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Original Paper

Ethnobotanical Survey and Habitat Mapping of Medicinal Plants and Its Implication on Conservation Management in Rural Kwara Communities

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Abstract

Background: *In Nigeria, medicinal plants are now being threatened due to increased urbanization, land clearing for farming and over-harvesting from their natural habitats. As such, if such trends continue, some of these medicinal plants might increasingly become not available and in the extreme circumstance be faced with extinction.*

Methods: *An epidemiological descriptive field survey that employed a carefully-structured, closed-ended, interviewer-administered, paper-based questionnaire designed to capture information on the use of medicinal plants as antimalarial and for management of other associated illnesses. We also employed Global Positioning System (Garmin etrex 75) to captures the geo-coordinates of previously identified medicinal plants across the footpath transect at 20 m intervals. A total of twenty-one (21) medicinal plant species were surveyed across five communities with varying numbers per locations.*

Results: *Out of the nine (9) identified traditional healers across the communities, all claimed to have used at least one or combinations of these plants for treatment of malaria. An image classification performed through land cover land use map of the study area revealed six classes: swamp /water bodies, river valley, savanna woodland, degraded woodland, grassland and settlements cluster. Most*

threatened species such as Aristolochia ringes, Mucuna prurins, Azadirachta indica, Kigelia africana, Citrus limon, Ludwigia suffruticosa, Parkia biglobosa, and Picralima nitida are those found in Malete KWASU campus axis in the degraded woodland and settlement cluster classes. This is due to the high level of forest destruction in the area as a result of growing student population and massive constructions of students' hostel. We reported that about 60% of original plant cover has been lost between 2005 and 2015. It was observed that availability of surface water bodies played a crucial role in influencing the distribution of identified medicinal plants. The nearest neighbour analysis gave a nearest neighbour index of 0.695 at p=0.000003 and z-score of -4.70314. This shows that the observed random distribution of medicinal plants in the study area was statistically significant. It has been observed that random patterns are usually associated with natural occurrences. The random spatial pattern confirms that these plants have not yet been affected by anthropogenic activities and hence need to be conserved there in the wild.

Conclusion: *There is need to leverage on conservation of medicinal plants for treating malaria in their natural habitats. Also, the need to ensure sustainable harvesting and other socio-ecological process to ensure these are not threatened to the extreme case of extinction in these communities. In the view of the above, we recommend that KWASU-Malete campus axis be monitored, proper urban planning initiatives implemented and ensure cultivation and preservation of these plants are incorporated into the greening efforts of the Kwara state government in this area.*

Keywords

Medicinal Plants, Ethnobotanical Survey, Questionnaire, Global Positioning System, Traditional Healers, Rural, Kwara State

1. Introduction

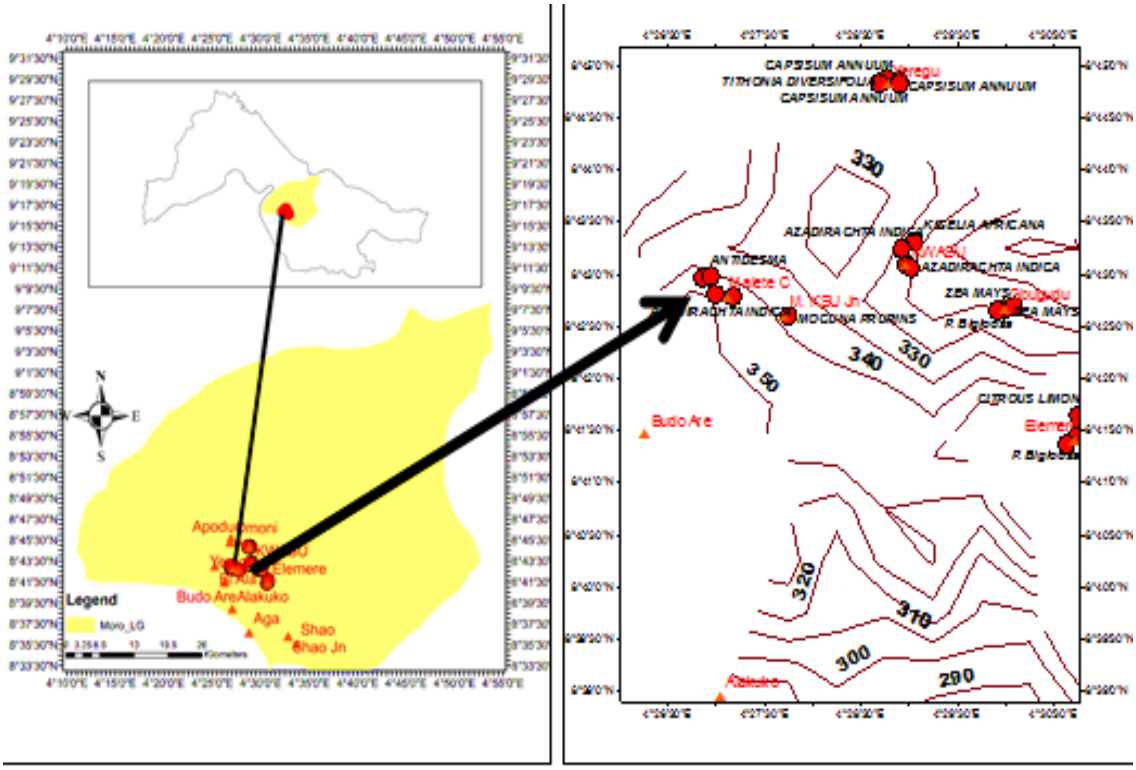
Medicinal as well as aromatic plants are seen globally as raw materials in the pharmaceutical and traditional health sectors (Phondani, Maikhuri, & Saxena, 2014). It has been observed that over 85% of traditional herbal medications globally are derived from medicinal plants (Phondani, Maikhuri, & Saxena, 2014). Such is seen in the Indian pharmaceutical sector where out of the 280 medicinal plants being used, 175 are found in the Indian Himalayan Region (Kumar, 2015). Studies from Iran showed that there are 8,000 medicinal plants growing in the wild and Geographical Information System (GIS) has been leveraged upon to map these to strengthen operationalization of policies and plans towards improving livelihoods for rural communities (Mashayekhan, Reza, Jidian, Jalilvand, Gholami, & Teimouri, 2016). Most of these medicinal plants are now being threatened due to urbanization, land clearing for farming and overharvesting from their natural habitats. As such, if such trends continue, some of these medicinal plants might increasingly become not available and in the extreme circumstance be faced with extinction. Nonetheless, best practices on cultivation, and sustainable harvesting could be leveraged on as strategies for sustainable livelihood in rural communities. Some countries like Canada have already commenced commercial cultivation of high value medicinal plants in British Columbia

under the Medicinal Plant Project (Chowdhury, Koike, Muhammed, Halim, Saha, & Kobayashi, 2009). This study attempted to present systematic biodiversity, ethno-botanical survey and geospatial analysis of indigenous medicinal plant species used for management of malaria and other associated illnesses and its implication on conservation management in rural Kwara State, Nigeria.

2. Methods

2.1 Study Area

Our study area is located in Moro local government area (LGA) of Kwara state, Nigeria. Kwara state is located in the Derived Savannah zone of North-Central Nigeria. It comprises the sample settlements of Malete-Okete, Gbugudu, Malete-Kwasu campus, 2 km south of Yeregi, cluster of settlements around Apodu and Alapo axis. The climate and occupational activities in the area are described in Olalubi et al. (2020). Being rural communities the landscape provides good habitat for several medicinal plants which are harvested by the local for alternative health care delivery and services. However, the establishment of Kwara State University (KWASU) in 2009 at Malete has not only altered the population structure of the area but also the composition and quantity of plant diversity.



a **b**

Figure 1. (a) Map of Study Area (Kwara State and Moro LG Inset) (b) Medicinal Plant Species Distribution

2.2 Field Survey

Field survey was carried out by the team of researchers and 2 local assistants from the communities along the footpath transect at 20 m intervals using Global Positioning System (Garmin etrex 75) to captures the geo-coordinates of sampled villages and previously identified medicinal plants. A total of twenty-one (21) medicinal plant species were surveyed across five communities with varying numbers per locations. Simultaneously, an in-depth verbal interview was conducted with nine (9) head of traditional healers and home-made herbal medicine users by team members and covered by University relations media department. Also, a mixed, paper-based, structured, interviewer-administered, questionnaire made up of both open-ended (qualitative and exploratory) questions and standardized closed-ended part provides quantitative data. It was designed to capture information on the use of medicinal plants as antimalarial and management of other associated illnesses, plant materials used in isolation or combination for malaria management and most effective medicinal plant used for treatment of acute, uncomplicated and severe malaria across the study settlements.

2.3 GIS Operation for Land Cover Mapping

We subset the geographic extent of the study area using both the settlement point data and the administrative shape file at ward level in ArcGIS 10.2 (Figure 1). The 2019 Sentinel satellite images of the Ilorin-Igbeti scenes at 20 m spatial resolution was obtained and downloaded from web portal of Copernicus project (https://scihub.copernicus.eu).

Raster processing was performed by cropping the study area extent from the larger satellite images. Image enhancement and band combinations were performed to extract land cover features such as vegetation water bodies and settlements. All the satellite images were co- registered to the same study area shape file to give similar spatial dimension. As shown in Figures 2 and 3, vegetation index analysis was performed using soil adjusted vegetation index (SAVI) as proposed by Huete (1988) to distinguish gradient of plant cover and minimize the effect of soil background on vegetation signal in the landscape. We set our soil adjustment L factor to 0.5 given the semi forest nature of the study area. SAVI is mathematically denoted as

$$SAVI = \frac{nir - red}{(nir + red + L)}(1+L)$$

Where

nir = near-infrared band

red = visible red band

L = soil adjustment factor

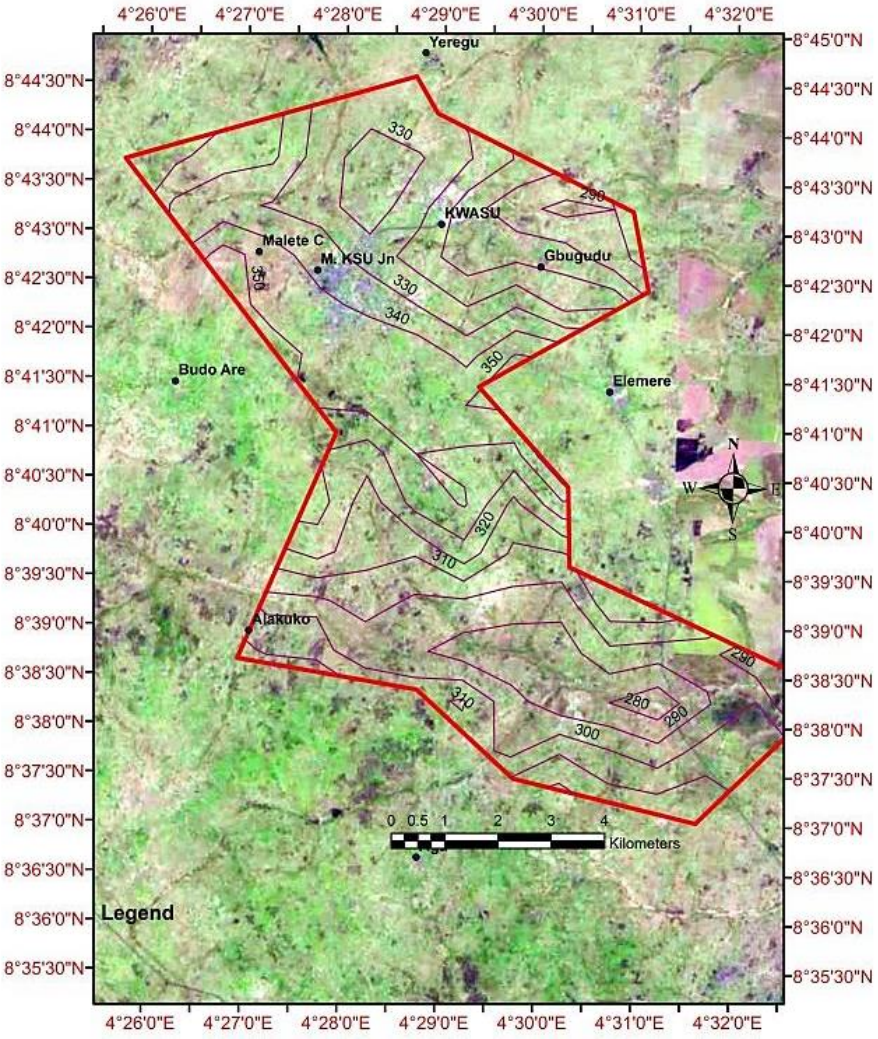


Figure 2. Study Area Overlaid on Composite Sentinel Images

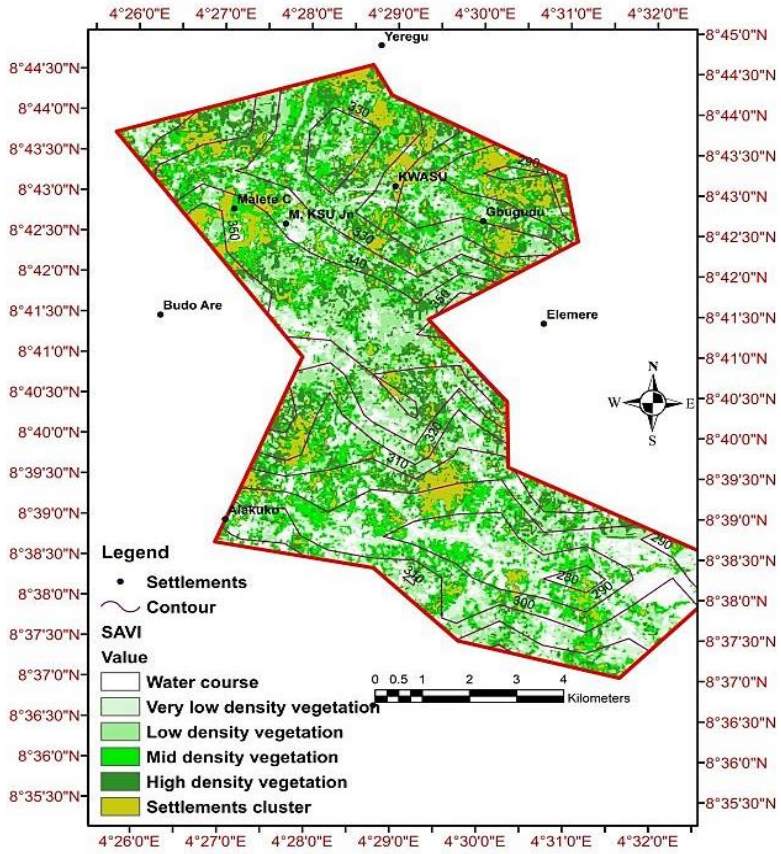


Figure 3. Soil Adjusted Vegetation Index

The Nearest Neighbour Analysis was carried out to determine the spatial pattern of observed medicinal plants in the study area. NNA is a statistical model used to determine the probability of finding a point within a radius around one point follows a Poisson distribution when sampled from a population of points on a plane (Clark & Evans, 1954). It is indexed from 0 being clustered to 1 being random and 2.15 being regular in spatial pattern.

$$R_n = \frac{\dot{X}(Obs)}{0.5\sqrt{\frac{a}{n}}}$$

Where

R_n = Nearest neighbour value

$\dot{X}(Obs)$ = mean observed nearest neighbour distance

a = area under study

n = total number of points

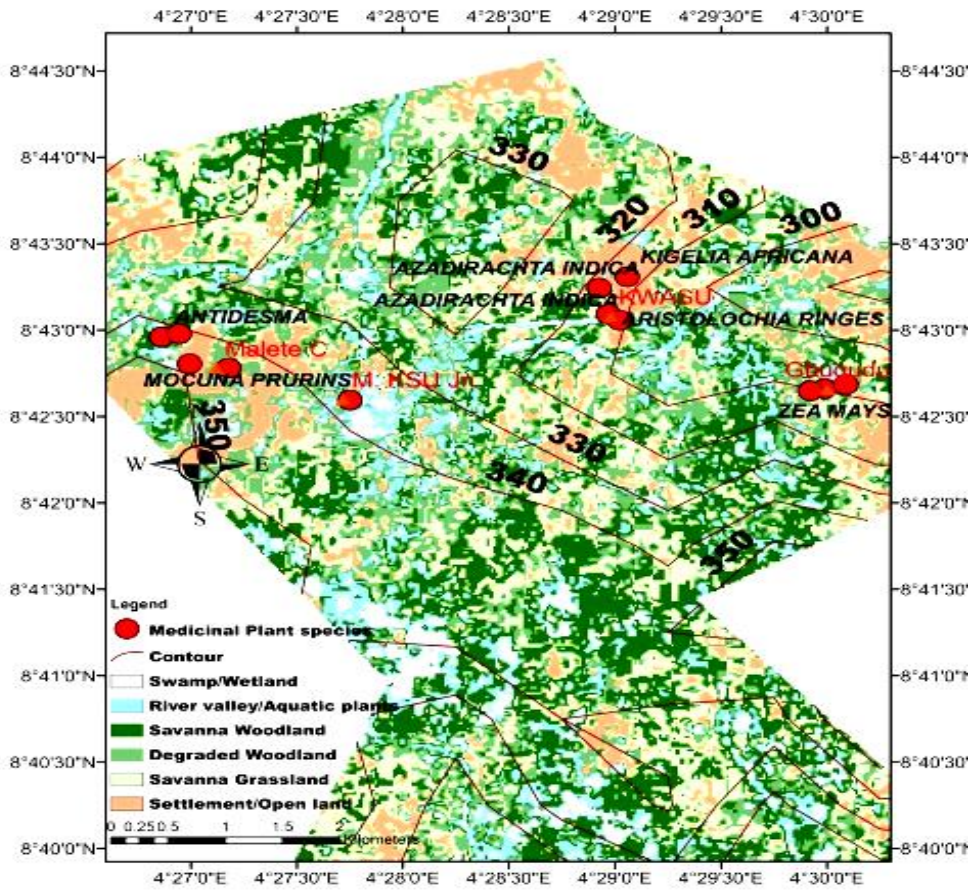


Figure 4. Spatial Distribution of Medicinal Plants by Landcover Classes

2.4 Collection and Identification of Plants Specimens

A series of field trips were conducted to collect specimens of the reported plants from the natural vegetation with the help of some traditional healers / home-made herbal medicine users recruited as respondents. Identification and scientific authentication of the sampled plants and generation of voucher specimen number was done at the Department of Forest Conservation and Protection, Forestry Research Institute of Nigeria, Jericho, Ibadan. The online plant diversity resources further confirmed the identity of the surveyed plants. The Voucher specimens were collected, pressed and deposited in the herbarium of Kwara State University, Malete, Nigeria.

2.5 Statistical Analysis

Each study questionnaire involved seventy-six constructs/variables on the entire subject matter. Among these variables, fifty-one (51) are quantitative variables while the remaining twenty-five (25) constitute qualitative variables. For the nine respondents, the study involved a total of 459 observations from qualitative variables among which 42 were missing due to non-responses. We completed cases for the data by automatically replacing the missing entries in a reliable data-adaptive way using multivariate imputation by chained equation technique, package of the version 3.6.1 of the R software for statistical computing and graphics (R Core Team, 2019).

2.6 Ethical Clearance

All aspects of the study were approved by Kwara State University Research Committee and Ethical Review Board. Verbal and written Informed consent was obtained from the traditional healers used as respondents through community leaders and magajis'. They were assured of voluntary participation, confidentiality of their responses and the opportunity to withdraw at any time without prejudice in line with the Helsinki Declaration was emphasized (World Medical Association, 2001).

3. Results

The study found twenty-one (21) different ethno-medicinal plants used in different forms for management of malaria and other associated allied illnesses in the rural communities (Table 1).

Table 1. Novel Medicinal Plants Usage by Settlements across Study Area

S/No	Specie Name	Local / Yoruba Name	Common /English Name	Family Name	Settlement	Voucher ID No	Morphology, Part Used / Status	Medicinal Use(s)	Usage & Dosage
1	*Antidesma velutinum L.*	Aro-dudu	Antidesma	Euphorbiaceae	Okete	FHI 112959	Climber grown to a tree, leaf, Yellowish green in colour. Stem bark and Green leaf used	Malaria	Use along with ewe aafe, soak and boil to steam together, inhale the steam, drink in the morning and evening (5mls-10mls) and bath when warm, three times over three days.
2	*Cedrela odorata L.*	Ewe-gbogi	Cedar Wood	Meliaceae	Yeregi	FHI 112960	Green, leaf	Malaria, measles	Boil with ewe-rodorodo and water, baths and drink twice daily. For measles, Pound or impulverized with ripe banana, poured inside a fairly big covered plastic with red palm oil. Cream the child every night over three days. It could be used to treat measles in children. The

									concoction could last for 1 year.
3	*Capsisum annuum L*.	Ewe-rodo rodo	Bell-pepper	Solanaceae	Yeregi	FHI 112958	Green, leaf	Malaria, Vitamin C, stimulant	Boil with ewe-gbogi and water, baths and drink twice daily
4	*Tithonia diversifolia* L.	Ewe-Jogbo	Tree marigold	Asteraceae	Alapo	FHI 112957	Green, leaf	Malaria, Yellow fever	Bitter in taste due to presence of alkaloids, combine with dry banana leaves, boiled together to steam, inhale the steam, drink 5-10mls twice daily, morning and evening over three days. Bath with the concoction once daily over three days.
5	*Ficus thoningii* Blume	Ewe-Odan eki	Blume	Blume Moraceae	Alapo	FHI 112956	Root, stem bark, green leaf	Malaria, fever, hepatitis,diarrhoea,urinary schistosomiasis, urinary tract infections, diabetes mellitus, gonorrhoea, respiratory infection	Blend the leaf with banana fruit, add red palm oil, keep under the sun for 3 hours to achieve homogenicity. Rub on the body once daily for 5 days.
6	*Solanum torvum* Sw.	Ewe-Elegun / Ewe Egun Onitan meta	Turkey berry	Solanaceae	Alapo	FHI 112955	Green, leaf	Malaria, cough, fever	For cough, weigh the Leave, add odan opupu leaves. Wrap ewe elegun with ewe odan opupu and tied with rope, bury it in hot ash for 5mins, after which the steamed content is removed, pressed to extract the juice. One

									teaspoon is consumed once daily either morning, afternoon or evening. For malaria: weigh the plant, squeeze, filter, add common salt sodium chloride, drink thrice (morning, afternoon and evening) for a day.
7	*Petiveria allicea* L.	Ewe-Awogba	Anamu	Phytolaccaceae	Okete	FHI 112954	Green, Leaf	Malaria, Cancer and Gonorrhea	For gonorrhea (atosi), grind to powder, dry and sieve and pulverized further. For malaria, the powdery form (10mg) is consumed with pap.it can also be taken with water.
8	*Spondias mombin* L.	Iyeye ode	Hog plum	Anacardaceae	Okete	FHI 112921	Yellowish Green, leaf and Bark	Malaria, cough, fever	Soak with water, Boil, decant, drink and bath. Drink 5 to 10mls three times (morning, afternoon and evening) for one day. Bath with the warm concoction once daily.
9	*Byrsocarpus coccineus* Schumach	Owo Ataba / Owo-Ile	Huntsman's pepper	Connaraceae	Gbugudu	FHI 112950	Herbaceous plant Green, leaf	Malaria, measles	Burn the leaves to ashes with alligator pepper (atare), add red palm oil to it and licked. Use as cream / rub on the skin for four (4) days. Rub over the body in the morning and evening.
10	*Zea mays* L.	Ewe Agbado	Maize Plant /	Poaceae	Gbugudu	FHI 112920	Green, leaf	Malaria, gall bladder	Boil the leave together, sieve and

			sweet corn – agbado					stone	drink three times (morning, afternoon and evening) in a day.
11	*Mitragyna inermis*	Ewe Okobo	African linden	Rubiaceae	Alapo	FHI 112952	Green, leaf, bark	Malaria, gonorhoea, dysentery, pile	For malaria, boil and drink three times a day and bath once daily. For pile, Impulverized with water, sieve, filter and drink the filtrate three times a day
12	*Piper guineense* Schmach	Iyere	African locust beans	Piperaceae	Malete	FHI 112922	Green, Root, seed & leaf	Malaria	Mix together, sieve, pour inside ragolis bottle. Drink one cup once daily for 3 days.
13	*Picralima nitida* T. Durand	Abere	Spanish needles	Apocynaceae	Malete	FHI 112923	Green, Root, seed & leaf	Malaria, abdominal disorders	Extremely bitter, Mix together with water, sieves, and pour inside ragolis bottle. Drink one cup once daily for 3 days.
14	*Vernonia amgdalina* De	Ewuro (Bitter leave)	Water primrose	Asteraceae	Malete	FHI 112924	Green, leaf	Malaria, wound, fever and pile	Freshly pulverized with water and filtered. Add common salt ($Nacl_2$) to filtrate and drink three times, morning, afternoon and evening in a day.
15	*Citrus limon* (L) Buru .F.	Osan-laimu	Lemon	Rutaceae	Malete	FHI 112925	Green leaf, Unripe Lemon Seed and Juice	Malaria, cold, stomach ache	Half cup twice daily, morning and evening.
16	*Kigelia Africana* (Lam) Benth	Pandoro	Sausage tree	Bignoniaceae	Malete	FHI 112926	Bark	Malaria, kidney disorder	Cut the bark into pieces, mixed together with palm wine, left over for two (2) days
17	*Azadirachta indica* A. Juss.	Dongo-yaro	Neem tree	Meliaceae	Malete	FHI 112927	Root	Malaria, ring worm, syphilis	Wash with water, cut into tiny pieces, soaked

									in alcohol or water. Drink one cup per day for 3 days.
18	*Mucuna prurien* (L) DC.	Ewe yerepe	Stinging bean	Leguminosae	Malete	FHI 112928	Green, leaf	Malaria, skin diseases, diuretics.	Cut into tiny pieces, macerate with water and salt, sieve, and pour inside Ragolis bottle. Drink One (1) cup, once daily for 3 days.
19	*Aristolochia ringens* Vahl	Akogun	Snake work	Aristolochiaceae	Malete	FHI 112929	Root	Malaria, Typhoid, Antidote	Mix together, sieve, pour inside ragolis bottle. Drink one cup once daily for 3 days.
20	*Alstonia boonei* De Wild	Epo Aganwo	Alstonia, pattern wood, stool wood	Apocynaceae	Alapo	FHI 112953	Bark	Malaria	Pulverize the fresh bark along with edible locust bean seed, dry in sunlight, sieved and packed. Use in 100mg of the powdery form with a cup of water or pap. It could be tablet or capsulated It can be used as analgesic.
21	*Chromolaena odorata* (L) R.M. King	Ewe Akintola	Siam weed	Asteraceae	Alapo	FHI 112951	Green, leaf	Malaria, dysentary, diarrhoea.	Boil water till warm, Squeeze the leave inside warm water. Sieve / filter, drink three times a day over three days.

NB: FHI=Forest Herbarium Ibadan

Source: Author (2021)

All the ethno-medicinal plant experts (traditional healers) included as respondents in the study were married males aged 50 year and above. Majority of the respondents have primary school level education as presented (Table 2).

Table 2. Educational Level of Respondents

Educational Status	Frequency	Percent
Primary	8	88.9
Others	1	11.1
Total	9	100.0

Common illnesses identified include malaria, typhoid fever, skin rashes, cough, diarrhea, cholera, measles, convulsion, diuretics and others in the settlements. However, data evidence revealed that all (100%) of the respondents are aware of malaria in their practice and experience with ethno-medicinal plants and herbs. Data evidences also showed that majority of the traditional healers combine the identified medicinal plants in the treatment of malaria as presented (Table 3).

Table 3. Plant Materials Used in Isolation or Combination for Malaria Management

Responses	Frequency	Percent
Yes	7	77.8
No	2	22.2
Total	9	100.0

Some of the combinations therapies are presented in table 3 while those acclaimed to be most effective for treatment of both acute uncomplicated and severe malaria are listed in Table 4 respectively.

Table 4. Medicinal Plant Used as Combination Therapies for Acute Uncomplicated and Severe Malaria

S/No	Local / Yoruba Name	English / Specie Name	Usage and Dosages
1	*Ewe-Gbogi + Ewe- Rodo Rodo*	*Cedrela odorata* Leaves + *Capsisum annuum* L. (Bell Pepper) Leaves	Boil both leaves together in water, baths and drink twice daily
2	*Ewe Odan Eki + Unripe Banana fruit*	*Ficus thoningii* + *Musa spp*	Boil the leaf, macerate with unripe banana fruit and potassium permanganate, dissolves in palm oil, poured inside bottle, place under the sun and shake vigorously. Then rub once on the body of the child. Two (2) teaspoon of the concoction is consumed twice daily. The patient sweats after five (5) minutes of administration, as an indicator of efficacy of the herb.
3	*Epo Aganwo + Locust Bean seed*	*Astonia borni* + Parkia biglobosa (Jacq.) G.Don	*The bark of Astonia borni is cut into pieces, boiled to steam.* The seed of

			Locust Bean is added to improve taste. Allow to cool for 40minutes. Half or One Cup is then consumed twice daily.
4	*Ewe (leaves) Ewuro & Lemon Juice*	*Vernonia amygdalina* – (Ewuro) + *Citrus limon* Lemon	Macerate, sieve, pour inside Ragolis bottle Half cup twice daily, morning and evening.
5	*Epo (Bark) Pandoro & White Palm Wine*	*Kigelia africana*	Cut the bark into pieces, mixed together with palm wine, left over for two (2) days.
6	*Ewe (leaves) Imi-esu & Epo (Bark) of Obo*	*Ageratum conyzoides* (White-Weed) & *Ficus platyphylla* (Anti-witchcraft leave)	Macerate together with mortar and pestle; add one local egg, mixed with black soap to bath for 3 days.
7	Unripe Lemon Juice & Omi (water) Wara	*Citrus limon* Lemon & (fermented *water* from raw cow milk).	Mix together, sieve and pour inside Ragolis bottle. Drink one (1) cup once daily for 3 days.
8	Egbo (Root) Akogun & Abere (seed) & Iyere (seed)	*Aristolochia ringes* + *Bidens pilosa* + *Piper guineense Schmach* (African locust beans)	Mixed with water, macerate, sieve and pour inside Ragolis bottle. Drink one (1) cup once daily for 3 days

Source: Author (2021)

Table 5. Most Effective Medicinal Plant for Treatment of both Acute Uncomplicated and Severe Malaria

S/No	Local / Yoruba Name	English / Specie Name	Usage and Dosage
1	Aro Dudu	Antidesma *Antidesma velutinum* L.	Macerate and Boil the leaf in water to steam, allow to cool, baths and drink. Drink one (1) cup twice daily for three (3) days
2	Ewe Okobo	*Mitragyna inermis* (African linden)	The leaves are macerated with water, add salt, filter and drink. Drink one (1) cup once daily for 3 days.
3	Ewe-Odan eki	*Ficus thoningii blume* (Strangler fig, common wild fig, bark-cloth fig)	Boil the leaf, macerate with unripe banana fruit and potassium permanganate, dissolves in palm oil, poured inside bottle, place under the sun and shake vigorously. Then rub as cream once on the body of the child. Two (2) teaspoon of the concoction is consumed twice daily. The patient sweats after five (5) minutes of administration, as an indicator of efficacy of the herb. It is also effective for the treatment of diarrhea, dysentery and vomiting. *Ficus* specie plant could also be used singly to treat malaria without combining it with other plants
4	Ewe-Gbogi + Ewe- Rodo Rodo	*Cedrela odorata* + *Capsisum annuum* L. (Bell Pepper)	Macerate and Boil both leaves together in water, baths and drink. Drink one (1) cup twice daily for three (3) days.
5	Ewe Iyeye-Ode	*Spondias mombin* (Hog plum)	Macerate and Boil the leaf in water to steam, allow cooling, baths and drink. Drink one (1) cup twice daily for three (3) days.

Source: Author (2021)

Six classes of land use land cover (LULC) were identified as follows: Water bodies, river valley, savanna woodland, degraded woodland, grassland and settlements cluster with the associated medicinal plants (Table 6).

Table 6. Observed Medicinal Plants Distribution Based on LULC

S/No	Settlements	Land cover categories	Associated medicinal plants
1	Apodu	Swamp/wetland	Citrus lemon
2	Alapo	River valley	*Mitragyna inermis, Solanum torvum Sw, Ficus thoningii Blume, Tithonia diversifolia Chromolaena odorata*
3	Yeregi, Gbugudu	Savanna woodland	*Antidesma velutinum, Capsisum annum, Cedrela odorata, Byrsocarpus coccineus Schumach*
4	Malete, Okete	Degraded woodland	*Kigelia Africana, Spondia mombin L, Azadirachta Indica*
5	Central Malete	Savanna Grassland	*Vernonia amgdalina Azadirachta Indica*
6	Malete, KWASU	Settlement cluster / Openland	*Azadirachta Indica*

Source: Author (2021)

4. Discussion

Most threatened species such as *Aristolochia ringes*, *Mucuna pruriens*, *Azadirachta indica*, *Kigelia africana*, *Citrus limon*, *Ludwigia suffruticosa*, *Parkia biglobosa*, and *Picralima nitida* are those found in Malete, KWASU campus axis in the degraded woodland and settlement cluster classes. This is due to the high level of forest destruction in the area as a result of growing student population and massive constructions of students' hostel. This area showing the LULC results (Figure 4) was reported to have lost about 60% of its original plant cover between 2005 and 2015 (Suleiman, Sawyerr, Adio, & Salako, 2018). It was observed that availability of surface water bodies played a crucial role in influencing the distribution of identified medicinal plants as shown in Figure 4. The nearest neighbour analysis gave a nearest neighbour index of 0.695 at p=0.000003 and z-score of -4.70314. This shows that the observed random distribution of medicinal plants in the study area was statistically significant. It has been observed that random patterns are usually associated with natural occurrences (Garcia-Baquero & Crujeiras, 2015). This further support the aim of this study which seeks to leverage conservation of medicinal plants for treating malaria in their natural habitats. The random spatial pattern confirms that these plants have not yet been affected by anthropogenic activities and hence they need to be conserved there in the wild.

5. Conclusion

Out of the nine identified traditional healers in the community, all nine claimed to have used at least one or some in combinations of these plants for treatment of malaria. It could be seen that all identified species of medicinal plants when mapped had statistically random distribution proving their growth being in the wild and being influenced by nature. With increasing reliance on traditional medicine,

there is a need to ensure sustainable harvesting and other socio-ecological process to ensure these are not threatened to the extreme case of extinction in these communities. Urbanization due to increasing sphere of influence of KWASU in the area should also be monitored and proper urban planning initiatives incorporated to ensure cultivation of these plants are incorporated into the greening efforts of the Kwara state government in this area.

Competing interests

No conflict of interest associated with this work.

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Contribution of Authors

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

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Appendices

Novel Medicinal Plants for management of malaria and other concomitant illnesses by settlement across study zones



Appendix 1: *Antidesma velutinum L.*

Ewe-Aro dudu from Okete settlement



Appendix 2: *Spondias mombin* L.

Iyeye Ode Plant from Okete settlement



Appendix 3: *Byrsocarpus coccineus* Schumach

Owo Ataba / Owo-Ile plant from Gbugudu settlement



Appendix 4: *Zea mays* L.

Maize leaves from Gbugudu settlement



Appendix 5: *Cedrela odorata* L.

Ewe gbogi leaves from Yeregi settlement



Appendix 6: *Capsisum annuum* L

Ewe-rodo rodo from Yeregi settlement



Appendix 7: *Tithonia diversifolia* L.

Ewe-Jogbo from Alapo settlement