farmers in both Lavun and Mokwa LGAs are almost the same. About 89.4% and 87.5% of the farmers were married in Mokwa and Lavun, respectively. All the farmers in both locations are males; this might not be unconnected to the fact that kolanut production is a family enterprise with the head of the family (the father in most cases) being the owner. The rest of the family members assist in the production activities ranging from weeding to harvesting and processing of the prods.

About 70.2% and 52.1% had no formal education in Mokwa and Lavun, respectively, and the majority were old with larger percentages around 50 years and above (Table 2). Many of the farmers were in their old age and did not acquire formal education. Although the old age may mean high level of experience in kolanut production; however,

| LGAs    | Sample size | Response | Response rate (%) |
|---------|-------------|----------|-------------------|
| Lavun   | 50          | 48       | 96                |
| Mokwa   | 50          | 47       | 94                |

TABLE 1: Response rate of the farmers from the two selected Local Government Areas.
the implication is that the experience is at the local level without any exposure to the use of improved and modern technology in the production. This issue of old age is further complicated with low level of formal education; this may slow down the adoption process of modern technologies and scientific research. Lack of formal education by the farmers does not in its entirety translate to lack of knowledge. The farmers have gathered valuable knowledge on all aspects of kolanut production over the years. This could assist in the development of scientific technologies; both the formal and informal knowledge should therefore complement each other. The researchers should work with the local farmers in developing improved varieties of kolanut that is not only very productive but also acceptable by the farmers.

2.6. Local History of Kolanut in Niger State as Told by Farmers in Labozi Community. History of kolanut production in northern part of Nigeria was traced to Labozi located in Mokwa LGA of Niger State, and most especially the significant role played by a woman named Nnakogba. It was told that some merchants were passing through Labozi and made a stopover with the intention of cooling off. On that faithful day, the housewife (Nnakogba) was alone at home because her husband has gone to the farm. She gave the merchants warm welcome and some water to drink; in return the merchants gave her kolanut. That was the first time kolanut was brought to the village and nobody knew what it was used for. Having received the kolanut, she kept it until her husband returned from the farm. She gave the kolanut to the husband, also because he did not know what to do with it, he planted the nut somewhere beside the house. The nut indeed germinated and grew into a full tree which started bearing fruits. The research team was taken to the site where the first kolanut tree was planted, the tree was found still alive. The community informed that each time the tree is very old, before it dies it is coppiced (develop a young seedling) around the base to regenerate. Along the line, through trade and cultural interaction, people started to know what kolanut is used for and its economic importance. Planting of the kolanut seedling started expanding from scattered trees on farmlands to plantations. Kolanut trade then became important produce in the economy of the village by generating bulk of the household incomes. Traders came from various parts of the northern Nigeria to purchase kolanut at Labozi. Labozi eventually became popular as the major kolanut production zone in the northern Nigeria. It is generally believed that the seedlings of kolanut were taken to other parts of the state and northern Nigeria from Labozi.

After her demise, Nnakogba was immortalized by building a shelter over her burial ground which is just about 50 meters to the site of the first kolanut tree in the community. The entire community sets aside a day every year for her remembrance and to offer prayer to God. The day is usually filled with celebration for the whole community and was observed in 2011 when this study was conducted.

It is interesting to note that there are private establishment of kolanut plantation in Niger State. Large scale plantation of improved kolanut trees with improved and high yielding variety have been established around Labozi. Here, people were employed to meet the demand of large scale production.

2.7. Production Characteristics and Composition of Kolanut Farms

(1) Kolanut Plantation. Unlike in the southeastern Nigeria, where it was reported by Asogwa et al. [18] that there is no contiguous kolanut plantation, there are large plantations of kolanut in Niger State. However, majority of the kolanut farmers did not keep record of the sizes of their plantation. Plantations within the study areas were old (Table 3). More than two third of the plantations in both Lavun and Mokwa were around 60 years and above. A number of the farmers informed that their plantations were handed over to them and actually planted by their parents. Few of the old farmers that mentioned that they personally planted their kolanut plantations did the planting while they were young. One of the farmers categorically informed that one of his kolanut plantations was planted more than 100 years ago by his parent and the one he personally planted was up to 70 years. Plantations within the study areas were old (Table 3). More than two third of the plantations in both Lavun and Mokwa were around 60 years and above. A number of the farmers informed that their plantations were handed over to them and actually planted by their parents. Few of the old farmers that mentioned that they personally planted their kolanut plantations did the planting while they were young. One of the farmers categorically informed that one of his kolanut plantations was planted more than 100 years ago by his parent and the one he personally planted was up to 70 years.

(2) Species of Kolanut Planted. All the sampled farmers planted Cola nitida and none indicated Cola acuminata (Table 3). The major physical difference between C. nitida and C. acuminata is that the former normally have two

| Table 2: Demographic information on kolanut farms in Niger State, Nigeria. |
|-----------------------------|-----------------------------|-----------------------------|
| S/N | Characteristics | Lavun | Mokwa |
|---- |-----------------|-----------------|-----------------|
| (1) | Marital         |                 |                 |
|     | (i) Single      | 6               | 5               | 10.6 |
|     | (ii) Married    | 42              | 42              | 89.4 |
| (2) | Gender          |                 |                 |
|     | (i) Male        | 48              | 47              | 100 |
|     | (ii) Female     | 0               | 0               | 0   |
| (3) | Education       |                 |                 |
|     | (i) No formal   | 25              | 33              | 70.2 |
|     | (ii) Primary    | 18              | 10              | 21.3 |
|     | (iii) Secondary | 5               | 4               | 8.5 |
|     | (iv) Tertiary   | 0               | 0               | 0   |
| (4) | Age (years)     |                 |                 |
|     | (i) <20         | 0               | 2               | 4.3 |
|     | (ii) 21–30      | 5               | 3               | 6.4 |
|     | (iii) 31–40     | 3               | 2               | 4.3 |
|     | (iv) 41–50      | 10              | 5               | 10.6 |
|     | (v) 51–60       | 10              | 15              | 31.9 |
|     | (vi) >60        | 20              | 20              | 42.6 |

Lavun Mokwa
n = 48 %
47 %

(1) Kolanut Plantation. Unlike in the southeastern Nigeria, where it was reported by Asogwa et al. [18] that there is no contiguous kolanut plantation, there are large plantations of kolanut in Niger State. However, majority of the kolanut farmers did not keep record of the sizes of their plantation. Plantations within the study areas were old (Table 3). More than two third of the plantations in both Lavun and Mokwa were around 60 years and above. A number of the farmers informed that their plantations were handed over to them and actually planted by their parents. Few of the old farmers that mentioned that they personally planted their kolanut plantations did the planting while they were young. One of the farmers categorically informed that one of his kolanut plantations was planted more than 100 years ago by his parent and the one he personally planted was up to 70 years.

(2) Species of Kolanut Planted. All the sampled farmers planted Cola nitida and none indicated Cola acuminata (Table 3). The major physical difference between C. nitida and C. acuminata is that the former normally have two
Table 3: Production characteristics of kolanut in Niger State, Nigeria.

| S/N | Characteristics                                   | Lavun  | Mokwa |
|-----|---------------------------------------------------|--------|-------|
|     |                                                   | Freq   | %     | Freq   | %     |
| (1) | Age of kolanut plantations                        |        |       |        |       |
| (i) | <20                                               | 3      | 6.3   | 0      | 0     |
| (ii)| 21–30                                             | 3      | 6.3   | 3      | 6.4   |
| (iii)| 31–40                                             | 5      | 10.4  | 5      | 10.6  |
| (iv)| 41–50                                             | 6      | 12.5  | 5      | 10.6  |
| (v) | 51–60                                             | 10     | 20.8  | 11     | 23.4  |
| (vi)| >60                                               | 21     | 43.8  | 23     | 48.9  |
| (2) | Species of kolanut planted                        |        |       |        |       |
| (i) | Cola nitida                                       | 48     | 100   | 47     | 100   |
| (ii)| Cola acuminata                                    | 0      | 0     | 0      | 0     |
| (3) | Land acquisition                                  |        |       |        |       |
| (i) | Purchase                                          | 2      | 4.2   | 0      | 0     |
| (ii)| Inheritance                                       | 42     | 87.5  | 45     | 95.7  |
| (iii)| Lease/rent                                        | 4      | 8.3   | 2      | 4.3   |
| (4) | Deliberate planting of crops within kolanut plantation |        |       |        |       |
| (i) | Yes                                               | 43     | 89.6  | 2      | 4.3   |
| (ii)| No                                                | 5      | 10.4  | 45     | 95.7  |

cotyledons while the latter have more than two cotyledons. In some cases, the latter may also have two cotyledons, but could be differentiated with taste, among other characteristics. The farmers noted that *C. nitida* is with high demand and the taste of *C. nitida* is preferred to *C. acuminata*; the latter is slimy when eaten. Moreover, *C. nitida* was the main species planted in the plantation and handed over to the farmers.

(3) Farm Ownership Structure. Kolanut farms were mainly owned through inheritance (Table 3). Majority of the plantations were planted by the head of the family, mainly the fathers (sometimes forefathers) and handed over to the children. In some cases, the head of the family may allocate land to the children for kolanut production. At survival of such seedlings, the farm belongs to the child that established it. Whichever the case, the land on which the kolanut is planted is a family land transferred to the bona fide member of that family.

(4) Intercrop with Kolanut. As indicated in Table 3, there are some differences among the farmers in planting of crops within the kolanut plantations. Farmers in Lavun deliberately planted some crops within kolanut plantation. Some of the crops planted within the kolanut plantations include cocoyam, plantain, and pineapple, among others. Farmers in Mokwa informed that they did not plant crops within the kolanut plantation; however, some food and economic crops that naturally grew within the kolanut plantations, for instance oil palm, banana, and plantain, may be deliberately spared. The justification for not planting many crops within kolanut plantation was the issue of shade that hinders sunshine penetration, thereby leads to poor crop growth.

2.8. Practices and Activities Involved in Kolanut Production

(1) Planting Stocks. Farmers do not intentionally plant kolanut to establish new plantation, rather scout for the young seedling under old plantations. Matured pods that dropped from kolanut trees and were not picked germinate under rotten leaves on the floor of kolanut plantations. Farmers transplant the seedlings during rainy season to already prepared site. On the new site, the seedlings were nourished until fully established.

(2) Fruiting. As informed by the farmers, kolanut tree fruits two times in a year—May/June and November/December. The major harvest season is the later, while mild harvest is usually in May/June.

(3) Harvesting Technique. Mass harvest was mainly employed by the farmers. Dropping fruit is indicative of maturity of pods, hence harvesting commences. All the pods on a tree are harvested once by plucking. Single harvest was adopted due to the fear of pilfering. Some of the farmers in Lavun inform that they prefer to harvest all the pods before it is fully matured; this is to prevent attack by the insects and germination while in storage. It was gathered
that an average farmer in Lavun can harvest up to 30 bags (50 kg bag) of pods from his kolanut plantation per season. This can be between ₦25,000–30,000 per bag.

(4) Labour on Plantations. As shown in Table 4, the use of family members and relatives was the main labour employed by majority of the farmers in Mokwa (74.5%) and Lavun (58.3%). Stage of production that demanded highest labour was during harvesting, and the reason for this was as a result of the mass harvesting technique employed by the farmers.

(5) Processing of Kolanut Pods. After plucking, the farmers cut open the pods with knife or cutlass to remove nuts embedded in the husks. The nuts at this stage are still covered with skin or coat; this is soaked in water for about 24 hours to aid fermentation. Fermentation is complete when the skin is soft, this is then removed with hand, washed, and drained.

(6) Storage and Preservation. The washed and drained nuts are covered in basket with leaves to undergo curing. Leaves of plant locally called finiko (at Labozhi) or plantain/banana leaves (in many places) is used to line basket before the nuts are carefully arranged, thereafter the leaves are used to cover the top. Farmers in Lavun used polythene nylon instead of basket to store the nuts before sale. To preserve the nuts in storage from insect attack, a number of methods are adopted by the farmers. In Mokwa, especially in Labozhi, some of the farmers informed that little quantity of Gammalin 20 EC (organochlorine) is diluted in water used to finally wash the nuts before storage. Moreover, some of the farmers said some quantities of lime (small and bitter citrus) are cut opened and put on top of the basket containing the nuts before finally covering with dried plantain or banana leaves. Farmers at Lavun informed that they do not put the Gammalin directly to the kolanut while in storage, rather they used it to form circle on the floor around the polythene nylon in which the kolanuts are packed.

(7) Regeneration of Old Kolanut Trees. At Mokwa, farmers informed that they do not cut the old kolanut trees but allow them to continue to fruit. When a tree is very old, it naturally falls either by wind or rain. Meanwhile, before it dies, it would have developed young seedling(s) around the base (coppice). These young seedlings are taken care of while the old stem and crown cutoff are used as firewood. On the other hand, farmers in Lavun informed that they establish few hectares of new kolanut stands almost every year and they adopt cultural practices in their old kolanut farms in the form of deliberately felling of unproductive kolanut trees to initiate coppicing and new shoot from the old stump, thereby facilitating another cycle of production (Table 5). Out of the sprouted young shoot(s) on the old stump, one or two considered to be most promising or appeared very strong are allowed to develop into full tree(s) while others are pruned.

(8) Soil Improvement. Old kolanut trees need adequate soil improvements as a result of nutrient mining. Farmers in villages around Lavun applied mixture of cow dung and chaff of rice as organic manure to improve the soil (Table 5). On the contrary, farmers in Labozhi informed that they neither apply organic or inorganic fertilizer to their kolanut plantations because they believe that their land is still very rich in nutrient, although some later complained of lack of money to purchase the fertilizers. In addition, they did not apply organic or inorganic fertilizers and pesticides in their kolanut farms.

2.9. Pest and Other Attack of Kolanut in Storage

(1) Kolanut Weevil. The major pest of kolanuts informed by farmers was kolanut weevil. Kolanut weevils are major pest of kolanuts both prior to the harvest and during storage [3, 4, 13, 19–21]. Kolanut weevil was also discovered by Asogwa et al. [22] as the most destructive insect pest of kolanut in kolanut growing belt of Nigeria. The kolanut weevils Balanogastria kolae and Sophrorhinus spp. (Coleoptera: Curculionidae) are the most destructive field-to-store pests of kolanuts in West Africa [2, 23]. The kolanut weevils is identified as field-to-store pests of kolanut capable of causing 30–70% damage on the stored nuts, while 100% damage has been recorded in cases of late harvest and in storage [23]. A study conducted by Esther et al. [24] also discovered significant loss in weight and caffeine content of kolanut in storage due to weevil attack. The high significant level of weevil damage on stored kolanuts has been attributed to the favourable storage conditions, which encourage continuous development of various instar stages of the kolanut weevil within field infested nuts [23–26]. It was reported by Asogwa et al. [22] that farmers and kolanut vendor use banned and dangerous pesticide such as Gamalin 20 EC (organochlorine) and other synthetic insecticides to drastically reduce infestation by kolanut weevils on stored kolanuts. Unfortunately, this practice poses great danger to health as kolanut does not undergo any other formal processing before consumption.

(2) Mould/Fungal Attack. Some of the farmers at Lavun reported rottenness of the nuts subsequently producing foul odour while in storage. This could easily be attributed to

| S/N | Characteristics | Lavun Total | Lavun Freq | Mokwa Total | Mokwa Freq |
|-----|----------------|-------------|------------|-------------|------------|
| (1) | Major labour used on-farm | | | | |
| (i) | Paid labour | 12 | 25 | 2 | 4.3 |
| (ii) | Family and relatives | 28 | 58.3 | 35 | 74.5 |
| (iii) | Colleague and friends | 8 | 16.7 | 10 | 21.3 |
| (2) | Stage of production with highest labour | | | | |
| (i) | Weeding | 5 | 25 | 0 | 0 |
| (ii) | Harvesting | 10 | 50 | 5 | 100 |
| (iii) | Processing | 5 | 25 | 0 | 0 |
either rotten of immature kolanuts or attack by mould. Rotten nuts may initiate development of mould and fungus [27, 28]. The growth of the mould could subsequently lead to production of Ochratoxin A (OTA) in kolanut. However, the incidence of OTA in kolanut has been reported by Dongo et al. [29]. OTA is a toxic metabolite produced by a few moulds, mostly in the general Aspergillus al. [29]. The growth of the mould could subsequently lead to colonization of crops in the field or after harvest [29]. The constant ingestion of food or its products contaminated with OTA poses a potential threat to both human and animal health. OTA is reported to be carcinogenic [30], immunotoxic [31], genotoxic [32], immunosuppressive [33], and nephrotoxic [34]. There is also reduction in the nutritional quality of healthy kolanuts when attacked by mould. Agheniyi and Ayodele [35] discovered a decrease of 42.9% of moisture content and 54.4% of crude protein and fat content in infected kolanuts by fungus when compared with the healthy ones. High moisture content of 54–64% in kolanut enhances infected kolanuts by fungus when compared with the healthy content and 54.4% of crude protein and fat content in healthy kolanuts when attacked by mould. Agbeniyi and Ayodele [35] discovered a decrease of 42.9% of moisture content and 54.4% of crude protein and fat content in infected kolanuts by fungus when compared with the healthy ones. High moisture content of 54–64% in kolanut enhances its susceptibility to fungus infection [15]. Subsequently, curing of kolanut at 30°C for 48 hours was recommended prior to storage [36].

(3) Ants. Another insect reported by the farmers was tailor ant locally known as salamo. This ant poses great challenge to harvesting of the pods as well as damage to leaves of kolanut trees. It was reported by Asogwa et al. [18] that tailor ants Oecophylla longinoda Lat. (Hymenoptera: Formicidae) weave kolanut leaves to build nest and scale insect are sometimes harbored in these nests for protection against natural enemies. These ants are both agents of dissemination and sources of inoculum for some pathogens [37]. High rate of ant incidence in most cases constitutes great nuisance as they bite the farmers and thus disturb normal cultural work on the farm.

(4) Parasitic Plants. Kolanut trees were observed to be attacked by some parasitic epiphytes in the plantations. Parasitic epiphytes have been recorded on the kolanut trees [38]; however, epiphytic plants are associated with old kolanut trees. According to Asogwa et al. [18], the two mistletoes identified with kolanut trees in southeastern Nigeria are Phragmanthera incana and Tapinanthus bangwensis. Mistletoes sometimes take over the foliage of the trees, thereby reducing the photosynthetic activities. The mistletoes are usually transmitted by birds, which feed on the ripe attractive reddish berries [18]. Room [39, 40] reported that the birds normally feed on the succulent pericarp of the berries and then drop their sticky seeds on the branches of kolanut trees, where they latter germinate and grow into full mistletoe plant.

2.10. Marketing of Kolanut. Marketing of kolanut is still a lucrative business. The trade of kolanut in the country dates back to ancient times. There is a common saying in Nigeria that “kolanut is produced in the West by Yorubas, consumed in the North by Hausas and worshiped in the East by Ibos” [18]. However, it was observed that a significant portion of kolanut is also produced in Niger State, located in the northwestern part of Nigeria. Also, the internationally recognized C. nitida is mostly produced in the state, unlike the C. acuminata mainly produced in the southeast of Nigeria. For the marketing of kolanut in the sampled LGAs, the farmers informed that buyers come as far as from adjoining states and cities such as Sokoto, Zaria, Kaduna, and other northern states of Nigeria to buy the kolanut. There are local markets where the kolanuts are assembled for middlemen to make their purchases. For instance, some of the major markets in Mokwa are located in Enagi, Mokwa, and Bida, among others.

The farmers at Lavun informed that middlemen used to come and make reservations for the kolanut prior to harvesting. The farmers indicated that this is an advantage because they do not need to transport the kolanut to the market. The concern about this method of marketing is that it could easily lead to exploitation of the farmers by the middlemen or accrued loss to the middlemen. To prevent exploitation, farmers must be conversant with the current market price to be able to make good bargain and profit, while the middlemen must gather enough nuts at good market price and cover the cost of transportation.

The final selling price of the nuts at the farm gate is reached through bargain between the farmers and the
2.11. Ways of Marketing Kolanuts

(i) Standing Trees. In this practice of marketing kolanut, both farmers and middlemen agreed on prices for each standing tree offered for sale in the plantation. Middlemen carry out the harvesting after purchase and transport to the final destination. Prices offered for the standing trees depend on how “heavy” the tree fruits and sizes of the pods are. Selling of kolanut through standing trees has been greatly reduced but was popular when kolanut trade was booming. Marketing through standing trees was adopted by farmers to reduce the stress of harvesting and transportation. However, this practice is fading out these days as a result of the challenge of low yield experienced in Mokwa and reduced marginal profit to the farmers in Lavun. Farmers therefore preferred to personally harvest and sell in pods or nuts.

(ii) Basket of Mature Fruits (Pods). Unprocessed fruits (pods) are sold by the farmers to the middlemen in basket. Marketing of the unprocessed fruits requires some level of experience on the part of both the kolanut farmers and the middlemen in determining the value of the pods. On the part of the farmer, he needs to know the value of the unprocessed fruit he is offering for sale so as not to be cheated, while the middlemen need to deduce value of the final product after processing, possibly from pods that contain big nuts as compared to those with small nuts. As informed at Labozhi, a basket of pods was sold between N3,000 and N4,000. A farmer can get between 20 and 30 baskets per kolanut plantation in a season.

(iii) Nuts. Nuts are sold by counting, mainly in 100s at the plantation in a season. A farmer can get between 20 and 30 baskets per kolanut. Middlemen carry out the harvesting after purchase and transport to the final destination. Prices offered for the standing trees depend on how “heavy” the tree fruits and sizes of the pods are. Selling of kolanut through standing trees has been greatly reduced but was popular when kolanut trade was booming. Marketing through standing trees was adopted by farmers to reduce the stress of harvesting and transportation. However, this practice is fading out these days as a result of the challenge of low yield experienced in Mokwa and reduced marginal profit to the farmers in Lavun. Farmers therefore preferred to personally harvest and sell in pods or nuts.

2.12. Potentials of Kolanut Production. Despite of the low yield from kolanut plantations in majority of the study areas, the farmers still believe in future prospect of kolanut production in the state. This could be deduced from this statement made by a farmer in Labozhi:

...we actually believe that the future of kolanut in Labozhi is bright. If kolanut production in Labozhi is finally revived with the provision of improved seedlings varieties and necessary assistance by the government, kolanut traders all over the north will know and start to come back, the news that will spread like wildfire is “Labozhi don come back!”

Farmers and villagers in Lavun hold kolanut in high esteem to the extent that they turn against anybody that gives the impression of abandoning his/her kolanut plantation. Such a person is seen as enemy of progress.

As informed by the farmers, there is vast area of land which could be used for kolanut production. The farmers said that with the provision of improved and disease resistance varieties of kolanut and appropriate incentives like funding and inputs, they are ready to go back into full scale production. Farmers are also willing to improve their output by replanting their old kolanut plantations with high yielding varieties. If the kolanut business is revived and made attractive, most of the unemployed youths are potential kolanut producers.

2.13. Challenges of Kolanut Production

(i) Low Yield. Farmers sampled in Labozhi gave the main challenges facing kolanut production in their area to be drop in yield of kolanut trees resulting from old age. The few yields obtained are either consumed locally or sold if adequate. As a result of low return from the kolanut stands, farmers resolved at abandoning their kolanut farms for the production of annuals crops like maize, cassava, guinea corn, and vegetables (pepper, tomatoes, etc.), among others.

(ii) Lack of Information and Dissemination of Improved Technology. The farmers at all the study areas informed that they have neither received visitation from researchers and/or extension agents nor have there been introduction of new kolanut technology and innovation. The farmers also complained of researchers not working with kolanut farmers; this was mentioned because some researchers have been working and developing other agricultural crops in the area but not kolanut. Some of the farmers informed that few of the researchers that visited their area just came to collect information and return without coming back again. However, the farmers showed their eagerness in working with researchers in developing improved technologies on kolanut and acceptance of same when introduced to boost their production.

(iii) Unavailable of Improved Seeds/Seedlings. The farmers in Labozhi complained of unavailability of improved kolanut seed/seedlings for them to establish new plantations, thereby replacing the old plantations for improved yields. Farmers indicated that they are ready to buy improved seedlings if brought to them.

(iv) Attack of Fruits by Wild Animals. Farmers in Labozhi informed that monkeys are seriously reducing their harvest by feeding on the kolanut pods still on the trees. Monkeys come into the farms in groups when farmers are not around, jumping from trees to trees and feeding on kolanut pods. This is causing a great loss to the final harvest and accrued income.

(v) Water Logging. Some of the farmers in Labozhi community complained that too much rainfall has led to increase in the quantity of water in the soil, resulting in water logging, and consequently low yield of kolanut trees. Their belief is that too much water in the soil reduces yield of kolanut trees.
(vi) **Unavailable of Kolanut Farmers Association.** The farmers are not organized into any association or group, and this is causing disparity in the prices as well as organisation of the marketing network.

(vii) **Government Attitude toward Kolanut.** The farmers lamented about the lack of interest by the government and policy makers in developing kolanut sector.

(viii) **Transportation.** Farmers complained of unavailability of transport and high fare for the available one to convey their produce to and fro the farm. Most especially, farmers at Lavun complained of the high cost of hiring tractor to convey cow dung and rice chaff used as organic manure to their farms.

### 3. Conclusion

Farmers in the study areas still hold kolanut production in high esteem, and there is vast area of land that could be used to expand the production. Kolanut production is faced with lots of challenges ranging from the farms to the marketing channels. Kolanut farms are dominated with old stands, and this is seriously affecting total yield and output, while the nuts in storage are also facing pest and disease attack.

It is unfortunate to discover that kolanut farms received less care and attention in some areas than the other. For instance, farmers at Lavun gave more attention and adopted more cultural practices on the kolanut farms than the farmers at Mokwa. These practices include application of organic manure and mulching to the kolanut trees, regeneration of old kolanut trees through pruning and felling of unproductive kolanut trees to initiate coppicing, and adoption of multiple land practice to mention a few. Due to these efforts, the farmers at Lavun got more harvest from their kolanut plantations than those at Mokwa. This shows that with more care and adequate cultural practices, old kolanut farms still have the potential of increasing beyond the current output. However, for aggregate increase in yield and output of kolanut in Niger State, there is a need for urgent intervention in tackling the challenges faced by the kolanut farmers.

### 4. Recommendations

The following are recommended as interventions to improve kolanut production in the study areas:

1. **Government should give attention to kolanut production in already identified places with suitable soils, such as Niger State in this case, while policy makers formulate appropriate policy that could enhance production and marketing at both local and international levels.**

2. **Dissemination of newly developed technologies and innovation from research institutions are pertinent to facilitate improve kolanut production in the study areas.** Concerned research institutes, most especially Cocoa Research Institute of Nigeria (CRIN), that is given the national mandate of developing scientific technologies on kolanut, should work with local farmers in developing new varieties of kolanut and disseminating same. The researchers should be as practical as possible in working with the farmers.

3. **There should be provision of improved kolanut varieties to replace the species existing in most of the old plantations.** The existing species in most of the areas have low yielding capacity unlike the improved varieties already developed. Introduction of improved kolanut varieties, at either free or subsidized rate, is pertinent to attract the youths, resuscitate the kolanut sector as well as increase the yield of kolanut beyond the current level.

4. **Farmers should be assisted in provision of appropriate storage facilities for the kolanut.** This is pertinent to stop the usage of *Garma lin* used to prevent pest attack while in storage. The chemical is a poisonous substance that its usage as crop pesticide has been banned.

5. **Farmers should be assisted through the provision of tractor that they could use in conveying cow dung and rice chaff used as organic manure, especially at Lavun areas.**

6. **Efforts geared toward organizing kolanut farmers into association and/or cooperative are highly recommended.** Organizing the farmers into association and/or cooperative has the potentials of facilitating market coordination for local and international network, boosting the bargaining power as well as stability in the prices of the kolanut.

### Acknowledgment

The authors wish to acknowledge the support of the staff and management of CRIN.

### References

[1] T. Quarcoo, *A Handbook on Kola*, CRIN, Ibadan, Nigeria, 1973.

[2] A. M. Daramola, *Insect Pests of Cola in Nigeria (Research bulletin)*, vol. 3, CRIN, Ibadan, Nigeria, 1978.

[3] A. M. Daramola, “The biology of the kola weevils Balanogastris kolae on Cola acuminata and C. Verticilata,” *Insect Science and Its Application*, vol. 2, no. 4, pp. 201–205, 1981.

[4] A. M. Daramola, “Studies on the control of Kolanut weevils. *Balanogastis kolae and sorphorhinus Sp (coleopteran curculionidae),*” *Tropical Stored Products Information*, vol. 46, pp. 11–16, 1983.

[5] C. L. M. van Eijatten, *Kola, Its Botany and Cultivation*, vol. 59 of *Communication*, Royal Tropical Institute, Amsterdam, The Netherlands, 1969.

[6] O. Nzekwu, “Kola nut,” *Nigeria Magazine*, vol. 71, pp. 298–305, 1961.

[7] N. E. Egbe and O. Sobamiwa, “Utilization of cocoa, kola, coffee, cashew and tea in Nigeria,” in *Progress in Tree Crop Research*, pp. 217–224, CRIN, Ibadan, Nigeria, 1989.
[8] T. Quarcoo, “Development of kola and its future in Nigeria,” Proceedings of the Agricultural Society of Nigeria, vol. 6, 1969.
[9] V. I. Jacob, Yield characteristics, incompatibility and sterility studies in Cola nitida (Vent) Schott & Endlicher [Ph.D. thesis], University of Ibadan, 1973.
[10] O. A. Odigbaro, “Regeneration of old kola trees Cola nitida (Vent) Schott & Endlicher by coppicing,” Turrialba, vol. 23, no. 3, pp. 334–340, 1973.
[11] V. I. Jacob, “Self-incompatibility of Cola nitida,” CRIN Annual Report, vol. 70, pp. 16–22, 1969.
[12] E. U. Asogwa, J. C. Anikwe, and E.C. Mokwunye, “Kola production and utilization for economic development,” African Scientist, vol. 7, no. 4, pp. 217–222, 2006.
[13] L. K. Opeke, Tropical Commodity Tree Crops, Spectrum Books Limited, Ibadan, Nigeria, 2005.
[14] G. B. Beattie, “Soft drink flavours: their history and characteristics. 1: Cola for cola flavours,” The Flavour Industry, pp. 390–394, 1970.
[15] D. B. A. Ogutuga, “Chemical composition and potential commercial uses of kola nuts Cola nitida (Vent.) Schott & Endlicher,” Ghana Journal of Agricultural Science, vol. 8, pp. 121–125, 1975.
[16] M. A. O. Oladokun, “Objectives and achievements in Kola propagation. Research paper presented at a symposium to mark the 21st Anniversary of the Establishment of CRIN,” 1985.
[17] Niger State, Online Nigeria. Community Portal of Nigeria, 2003, http://www.onlinenigeria.com/links/nigeradv.asp?blurb=335.
[18] E. U. Asogwa, A. H. Otuonye, F. C. Mokwunye, K. A. Oluyole, T. C. N. Ndubuaku, and E. O. Uwagboe, “Kolanut production, processing and marketing in the South-eastern states of Nigeria,” African Journal of Plant Science, vol. 5, no. 10, pp. 547–551, 2011.
[19] A. M. Daramola and T. A. Taylor, “Studies on the reinestation of kola in store by kola weevils in Southern Nigeria,” Journal of Stored Products Research, vol. 11, no. 1, pp. 61–63, 1975.
[20] A. M. Daramola and T. A. Taylor, “A new species of weevil from Nigeria—Sporophrinius ghanjanensis (Coleoptera: curculionidae),” Journal of Natural History, vol. 9, pp. 397–402, 1975.
[21] A. M. Daramola, “Studies on the survival of the kola weevils between the seasons of kola production in southern Nigeria,” Turrialba, vol. 21, no. 3, pp. 309–310, 1974.
[22] E. U. Asogwa, T. C. N. Ndubuaku, and I. U. Mokwunye, “Occurrence of storage pest of kolanuts across the kola growing belt of Nigeria,” Agricultural Journal, vol. 3, no. 4, pp. 258–262, 2008.
[23] A. M. Daramola, The bionomics of kola weevils, Sporophrinius spp (Coleoptera: curculionidae) [Ph.D. thesis], University of Ibadan, Ibadan, Nigeria, 1973.
[24] W. Esther, A. M. Petu-Ibikunle, A. Audu, and Y. Y. Shallagwa, “Assessment of damage and losses to kolanuts caused by kolanut weevils Balanogastis kolae (Desbr) Coleoptera: curculionidae,” African Journal of General Agriculture, vol. 6, no. 1, pp. 1–5, 2010.
[25] M. F. Ivbijaro, “Gamma-BHC residues in kola nuts Cola nitida and control of the kola nuts weevil Balanogastrys kolae Desbr,” Indian Journal of Experimental Biology, vol. 15, no. 12, pp. 1236–1238, 1977.
[26] A. Ojo, “Identification of insect pests of Kola,” Annual Report, Cocoa Research Institute of Nigeria, Ibadan, Nigeria, 1979.
[27] A. C. Odebode, Post harvest rot of kolanuts caused by Botryodiplodia theobromae and Fusarium pallidoroseum [Ph.D. thesis], University of Ibadan, Ibadan, Nigeria, 1990.
[28] S. O. Agbeniyi, H. A. Otuonye, and A. R. Adeleji, “Mycoflora associated with post harvest processing stages of kola nut (Cola nitida Vent Scott and Endlicher),” The Journal of Food Technology in Africa, vol. 5, no. 4, pp. 129–131, 2000.
[29] L. N. Dong, K. Manjula, and S. B. Orisajo, “Occurrence of ochratoxin A in Nigerian kola nuts,” in Proceedings of the African Crop Science Conference Proceedings, vol. 8, pp. 2133–2135, 2007.
[30] G. Boorman, “Ed NTP Technical report on the toxicology and carcinogenesis studies of ochratoxin A (CAS No. 303-47-9) in F344/N Rats (Gavage Studies) (NIH Publication No. 1981),” Tech. Rep., National Toxicology program, U.S Department of Health and Human Services, Research Triangle Park, NC, USA, 1989.
[31] H. D. Haubek, G. Lorkowski, E. Koelsch, and R. Roeschenthaler, “Immunosuppression by ochratoxin A and its prevention by phenylalanine,” Applied and Environmental Microbiology, vol. 41, no. 4, pp. 1040–1041, 1981.
[32] S. Obrecht-Pflumio, T. Chassat, G. Dirheimer, and D. Marzin, “Genotoxicity of ochratoxin A by Salmonella mutagenicity test after bioactivation by mouse kidney microsomes,” Mutation Research, vol. 446, no. 1, pp. 95–102, 1999.
[33] K. Mayura, J. F. Edwards, E. A. Maull, and T. D. Phillips, “The effects of ochratoxin A on postimplantation rat embryos in culture,” Archives of Environmental Contamination and Toxicology, vol. 18, no. 3, pp. 411–415, 1989.
[34] M. Castegnaro, H. Bartsch, and I. Chernozemsky, “Endemic nephropathy and urinary tract tumors in the Balkans,” Cancer Research, vol. 47, no. 13, pp. 3608–3609, 1987.
[35] S. O. Agbeniyi and M. S. Ayodele, “Mycoflora in cocoa (Theobroma cacao L.) and mistletoe,” in Proceedings of the 3rd International Cocoa Research Conference in West Africa,” in Proceedings of the 3rd International Cocoa Research Conference, pp. 517–521, Accra, Ghana, 1970.
[36] P. M. Room, “Some physiological aspect of the relation between cocoa (Theobroma cacao) and mistletoe. Theobroma bangwensis. (Engl. and K Krause),” Annals of Botany, vol. 35, no. 1, pp. 169–174, 1971.
Submit your manuscripts at
http://www.hindawi.com