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The Global Environment during the Last Glacial Maximum (LGM) and the Implications for the Perceived Climatic Change in the Developing Countries

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Abstract

Earth's environment is the home of mankind. The constituents are there as the provisions for man to live and be sustained. Naturally, the environment experiences changes (either hot warm or dry cold) which occur from time to time, every time, with varying degrees of the effects. The actions of man however, began significantly to influence such changes to occur and affect life rather too adversely even when the condition ought to be more favourable. For the Anatomically Modem Human (AMH) emerged in the hot warm period and has since had significant influence on the general condition of the environment. This influence especially since about 1950 has tended to change the situation of things within earth's environment to the worse as it is now occurring quicker with more devastating effects on the existence of man, other organisms, and the entire rich constituents of the environment. Here, a note of warning is issued using the natural example of the LGM as has been documented in the earth's 'library' and re-affirmed through prehistoric environmental studies. The LGM was evidently so devastating that some species of the world went into extinction while it lasted. But the reverse to the rosy hot warm phase, especially since the 'Recent' came as a relief particularly to the more vulnerable man. Man however, seems to have been extreme, experiencing this beautiful epoch of the Quaternary to his advantage. His limits are beginning to frightfully overshoot the boundary, to the detriment of the environment and the survival of especially humans with the boat being rocked to near capsize irrespective of nature's navigatory itenary. This, he must act against, through more careful operation such as the suggested 'management by avoidance' means of operation in especially the developing countries areas of the world where this has not been put into real practice. Everybody therefore, should be meaningfully involved in the upkeep of the environment without the notions of hide and seek from some quarters.

Introduction

The Last Glacial Maximum (L.G.M) is a major stadial phase that occurred during the last glacial period in the earths' history, that is between C 127,000- 14,000 YBP (Emiliani 1970). The L.G.M was a period of severe cold and dry climate around the globe. The intensity of this condition is on the basis of uniformitarianism, assumed upon other indications to have been the last and most extreme (severe). Hence it is known as the Last Glacial Maximum. This phase of cold stadial commenced variously at different places ranging from a. 26,000 YBP and terminating likewise to between 17,000 YBP and 14,000 YBP. This is attested to by various dates of limit fixing put forward for the phase by different scholars using different approaches and sometimes at different locations culminating to even different names. (See Clark *et al.* 2009; Barrow *et al.* 2002; Kautman *et al*. 2012; Otto-Bliesner *et al*. 2006, and Frisia *et al.* 2017).

Goudie, (1992:42), noted that the sequence of glacial events in the former USSR shows a series of glacials and interglacials since the Brunhes-Matuyama boundary (ca. 700,000 YBP) with the last Valdai glaciations corresponding with Wisconsin of the USA and the Weichsel and Wurm of Europe and coinciding with a period of great aridity in Africa (the Ogolean regression).

Sowunmi (1981), using palynological approach to work on cores from Lake Mobutu Seseseko in the East African Democratic Republic of Congo (formerly Zaire) observed that the period of between Ca. 25,350 and 14,700 YBP coincided with the Last Glacial Maximum. This period she noticed was marked by an overall drastic reduction of pollen, which suggested that the vegetation probably consisted of small patches of aquatic and swamp vegetation behind which was an open grassland. This could account for the extreme aridity that occurred in the tropics for instance the tropical Africa, between Ca. 18 - 14,000 YBP known as the Ogolian II regression (Sowunmi 1987). [For similar works in this regard, see Elenga *et al.* (2000); Tarasov *et al.* (2000) and Willis *et al.* (2004).

Helmens *et al.* (1996), with a comparison of dated palynogical, palaeopedological and glacial geomorphological evidence from the area of the high plain of Bogota in the Columbian Eastern Cordillera showed a variation. They came-up although reservedly with a result of significant climatic warming during the generally accepted extreme cold period of between 19,500 - 17,000 YBP. On their own however, Sabin and Pisias (1996), think that the increased abundance of the Bering Sea factor in the Sea Surface Temperature (SST) study in North Eastern Pacific Ocean, and absence of the Eastern Boundary current factor between 20,000 and Cal. YBP are indications that during this time period, coinciding with the (LGM), very cold condition prevailed.

Others with similar dates for the period are from Ca.28,000 to YBP (Mercer and Palacios 1977); Ca. 24,000 - 12,000 YBP (Wright, 1983); Ca. 20,000 - 18,000 YBP (Clapperton 1972; 1987); 20,000 - 17,000 YBP (Butzer *et al*. 1972). LG.M is however, estimated to have lasted from Ca. 20,000 yrs. to 17,000yrs. BP (CLIMAP 1981). The peak of the (LGM) that is when it was most severe occurred Ca. 18,000 YBP (Flohn, 1978: 135; Maley, 19871-594). This period was characterized by the extension of glaciers and vegetation belts to attitudes much lower than those of today (Flenley 1979). In this paper the global environmental situation during this period (L.G.M) and its implications for the perceived climatic change especially in the developing countries are discussed.

Various proxy data (material evidence of providing indirect measure of climate) Ingram *et al.* (1981), have indicated a significant fall in the atmospheric temperature (stadial) at the tail end of the last glaciations referred to as (L.G.M) (CLIMAP 1976, 1979, and 1981). Scientists in this area have tried to explain the temperature lowering as can be deduced from these data. A look at the environmental climate indicators through which such palaeoclimatic conditions are inferred will aid a better understanding of the condition at this period (LGM). Such proxy data and inferred conditions are in the likes of moraines, dunes, ice-sheet advance; glacier formation; thickness of snow, snow line; desertification; degree of decrease temperature eustatic sea level fall / sea regression; wind intensity; ocean upwelling mountain tree line; high albedo; drastic reduction in vegetation; migration and extinction (flora and fauna) loess, sand surface formation, lake level fall and desiccation of rivers and similar continental water bodies. These when discussed as they occurred in the temperate and the tropics will inform us inferentially of the nature of the global environment during the Last Glacial Maximum (L.G.M).

It is a fact that there are and most probably have been ice-sheets in certain areas of the globe (for example the Arctic and Antarctic both still bearing ice-sheet). It is also a fact that they and their likes expand with time following natural order (Fairbridge, 1981) and that accompanied with their extension, is the falling of snowflakes. These get compacted into glaciers which in turn join the extended ice-sheets in a decreased temperature. This situation occurs in different degrees and so are its impacts on the environment. Towards the end of the last major glaciation in the Pleistocene that started ca 127,000 YBP. The intensity of the cold dry condition increased (stadial) significantly. Starting at ca20,000 and elapsing around 14,000 YBP. During this period, the various conditions characterized the facets of the globe; and through their relicts, we can now infer the general conditions of the earth's environment.

Wright and Frey (1965), in Goudie (1992), recorded that during the LGM, ice was nearly continuous across North-America from the Atlantic to the Pacific. And that it consisted of two main bodies, the Cordilleran glaciers which is associated with the costal Rangers and the Rockies, and the great Laurentide Sheet. The Cordilleran glaciers were extensive in the mountains, diminishing northward into Alaska and Jukon, and Southward through the Western United States (Goudie 1992:56). Goudie continued by stating that the Southern limit of continuous ice was south of the Canada- U.S.A. border further down to the Columbia River and the Columbia Plateau. Southward this area, were several localized ice-caps and glaciers, with the thickness as much as 2300m deep (in the Sierra Nevadas).

The Laurentide ice sheet, together with the Scandinavian ice-sheet, are largely responsible for the great difference in world glacial areas between the alternating and ever reoccurring glacial phases and the intermittent interglacials. The laurentide ice-sheet during the (LGM) reached its extreme extent in the Ohio-Mississippi basin at latitude 39°. It is said to have extended to about today's areas of St. Louis and Kansas city. Goudie (1992), recorded the ice thickness, of (3300m), which occurred over Hudson Bay on the basis of post-glacial isostatic readjustment. Such periglacial areas as Nebraska and Western South Dakota however, were largely ice-free.

In mainland Europe and Asia, there were three main ice areas namely the Siberian, the Scandinavian and the Alpine Ice (t1) during the (LGM). The Alpine glaciers extending ca. 150,000km2 was about 150m thick. In-between this ice mass and the Scandinavia glacier to the north, was an ice- free periglacier. The Siberian ice-sheet at this period however, joined that of the Scandinavia but did not extent as south, as it was smaller. The size of the Siberian glaciers could be explained by the absence of suitable source of moisture and energy (Goudie 1992). The Scandinavian ice sheet during the (LGM) grew together and in union with those of the rural mountains of Russian, and British origin in the South West. The Scandinavian ice-sheet maximum thickness is estimated to have exceeded 3000m during this period over the Sogefjord region of Western Norway, and at the Gulf Bothnia with an average of 1900m.

In the Southern hemisphere, just as in today with few spots of perpetual ice-sheet in South American Peru, comparatively small landmass was covered by glaciers during the (LG.M). This glaciation of the Southern hemisphere for example in South America and South Australia both of which still experience snow fall during winter season, has been synchronous with the glacial period of the Northern hemisphere as in the present winter season and as with many other events. Clapperton (1990), suggests that this synchroneity is evident in the similar dates for the last glacial maximum and Allerod oscillation of both hemisphere. There were also glaciations in Patagonia and Tasmania area of Australia during this period. Rodbell (1993), observed that the South American Codillera ice- sheets were greatly expanded with glaciation in the far south covering over 200km wide and the ice thickness over 120Dm.

This glaciation according to Goudie (1992), extended to about 30°S, but that at north of 38°S, the ice tended not to expand very far from the Cordillera either to the pacific in the West or into the plainlands in the east. Schubert (1984), recorded that the furthest north ice body occurring probably during the (L.G.M) was that which capped the Sierra Nevada de Santa Marta in Colombia. In the middle and lower latitudes the snowline has been reconstructed by Flint (1975: 415-416) systemically to be lower than the existing snowline by some 1000m. This implied temperature lowered by 7°C or more there, and in Europe 8°C (Penck 1973a in Flint 1975). This lowered temperature was such that even the warm summer of today, was cold as the mean July temperature was as low as 7°C. In Southern Africa, indications of periglacial activity abound. The area of Drakensberg mountains and parts of Australia however, seem to have been largely affected by glacial activity. These ice-sheets expansion and glaciation in general have moraines (diatomit relict deposits of the glaciers) as one of their imprints. The moraines also account for the intensity of the glaciation, for instance during the (LG.M). On the basis of stratigraphic position and qualitative assessment of depositional alteration, Clapperton (1987), was able to delineate Pleistocene moraine groups. He stated that the ubiquitous, relatively fresh lateral and terminal moraines were deposited during the (LG.M) (ca. 20,000-18,000YBP). The occurrence of moraines, depict the intensity and extent of the glaciation during the (L.G.M). In some places, the outwash has shown evidence of having travelled several kilometres from where they are subsequently deposited- The composition of boulders (and other materials) in the deposit, attest to this distance; and their sizes, the intensity of the glaciation. This becomes more understandable in eastern England and near Ely for instance, where the size of this deposit is of some 400-600m tong and up to 50m thick.

The cold condition during the L.G.M was also evident in the permafrost (frozen condition in soil, alluvium, or rock found in high northern latitudes) found beyond the limits of the great Pleistocene ice- sheets around areas of open tundra, especially in Europe. Goudie (1992:65), noted that the current Southern boundary of continuous permafrost coincides approximately with the -5° or -6°C mean annual isotherm. This therefore, is by implication the average annual mean temperature in parts of the Northern hemisphere such as Siberia. This is because in Europe during the (LG.M), there is very strong indication for the former extension of the permafrost spreading widely in Europe for example South and East England. Such evidence is the casts of wedge which form polygonal patterns in areas of permafrost. Permafrost is controversially said not to have extended southwards into the northerly peninsular Italy, the Iberian and Southwest France mainland Europe. This shows according to Goudie (1992:67), the degree to which tundra and periglacial conditions were forcibly displaced southwards, and the extent to which temperature conditions were depressed in much of Europe at this period.

Johnson (1990), in Goudie (1992), using result of patterned ground, suggests that in the Late Wisconsin period permafrost extended as far South as 38°3'N. There was, especially in America, due to latitudinal difference, longer and shorter days in winter and summer respectively than in any high latitude periglacial area of today. During this LGM period, the sun is said to have risen higher in the sky, giving higher midday temperatures and significant diural changes. This in turn would have led to high rate

of evaporation.
Loess, a largely non-stratified and non-consolidated silt that has some clay, sand, and carbonate, deposited primarily by the wind (Smalley and Vita-Finzi 1968), had its largest deposition during the (LGM). This can be seen around the great ice-sheets in the temperate world. Occurrence of Loess is an indication of dry climate. The sources of loess include desert basins and especially the exposed outwash and areas of till recently uncovered by deglaciation (Goudie 1992). The Loess thickness may be 30m thick for example in Missouri valley Kansas, 10m in European Russia, 30m in Argentina, 18m in New Zealand and more than 330m Lanzhou in China.

The incidents of extensive loess during the LGM, is not only a testimony of its extreme dryness and cold but of the wind intensity. The vigorous winds, some of which is said to have blown away the ice- sheets with great velocity, moved the finer materials. These materials were subsequently deposited as loess at some distances, especially where dense vegetation cover traps them (Flohn 1979); for example along river valleys. During the various glacial stages of the pleistocene, including the LGM (during which time it became even worse) the vegetation of much of unglaciated periglacial world was characterized by its open nature. Trees were relatively rare with the general plant assemblages showing characteristics such as those of cool steppe or Savanna Isabel ecotone, where there had been flourishing forest vegetation. Western Europe palynological studies have shown common traces of Artemisia and Thalictrum and little of those of arboreal pollen during the LGM. An indication of open habitation for the former, and very sparse nature of tree stands for the later. In fact at some places they were more or less non-existent, for instance, in the ice fronts areas of East Europe. Goudie (1972), stated that Cornwall and Ireland in Europe (both maritime) areas had some dwarf birch and willow with is- Biarritz in Southern and Western France having low tree pollen proportion in the LGM except in the Gascogne lowlands.

The areas of loess deposition, harhoured in some cases herbaceous flora while there was for example in the Russian area starting from southern Poland to the southern Vrals the salt-tolerant dry Artemisia steppe. Just south of this area, Goudie (1992), noted that there was a forest tundra or forest steppe, together with small woodland areas in the Crimea and along the shores of the expanded Caspian Sea. This steppe characteristic of arid vegetation was also noticed in southern parts of Europe, the Levant and around the Mediterranean Sea's northern shores; Zagros Mountains and Western Iran (Bonatti 1966; in Goudie 1992). In North America, evidence have shown that much of the area south of the ice sheet during the LGM was covered with boreal forest rather than with tundra vegetation. This is moving much further south than it was in Europe, (for example 39° N in Illinois compared to 52° N in Germany). The Alps with large ice carps sort of which are in North America, were said to have - reinforced the semi-permanent area of high atmospheric pressure associated with the Scandinavian ice sheet. Also that this tended to divert warm, westerly air flows southwards to the Alps. Even this wide-spread bored forest in America dominated by *Pinus picea,* was not that ubiquitous. Flint (1997), noted that there were patches of tundra and of treelessness although not as extensive as in Europe. Nonetheless, from the pluvial lakes in the South, pollen evidence indicates high percentage of Pinus and other montane conifers in the LGM where today, they are characterized by semi-desert shrubs. Tree - lines were lowered 800 - 100m, around Western Cordillera, with the extent of alpine vegetation in the mountain being greatly expanded. The arctic timber - line in this period was contrary to what it was thereafter, being moved latitudinally to about 24° - 25° N.

Generally island flora suffered this great ice - cold period the most. For example, Pennington (1969:1) in Goudie (1992:90), noted that the few number of flora species in Britain resulted from successive wiping-out of forest - sensitive species by repeated glacial episodes. In the LGM, this was even more pronounced in such areas with the flora and fauna lives migrating enmass leaving in the end to exist there, those that managed to follow the ice back as it retreated and the resilient hardy species. This is evident in the species variation and similarity of both animals and plants in island close to each other such as England, Wales and Ireland; others are Malta and Sicily, Capri and Italy, the Belearis and the Ionian Island. Our aid by nature in protecting some of these lives, were the refugia and nuntaks (small areas where some species were able to survive as the places were not affected so much by the overall cold condition). The fall in ocean temperature (3-8°C) in line with the LGM cold nature also affected the distribution of morain life as is evident in the study of coral reefs. Today, the present effective limit of reef growth is approximately that of the 20°C ocean water isotherm (Stoddart 1973). Through uniformitarianism principle therefore, the LGM coral reef growth shows considerable degree of contraction which must have taken place in reef distribution. With this, very low still-stands of the sea - level during the LGM, would have aggravated the demise of the reef corals.

In the same vein Goudie (1992:93 - 96), noted the North - South migration of polar waters in the North Atlantic as being the response to major cycles of glaciations. He saw the boundary between the polar fossil assemblages (diagonal ruling) and the position of the oceanic polar front which at the LGM was at about 200km farther south contrary to its interglacial maximum position (for example those of today and 125, 000 YBP). Kvasov and Verbitsky (1975), put the sea level of the LGM at about 150m lower than today. These authors, after a numerical experiment, postulated that temperatures and precipitations during this period, in relation to the base area is 10% larger than at present. Arriving at 23.4million km^3 for the volume of the ice sheet, (with the volume of the continent above sea level), the causes of the events of the LGM in the latitudes said to have been fundamentally triggered off from the tropics as it were, boomeranged, culminating in the major environmental changes in the lower latitudes. The decrease temperature descending on the tropics and subtropics with associated wind intensity etc., led to the sand deserts shifting (expanding). The extent of the dryness during this LGM inter- pluvial (dry phases) in these areas can be understood from the study of the major dune-fields and their fossils Sand dunes and associated deserts (that is those between 30°N and 30°S) were much more widely spread 18,000YBP than they are today, characterizing about 50% of the above land area and forming two vast belts (Samthein 1972:43). As a result the major cycles of glaciations. He saw the boundary between the polar fossil assemblages (diagonal ruling) and the position of the oceanic polar front which at the LGM was at about 200 farther south contrary to its interglacial maximum position (for example those of today and 125,000 YBP). As a result the tropical rainforest and adjacent Savanna were reduced to narrow strip off, in some places only a few degrees of latitude wide.

In Southern Africa (Grove 1969); West Africa (Ogollian II regression) (Grove 1958); Northern Africa, and Northern India, can be found fossil dunes (parabolic transverse, longitudinal, and wind-drift types) known to have been wide spread during the LGM. These dunes date back to before 14,000 YBP at Didwana Lake (Agrawal *et al*. 1989 in Goudie 1992). During this period, sand dunes (ergs) for instance were said to have blocked river courses such as those of Niger (Goudie 1992), and Senegal (Sowunni 1987). Goudie suggested that wind and rainfall belts shifted 450km (Goudie 1992). Thus, for such terrestrial evidence in the tropics of climatic conditions during the LGM especially in the tropics, a review of such works as those of Maley (1978, 1979); Street and Grove. (1979), Goudie. (1992); Petterson *et al*. (1979), would help inter alia. These authors applied certain principles - analogue, uniformitarianism etc., on the research results to finally arrive at conclusions.

Maley (1989:501), writes on the temperature at the LGM in the tropics; that the gulf of Guinea among other areas around the Atlantic ocean had the temperature of 4° - 8°C lower than those of the present Southern winter citing Prell *et al*. (1976); Morley and Hays, (1979), and Mix *et al.* (1986). These scientists with the use of assemblages of Plantonic foraminifera and radiolarian to reconstruct the Sea surface temperature, indicated that at about 18,000 YBP, the equatorial cold waters upwelling maintained a nearly constant position Through the same method, Prell *et al* (1976), noted that during this period the Southern summer (February) being the warmest water season, the surface temperature were 3° lower than today. Maley argues that the upwelling of cold waters would have been a nearly year - round feature (Marley 1989). She thinks on the basis of uniformitarianism, using the same data above that they show that a very powerful anticyclonic high pressure above the Southern Atlantic associated with very strong trade winds. This she cited Newweil *et al*. (1981), showing a significant strengthening of the trade winds around 18,000 YBP.

Maley (1989:605), concluded that the present - day interannual synchronism throughout the upwelling area in the Guinea Gulf (equatorial and coastal) means that in the past the SST variations have had a large climatic impact on the equatorial

Africa. Especially those areas in the present day rain forest. The ariditification of the climate, the disappearance of large areas of rain forest, the cooling effect of what Maley called quasi permanent cloud covers and the accompanying extension of montaen biotopes to lower elevations at the LGM she thinks could be explained through these phenomena of SST etc., and the action of stratiform cloud cover midland.

Judging from the dunes at this period spread over the tropical world for instance North and West Africa, North and South America (Nebraska, Dakota, Pampas, and other areas of Argentina); Australia (Fiteroy plains of North - Western Australia); less occurrence in both Europe and Asia) compared with today's active ones, the climatic condition must have been very intense. According to Goudie (1992), they are comparable to those in Northern Nigeria (rounded subdued form with vegetation cover) and represent an equator ward shift of the isolytes by about 8° of latitude (Ca 900km). Stratigraphic data derived from different places show that a majority of the dunes were formed within the LGM 25 - 13,000 YBP (Wasson 1984 in Goudie 1992).
Pluvial or lacustral phases (increased hydrological activity as a result of either a temperature decrease or an absolute precipitation increase) were very pronounced during the Last Glacial Maximum in the tropics. Their relicts (where they do hold more or less no water) are known as pluvial. Climate factor is dominant in controlling water level (e.g the lake levels). At this period the climatic change in the high latitudes have set in towards the lower latitudes and both the ocean and atmospheric circulation are interconnected. Again, the north and south polar fronts control the ITD, which determines such climate changes and variation as in precipitation and temperature. During the LGM there were decreased temperatures around the tropics coupled with increased precipitation and less evaporation. The ITD at this period was due to intensity of the North polar front forced farthest to the South in accordance to its most extreme cold nature. This must have led to the intensification of the Northeast trade wind that strongly drives the ITD downwards with a resultant aridity in the tropical and sub-tropical areas.

Street and Grove, (1979), in their thorough compilation and comparison of lake-levels over the past 30,000 YBP, first noted that at the glacial maximum between around 24,000 and 23,000 YBP onset African lakes seemed to be high but for those of Turkana, Manyara, Mobutu Sese Seko; (as in Southern Mediterranean region, Arabia and Columbia). Some lakes however, reached their maximum level in other areas around the Mediterranean on both sides of the Red Sea and in the Kalahari (e.g a closed, moraine-dammed lake in the Soviet Tien Shan Range (Sehrutnitov *et al*. in Street and Grove 1979). Whereas in the temperate Australia, the lakes were said to have just began their final drying phase evidenced by dune formation and oscillating water levels (Boler, 1976). In tropical Australia or Galapagos no significant change happened. Aridity set in proper across much of Africa between 18,000 and 17,000 YBP. Except for the northwest Sahara and probably South Africa where weather conditions were said to still prevail. Such equatorial lakes as Lakes Mobutu Sese Seko and Manyara were high or intermediate (Street and Grove, 1979; Sownumi, 1981), although with indications of aridity (Sownnmi 1981). Those in the Afar and Arabia were just about drying - up. In Columbia, Galapagosi, Queensland and probably tropical Mexico, Heine, (1977), in Street and Grove, (1979), recorded low lake levels as well. While in North America and Middle East, all lakes were said to have maintained intermediate or high levels.

Just 2,000 years after this, tropical aridity became very intense and widespread. At this point in time even Lake Mobutu Sese Seko was disappearing Street and Grove, (1976), (1979); Sowunmi (1981). But the Tibesti Massif, Jebel Marra and the Red Sea Udis (Butzer and Hansen, 1968 in Street and Grove 1979), signalled increased wetness between 15, and 14,000 YBP. The dry condition of this period was said to have also persisted in Colombia, Galapagos and on both poleward and equator word margins of Australia. But for USA Street and Grove (1979), reported slight drop in level occurring in some basins which levels generally remained high. The implication of this, generally seeming incoherent, inconsequential manner of water balance of lake levels around the globe is understandable. Street and Grove (1979), think that they are more defined at some times than others, appearing most chaotic during periods of rapid change but broadly exhibiting strong latitudinal organization. They cited Seller (1965:84), when they observed the similarity between the scale of variation and the mean annual latitudinal distributions of precipitation, evaporation and runoff. And that this shows peaks and troughs corresponding to major feature of the general atmospheric circulation such as the mid-latitude waterlines, the Inter-Tropical Discontinuity and the subtropical high-pressure belts. They were able to infer through the knowledge of interconnectedness of the components of the environment, that systematic changes in lake level patterns resulted from both intensification or weakening and north- south displacements of these mean circulation features. They however, recognized non-zonal and regional departure patterns as playing important part in climatic variability in low latitudes.

Following these indicators of the lake-levels since 30,000 YBP, Street and Grove (1979), were able to point out that the cooling condition which started earlier, before between 26 and 21,000 YBP actually was moving beyond the average during this period. Thus setting into motion the Last Glacial Maximum in northwest Europe about 25,000 YBP of which they cited Coope, (1977), and Dreimanis and Rankas, (1975), for other areas of the world they experienced a climatic deterioration centered on 23,000 YBP. A little earlier, the lakes in South-western USA were rising (for example Late Bonnevill rose to the “White Marl” maximum after 21,000 YBP) (Morrison and Frye, 1965); in; Street and Grove 1979). The period of between and 12,500 YBP in the tropics generally experienced aridity with the exception of Southern Mediterranean Saharan mountains and Red Sea area, where there were still wetter conditions.

Maley (1978), informs us that between 20,000 and 17,000 YBP, lakes around monsoonal zone which had been high, became rapidly dry or very shallow or saline. In tropical NE Australia, the vegetation as deduced by Kershaw (1974) in Maley (1978), from the pollen preserved in Lynch's Crater (Ifs), was consistent with a mean annual precipitation of 750- 1400mm for the period >60,000 to> 6,000 YBP, contrary to 2,500mm of present. Also, pedogenetic carbonate nodules in late Pleistocene sediments on the Sahul shelf between Timor and Darwin also indicate a substantial reduction in precipitation between ca. 18,000YBP and the beginning of the Recent (Van Andel and Veevers 1967, Van Andel *et al*. 1967 in Maley 1989). The later period of the glacial aridity in tropical Australia happened at about the same time with the period of low lake levels in East Africa, Afar, Chad and Mauritania in tropical Africa. This is supported with palynological evidence of a less mesophytic vegetation in the mountains of Uganda (Livingstone 1967, Hamilton 1972 in Maley 1989). Hurault (1970), supported by Hervien (1970), attributed the intensive gully erosion in north Cameroon between 24,000 and 18,00YBP, to a reduction in plant cover brought about by aridity. This resulted in the sand deposition during this period around such area for example, the Hogger coarsegrained "Moyenne terrasse" (Rognon 1967).

There were reduced evaporation throughout the tropics, due to the global reduction in sea-surface temperatures, associated with extensive continual glaciation and the advance of tropical glaciers in New Guinea and East Africa during this period. With colder seas and decreased evaporation, precipitation became low, thus causing certain Low dry areas to become significantly wetter during this period. Deduced h-am pollen in the New Guinea high-lands yielded temperatures up to 10 - 11°C lower than today during the (LGM) although this is said to have depended mostly upon higher post Pleistocene in the area. Generally Sea levels were lowest (150m) together with continentality effect towards the peak of the (LGM). There was a significant intensification and expansion of the tropical continental anticyclones advancing much nearer the equator in both hemisphere and probably nearer the pole in Australia. Maley (1972) cited in Williams (1975), admitted that the lowest temperatures recorded in New Guinea, the North Atlantic and SE Australia including Tasmania were at about 18,000YBP - 16,000YBP. Supporting this evidence from deep-sea cores, palynology, geochemistry, and geology which points to penecontemporaneous aridity in the intertropical zones at the LGM.

In the northern area of the Sahara, the westerlies encroached as far south as the tropics, bringing winter rains to the L-loggar and to the Nubian Wadis. Maley suggested that the probable increased incidence of brief cold spells associated with presence of cold air over Europe, brought heavy rainfall to NW Africa. The retreat of the ITD towards the equator and disorganization of the monsoonal regime, resulted in extreme aridity in northern Australia and the Southern Sahara. To add to the intensification of this aridity, were the increased continentally, lower global evaporation and precipitation consequent upon lowered global temperatures and possible equator-ward extension of the cold currents off Western Australia and the West of Sahara. Scientists think that the fundamental cause of this aridity was increase in thermal gradients between the low and the middle latitudes during the Wisconsin glaciations that was reflected in stronger trade winds and more active dune building. Also, the reduced summer temperatures over arid tropical Australia, Africa and India, coupled with the presence of strongly reinforced tropical anticyclones, are two factors that are probably genetically related to the disruption of the summer monsoon. For the explanation of the high lake-levels of some lakes e.g Lake George as against those of low level ones at the same period within the tropical margin for example Lake Mobutu in now Democratic Republic of Congo and Uganda border and Lake Abhe. Galloway (1965b), noted that somewhere more sensitive to reduced evaporation than to decreased precipitation. Thus such lakes remained high when others were falling as a result of reduced precipitation over their catchments. Another means of explaining the situation is with the lapse rates concept. The idea is that these lapse rates are the mean rates at which temperatures change with attitude (generally 0.6°C/100m), but which are subject to local distribution.

One problem noticed from this variation during this period as well as in other periods before or after LGM, is that finding the conditions at this period at a certain depth at a site to correspond with all others, is not always the case. This is because climatic conditions vary geographically [See Strandberg *et al.* (2011); Kaplan *et al.* (2003); and Aydin *et al.* (2016)] and climatic change may be time transgressive. As such Petterson *et al.* (1979), observed that local evidence for maximum cold or dryness or for maximum glacial advance, can be insufficient grounds for identifying the depth of the 18,000YBP data in a core for instance.

Humans deserve a special place in this discussion. Although not quite different from other animals, humans due to their intellectual ability that is manifested in their cultural remains have had to strive to survive during such severe cold period. In the northern hemisphere especially areas of intense glaciations, there is scarcely any how humans would have existed in such areas with kilometres length and breadth of ice domination of the earth surface. Humans must have retreated (migrated) alongside other animals and vegetation both of aquatic and terrestrial habitation of which they were appropriating. There were however, unglaciated niche periglacial areas as Binford observed. The Nynamuit Eskimos in their subsistence economy, especially when they had great distance to cover, trying to beat the ordeals of glaciations relied on such. This is similar to the view held by some on the incidence of AMH hunter-gatherer Caucasians arriving Europe and taking over with fire as their main instrument of hunting adaptation at about 48 thousand years ago (Kaplan *et al.* 2016). This notwithstanding, the even sparse population of humans was cut down as many died out. Survival cases could have been better in the tropics. Here, evidence abound on how humans occupied the lake basins of the rift valley following their fluctuation as many archaeological and anthropological finds in East Africa witness at Lake Turkana and the Omo Valley (Ethiopia and Kenya), Olduvia Gorge (Tanzania) Ologesaillie (Kenya), occur in association with lake beds (Goudie 1992). On a general basis, the LGM in tropical Africa was by implication a relatively drought period. The desiccation of the Sahara coincided with the LGM and caused displacement of inland dwellers where there was a flourishing life, to scattering towards the coast. The Bantu hypothesis is a case in point. Also as revealed by the tool type- Ateria Sangoan, Achuelian - sequence in archaeological investigation thus far and the implication of the cultural remains in the D'har Tchitt Mason (1977), Lake Chad area, Connah (19 81) and Kintampo Stahl (1985). For the 20,000 YBP period, Deacon (1989) in Mellars and Stringer (1989) revealed important changes in raw material usage, artifact styles, economy and fruition of site that have been documented against, following a systematic synthesis of modem habitat conditions achieved just for the last 50,000 years.

In Africa the faunal life was touched by this drastic change in the climate. The distribution of crocodile, said to be ubiquitous in the rivers of the continent, from Natal to the Nile, can only be found in pools in the Tibesti Massif in the heart of the Sahara, 1300km from either Niger or Nile and clearly isolated (Goudie 1992). According to (Goudie 1992: 133), "there is no likelihood of natural migrations there, across the arid Saharan wastes, given present hydrological conditions, so that pluvial conditions presumably played a role". Breadly (1974), in Goudie (1992), stated that by a study of present and the fossil fish types, and also of crocodiles, the consequences of these changes can be identified and this helps to unfathom the anomalies of zoo-geography (in time and space). By implication many died-out. This species alone was not affected, there were many others and in fact some went into extinction (Osborne 1988). For the flora life, which has already been touched in this paper, there were still incidents of isolation of some more in the East African Mountains; for instance the distinctive tree heath *Erica arboreal* occurring in distinctive areas such as the mountain of Ruwenzori, the Ethiopian mountains, the Cameroon mountains in West Africa and the peaks of the Canary Islands and other forest refugia (Maley 1989; Kaplan *et al.* 2016).

Conclusion

In sum the global environment during the Last Glacial Maximum a period of very severe cold climate was drastic, drastic in the sense that virtually every component of earth's environment felt the ping of it with some becoming exterminated from the earth's surface. Starting from about 26,000 to ca. 14,000 YBP with its peak at ca 18,000 YBP as perceived by various places, both the biological and physical ones - were afflicted. Various forms of life were drastically afflicted including humans who upon being bestowed with relatively super intellect, suffered the dry and cold condition. Humans were in most cases forced to migrate to a more favourable habitat for shelter and warmth and other resources to survive on. Their movements have been mainly determined by the general environmental deterioration including those of reduced vegetation and associated fauna (games) as a result of increase wind vigour, sand surface formation, desertification, dune formation, drying up of continental water bodies and subsequent shift in the ITD southwards, that caused great aridity in the tropics. In the temperate area, the story was similar, with even more decreased atmospheric temperature ice-sheet advance, coupled with glacier formation especially in the high latitudes. There were consequent landslide occurrences, sea level eustatic fall or regression of seas with decreased upwelling activity in ocean waters. There was also decreased evaporation rate as land albedo had greater surfaces as catalyst. Earth's environment has been like this, except for the human induced changes; from hot wet to cold dry and organisms including humans have had to contend with the changes therein. The present challenge may be more intense so we are left with the choice of preparation for the inevitable change to occur [See Kageyama *et al.* (1993); Power *et al.* (2008); Scherjon *et al.* (2015); and Kaplan *et al.* (2003)]. The problem is how to wait. There should be commensurate plan and action preparatory to the expected and sometimes unexpected change occurring in the global environment. This sort of preparation is being made in some areas of the world while in others, it has not been so observed. The situation is about survival, a response to natural (although to some extent man - induced) condition and should be taken seriously if we do not intend to give - up the struggle anyhow. The northern hemisphere is more vulnerable to the impact of environmental change as have been described above.

The people of the area however, seem to be alert and in steady check for the change than the southern counterpart. The people of the north have taken up the challenge which at most times devastated the area, boldly, that their concern for the change is pursued with vigour though sometimes diplomatically so by some of them. In the southern hemisphere, the story is not the same as it appears like majority of the people would rather wish it away or do so little that the seriousness is in doubt. Although majority of the countries to the south are not within the developed countries rating bracket, some of the people's mindless behaviour towards the environment are disheartening, bearing in mind the inevitability of the change in the climatic and general environmental situation of the earth.The almost plan-less or unfaithfulness manners of dealings on the environment of most of the urban and semi-urban dwellings in the area should be a major source of worry for any concerned environmentalist. Global warming which bring with it, extreme precipitation that further lead to increased atmospheric temperature and particularly flooding, would significantly affect the area and the populations therein. From the signals being received from the experts on climate and environment generally, the danger may be difficult to contain in especially the south. Here, many people are busy trying to survive in the present time and are not disposed to thinking much about the future. They therefore, muddle up things in their reckless struggle to live now. A certain percentage of the north is also affected in this way.

For instance, in Nigeria and most of the west, east, central and north Africa which are in the northern hemisphere, the same attitude is noticed. The rational and modalities of achieving this should be properly conceived and executed.

The Nigerian example of 2012 flooding particularly, which caused pain and misery to many of its people, should be an eye-opener for all. It was not in the capacity of a tsunami or any such major environmental disaster yet it was experienced as such. People did not get or heed advice from the meteorologists and government personnel's on the problem because it was not in their very contingency plan and not enforced by the government which though would have been difficult. Even for those who would have listened and taken evasive action, most of such people were incapacitated to do so. Government's efforts in the end seem like putting the cart before the horse. The monies disburse to the various states and the people, would have got to them when the damage has not been done. The people have been allowed to move back into the same area where they were affected by the floods but the floods are yet coming. The people and the government are rotating through a visious circle in this regard. In these places mismanagement of resources by the governments and the people has made the situation an intractable one for the people. This is not quite different from the conditions noticed in many other developing nations in South America, South Asia and the Middle East.

The information here is that earth's environment is one and its concerns in any area of it should be those of everybody; to the southern and the northern hemispheres, the haves and the have-nots. The world is connected at the bottom by the oceanic waters and on top, the same atmosphere and the ozone layer. Pollution of the water in one area would invariably translate to every place of it and so is the pollution of the atmosphere. The depletion of the ozone layer especially, as is caused mainly by the greenhouse gases, is attributive to man (especially around the northern hemisphere with advanced countries and advanced scientific and technological acquisitions), should be the concern of all. Proactive efforts should be made to reverse some of such behaviour so to protect, preserve and sustain the environment effectively. There should be a management by avoidance mechanism adopted in such areas to be followed well. The proposed new exquisite mega city in Lagos state appears outlandish in the present situation of Nigeria where the standard of living has failed to rise for over two decades now even with the dividends of democracy. Repeatedly experts would inform us that the average Nigerians who represent about 65% of the estimated one hundred and seventy million people of Nigeria live below one dollar per day. New estates (especially the low cost houses and owner-occupier type) should be built in mainly the affected areas of the country. The satellite settlements found around thickly populated urban areas (the towns and cities) of Nigeria should be better developed to deal with the urban bias situations in such places. The present Government of Nigeria's current FISH housing programme should be up-scaled to go beyond the FCT (Abuja) area to other places in the

country.
The drainage system in Nigeria is naturally good. It should be the clue to solving the flooding and similar environmental problems. The government should ensure that congestions do not occur along the natural and man-made channels for water. The government should through its particular organs or agencies also be directly involved in food-production and not to leave it in the hands of the peasants and very few in-consequential numbers of big time farmers. The various aspects of the processes of food production should be managed by government personnel, who will in turn harness the local labour, who may be trained in the different areas of agro-business. There should be incentives and similar support for the industry so to make it attractive to especially the teeming youth population who at present do not seem interested in the traditional slash and burn; pastoralism or any form of subsistent agricultural methods still in use in the area till date.

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