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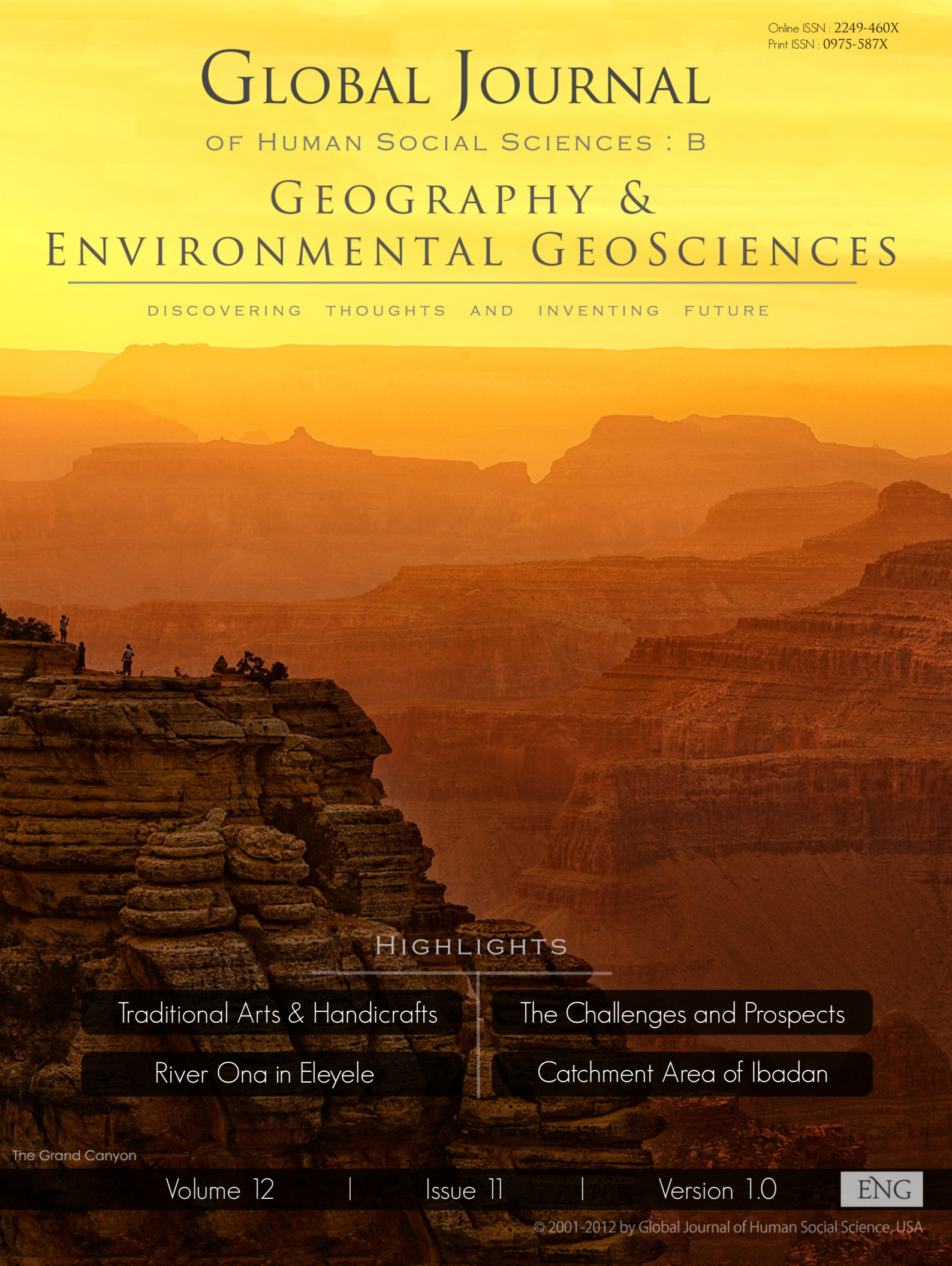

Highlights

- Traditional Arts & Handicrafts
- The Challenges and Prospects
- River Ona in Eleyele
- Catchment Area of Ibadan

The Grand Canyon

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Indigenous Knowledge on Plant Species of Material Culture (Construction, Traditional Arts & Handicrafts) used by the Afar & Oromo Nations in & Around the Awash National Park, Ethiopia

By Tinsae Bahru, Zemede Asfaw & Sebsebe Demissew
Addis Ababa University

Abstract - Indigenous knowledge (IK) on plant species of material culture (construction, traditional arts and handicrafts) used by the indigenous people in and around the Awash National Park (ANP), Ethiopia was conducted ethnobotanically. The study aimed to investigate various aspects of IK on plant species of material culture. A total of 96 informants between the ages of 20 and 80 were selected using prior information. Data were collected using semi-structured interview, guided field walk, discussions and field observation. Simple Statistical methods and Jaccard's coefficient of similarity was applied for data analysis. A total of 156 plant species of material culture belonging to 115 genera and 70 families were collected. Of these, 79 species serve as sources of raw materials for various construction purposes, while 77 for traditional art and handicrafts. Out of these, 8 species were reported by the Afar Nation, 14 by the Oromo Nation and the rest by both Nations.

Keywords : ANP, Ethiopia, indigenous knowledge, material culture.

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Indigenous Knowledge on Plant Species of Material Culture (Construction, Traditional Arts & Handicrafts) used by the Afar & Oromo Nations in & Around the Awash National Park, Ethiopia

Tinsae Bahru [α], Zemede Asfaw [σ] & Sebsebe Demissew [σ]

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Keywords/phrases : *ANP, Ethiopia, indigenous knowledge, material culture.*

I. Introduction

According to Cotton (1996), although synthetic plant products have an increasing influence on the existing material culture of traditional societies, both wild and cultivated plants remain vital to many aspects of traditional life. This author defined the term *Material culture* as the total range of objects produced by a particular society including functional items such as tools, shelters and clothing as well as more decorative arts and handicrafts.

Plant species serve humans with many ranges of useful materials for building and construction of timber, poles, fencing and other purposes (Hill, 1952; Abbiw, 1990; Cotton, 1996; Kochhar, 1998). Timber, which is a major forest product, has a considerable importance in the construction of temporary shelters and permanent homesteads, fences and other items within the traditional societies (Hill, 1952; Cotton, 1996). Besides, other plant parts are used in roof construction especially stems and sheets of bark or split wood in traditional dwellings (Abbiw, 1990). He stated that in Ghana at least 15 various plant species are useful to make roof shingles. Furthermore, roofing materials are produced by the leaves of large palm fronds and/or various species of grasses for traditional dwellings (Abbiw, 1990; Cotton, 1996; Cunningham, 1996). For example, a number of thatching grasses, particularly *Eragrosits pallens* and *Stipagrostis uniplumis,* are used as construction material for roofs, hut walls, yards and mats in Botswana (IUCN, 2007). The roofing plant materials can be chosen according to functional properties like availability, durability and water-proofing nature (Abbiw, 1990).

Plant and plant products also have additional uses in traditional arts and handicrafts including tool handles, cooking utensils, mortar and pestles, walking/herding sticks, combs, paddles, containers and many others. For example, fibrous stems and roots are used to make basket, cordage and textiles (Cotton, 1996; Cunningham, 1996). Likewise, plant extracts and exudates are sources of dyes, gums, tannins, latex, waxes, resins, adhesives and others. In turn, in many cultures, there are traditional plant based tools, which are used in hunting and defense such as harpoons, bows, arrows, spears, fishing reels and traps, hunting clubs and so forth (Abbiw, 1990; Cotton, 1996). Therefore, the present study aimed to assess IK on plant species of material culture (construction, traditional arts and handicrafts) used by the indigenous peoples of the

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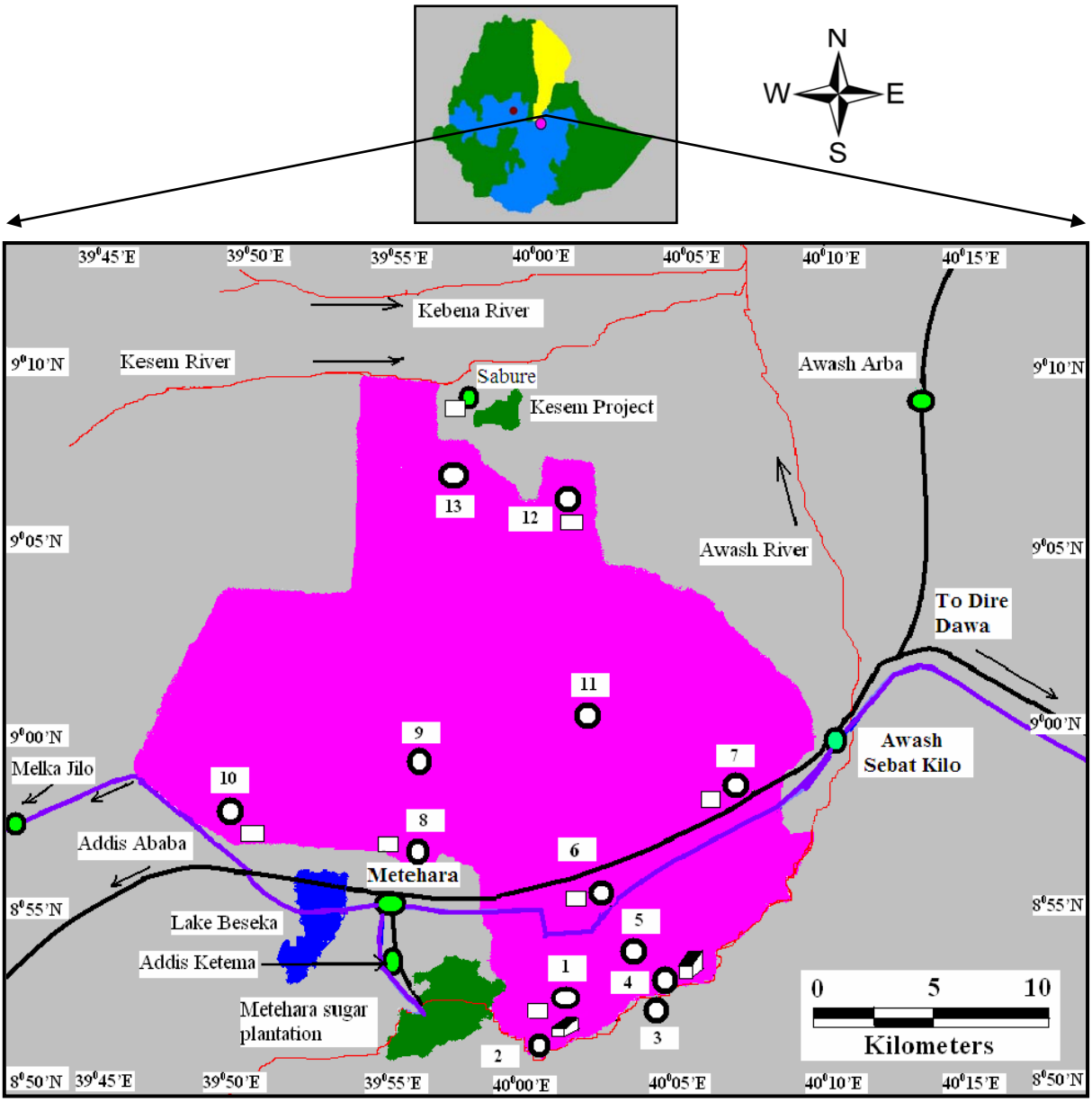
Afar and Oromo (Kereyu and Ittu) Nations in and around the ANP and thereby record, compile and document the associated IK to assist in the proper utilization, management and conservation of useful plants and the settings of the Park as a whole.

II. The Study Area

a) Geographical location

The study was conducted in ANP, Ethiopia, which is 225 km away from Addis Ababa and situated between latitudes 8°50' and 9°10' north and longitudes 39°45' and 40°10' east (EMA, 1992) (Figure 1). ANP is characterized by semi-arid climate or *Qolla* Zone and bimodal rainfall with the annual rainfall ranging between 400 and 700 mm (Jacobs and Schloeder, 1993). Out of the nine vegetation types of Ethiopia, the vegetation type of ANP is classified under *Acacia-Commiphora* woodland (Sebsebe Demissew and Friis, 2009) in the Somali-Masai Regional Center of endemism (White, 1983). Jacobs and Schloeder (1993) reported that ANP occurs in one of the most geologically active regions of the world. The phenomena of rifting and volcanism are continuous processes. Hence, it is estimated to have continued for 25-30 million years in Ethiopia, while about 5 million years in the ANP. According to Jacobs and Schloeder (1993), ancient alluvial and colluvial soils, soils of volcanic origin as well as recent alluvial soils are the three major soil types of the study area. The major water sources in the study area include Awash River with major tributaries around ANP including the Kesem and Kebena Rivers, Lake Beseka and the Hot Springs at the northern tip of the ANP. Thirteen data collection sites in ANP were: 1. Gotu, 2. Awash River, 3. Awash Gorge, 4. Karreyu Lodge, 5. Ilala Sala plain, 6. Hamareti, 7. Geda, 8. Sogido, 9. Mt. Fentale, 10. Sabober, 11. Dunkuku (Kudu Valley), 12. Filwuha, and 13. Sabure (Figure 1).



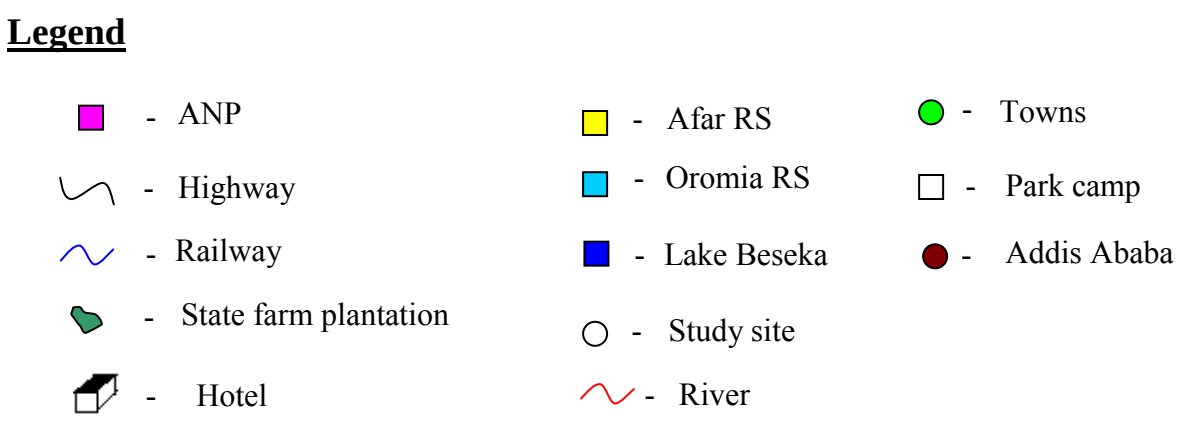
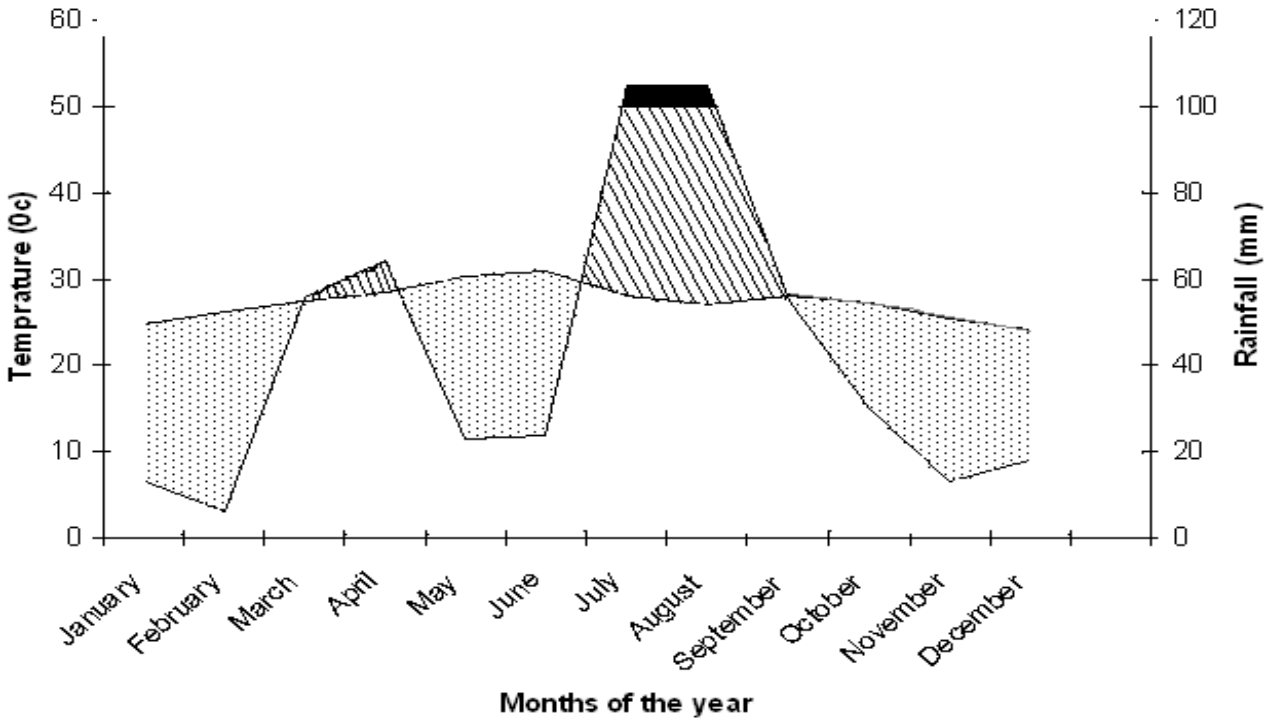


Figure 1 : Map of ANP modified from EMA (1992), Jacobs and Schloeder (1993) and Berihun Gebremedhin and Solomon Yirga (2005)

Awash Sebat Kilo

Altitude: 960 m a.s.l. Latitude $8^0 59'$ N Longitude $40^0 09'$ E



Source : Raw data obtained from NMSA (2009)

Figure 2 : Climadiagram at Awash Sebat Kilo meteorological station, east of ANP (from 1999-2008)

III. Materials and Methods

a) Sampling techniques and data collection

A reconnaissance survey of the study area was conducted from August 15-30, 2008 in order to obtain an impression about site conditions, to collect information on accessibility of plant species that serve as material culture and to identify sampling sites. Accordingly, 13 study sites (see Figure 1) were selected and established as data collection sites. Following this, ethnobotanical data were collected between September, 2008 and March, 2009, on three field trips that were carried out in each study site, following the methods by Martin (1995), Cotton (1996) and Cunningham (2001). Semi-structured interview, guided field walk, discussions and observation, with informants and key informants were applied based on a checklist of questions using the Afar and Oromo languages with the help of

translators to obtain IK of the local people on plant species of material culture. Voucher specimens were collected, identified and kept at National Herbarium, Addis Ababa University.

During the study, information regarding the IK on plant species of material culture in and around the ANP was gathered and the selection of informants and key informants was carried out based on prior information obtained from clan and religious leaders, knowledgeable elders, Park's scouts (*i.e.,* who have served in the ANP for more than 12 years and members of either the Afar or the Oromo Nations), pastoralists and agropastoralists. Others included individuals from different age groups, gender and Nations as well as field observation. Despite the effort made to involve as many women informants, only few women could take part in the study as they are not encouraged culturally within the society. Others are lack of permission from their husbands or other socio-cultural reasons, which they refrain from describing. Consequently, informants were selected from the Afar and/or the Oromo Nations based on the vicinity of their Kebeles to the Park. Four Kebeles from the Afar Nation (Awash, Doho, Dudub and Sabure Kebeles), whereas five Kebeles from the Oromo Nation (Benti, Fate Leidy, Gelcha, Ilala and Kobo Kebeles) were taken. Of these, 96 informants 7 or 8 individuals for each study site (76 men and 20 women) between the ages of 20 and 80 were selected using prior information. Out of these, 36 key informants (32 men and 4 women) were selected. Basic information on plant species of material culture including their vernacular names, habit, part (s) used, uses and their major use categories was/were collected from informants.

b) Ethnobotanical data analysis

The data were analyzed and summarized using simple statistical tools such as percentages, graphs and tables. The Jaccard's Coefficient of Similarity (JCS) was also calculated and the similarity in plant species composition between the Afar and the Oromo Nations were compared as it was described in Kent and Coker (1992). Accordingly, JCS was calculated between paired habitat types (A and B) as follows:

$$JCS = \frac{c}{c + b + a}, \text{ where}$$

a - is the number of species found only in habitat A,
b - is the number of species found only in habitat B and
c - is the number of common species found in habitat A and B.

Finally, JCS was multiplied by 100 in order to obtain the percentage similarity in species composition between the Afar and the Oromo Nations as applied by Kent and Coker (1992).

IV. Results and Discussion

a) Diversity and distribution of species of material culture

In this field study, a total of 156 plant species of material culture were recorded, being distributed in 115 genera and 70 families (Appendix 1). Of these, 79 species serve as sources of raw materials for various construction purposes and 77 are used for traditional art and handicrafts (Figure 3). Out of 156 plant species of material culture, 8 species were reported by the Afar Nation, 14 by the Oromo Nation and the rest by both of them. About 93% of the species were reported with their vernacular names, where 73% were reported by the Afar Nation and 87% by the Oromo Nation. Shrubs 61 species (39.6%) contributed the highest proportion of growth forms, which was followed by trees 58 (37.4%). Stems 119 (76.8%), followed by cut branches 24 (15.5%) were the most frequently utilized parts of the plant species in the study area by the local peoples. Some species are used in more than one material culture.

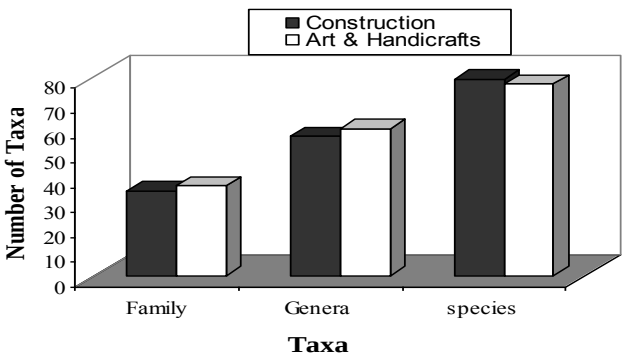


Figure 3 : Taxa of plant species for material culture.

Local communities in and around the ANP are highly dependent on plant species for various construction purposes such as house construction, species are used as a raw material for various household furniture and/or utensils, tool handles, dry fencing, roofs and/or walls thatching and so many other uses. Findings showed that more than 87% of the plant construction purposes (house construction, furniture,

fence posts and dry fencing) by the local communities in the study area. Some of the species used in house construction (load-bearing house posts, beams, roof supports, house walls and others), furniture as well as fence posts include *Acacia tortilis*, *Acacia nilotica*, *Acacia brevispica*, *Acacia mellifera*, *Acacia senegal*, *Balanites aegyptiaca*, *Olea europaea* subsp. *cuspidata, Dichrostachys cinerea*, *Cordia monoica*, *Tamarindus indica*, *Terminalia brownii*, *Ehretia cymosa* and *Ziziphus* species. Similarly, a study conducted in North Shoa Zone revealed that *Acacia brevispica* and *Acacia nilotica* for construction uses; *Ehretia cymosa* and *Terminalia brownii* for farm tools, whereas *Ehretia cymosa* for making furniture are more preferred by key informants (Hussien Adal, 2004). However, from field observation and informants report, it is clear that many homes around the study area are built from exotic tree species such as *Eucalyptus globulus* and *Prosopis juliflora* due to scarcity of indigenous tree species. Again, the fiber from the bark of *Acacia oerfota*, *Acacia tortilis* and *Grewia* species provide as ropes for tying the walls and roofs during house construction. On the other hand, plant species having thorns as well as faster growing rate were preferred more by the local peoples for dry fencing around homesteads, animal enclosures and farmlands. For instance, local people use various types of dry fencing by piling up branches of thorny plant species particularly *Acacia*, *Ziziphus* and *Cadaba species*, *Balanites aegyptiaca*, *Commiphora habessinica* and *Prosopis juliflora*.

Roofs, in turn, were thatched with a variety of grass species, the most commonly used being *Cymbopogon pospischilii*, which is commonly used by pastoralists for house construction around the study area. A similar result was also reported by Jacobs and Schloeder (1993). Likewise, Afar pastoralists also used the leaves of *Hyphaene thebaica* and *Typha* spp., which are the most preferred species for roof thatching. Other commonly used roof thatching materials include *Chrysopogon, Aristida adscensionis*, *Hyparrhenia* species, *Pennisetum setaceum*, *Sporobolus cosimilis* and many others. The people in Cheffa further revealed that roofs are thatched with *Hyparrhenia hirta* and *Hyparrhenia rufa* during the construction of houses. Fröman and Persson (1974) described that the tall and stemmy *Hyparrhenia* species are widely used for roof thatching. As informants stated that, in a rare case, if other resources are not available, the leaves of *Calotropis procera* are also used as roof thatching. This result is reported conversely in Ghana by Abbiw (1990) and Cotton (1996), where the stems of *Calotropis procera* was used as roof thatching. However, the corrugated iron sheets are replacing the use of roof thatching grasses through time due to modernization. Another reason might be due to shortage of tall grasses in the area. In turn, materials for house construction and traditional household utensils were replaced gradually by plastics and industrial products as a result of urbanization and loss of traditional way of life.

On the other hand, out of 77 plants of traditional art and handicrafts, 57 species (36.8%) are sources of farm implements, tool handles, household utensils and fencing tool (Felka (Af); Koko (Or)). The rest species serve for ritual values, soften leather, toothbrush, bed making, walking/herding sticks, bows and arrows, coloring/soften hair and many others (Appendix 1). Most of the species such as *Acacia tortilis*, *Balanites aegyptiaca, Berchemia discolor, Ceiba pentandra, Celtis toka, Cordia monoica, Dobera glabra, Tamarindus indica, Terminalia brownii, Ximenia americana, Ziziphus* species and many others are widely used for farm implements, tool handles, household utensils and fencing tool (Felka (Af); Koko (Or)). In turn, *Grewia* species are used for walking and/or herding sticks by children or elder persons; *Terminalia brownii* for coloring the body; the resin of *Ficus vasta* as adhesive and sealant and so forth. Again, the most widely used species for toothbrush reported by the informants were *Salvadora persica*, *Cadaba farinosa*, *Olea europaea* subsp. *cuspidata* and *Sida rhombifolia*. Likewise, Gemedo-Dalle *et al*. (2005) documented *Salvadora persica* as the most important plant species for toothbrushes in Borana lowlands, whereas Munishi *et al*. (2006) documented *Salvadora persica* and *Cadaba farinosa* in Tanzania for the same purpose. Of these, *Salvadora persica* is the best toothbrush from all and it is even sold in local and national market areas including Awash Sebat Kilo, Metehara, Addis Ketema, Sabure, Melka Jilo and Addis Ababa towns as well as along the main highway.

They have also certain cultural values within both Nations due to sharing of resources. For instance, both the Afar and the Oromo Nations use *Vernonia cinerascens* as cultural comb having only one stick, which is thinner or pointed at both ends. Again, *Acacia brevispica*, *Acacia tortilis* and *Balanites aegyptiaca* are used by both Nations for fencing tool (*Felka* (Af); *Koko* (Or)), which is a long stem ending with forked ends. Similarly, the smoke bath from *Terminalia brownii* wood with other ingredients (e.g. *Boswellia papyrifera* incense, sandals, etc.) is commonly used by women to scent (Eritole (Af); Bukbuka (Or)) their bodies and clothes as well as to flavouring milking utensils (Ayine (Af); Chocho (Or)). Such diverse uses of plant species over wider geographical areas between both Nations indicated that the existence of common knowledge (Kebu Balemie and Fassil Kebebew, 2006) as well as cultural diffusion (Teshome Soromessa and Sebsebe Demissew, 2002; Kebu Balemie and Fassil Kebebew, 2006) across a range of diverse cultures and geographical areas. Consequently, both Nations share most of the useful plant species around them within each other (Kebu Balemie and Fassil Kebebew, 2006).

On the contrary, useful plants also have certain cultural and ritual values within particular social groups. For instance, stem and leaves of Doum palm tree (*Hyphaene thebaica)* and *Typha* spp., which are restricted in the Northern tip of ANP, are a very important

resource for house and granary (major means of storing crops) construction, basketry, bed making and roof thatching around the Sabure, Doho and Dudub Kebeles by the Afar Nation. Women also make mats for sitting or sleeping on, as well as for drying crops. In line with this, *Ziziphus mucronata* and *Ziziphus spina-christi* are used by the Afar Nation to wash and soften dead person's body as well as coloring/soften hairs. Whereas, *Ficus sycomorus*, *Acacia tortilis* and *Balanites aegyptiaca* are highly respected and conserved by the Oromo Nation since they are the most important and widely used plants in the Oromo culture. Most traditional rituals and meetings are held in the shade of *Ficus vasta*, *Ficus sycomorus* and *Acacia tortilis* trees. However, in the case of the Afar Nation such traditional rituals and meetings are held in any type of tree shade without the selection of species. This indicated that IK distribution can be influenced by socio-cultural factors among different Nations (Cotton, 1996).

b) Plant species of material culture use diversity

Overall, plant species that serve as material culture in the study area were found to have multi-purpose values (use diversity) in various ways. These are forage/fodder, fuel wood (charcoal and firewood), medicine, food as well as miscellaneous uses. Out of the total recorded plant species which serve as material culture, 16% of the species were found to have 4 and 5 distinct uses each, while 34% with 6 uses to the local people (Appendix 1)

c) Variation of indigenous knowledge between the Afar and the Oromo Nations

Research outputs during data collection revealed that both Nations equally reported 19 species for material culture independently, whereas 118 were common to both Nations (Table 1). The percentage similarity (about 76%) for the species, in turn, indicated that since the two groups situated almost in close geographical settings, there is a cultural diffusion and sharing of experiences and knowledge between them. Thus, they commonly utilize the same species.

Table 1 : The species similarity between the Afar and the Oromo Nations for plant species of material culture and the JCS in the study area

Total number of species	Total number of species reported by:			Jaccard's coefficient of similarity	Percentage similarity
	The Afar Nation	The Oromo Nation	Both Nations		
156	19	19	118	0.76	76

V. Conclusion and Recommendations

Indigenous people in and around the study area mainly depend on plant species of material culture for various construction purposes as well as traditional art and handicrafts. As a result, high diversity of species is recorded even if human-induced and natural factors influence the species. Planting of these important species around homesteads and farmlands for household use and sale; raising tree seedlings at nursery for large scale plantation of more exploited species (e.g. *Terminalia brownii, Acacia* spp., *Olea europaea* subsp. *cuspidata, Tamarindus indica*, etc.); better animal husbandry practices and improved shortage of grazing lands to minimize overgrazing of thatched grasses (e.g. *Cymbopogon pospischilii*, *Chrysopogon plumulosus*, *Hyparrhenia* spp., etc.); sustainable utilization and conservation of the species and awareness raising of the local people are recommended.

VI. Acknowledgements

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Appendix 1 : List of plant species as a raw material for construction purposes (material culture) in the ANP

Key: Major use category *[F = Forage/fodder; Fu = Fuel wood; M = Medicine; Fo = Food; Mc = Material culture; Mi = Miscellaneous uses];* ***Habit*** *(Ha) [C-Climber; H-Herb; S-Shrub; T-Tree]; [* Species reported by the Afar Nation; ** Species reported by the Oromo Nation; Species without* ***asterisks*** *are reported by both Nations];* ***Note*** *[Components of house construction include load-bearing house posts, beams, roof supports, house walls, windows and doors]*

Scientific name	Family name	Ha	Vernacular name	Major use category	Part (s) used	Uses
Acacia brevispica Harms	Fabaceae	S	HAMARESA (Or)	F, Fu, Fo, Mc	Stem; cut branches	House construction, fence posts; dry fencing
Acacia dolichocephala Harms	Fabaceae	T		F, Fu, Mc, Mi	Stem; cut branches	Fence posts; dry fencing
Acacia mellifera (Vahl) Benth.	Fabaceae	S	MAKA'ARTO/ MA'EGHERTO (Af); SEPENE GURO (Or)	F, Fu, M, Fo, Mc, Mi	Stem; cut branches	House construction, furniture; dry fencing
Acacia negrii Pic. - Serm.	Fabaceae	S	KESEL-E (-TO) (Af); KESELE (Or)	F, Fu, Mc	Stem; cut branches	Fence posts; dry fencing
Acacia nilotica (L.) Willd. ex Del.	Fabaceae	T	KESEL-E (-TO)	F, Fu, M, Fo, (Af); BURKUKE (Or)	Stem; cut Mc, Mi	House branches construction, fence posts; dry fencing
Acacia oerfota (Forssk.) Schweinf.	Fabaceae	S	GOMERTO (Af); AJO (Or)	F, Fu, M, Fo, Mc, Mi	Stem; cut branches; bark	House construction; dry fencing; fiber used as rope & tying material
Acacia prasinata Hunde	Fabaceae	T	SEKEKTO (Af); DODOTI (Or)	F, Fu, Mc	Stem; cut branches	House construction, fence posts; dry fencing
Acacia r obusta Burch.	Fabaceae	T	GERE'INITO (Af); WANIGAYO (Or)	F, Fu, Mc	Stem; cut branches	House construction, fence posts; dry fencing
Acacia senegal (L.) Willd.	Fabaceae	S	ADADO (Af); SEPENSA DIMA/ SEPESA (Or)	F, Fu, M, Fo, Mc, Mi	Stem and branches; cut	House construction, furniture;
Acacia seyal Del.	Fabaceae	T	ADIGENTO/ MAKANI (Af); WACHU (Or)	F, Fu, Fo, Mc	branches Stem; cut branches; bark	dry fencing House construction, fence posts; dry fencing;

Acacia r obusta Burch.	Fabaceae	T	Gere'inito (Af); Wanigayo (Or)	F, Fu, Mc	Stem; cut branches	House construction, fence posts; dry fencing
Acacia senegal (L.) Willd.	Fabaceae	S	Adado (Af); Sepensa dima/ Sepesa(Or)	F, Fu, M, Fo, Mc, Mi	Stem and branches; cut branches	House construction, furniture; dry fencing
Acacia seyal Del.	Fabaceae	T	Adigento/ Makani (Af); Wachu (Or)	F, Fu, Fo, Mc	Stem; cut branches; bark	House construction, fence posts; dry fencing; fiber from bark is used as rope
Acacia tortilis (Forssk.) Hayne	Fabaceae	T	E'ibito/Behbey (Af); Dedecha (Or)	F, Fu, M, Fo, Mc, Mi	Stem; cut branches; bark	House construction, furnit ure; dry fencing; bark used for ropes
Acalypha fruticosa Forssk.	Euphorbiaceae	S	Chiri (Or)	F, Fu, Mc, Mi	Stem & branches	Temporary house construction
Agave sisalana Perrine ex Engl.	Agavaceae	H	Ya'a (Af); Alge dheltu (Or)	Mc, Mi	Stem; leaves	House construction; fibers are used to make strong ropes
Aristida adscensionis L.	Poaceae	H	Durfi (Af)	F, Mc	Whole part	Roof thatching
Balanites aegyptiaca (L.) Del.	Balanitaceae	T	Udayito/Ala'ito (Af); Bedeno (Or)	F, Fu, M, Fo, Mc, Mi	Stem; cut branches	House construction, fence posts, furniture; dry fencing
Berchemia Discolor (Klotzsch) Hemsl.	Rhamnaceae	T	Yeyebito (Af); Jejeba (Or)	F, Fu, Fo, Mc	Stem	House construction, fence posts, furniture
Boscia salicifolia Oliv. *	Capparidaceae	S	-	F, Fu, Fo, Mc	Stem	House construction
Cadaba farinosa Forssk.	Capparidaceae	S	Fura (-yito)/ Numhele (Af); KelikNationha (Or)	F, Fu, M, Fo, Mc, Mi	Stem; cut branches	House construction; dry fencing
Calotropis procera (Ait.) Ait.f.	Asclepiadaceae	S	Gele'ato/ Ghula'ento (Af); Felfela adal (Or)	Fu, M, Mc, Mi	Stem; leaves	House construction; used for roof thatching if thatching grass is scarce

Capparis tomentosa Lam.	Capparidaceae	S	Harenigema (Or)	F, Fu, M, Fo, Mc, Mi	Cut branches	Dry fencing
Ceiba pentandra (L.) Gaertn.*	Bombacaceae	T	Ferenji tuti (Af)	F, Fu, Fo, Mc, Mi	Stem	House construction, fence posts, furniture
Celtis toka (Forssk.) Hepper & Wood	Ulmaceae	T	Gudibi'ato (Af); Metekoma (Or)	F, Fu, Fo, Mc	Stem	Furniture
Chrysopogon aucheri (Boiss.) Stapf	Poaceae	H	Durfi (Af); Alelo (Or)	F, Mc	Whole part	Roof thatching
Chrysopogon plumulosus Hochst.	Poaceae	H	Durfi (Af); Deremo (Or)	F, Mc	Whole part	Roof thatching
Cissampelos mucronata A. Rich. **	Menispermaceae	C	Hidi (Or)	Mc	Stem	Tying material
Cissus quadrangularis L.	Vitaceae	C	Ali'e (Af); Chophi (Or)	M, Fo, Mc	Cut branches	Dry fencing
Cissus rotundifolia (Forssk.) Vahl **	Vitaceae	C	Buri (Or)	F, Fo, Mc	Stem; bark	Furniture; fiber used as tying material
Combretum molle R. Br. ex G. Don	Combretaceae	T	We'iba'ito (Af); Rukesa (Or)	F, Fu, Mc, Mi	Stem	House construction, fence posts, furniture
Commiphora erythraea (Ehrenb.) Engl.	Burseraceae	T	Yeyebito (Af); Chelanka (Or)	F, Fu, Mc	Stem	Furniture, fence posts
Commiphora Habessinica (Berg) Engl.	Burseraceae	S	Hedayito (Af); Hamesa (Or)	F, Fu, Fo, Mc, Mi	Stem; cut branches	Furniture, fence posts; dry fencing
Cordia monoica Roxb.	Boraginaceae	S	Mine gure Subula (Af); Medero (Or)	F, Fu, Fo, Mc	Stem	House construction, fence posts, furniture

Crotalaria incana L.	Fabaceae	H	Ijisise (Or)	Fu, M, Mc, Mi	Stem; cut branches	House construction; dry fencing
Cryptostegia grandiflora Roxb. ex R. Br.	Asclepiadaceae	S	Hali mero (Af); Hakonkol (Or)	Fu, Mc, Mi	Stem & branches; bark	House construction, to construct granary (Gotera (Or)) for storing cereal crops **; fiber used as tying material
Cymbopogon pospischilii (K. Schum.) C.E. Hubb.	Poaceae	H	Isesu/Ayiso (-yita) (Af)	F	Whole part	Roof thatching
Dalbergia lactea Vatke **	Fabaceae	S	Dilo lelafa (Or)	F, Fu, Mc	Stem	House construction, fence posts
Dichrostachys cinerea (L.) Wight & Arn.	Fabaceae	S	Jirme (Or)	F, Fu, Mc, Mi	Stem; cut branches; bark	House construction, fence posts; dry fencing; fibers are used as tying materials
Dobera glabra (Forssk.) Poir.	Salvadoraceae	T	Ghersa (Af); Ade (Or)	F, Fu, Fo, Mc, Mi	Stem	House construction, fence posts, furniture
Ehretia cymosa Thonn.	Boraginaceae	S	Mine gure (Af); Ulaga (Or)	F, Fu, M, Fo, Mc	Stem; bark	House construction, fence posts, furniture; fiber used as tying material
Ficus sycomorus L.	Moraceae	T	Subula (Af); Od a (Or)	Fu, M, Fo, Mc, Mi	Stem	House construction, fence posts, furniture
Ficus vasta Forssk.	Moraceae	T	Mara'ito (Af); Kiltu (Or)	Fu, M, Fo, Mc, Mi	Stem	House construction, fence posts, furniture
Flacourtia indica (Burm.f.) Merr. **	Flacourtiaceae	S	-	F, Fu, Fo, Mc	Stem	Furniture, fence posts
Grewia bicolor Juss.	Tiliaceae	S	Adibi'ato (Af); Haroresa (Or)	F, Fu, Fo, Mc	Stem; bark	House construction; fiber used as tying material
Grewia ferruginea Hochst. ex A. Rich.	Tiliaceae	S	Adibi'ato/ Fo (Af); Haroresa (Or)	F, Fu, Fo, Mc	Stem; bark	House construction; fiber used as rope & tying material

Grewia schweinfurthii Burret	Tiliaceae	S	Adibi'ato (Af); Mudhe gure (Or)	F, Fu, Fo, Mc	Stem; bark	House construction; fiber used as tying material
Eucalyptus globulus Labill.	Myrtaceae	T	Bahir zafi (Af & Or)	Fu, M, Mc	Stem	House construction, fence posts, furniture
Euclea racemosa Murr. subsp. *schimperi*(A. DC.) White	Ebenaceae	S	Miessa (Or)	F, Fu, Fo, Mc	Stem	House construction, fence posts
Grewia tenax (Forssk.) Fiori	Tiliaceae	S	Hedayito/ Huda /Mine gure (Af); Deka tuntuna (Or)	F, Fu, Fo, Mc	Stem; bark	House construction; fiber used as rope & tying material
Grewia velutina (Forssk.) Vahl	Tiliaceae	S	Adibi'ato (Af); Haroresa (Or)	F, Fu, Fo, Mc	Stem; bark	House construction; fiber used as rope & tying material
Grewia villosa Willd.	Tiliaceae	S	Gariwa (Af); Ogomdi (Or)	F, Fu, M, Fo, Mc, Mi	Stem; bark	House construction; fiber used as rope & tying material
Hagenia abyssinica (Bruce) J.F. Gmel.	Rosaceae	T	Begala (Af); Heto (Or)	Fu, M, Mc	Stem	House construction, fence posts, furniture
Hippocratea africana (Willd.) Loes.	Celastraceae	C	Misi (Af); Tero (Or)	F, Fu, Mc	Stem & branches	House construction, to construct granary (Gotera (Or)) for storing cereal crops ** ; tying material
Hyparrhenia hirta (L.) Stapf	Poaceae	H	Ayisoyita/ Isesu (Af); Mene chita (Or)	F, Mc	Whole part	Roof thatching
Prosopis juliflora(Sw.) DC.	Fabaceae	S	Weyane (Af & Or)	F, Fu, M, Fo, Mc, Mi	Stem; cut branches	House construction, fence posts; dry fencing
Rhynchosia Malacophylla (Spreng.) Boj. **	Fabaceae	H	-	Mc, Mi	Stem	Tying material during house and fence construction
Pennisetum setaceum (Forssk.) Chiov.	Poaceae	H	Areb muri (Or)	F, Mc	Whole part	Roof thatching

Persicaria setosula (A. Rich.) K. L. Wilson	Polygonaceae	H	Alelitu (Or)	Mc	Above ground part	Used for roof thatching if thatching grass is scarce
Hyparrhenia rufa (Nees) Stapf	Poaceae	H	Isesu (Af); Mene chita (Or)	F, Mc	Whole part	Roof thatching
Hyphaene thebaica (L.) Mart.*	Arecaceae	T	Unga/ Gara'ito (Af); Meti (Or)	F, Fu, Fo, Mc	Stem and leaves; leaves; bark	House construction; roof thatching; fiber used as tying material
Hyphaene thebaica (L.) Mart.*	Arecaceae	T	Unga/ Gara'ito (Af); Meti (Or)	F, Fu, Fo, Mc	Stem and leaves; leaves; bark	House construction; roof thatching; fiber used as tying material
Lantana camara L.	Verbenaceae	S	Baduwa hara (Af); Midan dubra (Or)	F, Fu, Fo, Mc, Mi	Cut branches	Dry fencing
Maerua angolensis DC. *	Capparidaceae	S	Dunibiayito/ Sekileli'a (Af)	F, Fu, Fo, Mc	Stem	Household furniture, fence posts, furniture
Manilkara butugi Chiov.	Sapotaceae	T	Butuye (Af); Butuji (Or)	F, Fu, Fo, Mc, Mi	Stem	House construction, fence posts, furniture
Moringa stenopetala (Bak.f.) Cuf.	Moringaceae	T	-	Fu, Fo, Mc	Stem	Household utensils, furniture
Morus mesozygia Stapf	Moraceae	S	-	F, Fu, Mc	Stem	Furniture, fence posts
Olea europaea L. subsp. *Cuspidata* (Wall.ex G.Don) Cif.	Oleaceae	T	Weyibo (Af); Ejersa (Or)	F, Fu, M, Mc, Mi	Stem	House construction, fence posts, furniture
Parkinsonia aculeata L.	Fabaceae	S	-	F, Fu, Fo, Mc	Stem; cut branches	Fence posts; dry fencing
Pennisetum menzianum Leeke	Poaceae	H	-	F, Mc	Whole part	Roof thatching

Rhynchosia minima (L.) DC. **	Fabaceae	C	Kelela (Or)	Mc	Stem	Tying material during house and fence construction
Salvadora persica L.	Salvadoraceae	S	Hadayito/ Dadaho (Af); Ade (Or)	F, Fu, M, Fo, Mc	Stem	House construction, furniture
Schinus molle L.	Anacardiaceae	T	Kundo berbere (Or)	Fu, M, Mc, Mi	Stem	Fence posts, furniture
Sesbania sesban (L.) Merr.	Fabaceae	S	Enchini/ Harcha (Or)	F, Fu, Mc	Stem; young stems	House construction; fibers used as tying material
Sporobolus cosimilis Fresen.	Poaceae	H	Hamelito (Af)	F, Mc	Whole part	Roof thatching
Sterculia africana (Lour.) Fiori	Sterculiaceae	T	Kereri (Or)	F, Fu, Fo, Mc, Mi	Stem; cut branches	Fence posts, furniture; dry fencing
Tamarindus indica L.	Fabaceae	T	Segentu (Af); Roka (Or)	F, Fu, M, Fo, Mc , Mi	Stem	House construction, fence posts , furniture
Terminalia brownii Fresen.	Combretaceae	T	We'iba'ito (Af); Bir'ensa (Or)	F, Fu, M, Mc, Mi	Stem	House construction, fence posts, furniture
Trilepisium madagascariense DC. **	Moraceae	T	Selaweta (Or)	Fu, Mc	Stem	House construction, fence posts, furniture
Typha spp.*	Typhaceae	H	Gede (Af)	F, Mc	Whole part	Roof and walls thatching
Ximenia americana L.	Olacaceae	T	Hudha (Or)	F, Fu, Fo, Mc	Stem	Fence posts, furniture
Ziziphus mucronata Willd.	Rhamnaceae	T	Kusir-a (-to) (Af); Kurkura hado (Or)	F, Fu, M, Fo, Mc, Mi	Stem; cut branches	House construction, fence posts, furniture; dry fencing
Ziziphus spina-christi (L.) Desf.	Rhamnaceae	T	Kusir-a (-to) (Af); Kurkura (Or)	F, Fu, M, Fo, Mc, Mi	Stem; cut branches	House construction, fence posts, furniture; dry fencing

Appendix 2 : List of plant species as sources of traditional arts and handicrafts (material culture) in the ANP.

Key: Major use category *[F = Forage/fodder; Fu = Fuel wood; M = Medicine; Fo = Food; Mc = Material culture; Mi = Miscellaneous uses];* ***Habit*** *(Ha) [C-Climber; H-Herb; Semi-parasitic-SP; S-Shrub; T-Tree]; [***** Species reported by the Afar Nation;* ******** *Species reported by the Oromo Nation; Species without* ***asterisks*** *are reported by both Nations]*

Scientific name	Family name	Ha	Vernacular name	Major use category	Part (s) used	Uses
Abutilon ramosum Guill. & Perr.	Malvaceae	H	Hambukto (Af); Ataye (Or)	F, Mc	Stem	Toothbrush
Acacia brevispica Harms	Fabaceae	S	Hamaresa (Or)	F, Fu, Fo, Mc	Stem	Tool handles, farm implements, long stem ending with forked ends used as fencing tool (Felka (Af); Koko (Or))
Acacia mellifera (Vahl) Benth.	Fabaceae	S	Maka'arto/Ma' egherto (Af); Sepene guro (Or)	F, Fu, M, Fo, Mc, Mi	Stem (wood)	Farm tools
Acacia nilotica (L.) Willd. ex Del.	Fabaceae	T	Kesel-e (-to) (Af); Burkuke (Or)	F, Fu, M, Fo, Mc, Mi	Stem; bark	Tool handles, household utensils (mortars and pestles), arrows & bows *; ink making, to soften leather
Acacia oerfota (Forssk.) Schweinf.	Fabaceae	S	Gomerto (Af); Ajo (Or)	F, Fu, M, Fo, Mc, Mi	Stem	Household utensils (milking utensils)
Acacia prasinata Hunde	Fabaceae	T	Sekekto (Af); Dodoti (Or)	F, Fu, Mc	Stem	Farm tools
Acacia robusta Burch.	Fabaceae	T	Gere'inito (Af); Wanigayo (Or)	F, Fu, Mc	Stem	Household utensils
Acacia senegal (L.) Willd.	Fabaceae	S	Adado (Af); Sepensa dima/ Sepesa (Or)	F, Fu, M, Fo, Mc, Mi	Stem; seed	Farm implements; dye is used for coloring
Acacia seyal Del.	Fabaceae	T	Adigento/ Makani (Af); Wachu (Or)	F, Fu, Fo, Mc	Stem; bark	Farm implements, tool handles, household utensils, fencing tool (Felka (Af); Koko (Or)); dye is extracted from bark

Acacia tortilis (Forssk.) Hayne	Fabaceae	T	E'IBITO/BEHBEY (Af); DEDECHA (Or)	F, Fu, M, Fo, Mc, Mi	Stem; leaves & bark	Household utensils (mortars and pestles), fencing tool (FELKA (Af); KOKO (Or)); ritual value **
Agave sisalana Perrine ex Engl.	Agavaceae	H	YA'A (Af); ALGE DHELTU (Or)	Mc, Mi	Leaves	Fibers are used to make sacks and mat
Artemisia absinthium L. **	Asteraceae	H	HARITI (Af); ARITI (Or)	Mc, Mi	Above ground part	Ritual value
Asparagus africanus Lam. **	Asparagaceae	C	HIDE SERE/SERITI (Or)	M, Fo, Mc, Mi	Whole plant	Ritual value
Balanites aegyptiaca (L.) Del.	Balanitaceae	T	UDAYITO/ALA'ITO (Af); BEDENO (Or)	F, Fu, M, Fo, Mc, Mi	Stem; whole plant	Household utensils, farm implements, tool handles, fencing tool (FELKA (Af); KOKO (Or)); cultural value**
Berchemia discolor (Klotzsch) Hemsl.	Rhamnaceae	T	YEYEBITO (Af); JEJEBA (Or)	F, Fu, Fo, Mc	Stem	Household utensils, tool handles, farm tools, toothbrush
Boswellia papyrifera (Del.) Hochst.	Burseraceae	T	LUBATEN (Af); MUKE ITANA (Or)	F, Fu, Fo, Mc	Resin (incense)	Resin (incense) is used as smoking for good scent (ERITOLE (Af))
Cadaba farinosa Forssk.	Capparidaceae	S	FURA (-YITO)/ NUMHELE (Af); KELIKNATIONHA (Or)	F, Fu, M, Fo, Mc, Mi	Stem	Toothbrush, walking sticks
Calotropis procera (Ait.) Ait.f. **	Asclepiadaceae	S	GELE'ATO/ GHULA'ENTO (Af); FELFELA ADAL (Or)	Fu, M, Mc, Mi	Whole plant; stem (wood)	To make cultural pillow
Ceiba pentandra (L.) Gaertn. *	Bombacaceae	T	FERENJI TUTI (A)	F, Fu, Fo, Mc, Mi	Stem; mature fruit	Household utensils, tool handles, farm implements; fibers from mature fruit used as making pillow and mattresses
Celtis toka (Forssk.) Hepper & Wood	Ulmaceae	T	GUDIBI'ATO (Af); METEKOMA (Or)	F, Fu, Fo, Mc	Stem	Household utensils, tool handles, farm implements
Combretum molle R. Br. ex G. Don	Combretaceae	T	WE'IBA'ITO (Af); RUKESA (Or)	F, Fu, Mc, Mi	Stem (wood)	Tool handles, farm implements, household utensils

Commiphora erythraea (Ehrenb.) Engl.	Burseraceae	T	Yeyebito (Af); Chelanka (Or)	F, Fu, Mc	Gum & resin	Gum & resin is used for an incense and insecticide
Commiphora habessinica (Berg) Engl.	Burseraceae	S	Hedayito (Af); Hamesa (Or)	F, Fu, Fo, Mc, Mi	Stem	Tool handles, farm implements, household utensils, toothbrush
Cordia monoica Roxb.	Boraginaceae	S	Mine gure/Subula (Af); Medero (Or)	F, Fu, Fo, Mc	Stem	Tool handles, farm implements, household utensils (mortars and pestles)
Crotalaria incana L.	Fabaceae	H	Ijisise (Or)	Fu, M, Mc, Mi	Stem	Farm implements, herding sticks
Cucumis prophetarum L. **	Cucurbitaceae	H	Hare goge (Or)	F, M, Mc, Mi	Fruit	Boys play with fruit like a ball
Cymbopogon citratus (DC.) Stapf **	Poaceae	H	Teji sar (Af); Tij sara (Or)	Mc		Above ground Ritual value
Dichrostachys cinerea (L.) Wight & Arn.	Fabaceae	S	Jirme (Or)	F, Fu, Mc, Mi	Stem	Household utensils (mortars and pestles), tool handles
Dobera glabra (Forssk.) Poir.	Salvadoraceae	T	Ghersa (Af); Ade (Or)	F, Fu, Fo, Mc, Mi	Stem	Household utensils (mortars and pestles), tool handles, camel saddles, toothbrush
Ehretia cymosa Thonn.	Boraginaceae	S	Mine gure (Af); Ulaga (Or)	F, Fu, M, Fo, Mc	Stem	Household utensils, tool handles, farm implements, walking/herding sticks
Eucalyptus globulus Labil	l. Myrtaceae	T	Bahir zafi (Af & Or)	Fu, M, Mc	Stem	Tool handles, farm implements
Euclea racemosa Murr. subsp. *schimperi* (A. DC.) White	Ebenaceae	S	Miessa (Or)	F, Fu, Fo, Mc	Stem	Tool handles, farm implements, household utensils, toothbrush
Ficus sycomorus L.	Moraceae	T	Subula (Af); Oda (Or)	Fu, M, Fo, Mc, Mi	Stem; whole plant; bark	Household utensils; ritual value **; to make beehives
Ficus vasta Forssk.	Moraceae	T	Mara'ito (Af); Kiltu (Or)	Fu, M, Fo, Mc, Mi	Stem; resin; bark	Household utensils; adhesive and sealant; to make beehives

Flacourtia indica (Burm.f.) Merr.	Flacourtiaceae	S	-	F, Fu, Fo, Mc	Stem	Tool handles, household utensils, farm implements
Gossypium hirsutum L.	Malvaceae	S	Tut (Af)	Mc	Seed hairs	Fiber derived from seed hairs (cotton) is used for making clothes
Grewia bicolor Juss.	Tiliaceae	S	Adibi'ato (Af); Haroresa (Or)	F, Fu, Fo, Mc	Stem	Tool handles, bed making *, walking/cultural/ herding sticks, bows & arrows, toothbrush
Grewia ferruginea Hochst. ex A. Rich.	Tiliaceae	S	Adibi'ato/Fo (Af); Haroresa (Or)	F, Fu, Fo, Mc	Stem	Farm implements, bed making *; walking/herding sticks, bows & arrows
Grewia schweinfurthii Burret	Tiliaceae	S	Adibi'ato (Af); Mudhe gure (Or)	F, Fu, Fo, Mc	Stem	Farm implements, bed making *
Grewia tenax (Forssk.) Fiori	Tiliaceae	S	Hedayito/ Huda/Mine gure (Af); Deka tuntuna (Or)	F, Fu, Fo, Mc	Stem	Farm implements, bed making *, walking/ herding sticks, bows & arrows
Grewia velutina (Forssk.) Vahl	Tiliaceae	S	Adibi'ato (Af); Haroresa (Or)	F, Fu, Fo, Mc	Stem	Tool handles,bed making *, walking /herding sticks, bows & arrows, fencing tool (Felka (Af); Koko (Or))
Grewia villosa Willd.	Tiliaceae	S	Gariwa (Af); Ogomdi (Or)	F, Fu, M, Fo, Mc, Mi	Stem; Bark	Tool handles, farm implements,bed making *, walking /herding sticks, bows & arrows; fluid from inner bark is extracted & used as coiling hairs culturally *
Hagenia abyssinica (Bruce) J.F. Gmel.	Rosaceae	T	Begala (Af); Heto (Or)	Fu, M, Mc	Stem	Household utensils, tool handles, farm implements, bed making
Hibiscus micranthus L. f.	Malvaceae	H	Akilehena (Af)	F, Fu, Fo, Mc	Stem; root	Walking sticks; magical value *

Hyphaene thebaica (L.) Mart. *	Arecaceae	T	Unga/Gara'ito (Af); Meti (Or)	F, Fu, Fo, Mc	Stem and leaves; fibers from bark; seed	Bed making, making baskets & mats; to fix milking utensil;
Indigofera arrecta Hochst. ex A. Rich.	Fabaceae	H	Herchumen (Or)	Fu, M, Fo, Mc	Stem; leaves	Household utensils; coloring han , toothbrush,
Kleinia odora (Forssk.) DC. **	Asteraceae	S	Luko (Or)	F, Fu, Mc, Mi	Stem & leaves	To soften leather
Lagenaria	Cucurbitaceae Dunibiayito/	C	Dela (Af); Buki (Or)	Mc	Fruit	Mature fruit is used as milk/water container : is decorated to express their culture
Maerua angolensis DC. *	Capparidaceae	S	Sekileli'a (Af)	F, Fu, Fo, Mc	Stem	
Manilkara butugi Chiov.	Sapotaceae	T	Butuye (Af); Butuji (Or)	F, Fu, Fo, Mc, Mi	Stem (wood)	Tool handles, farm implements,
Morus mesozygia Stapf	Moraceae	S	-	F, Fu, Mc	Stem	Tool handles;
Ocimum forskolei Benth.	Lamiaceae	H	Suri mi'a (Af); Dama kese (Or)	F, Mc, Mi	Whole plant	Making broom (brush) for sweeping indoors or outdoors
Ocimum stirbeyi Schweinf. & Volk.	Lamiaceae	S	Biriteli (Af)	Fu, Mc	Stem	
Olea europaea L. subsp. *cuspidata* (Wall.ex G.Don) Cif.	Oleaceae	T	Weyibo (Af); Ejersa (Or)	F, Fu, M, Mc, Mi	Stem (wood); whole plant	Farm implements, household utensils, tool handles walking/herding sticks;
Oncocalyx schimperi (A. Rich.) M. Gilbert	Loranthaceae	SP	Hatote (Af); Dertu haroresa (Or)	Fu, M, Mc	Whole plant	To soften leather
Parkinsonia aculeata L.	Fabaceae	S	-	F, Fu, Fo, Mc	Stem	Tool handles, farm implements
Plicosepalus Sagittifolius (Engl.) Danser	Loranthaceae	SP	Hatote (Af); Dertu dedacha (Or)	Fu, M, Mc	Whole plant	To soften leather
Prosopis juliflora (Sw.) DC.	Fabaceae	S	Weyane (Af & Or)	F, Fu, M, Fo, Mc, Mi	Stem	Tool handles, farm implements
Pupalia lappacea (L.) A. Juss.	Amaranthaceae	H	Sorot kufu (Af); Metene (Or)	F, M, Mc	Fruits	Children collect many hooked fruits, fixed together like a ball & play with it
Rhus vulgaris Meikle	Anacardiaceae	S	Debobesa (Or)	F, Fu, M, Fo, Mc	Stem	Farm implements, household utensils, tool handles

Ricinus communis L.	Euphorbiaceae	S	Sherbeti (Af); Kobo (Or)	Fu, M, Fo, Mc	Seed	Crushed seeds used for greasing baking plates for *injera* & bread, to soften leather
Salvadora persica L.	Salvadoraceae	S	Hadayito/ Dadaho (Af); Ade (Or)	F, Fu, M, Fo, Mc	Stem	Household utensils, tool handles, farm implements, toothbrush
Sansevieria ehrenbergii Schweinf. ex Baker	Dracenaceae	H	Yi'e (Af); Alge (Or)	Mc	Leaves	Fibers used for basket, rope & whip making
Schinus molle L.	Anacardiaceae	T	Kando berbere (Or)	Fu, M, Mc, Mi	Stem	Household utensils, tool handles, farm implements
Sesbania sesban (L.) Merr.	Fabaceae	S	Enchini/ Harcha (Or)	F, Fu, Mc	Stem	Farm implements, tool handles
Sida rhombifolia L.	Malvaceae	H	Welayineba (Af); Hatawi (Or)	F, M, Mc, Mi	Stem	Toothbrush
Sida schimperiana Hochst. ex A. Rich.	Malvaceae	S	Welayineba (Af); Korcha ijole (Or)	F, Fu, M, Mc, Mi	Stem	Toothbrush
Solanum incanum L. **	Solanaceae	S	Amboko aso (Af); Hidi loni (Or)	F, Fu, Mc, Mi	Above ground part	It is hold with cultural sticks during marriage
Sterculia africana (Lour.) Fiori	Sterculiaceae	T	Kereri (Or)	F, Fu, Fo, Mc, Mi	Stem	Household utensils, farm implements
Tamarindus indica L.	Fabaceae	T	Segentu (Af); Roka (Or)	F, Fu, M, Fo, Mc, Mi	Stem; gum; bark	Household utensils, tool handles, farm farm implements;ink ink making; to soften leather
Terminalia brownii Fresen.	Combretaceae	T	W'iba'ito (Af); Bir'ensa (Or)	F, Fu, M, Mc, Mi	Stem (wood); bark	Tool handles, household utensils (mortars and pestles, spoons, tongs, etc.), farm implements, smoke bath of clothes and women's body body for good scent (Eritole (Af); Bukbuka (Or)) and bark smoking to flavor milking utensils (Ayine (Af); Chocho (Or)) ; dye used as coloring the body
Trilepisium madagascariense DC.	Selaweta (Or)	T	Moraceae	Fu, Mc	Stem	Farm tools, household utensils, tool handles
Vernonia cinerascens Sch. Bip.	Asteraceae	S	File neme'a (Af); Kertatume (Or)	F, Fu, Mc	Stem & branches	To make cultural comb from a single stick

Withania somnifera (L.) Dunal	Solanaceae	H	Gerba ado (Af); Bale uru (Or)	F, M, Mc, Mi	Leaves & branches	Herding sticks
Ximenia americana L.	Olacaceae	T	Hudha (Or)	F, Fu, Fo, Mc	Stem	Household utensils, farm implements, tool handles
Ziziphus mucronata Willd.	Rhamnaceae	T	Kusir-a (-to) (Af); Kurkura hado (Or)	F, Fu, M, Fo, Mc, Mi	Stem; leaf & stem; leaf	Household utensils, farm implements, hunting tools (spear shafts); to wash & soften dead person's body*; coloring/soften hair *
Ziziphus spina-christi (L.) Desf.	Rhamnaceae	T	Kusir-a (-to) (Af); Kurkura (Or)	F, Fu, M, Fo, Mc, Mi	Stem; leaf & stem; leaf	Household utensils, farm implements, hunting tools (spear shafts) ;to wash & soften dead person's body*; coloring/soften hair*

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Forecasting of Load - Carrying Ability of The Earth file Around of Horizontal Cavities

By S.A.Piriyev
Baku State University

Abstract - The scattered destruction of a heavy half-plane with a circular hole under an operation of internal constant pressure is investigated. On a rectilinear side a border of the half-plane is under load. The Suvorov-Akhundov's theory on isotropic bodies' damage is used. In chosen final investigated area a numerical way of the solution is used and border conditions in infinity were transferred on it. Lateral pressure coefficient three values illustrations on time of development of the destroyed area are given.

Keywords : *Destruction, tunnels, deformation, stress.*

GJHSS-B Classification : *FOR Code: 160403, 160802*

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Forecasting of Load - Carrying Ability of The Earth file Around of Horizontal Cavities

S.A.Piriyev

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I. Introduction

Necessity of stressed and deformed state definition of soil mass around tunnels appears while making underground tunnels and metro lines as well. This is actual as for unfixed tunnel-mine working so as for fixed tunnel. Complexity of this problem is in amount of reological properties of soil variety, nonhomogeneousness, structural changes, particularly connected with destroying process and underground water presence. The bad that metro lines are put in the places where surface construction are presented, also complicates this issue. Calculation method of stressed state of one or two horizontal cylindrical cavities in the soil mass is offered in this research. The problem is solved for the case wish surface deformation taking in to account soil mass stratification, underground water presence, process formation and damage accumulation.

The contour of the cavity is effected by the given pressure. The presence construction on the surface is modified according to the given on it power-pressure system.

Numerical algorithm of stressed state calculation and its changeability in time has been developed.

Based this algorithm not only stressed state definition in the area around cavities tunnels appears, but searching of appearing and extending destroying zones as well (fig.1).

II. Preliminary Notes

$$\sigma_u + M^* \sigma_u = \sigma_M$$

Here σ_M *is instantaneous ultimate stress limit,* σ_u *is stress intensity*

III. Main Results

For illustrating the process in the figure below specific picture of extending destroying zones around cavities for homogeneous soil masses (○, ●, △ -the areas of consequent destroying) is given.

From numerical experiment the influence of the factors soil mass weight, its stratification, damage tunnel location according to surface construction, underground water and others on the process if tension redistribution in round-tunnel space has been identified. The given calculation method is used while projecting of Baku metropoliten constructing area. It gives us chance to predict long stable soil mass characteristic around put tunnel. The importance of the suggested method is that it is applicable for tunnels of small put at over-constructed area of tunnel pass existence.

a) Properties

i. *The main defining correlation are*

$$\sigma = 3K_0\varepsilon;\quad S_{ij} = 2G_0\Im_{ij};\ \sigma = \sigma_{ii};\quad \varepsilon = \varepsilon_{ii};\ S_{ij} = \sigma_{ij} - \frac{1}{3}\sigma\delta_{ij};\quad \Im_{ij} = \varepsilon_{ij} - \frac{1}{3}\varepsilon\delta_{ij}$$

Here $\Im_{ij}$ and S_{ij} are strain and stress deviators respectively, G_0 and K_0 are instantaneous coefficient of elasticity, M^* and N^* are destruction operators of hereditary type.

$$\varepsilon_{ij} = \frac{1}{2G_0}(1+M^*)\sigma_{ij} + \frac{1}{3}\left\{\left(\frac{1}{3K_0} - \frac{1}{2G_0}\right) + \left(\frac{1}{3K_0}N^* - \frac{1}{2G_0}M^*\right)\right\}\sigma\delta_{ij} \qquad 1$$

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ii. *The criterion of failure will be*

$$\sigma_u + M^*\sigma_u = \sigma_M \qquad 2$$

Here σ_M is instantaneous ultimate stress limit, σ_u is stress intensity

$$\sigma_u = \sqrt{\sigma_{11}^2 + \sigma_{22}^2 + \sigma_{33}^2 - \sigma_{11}\sigma_{22} - \sigma_{11}\sigma_{33} - \sigma_{22}\sigma_{33} + 3\sigma_{12}^2} \qquad 3$$

i. *Since, the problem is a plane one then equations of motion will be will have the following form*

$$\begin{cases} \dfrac{\partial\sigma_{11}}{\partial x_1} + \dfrac{\partial\sigma_{12}}{\partial x_2} = 0 \\ \dfrac{\partial\sigma_{12}}{\partial x_1} + \dfrac{\partial\sigma_{22}}{\partial x_2} - \gamma = 0 \end{cases} \qquad 4$$

Here γ is specific gravity of rock.

Equations of deformation compatibility,

$$\frac{\partial^2\varepsilon_{11}}{\partial x_2^2} + \frac{\partial^2\varepsilon_{22}}{\partial x_1^2} = 2\frac{\partial^2\varepsilon_{12}}{\partial x_1\partial x_2} \qquad 5$$

The criteria were given by means of stresses, therefore we express the problem trough the stresses. For that, taking into account (1) and (5), we obtain the following system

$$\begin{cases} \dfrac{1}{2G_0}(1+M^*)\left(\dfrac{\partial^2\sigma_{11}}{\partial x_2^2} + \dfrac{\partial^2\sigma_{22}}{\partial x_1^2}\right) + \dfrac{1}{3}\left\{\left(\dfrac{1}{3K_0} + \dfrac{1}{2G_0}\right) + \dfrac{1}{2G_0}M^*\right\} * \\ * \left(\dfrac{\partial^2\sigma_{11}}{\partial x_2^2} + \dfrac{\partial^2\sigma_{22}}{\partial x_2^2} + \dfrac{\partial^2\sigma_{33}}{\partial x_2^2} + \dfrac{\partial^2\sigma_{11}}{\partial x_1^2} + \dfrac{\partial^2\sigma_{22}}{\partial x_1^2} + \dfrac{\partial^2\sigma_{33}}{\partial x_1^2}\right) = \dfrac{1}{G_0}(1+M^*)\dfrac{\partial^2\sigma_{12}}{\partial x_1\partial x_2} \\ \dfrac{1}{2G_0}(1+M^*)\sigma_{33} + \dfrac{1}{3}\left\{\left(\dfrac{1}{3K_0} - \dfrac{1}{2G_0}\right) + \left(\dfrac{1}{3K_0}N^* - \dfrac{1}{2G_0}M^*\right)\right\}(\sigma_{11} + \sigma_{22} + \sigma_{33}) = 0 \\ \dfrac{\partial\sigma_{11}}{\partial x_1} + \dfrac{\partial\sigma_{12}}{\partial x_2} = 0 \\ \dfrac{\partial\sigma_{12}}{\partial x_1} + \dfrac{\partial\sigma_{22}}{\partial x_2} - \gamma \end{cases} \qquad 6$$

This system of equations with equilibrium equation (6) forms by stress component an isolated system of equations. As was noted, in the system N^* and M^* are integral operators of hereditary type, characterizing failure process. Since the amount of failure formed by volumetric deformation significantly smaller than the amount of failures formed due to volumetric friction, $N^* = 0$.

Since forces on segment [a, b] of rectilinear domain of half-plane are taken uniformly distributed, and out of the

segment all forces are taken equal to zero, then here boundary conditions will be as following:

$$\sigma_{xy} = 0; \sigma_{yy} = -p; \quad y = H, a \le x \le b \qquad 7$$

Because of uniform distribution of forces inside of circle, the boundary conditions on the contour of aperture will be the following:

$$\sigma_{rr}\Big|_{r=R} = -q; \quad \sigma_{r\varphi}\Big|_{r=R} = 0 \qquad 8$$

At the point at infinity stress tends to the natural stress, i.e. on a heavy half-plane, where aperture is absent

$$\sigma_{ij} \longrightarrow \sigma_{ij}^{0};\ \ x^2 + y^2 \longrightarrow \infty \qquad 9$$

Here σ_{ij}^{0} are stress corresponding to initial natural state, where

$$\begin{cases} \sigma_{yy} = -\gamma(H - y) \\ \sigma_{xx} = -\lambda\gamma(H - y) \end{cases} \qquad 10$$

Here $\lambda\ (0 < \lambda < 1)$ is the construction coefficient, in elastic state $\lambda = \nu/(1-\nu)$, ν is Poisson coefficient.

Analytical solving of (6) is very difficult therefore here numerical method and finite net method were applied. For that we pass from infinite half-plane onto finite rectangle. Its incremental dimensions are defined during the numerical computations. Damaging operator is of the form,

$$M^{*}\sigma_{ij} = \sum_{k=1}^{n} \int_{t_k^-}^{t_k^+} M(t-\tau)\sigma_{ij}(\tau)d\tau + \int_{t_{n+1}^-}^{t} M(t-\tau)\sigma_{ij}(\tau)d\tau \qquad 11$$

$$\sigma_{u_r} - \sigma_{u_{r-1}} \qquad 12$$

IV. Labels of Figures and Tables

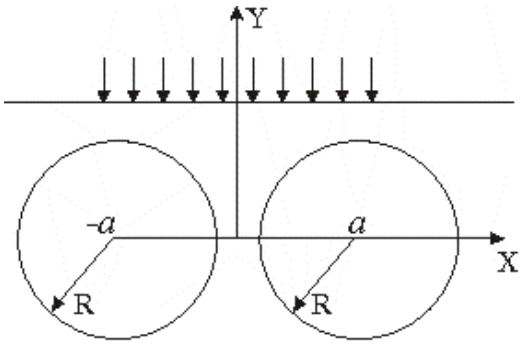

Figure 1

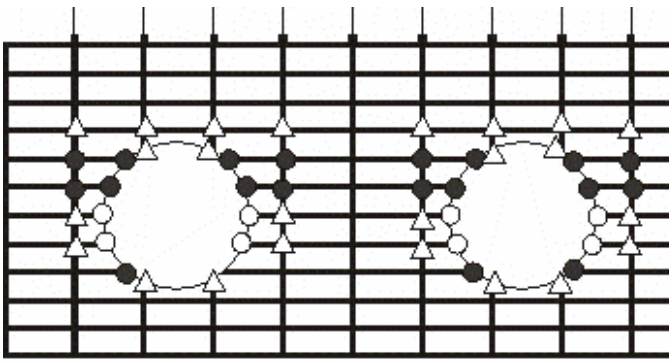

Figure 2.

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Agroforestry Practice as Adaptation Tools to Climate Change Hazards in Itu Lga, Akwa Ibom State,Nigeria

By Ekpo, F. E & Asuquo. M. E
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Abstract - Agriculture is the human enterprise that is most vulnerable to climate change. Tropical agriculture, particularly subsistence agriculture is particularly vulnerable, as smallholder farmers do not have adequate resources to adapt to climate change. While agroforestry may play a significant role in mitigating the atmospheric accumulation of greenhouse gases (GHG), it also has a role to play in helping smallholder farmers to adapt to climate change. A combination of participatory approaches including structured questionnaire, household survey, focus group discussions and field survey was conducted in Itu Local Government Area, Akwa Ibom State Nigeria. Climatic elements of rainfall, relative humidity and temperature were collected from Uyo Meteorological Station, Akwa Ibom for 30 years. The study was aimed at ascertaining changes in climate pattern and contribution of agroforestry to the adaptation in the study area. Rainfall shows a decreasing trend of -1.32mm/year. Temperature and relative humidity showed increasing trend of 0.6430C/ year and 0.13 percent year respectively.

Keywords : *Agroforestry, climate change, adaptation measures, rural farmers.*

GJHSS-B Classification : *FOR Code: 160802, 160401*

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Abstract - Agriculture is the human enterprise that is most vulnerable to climate change. Tropical agriculture, particularly subsistence agriculture is particularly vulnerable, as smallholder farmers do not have adequate resources to adapt to climate change. While agroforestry may play a significant role in mitigating the atmospheric accumulation of greenhouse gases (GHG), it also has a role to play in helping smallholder farmers to adapt to climate change. A combination of participatory approaches including structured questionnaire, household survey, focus group discussions and field survey was conducted in Itu Local Government Area, Akwa Ibom State Nigeria. Climatic elements of rainfall, relative humidity and temperature were collected from Uyo Meteorological Station, Akwa Ibom for 30 years. The study was aimed at ascertaining changes in climate pattern and contribution of agroforestry to the adaptation in the study area. Rainfall shows a decreasing trend of -1.32mm/year. Temperature and relative humidity showed increasing trend of 0.643^{0}C/ year and 0.13 percent year respectively. Major causes of climate change in the area are deforestation ,fossil fuel burning, land use system, pollution, population, military activities, and economic pressure that had (28%,20%, 15%,15%, 12%, 10% and 13% respectively). Impacts of climate identified by the respondents were longer distance to access water, firewood, poor crop yields, malnutrition loss of farm land, migration, difficulty in collecting forest product, food security and unemployment. Increase in soil nutrient, provision of shade to crops, erosion control, income generation and sources of vitamin were 63%, 54%, 44%, 55%, and 35% respectively. Thus, agroforestry offers the potential to develop synergies between efforts to mitigate climate change and efforts to help vulnerable farmers to adapt to the negative consequences of climate change.

Keywords : Agroforestry, climate change, adaptation measures, rural farmers.

I. Introduction

Developing countries are going to bear the brunt of climate change and suffer most from its negative impacts. Global conventions are not sufficiently effective to halt the increase of atmospheric greenhouse gases (GHGs) concentrations, and we now accept that the primary drivers of climate change are not going to stop. Mitigation efforts will therefore only provide a long term remedy to the effects of climate change. Local climates and terrestrial ecosystems will change, threatening biota and human livelihoods. Yet, even as climate changes, food and fiber production, environmental services and rural livelihoods must improve, and not just be maintained. The degradation in the developing world cannot be allowed to persist. Developing countries are faced with urgent needs for development, to improve food security, reduce poverty and provide an adequate standard of living for growing populations.

Large percentages of the populations of developing countries depend on rainfed agriculture for their livelihoods. Climate change is already affecting agriculture and other sources of livelihood in these countries and this situation is likely to worsen. Recent debates within the UNFCCC process on the relation between global adaptation and mitigation measures lack substance due to lack of pertinent experience on the ground. Discussions are often treated in a much generalized manner and are not specifically related to distinct sectors such as agriculture or forestry (IPCC, 2001). A practical understanding of the link between adaptation and mitigation measures does not yet exist. However, for some decades now agricultural research has been focusing on the questions of increasing the resilience (against drought, flood, erosion, fertility loss, etc.) and productivity of agricultural systems. Increasing system resilience is directly related to increasing the adaptive capacity of farmers.

Agroforestry provides a particular example of a set of innovative practices that are designed to enhance productivity in a way that often contributes to climate change mitigation through enhanced carbon sequestration, and that can also strengthen the system's ability to adapt to adverse impacts of changing climate conditions. This study looks into ascertaining the changes in some climatic regimes within Itu Local Government Area, Akwa Ibom State and explores sustainable agroforestry potentials that will enhance resilience and thereby reduce vulnerability of smallholder farmers in the study area

Itu Local Government Area, Akwa Ibom State is one of the Niger Delta states of Nigeria. The area is living in a low lying coastal region that is vulnerable to climate change impact. Climate-related hazards make agricultural activities of the area highly susceptible to climate -related extreme events such as

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floods, salinity intrusion from Atlantic Ocean, severe wind storms, soil erosion, river bank erosion and excessive rise in temperature. In recent times, the frequency of these events has become alarming (IPCC,2007). The livelihoods of the rural poor farmers are at high risk due to the extreme climatic induced events.

In the Niger Delta region of Nigeria, agriculture and fishing are the major occupations of the inhabitants. There have been reports of changes in the onset and cessation of annual rainfall in the area. Also prolong rainfall and temperatures are also noted to have increased over the years. The changes in the pattern and quantity of rainfall as well as other climate parameters such as temperature, wind storm and relative humidity will no doubt impact on the lives of farmers and other vulnerable groups in the area. This makes the zone vulnerable to inter-annual climate variability and climate change. Also the degradation of the area as a result of oil exploration, exploitation and gas flaring has been known to lowering crop yields in this zone (IPCC,2001). Given the fundamental role of agriculture in this zone, concern has been expressed nationally and locally by scientists and government about the effect of climate change on crop production. Interest in this issue has motivated the need for this study in the Niger Delta zone of Nigeria.

Therefore the study is expected to unveil the pattern of changes in climatic parameters and the importance of agroforestry system in adapting to effect of climate change in the area.

II. Materials And Methods

The study used both primary and secondary data. The primary data were obtained using In-depth Interview, Focus Group Discussion and Questionnaire administered to the farmers in the study area on the used of agroforestry as adapting tools to climate change hazards. Information on the communities and climatic conditions in the area were obtained from heads of communities, community chiefs, women leaders, elders and other opinion leaders that have been living in the place for the past 30 years. The questionnaires were structured to elicit much information as possible on the climate-related extreme events; these included previous studies on all possible impacts of climate change, identifying particularly vulnerable area and capacity building which may be taken to prepare for adaptation to climatic hazards in the area.

Secondary data were collected from Meteorological Station (NIMET) Uyo, Akwa Ibom (Station Number 050705B), Agricultural Development Programme, Cross River Basin Authority.

The existing meteorological data were collected for 30 years on daily temperature (maximum and minimum), relative humidity, and daily rainfall. The data were analyzed to ascertain the pattern of these parameters over the years.

III. Assessment of Farming Activities and Adaptation Measures

The parameters most affected by the impact on climate change were assessed. i.e. key climatic hazards in the area, the past and present status of season of planting, type of crops, time of flooding, income generation, chemical input, method of cropping, yield of crop per unit area, change in cropping system, changes in disease pattern affecting crops, changes in the number of farmers over years, income from farming, labour availability and alternative occupations

Adaptation in this study involves a process of adjusting in relation to the impact of climate change which includes ecological, social and economic adjustments in anticipation or actual changes in climatic conditions. The method used to assess adaptation measures in the area were structured questionnaires, in depth interviews and focus group discussion with the inhabitants of the area. The indices used in this assessment included identifying the alternative options that sustained their livelihood during climate disasters, coping measures to climate change events, and new technologies that can be introduced to remedy the situation.

IV. Methods of Data Analysis

Descriptive statistical presentations of the data (Seepersad and Henerson, 1984; Shepherd and Roger, 1991) were used to analyze data from questionnaires. Correlation analysis and analysis of variance (ANOVA) were used according to Steel and Torrie, (1980).

V. Result and Discussion

a) Pattern of climate change in the study area.

Statistical record of rainfall obtained in Uyo, Akwa Ibom State from 1979-2010 shows a decreasing trend with the highest amount of rainfall in 1979 and the lowest amount of rainfall in 1983 (Fig.1). The value of the highest volume of rainfall recorded in 1979 was 3373.7mm while the lowest recorded in 1983 was 1619.4mm. The mean and standard deviation of rainfall data in the area from 1979-2010 were 1876.475mm and 250.34mm respectively (Table.1). The trend coefficient was -1.32mm/year and implies that there is negative relationship in the amount rainfall from year to year. Also the value of coefficient correlation was 0.0587 which shows that there is positive relationship between amount of rainfall and time in the study area. The irregular pattern of the graph (Fig. 1) shows the uncertainties in the onset and the amount of rain in each year, also due to changes in rainfall characteristic in which early rains may not be sustained, crops planted at that time may

become smothered by heat waves resulted to loss of income to the farmers. NEST, (2000) predicted that climate change will pose serious threat to food security. This is because agriculture in the study area is highly dependent on rain and irrigation is seldom practiced. Changes in rainfall pattern will greatly affect agriculture in area, because the area is in a low lying coastal region, which that is vulnerable to climate –related hazards such as floods, salinity intrusion from Atlantic Ocean, severe wind storms, river bank erosion and excessive rise in temperature.

Data on temperature from 1979-2010 shows increasing trend with the maximum temperature (31.2 ^{0} C) recorded in 2006 and minimum temperature (25.9 ^{0} C) recorded in 1994 (Fig. 2). The mean value of temperature and its standard deviation over the period were 27.58 ^{0} C and 0.36 ^{0} C respectively. The trend coefficient was 0.119 ^{0} C/year, implying that there increase in the value of temperature from year to year. The coefficient correlation was 0.643 implying that there is positive relationship between temperature and time in the study area (Table 2). The effects of high temperature on crop yield is poor, spread of diseases and pest, increase in evapotranspiration and reduces productivity of the farms resulted in low income.

Relative humidity data from 1980-2010 showed an increasing trend with its highest value for the period (84.4 %) recorded in 2006 and lowest value (71.3%) recorded in 1998 (Fig.3) The mean and standard deviation values of relative humidity over the period are 72.8 and 2.87 percent implying that relative humidity has a narrow variability with time. The trend coefficient is 0.1308 percent per year confirming an increasing trend of relative humidity and is statistically significant. The coefficient of correlation has a value of 0.201 showing a strong relationship between relative humidity and time. The high relative humidity (RH) directly influences the water relations of plant and indirectly affects leaf growth, photosynthesis, pollination, occurrence of diseases and finally economic yield. The dryness of the atmosphere reduces dry matter production through stomatal control and leaf water potential. Smith, (2004) reported that turgor pressure is high under RH due to less transpiration. Thus high relative humidity enhance leaf enlargement. Also, incidence of insect pests and diseases is high under high humidity conditions, and high relative humidity favours easy germination of fungal spores on plant leaves. Ekpo, (2004) observed that the blight diseases of potato and tea spread more rapidly under humid conditions, and several insects such as aphids and jassids thrive better under moist conditions. However, effect of high values of relative humidity : results reduced evapotranspiration; increased heat load of plants; stomatal closure ; reduced CO_2 uptake and reduced transpiration which influences translocation of food materials and nutrients

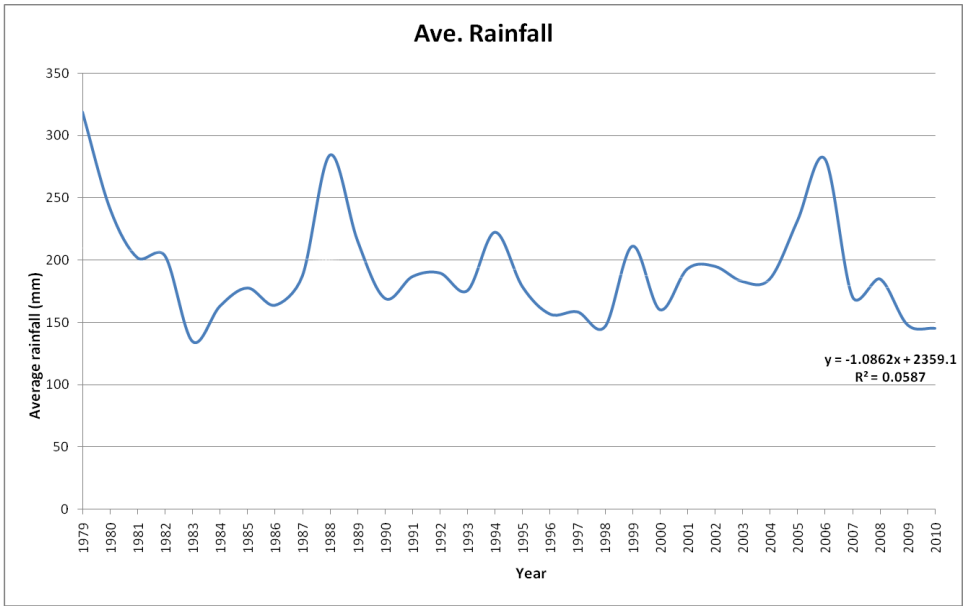

Figure 1 : Trend of rainfall data in Uyo, Akwa Ibom State of Nigeria from 1979-2010

Table 1: Analysis of rainfall data from 1979-2010

Rainfall	Value
Mean (mm)	1876.475
Standard deviation (mm)	250.34
Maximum rainfall (mm)	3815.1
Minimum rainfall (mm)	1619.4
Trend (mm/year)	-1.0862
Correlation	0.0587

Source : Department of Meteorological Services, Station Number 050705B, Nigeria. Computer SPSS result.

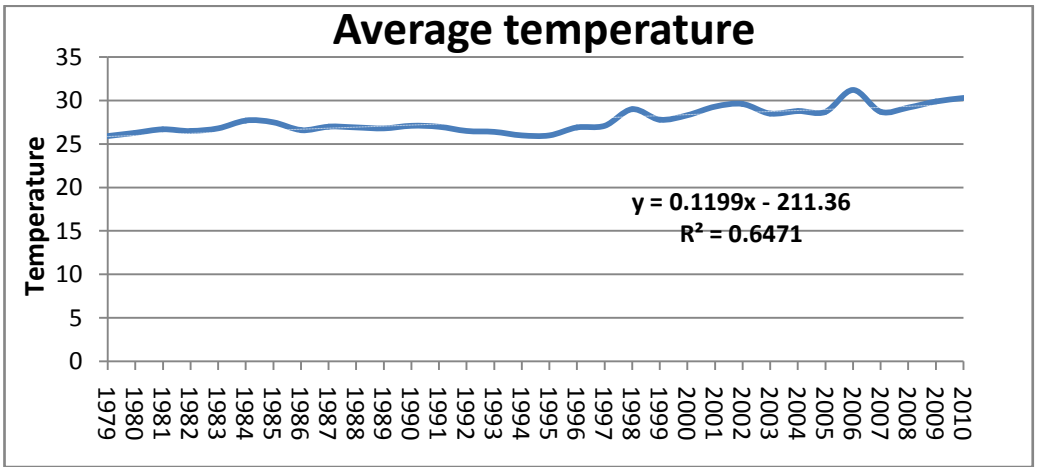

Figure 2 : Trend of temperature data in Uyo, Akwa Ibom State of Nigeria from 1979-2010

Table 2 : Analysis of temperature record from 1979-2010 in Uyo, Akwa Ibom State.

Temperature	Value
Mean (^{0}C)	27.58
Standard deviation	0.36
Maximum Temperature (^{0}C)	31.2
Minimum Temperature (^{0}C)	25.9
Trend (^{0}C)/year)	0.1199^{xxx}
Correlation	0.6471^{xxx}

^{xxx} Significant at 0.05% level

Source : Department of Meteorological Services, Station Number 050705B, Nigeria. Computer SPSS result

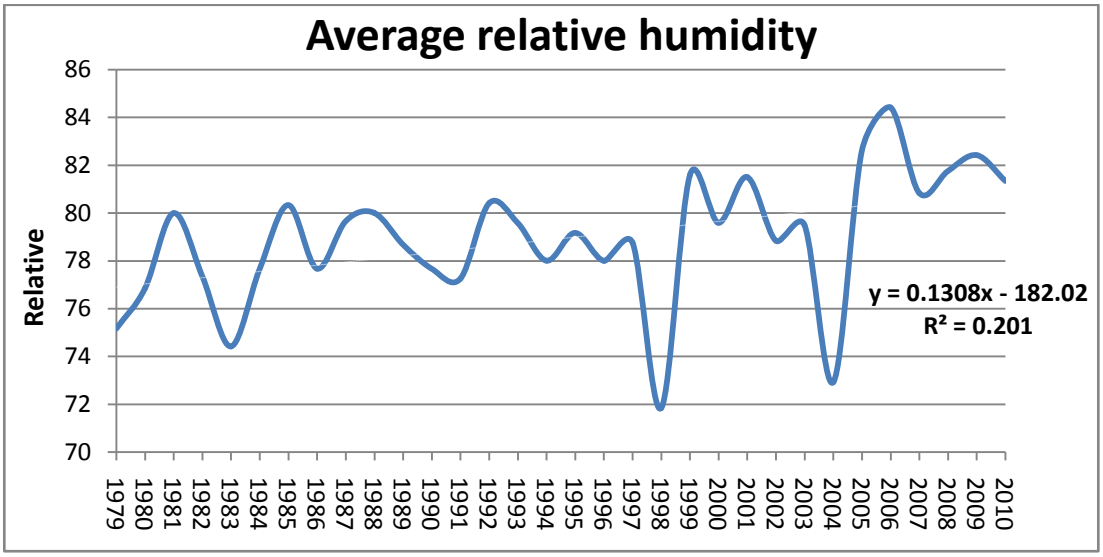

Figure 3 : Trend of relative humidity data in Uyo, Akwa Ibom State of Nigeria from 1979-2010.

Table 3 : Analysis of Relative Humidity record from 1979-2010 in Uyo, Akwa Ibom State.

Relative humidity	Value
Mean (%)	72.81
Standard deviation	2.87
Maximum Relative humidity (%)	84.4
Minimum Relative humidity (%)	71.3
Trend (%/year)	0.1308[xxx]
Correlation	0.201[xxx]

[xxx] *Significant at 0.05% level*

Source: Department of Meteorological Services, Station Number 050705B, Nigeria. Computer SPSS result

VI. Key Climate Change Hazards in The Study Area

Flooding had the highest percentage of 53.2 percent and was rated as the most prevalent climate change hazards in the communities within the study area by the respondents.(Fig.4). Soil erosion and river bank erosion was 48.4 and 42 .1 percent respectively. Severe wind storm and rise in temperature had 33.2 and 27.4 percent respectively. Also salinity intrusion into fresh water from Atlantic Ocean was recorded 20,2 percent. Analysis of rainfall pattern of the study area over a period of 30 years indicated a higher intensity of rainfall particularly within the wet months (May-October). Ebong (2000) had reported incidents of heavy flooding in Itu community between the years of 1991-2000. Respondents during IDI exercise complained the flooding has become annual occurrences which affect the livelihood of the people. The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) reported that increasing greenhouse gas concentrations have a detectable effect on earth's climate system, including increase in global-mean sea level (IPCC, 2007). An increase in temperatures would raise sea level by expanding ocean water and melting glaciers. Sea level rise is increasing the susceptibility of communities in Itu and their ecosystems through the permanent inundation of the area. Ultimately, this may lead to the displacement of millions of people, significant damage to property and infrastructure, and a considerable loss of coastal ecosystems in the study area.

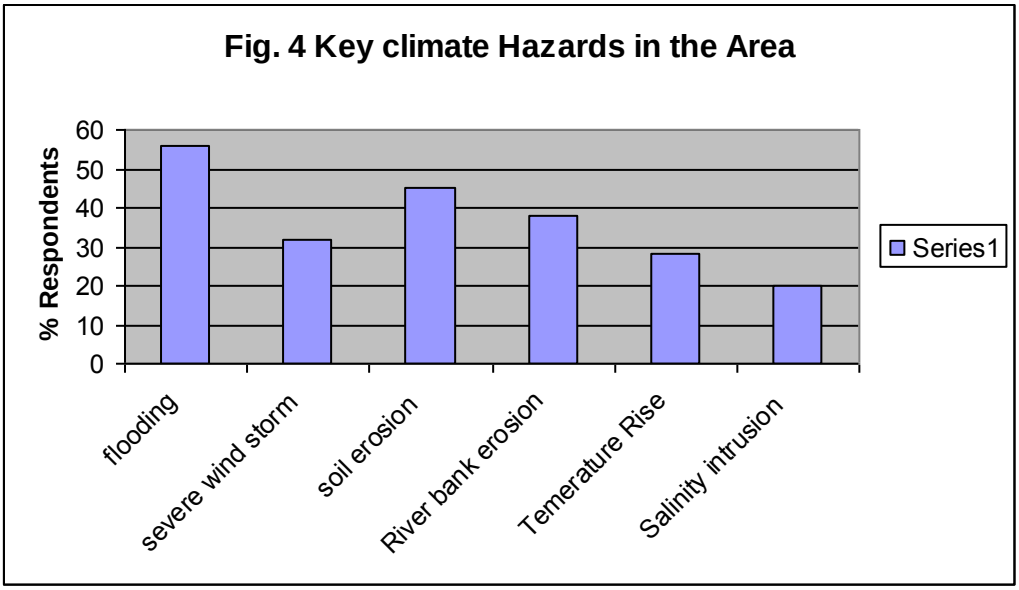

Table 4 : Consequences of climate change hazards on farmers in the area.

Consequences of climate change hazards on farmers	Percentage of respondents affected
Longer distance to access water	36.80
Longer distance to access fuel wood	29.40
Reduction in farming and other economic activities	37.50
Low output from farming and other economic activities	40.50
Low income from sales of farm produce and other economic activities	42.70
Malnutrition	51.30
Drop outs from school as a result of school fees and other cost of children	27.10
Homeless	32.30
Loss of farm land	34.20
Increasing unemployment	36.70
Migration	13.40
Difficulty in collecting forest foods	23.50
Food security	48.30
Erosion	35.50

VII. Agroforestry as Adaptation Tools To Climate Change Hazards

a) Importance of agroforestry in combating climate change hazards

Agroforestry options may provide a means for diversifying production systems and increasing the sustainability of smallholder farming systems in Itu Local Government Area of Akwa Ibom State, Nigeria. The most worrisome component of climate change in the study area is increased interannual variability of rainfall and temperature. Agroforestry systems have some advantages for maintaining production during wetter and drier years. First, their deep root systems are able to explore a larger soil volume for water and nutrients, which will help during dry season. Second, increased soil porosity, reduced runoff and increased soil cover lead to increased water infiltration and retention in the soil profile which can reduce moisture stress during low rainfall years. Third, agroforestry systems have higher evapotranspiration rates than row crops or pastures and can thus maintain aerated soil conditions by pumping excess water out of the soil profile more rapidly than other production systems (Dhillon *et al.*, 2009, 2010). Finally, agroforestry systems often produce crops of higher value. Thus, diversifying the livelihood activities of farmers to include tree component which may buffer against income risks during extreme weather events.

The contribution of agroforestry in buffering against climate variability in a degraded land has been

reported to enhance the yield of crops (Rani *et al.*, 2011). These systems greatly improve crop yields on degraded soils where nitrogen is limited (Henderson and Jose, 2010). Also agroforestry systems are highly valued by farmers because economic yields from marketable tree products compensate for the loss of crop yield. In Kenya and India, farmers have developed an intensive agroforestry system using the fast-growing indigenous species *Melia volkensii* and *Populus deltoide*, which is reputed to be highly compatible with crops and can provide high value timber in 5–10 years (Stewart and Blomley 1994 ; Dogra et al., 2007 and Chauhan *et al.*, 2010a).

b) improve soil nutrient

Agroforestry practice improve soil nutrient that have been washed by erosion or flooding in the area. This is because nutrient deficiency is one of the major characteristics that affect farm yield. Climate-related hazards can either improve the nutrient status or increase the degradation of the soil fertility (Scherer, 1999). Young (1986) observed that sustainable agroforestry practice in any farming community will increase or at least maintain the organic content matter levels of the soil. Tree components of any agroforestry species perform one major function in controlling erosion; the trees may act as barriers or as cover (Gupta *et al.*, 2006). The barrier function is the conventional approach to erosion control by checking runoff of water and suspended sediment. The cover function involves reducing raindrop impact and runoff by increasing soil cover, with living or dead plant materials. Therefore, agroforestry systems have a significant influence on soil erosion in the study area. This agree with the work of Akpan (2000) who reported that crown cover of some forest trees reduced the intensity of rain water in the soil thereby, reducing the impact of washing the organic matter in the forest soil.

Also tree canopy shade alters soil conditions to promote microbial activity and the rate of soil mineralization (Martius *et al.*, 2004, *Yadav et al.*, 2011) and carbon sequestration (Takimoto *et al.*, 2009 and Chauhan *et al.*, 2010b,2011). This influence is important in agricultural areas where the soil nitrogen level is a limitation to crops or pasture growth.

c) Source of food and vitamin

With the increasing awareness among nutrition experts that the fruits and vegetable improved vitamin A status. Agroforestry system provides the poor farmers with fruits and vegetable in the study area. Also agrosilvopastoral practices that include the incorporation of a wide range of livestock in the area may reduce the vulnerability to climate change hazards in the area. This system produces substantial amounts of meat and related income per year (Asare,2000). Generally, agroforestry system in the study area incorporate sheep, goat, rabbit and chickens. However, the incorporation of animals in the agroforestry system is a clear indication of the vital role the livestock play in the rural household economy and will enhance the livelihoods of poor farmers during extreme related climate events in Akwa Ibom State.

Agroforestry is believed to be dependable source of improved nutrition and provide additional income to households. Mitchell and Hanstad (2004) stated that income from agroforestry significantly improves the family financial status in many parts of the world; justifying the revenue generating potential of agroforestry. Okeke (1999) asserted that it is a common misconception that agroforestry is exclusively subsistence-oriented, whereas, it provide households with cash crops as well as food crops. Marsh (1998) also noted that economic returns to land and labour are often higher for agroforestry practices than any other system of agriculture. Incomes from agroforestry could be generated in several ways. Households may sell products in their farm including fruits, vegetables, animal products and other valuable materials such as bamboo and wood for construction or fuel. According to Okigbo (1990), livestock and tree crops produced in agroforestry in Southern Nigeria accounted for 60% of family cash income.

d) Soil and land management

Climate change adaptation for agricultural cropping systems requires a higher resilience against both excess of water (due to high intensity rainfall) and lack of water (due to extended drought periods). A key element to respond to both problems is soil organic matter, which improves and stabilizes the soil structure so that the soils can absorb higher amounts of water without causing surface run- off, which could result in soil erosion. Soil organic matter also improves the water absorption capacity of the soil during extended drought. FAO (2000) promotes low tillage and maintenance of permanent soil cover that can increase soil organic matter and reduce impacts from flooding, erosion, drought, heavy rain and winds. Intensive soil tillage reduces soil organic matter through aerobic mineralization, low tillage and the maintenance of a permanent soil cover (through crop residues or cover crops and the introduction of diversified crop rotations) increases soil organic matter (Young, 1986). A no- or low-tilled soil conserves the structure of soil for fauna and related macrospores (earthworms, termites and root channels) to serve as drainage channels for excess water. Udofia (2010), observed that surface mulch cover protects soil from excess temperatures and evaporation losses and can reduce crop water requirements by 30 percent. With the increasing trend of temperature from the result (Figure 2) the trees leaves will protects the crops from high temperature and also prevent evaporation loss.

VIII. Enhancing Adaptive Capacity Through Agroforestry

The effects of different agroforestry techniques in enhancing the resilience of agricultural systems against adverse impacts of rainfall variability, shifting weather patterns, reduced water availability, soil erosion as well as pests, diseases and weeds has been well tested. Much of this knowledge is relevant for mainstreaming adaptation measures to climate change into the agricultural sector. The role of agroforestry in reducing the vulnerability of agricultural systems and improve the livelihood of rural communities to climate change or climate variability is strongly emphasized (Akpan, 2000).

Rainfall variability is a major cause of vulnerability in many areas of the tropics, especially in the Niger Delta of Nigeria. However, its effects are often exacerbated by local environmental degradation and oil exploration and exploitation. In reality, vulnerability in many of these fragile ecosystems is often the result of a degenerative process due a combination of factors (deforestation, continuous cropping and changing in land use system), which, when associated with extreme climate, represents a major setback for agricultural and economic development. Therefore, curbing land degradation can play an important role in mitigating the negative impacts of climate change/variability, and that is where agroforestry can be a relevant. A successful and well-managed integration of trees on farms and in agricultural landscapes inevitably results in diversified and sustainable crop production, in addition to providing a wide range of environmental benefits. Systems such as hedgerow intercropping and boundary plantings are effective in protecting soils from erosion and restoring some fertility in degraded lands. In western Kenya, the World Agroforestry Centre, in collaboration with the Institute Recherche pour le Développement (IRD) and Kenyan National Agricultural Research Services, has tested the potential of improved fallow for controlling soil erosion, using fast growing shrubs such as *Crotalaria grahamiana* and *Tephrosia spp*. These species showed great promise in reducing soil losses (Singh, 2001).

Improved infiltration of water, while reducing runoff and transportation of sediments, also has a direct effect on water storage in the soil. Studies on water dynamics in a maize field in Northern Nigeria showed that, after a rainfall event, soil moisture accumulates much faster under improved fallow than under maize crop and natural fallow. In addition, the improvement of the soil structure and the soil organic matter allows the water to be stored much longer in the improved systems than in the continuous maize during a dry period. The implication is tremendous from an agronomic point of view. If rainfall is scarce, then crops that follow an improved fallow are likely to have a better water supply than those which follow another crop. Therefore, optimizing the use of increasingly scarce rainwater through agroforestry practices such as improved fallow could be one effective way of improving the adaptive capacity of systems to climate change.

Pests, diseases and weeds already stand as major obstacles to crop production in many tropical agro-ecosystems and there are strong reasons to believe that their prevalence and their deleterious effects on crops may increase with a warmer climate. It is strongly believed, yet not sufficiently tested, that enhancing plant biodiversity and mixing tree and herbaceous species in agricultural landscapes can produce positive interactions that could contribute to controlling pest and disease outbreak. Weeds are one of the most serious limiting factors to tropical agriculture and their control has been beyond the capacities of many smallholder farmers (Akobundu, 1991; Akobundu, 1993). Following climate change scenarios weed pressure can be expected to become more serious in most parts of Africa. The most obvious mechanism of weed control through trees in agricultural systems is through competition for light (shading effect), water and nutrients (Impala, 2001). But there are other specific processes such as allelopathy, which have also been described in some of fallow trees (Gallagher *et al*., 1999). In addition, some agroforestry trees are known to act as trap crops triggering the germination of the weed seeds without being suitable hosts. For example, *Sesbania sesban*, and *Leucaena diversifolia* have shown good potential in controlling *Striga hermonthica*, a parasitic weed that plague many cereal production systems in Africa (Oswald *et al*., 1996).

IX. Conclusion

Agroforestry system serves as the immediate and nearest source of food during hungry periods. Fruits, nuts and root crops from farm areas produced during the main crop off-season add to the household's nutrition. Animals raised in the backyard provide the meat requirement of the family. Agroforestry is an essential part of the effort to feed the hungry people in the rural area Home gardens in Kerala, India are best examples for meeting the multifarious requirements of the farmers through integrated system (Kumar, 2006). While agroforestry efforts cannot substantially alter the social, economic and political factors that cause food supply inequalities, they can help build up the household food security. Also, agroforestry can contribute to increasing the resilience of tropical farming systems and reduce climate change hazards. Thus, agroforestry has the potential to contribute to adaptation to climate change and climate variability in the area.

Potential impacts of agroforestry to the farmers include:

- Reducing poverty through increased production of agroforestry products for home consumption and sale;
- Contributing to food security by restoring farm soil fertility for food crops and production of fruits, nuts and edible oils;
- Reducing deforestation and pressure on woodlands by providing fuelwood grown on farms;
- Increasing diversity of on-farm tree crops and tree cover to buffer farmers against the effects of global climate change and
- Improving nutrition to lessen the impacts of hunger and chronic illness associated with climate change.

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Comparative Study of Urban Area Extension and flood Risk in Dhaka City of Bangladesh

By Md. Abu Taleb
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Abstract - Dhaka, the capital of Bangladesh could be the best illustration of human activities and associated environmental change. The capital Dhaka expanded rapidly between 1960 and 2005 built up areas increased approximately 15,924 ha, while agricultural land decreased 7,614 ha, vegetation decreased 2,336 ha, wetland /lowland decreased 6,385 ha, and water bodies decreased about 864 ha. The amount of urban land increased from 11% (in 1960) to 34% (in 2005). Historically, the direction of urban expansion of Dhaka has greatly been constrained by the low elevation of lands, surrounding rivers and risk of flooding also geomorphologic and hydrologically Dhaka city are greatly vulnerable to seasonal inundations. The present paper discusses comparative analysis of urban growth and flood risk in newly buildup urban areas of Dhaka, Bangladesh. Both primary and secondary data have been used in the present research. This study suggested comprehensive measures including structural and non structural measures that will be included a number of flood control and mitigation programs as well as alternative valuable resources for urban planners and decision makers to devise sustainable land use and environmental planning.

Index Terms : *Urbanization, Flood Risk, Geomor- phology, Hydrology.*

GJHSS-B Classification : *FOR Code: 160802 ,160810*

Strictly as per the compliance and regulations of:

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I. Introduction

Geographically Dhaka is located between 23° 58´ and 23° 90´ North latitudes and 90° 33´ and 90° 50´. East longitudes, topographically, the area is a flat land and is located mainly on an alluvial terrace, popularly known as the Modhupur terrace of the Pleistocene period [1]. Dhaka is surrounded by four major river systems, namely the Buriganga, Turag, Tongi and Balu, which are flowing to the south, west, north and east sides, respectively. Dewan and Yamaguchi (2008), [2] found their study that Dhaka expanded rapidly between 1960 and 2005, the amount of urban land increased from 11% (in 1960) to 34% (in 2005). The surface elevation of the area Dhaka are ranges between 1 and 14 m and most of the built up areas located at the elevations of 6-8 m [3]. The previous study about Dhaka city considering the hydrological aspects found that the surrounding rivers like the Buriganga, Turag, Tongi and Balu,(Fig-1) are mainly fed by local rainfalls and also receive spills from three mighty rivers crisscrossing the country, namely the Ganges, Brahmamaputra and Meghna through their tributaries and distributaries in the monsoon. In terms of geomorphologically, hydrologically and socio-economically the newly built-up northeastern parts of Dhaka city are greatly vulnerable to seasonal inundations.

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II. Materials & Methods

Both primary and secondary data have been used in the present research. Composition of the total inundated area and extended urban areas has been made on the basis of some recent satellite imageries, old and new city flood maps that exhibit the flood situation of Dhaka City, as well as ground survey and observations. Furthermore an elaborate questionnaire designed for the purpose of gathering information related to urban growth and historical flood hazard in Dhaka city of Bangladesh. The secondary information sources were various organizations such as Rajdhani Unnayan Kartripakhya (RAJUK), Bangladesh Water Development Board (BWDB), Disaster Management Bureau (DMB), Ministry of Water Resource, Bangladesh Bureau of Statistics (BBS), Institute of Water and Flood Management (IWFM), Department of Water Resource Engineering (WRE) of Bangladesh University of Engineering and Technology (BUET) and Dept. of Geography and Environment of Dhaka University, Institute of Water Modeling (IWM), Different Journals, Articles, published and unpublished research papers etc.

III. Objectives

The following are the specific objectives of the study;

1. To examine the urbanization trend in Dhaka City of Bangladesh;
2. To investigate the flood risk in the surrounding area of Dhaka;

IV. Results & Discussion

a) Urbanization trend of Dhaka City of Bangladesh:

The urbanization of Dhaka started from the banks of the Buriganga river. Dhaka became one of the biggest cities of this region after the arrival of British. The British rural initially expanded the city up to Palashi where they built a garrison of the company army. It also became a communication hub. At 1801, Dhaka was a city with 200,000 people. But the population decreased

due to the destruction of the Cottage Industries of Dhaka. Moreover the establishment of small industries made Dhaka more important. After the independence of Bangladesh on December 16, 1971, the city's population raised suddenly to 1403000 in 1974 [5]. The interpretation of the 2003 and 2005 land cover maps are indicated that Dhaka is being started to expand in all directions, specifically to north-east, south-east and southern trends by filling up low lying areas. Dhaka is expanding apace, at an average rate of 4.24% yearly projected to be the third largest mega city in the world by the year 2020 (World Bank).In order to lessen the flood susceptibility, earth filling is a very popular means of land development in Dhaka Metropolitan [5]. The earlier direction of the built up land was followed by north, north-west, and west trends, but the current trend shows a horizontal expansion [2].

b) Level of Urbanization:

Urbanization refers to the proportion of a nation's population living in the urban areas. Its demographic meaning emphasizes largely on only two variables, population and location. The demographic approach focuses on location but it largely ignores individual behavior and the structure of occupations, in its most concise from it postulates that urbanization is a process of population concentration. Urbanization is indicated by an increase in urbanization over a period of time. For example, in 1981 the total population of Merul Badda one of extended urban area of Dhaka city was 32,120 and the urban population was 110 million [5].

Hence $Un_{81} = 110/32,120*10$

The degree or level of Urbanization may be denoted as,

$U_n = (U_p/T_p)*100;$

Where U_n: level of urbanization

U_p: Total urban population

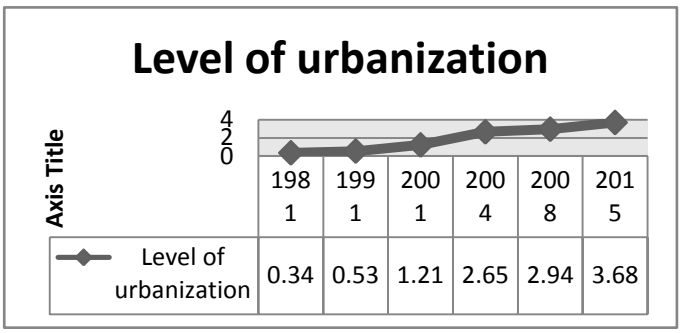
T_p: Total population 0=0.34%

Table 1 : Level of Urbanization of Merul Badda one of newly built-up urban area of Dhaka.

Year	Total Population	Growth Rate	Total Urban Population	Level of Urbanization
1981	32,120	0.34	110	0.34
1991	45,000	0.83	240	0.53
2001	73,156	1.86	890	1.21
2004	76,615	2.45	1880	2.65
2008	85,032	2.74	2500	2.94
2015*	90,758	3.43	3340	3.68

*(*Projected) Source : BBS, 2004 and Field Survey, 2008.*

Figure 2 : Level of Urbanization of Merul Badda one of newly built-up urban area of Dhaka.



Source : BBS, 2004 and Field survey, 2008.

The study explains an upward trend line of changing pattern of the level of urbanization. The level of urbanization of the study area is increasing gradually. 6Changes in land use are the end result of a variety of forces that drive the millions of separate choices made by individuals and governments.

c) Flood Risk in Dhaka City of Bangladesh:

Regionally, the Dhaka is located in the central part of Bangladesh, and lies in the sub-tropical monsoon zone under the humid climatic condition. The city experiences about 2,000 mm annual rainfall, of which more than 80% occurs during the monsoon season [June-September].The city of Dhaka, especially its lower areas have been suffering from floods of varying magnitudes and nature. The extent of spread, depth, duration, frequency and overall nature of these floods are peculiar and greatly different from each other. Analysis of flood-data (i.e. hydrological reports) reveals that at least one eighth of total area of the city of Dhaka goes under water during a normal flood. However, during the time of some severe inundations (i.e. 1988 flood and 1998's) about two-thirds or more area of the city was submerged under the floodwater [6]. Normally, the ordinary floods or rain-fed inundations of the city stay for shorter period. However, in the low-lying areas

of the city it stays for longer duration. These normal monsoon floods of the city, like those of other low lying areas of the country, come slowly, rise gradually, stay for a few weeks and then recede slowly. But, some abnormal greater floods, which are becoming more prevalent currently in the city along with other parts of the country, occur and spread very fast and achieve abnormally higher or deeper depths. At the same time these floods stay for longer time in different parts of the city. For example, during the abnormal floods of 1954, 1955, 1970, 1974, 1987, 1988, [7], 1998 and 2004 flood water went well in to the heart of the city consecutively.

Figure 1: Present Drainage System in Dhaka city.

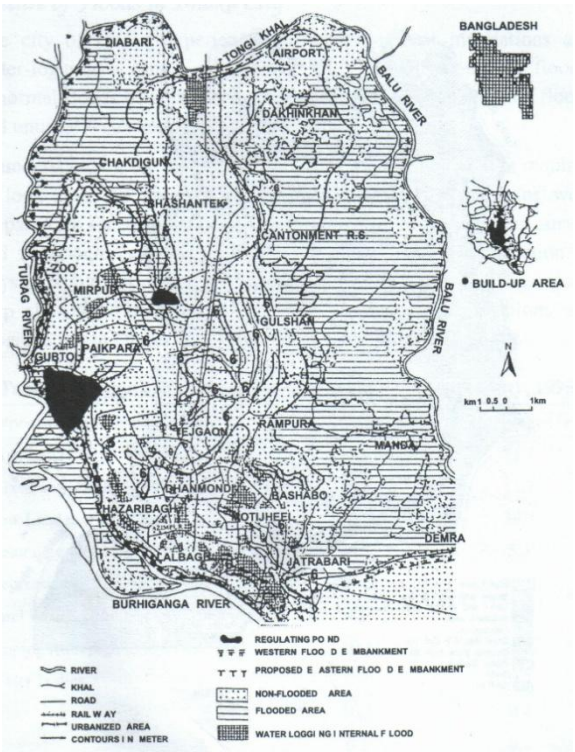


Figure 2 : Relationship between Flood (Normal) Land Elevation and Urbanization in Dhaka City.

d) Flooded Area:

The total flooded areas of normal flood in and around Dhaka City is found to cover about 25 sq. km or about 17 percent of the urbanized area where 42.78 percent of the submerged area is under low land with an elevation of 1.5 to 5m heights. These areas cover some parts of Dakshin Khan in the northeast, Barua, Khilkhet, Dumni, Bahatra, Kallyanpur, Baunia, Chak Digun, lower part of Mohammadpur, Joarsahara and Badda (Fig-2). During the severe floods of 1988, about 10 sq.km (11.75%) area of 6-13m elevation zone went under flood water in Dhaka City's urban area and 21.22 sq.km (29.67%) and 50.52 sq. km (33.93%) of 1.5-5 and 5-6m elevation zones were flooded respectively [6]. In total about 82 sq. km of about 66 percent of the area of the city was affected by this severe inundation of 1988. However, this was an unusual occurrence in the city.

e) Depth and Duration of Normal Flood in Dhaka City:

The maximum and average depth of normal flood in Dhaka city is 5.7m and 3.0m respectively (BWDB 1989 and Islam 1996). In some areas of the city the depths of floods sometimes are being controlled or influenced by the local construction situation. The minimum and average flood duration in Dhaka City is 12 and 32 days respectively [3]. On the other hand, the depth of flood of 1987 was 1,0m in Uttar Khan while it was comparatively higher in Baunia and Bailjuri with a height of about 3.9m in the same elevation. It varied from north to south and east to west. This depth of flood condition happened due to favorable sources of coming water in the river and various physiographic conditions in Dhaka city and its adjoining areas.

V. Key Factors of Flood Occuring in Dhaka City

a) Natural and Environmental Factors

1. About 60 percent of the city of low topography is criss-crossed by about 30 khals, which facilitates easy spread of flood water out of a total of about 300 sq. km area.
2. Only 110 sq. km of the built-up area is free from normal flood.
3. Synchronization of major river peaks and influences of those major rivers upon rivers Lakhya, Buriganga etc.
4. Heavy rainfall in upstream of the river Buriganga and Lakhya.
5. Tidal and wind effects on slowing down the river outflow (back water effect) of the river Buriganga.
6. Tectonic anomalies, such as- faults, lineaments etc. change the river flow/morphology, upliftments and subsidence of the land surfaces.
7. Changes in climatic condition of the region and increase in rainfall in the catchments of the rivers,
8. Silting up of the local rivers, bank erosion and land subsidence in some areas.

b) Human Interferences

1. Construction of unplanned roads, bridges, housing etc.
2. Flood embankments and dams.
3. Diversion structures, drainage congestion and choking up of the local urban drainage.
4. Indiscriminate earth fillings in the low-lying areas of the city.

VI. Conclusion

This study find out that, recent unplanned urban development in Dhaka city of Bangladesh have directly impact on drainage system of the city, from the above discussion it is evident that the low-lying areas of the City of Dhaka, especially its eastern and western buildup fringes are greatly vulnerable to seasonal inundations. The study further reveals that the spree of recent urban growth and the associated structural development have significantly been affecting the urban-inundations and drainage failure in the City. The process of ceaseless human interferences in the form of encroachment in the lowlands (i.e., bils, Jheels, Khals, etc.) of the City and unplanned construction of roads, building embankments etc. in different parts of the city are also affecting the hydrological situation of Dhaka City. In the recent views, the drainage failures and the resultant flooding and submersions of parts of the City have been gaining momentum. Constructions of flood protection embankment in Demra area (DND) and Kurmitola area have proven to be a partial failure in achieving maximum benefits. Only some appropriate integrated environment-friendly adjustment-oriented measures may bring some success in this respect. At the same time special attention need to be given to the facts that the normal natural settings i.e. morphological and hydrological situation of the City should not be disturbed in the process of urban-development. With this respect the endangered and extinct khals (channels) and, rivers and other existent important wetlands of the city should be preserved and saved for the sake of the smooth functioning of the City's choked and disturbed drainage system.

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The Challenges and Prospects of oil Companies Activities on Communities in Akwa Ibom State, Nigeria

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Abstract - The rising issues is what has happened to the impoverished communities in Eket Local Government Area whose livelihoods have been affected due to the activities of oil companies which is the backdrop of this work. However, Two communities were used namely Mkpanak, and Upenekang of which ninety three copies of questionnaire were randomly distributed to each of the community in order to captured the impact of the oil companies activities such as type of infrastructural development ,impact on the environment, nature of activities and companies by-products. The data collected were analyzed using the Pearson's product moment correlation. However, Findings show that even though the oil companies in the area have contributed significantly to the socio-economic wellbeing of the people through income generation, employment creation, provision of social amenities, their activities were not devoid of environment crises. These crises arises due to oil spills which in turn affect the soil nutrients, lost of aquatic life and mangroves.

Keywords : *Aquatic life, Devastated, Ecosystem, Environment, oil companies.*

GJHSS-B Classification : *FOR Code: 160605, 160810,160802, 160401*

Strictly as per the compliance and regulations of:

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Keywords : Aquatic life, Devastated, Ecosystem, Environment, oil companies.

I. Introduction

In recent times Nigeria is the leading producer of oil producing nation in Africa, it is ranks 11th in the world. Today, it is a major supplier of oil to Western Europe and the United States of America. According to World Bank, Nigeria is the giant in Africa with enviable resources. With over 100 million people, it is the most populous country in sub-Saharan Africa, and earns annual oil revenue of over $6 billion a year. Nigeria also has a huge reserve of natural gas, yet to be fully exploited. Yet instead of turning Nigeria into one of the prosperous states on the African continent, these natural resources have enriched a small minority while the vast majority has become increasingly impoverished: with a per capita gross national product of only U.S $260 a year, Nigeria is one of the poorest countries in the world. The poverty, instability and erosion of human dignity, which we see in Nigeria, besides other factors, are hugely as a result of corruption, greed and mismanagement. Oil is the bedrock of the Nigerian economy and the presence of this essential commodity in a technological age has attracted the presence of some multi-national oil companies into Nigeria. These multi-national companies like Royal Dutch/Shell, Exxon, Mobil, Chevron, Texaco, Total, Elf and Agip etc, go into every country with promises of a better life for the populace. They usually have only one thing in mind; making profit at whatever cost, even at the cost of the environment and human lives. Nigeria is an example of this situation. These multi-national companies have been aptly described as "modern day Gulliver on the rampage, waging an ecological war wherever they set down their oil rig. These multi-national, borderless corporations are oftentimes not accountable to any government and so are at liberty to violate human rights with impunity. The case of Exxon, Mobil activities in Eket Local Government Area of Akwa Ibom State since it started oil exploration in the area has proven this to be true. Ever since Exxon, Mobil drilling oil in communities such as Mkpanak and Upenekang life has been a living hell for the people as their activities have damaged the natural ecosystem which is the only source of their livelihood sustenance in the area

Beside, the activities of the oil companies have devastated the environment through oil and gas deposits which have extensively depleted the forests, abundant wildlife, mangroves and fertile agricultural land where rice, sugar cane, plantain, beans, palm oil, yams, cassava and timber hence living the people with no alternative source of livelihood. Apart from these ,their activities have not only caused degradation to the environment and destroyed the traditional livelihood of the region but have caused environmental pollution that has affected weather conditions, soil fertility, waterways aquatic habitats and wildlife. More so, majority of the inhabitants still live a rural, subsistent existence

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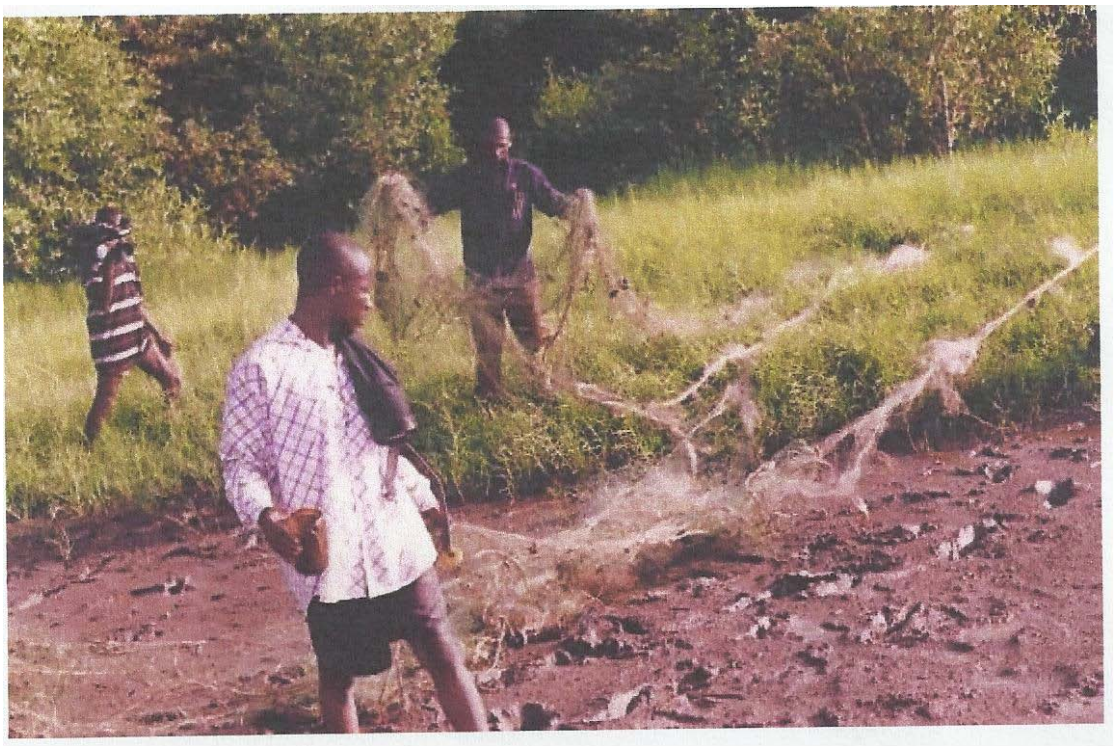
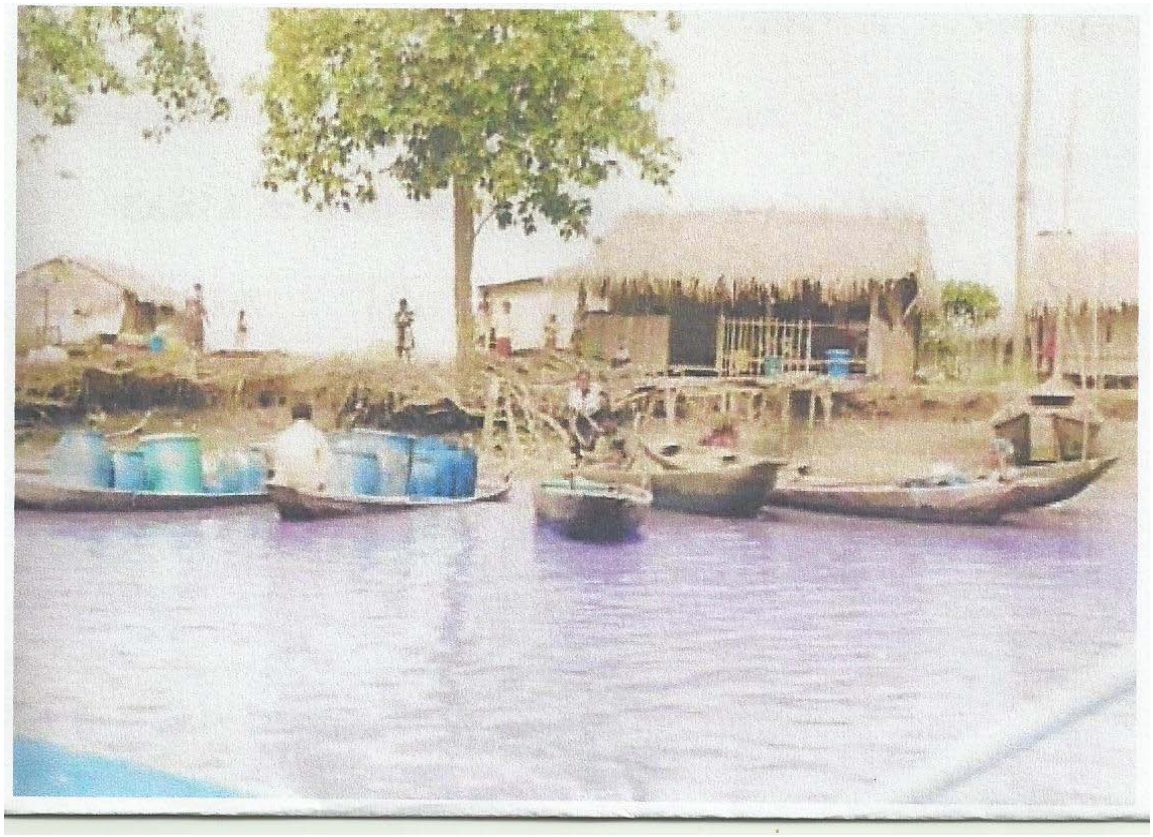
characterized by a total absence of basic facilities such as electricity, pip-borne water, hospital proper housing and motor able roads To this end one would ask if the oil companies in the area are really contributing to the livelihood of the inhabitants with specific reference to the challenges and prospects of oil company activities as regards communities benefits from oil company ,infrastructural development by the oil companies, Problems associated with their activities on the environment, activities of the companies and companies by-products

II. Study Area

This research was conducted in Akwa Ibom State taking into consideration Eket local Government Area. Two communities where used in Eket Local Government Area which include, Mkpanak and Upenekang. These are communities that the activities of the oil companies have devastated their natural ecosystem Howeve, 186 copies of questionnaires were distributed to the communities of which 93 were distributed in each of the communities using random sampling technique which allow every member of the community equal chance of being selected for this study. Information such as the benefits, oil companies' activities, by-product and infrastructural development from the companies were captured in the questionnaires. Nevertheless, the data collected was analyzed using the Pearson's Moment Correlationss which try to assessed whether or not a relationship exist between the companies by-product and impact on the area the result obtained was further validated by the use of student T test.



Impact of oil spillage on the natural ecosystem in Mkpanak.



Effect of oil pollution on the water ecosystem

Oil spill from company activity on the environment

III. Literature Review

a) Definition of development

Mabogunje (1981) views development as that which includes economic growth, modernization, distributive justice and socio-economic transformation. By the end of the early 1960s, development began to be seen not as only increasing the per capita income but more importantly, reducing the poverty level among the masses or, as it was better put, satisfying their basic needs Development and economic development have been used interchangeable mainly because much of development has to do with economic issues and then social/welfare matters. The assumption has always been that other aspects of development will not be very functional without and cannot be isolated from economic matters and vice versa. This establishes a give and take scenario; just as it is the case of increased real income per capita in relation to improvements in health and nutritional status, educational achievement, access to resources, a 'fairer' distribution of income and increase in basic freedoms. As stressed by Sada (1988), development goes beyond issues of per capita income and Gross National Product to include a socio-economic context which includes issues of human welfare. The socio-economic context of development implies modernization, "a process whereby a society is reoriented in its structure, institutions, values, and patterns of behaviour. Modernization is said to be a complex human relations as well as the generation and utilization of technological resources to change the quality of human life. Mabogunje (1988) also conceived development as distributive justice which comprises the nature of goods and services that government must provide; the need for goods to be accessible to all members of the society; and attempts at controlling, eliminating or sharing the burden of development usually referred to as "externalities". All these take place within the human environment.

b) Environment – The home of man

The word "environment" is traditionally defined as the total surrounding which includes natural and biological resources. However, with the current trend of sustainable development, the definition of the environment has been widened to include natural and human resources and their interactions with each other. The World Bank (1991), therefore defines the environment as the natural and social conditions surrounding all mankind and including future generations. Environment could be treated within the framework of natural human surrounding and activities, which include biophysical components and processes of natural environment of land, water and air. It also includes all layers in the atmosphere, inorganic and organic matters (both living and non-living), socio-economic components and processes of the human environment. These components and processes include social, economic, technological, administrative, cultural, historical, archaeological components and processes. Land and associated resources, structures, sites, human health, nutrition and safety are also inclusive (Emmanuel and Alakinde, 2006). In the above context, the environment is seen as the natural habitat of man with several components and within which series and various levels of activities and processes take place. These components and activities or processes, in most cases, reflect the level of development in the environment that needs to be protected in all ramifications. What is going on in the Niger Delta area of Nigeria is a clear demonstration of the fact that after 38 years of oil exploration in the Niger Delta, the natives have become poorer and less empowered, contrary to what one would have expected, judging from some cases of oil rich countries like Venezuela and Saudi Arabia, who have learnt how to manage the excess wealth generated by this lucrative commodity. The violence, poverty and environmental degradation which oil exploration has fostered in the Niger Delta is a clear violation of human dignity. Pope John XXIII makes it clear in the encyclical, *Pacem in Terris* that "human dignity is violated when there exist conditions that prevent access to adequate food, shelter and other goods, necessary for human 4 well being and flourishing. The poverty which structures of exploitation perpetuate is a threat to the dignity of the human person created in the image and likeness of God. Whatever will not allow human beings to live life to the full is a hindrance to human beings realizing their full potential as humans. We believe that oil as an essential commodity in this technological age, even though it has empowered many countries that possess it, has ended up impoverishing some countries like Nigeria, who cannot manage the enormous profit it generates as a result of corruption, selfishness and greed. In Nigeria in particular, some of the adverse effects of this lack of ability, or unwillingness to employ the profit from oil to the betterment of the living condition of the people is poverty, environmental degradation, and violence. These adverse consequences can be adequately challenged using the core principles of Catholic Social Teaching, namely, the dignity of the human person, and stewardship of creation. Made in God's image, all human life has inherent dignity which is the basis of fundamental human rights. We agree with Bill Ryan, that Catholic Social Teaching can and did have significant, if rarely determining, influence in shaping history in particular situations. It can also do same in the case of Nigeria. In fact, the principles of Catholic social teaching are in a better position to challenge the phenomenon of poverty, and environmental degradation because, "the

core values of Catholic social teaching are common and accepted, at least in principle, in all local churches-even if the living out of them leaves much to be desired…its core social values are found to some degree in all world religions."

Oil exploration in Nigeria is fostering inequality, injustice, and violence. This inequality exists among people living in the same country simply because the majority of the masses who have no access to the wealth generated by oil exploration and exportation, cannot compete with employees of oil companies who are paid better salaries. Hence the cost of living in oil producing states in Nigeria is higher because of the presence of oil companies and their employees. In the same country "while most Nigerians have been sliding into destitution, the political and economic elites of the country have grown ever richer- in most cases obscenely so."

Having lived in the Niger Delta area of Nigeria, I have witnessed firsthand the effect of poverty and its attendant erosion of human dignity. I was very often caught in the demonstrations and riots against oil companies like Shell and the Nigerian government, and still have friends and family, who still live in this part of Nigeria. In the face of all these I have come to the conclusion that there are alternatives. It offends God to see human beings created in his image wallow in abject squalor as a result of structures of sin, set up by fellow humans. Nigeria could become one of the richest countries in the world if only corruption and greed were eschewed and accountability embraced. Many countries have applied oil wealth to better use. Nigeria can do the same.

The history of the contact between multi-national oil companies and the natives of the Niger Delta, has been that of impoverishment and environmental degradation. This impoverishment affects more their eco-system, which is widely acclaimed as one of the best in the world. The struggle by the local communities of this area of Nigeria with the Nigerian government and oil companies for a fair share of the products of their land has transformed this once peaceful part of Nigeria into a violence-prone zone.

I believe that these negative consequences of oil exploration can be more effectively challenged using the principles of Catholic social teaching. Oil exploration in the Niger Delta over the years has perpetuated poverty and environmental degradation, which violate human dignity, and becomes an abuse of the mandate received from God to care for creation. Using the Bible and Magisterial texts we can critique effectively, the poverty and violence which oil exploration has fostered as these constitute a threat to 5 the dignity of the human person created in the image and likeness of God. Ecological disasters, as a result of reckless use of resources of the earth, are an abuse of the mandate give to human beings by God to subdue the earth. Humans are constituted stewards of creation, and so actions of some trans-national companies with the collaborations of some governments should be challenged, not just from the ecological point of view but also from a theological standpoint. The task of preserving the earth is not just for environmentalists, but is also a theological concern.

The church in Nigeria has no doubt been a voice for the voiceless and the conscience of the nation since independence in 1960. Following the example of the universal church, she has always taken the side of the poor in denouncing structures of oppression and injustice. Unfortunately she has done little or nothing in the case of ecological concerns especially as it affects the Niger Delta area of Nigeria. We call for an urgent response from the church in Nigeria with regard to ecological issues. The Gospel message should be liberative, especially in places like Nigeria where the faith is flourishing. *Evangelii Nuntiandi* makes the link between proclamation of the Gospel message and social liberation when it says that "the church has the duty of proclaiming the liberation of millions of human beings, many of whom are its spiritual children, the duty of aiding liberation at its start, of giving witness in its favor, and of accompanying its effects that it may be achieved. This is not apart from evangelization. belief that even though the faith is "flourishing" in Nigeria, the needed social transformation which should accompany this has not yet been achieved because here, the Bible is often given a spiritualized interpretation and only read for the nourishment of individual souls towards spiritual salvation and not in view of societal transformation. But Pope Paul V1 makes it clear in his address to the Diplomatic Corps on January 17, 1967 that "the church cannot remove herself from temporal affairs, because the temporal is the activity of men, and all that concerns the Church. A disembodied Church separated from the world, would no longer be the Church of Jesus Christ, the Church of the incarnate Word. The Church, on the contrary, interests herself closely in every generous endeavor which helps to set humanity on the road to heaven, but also in the search for well-being, for justice, for peace, for happiness on earth.

The church in Nigeria has on many occasions lived up to her calling as a force for social transformation. The Niger Delta area can benefit more from the prophetic voice of the Nigerian church.

IV. Findings

a) Community benefits from oil companies

The benefits of communities from the oil companies presented in table 1 show that 23.63% of the

communities benefited from oil companies through the building of hospitals. This result was shown in communities with 22.58% and 21.50% of the sampled population in Mkpanak agreeing that the oil companies in the area have contributed in the construction of hospitals and engagement of youth in training in the area. This result was evidenced in the sampled population of 24.73% and 20.43% in Upenekang agreeing that the major contribution of the oil companies in the area was the building of hospitals and provision of youth training. However, it was observed in Table1 that even though the oil companies provided hospitals and youth training they also provided 16.13% employment and 13.98% micro-credit to farmers and fishermen in Mkpanak community while 18.28% and12.09% of the sampled population in Upenekang also affirmed that employment and micro-credit was provided by the oil companies in the area

Table 1 : Communities benefits from oil company activities in the area.

Variables	mkpanak	percentage	Upenekang	Percentage	Percetage total
provision of scholarship	3	3.23	2	2.15	2.68
Provision of employment	15	16.13	17	18.28	17.20
Building of hospital	21	22.58	23	24.73	23.63
Training of the youths	20	21.50	19	20.43	20.97
Give micro credit	13	13.98	12	12.90	13.44
All of the above	17	18.28	18	19.35	18.82
None of the above	4	4.30	2	2.15	3.22
Total	93	100	93	100	100

Source : field work (2011).

b) Contributions of oil companies in Infrastructural development

The level of in infrastructural development from the oil companies presented in table 2 revealed that the provision of class room block was one of the major infrastructure provided by the oil companies in the area with a high values of Mkpanak 16.13% and Upenekang 17.27% followed by the provision of electricity with a values of Mkpanak 15.05% Upenekang 16.13%. It was noticed in table 2 that the oil companies provided seaports and airports in the two communities with Mkpanak having a values of seaports 11.83% airports 9.68%, Upenekang seaports 10.75% and airports 5.37% while the construction of hospitals was on the least side in terms of infrastructural development the two communities with values of Mkpanak 9.6% and Upenekang 9.14%. Nevertheless, table 2 indicate that the percentage total population sampled in the sampled communities show that both communities have benefited from the oil companies activities in the area through the construction of class room blocks with a high value of 17.20% compared to other variables. Although, 26.34% of the sampled population in the two communities agreed that all the aforementioned infrastructures were provided by the oil companies operating in the two communities

Table 2 : Infrastructural development by the oil companies.

Infrastructures	Mkpanak	Percentage	Upenekang	Percentage	Percentage total
Building of air port	9	9.68	5	5.37	7.52
Provision of electricity	14	15.05	15	16.13	15.55
Building of class room block	15	16.13	17	18.27	17.20
Road construction	11	7.52	13	13.07	12.90
Building of seaport	11	11.83	10	10.75	12.90
Building of hospital	9	9.67	8	8.6	9.14
All of the above	24	25.81	25	26.85	26.34
Total	93	100	93	100	100

Source : field work (2011).

c) Oil companies activities in the area

The oil companies activities shown in table 3 indicate that all the activities mentioned were undertaken by the oil companies in the area .However, it was noticed that 20.96 % and 14.50% of the sampled population agreed that drilling and servicing and maintenance were the major activities of the oil companies in the area. This result was also evidenced in an individual note as drilling in Mkpanak and Upenakang have a value of 20.43% and 21.50% while services and maintenance both have a value of 3.98.% and 15% respectively. Besides, it was observed in table 3 indicate that the oil companies in the area embarked on activities such as transportation and storage with values of 12.5% and 12.90% while administration and refining were on the least side with values of 0.1% and 6.45%.respectively

Table 3 : The oil companies activities.

Activities	Mkpanak	Percentage	Upenekang	Percentage	Percentage total
Drilling	19	20.43	20	21.58	20.90
Refining	7	7.53	5	5.37	6.45
Administration	10	10.75	11	11.82	0.1
Servicing/maintenance	13	13.98	14	15	14.51
Transportation	12	12.90	11	11.82	12.56
Storage	11	11,82	13	13.92	12.90
All of the above	21	22.58	19	20.40	21.50
Total93	93	100	93	100	100

Source : field work (2011).

d) Impact of oil companies activities in the area

The impact of oil companies in the area presented in table 4 revealed that 13.44% of the sampled population are of the opinion that the oil companies activities in the area has caused the migration and death of fishes followed by water pollution with a value of 10.75%. However, it was noticed that the oil companies activities also influenced the destruction of crops in the two communities with values 13.97% and 12.90% while corrosion of zinc and killing of mangroves were another impact generated by oil companies activities on the environment. Table 4 revealed that 23.65% of the sampled population agreed that all the aforementioned variables constitute the major impact of oil companies activities on the environment of Mkpanak and Upenekang communities in Eket Local Government Area of Akwa Ibom State

Table 3 : Impact of oil companies activities on the environment.

Env.effect	Mkpanak	Percentage	Upenekang	Percentage	Percentage total
Water pollution	19	20.43	20	21.50	10.75
Poor crop yield	13	13.97	12	12.90	6.45
Corrosion of zinc	12	18.28	10	10.75	5.37
excessive heat	7	7.53	6	6.45	3.22
lost of mangrove	9	9.68	9	9.67	4.83
Lost of fishes	12	12.90	13	13.97	13.44
All of the above	21	22.58	23	24.73	23.67
Total	93	100	93	100	93

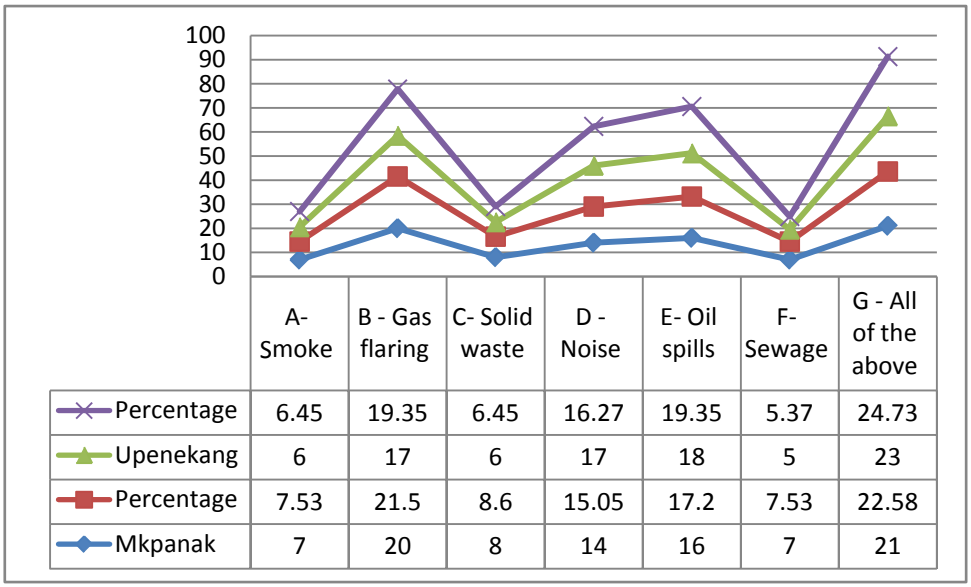
Source : field work (2011).

e) By- product of oil companies activities

The by- product from the oil companies presented in figure1 show that the major by- product produce by oil companies in the two communalities was gas flaring with a value of 20.43% followed by oil spills with a value of 18.27%. Although, it was observed in figure1 that noise pollution was another by-product produce by the oil companies with a high value of

16.66% and 6.45%respectively. This result was also observed in each of the community as gas flaring in Mkpanak had a value of 21.50%, Upenekang with a value of 19.35% while oil spills in Mkpanak had a value of 17.20% and Upenekang with a value of 19.35%. Nevertheless, 23.65% of the sampled population in the two communities attest to the fact that all the mentioned variables constitute the by- product of the oil companies in the area. However the data collected were analyzed and a correlation coefficient of 0.97 was obtained which show a high positive correlation coefficient and indicate that a strong positive relationship exist between the by-products in the area. This means that the by-products of oil companies played significant roles in environmental degradation in the area. Furthermore, a coefficient determination of 0.09409, which is otherwise seen as 94.09%, explains the fact that 94.09% of the bye-products of oil companies are related to the experienced environmental problems in the study area. More so, the student T test was used to test the validity of the data obtained and a calculation value of 4.91 was obtained with a table value of 2.57 at 5 degree of freedom in a two-tailed test at 0.05 level of significance .This result show that since the calculated value was greater than the table value, the null hypothesis was accept and the alternative hypothesis rejected. which show that the higher positive correlation did not occur by chance, thus, the bye-product of oil company activities has a significant effect on the environment.

Figure1 : By- product of oil companies activities.



	A- Smoke	B - Gas flaring	C- Solid waste	D - Noise	E- Oil spills	F- Sewage	G - All of the above
Percentage	6.45	19.35	6.45	16.27	19.35	5.37	24.73
Upenekang	6	17	6	17	18	5	23
Percentage	7.53	21.5	8.6	15.05	17.2	7.53	22.58
Mkpanak	7	20	8	14	16	7	21

Source : field work (2011).

V. Conclusion and Recommendations

Today, what is going on in the communities understudy show that the oil companies in these oil producing environment have impacted significantly on the community livelihood. However, the significant impact recorded by the oil companies in area were not devoid of environmental problems as a result of the company's activities. The data collected show that the oil companies in the area have contributed in socio-economic development of the area through infrastructural development and on the livelihood of the local communities through employment provision income generation and provision of micro-credit. However, the companies in the areas have also impacted negatively on the natural ecosystem through destruction of farmland, aquatic live and depletion of soil nutrients which affect crop yield in the area .It is on this note that one would wonder if the oil companies in the area are really protecting the natural ecosystem and also putting the communities livelihood into consideration. Therefore, the following recommendations are hereby put forward if the natural ecosystem and the communities livelihood must be maintained.

1. The government should provide adequate mechanism that would monitored the activities of the oil companies in the area.
2. The affected communities should be provided with an alternative livelihood since their environment has been devastated due to oil companies activities.
3. The companies and the government should established a public relation units that would

mediate between the community, government and the companies

4. The communities should be provided with micro-credit facilities so as to enable the affected individual diversify their economy
5. The indigenes should be allowed to participate in the decision making and policy formulation and implementation, this process would help the communities and the companies to look at essential issues affecting the communities

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Impact Evaluation of Urbanization on River Ona in Eleyele Catchment, Ibadan, Nigeria

By Awomeso, J. A., Gbadebo, A. M ,. Taiwo, A. M., Ogunniyi, I.M. , Ufoegbune G.C Eruola, A.O.
University of Agriculture, Nigeria

Abstract - The study investigated a long-term effect of urbanization on the water quality of Ona River in Eleyele Catchment, Oyo State Southwest Nigeria. Secondary water quality data between 1979 and 2007 were collected from Eleyele's Water Works, Ibadan. In compliment, water samples were collected from five sampling points along River Ona. Important water parameters analyzed using standard procedures were: temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, total alkalinity, total hardness, metals (calcium, magnesium, sodium, copper, lead, cadmium, chromium, nickel, iron) and anions (nitrate, sulphate, chloride). Results showed increased concentration of nitrate and chloride and decreased dissolved oxygen level of River Ona over 28-year assessments. Present field study showed relatively high values of Pb (0.06-1.15 mg/L), Cr (0.01-1.31 mg/L), Cd (0.00-0.26 mg/L), Fe (0.40-1.96 mg/L), Ni (0.02-0.27 mg/L) and nitrate (27.0-50.0 mg/L) compared with World Health Organization (WHO) permissible standards in drinking water. Water quality parameters were generally high between sampling point 1 and 3 due to the influx of industrial effluent from the nearby industries and indiscriminate disposal of wastes at the bank of the river.

Keywords : *Assessment, water quality, parameters, standards, long term effects.*

GJHSS-B Classification : *FOR Code: 160810,160514,160404*

Strictly as per the compliance and regulations of:

Impact Evaluation of Urbanization on River Ona in Eleyele Catchment, Ibadan, Nigeria

Awomeso, J. A.[α], Gbadebo, A. M.[α], Taiwo, A. M.[σ], Ogunniyi, I.M.[α], Ufoegbune G.C[α] & Eruola, A.O[α]

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Keywords: *Assessment, water quality, parameters, standards, long term effects.*

I. Introduction

The impact of urbanization and human activities on surface water quality has received a considerable amount of attention in the recent times (Varis, 1998; Vakkilainen and Varis, 1999; ENCARTA, 2001). Urbanization leads to increase in population and proliferation of industries with consequent increase in waste generations, effluent discharges, which eventually find self streamed into a water body through erosion. This could, however, lead to increased cases of waterborne diseases and heavy metal's toxicity in humans (Swerdlow et al., 1992; Besser et al., 1995). In urban and suburban areas, much of the land surface is covered by buildings and pavement, which do not allow rain to soak into the ground. Instead, most developed areas rely on storm drains to carry large amounts of runoff from roofs and paved areas to nearby waterways. The storm-water runoff carries pollutants such as oil, dirts, chemicals, and lawn fertilizers directly into streams and rivers, where they seriously harm water quality (EPA, 2003). These activities, therefore, affect the physical process of river growth, modify stream structure and further influence the functions of river system (Yuan et al., 2006). According to Strahler and Strahler (1973), whenever there's a rainfall, varieties of ions from atmosphere and land surfaces are deposited into surface and ground waters resulting into pollution. The vulnerability of surface water and sometimes groundwater to ecological degradation depends on a combination natural landscape features, such as geology, topography, soils, climate and atmospheric contributions; human activities related to different land use and land management practices. WHO reported that the pollution of surface and underground water spreading across the world could be attributed to population expansion, rapid urbanization, industrial and technological expansion that often leads to generation of enormous wastes from domestic and industrial sources (Fawole et al., 2008). This research work aimed at evaluating the long term-effect of urbanization on water quality of River Ona along Eleyele catchments.

II. Materials and Methods

a) Description of the Study Area

Eleyele catchment's area is located in Ibadan the capital of Oyo State (Fig. 1). Ibadan is located between latitude 7° 20' N – 7° 25' N and longitude 3° 51' E – 3° 56' E. River Ona is dammed at Eleyele creating a reservoir. There are two streams (one of which takes its source from the north of the International Institute of Tropical Agriculture (IITA) and flows through the Institute, while the other takes its source from the south east of IITA, and form a confluence at Ojoo area and then flows into the reservoir at Eleyele (Fig. 1). The River is also abstracted by the Oyo States Water Corporation at Eleyele Treatment Works for treatment and supply of potable water to Ibadan's people. Ibadan is the largest city in West Africa and the second largest in Africa, with land size covering an area of 240 km^2 (Filani, 1994). Ibadan is a major transit point between the coast and areas to the north. It is inhabited by the Yoruba speaking people of Nigeria, and it is the centre of trade for a farming area producing cocoa, palm oil, yams, cassava,

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corn and fruits. Industries in Ibadan city include- the processing of agricultural products, brewing, vehicle assembly, and the manufacture of cigarettes. The city is the site of several major research institutes like International Institute of Tropical Agriculture (IITA), Cocoa Research Institute (CRI), Forestry Research Institute (FRI), National Horticultural Research Institute (NHRI), and Nigerian Institute of Social and Economic Research (NISER). Most of Nigeria's leading publishing companies are based in the city. Ibadan is drained by two major rivers: River Ona and River Ogunpa with the River Ona located in Eleyele catchment (Figure 1). River Ona has a total area of 2,148,617.61 km^2 while Eleyele catchment area has a total land area of 323 km^2 (GKW, 2003).

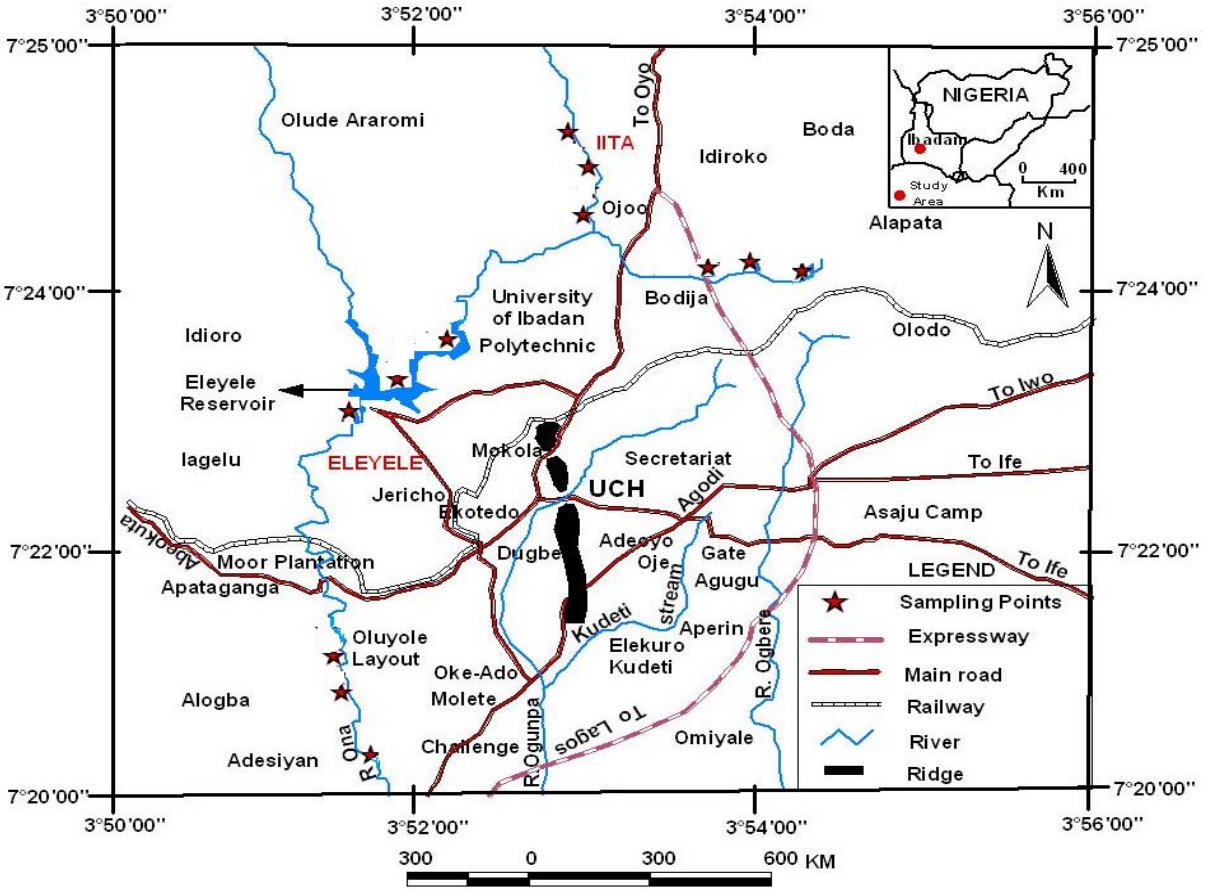


Figure 1 : The map showing the sampling locations.

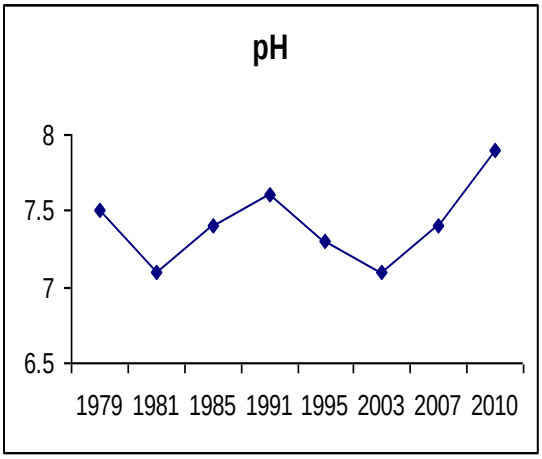
b) Methodology

Fifteen water samples were collected from four sampling sites (stream besides IITA, Bodija, Eleyele reservoir and River Ona) as shown in Figure 1. Water samples were also collected at Eleyele Water Works. The samples were analyzed for temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, acidity, total hardness, total alkalinity, Ca, Mg, Na, Cl^-, NO_3^-, SO_4^{2-}, Cu, Cr, Ni, Pb, Cd, Zn, Mn and Fe. Temperature was determined with the aid mercury in glass thermometer while the pH/TDS/EC meter was used to determine the values of pH, TDS, and electrical conductivity. Total hardness and chloride were measured by titrimetry (APHA, 1989). Total alkalinity was determined using the Alkalinity Test Kit (HI3811) while turbidity was determined with the aid of electric operated DRT 100B HF Scientific Turbidimeter. Sulphate and nitrate were analyzed by turbidimetry and sodium-salicylate methods respectively (Ademoroti, 1996). Samples for cations' determination were digested by addition of 2 ml concentrated HCl into 100 ml of the sample after which the samples were heated for 30 minutes. The samples were then allowed to cool, filtered and were made up to the 100 ml mark with of distilled water. Digested samples were analyzed using Atomic Absorption Spectrophotometer (AAS) for Cu, Cr, Ni, Pb, Cd, Zn, Mn and Fe respectively while Na and K was determined using a flame photometer.

Water quality data of River Ona from 1979-2007 were collected from Oyo State Water Corporation. These data were plotted along with the field data collected in 2010 for a true picture of long-term effect urbanization on the study River.

III. Results and Discussion

The impacts of long- effect urbanization (1979-2010) on River Ona water quality were shown in Fig. 2 (a-j). pH values ranged from.5 – 8.0, temperature, 26-29 °C, total solids (TS), 200-300 mg/L, dissolved oxygen, 1.06-8.0 mg/L, total alkalinity (TA), 90-130 mg/L, total hardness (TA), 70-100 mg/L, calcium, 20-60 mg/L, chloride, 5.0-120 mg/L, iron, 0.0-2.0 mg/L, and nitrate, 1.0-40.0 mg/L. Table 1 and 2 showed the results of physico-chemical parameters of the River from different sampling points in 2010. These field analyses were complimentary to the results of water parameters collected from Eleyele water works.



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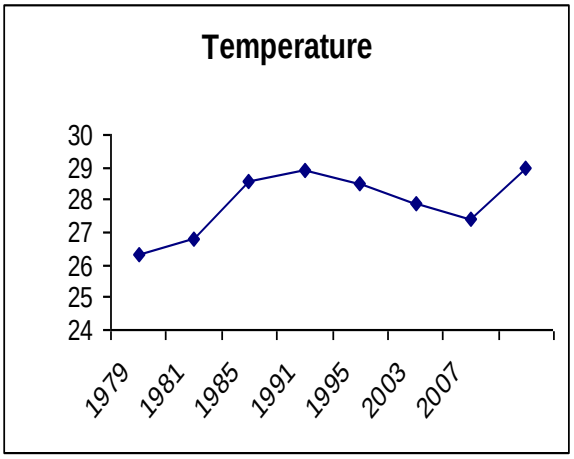

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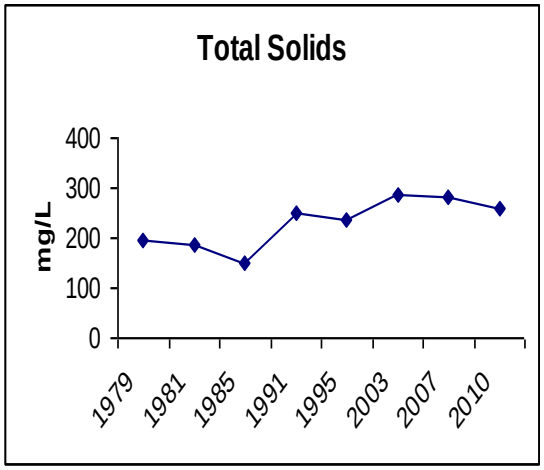

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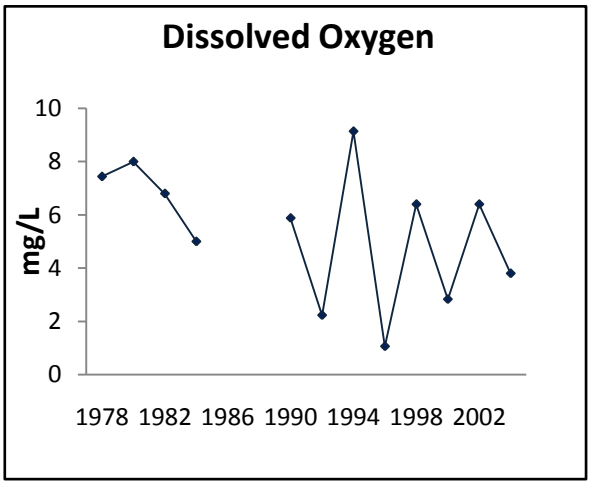

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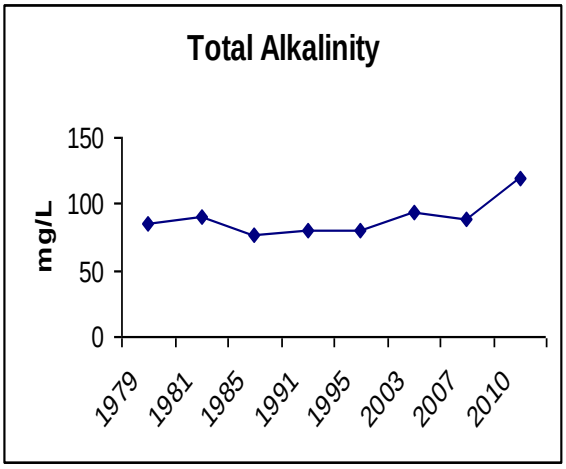

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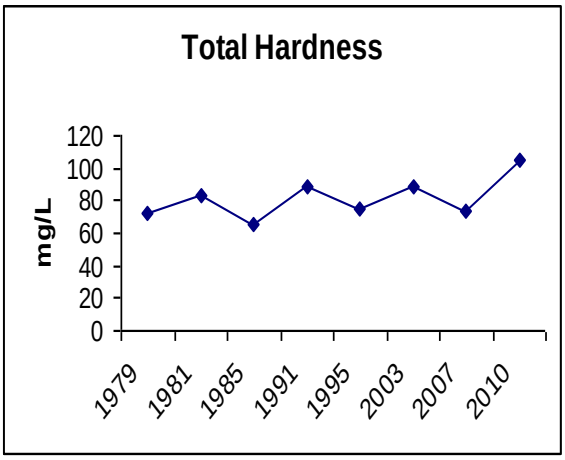

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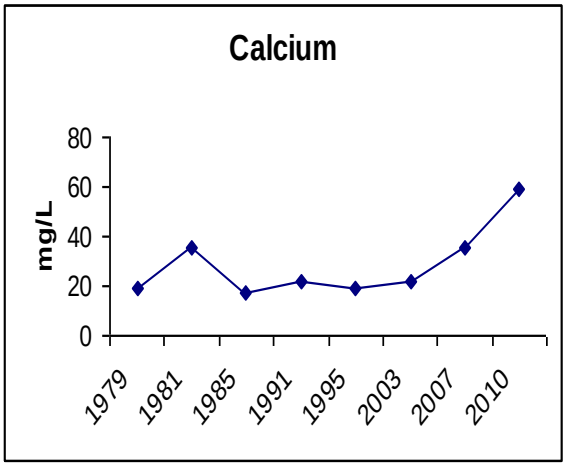

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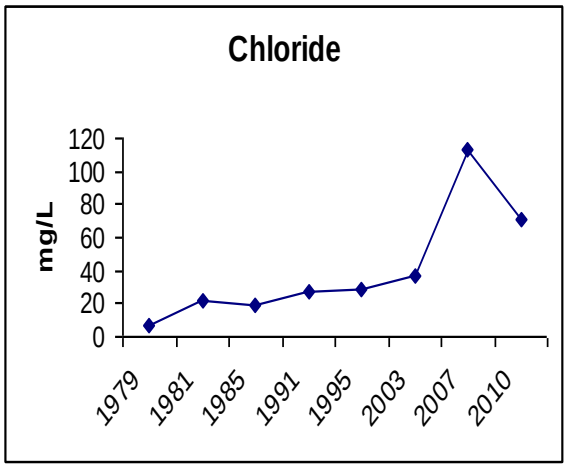

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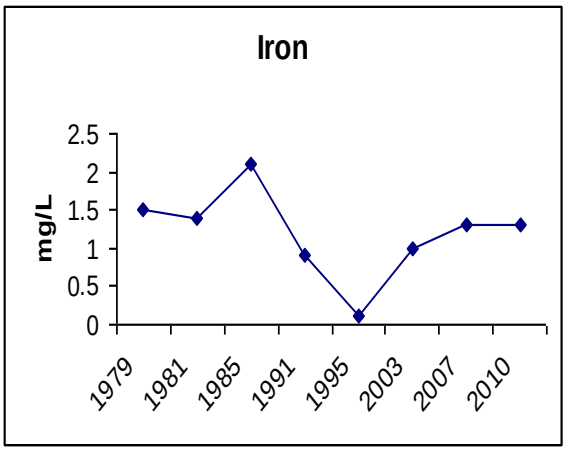

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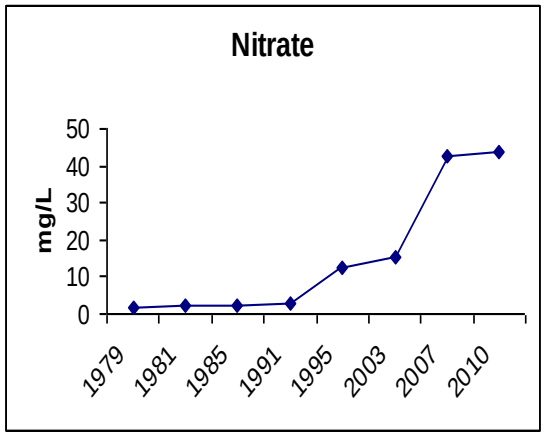

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Fig. 2 : Long-term Impact of urbanization on River Ona water quality.

Table 1 : Some measured water quality parameters along Eleyele catchment.

Sample Locations	Temperature (°C)	pH	EC (μS/cm)	TDS (mg/L)	Turbidity NTU	Total hardness (mg/l)	SO_4^{2-} (mg/L)	NO_3^- (mg/L)	Cl^- (mg/L)	Total alkalinity (mg/l)
Iita	26	7.3	570	280	0.52	82	300.0	50.0	163.30	99.0
Bodija	28	6.9	800	400	0.58	70	380.0	50.0	248.50	102.0
Eleyele Reservior	26	7.6	560	280	0.17	58	88.0	44.0	44.73	74.0
River Ona Downstream	29	7.9	530	260	0.09	105	100.0	48.0	71.00	120.0
Eleyele Water Works	28	7.5	400	200	0.05	54	180.0	22.0	40.47	46.5

Table 2 : Metal of the study areas

Sample Locations	Na (mg/L)	Ca (mg/L)	Mg (mg/L)	Cu (mg/l)	Cr (mg/L)	Ni (mg/L)	Pb (mg/L)	Cd (mg/L)	Zn (mg/L)	Mn (mg/L)	Fe (mg/L)
Iita	160.40	48.39	26.04	0.05	0.05	0.06	0.54	0.00	0.08	0.20	1.96
Bodija	120.07	45.14	33.40	0.18	0.06	0.27	0.27	0.26	0.26	0.40	1.29
Eleyele Reservoir	120.24	30.34	21.64	0.02	0.01	0.02	0.79	0.01	0.05	0.20	0.49
River Ona Downstream	140.80	59.54	18.84	1.31	0.05	0.21	1.15	0.00	0.18	0.05	1.32
Eleyele Water Works	130.09	28.74	16.05	0.01	0.05	0.13	0.06	0.00	0.04	0.03	0.40

The pH of the River followed a w-shape trend indicating phases of variations over the long period of time. pH of the present study was the highest since 1979. Most of the wastes being dumped or washed into the river via run-off are alkaline in nature. The 28-year pH data were within the SON (2007) range in drinking water. Water temperature of the River was generally high. There is a significant increase in temperature values over the years with a slight decrease in 2007. High water temperature had been associated with degradation of wastes (Baotong et al., 1983). Alabaster and Lloyd (1980) have attributed high-water temperature to insulating effect of nutrient load resulting from industrial discharges. As population increases, waste generation will also increase. The fall in temperature in 2007 may be directly linked to strong enforcement of environmental law by the local government against indiscriminate wastes' disposal. Subsequent increase in temperature may be related to weak enforcement and compliance.

TDS and EC have high values in water samples collected from IITA and Bodija sampling locations. An elevated TDS concentration is not a health hazard but indicator of the concentration of dissolved ions, which may cause the water to be corrosive, salty or brackish, resulting in scale formation (Orewole et al., 2007). Discharges such as sewage could have responsible for a rise in the conductivity at both IITA and Bodija sampling sites because of the presence of chloride, phosphate and nitrate (EPA, 1997). TS values of River Ona have increased over the years (Fig. 2c) as a result of urbanization. However, the values of TDS from 1979 to 2010 are less 300 mg/L, which is within WHO standard.

There is a sharp decline in DO values of the river over the years (2d). Reduced DO coupled with yearly increase trend of Cl^- and NO_3^- could be linked directly to urbanization as raw untreated sewage and wastes generated from urbanization could lower the DO of the River (Wilcock et al., 1995). Ontario Ministry of the Environment and Energy (1994), Canada had given a minimum range of 4-7 mg/L for DO in rivers because low DO in river could be lethal to aquatic organisms (Einum et al., 2002).

Total alkalinity and total hardness values had not varied significantly over the years unlike chloride and nitrate, which values had soared up (Fig. 2 e,f,h,j). Increase in nitrate values of the river is of health concern, especially for children. For this present study, it was observed that the sampling points at IITA and Bodija were heavily polluted. Water parameters were generally high at these study sites compared to other sites probably due to disposal of laboratory chemicals and wastes into the river.

Sulphate and chloride values at the Bodija sampling point were high (Table 2), while sulphate was higher than WHO standard given as 250 mg/L, chloride was within the permissible limit. High chloride content in drinking water may indicate possible pollution from sewage, animal manure or industrial wastes (Department of National Health and Welfare, 1978). The values of nitrate in this study were relatively intense ranging from 22 – 50 mg/L, although, this was within the maximum acceptable limit of 50 mg/L (WHO, 2008). The health implication associated with elevated concentrations of nitrate greater than 11 mg/L in water is blue-baby syndrome known as Methemoglobinemia in children (Ward et al., 2005) and insulin-dependent diabetes (IDDM) in adult when concentration exceeds 25 mg/L (Kostraba et al., 1992). Adeyeye and Abulude (2004) had attributed high nitrate concentration in groundwater to sewage discharge - is peculiar to urbanization.

Most of the metals (Na, Cu, Mg, Zn, Cr, Mn) determined were below the WHO limits. Calcium and Magnesium are essential elements needed in good quantity by the human body. Ca functions in teeth and bone formation, neuromuscular extractability, good functioning of the contractibility, blood coagulability (František Kožíšek, 2003). Mg concentrations exceeding 125 mg/L in water according to Orewole et al. (2007) may have a laxative effect on some people. Nickel values of the river at Bodija sampling point and River

Ona downstream were higher than acceptable limits of 0.07 mg/L in drinking water (WHO, 2008) while lead values were extremely high at all the sampling points. High lead concentration of the river may result from runoff of lead-containing wastes from dumping sites and vehicular emission (Inanc et al., 1998, Martin et al., 1998). Lead is a pediatric poisonous that affects central and peripheral nervous system and also causing a kidney damage (Hassinger and Watson, 1998; Roberts, 1999). The observed cadmium value of 0.26 mg/L at the Bodija sampling point is outrageous and dangerous to human health. Cadmium is a potential carcinogen and kidney destroyer (Lewis, 1991). Iron concentrations of the river were also very high with the ability of initiating negative effect on taste and corrosiveness of water from the river (Taiwo, 2010).

By comparing River Ona water quality parameters with studies on notable rivers in southwest Nigeria, the influence of urbanization on this River is obvious. Parameters like TDS, nitrate, chloride, Pb, Cd, Zn, Mn and Fe were higher in River Ona than Ogun River as reported by Jaji et al. (2007). Higher concentrations of TDS, turbidity, Ca and Na were also observed in this study than values observed by Olajire and Imeokpara (2001) on Osun River. However, the recent study of Adeogun et al. (2011) on impacts of abattoir and saw mill effluents on Ogun River had shown elevated values of nitrate, phosphate and TDS higher than River Ona.

IV. Conclusion

Elevated values of water quality parameters observed for River Ona had indicated the influence of human activities due to urbanization. Increasing trends observed for long-term values of chloride and nitrate is a direct effect of sewage, urban-runoff and agricultural pollution. Annual decline in DO also established organic contamination of the River. High concentrations of water parameters at IITA and Bodija in addition had showed high level of pollution of River Ona at the upper stream due to possible contamination from agricultural and industrial effluents. It is therefore recommended that effluent treatment should be enforced before disposal into the streams and rivers. In addition, necessary actions should be taken to improve the water treatment process at the water works. Proper disposal of wastes should be ensured around the catchment area of the River.

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Assessment of Non-Government Organizations' Contribution to Environmental Awareness in Nigeria

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Abstract - Environmental management challenges have assumed a global scale and attention. However, it is misleading to conclude that the current challenge of sustainable environmental management is fully known to the populace, especially at the grassroots. This paper examined Non-Government Organizations ' Contribution to Environmental Awareness in Nigeria using Uyo as a case study. The study collected data using the semi-structured questionnaire on awareness of environmental issues, relationship between people in the study area and ENGOs, activities of ENGOs and benefits from ENGOs. Findings revealed that ENGOs has not significantly created a positive environmental awareness on respondents and has consequently failed to meet global expectations in addressing environmental challenges. Recommendations were made to enhance environmental awareness: improved education and orientation of the people on environmental problems, encouragement of youth participation in environmental management by ENGOs, media houses should increase awareness of environmental problems in the study area, and funding agencies should monitor the implementation of planned environmental awareness programmes.

Keywords : ENGOs, Environmental awareness, Environmental problems, Environmental management,Uyo.

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Afangideh, A. I.[α], Obong, Linus B.[σ] & Robert, U. I.[ρ]

Abstract - Environmental management challenges have assumed a global scale and attention. However, it is misleading to conclude that the current challenge of sustainable environmental management is fully known to the populace, especially at the grassroots. This paper examined Non-Government Organizations ' Contribution to Environmental Awareness in Nigeria using Uyo as a case study. The study collected data using the semi-structured questionnaire on awareness of environmental issues, relationship between people in the study area and ENGOs, activities of ENGOs and benefits from ENGOs. Findings revealed that ENGOs has not significantly created a positive environmental awareness on respondents and has consequently failed to meet global expectations in addressing environmental challenges. Recommendations were made to enhance environmental awareness: improved education and orientation of the people on environmental problems, encouragement of youth participation in environmental management by ENGOs, media houses should increase awareness of environmental problems in the study area, and funding agencies should monitor the implementation of planned environmental awareness programmes.

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I. Introduction

Environmental management is central to sustainable environment. Hence, the continuity of all life on earth relies on human activities in and around the biosphere. As observed by Akpabio (2009), environmental management is much more than the control of nuisance. He contends that it involves an orientation that is philosophical in nature which is deliberately designed to encourage the existence of a congenial environment for healthy life, liberty and industry as well as promoting beauty of the environment.

At the fore of environmental management are the Environmental Non-Governmental Organizations (ENGOs). ENGOs are the most active actors in the environmental arena. In Nigeria, ENGOs are observed to be involved in managing the environment for the last four decades (Oyeshola, 1995). They advocate sustainable development, protest for the environment and engage in all kinds of environmental activities. As Non-Govemmental Organizations (NGOs), ENGOs are known to have a mission to changing people's unsustainable attitudes and behaviours (Ebong and Bassey, 2004). In order to achieve their goals, the ENGOs need to draw attention of the public, business organizations or even politicians to the reality of development and environmental sustainability. Using the media, public awareness could be created on how best to manage the environment for continued existence.

Historically, a number of non-governmental organizations with environmental inclination abound. For example, Table 1 shows the various NGOs over time:

Table 1: NGOs in Nigeria over time.

S/N	NAME OF NGO	ABBREVIATION	YEAR FOUNDED
01	FORESTRY Association of Nigeria	FAN	1970
02	Ecological Society of Nigeria	ESN	1973
03	Nature Club of Nigeria	NCN	1980
04	Nigerian Conservation Foundation	NCF	1982
05	Nigerian Environmental Study/Action Team	NEST	1987
06	NIGERIAN Society for Environmental Management and Plannin	NSEMP	1987
07	Green Crocodile Foundation	GCF	
08	Environmental Watch Association International	EWAN	
09	Food Basket Foundation International	FBFI	
10	Population Environment and Development Agency	PEDA	
11	Friends of the Environment	FOTE	
12	Foundation of Environmental Development and Education in Nigeria	FEDEN	
13	Green Environment Movement	GEM	
14	Living Earth Nigeria Foundation	LENF	

Source: Akpabio (2009) and Okaba and Obong (2006).

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Indisputably, NGOs at the local, regional and international levels are the saviour and stewards of environment; they protect the environment from abuse, misuse and damage. However, it is the believe of Akpabio (2009) that of the NGOs in Table 1, only few have really made any significant impact in the promotion of environmental awareness, scientific research and protection of endangered species and critical habitats. Since human influences virtually all areas of life, a means of communicating information and innovation on managing the influences becomes crucial. This view is shared by experts in Agricultural Extension (Leeuwis, 2004), Behavioural Scientists (Ikurelong, 2009), Educationists and Environmentalists (Okaba and Obong, 2006) and Ukpong, 2009).

Creating environmental awareness is a complex process that requires meticulous and continuous efforts. It involves people from all classes of life. It also involves government and non-governmental bodies, their behavior and cooperation is highly needed for success in all facets of life. Over time, the need for awareness and management of our environment seems insurmountable. Strides in environmental management has transformed immeasurably from various forms of awareness to mitigation as well orchestrated foray into combating critical environmental issues. Bereft of consummate effort to ensure effective awareness creation, is a life challenge of slow diffusion of information by the populace. This study, however, focuses on the contribution of Non-Government Organizations to Environmental Awareness in Nigeria using Uyo Metropolis as a case study.

II. Impetus for Research

Today, the entire world seems to be aware of the ailing environment. Rural environments are fast becoming urban and there are rising concerns over cases of air, land and water pollution. The challenge managing waste materials from anthropogenic activities leave palpable fear in environmentalists and environmental managers and planners of may become of our home shortly.

The question of sustainable environment in urban areas like Uyo Metropolis keeps rising with the growing concern if the public is aware of the need to manage the environment. Since the government alone cannot take the challenge of creating environmental awareness, the question is: what are ENGOs doing to create awareness in Uyo Metropolis?

The concerns above, therefore inform this study which was designed to assess the level of environmental awareness by ENGOs in the study area, identify the pressing environmental issues in the study area, ascertain the impact of ENGOs in the study area and determine the effectiveness of the mechanism, tools and skills adopted by ENGOs on public communication and relation of environmental information. A null hypothesis which states that "Environmental Non-Governmental Organizations have not created significant environmental awareness in the study area" was also tested in the study.

III. Methods and Approach

Uyo the study area is the state capital of Akwa Ibom State, Nigeria. It occupies a landmass of 8,421 square kilometers. The study area is stratified into regions. Four of the regions were randomly sampled for administration of structured questionnaire. 100 persons were selected from each region on the basis of one person in every five adults encountered in selected offices. Also, 20 offices were randomly selected in each region. 40 Environmental Non-Governmental Organizations were selected from among those that registered with the government (Ministry of Environment and Corporate Affairs Commission. A number of 10 in each of the four regions of the study area were also randomly selected which gave a total of four hundred (400) respondents and forty (40) Environmental Non-Governmental Organizations in all.

The structured questionnaire and oral interviews was the major instrument for data collection. Data collected was on the location or contact region of respondents, level of environmental awareness by ENGOs in the study area, awareness and acquaintance with ENGOs activities, relationship with ENGOs in the study area, benefits derived from ENGOs and environmental awareness creation by ENGOs in the study area.

Collected data was sorted, presented and analyzed using tables and graphs; while the stated hypothesis was statistically tested using the Contingency Chi-Square test statistic technique.

IV. Results and Discussion of Findings

The data for the study was collected from residents in Abak Road 112 (31%), Ikot Ekpene Road 108 (27%), Aka Road 81 (20%) and Oron Road 89 (22%) of the study area (see Table 1).

Table 1: Contact region of respondents.

Contact regio	Frequency	Percentage (%)
Abak Road	112	31
Ikot Ekpene Road	108	27
Aka Road	81	20
Oron Road	89	22
Total	**400**	**100**

Source : Fieldwork, 2010.

a) Level of environmental awareness by ENGOs in the study area

The study assessed the level of respondents' awareness of Environmental Non-Governmental Organizations (ENGOs) in the study area. Table 2 reveals that only 25 per cent (100 respondents) are aware of ENGOs in their area. On the other hand, as high as 300 respondents, representing 75 per cent are not aware of the group in their area.

Table 2 : Awareness of respondent on ENGOs.

Awareness of ENGOs	Frequency	Percentage (%)
Yes	100	25
No	300	75
Total	**400**	**100**

Source : Fiedwork , 2010.

Consequently, Table 3 shows that respondents awareness and acquaintance with the activities of the ENGOs. Out of 400 respondents, 50 per cent (200 respondents') awareness was self - created , 100 (25%) per cent was created by by government programme and 100 (25%) per cent awareness was created by the ENGOs.

Table 3 : Level of Awareness And Acquaintance With ENGOs activities in the study area.

Level of awareness and acquaintance of ENGOs	Frequency	Percentage (%)
Self-created	200	50
ENGO-created	100	25
Government programme	100	25
Total	**400**	**100**

Source : Fiedwork, 2010.

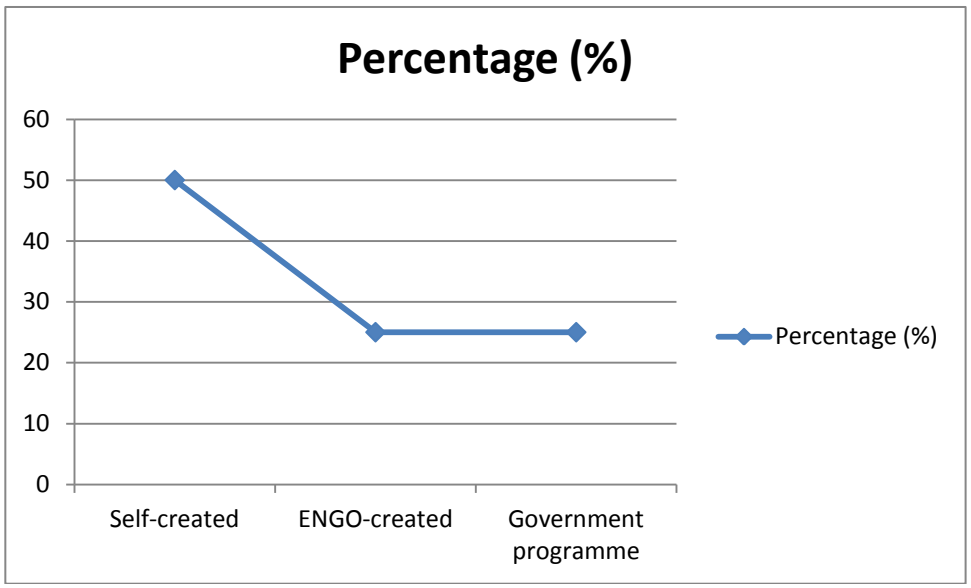

Figure 1 : Level of awareness and acquaintance with ENGOs activities.

From Table 3 and Figure 1, it implies that individuals in the study area have self awareness of environme ntal issues. Although ENGOs have created a level of awareness, it has a low percentage as well of the government.

V. The Pressing Environmental Issues in The Study Area

The study also identified a number of environmental concerns in the study area. The issues are captured in Table 4 and include waste disposal, erosion, flooding, water pollution, air pollution, gas flaring, noise pollution, oil spillage, and drought.

Table 4 : Environmental issues in the study area.

Environmental issues	Frequency	Percentage (%)
Waste disposal	120	30
Erosion	80	20
Flooding	100	25
Water pollution	20	5
Air pollution	16	4
Gas flaring	8	2
Noise pollution	40	10
Oil spillage	8	2
Drought	8	2
Others (specify)	0	0
Total	**400**	**100**

Source: Fieldwork, 2010.

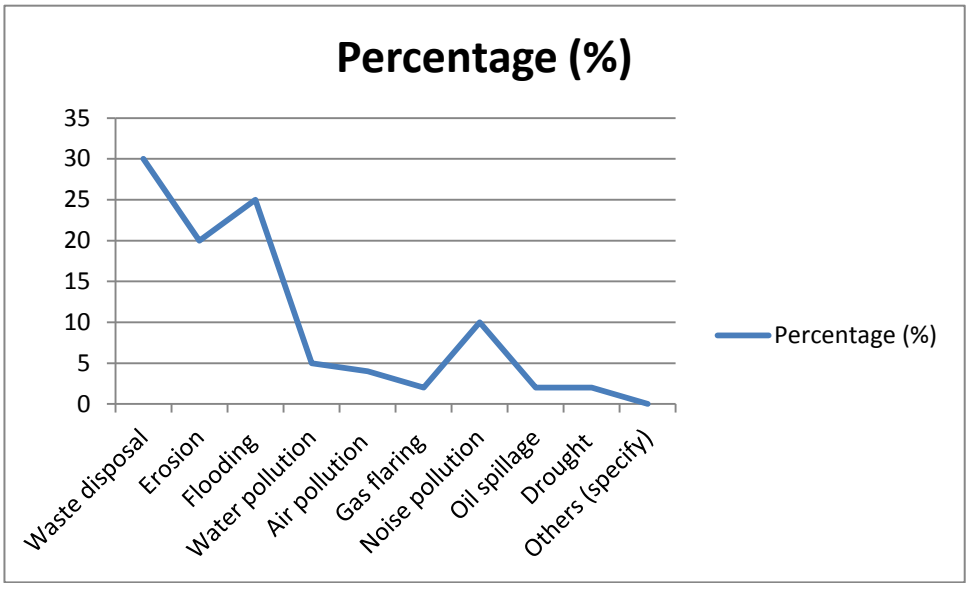

Figure 2 : Environmental issue in the study area.

As depicted in Table 4 and Figure 2, a list of environmental concerns in the study area shows that waste d isposal has the highest percentage of 30 representing 120 respondents, followed by flooding with a total o f 100 (25%) respondents, erosion (20%) representing 80 respondents. Others are noise pollution 40 (10%) , water pollution 20 (5%), air pollution 16 (4%), while gas flaring, oil spillage and drought has a total of 8 (2%) respectively as pressing environmental issues.

VI. Impact of Environmental Non - Governmental Organizations (ENGOs) in the Study Area

Table 5 shows that 100 (25%) respondents indicate that there exists a good and cordial relationship between ENGOs and residents in the study area; while 400 (75%) of respondents maintained that there is a bad and aggressive relationship.

On benefit from ENGOs by members of the study area, result show that 40 (10%) respondents have benefited in training, 40 (10%) benefited in financial compensation, 20 (5%) in seminars and a total of 300 (75 %) have not had any benefit at all (Table 6).

Table 5 : Level of relationship with ENGOs in the study area.

Level of relationship	Frequency	Percentage (%)
Good and cordial	100	25
Bad and aggressive	300	75
Total	**400**	**100**

Source : Fiedwork , 2010.

Table 6 : Benefit from Environmental Non – Governmental organizations (ENGOs).

Kind of benefit from ENGOs	Frequency	Percentage (%)
Training	40	10
Financial compensation	40	10
Seminars	20	5
None	300	75
Total	**400**	**100**

Source : Fiedwork, 2010.

VII. Effectiveness of The Mechanism, Tools, and Skills Adopted by the Engos on Public Communication and Relation of Environmental Information

The creation of environmental awareness by ENGOs is carried out through radio, television and other mas s media outlets. Percentage distribution as pictured in Table 7. It could be seen that only 100 (25%) of the total respondents have seen, read and heard of the awareness programme embarked upon by the ENGOs o n environmental issues, while the remaining 300 (75%) of the population have not seen, heard or read any thing from the ENGOs on environmental issues in the study area.

On occurrence of programme, Table 8 shows that the Environmental Non-Governmental Organizations (ENGOs) carry out awareness only once a week representing 100 (25%) of the total percentage and 300 (7 5%) have not been opportune to know about the programme in the study area.

Table 7 : Environmental awareness creation by ENGOs.

Environmental awareness creation by ENGOs on radio, television, etc	Frequency	Percentage (%)
Yes	100	25
No	300	75
Total	**400**	**100**

Source : Fiedwork, 2010.

Table 8 : Occurance of ENGOs programme.

Occurrence of ENGOs programme	Frequency	Percentage (%)
Once a week	100	25
Once a month	00	00
Once a year	00	00
Once in two years	00	00
None	300	75
Total	**400**	**100**

Source : Fiedwork, 2010.

Table 9 summarizes the previous tables showing the contect region , level of environmental awareness by ENGOs in the study area , awareness and acquaintance with ENGOs activities, relationship with ENGOs in the study area , benefit from Environmental Non-Governmental Organizations (ENGOs) and Environmental awareness creation by ENGOs in the study area.

Table 9 : Contingency table of table 1 □ 8 (contact region) of respondent

Location (contact region)	Yes	No	Total
Abak Ro:ad	30	92	**122**
Ikot Ekpene Road	19	89	**108**
Aka Road	23	58	**81**
Oron Road	28	61	**89**
Total	**100**	**300**	**400**

Source : Fiedwork, 2010.

VIII. Test of Hypothesis

Tables 2-8 were used in testing the stated hypothesis which state thet "Environmental Non-Governmental Organisations (ENGOs) have nt created significant environmental awareness in the study area".Cells were represented by different regions using Yes and No of the responses.The computations of Contigency Chi-Square was drawn for the test (Table 10):

Table 10 : Computations of Contigency Chi-Square.

Cell	O	E	O-E	$(O-E)^2$	$(O-E)^2/E$
1	30	30.50	-0.5	0.25	**0.0082**
2	92	91.50	0.5	0.25	**0.0027**
3	19	27.00	-8.0	64.00	**2.3703**
4	89	81.00	8.0	64.00	**0.7901**
5	23	20.30	2.0	7.29	**0.3591**
6	58	60.80	-2.0	4.00	**0.0658**
7	28	22.30	5.7	32.49	**1.4570**
8	61	62.80	-5.8	33.64	**0.5036**
Total					**5.5568**

Source : Fiedwork, 2010.

The Chi-Square formula is given as:

$X^2 = \Sigma (O-E)^2$

The calculated $X^2 = 5.5568$

Degree of freedom = 3

Critical value = 7.815

From the calculations above, the Chi-Square value of 5.557 is less than the critical value of 7.815, therefore, the null hypothesis which states that "Environmental Non-Governmental Organizations (ENGOs) have not created significant environmental awareness in the study area" is accepted.

IX. Discussion of Findings

Findings of this study show that respondents on awareness of Environmental Non-Governmental Organizations (ENGOs) as an environmental group in the study area is low with a total of 25 per cent; as high as 75 per cent of respondents are not aware of the group in their area. It is however, observed that respondents' awareness and acquaintance with the activities of the ENGOs is up to 50 per cent awareness self-created, 25 per cent by government programme and 25 per cent awareness of environmental issues.

Although ENGOs have created a level of awareness, it has a low percentage as well of the government. Findings also show a number of environmental concerns in the study area. The concerns include waste dis posal, erosion, flooding, water pollution, air pollution, gas flaring, noise pollution, oil spillage, and droug ht. The list of environmental issues in the study area shows that waste disposal has the highest percentage of 30, followed by flooding with a total of 25 per cent and erosion 20 per cent. Others are noise pollution 10 percent, water pollution 5 percent, air pollution 4 per cent, while gas flaring, oil spillage and drought has a total of 2 per cent respectively as pressing environmental issues.

Other findings of the study indicate that there exists a good and cordial relationship between ENGOs and residents in the study area; while 75 per cent of

Creation of environmental awareness by ENGOs is carried out through radio, television and other mass m edia outlets. Notwithstanding the efforts in awareness creation, findings reveal that only 25 percent of the population have seen, read and heard of the awareness programme embarked upon by the ENGOs on environmental issues, while the remaining 75 per cent of the population have not seen, heard or read anything from the ENGOs on environmental issues in the study area.

On occurrence of programme, it was discovered that the Environmental Non-Governmental Organizations (ENGOs) carry out awareness only once a week with a total of 25 per cent in the study area.

Stated hypothesis was tested and results shows that Environmental Non-Governmental Organizations (ENGOs)

Stated hypothesis was tested and result shows that Environmental Non-Governmental Organizations (EN GOs) have not created significant environmental awareness in the study area. The finding is in agreement with Akpabio (2009) who stated that though there are a number of NGOs, only few have really made any significant impact on the promotion of environmental awareness, scientific research and protection of end angered species and critical habitats.

X. Recommendations and Conclusion

To ensure a more effective environmental awareness in the study area, ENGOs should improve on environmental awareness in the study area. Measures such as educative programmes, orientation programmes in order to create awareness among the people on environmental problems, encourage youth participation in environmental management, and use media houses to increase awareness of environmental concerns should be employed. Funding agencies should also monitor the planning and implementation of environmental awareness programmes. It is believed that when the measures above are enforced, the desired awareness and proper management of the environment would be achieved.

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4. Manuscript's Category,

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· Shun use of extra pictures - include only those figures essential to presenting results

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Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to

shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic

principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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