Final Evaluation Report

Your Details	
Full Name	Oyebanji Oyetola Olusegun
Project Title	Conservation of *Lophira alata*, an economically important and vulnerable tree species in Nigeria
Application ID	38001-1
Date of this report	October, 2023

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
To carry out an in-depth species re-assessment aimed at documenting the population status and distribution of L. alata across localities.				Transect lines were cut within the park, and sample plots of 50 m^2 quadrat were laid along each line. These sample plots were alternated with a spacing of 25 m. Individual stands of *L. alata* were carefully counted within each plot while identified associated species were also noted accordingly. The diameter at breast height (DBH) and height of each stand of *L. alata* were measured using a diameter tape and Spiegel Relascope respectively. GPS coordinates of each occurrence point were also taken using a hand-held Garmini® GPS device.
Identify threats (current and potential) affecting the survival of the species, habitat management, and reintroduce the species into its natural habitats through re-afforestation programmes.				Within the study area, indigenous knowledge about the focal species was gathered through 300 structurally designed questionnaires which were administered to the rural people who were familiar with the species and its associated habitat.
To project suitable habitats for the conservation of L. alata.				We collected coordinates from the field and combined with the occurrence data obtained from the Global Biodiversity information Facility. The valid occurrence points and 10 environmental variables were used to project future suitable habitats for *L. alata*.
Improve the level of conservation education through the enactment of conservation programmes				Conservation awareness and conservation education took place at the premises of the CRNP, and as well in the three major host communities (Aking, Netim, and Nsan) and all the

				small villages within the study area. Community leaders and youths were educated on the need to conserve the focal species and protect its natural habitat while depending on the forest for their livelihood. Pupils of the visited schools were also educated on the importance of biodiversity conservation amid changing climates. We administered a total of 300 questionnaires during the project.

2. Describe the three most important outcomes of your project.

a). To carry out an in-depth species re-assessment aimed at documenting the population status and distribution of *L. alata* across localities.

A total of 24 quadrat plots of 50 m^2 in size were sampled for the distribution of *L. alata* within the study area (Akamkpa or Erukot and Oban division). Our survey showed that 13 plots had fewer than 50 stands of *L. alata,* while 11 plots had more than 50. A total of 1,244 individual stands were observed (Table 1) and the percentage occurrence varies across the sampled plots (Figure 2A). Our study buttressed that the population of red iron wood is more abundant in Erukot than in the Oban area. We took measurements from each identified stand (Figure 3) and as observed, *L. alata* can reach a height of 38 m and girth of 400 m.

The diameter at breast height (DBH) and heights vary respectively for the two divisions. In Erukot, some stands of *L. alata* reach 400 cm in DBH (plot 7) and 37.5 m in height (plots 5, 10 & 14). In Oban division however, the highest DBH was 101 cm and height reaching 20 m (plot 23). The average DBH ranged from 3.3 cm in plot 1 (Erukot) to 116.2 cm in plot 19 (Oban) while the average height of *L. alata* stands recorded from the study ranged from 2.4 m in plot 9 (Erukot) to 16.7 m in plot 19 (Oban) (Figures B and C). Erukot had most stands with DBH ≥100 cm and heights ≥30 m, which is the merchantable height (Figure D and E). As a result of recent designation of Erukot division as a Biosphere Reserve by the United Nations (UNESCO), the Erukot section has received conservation attention. The Oban division, on the other hand, is more susceptible to anthropogenic activities, except for plots 18 and 19, which residents were unable to access due to the challenging terrain, rendering them unsuitable for farming and tree harvesting. Despite the presence of young stands of red ironwood that are likely to succeed the population in future, Erukot's population would be more sustainable due to its lower anthropogenic pressure than Oban's.

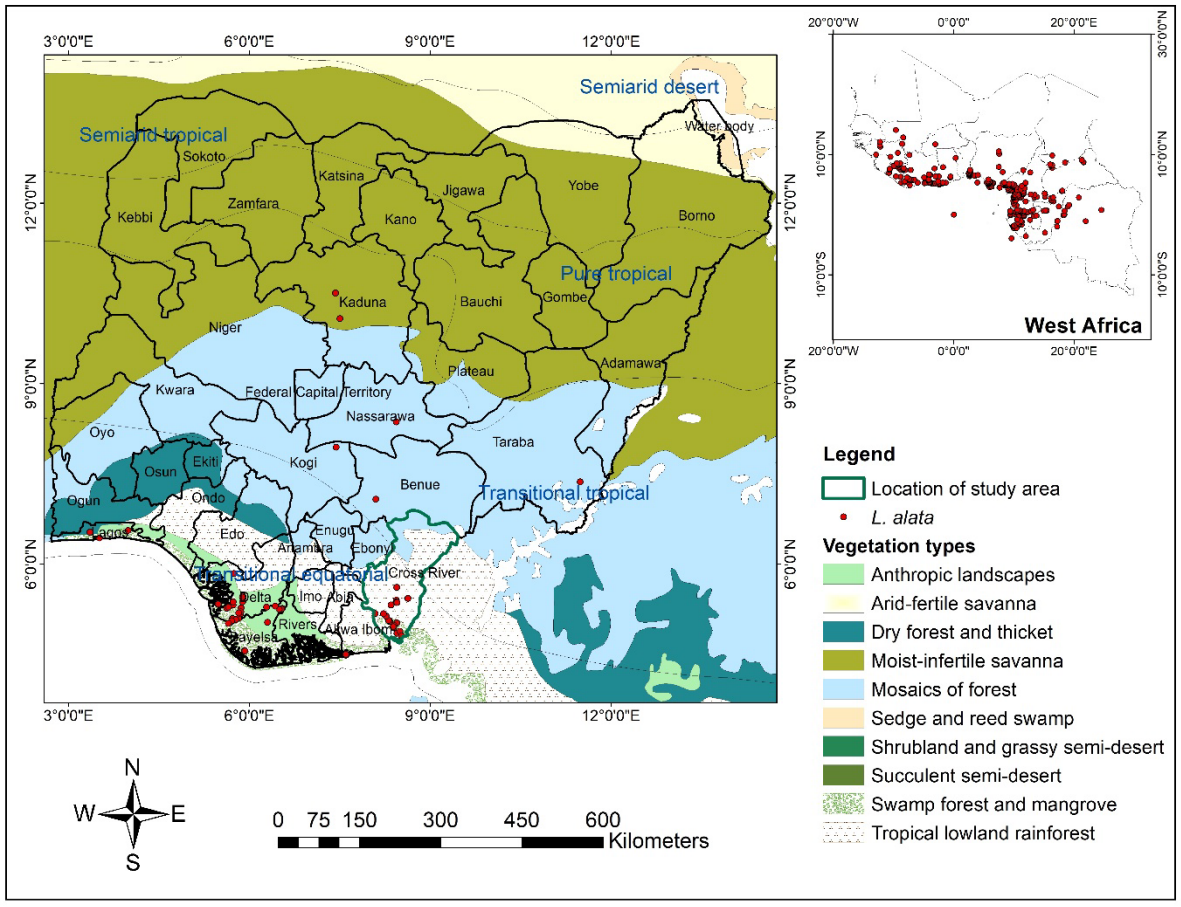


Figure 1. Distribution of *L. alata* in Nigeria.

Table 1. Distribution of *L. alata* in each sampled plot

Plots	Locality	Longitude	Latitude	No. of *L. alata*
1	Erukot	8.433556	5.365139	12
2	Erukot	8.434528	5.367222	98
3	Erukot	8.434917	5.368028	58
4	Erukot	8.435639	5.368528	73
5	Erukot	8.436083	5.369056	64
6	Erukot	8.436639	5.369528	131
7	Erukot	8.436917	5.36875	153
8	Erukot	8.437611	5.401361	149
9	Erukot	8.438028	5.366167	75
10	Erukot	8.438944	5.365472	116
11	Erukot	8.440028	5.364222	103
12	Erukot	8.441083	5.362944	6

13	Erukot	8.437389	5.363669	12
14	Erukot	8.438222	5.363833	94
15	Erukot	8.440667	5.362222	5
16	Erukot	8.443722	5.360333	12
17	Erukot	8.4445	5.359222	2
18	Oban	8.625833	5.614417	22
19	Oban	8.630167	5.431	6
20	Oban	8.627694	5.431056	8
21	Oban	8.629417	5.431722	9
22	Oban	8.629222	5.431306	12
23	Oban	8.610972	5.44775	15
24	Oban	8.629361	5.447111	9
Total				1,244

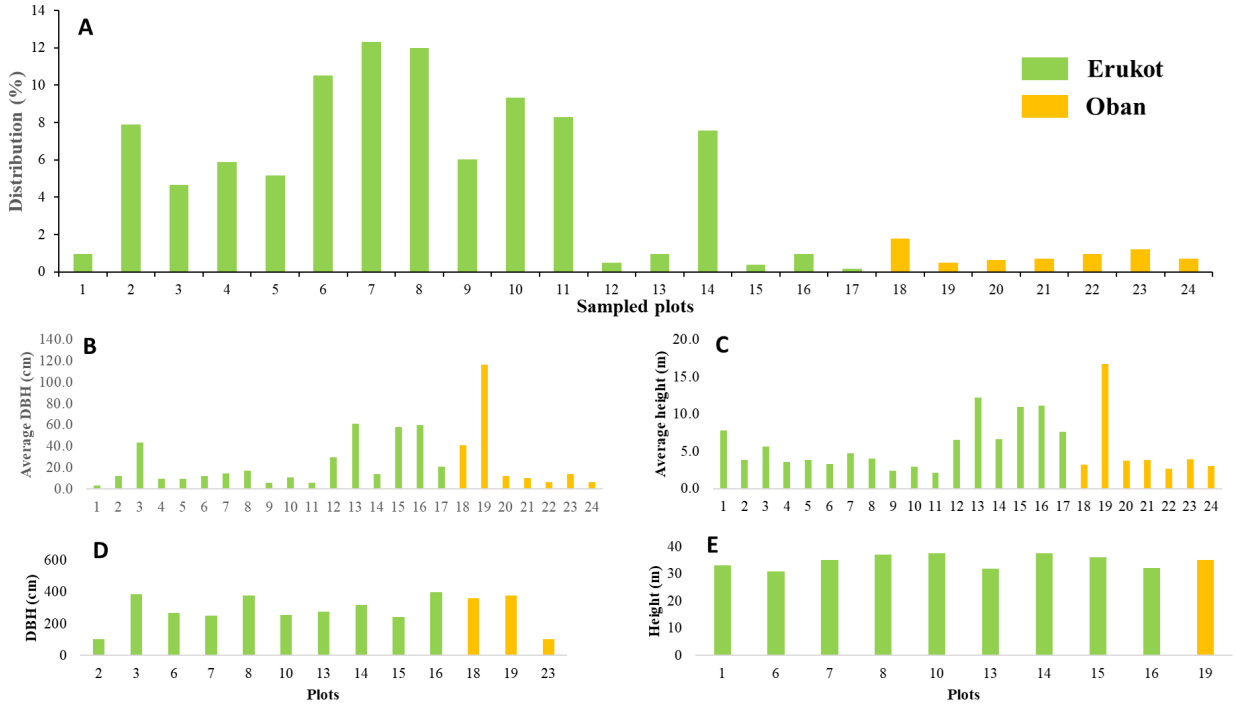


Figure 2. Biometrics of *L. alata* from sampled plots. (A) Percentage distribution, Average distribution of DBH and heights (B – C) and DBH ≥30m and heights ≥30m.

Figure 3: Field sampling for data collection (a) Establishment of the sampling plots and (b) Measurement of tree parameters.

b). Identify threats (current and potential) affecting the survival of the species, project climatically suitable habitats, habitat management, and reintroduce the species into its natural habitats through reforestation.

From the in-situ observation, the red ironwood is faced with conversion of forest into segmented farming areas for agricultural purposes, logging, and exploitation of non-timber forest products such as medicinal plants and beekeeping (for honey production). We modelled the current and future habitat suitability of *L. alata* under certain environmental conditions (Table 2) in the years 2050 and 2070. Our model evaluation showed that the prediction is reliable with the Area Under Curve (AUC) ≥0.9, TSS values ≥ 0.7 and overall accuracy ≥ 0.9 (Figures 4 and 5; Annexes 1 - 2). The current highly suitable habitat is estimated at 9,793 km^2 of the total land area of Nigeria. In the year 2050, the area is projected to reduce by half, while in the year 2070, a slow increase from the reduction in 2050 is projected if conservation strategies are initiated and managed (Table 3, Figures 6 - 8). The results of our modelling validated the reintroduction of red ironwood wildlings in the study area, which was identified as a highly suitable area to conserve the focal tree in future. Moreover, future studies could investigate other climate-suited regions around the southwest of Nigeria identified by our modelling.

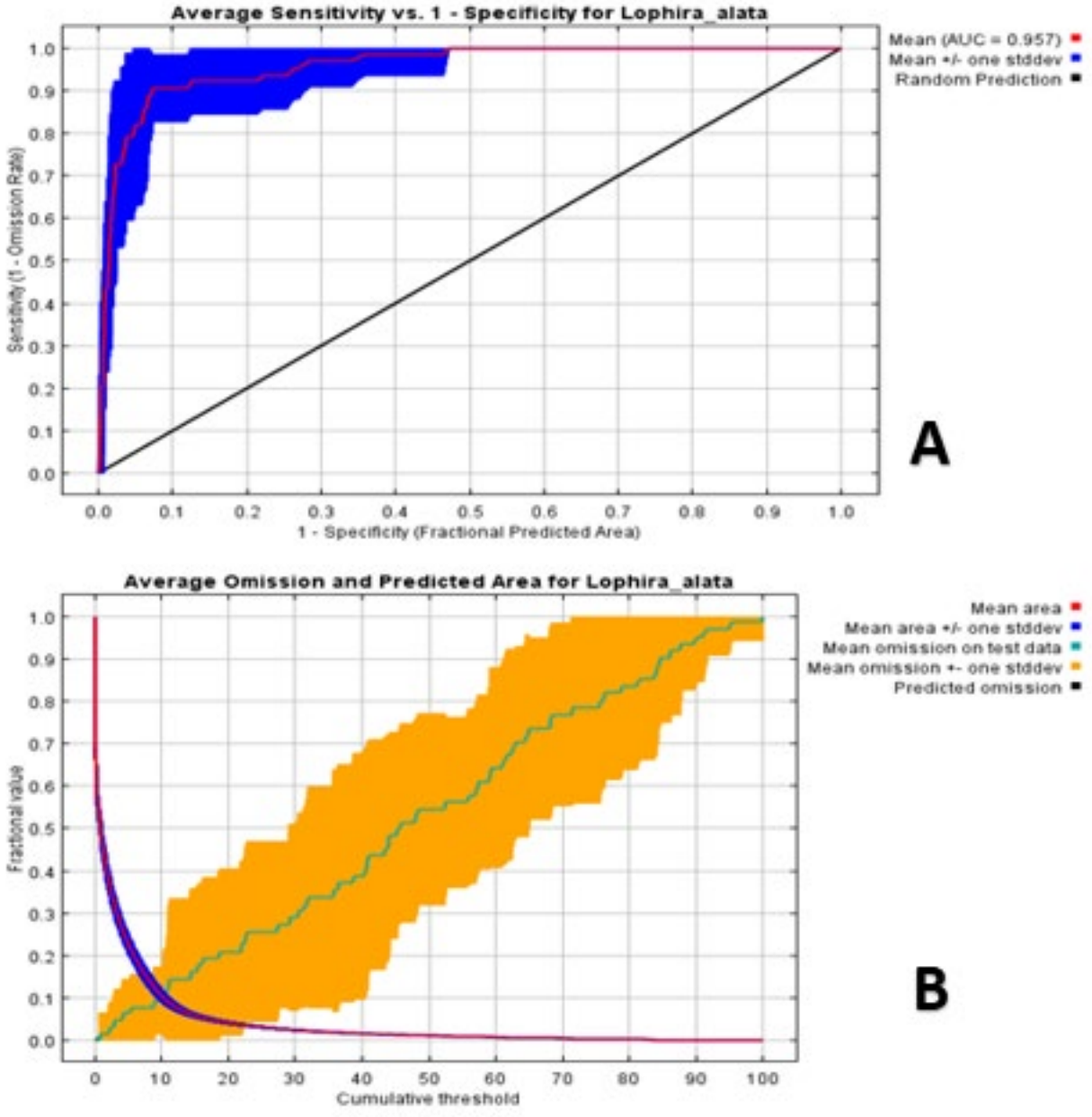


Figure 4: A- Receiver Operating Characteristics (ROC) curve showing high Area Under Curve (AUC) value. B- Omission and predicted area for the focal species.

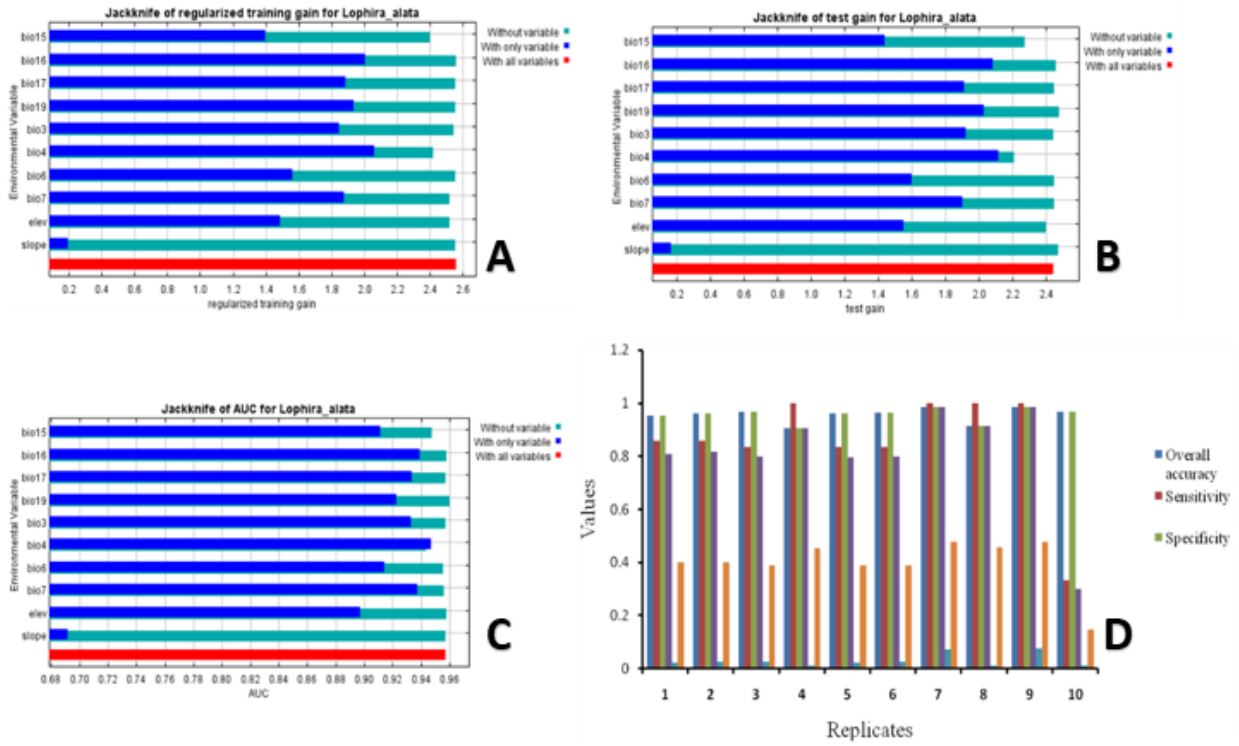


Figure 5. A-C - Comparative results of Jack-knife analysis for the environmental variables (A – C) while D - Test Skill Statistics (TSS) values reflecting the reliability of the model.

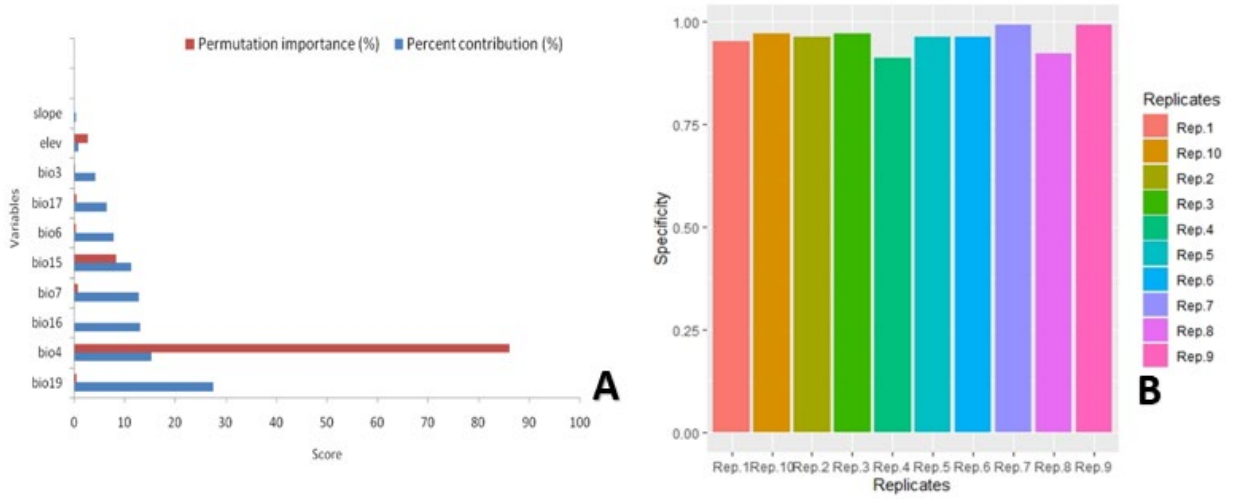


Figure 6: A- Predictor value contributions for each environmental variable. B- Average specificity values for model replicates.

Table 2. Selected environmental variables for the model evaluation.

Variable type	Code	Variable	Unit
Topographic	Elev	Elevation	M
	Slope	Slope	degree
Bioclimatic	Bio3	Isothermality (BIO2/BIO7) (×100)	-
	Bio4	Temperature seasonality (standard deviation ×100)	°C
	Bio6	Minimum temperature of coldest month	°C
	Bio7	Temperature annual range (BIO5–BIO6)	°C
	Bio15	Precipitation seasonality (coefficient of variation)	fraction
	Bio16	Precipitation of wettest quarter	mm
	Bio17	Precipitation of driest quarter	mm
	Bio19	Precipitation of coldest quarter	mm

Table 3. Area estimation as projected by the Global Climate Models

			Highly unsuitable		Unsuitable		Low suitable		Moderately suitable		Highly suitable	
Model	**Year**	**Total land area (km^2)**	**Area (km^2)**	**%**	**Area (km^2)**	**%**	**Area (km^2)**	**%**	**Area (km^2)**	**%**	**Area (km^2)**	**%**
	Current	910,770	838,307.4	92.0	35,287.2	3.9	17,478.8	1.9	9,903.7	1.1	9,793.0	1.1
CNRM-CMS	2050	910,770	869,604.2	95.5	19,710.2	2.2	9,266.4	1.0	7,732.3	0.8	4,457.0	0.5
	2070	910,770	870,387.7	95.6	17,774.6	2.0	9,343.3	1.0	7,886.1	0.9	5,378.3	0.6
Had GEM2-ES	2050	910,770	868,549.3	95.4	20,165.8	2.2	9,212.3	1.0	7,498.1	0.8	5,344.5	0.6
	2070	910,770	867,748.9	95.3	18,912.3	2.1	10,609.5	1.2	6,614.9	0.7	6,884.5	0.8

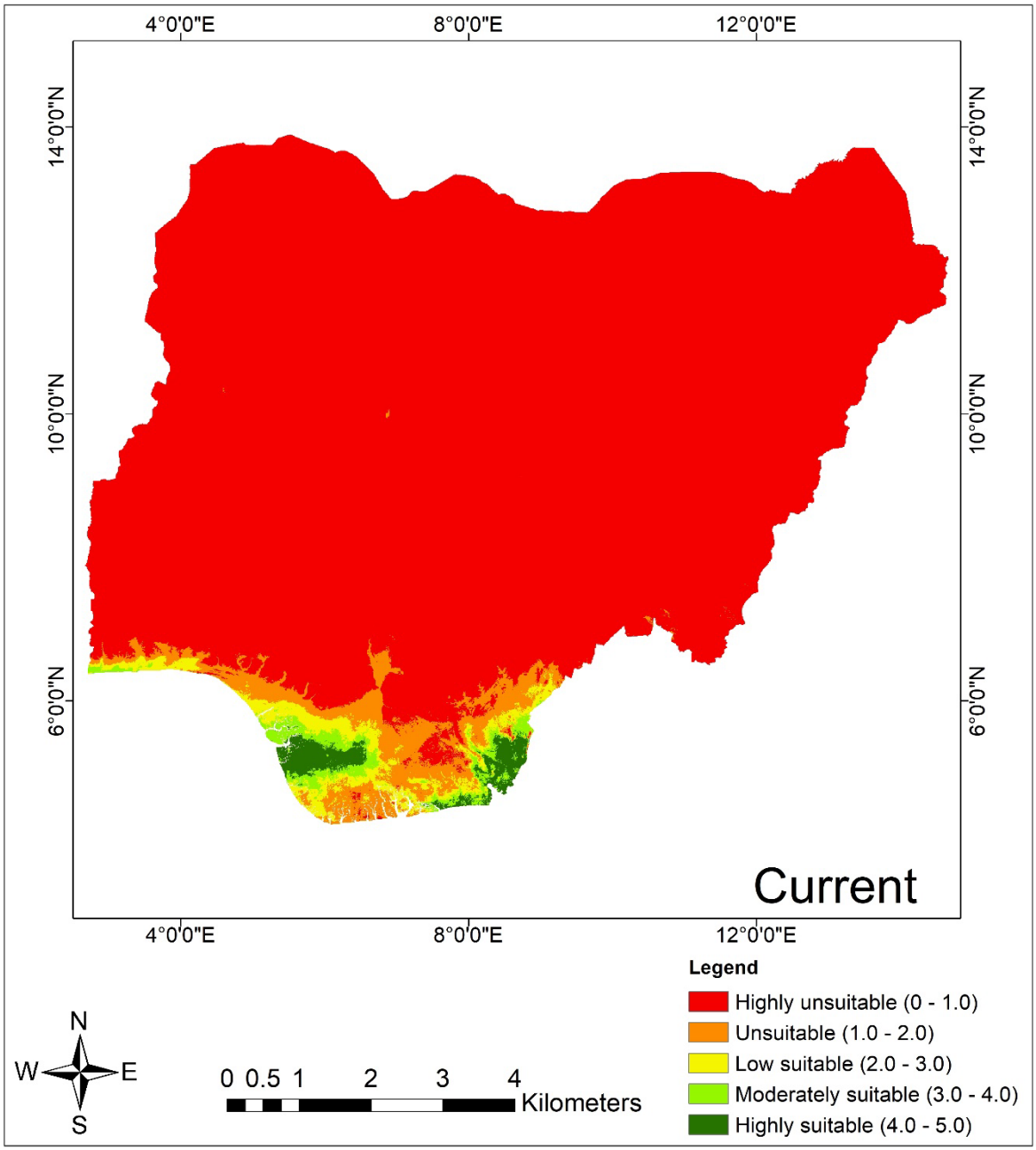


Figure 7. Habitat suitability for *L. alata* under current climatic scenario.

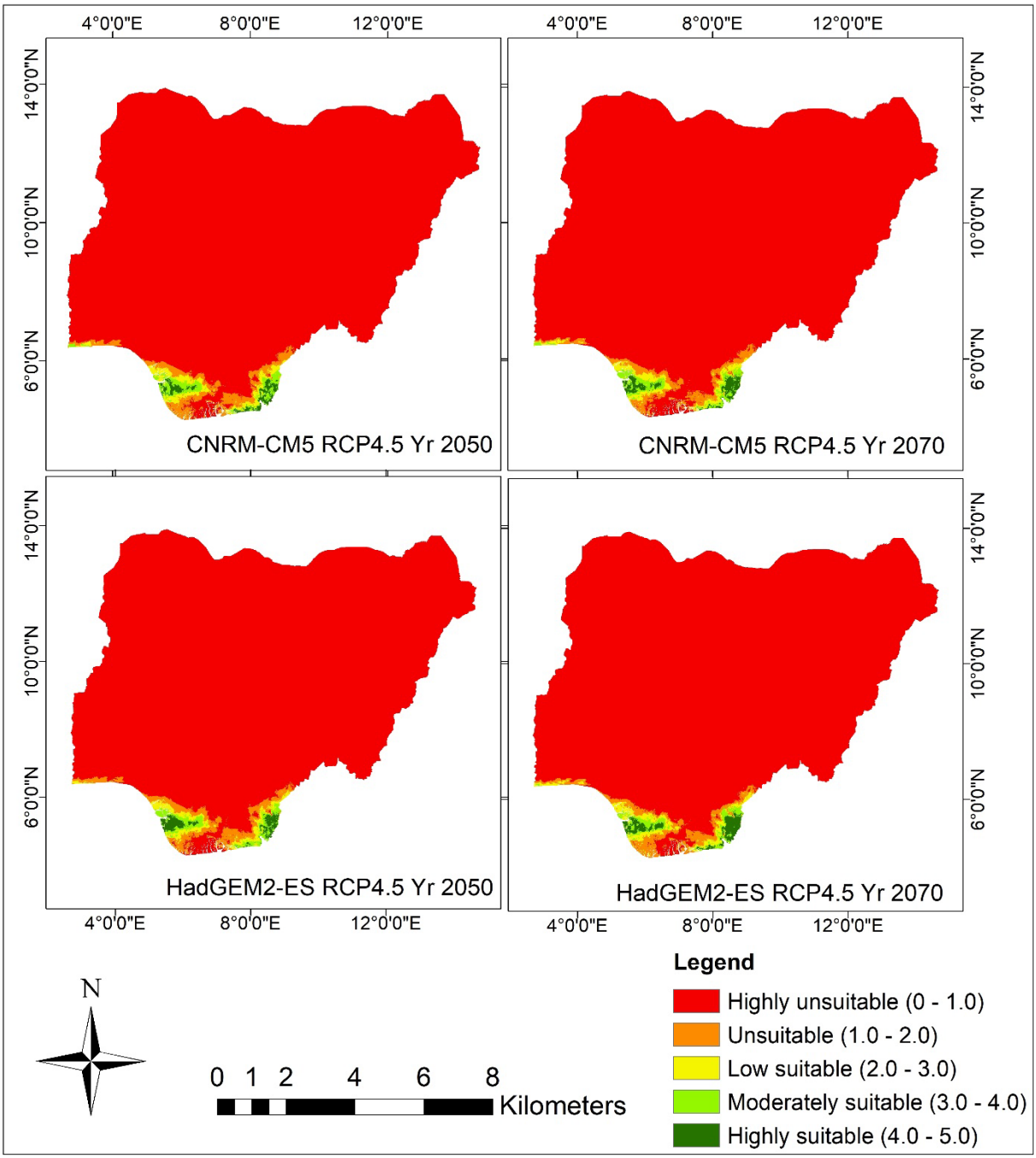


Figure 8. Future prediction of habitat suitability for *L. alata* under two Global Climate Models**.** **(GCMs)**

c). Conservation awareness and education.

Indigenous knowledge about the focal species as obtained using structurally designed questionnaires, showed that most of the respondents aged between 41-50 years, and men were more involved in the activities posing threats to *L. alata*. Specifically, the male respondents constituted 80% while the females were the remaining 20%. Those within the age-range of 41-50 constituted 44.3% while 20-30 year were the least represented (9.3%). However, respondents aged 50 years and above represented 24.7% while those within 31-40 had 21.6% representation (Figure 9). The figures for the conservation education and activities are presented in Annexes 3 – 6.

Observations also showed that 55.7% of the respondents had post-secondary education, 32% had secondary education and 11% had elementary education (Figure 10). By implication, the adjoining communities would welcome conservation efforts arround their forest estates given their elementary knowledge of science. About half (49.5%) of the respondents have been resident in the community for more than 20 years, while another 37% have lived there for 11-20 years. The remaining population have been in the community for 10 years or less (Figure 11).

The major occupation of the people is farming. This is represented by 48.5% of the total number of respondents (Figure 12). Our observations thus agreed with those of the respondents, who also noted that the remaining stands of *L. alata* are threatened by logging, timber exploitation, bush burning, and harvesting of plant parts for medicinal uses.

The red ironwood is harvested for its wood, which is used in the construction of bridges, canoes, railway sleepers, and other furniture. On the other hand, the bark, leaves and roots of *L. alata* are utilised in traditional medicine for the treatment of several ailments such as cough, headache, piles, and stomach ache (Annex 5c). While most respondents (78%) reported that there are no close substitute to the species in their locality, others suggest that there may be one oe more alternatives in the absence of the focal species. Interestingly, 88% of the respondent agreed that they will leave the species to continue growing if they have it in their farm, rather than fell it for monitary value (Figure 13). This reflects their readiness to support conservation initiatives. Unfortunately, the respondents reported that there are currently no known laws or regulations guiding the use or exploitation of *L. alata* in their community. By implication, the remaing popolations of the focal species is at greater risk of extinction, if efforts are not channelled towards its sustainability.

We found that *L. alata* regenerated or occurred naturally within the study area while only a few (<5%) are planted in farms (Figure 14). This may imply that the species is deliberately eliminated for agricultural purposes and was further reported that it is becoming difficult to come across matured stands in recent times. Again, an indication of illegal logging activities within the study area. As further observed, only little effort has been put in replacing removed stands of *L. alata*. Specifically, it was also revealed that only a few have been planted in the last ten years as noted by 88% of the respondents. Hence, the respondents supported the attempt to increase the availability of *L. alata* within the study area, suggest re-afforestation and stoppage of illegal fellers from invading the park, and constant monitoring of the area by the park officers. Others suggested the implementation of certain forest laws to guide against logging. Generally, the conservation initiatives of the red ironwood

were greatly supported and encouraged to ensure availability for the future generation. Finding also suggest that the high population of men in the community surrounding the CRNP may influence the loss of biodiversity by engaging incessant farming and logging even when they were young.

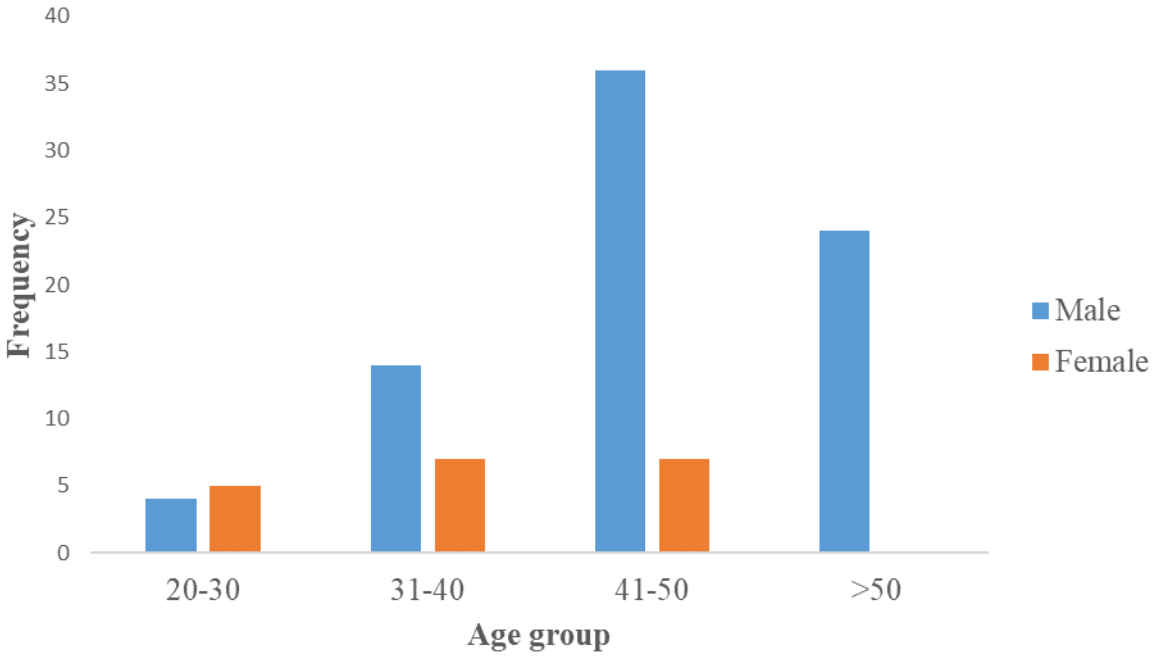


Figure 9: Age representation of respondents.

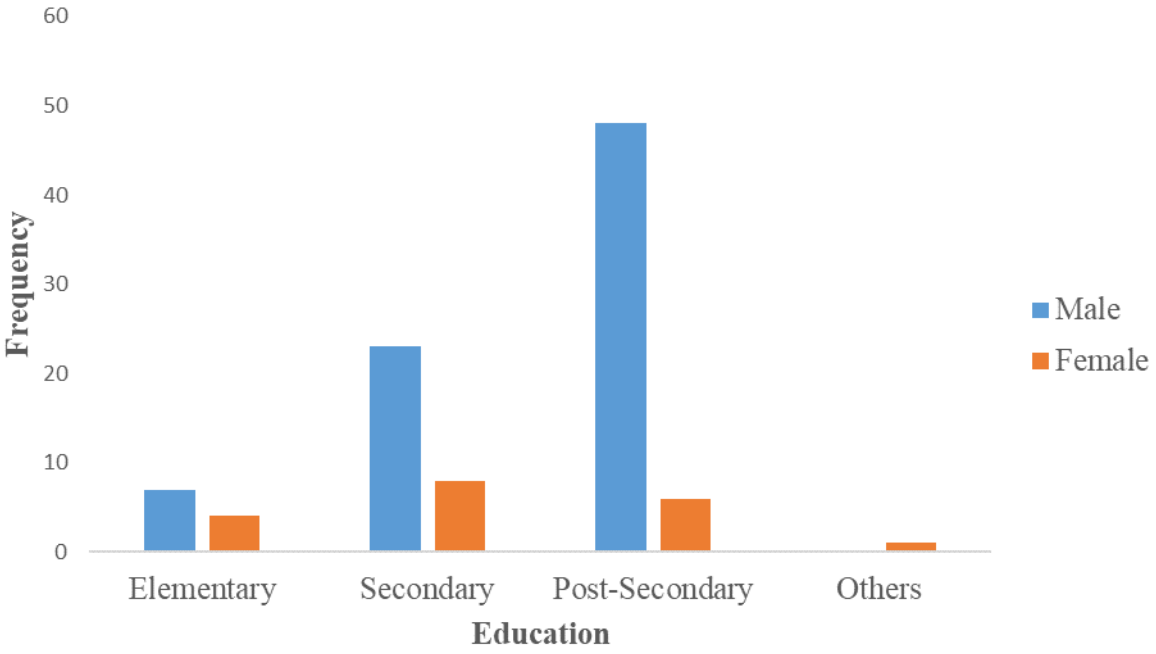


Figure 10. Education level of the respondents.

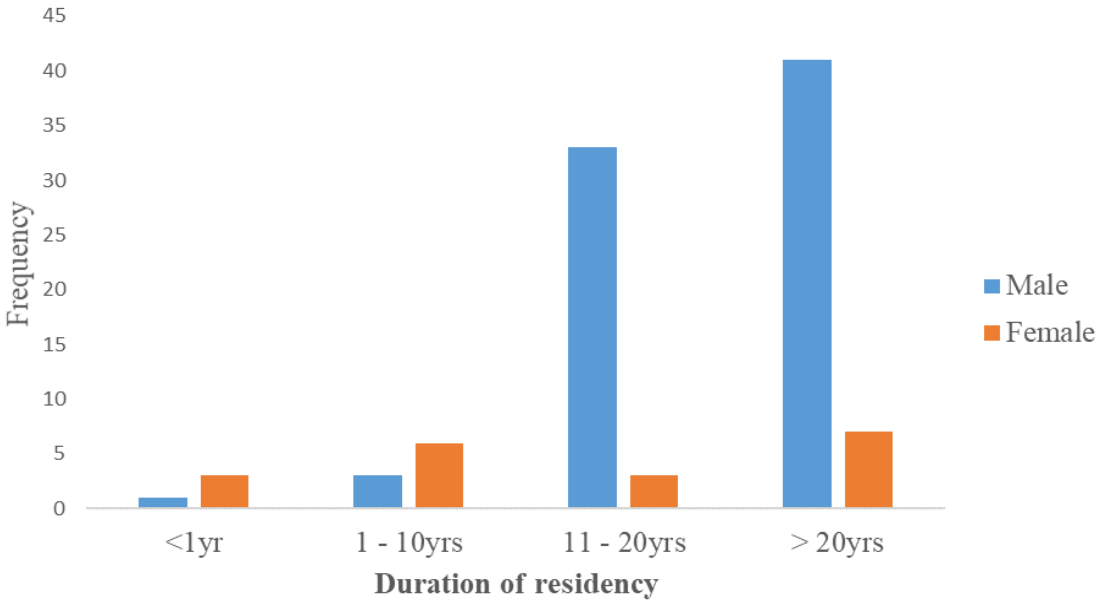


Figure 11. Number of years of stay in the community.

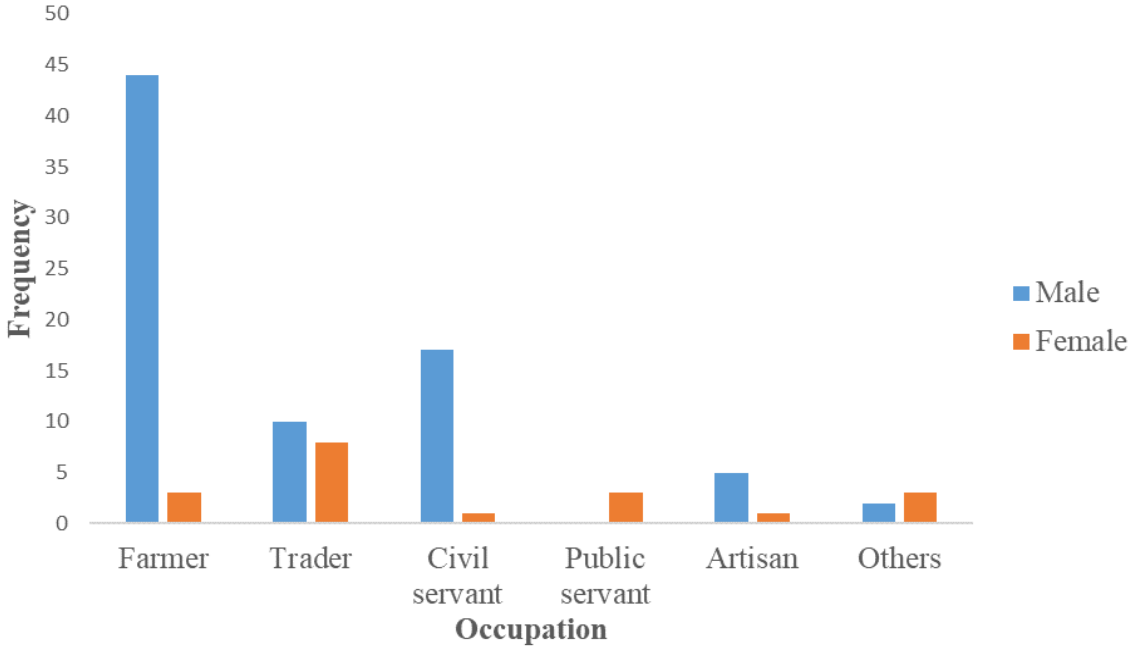


Figure 12. Occupation of the respondents.

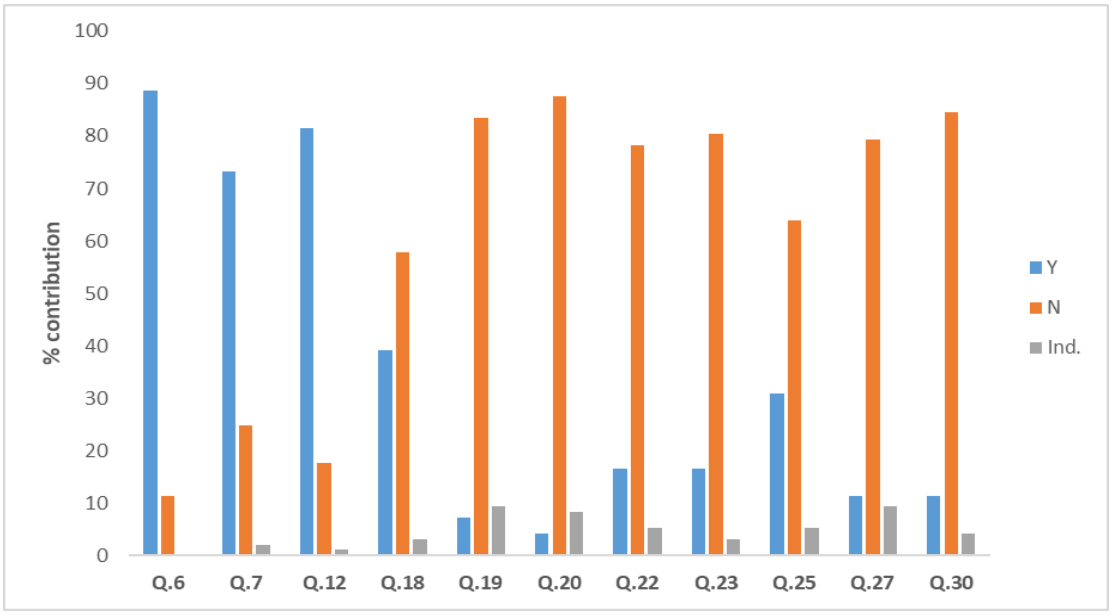


Figure 13. Responses of respondents to open questions.

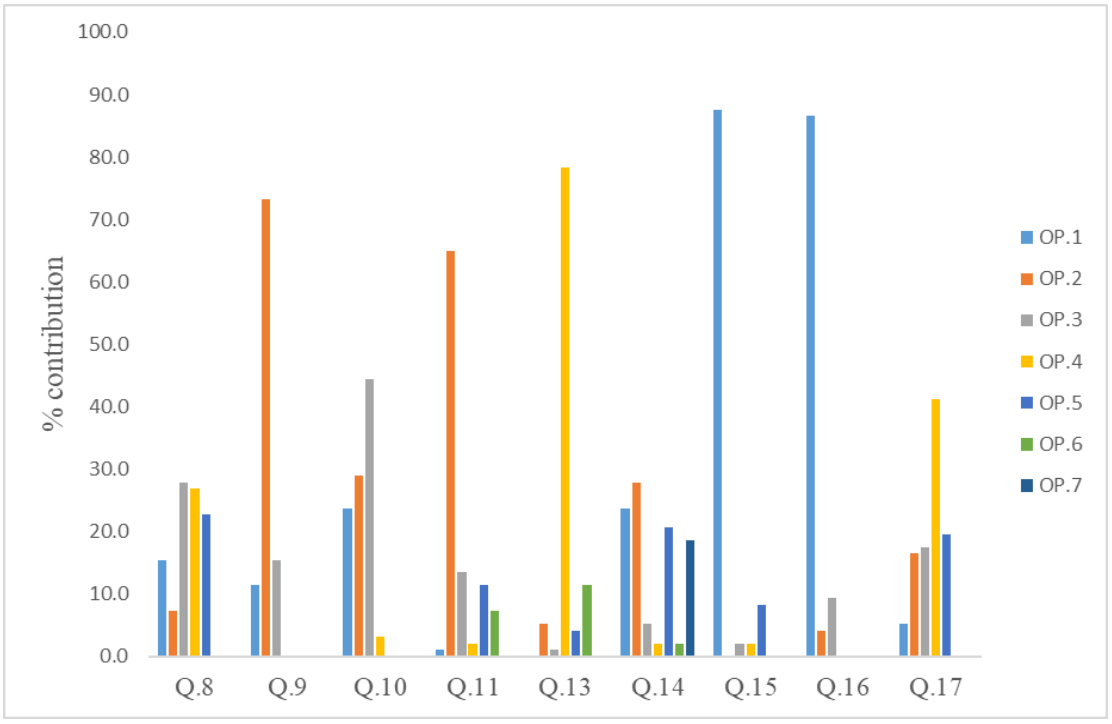


Figure 14: Responses of respondents to open questions.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

We encountered a significant transportation delay when heading to the study area, attributed to fuel shortage in the country. To address this, we rescheduled the trip to a later date when the transportation system was expected to stabilise. However, this

adjustment also impacted our ability to access the study area. To mitigate this issue, we strategically spaced out the sampling days. This approach allowed the rented cars and bikes to refuel adequately. We appreciate the efforts that went into resolving these challenges.

We also had some challenges during the field exploration and data collection, resulting from heavy rainfall within the study area. To address this issue, we strategically used voice recorders in areas where tree canopies were not enough to shield our writing materials. These recorded conversations were later translated into text and documented accordingly. In furtherance, we made provisions for raincoats and nylon bags to prevent our equipment from damages that may result from the rains.

Our interaction with the community faced obstacles due to an ongoing dispute between CRNP rangers and the local youth. This conflict had the potential to jeopardise the community science aspect, a vital component of our project. To navigate this situation, we took the initiative of convening a meeting with the community leaders at the CRNP substation office in Akampa (also known as Erukot). During this meeting, we provided a comprehensive overview of our project and earnestly requested insights from them regarding the youth's needs and preferences.

Remarkably, the youth expressed their willingness to support the project's success. They put forth a specific request for designated park rangers to engage with the community during the project duration. This positive outcome emerged from our collaborative efforts to address the challenges and concerns that arose, underscoring the importance of effective communication and cooperation.

4. Describe the involvement of local communities and how they have benefitted from the project.

The engagement of local communities stands as a pivotal pillar in the endeavour to conserve this species. Moreover, we have fostered a strong rapport with the local authorities, leading to a notable shift in their perception of the species within the study area. To ensure widespread awareness, we embarked on a campaign that entailed visiting local communities, acquainting them with the project's core objectives. Our initial efforts included hosting workshops, accompanied by an extensive environmental education initiative.

We took significant strides by involving five dedicated community members from each neighbouring community that were involved during the entire project. Looking ahead, we were able to educate younger ones within the community to emphasise the conservation of red ironwood. Given the nature of the project, the residents reap benefits through education, and offer honoraria to the selected volunteers. In pursuit of our expeditions, we involved the services of local guides and motor drivers. These individuals not only grasp the essence of the project but also serve as invaluable links between the communities and the programme itself.

5. Are there any plans to continue this work?

Yes, I have more plans to continue with this project. I've been working with conservation sensitive species in Nigeria for over a decade and I have seen the contributions of anthropogenic activities on biodiversity. Thus, the red ironwood needs to be protected and as well provide alternative means for the community. This is a good opportunity to create jobs for local people and significantly reduce human disturbances that negatively impact the habitats.

6. How do you plan to share the results of your work with others?

I plan to publish "Conservation of *Lophira alata*, an economically important and vulnerable tree species in Nigeria" in peer-review journal. Moreover, the results will be disseminated through meetings related to biodiversity at the national and international levels.

7. Looking ahead, what do you feel are the important next steps?

The next important steps are to continue engagement with the communities, increasing conservation awareness and the need to ensure sustainable use of *L. alata* within the study area. We also suggest the provision of alternative sources of livelihood for the host communities given their continued dependence on the forest resources for survival. We anticipate that our next project will continue monitoring of the re-forested areas.

8. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

Yes, I have used the Rufford Foundation logo for the posters during conservation education activities. I have also kept informed local people, forest office, and NGOs that this project was possible thanks to the funding of Rufford Foundation grant.

9. Provide a full list of all the members of your team and their role in the project.

CHUKWUMA, Emmanuel Chukwudi: He participated in the fieldworks, plant identification, coordinate records, tree measurements, data analysis, afforestation programme and report writing.

ADEWUMI Moradeke Deborah: She was involved with the conservation education and administration of the questionnaires and analysed the data.

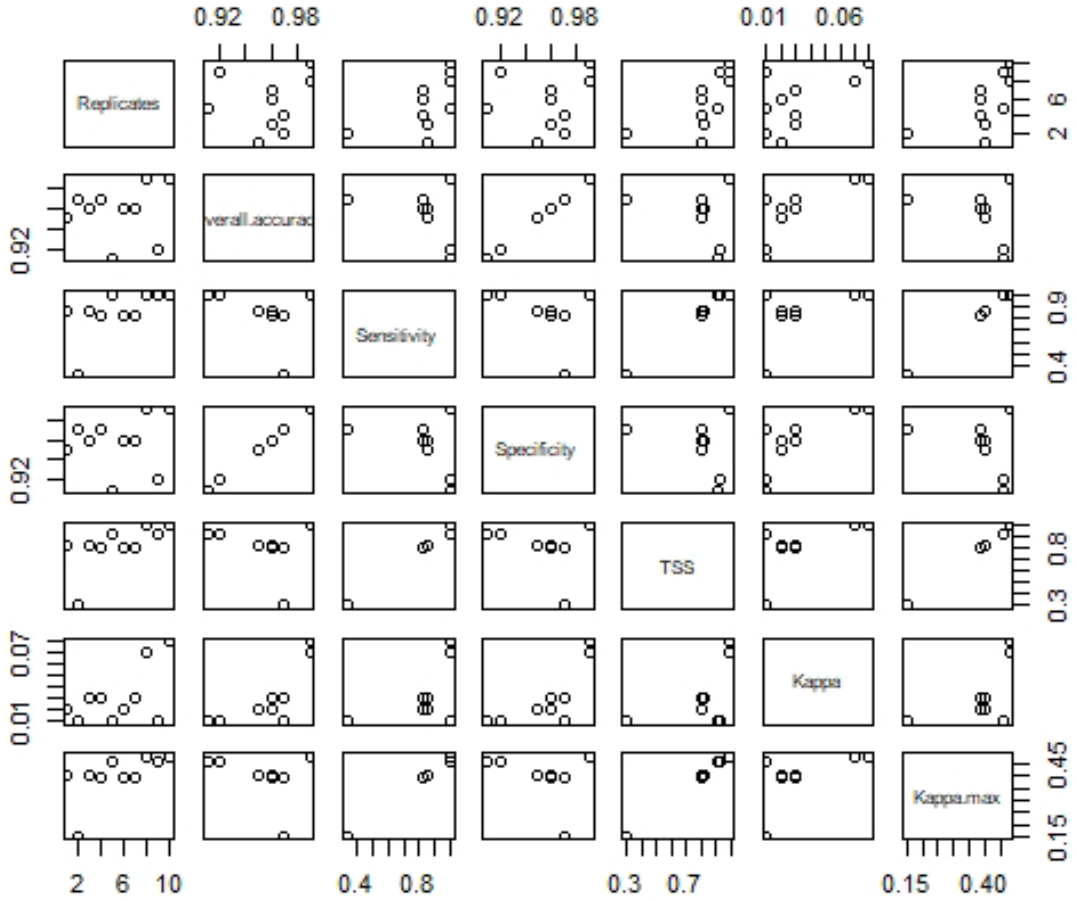
ODEWO, Peter Oluwadamilare: He has participated in sampling, collections, and tree measurements. He was also in-charge of the conservation education and first aid kits.

AGBO-ADEDIRAN, Opeyemi Adewale: He was in volved the field work, in tree measurements, collection of ecological data, and afforestation programme.

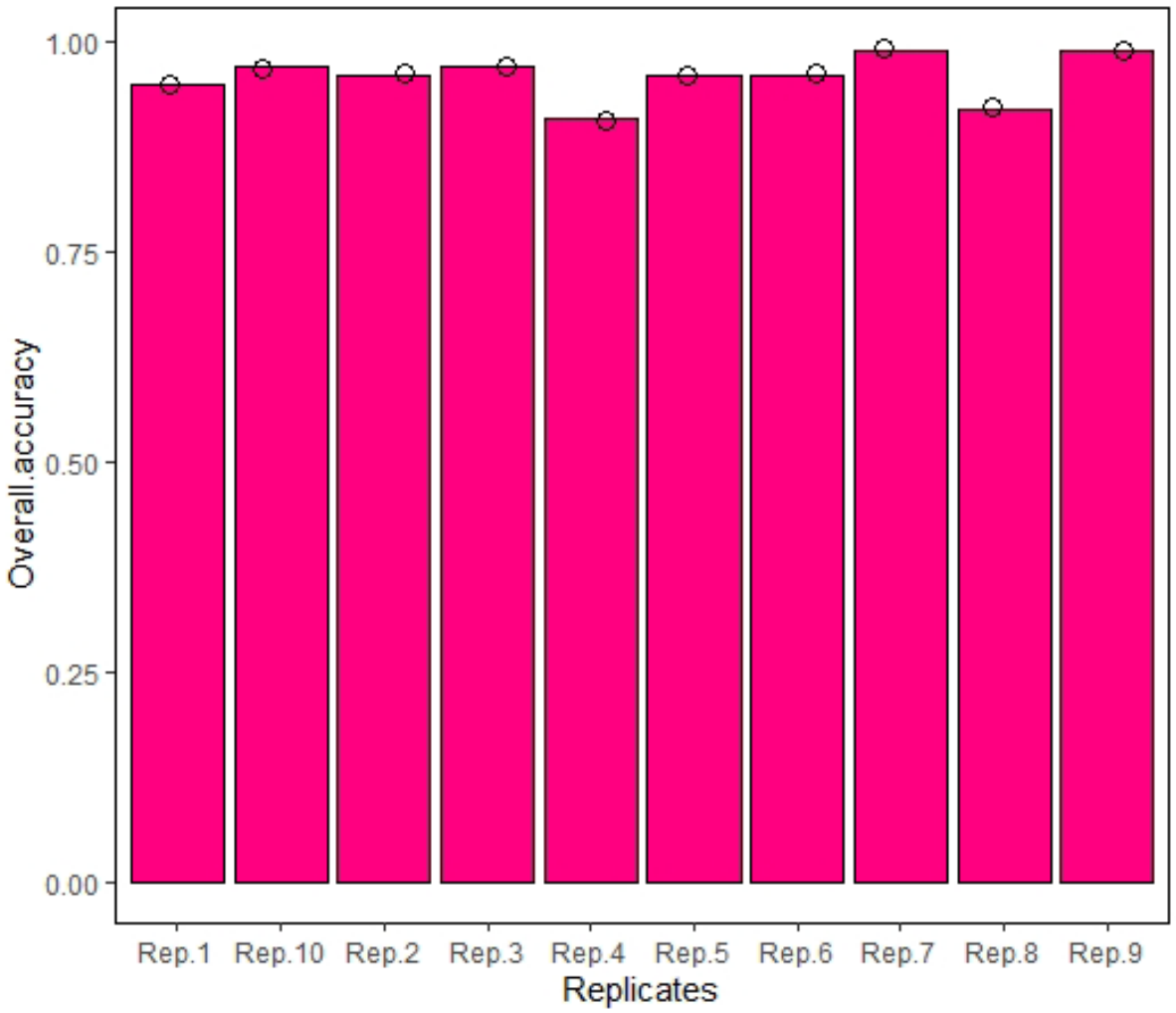
10. Any other comments?

I want to thank the teammates for their contributions towards the successful completion of the project. I also thank the local people for their availability and Cross River National Parks officers. Finally, we thank the Rufford Foundation for its generous support to fund this project. We acknowledge the foundation for the conservation initiatives it supports around the world.

Annexes



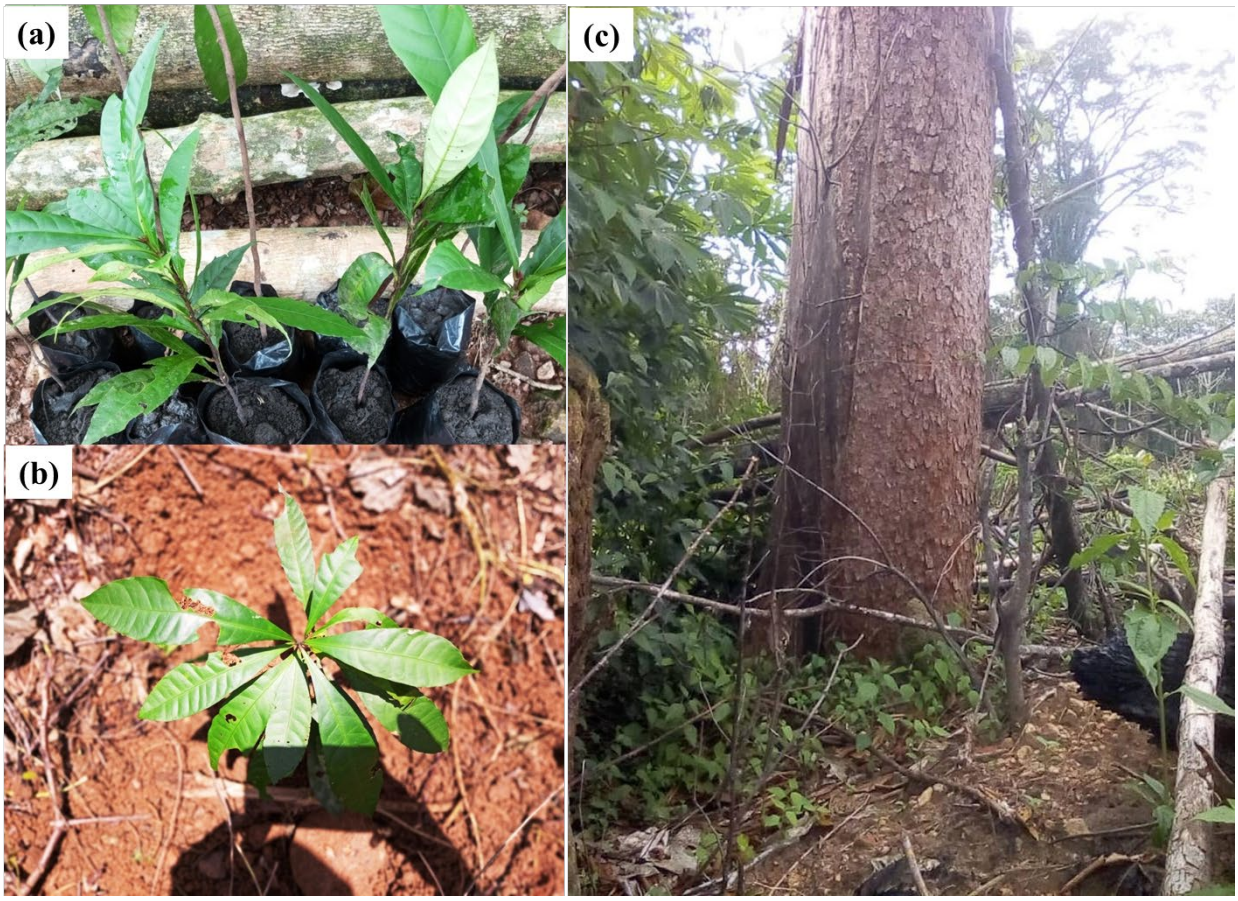
Annex 1: Plots for test skill statistics (TSS), model sensitivity, specificity and accuracy.



Annex 2: Plots for test skill statistics (TSS), model sensitivity, specificity and accuracy.

Annexes 3: (a) Arrival of the project team to the study site, (b-d) engaging park officers in conservation awareness**.**

Annex 4: Community-based conservation education. (a-c) involvement of the students during the project, (d-e) administration of questionnaires and (f-g) engagement of the community people during the community education.



Annex 5: Reforestation program. (a) representatives of the purchased potted seedlings and (b) saplings planted for demonstration during the project and (c) Evidence of debarking of mature tree for medicinal purpose.

Annexes 6: (a & b) Engaging youth leaders in conservation strategies, and administration of questionnaires, (c & e) conservation awareness and education in some schools visited, and (d) involvement of the community leader in tree planting exercise.