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# Vegetation, Climate Change and Pace of Agricultural Practice during the Last Two Millenia in Southwestern Nigeria

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A B S T R A C T

The pollen assemblage of some recent sediments from the Majidun creek, Lagos SW Nigeria was investigated to provide a baseline information on the quaternary paleovegetational and paleoclimatic changes hence the pace of agricultural practice during the last two millennia in Southwestern Nigeria. *Acacia cf. nilotica, Sapotacae, Grewia, Nitragyn*a which constituted an open Acacia scrub forest thrived in the region under relatively warm and humid climate with copacetic monsoon precipitation than what is obtainable today.Forest fire incidences was also evident based on the occurrence of fragmental charcoals. *Carophyllacae, Cheno/AM, Callibis sativa* which are all plant taxa of *Cerealis* emphasizes the agricultural practice. Between 1720 and 800yr BP, the expansion of the *Acacia cf nitolica* and several other aboreals viz *Terminalis, Grewia* and *Madhuca indica* from an Acacia scrub forest that turned profuse indicated a response to a predominantly humid climate change as indicated by a retrogression in the growth/expansion of the Acacia scrub forest; although agricultural practice continued in the same place as before. However, the tremendous decrease in *Cerealis* indicates a low pace of agricultural practice.

Keywords:. Pollen analysis, climate, vegetation, Two millennia, Southwestern Nigeria

## 1. Introduction

The pollen analytical investigation of the sedimentary deposits from the Majidun-Ilaje area of Ikorodu, Southwest Nigeria enabled the generation of quaternary paleovegetational and paleoclimatic data hence furnished some fundamental facts about the vegetation succession from a spontaneous reaction to variability in climate at very wide intervals during the Holocene from Southwest Nigeria where there was the prevalence if deciduous sal forests dominating most of the landscape.

However, the paucity of information on the short term climate variability and its attendant effect on forest resource particularly in the last millennia has been given very little attention. (Sowunmi, 1995; Durogbo et al., 2010; Ige, 2009, 2011; Ige et al., 2011).

In this study, an attempt had been made to highlight the pace of agricultural practice in the last two millennia in Southwestern Nigeria in response to short term climate variability and vegetation shifts through the pollen analytical studies of a series of samples at close intervals from a 3m deep sediment profile at the catchment of the |Majidun river, one of the numerous aquatic habitats that constitutes the Lagos lagoon complex.

Several workers have employed the use of pollen grains from lagoons and creek sediments in paleovegetational and paleoclimatic studies. (Jansen, 1984; Sowunmi, 1981; Birks, 1993; Stutz and Prieta, 2003; Adekanmbi and Ogundipe, 2007; Latoire et al., 2010; Cambon et al., (1997); Santos et al., (2001); Haghani et al., (2016); Adekanmbi and Ogundipe, 2007; Ivanor et al., 2007).

The site, Majidun creek is a relatively small, narrow shallow water body. It lies within latitudes 3’48E and 4’48E and stretches between longitude 6’61N and 7’12N. It is one of the numerous aquatic habitats that constitute the Lagos lagoon complex. Others adjoining include Ologe, Lagos Lekki and Epe

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lagoons, Yewa and Ogun rivers, Badagry and Ogudu creeks. Majidun creek drains directly into the Lagos lagoon and empties into the Atlantic Ocean via the Lagos harbor. Its shore is denticulate and surrounded with forests typical of those found in the mangrove swamps and brackish water systems. The climate in general is humid and is largely influenced by southwest monsoon. The vegetation of the region is characterized by the prevalence of tropical deciduous teak (*Tectonia granbdis*) forest (Lawson and Olusanya, 2010). The other less regular associates of teak are *Mitragyna parvifolia, Lagerstroemia parvifolia, Feronia lemonia, Adina cordifola, Terminali arjuna, T. bellerica, Emblica officilinalis, Diospyros melanoxylon* etc. However, groves of *Acacia nitolica* dominates the rugged and dried flood prone catchment of the Majidun creek. Also frequent in the scub forests are the thickets of *Ziziphus matania*, Carissa *opaca, Adhatodavasica*. Grasses together with *Ageratum conyzoides, Blumea spp, Micromeria bifloria, Oxalis acetosella, Mazus japaouicus*, are common constituents of the ground vegetation. *Solanium Xanthocarpum, Polygonium serallatum, Scriptus articulatous, Cyperus rotundus, Eriocaulon quinquangularis, Cantanella spp* are marshy elements along the water course. *F. benghalensis, Acacia nitolica, Ficus tinctonia, Melia azedarach, Madhuca indica, Bontea monospermia* are the usual trees of human habitation (Soyinka et al., 2010).

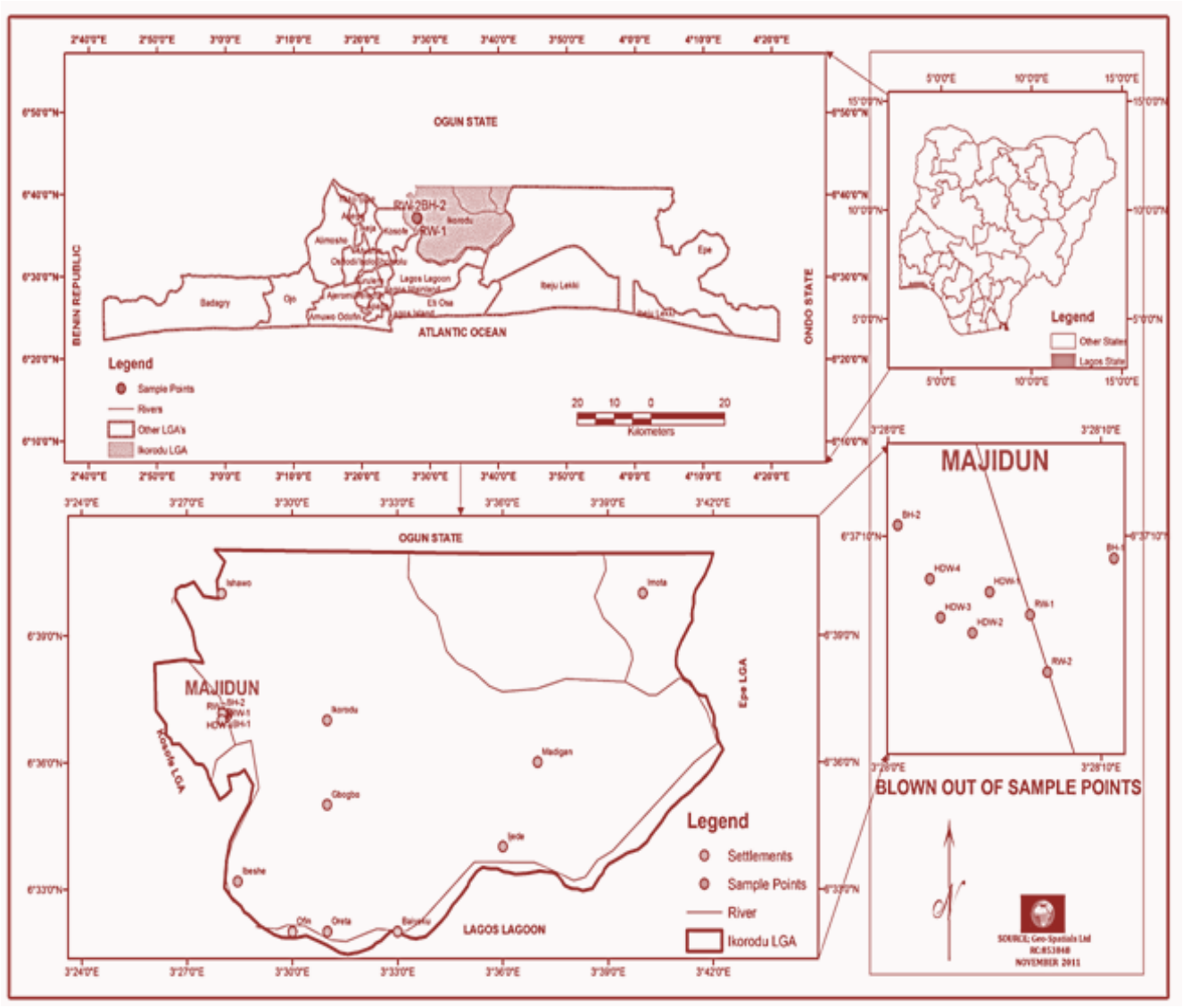



Fig1. Map showing the investigation site in the Majidun area

## 2. Materials and Methods

15 samples were collected at 10cm intervals from the sediment profile obtained by digging a 3m deep trench for pollen analysis along with 8 bulk samples at a much wider interval for radiocarbon dating. Charcoal pieces at different depths with minor fractions of sands, pebbles with predominant clay fractions constituted the sediment profile population. The thickest zone which comprises of greyish clay with sand and rootlets marks up the uppermost lithounit. Beneath this is a mixture of clayey sand with occasional rootlets (a thin lithzone), followed by greysish sandy clay with charcoal pieces. The lowest lithozone is full of pebbles with pockets of clay (Fig 2)

| Depth (in cm) | Lithology |
|---|---|
| 0-80 | Greyish clay with sand and rootlets |
| 80-100 | Clayey sand with rootlets |
| 100-130 | Greyish clay with sand |
| 130-180 | Greyish clay with charcoal pieces |
| 180-195 | Greyish clay with frequent charcoal |
| 195-200 | Clay with pebbles |

Fig 2: Depth Lithozone

Two radiocarbon ages i.e. 1980±70yrsBP (BS 2980) at 160-175cm depth and 1550±90yrsBP (BS 2849) at 130-155cm depth was determined for the sediment profile. The age allowed the delineation of the rates of sedimentation for the lithofacies, From the bottom, the ages 1980±70yrsBP(160-175cm) and 1550±90yrBP(130-155cm) indicated a 1.5cm/7.8yr calibration of the sedimentation rates whereas for the upper parts, on the premise that the surface is modern and using the age 1550±90yrBP(130-155cm), sedimentation rate 1.55/15years. Extrapolation of the ages of 2070yrBP at 300cm depth, 16450yrBP at 130cm depth and 725yrBP at 70cm depth formed the basis for these sedimentation rates hence enhanced the delineation of the vegetation chronology of the succession and the variability in climate change in the region in the last two millennia. Samples for microscopic examination was prepared in 50% glycerin solution and segregation of the pollen and spores from the sediments was done using the standard technique of acetolysis (Erdtman, 1943) using 10% aqueous KOH solution, 40% HF solution and acetolysing mixture (9:1, acetic anhydride and concentrated sulphuric acid).

The pollen counts varied from 250-450 depending upon the pollen productivity of the samples (Plate 1); hence all the samples analyzed were found to be rich in pollen/spores contents. Trees, shrubs, herbs, ferns, algae, drifted and fungi had been used to categorize the recovered pollen taxa and arranged in the same order in the pollen diagram.

Fig3. Below which shows the pollen diagram was divided into 3 pollen zones for a better understanding of the vegetation and climate change succession based on the predominant aboreals and non aboreals in the pollen recovered sediments

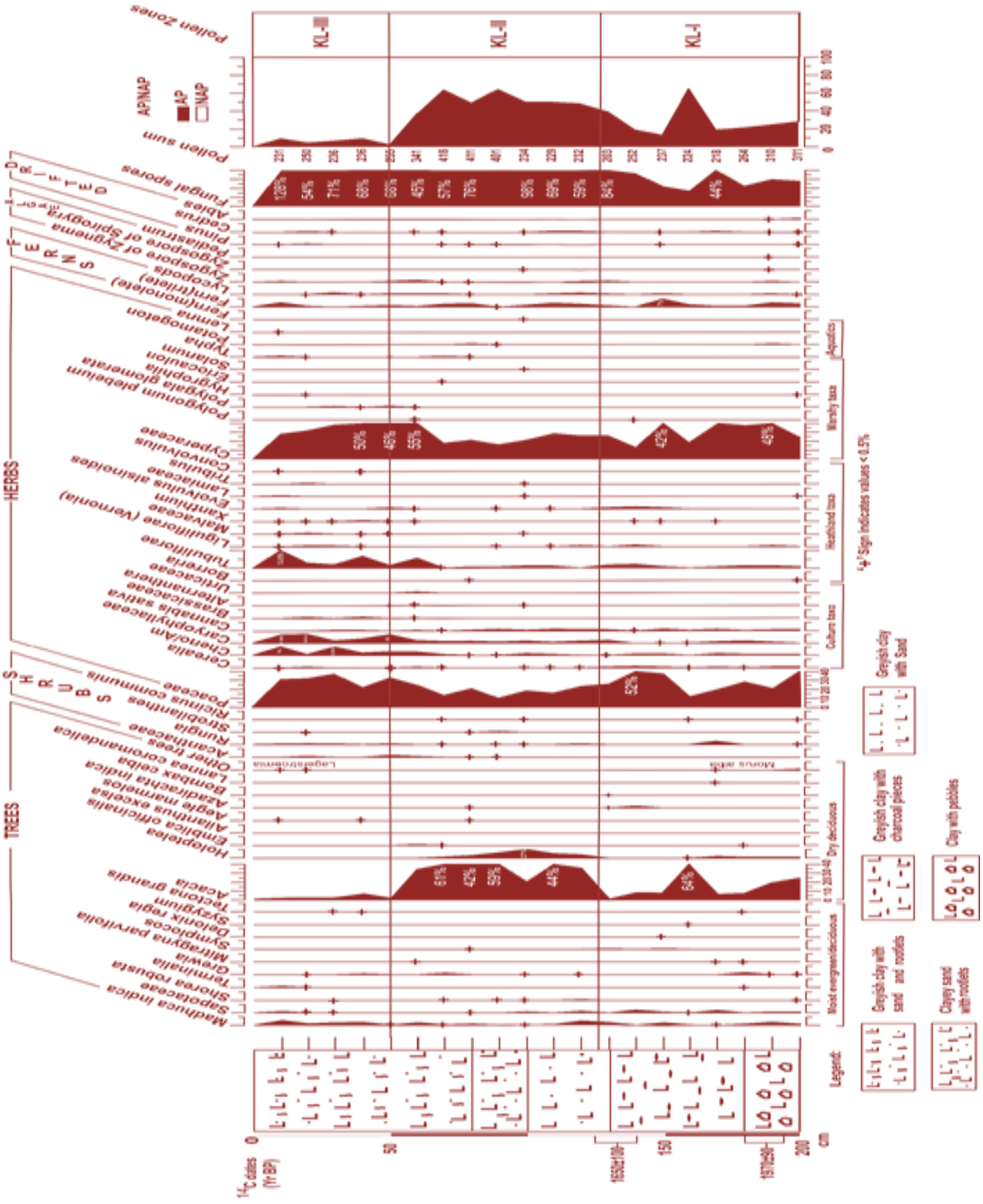



Fig 3: Pollen diagram from the Majidun creek

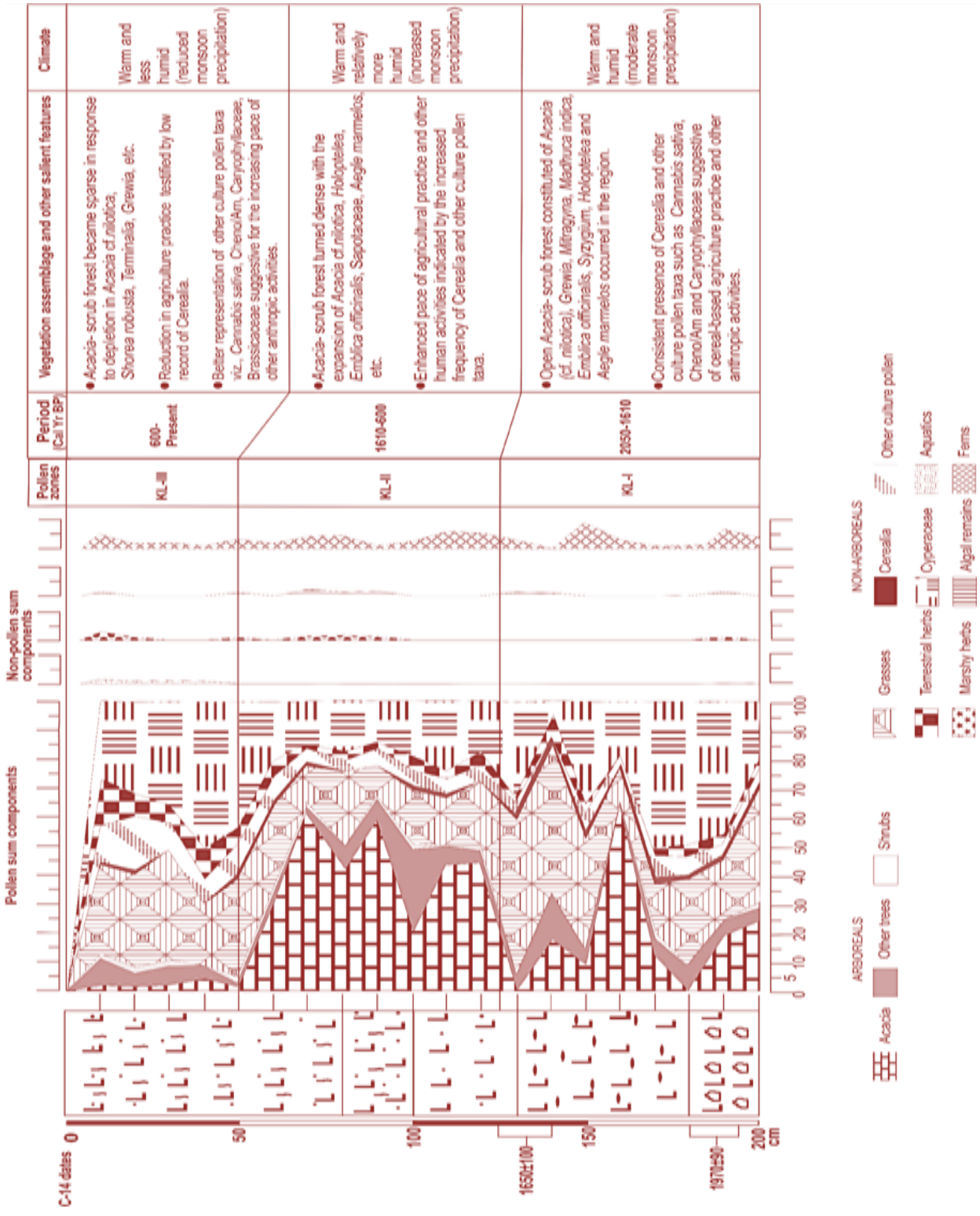



Fig 4.Composite pollen diagram showing the important features of investigation

**POLLEN ZONE 1 (300-155cm):***Acacia-Grewia-Sapotacae-Mitragyna-Parvifolia-Holoptelea-Pungia-Poacae-Caryophyllae-Cheno/AM- Cerealis-Tubuliflorae-Cyperacae-Ferns* Assemblage

This Pollen zone $^{14}C$ dated to (1980±70yrBP(160-175cm) and 1550±90yrBP9130-155cm) with an interval of time spanning 2070 to 1650 yr. BP and showed the prevalence of non aboreals over aboreals. Amongst trees, *Acacia cf. nitolica* (9.45-72.28%) is consistently recovered in high values. *Madhuca indica* (0.74-3.95%) and Grewia (0.22-5.16%) were moderately recovered whereas *Sapotacae, Holoptelea, Morcaae, Azadiurachta indica, Lanea coromandelia (0.49-1.72%)* were sporadically retrieved *and Shorearobusta, Syzygum, Delonix regia, Mitrogynia* and *Bombax cabi* (<0.4%) together with the shrubs viz *Rungia* (0.42-3.4%) and *Ricimus* (0.5%) are meagre. The major non aboreals are *Poacae* (12-52%), *Tubuliflorea* (0.75-11.34%), *Carophyllacae* (0.52-7.2%), *Cerealia* (1.92%), *Hygrophilla* (<0.7%) is scanty. *Pomtamogeton* (0.74%) represents the aquatic vegetation.

**POLLEN ZONE 2 (155-70cm):***Acacia-Holoptelea-Poacae-Caryophyllacae-Tubulifloae-Cheno/AM Cyperacae-Ferns* Assemblage

This zone constituted a time window of 1650-700yrBP punctuated the dominance in *Acacia cf nitolica* (30.08-71.2%) followed by Holoptelea (0.71-27.4%) than what was obtained in pollen zone 1. *Embilica officinallis* (1%), *Azadichta indica, symlocos and mitrugynia* (<0.4%) reduced in this zone. Poacae (10.48-27.92%) reduced considerably. *Tubuliflorae* (0.48 – 30.94%), *Caryophyllacae* and *Cheno/AM* (0.24-3.4%) remained almost the same reflecting significant improvements in the upper parts, Marshy elements *Cyperacae* (16.4-64%) declined except a spurt at the top whereas *Polygonium plebeim*, Eriocaulon and *Solanum* are rare. *Potamogeton* (0.58-1.58%) showed intermittent low values. Fern spores (Triletes, 0.68-5.36%) are steady though slightly reduced values while monoletes (<0.6%) is present in one sample only. Also seen in pocket amounts are fungal spores viz *Glonius, Nigrospora, Diplodus, Tetraplos, Cookenia Atternaria*.

**POLLEN ZONE 3 (70-0cm)**: *Madhuca indica, Acacia-Poacae-Caryophyllacae-Cheno/AM-Tubuliflorae-Cyperacae-Ferns* Assemblage.

The uppermost pollen facie is within a range 700yrBP to present and showed the prevalence of non aboreals and poor presence of aboreals. *Madhuca indica* (0.39-6.72%) exhibited larger values. *Acacia cf nitolica* (0.82-4.38%) reduced considerably while attaining the lowest values towards the termination of this zone. *Poacae* (22.03-39.7%) showed an increasing trend with the onset of this zone. *Cerealia* (0.29-2.2%) remains sporadic as before. *Tubuliflorae* (3.41-15.88%), *Caryophyllacae* (3.98-18.4%) *and Cheno/AM* (1.4-7.33%) showed increasing trend with higher values.

## 3. Discussions and Conclusion

The palynological investigation had elucidated some very vital facts regarding the short term variability in climate change and its attendant significant changes in vegetation and also being mindful of the effect of anthropogenic activities in this extensively stretched catchment of the Majidun river in Southwestern Nigeria.

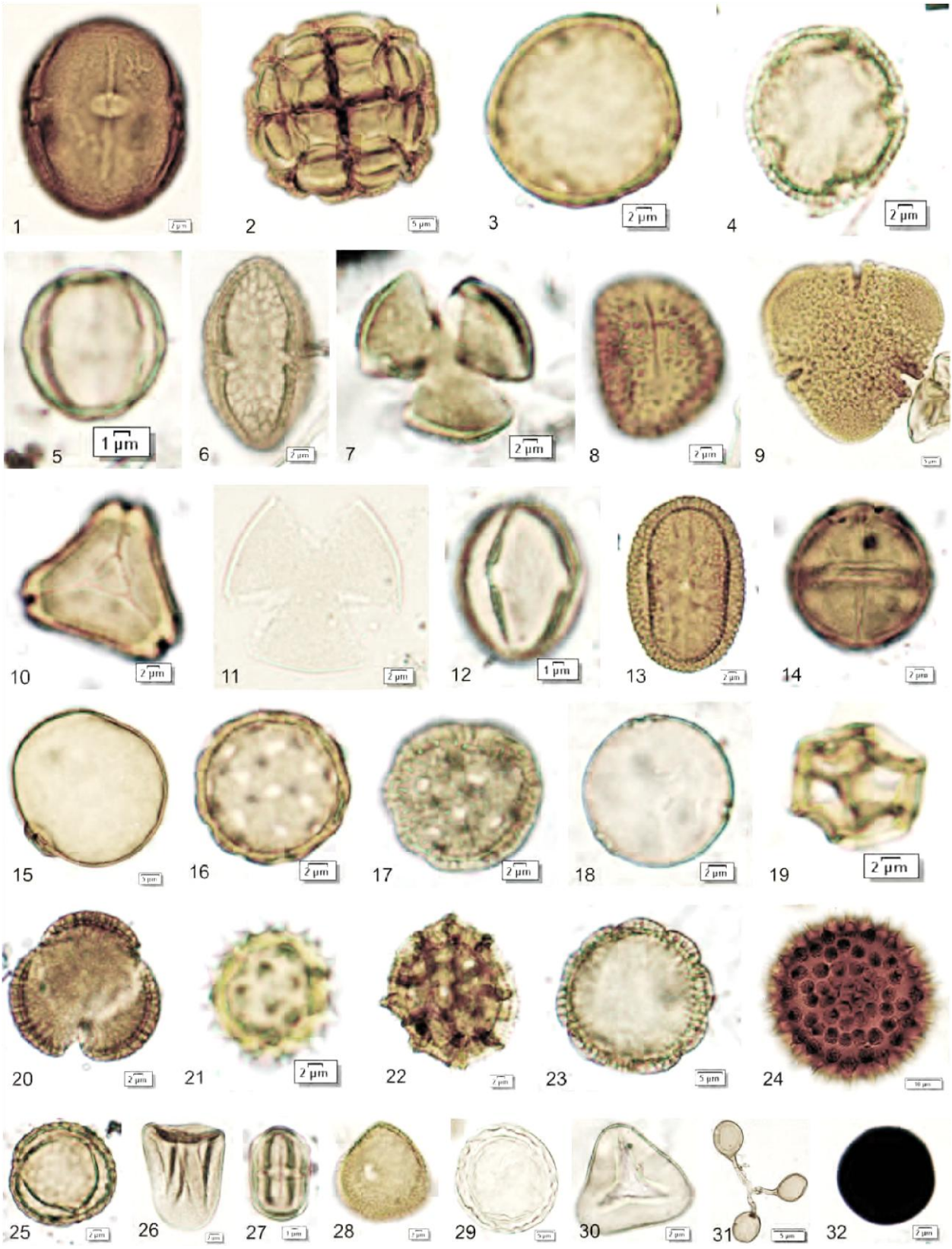
The emerged vegetation pattern had revealed that most of the flood prone catchment in the immediate environs of the Majidun river was occupied by Acacia scrub forest which was predominantly constituted by *Acacia cf nitolica*, a usual invader of drier beds as obtainable today from a vegetation pattern between 2070-1650BP i.e. 70BC to 300AD (Pollen zone 1). It can be deduced that a relatively warm to humid climate was prevalent in the region in response to moderate monsoon precipitation during this phase owing to the intermittent occurrences of moist loving trees. *Grewia, Mitrogynia* and members of Sapotacae *with Acacia cf nitolica* in the forest with a few sparing recoveries of *Madhuca indica, Emblica officinallis, Syzynium Delonix, Holoptelea* in the region. The inferred reason for the poor diversity and low forest cover could be the outcome of recurrent flood episodes in the areas adjourning the Majidun river, which restricted adequate regeneration and establishment of dense and varied tropical deciduous forests.

The frequent documentation of *Cerealia* along with ruderal plants such as *Chenopodicae/Amaranthacae* and *Caryophyllacae* in good numbers indicate the proximity of the waterways was under cereal based agricultural practice as well as some other sorts of anthropogenic activities. Repeated fire incidences in the neighboring forests from the charcoals were drifted and ultimately trapped in the sedimentary bed indicates the presence of fragmentary charcoals at the lithocolumn depths. Most of the area in the close surrounding of the Majidun creek remain intermittently water logged during the course of sediment accumulation as evidenced from the much better representation of marshy vegetation exclusively dominated by sedges (Cyperacae). The expansion of Acacia cf nitolica dominated forest is also well corroborated by a concurrent and sharp reduction of the grasses.

The cereal based agricultural practice continued with more or less same intensity as before since there is not any apparent alteration in the *Cerealia* and other culture pattern taxa. The consistent presence of *Madhuca indica* with an increasing trend denotes that this important constituent of modern forest in the region, would have been conserved by the local populace due to its multifaceted utility for food, fodder, fuel and low grade timber. The reduced presence of *Cerealia* is an indication that the adjourning areas to the investigation site was under low intensity agricultural practice, mostly likely attributed to flooding from time to time. However, there was significant proliferation in other anthropogenic activities as deduced from a better representation of culture pollen taxa such as *Canabis sativa*, members of *Chenopodicae/Amaranthacae, Caryophyllacae, Brassicacae* etc. throughout this phase. The region was also under the impact of pastoral activity particularly in the form of grazing as indicated by the great increase in Asteracae (*Tubuliflorae*), because the members of this family are rarely preferred by goats and cattle as they are not palatable.

Thus this pollen study had provided insights into 2070-1650BP, that catchment of the Majidun by open Acacia scrub forest under relatively warm and humid climate with moderate monsoon precipitation. the fragmentary charcoal retrieved indicated recurrent forest fires incidences in the region. Agricultural prosperity has been entrenched in most parts of the sequence except for a decline in 1450AD due to significant reduction in monsoon precipitation.

## Appendix A. Plate 1



1. *Madhucaindica*
2. *Acacia*
3. *Holoptelea*
4. *Emblicaofficinalis*
5. *Terminalia*
6. *Grewia*
7. *Tectonagrandis*
8. *Aeglemarmelos*
9. *Bombaxceiba*
10. *Syzygium*
11. *Shorearobusta*
12. *Lanneacoromandelica*
13. *Rungia*
14. *Ricinuscommunis*
15. Poaceae
16. Cheno/Am
17. Caryophyllaceae
18. *Cannabissativa*
19. *Alternanthera*
20. *Brassica*
21. Tubuliflorae
22. Liguliflorae
23. *Borreria*
24. Malvaceae
25. *Xanthium*
26. Cyperaceae
27. *Polygonum*
28. *Typha*
29. *Zygnema*
30. Fern trilete
31. *Glomus*
32. *Nigrospora*

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