



Indigenous knowledge of rural communities on socio-economic use, propagation, biology of *Chrysophyllum albidum* in Osun State G. Don in Osun State, Nigeria

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Abstract

Chrysophyllum albidum G. Don is one of the most widespread indigenous fruit trees in Nigeria. It is a research that revealed existing native knowledge and socio-economic use of *C. albidum* to livelihood as a food complement and for income generation among community dwellers. The results from the study show that the main non-timber products that contribute to demand domestication are the fruits besides; fruit taste, size, and tree height are mainly the attributes desired by the rural communities for improvement. Intensive human pressure on *C. albidum* trees has resulted in deforestation and the local people do not have maximum stewardship of *C. albidum* trees in the forest reserve. Information on the indigenous knowledge of *C. albidum* trees provides a valuable foundation for domestication, propagation, and improvement of its fruit and tree attributes, and management problems in both co-managed and government forest reserves.

Keywords: *Chrysophyllum albidum*, Indigenous knowledge, Improvement, Socio-economic.

Introduction

Chrysophyllum albidum G. Don which is commonly known as the “African Star Apple” is natural to many parts of tropical Africa widely spread in West, Central and East Africa for its edible fruits and several ethnomedical uses¹⁻⁴. It belongs to the family Sapotaceae, has up to 800 species that make up almost half of the order and grows as a wild plant⁵. Ecologically, the nutrient cycling of the tree is efficient and the high rate of mineralization of the leaves improves the quality of the top soil⁶. Forest fruit tree species that provide Non-Timber Forest Products (NTFPs) such as *C. albidum* have vast domestic significance to both rural and urban dwellers in West Africa with great export potentials⁷. The fruit pulp is widely consumed and therefore plays a significant role in food security⁸. Onyekwelu *et al*⁹ stated that the fruits of *C. albidum* are used as a delicacy and alternative source of food, income and rural employment through the collection and its sale. Other parts of *C. albidum* such as leaves seeds, roots and bark are also used for medicinal purposes to cure diseases such as diabetes, ulcer, sterility, sexual weakness, blood pressure, asthma, etc¹⁰. The juice can be used as part of the components for the production of soft drinks, wine or other alcohol¹¹. It has a nutritive value that children and women in rural communities benefit from through consumption¹² and also have more ascorbic acid than fruits like guava, cashew and orange¹³. Its fruit is appreciated in countries like Nigeria and Ghana, in which some manufacturing industries get their raw materials and vitamins from¹⁴.

In recent years, local dwellers have been recognized as contributing significantly to the management of natural resources¹⁵ by way of retaining a lot of knowledge on the trees that are of great worth to them. In order to fulfill the aims of conservation and satisfy claims of utilization by the local population scientists and rural dwellers must be partners in the planning implementation and sustainability of *C. albidum* trees. Also in tree domestication the concept of conservation through utilization is also important¹⁶. *C. albidum* has been enlisted among the endangered tree species in Nigeria¹⁷, with a high probability of becoming extinct in the near future which will definitely affect millions of livelihood, especially the rural dwellers that depend on the species as a substitute for food medicinal uses and source of household income⁸. Hence there is a need to develop suitable domestication approaches and policies that will encourage conservation and utilization of the species sustainably.

Methodology

Study Area: This research was done in two (2) vegetation zones of Osun State which are tropical rainforest and derived savanna. Osun State which is an inland state was created in 1991 from old Oyo State located in the South-Western part of Nigeria. The state lies within latitudes .0° and 9.0°N, and longitude 2.8° and 6.8°E, covers a total land area of approximately 8,602km² and lies between 300 and 600m above the sea level with a largely gentle and undulating landscape and bounded in the north by Kwara State in the east partly by Ekiti state and partly Ondo State in the south by Ogun State, and in

the west by Oyo State. It is made up of thirty Local Government Areas (LGAs)¹⁸. Figure-1 presents the map of Osun State showing the two vegetation zones and the LGAs.

Selection of Communities: From the thirty (30) Local Governments Areas, the state is divided into 12 LGAs in tropical rainforest zone and 18 LGAs derived savanna vegetation zone respectively. From each of the vegetation zones (tropical and derived savanna), three LGAs (Ife North, Isokan and Atakumosa West) and five LGAs (Odo-Otin, Ede North, Iwo, Ejigbo, and Boripe) were purposively selected and, from each LGA, three communities were purposively selected based on the abundance of *C. albidum* trees, as revealed in Table-1.

Data Collection: Semi-structured questionnaires were used in this research. Through snowball sampling technique, data were collected from five households that have abundance of *C. albidum* on their farmlands and/or home gardens in each of the communities selected. The community dwellers were interviewed in the local dialect with the help of translator. Information was gathered on their demographic characteristics socio-economic uses, biology, and propagation of *C. albidum*. Location of the selected communities was achieved using GPS, and was used to generate a map through QGIS software as revealed in Figure-3.

Socio-economic Use: Information was gathered on the several uses of *C. albidum* and information relating to its marketing such as selling points, prices, annual income and quantity of the fruits that are sold after they are harvested. This research provides information on the economic importance of *C. albidum* tree for the livelihood of the people.

Biology and Propagation: Information on the phonological stages such as season of flowering, fruit setting, maturation, pests and diseases associated with *C. albidum*, and quantity of fruits produced per tree were collected. Also, data on the preferred attributes for tree and fruit improvement was collected.

Statistical Analysis: The feedbacks were coded and analyzed using a Statistical Package for Social Sciences (SPSS) 21.0. All data were analyzed using descriptive statistics.

Table-1: Distribution of LGAs and communities visited across the vegetation zones.

Vegetation Zone	LGAs	Communities Visited
Rainforest	Ife North	Abere, Ogbagba, Amosun Edon Aboh
	Isokan	Aworin Olode, Aba Oba Olokoyi, Mopa Oja
	Atakumosa West	Omi-funfun, Iyemogun, Ijana
Derived savanna	Odo-Otin	Opete, Igbaye, Ekusa
	Iwo	Igede, Abolukotan, Ode-Oba
	Ejigbo	Ilawo, Ejigbo, Araromi-Iwata
	Boripe	Ladoja, Oke-Apo, Odo-Ada
	Ede North	Timi-Agbaye, Oloba-Atapara, isibo

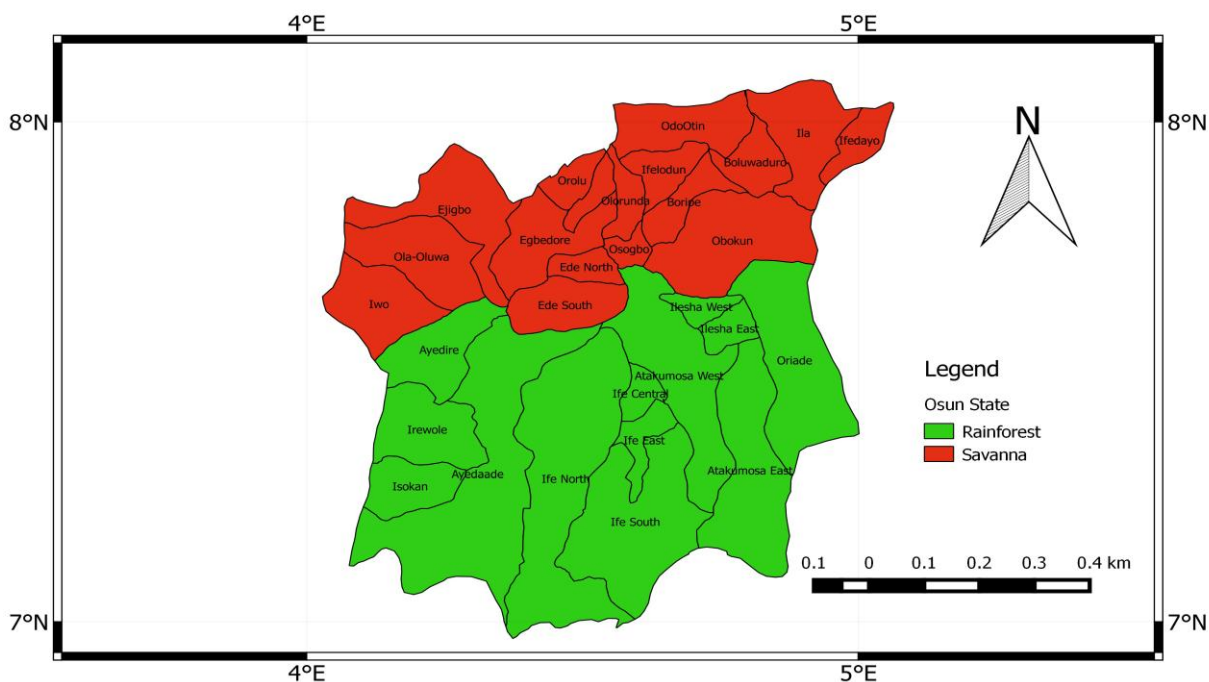


Figure-1: Map of Osun State showing the two vegetation zones and LGAs.

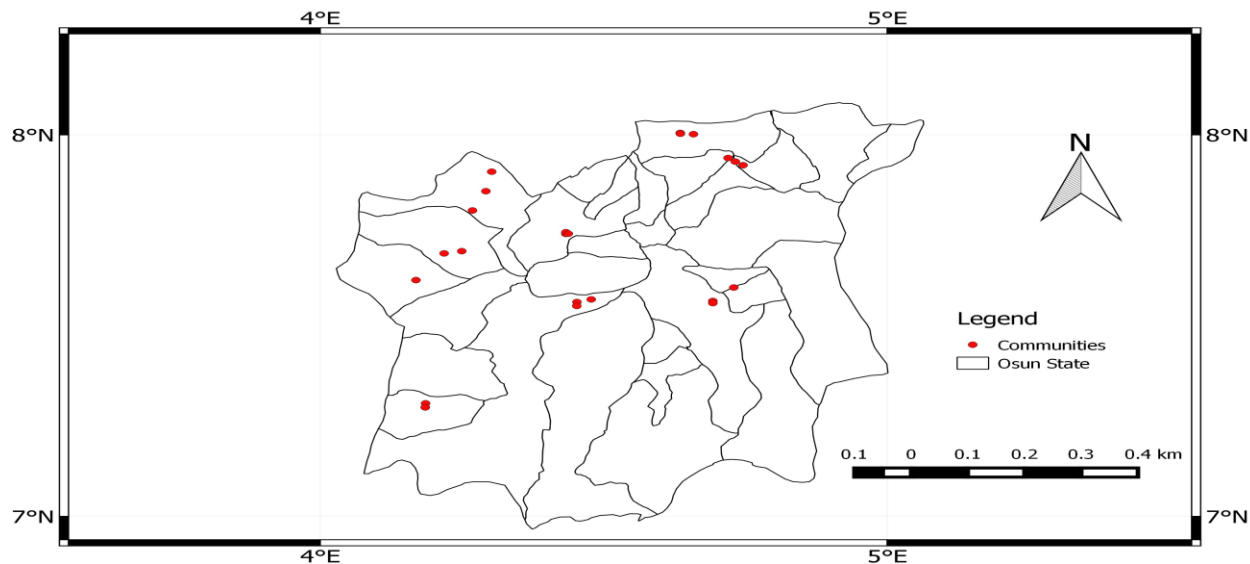


Figure-2: Distribution of communities visited (red dots).

Results and discussion

In the study area, a total of 8 LGAs, consisting of 24 communities and 120 household respondents were visited and sampled from the two vegetation zones. This study revealed that domestication of indigenous fruit trees emerged as a farmer-driven, market-led process and has become a significant initiative in the tropics^{19,20}, perhaps due to their nutritional and socio-economic importance.

In the rainforest and derived savanna zones, people who have *C. albidum* on their farms or in their home gardens are generally male and married, with an age range of 41 to 50 years (35.4 percent and 33.3 percent, respectively). This age range is active, according to Bolanle-Ojo and Onyekwelu²¹, ensuring an active labor force for the domestication of the species.

In the rainforest and savanna zones, respectively, 11.1% and 17.3% of respondents who owned *C. albidum* on their farmlands or in home gardens had no formal education. As a result, respondents without a formal education are more likely to live in the savanna habitat than the rainforest ecosystem (Table-2). Furthermore, the majority of responders in the rainforest zone have completed secondary school (46.7%).

As a result, the respondents' higher educational levels in the rainforest zone may have contributed to a higher level of domestication and improved *C. albidum* productivity in the ecosystem. On the other hand, as observed by Adekunle et al.²², a significant lack of education in the savanna zone might lead to increased deforestation of forest resources, which is a key threat factor for the species in the savanna ecosystem. Because it is simpler to raise awareness among educated individuals than among the uneducated, education may have an impact on future domestication of forest fruit tree species²¹.

Table-2: Demographic Information of Respondents.

Respondents	Variants	Rainforest (n=45)	Savanna (n=75)
		F %	F %
Age of Respondents	20-30 years	3 2.2	7 9.3
	31-40 years	10 22.1	13 17.3
	41-50 years	16 35.4	24 33.3
	51-60 years	15 33.1	17 22.6
	61-70 years	1 2.2	5 6.6
	71-80 years	0 0.0	7 9.2
	81-90 years	0 0.0	1 1.3
Highest Education Attained	No Formal Education	5 11.1	13 17.3
	Primary Education	18 40	46 61.3
	Secondary Education	21 46.7	15 20.0
	Tertiary Education	1 2.2	1 1.3

The results in Figure-3 show that the majority of *C. albidum* trees in both ecological zones are found on farmlands (rainforest and derived savanna). And none of the responders had been involved in the planting of *C. albidum* trees on purpose. The respondents' main reason for not planting the tree is based on a notion that they will die prematurely or immaturely, if the *C. albidum* tree is planted.

Socio-economic uses: According to the findings, *C. albidum* fruit trees contribute to a variety of socio-economic niches that help rural residents. *C. albidum* fruits provide for their fundamental subsistence needs. The multifunctional nature of *Chrysophyllum albidum* in the research region is revealed in Figure-4. *C. albidum* is used as food, income, and medication in the research region. In both ecological zones, food and medicine are the most common use categories among respondents (rainforest and savanna zones). This suggests that *C. albidum* fruits play an important role in local residents' livelihoods in both normal and drought years. This finding is consistent with previous research^{14,23,24}, which found that *C. albidum* trees have a wide range of uses. Houessou *et al.*⁹ also reported that the leaves of *C. albidum* were seldomly used as animal feeds or rotten or broken fruits were sometimes fed to pigs.

***C. albidum* Fruits' Cost in the Study Area (Rainforest and Derived savanna zones):** In the rainforest zone, the majority (88.9%) of respondents reported that the cost/basket of *C. albidum* fruits at the farmgate varied from ₦1,500 to ₦2,000, while 11.1 percent believed it was ₦1,500 to ₦1,800. In the derived savanna zone, 53.3% and 46.7% of respondents said the cost/basket of *C. albidum* fruits at the farmgate varied from ₦1,500 to ₦2,000 and ₦1,500 to ₦1,800 respectively.

More specifically, 93.40% and 6.6% of respondents said the cost/basket of *C. albidum* fruits ranged from ₦1,500 to ₦2,500 and ₦1,500 to ₦2,500, respectively, in the market as revealed in Table-3.

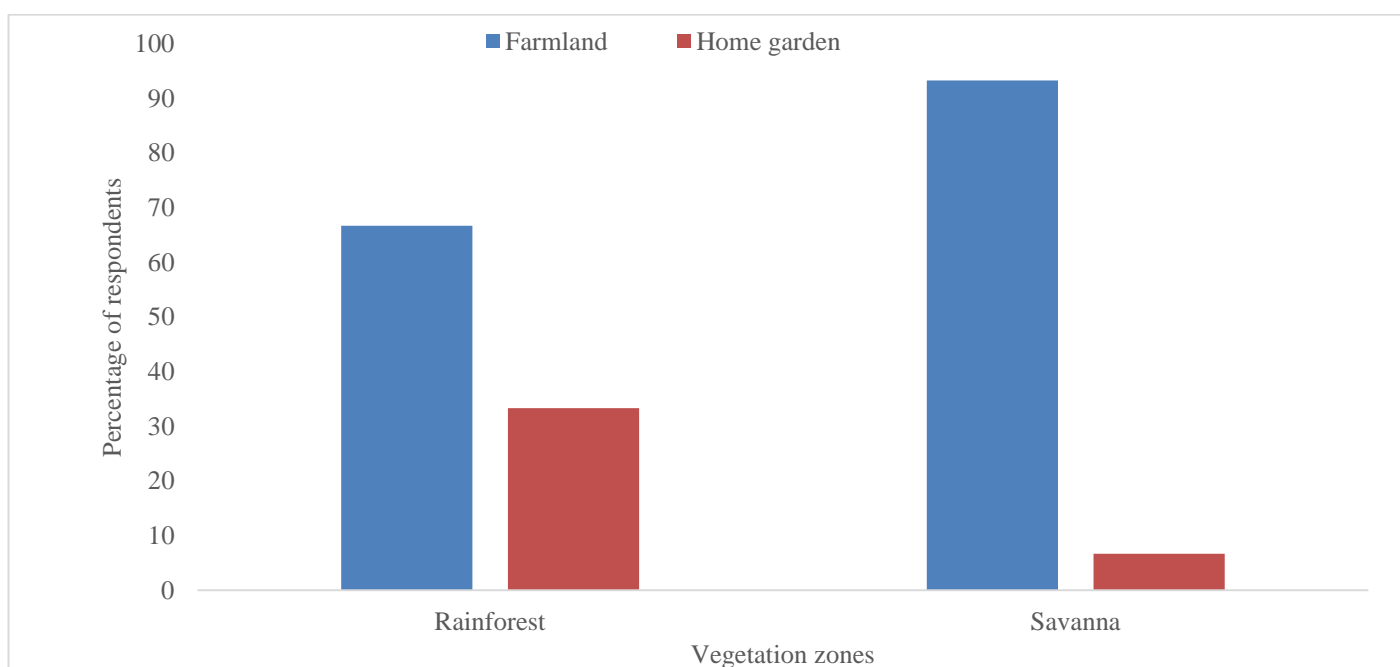


Figure-3: Locations of *C. albidum* trees.

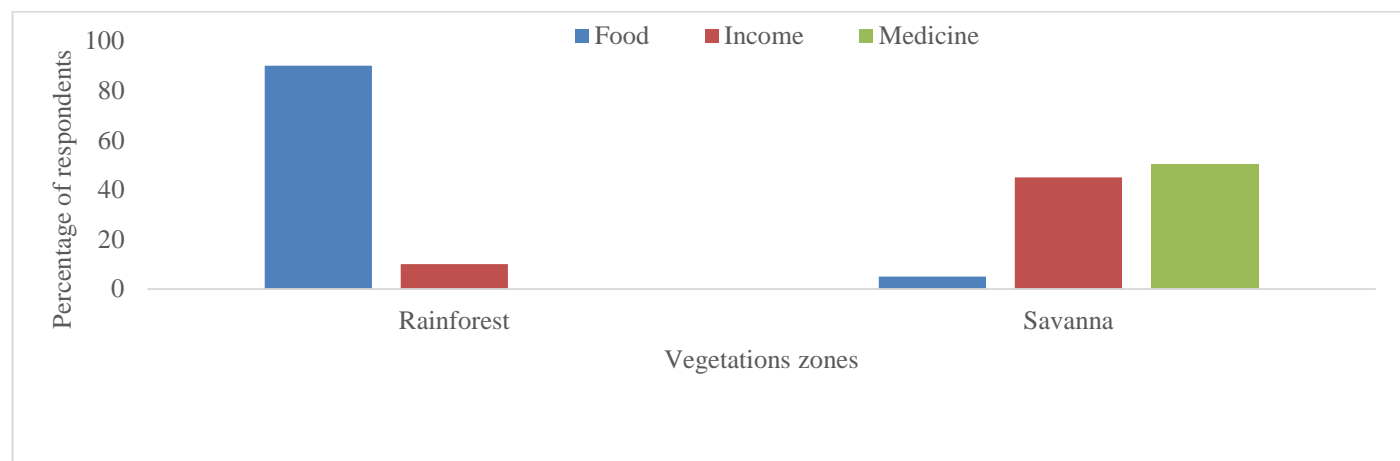


Figure-4: Uses categories of *C. albidum*.

Table-3: *C. albidum* Fruits’ Cost in the Study Area (Rainforest and Derived savanna zones).

Cost	Rainforest		Derived Savanna	
	Farmgate (%)	Market (%)	Farmgate (%)	Market (%)
₦ 1,500 – ₦ 1,800	11.1	0.0	46.7	0.0
₦ 1,500 – ₦ 2,000	88.9	100	53.3	93.4
₦ 1,500 – ₦ 2,500	0.0	0.0	0.0	6.6

Marketing of *C. albidum*: Aside *C. albidum* providing food and nutritional security, its fruits are sold locally for income purpose. The annual revenue generated by the respondents is shown in Figure-5. In the rainforest vegetation zone, annual income from *C. albidum* fruit marketing ranges from ₦5,000 to ₦150,000, whereas in the savanna vegetation zone, annual revenue ranges from ₦8,000 to ₦100,000. As shown in Figure-8, rainforest marketers typically earned more money from the selling of species than derived savanna marketers. In the rainforest zone, for example, 15.6% of respondents claimed to have made ₦30,000, whereas only 2.2% claimed to have made ₦150,000. In the derived savanna zone, 29.3% of respondents claimed to have made ₦10,000 through the sale of *C. albidum* fruits, while 1.3% claimed to have made ₦85,000. As a result,

the average yearly revenue from *C. albidum* fruit sales in rainforest and derived savanna zones was 22,955.56 and 21,813.33, respectively. It may be said that selling *C. albidum* fruits is a well-paying business because of the substantial annual revenue created from the sale of *C. albidum* fruits by a large percentage of dealers. The sale of *C. albidum* fruits is frequently a sideline to help with immediate household needs. Although the overall revenue collected from its sales is likely underestimated, it is sufficient to provide cash to local residents to purchase immediate and essential commodities such as soap and salt. This demonstrates the value and potential of *C. albidum* fruits as a source of revenue. Other research from around the world has found that households use forest fruits because of their high survival value and potential for cash income generation^{25,26}. The high annual revenue revealed in this study concurred with Adedayo²⁷ and Bada²⁸ study in Kwara and Ekiti States, which found that the majority of rural inhabitants in Kwara and Ekiti States earn over 200,000.00 per year by selling non-timber forest products. NTFPs also provide between 25% to 70% of rural household income, according to certain researchers²⁹⁻³¹.

C. albidum is considered an important tree for subsistence in Osun State. The findings show that the fruit of *C. albidum* is one of the tree's most essential components. As a result, gains in fruit yield and taste should be part of the tree's evolution. The few trees that were left on the farmlands after the land clearing suggest that the communities valued *C. albidum* trees, necessitating the community's domestication of *C. albidum* trees¹⁹.

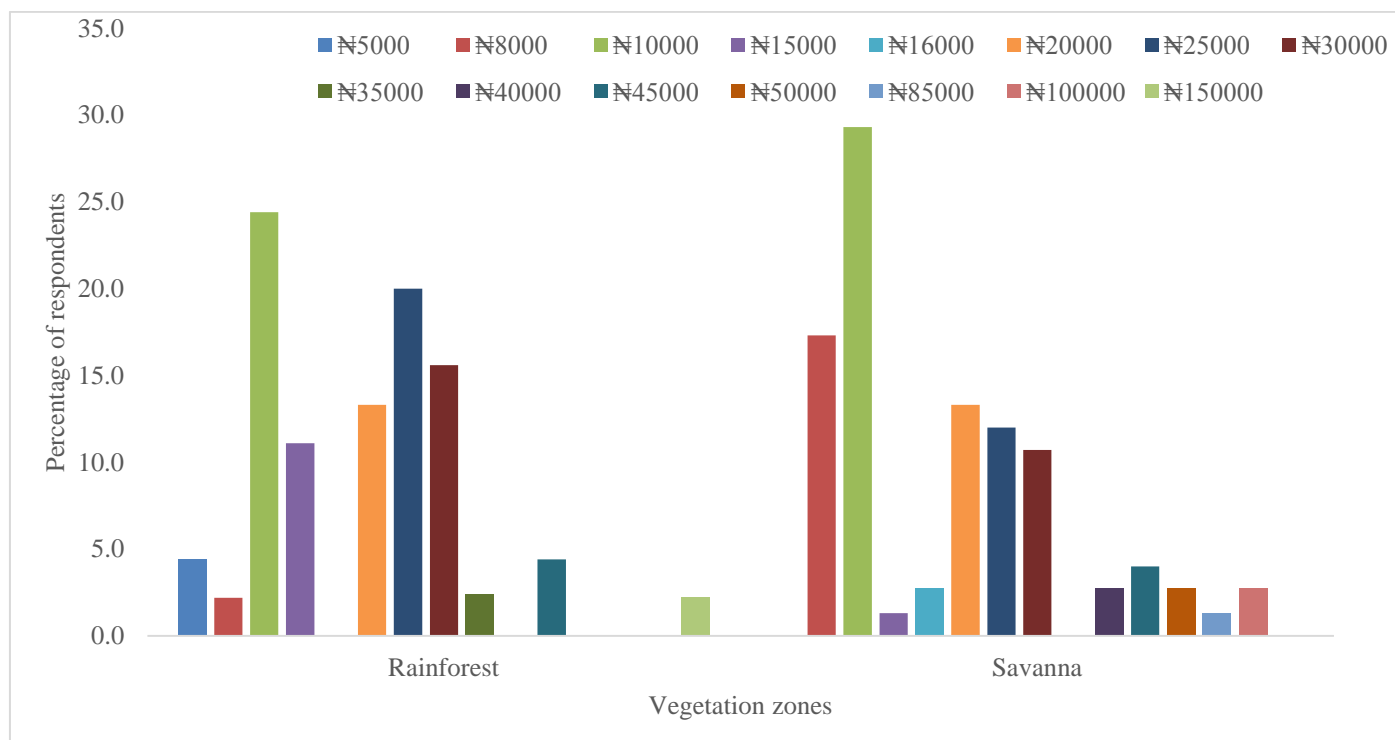


Figure-5: Annual Revenue from *C. albidum* Fruit Sales.

In the rainforest zone, the majority of respondents (88.9%) sell *C. albidum* fruits while they are still on the tree on farmland, and merchants pick the fruits later, whereas 11.1% harvest the fruits from the trees on a regular basis and sell them. All of the responders (100%) in the savanna zone sell the fruits by selling the full fruit on the tree (Figure-6).

Biology and Propagation: Figure-7 depicts the primary pests and illnesses related with *C. albidum* in the research area. In the rainforest zone, the majority of respondents (84.4%) said Maggot was the pest associated with *C. albidum*, 2.2% said Red ant, 2.2% said Maggot and Red ant, and 11.2% said no insect was linked with *C. albidum*. In the derived savanna zone,

however, the majority of responders (61.3%) said the pest associated with *C. albidum* was Maggot, 1.3 percent said Red ant, and 37.4% said Maggot and Red ant.

C. albidum fruit and tree features are mostly linked to fruit output and taste, indicating the plant's relevance in terms of food security and income generation. Short trees with dense crown cover that produce fruits early are favored traits for improvement in fruit tree species, according to Kwesiga *et al.*,³², while features linked to fruit size and yield are primarily preferred traits for improvement by breeders, according to Kadzere *et al.*³³.

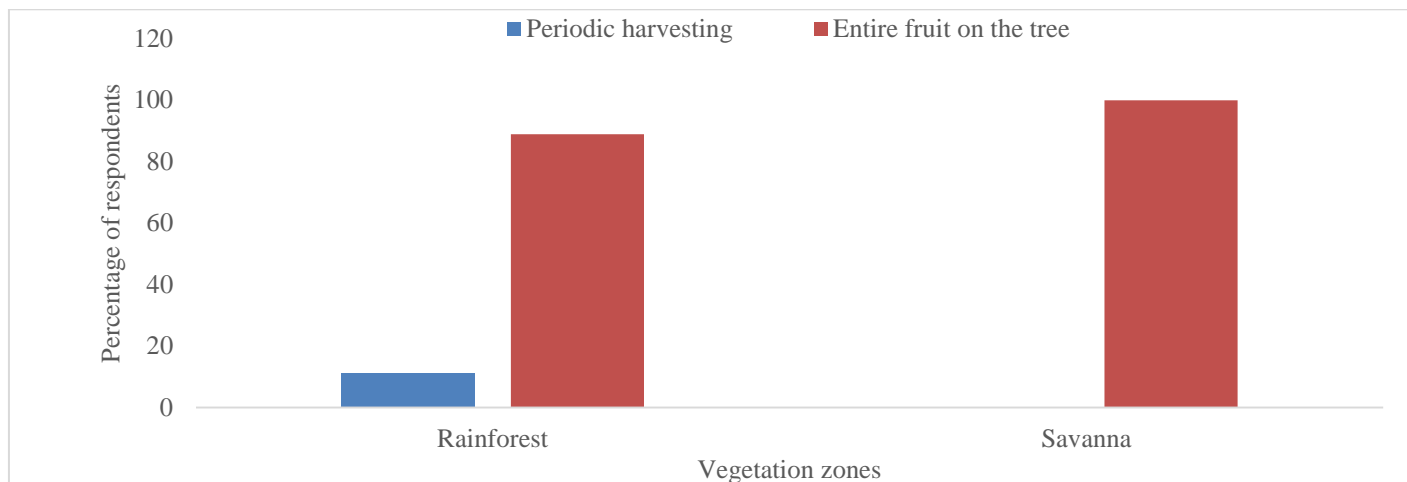


Figure-6: Methods of sales of *C. albidum*.

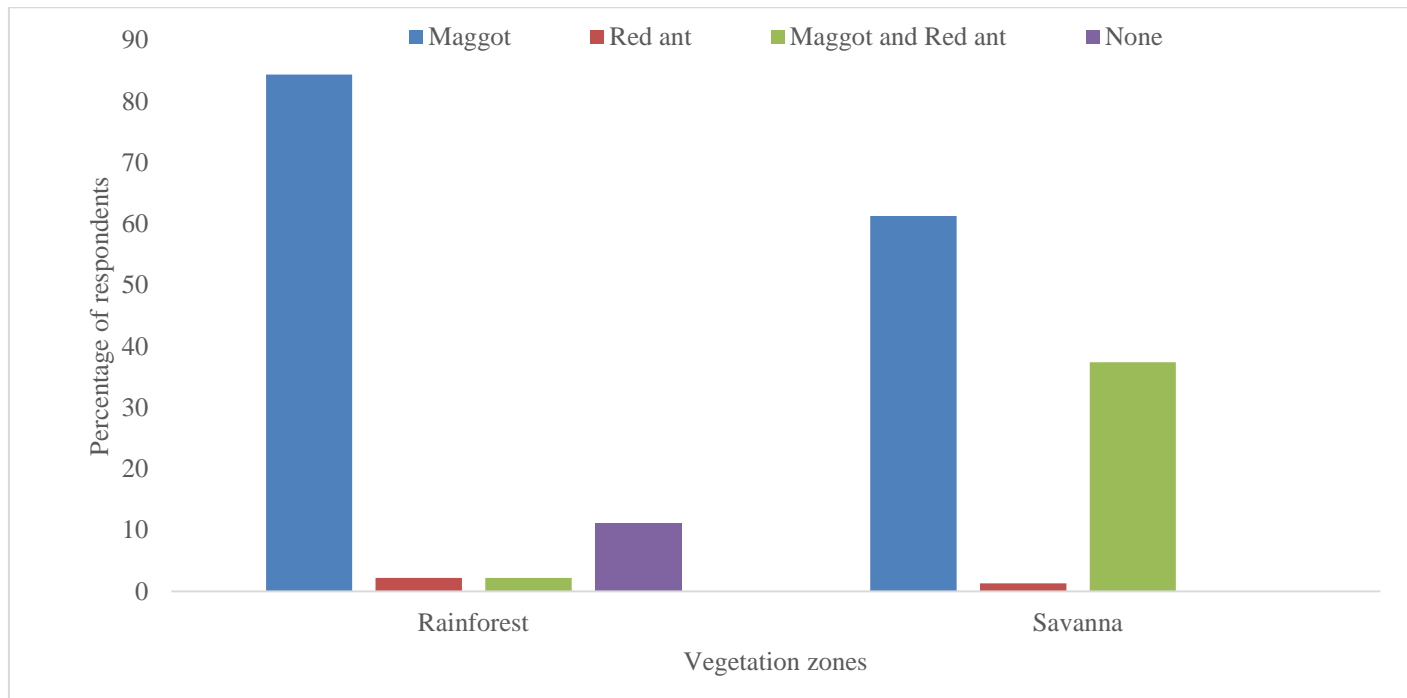


Figure-7: Pests and Diseases Associated with *C. albidum*.

Figure-8 shows the features that respondents wanted in *C. albidum* fruits. In the rainforest zone, 77.8% of respondents wanted the fruits to stay sweet and not have a sour flavor, 2.2% desired larger fruit sizes, and 20% wanted both sweetness and size improvements. However, in the derived savanna zone, 89.3% of respondents wanted the fruit's sweetness to be preserved, 4% wanted larger fruit sizes, and 6.7% wanted both fruit sweetness and size to be improved. This backs up previous information in this research, indicating that the *C. albidum* fruit has to be modified to fulfill public demand. This could indicate that respondents value the aroma and color of the fruit more than the amount of seeds, implying that the size of the fruit has a major impact on the edible fruit pulp. This result backed up the findings of Ntupanyama *et al.*¹⁶. According to Maghembe *et al.*³⁴, taste, size, and pulp ratio were essential fruit quality

qualities that needed to be researched in depth in a farmers' priority setting.

Respondents desirable traits of *C. albidum* tree Improvement: Figure-9 shows the respondents desirable traits of *C. albidum* tree for improvement. Majority of the respondents (28.9%) in the rainforest zone, wanted fast growth of *C. albidum* tree, not too tall, 20% wanted fast growth of *C. albidum* for production of fruits, 4.4% wanted improvement in the growth of *C. albidum* and 6.7% did not indicate need for any improvement of *C. albidum* tree. However, 54.7% of the respondents in the derived savanna wanted improvement in the rate of growth and height of *C. albidum* tree, 17.3% wanted fast-growing *C. albidum* tree for production of fruits, 26.7% wanted improvement in the growth of *C. albidum* and 1.3% did not indicate need for any improvement of the tree of *C. albidum*.

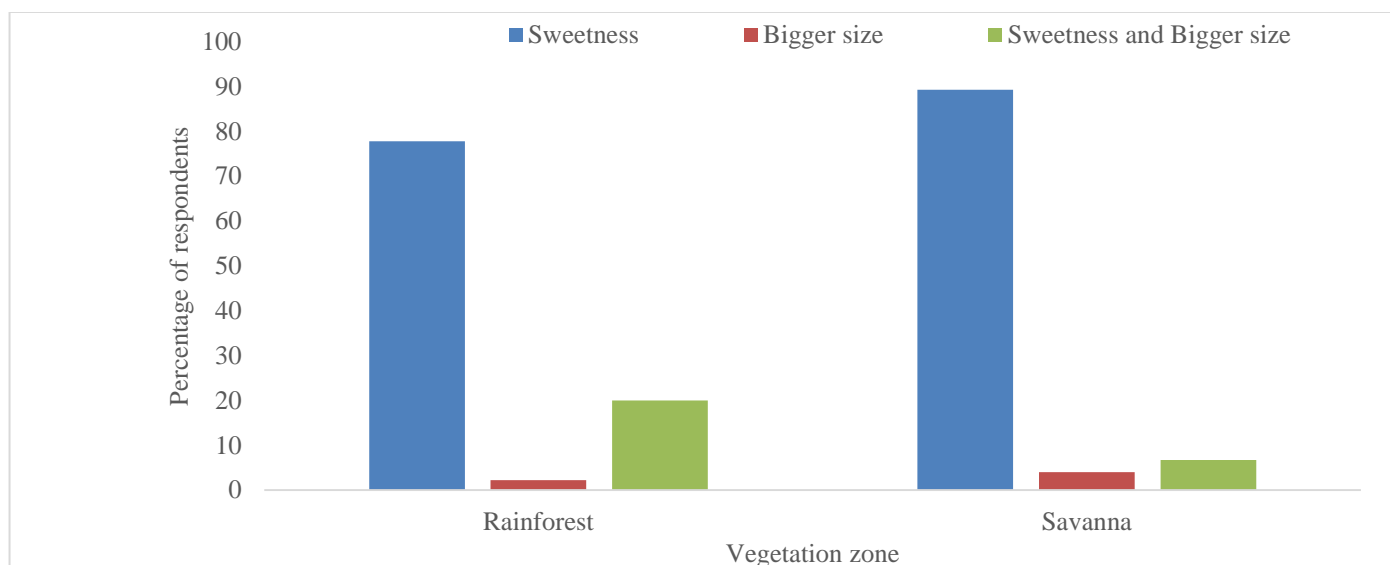


Figure-8: Respondents desirable traits of *C. albidum* fruit Improvement.

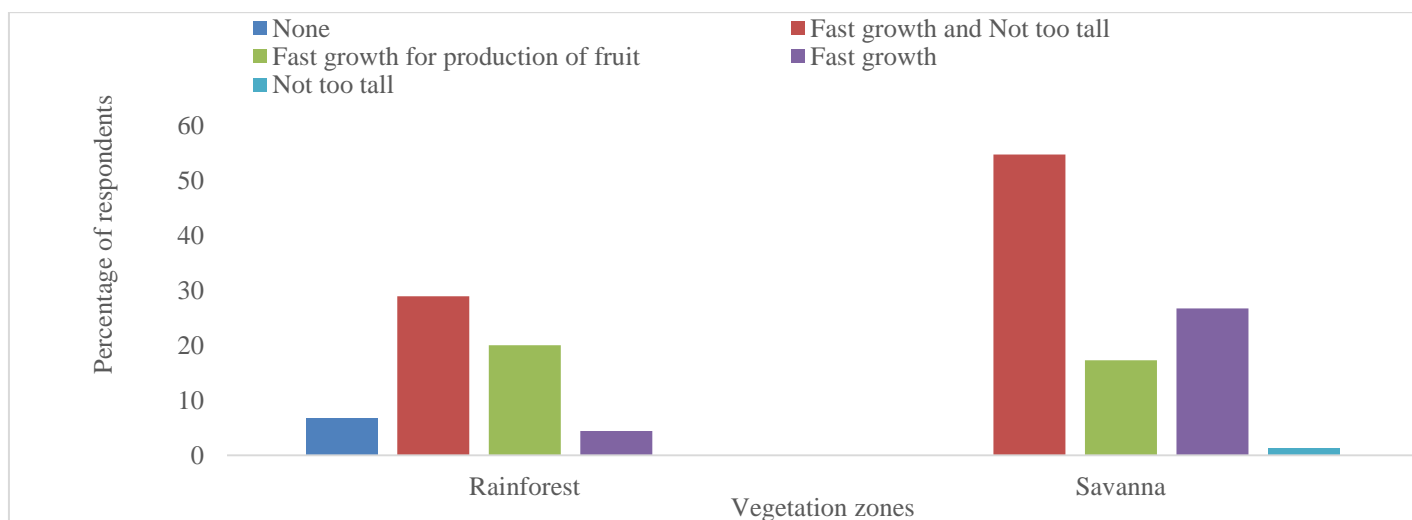


Figure-9: Respondents desirable traits of *C. albidum* tree Improvement.

Flowering Period of *C. albidum*: The indigenous understanding of *C. albidum* flowering differed greatly among the populations (Figure-10). The flowering time of *C. albidum* was claimed by 88.9% of respondents in the rainforest zone to be from January to March, and by 11.1% to be from March to April. In the derived savanna, 66.7% of respondents said *C. albidum* flowers from March to April, 26.7% said January to March, and 6.7% said November. The result suggests that there is a wide variation in flowering which might in the end affect fruit setting¹⁶ and this is in agreement with the research of Kadzere *et al.*,³⁴ who stated that variation in fruit size and total soluble solutes (TSS) within the same tree is a signal of variation in maturity.

Fruit Setting Period of *C. albidum*: Figure-11 shows when the fruits of *C. albidum* start setting. It revealed that, 66.7% of the respondents in the rainforest zone said the fruit setting period of *C. albidum* is in the month of September, 22.2% of the respondents said the fruit setting period of *C. albidum* is in the month June, 11.1% of the respondents said the fruit setting period of *C. albidum* is from the month December to January. Whereas, 53.3% of the respondents in the savanna zone, said that the fruit setting period of *C. albidum* is from the month December to January, 33.3% of the respondents said the fruit setting period of *C. albidum* is in month of January, 13.3% of the respondents said the fruit setting period of *C. albidum* is in month March.

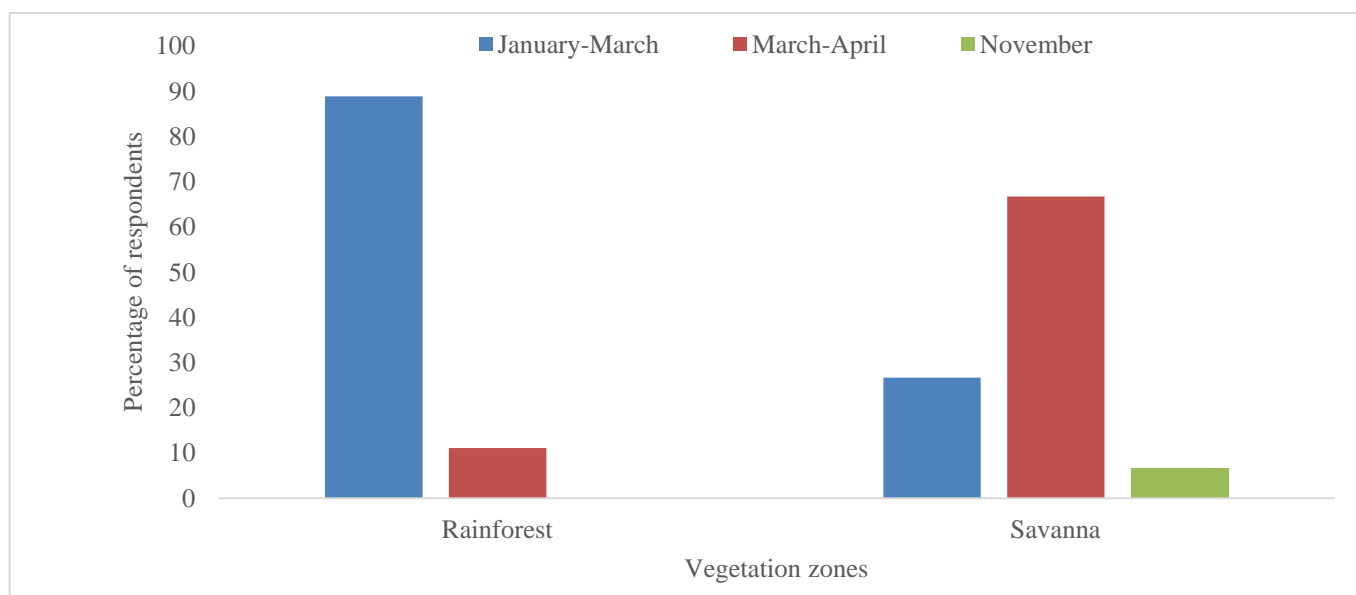


Figure-10: Flowering Period of *C. albidum*.

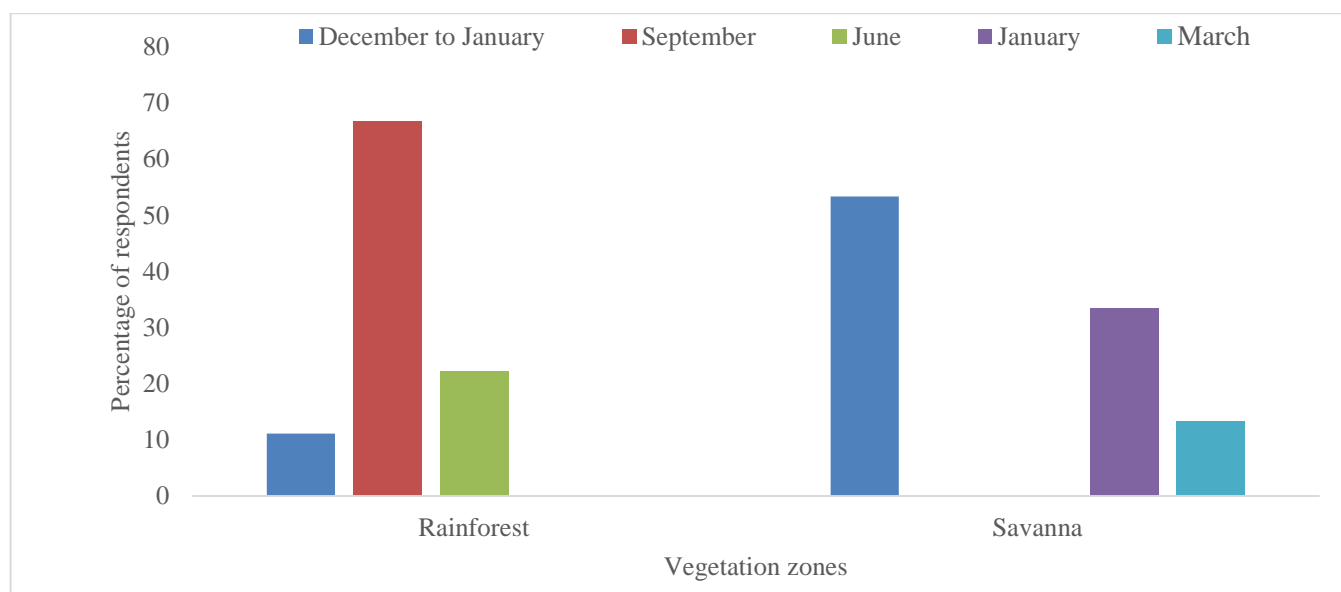


Figure-11: Fruit Setting Period of *C. albidum*.

Fruit Maturity Period of *C. albidum*: The result presented in Figure-11 shows the maturity period of *C. albidum*. Results showed that 66.7% of the respondents in rainforest zone said the maturity period of *C. albidum* fruit is in the month of December, 11.1% of the respondents said the maturity period of *C. albidum* fruit is in the month of April, 22.2% of the respondents said the maturity period of *C. albidum* fruit is in the month of November. Moreover, 60% of the respondents in the savanna zone said the maturity period of *C. albidum* fruit is in the month of April, 13.3% of the respondents said the maturity period of *C. albidum* fruit is in the month of March, 20% of the respondents said the maturity period of *C. albidum* fruit is in the month of January, and 6.7% of the respondents said the maturity period of *C. albidum* fruit is in the month of May.

Quantity of Fruits Produced per Tree: The amount of *C. albidum* fruits produced per tree in a fruiting period ranged from 8 to 10 baskets, according to respondents in both ecological zones (rainforest and savanna zones).

Conclusion

C. albidum tree has a significant economic potential in Osun State; nevertheless, due to various anthropogenic actions by humans, the tree has become scarce in many sections of the research area. The fruit of *C. albidum* has become a valuable alternative source of food for residents in Osun State's two vegetation zones. The fruit is a significant source of revenue for the people who live near the woodlands. If domestication is not promptly considered, this species may become extinct. The information demonstrates that the residents of the neighborhood are well-versed in the biology and application of *C. albidum*. It is critical that local communities establish a strategy to improve the species. In conclusion, *C. albidum* conservation should be reinforced by advances in desirable tree and fruit features. As a result, the administration of Osun State should strengthen its conservation policies for *C. albidum* and other indigenous tree species.

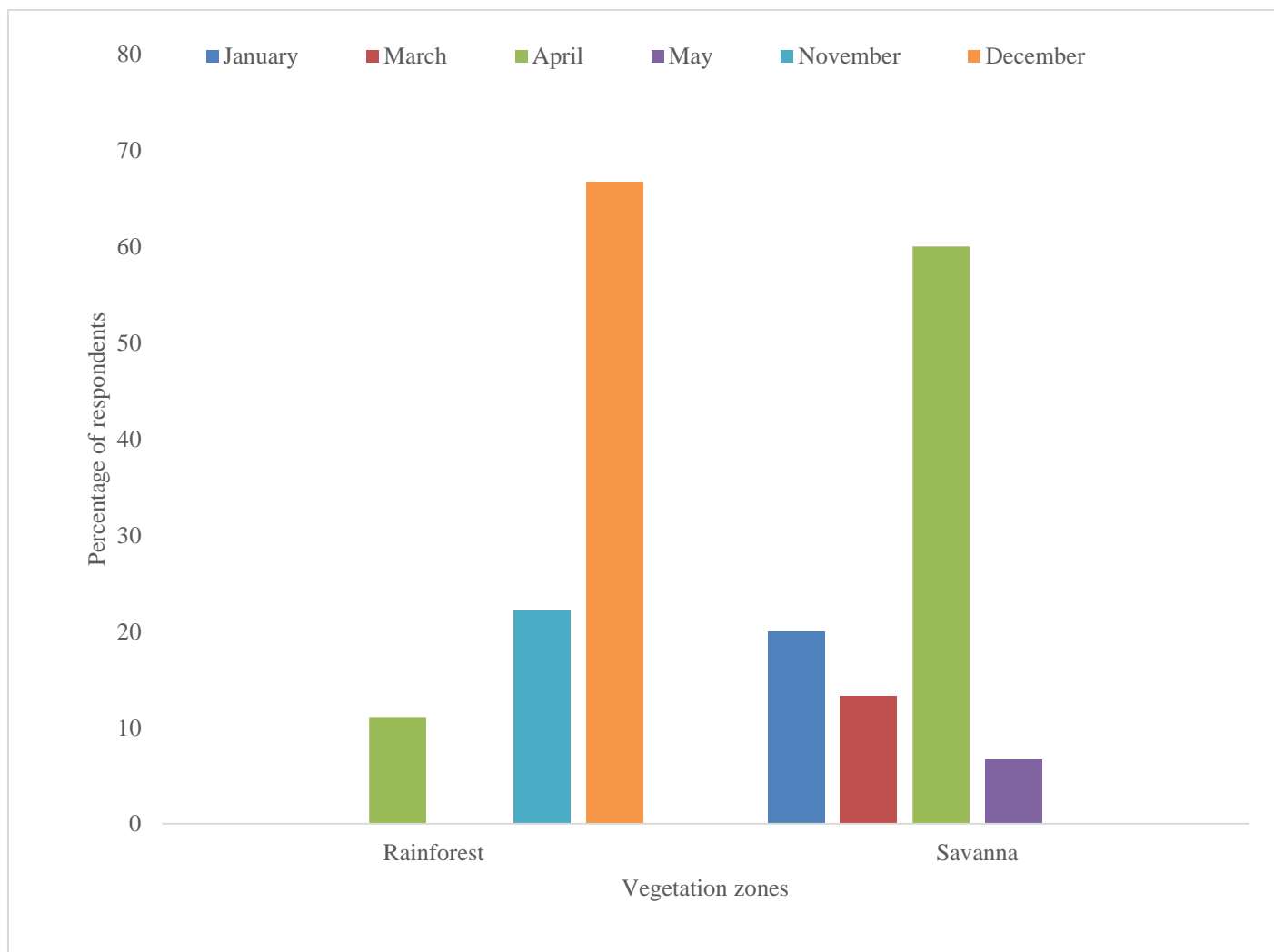


Figure-11: Fruit Maturity Period of *C. albidum*.

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