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Full Length Research Paper

Flora species assessment in burnt brick-producing wetlands in Benue State

Agera, S.I.N* and Agbidye, F.S.

Department of Forest Production and Products, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Benue State, Nigeria

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Vegetation clearing burning and soil excavation at burnt brick sites in wetland areas jointly or singularly exposes the soil to increased soil organic matter loss, insolation and water run0off which degrade the soil, leading to decreased soil productivity. This study was conceived to identify flora species sighted at burnt brick sites, identify the fuel wood tree species used in firing burnt bricks and outline the effects of removal of vegetation at burnt brick sites in Benue State, Nigeria. Eight out of twenty-three Local Government Areas were purposively selected for the study Belt transects were laid out at each of the selected brick sites (two per Local Government Area) and frame quadrants were used in estimating vegetation cover, density, frequency of species sighted at brick sites. The University of Agriculture Makurdi Herbarium, textbooks and the internet were user to identify plant species using local (*Tiv* language) , common and scientific names. Descriptive statistics was used to analyse data. A total of 200 flora species were identified at brick sites belonging to 58 families. Also, 35 tree species were used in firing bricks with *Prosopis africana* being the most preferred fuel wood species. Flora species threatened by brick production activities included: *Hyparrhenia involucrate Imperata cylindrical, Prosopis africana and Khaya senegalensis.* Vegetation removal and accompanying soil excavation at brick sites among other effects, accelerated soil erosion, and altered the landscape at brick sites. Afforestation of brick sites should entail selection of hardy, tolerant and fast- growing flora species suited to the properties of minesoil, and establishing them quickly under for the purpose of of controlling erosion

Keywords: Flora species, burnt brick production, devegetation, impact, wetlands and Benue State.

*Corresponding Author E-mail: stephenagera@gmail.com; Phone: 2348058484045

INTRODUCTION

The burnt brick industry is herein considered as a primary disturbance agent in wetland areas of Benue State on account of its overwhelming importance in many ecosystems. Brick is defined as a small, rectangular block of fired clay used in the construction of foundations, walls, piers, buttresses and arches of buildings and other structures and in the construction of ducts, flues, lining and chimneys of furnaces (Encyclopedia Britannica, 1998). The informal clay brick makers in Benue State and other developing countries lack formality in terms of the licensing laws, tax laws, labour laws and environment health regulations. These informal operations are small scale, mostly family or household-based enterprises that are unregulated by government institutions (Swiss

Agency for Development and Cooperation, 2014).

Daniel (1986) and Morton, (1999) identified five processes in brick production which have a high potential to impact on soil properties and vegetation viz:: land clearing, clay winning (excavation) and preparation, shaping of bricks, drying and firing. Land-clearing may be a necessary process at times or it may be optional, depending on the nature of existing vegetation or immediate past land-use option Access roads to brick sites are constructed to facilitate easy flow of vehicular transport for easy evacuation of burnt bricks.

Sites opened by disturbance emanating from burnt bricks production may allow regeneration of vegetation and succession cycles. Depending on the post-disturbance environment, disturbance can also accelerate changes in vegetation composition, possibly resulting in different vegetation dynamics and altered biodiversity (F.A.O, 1986, Thonicke, *et. al*., 2001).The irregularly occurring destruction of soil and vegetation structure, whether natural or anthropogenic, plays an integral part in shaping vegetation (Glenn-Lewin and Maarel, 1992).

Vegetation and soil composition in ecosystems are strongly affected by fire (Sykes, *et. al*., 2001). The season of burning, and the time between subsequent recurring fires at brick sites determine the plant and animal species composition (Egunjobi 1971) through selection in most ecosystems. In semi-arid and arid grasslands, the season of burning determines the assemblage of C3 and C4 grasses (Sykes, *et.al.* 2001)

Van Hook *et al.* (1982) classified the effects of increased woody biomass removal into direct and indirect effects. The direct effects accompanying increase in tree harvest include; nutrient loss in wood removed, soil disturbance and compaction, decreased/delayed regeneration of new stands, exposure of soil and litter to insolation and adverse elements of weather

There is dearth of data on the type of flora species available at brick sites. Also there is paucity of comprehensive information on the species of fuel wood used in firing of bricks in Benue State . This study therefore sets out to: (1) identify flora species that presently can be sighted at burnt brick sites (2) identify the fuel wood tree species used in firing burnt bricks (3) outline the effects of removal of vegetation at burnt brick sites.

MATERIALS AND METHODS

The Study Area (Benue State)

The study was conducted in Benue State, located along Longitude 6º35' and 10ºE and Latitude 6º30' and 8º10'N. The state has a total land mass of 30,955km^2. Benue State and was created by the Murtala Mohammed Military Administration from the. defunct Benue-Plateau State in 1976, with Makurdi as the state capital. The State has a population of 4. 219, 244 (NPC, 2007). The population has been extrapolated to 5, 505,157 in 2015 given an annual population growth rate of 3%. It is made up of 23 local governments (Figure 1) Benue State is bounded to the north by Nassarawa State, Taraba State to the East, Ebonyi, Cross River and the Repuplic of Camerrom ti the south as well as Kogi and Enugu States to the west.

Research Design and Sampling Technique

Eight out of twenty-three Local Government Areas were purposively selected for the study. A total of 800 brick-producing respondents were randomly interviewed using a semi-structured questionnaire. The completely randomized block design (RBCD) was used (Adesoye, 2004). Survey of vegetation and identification of flora species at burnt brick sites was undertaken as outlined below:

Survey and Identification of flora species

Belt transects measuring 100 m x 20 m were used to survey changes in vegetation along environmental gradients through different habitats (Akosim 1997; Adebisi, 1999). Belt transects consisted of frame quadrates of the desired size being laid contiguously along the length of the transects. Frame quadrants measuring 100 cm x 100 cm were used in estimating vegetation cover, density, frequency of species in any vegetation. The frame quadrants were made of four strips of wood, which were bolted together to form a square. (Sutherland, 1996): Fuel wood species preferences were ranked using the responses of the 800 sampled respondents as to which species they preferred to use in firing of bricks. Responses were tallied to each fuel wood species used and species with the highest tallies were arranged based on decreasing tallies. Thus, species appearing first on the list was the most preferred species, while the species appearing last were the least preferred.

The vernacular names of all the tree species used by brick producers in the study area were obtained using a semi-structured questionnaire, focused group discussion and use of key informants in the study area. Samples of vegetative and reproductive parts of the tree species were also taken to the Forestry Herbarium, University of Agriculture, Makurdi for identification. The following textbooks were used in the identification of trees and other flora species in the study area: 'A Textbook of West African Weed", by Akobundu and Agyakwa (1998), 'Trees, shrubs and lianas of West African dry zones'by Arbonnier (2004), "Tiv, Idoma, Igede, Akweya, Hausa and Scientific names of Plants' by Agishi (2010) and the Internet were used to come up with the Scientific, common, and family names of some of the fuel wood tree species.

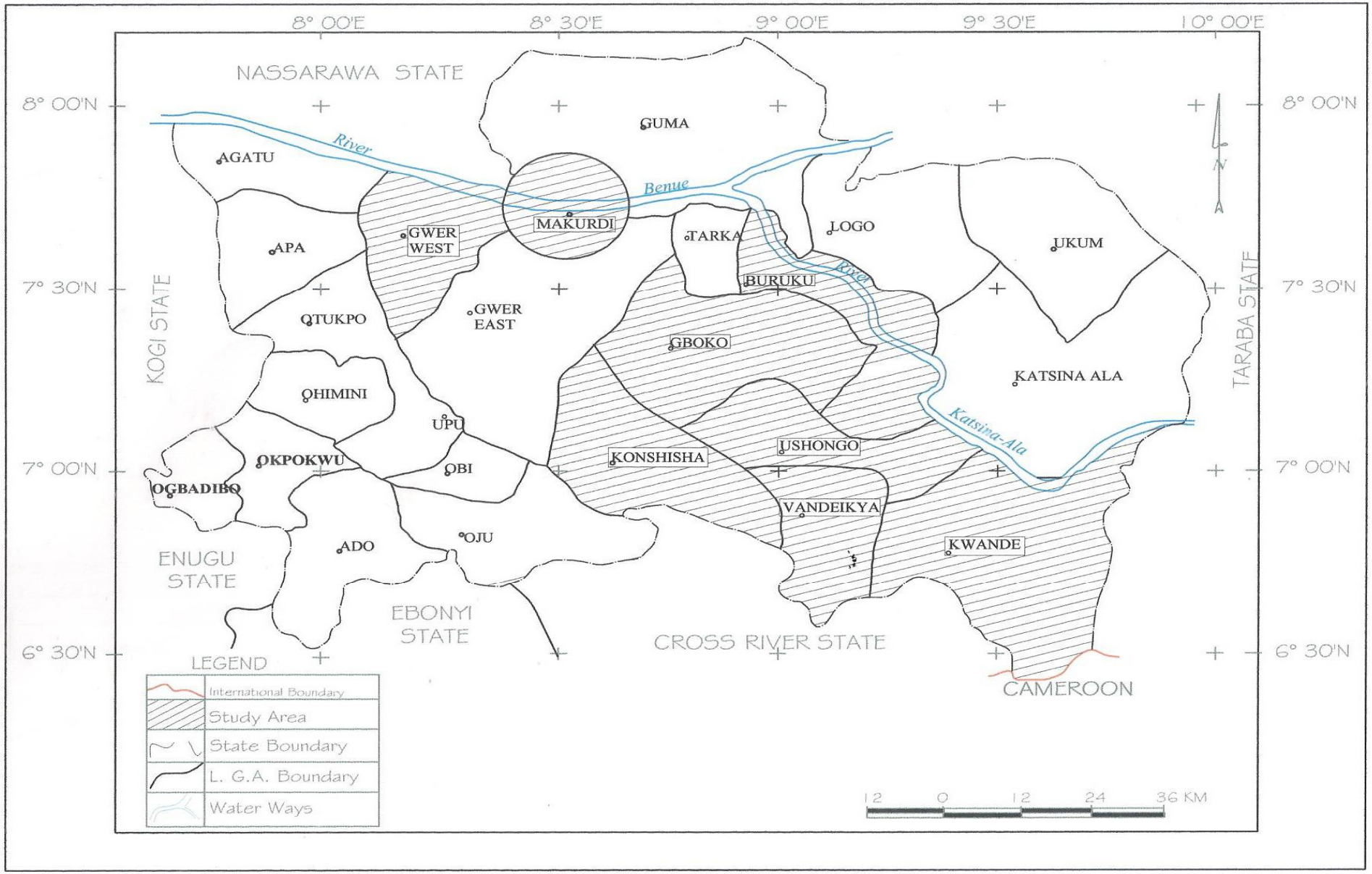

Figure 2. Map of Benue State Showing Study Area.
Source: Ministry of Lands and Survey Makurdy, 2013

RESULTS

Flora species assessed at burnt brick sites in Benue State

The sum of 200 flora species was identified at burnt brick sites in Benue State belonging to 58 families (Table 1). Table 1 contains the scientific names and common names of the flora species along with their corresponding Tiv language names and families. Table 2 contains a summary of the 58 families of flora species at the surveyed brick sites indicating the number of species sighted at the brick fields. The Poaceae family had the highest number of species (38) followed by the Fabaceae Family which had 17 species (Table 2). Most flora families (28) had only simgle specie identified from them. Flora species grown as food and cash crops by farmers at the brick sites included: *Abelmoschus esculentus, Arachis hypogaea, Cumunis melon, Capsicum annum, Dioscorea rotundata, D. Alata, Elaeis guineensis, Ipomoea batatas, Manihot esculenta, Musa paradisiacal, Nicotiana tabacum, Oryza sativa, Plantago major, Raphia farinifera*, *Saccharum officinarum, Zea mays and Zingiberaceae officinale.* Other wild flora species uecd as food included: *Borassus aethiopum, Dialium guineense, Elaeis guineensis, Mangifera indica, Platostoma africanum, Parkia biglobosa, Prosopis africana, Vitalleria paradoxa, and Vitex doniana.* Tree species of importance in burning bricks and domestic fuelwood included: *Afzelia africana, Anogeissus leiocarpus, Azadirachta indica, Crossoptyx fabrifuga, Dialium guineense, Entada abyssinica, Irvingoa gabonensis, Khaya grandifoliora, K. senegalensis, Lonchocarpus laxiflorus, Lophira lanceolata, Mangifera indica, Parkia biglobosa, Prosopis africana, Pterocarpus erineceus, Sygygium guineensis Vitalleria paradoxa,and Vitex doniana.* Common names and their corresponding *Tiv* names of these flora species appear in Table 1.

During burnt brick production, mainly hardwood tree spccies (such as listed above) which were big were felled for use as fuel wood in burning bricks, sometimes irrespective of their environmental, economic, aesthetic or social values. Other flora species considered by brick producers as having little or no value were cleared with hoes, cutlasses and axes. Cleared vegetation was used in mulching the green, unburnt bricks to prevent them from cracking as a result of accelerated drying. The rest of the cleared vegetation was burnt. Vegetation clearing at brick sites sometimes undermined the usefulness of cleared flora species in riparian buffer strip protection, so no buffer strips were preserved along rivers adjourning burnt brick sites. Continuous excavation and transportation of soil as finished bricks degrades the soil as indicated in soil analysis results at burnt brick areas. In consequence the sustained existence of some flora species has been threatened at most brick sites, moreso with indiscriminate use of non-selective, total weed killing herbicides in the continuously farmed parts of the brick sites. Flora species threatened included: *Hyparrhenia involucrate* and *Imperata cylindrical* known as *ach*o and *ihira* in Tiv language, respectively (both of which are extensively used as roofing grasses)

Identification and ranking of fuel wood tree species used in producing burnt bricks in Benue State

Table 3 below contains the names of the fuel wood tree species used in burning of bricks in Benue State alongside with their scales of preference, location of procurement and Local Government Areas where the species were used. Altogether, 25 species were found to be used in burning of bricks in the study area. *Prosopes africana* was the most preferred fuelwood tree specie with a preference scale of 1. *Khaya senegalensis*, *Vitellaria paradoxa* and *Pterocarpus erineceus* had a preference scale of 2 and were among the more preferred fuelwood tree species. *Isobslina doka, Daniellia oliveri, Uapaca togoensis, Anacardium occidentale, Entada abyssinica and Bambusa vulgaris* had aa scale of preference of 5 and belonged to the hardly used fuelwood species. However, with increasing cost and dearth of the preferred fuel wood tree species, there is a very high potential for increasing use of the hardly used fuel wood tree species. Most of the fuel wood tree species were procured from open woodlands, as well as farmlands. The used fuel wood tree species were largely not planted but grew naturally under environments moderated by man.

Table 1. Flora species identified at brick sites in Benue State (2013/2014)

S/No	Scientific Name	Common Name	Tiv Name	Family
1	*Abelmoschus esculentus* L.	Okra	Atuur	Malvaceae
2	*Acacia polyacatha* (Hochst. ex A. Rich.) Brenan	White thorn,	Asaa	Fabaceae
3	*Acalypha fimbriata* Schum & Thonn.	Copper leaf plant	NA	Euphorbiaceae
4	*Acanthospermum hispidu*	Bristly starbur	Asagher mbakuv	Asteraceae
5`	*Acanthus montanus* (Nees.) T. Anders	False thistle	NA	Acanthaceae
6	*Acroceras zizanioides* (Kunth) Dand*y*	Oat grass	NA	Poaceae
7	*Aeschynomene indica* Linn.	Indian Joint Vetch, budda pea,	NA	Papilionaceae
8	*Afzelia Africana* Sm.	Afzelia	Yiase	Fabaceae
9	*Ageratun conyzoides* Linn.	Billy goatweed	Hurhur	Asteraceae
10	*Alchonea cordifolia* (Schum.&Thonn) Mull	Christmas bush	Hunagh	Euphorbiaceae
11	*Amaranthus spinosus* Linn.	Thorny pigweed	Asagher u igyoo	Amaranthaceae
12	*Andropogon gayanus* Kunth var..gayanus	Giantgrass	Agom	Poaceae
13	*Andropogon tectorum* Schum. & Thonn.	Giant bluestem	Agom	Poaceae
14	*Aneilema aequinoctiale* (P.Beauv.) Kunth	clinging aneilema	Iwyarwyar	Commelinaceae
15	*Anogeissus leiocarpus* (DC.) Guill. & Perr.	Terminalia	Maaki	Combretaceae
16	*Anonna squamosa* L..	Cusstard apple	Ahur	Annonaceae
17	*Arachis hypogaea* L.	Peanuts, groundnuts	Ahi abun	Fabaceae
18	*Aspilia africana* (Pers.) C.D. Adams	Haemorrhage plant	Osu-osu	Asteraceae
19	*Aspilia bussei* O Hoffin &Mushl	White flowered homorrage plant	Osu-osu	Asteraceae
20	*Azadirachta indica* A. Juss	Neem Tree, Indian lilac,	Dogonyaro	Miliaceae
21	*Bambusa vulgaris* Schrad. ex JC Wendl. Bolinau (P. Bis.)	Common bamboo	Songugh	Poaceae
22	*Berlinia grandiflora* (Vahl) Hutch. & Dalziel	Berlinia	Ten	Caesalpiniaceae
23	*Boerhavia diffusa* L.	Tar Vine, Red spiderling	Ingbilayongo	Nyctaginaceae
24	*Borassus aethiopum* Mart.	African fan- palm	Kuugh	Arecaceae
25	*Bridelia ferruginea* BENTH	Kirni (Hausa)	Ikpine	Euphorbiaceae
26	Bryophyllum pinnatum (Lam.) Oken	Cathedral Bells	Igbo	Crassulaceae
27	*Burkea africana* Hook	wild seringa	Gbgbongum	Caesalpiniaceae.
28	*Calapogonium*	Devil's beans, Mucuna	Imo	Fabaceae
29	*Calapogonium muconoides*	Calapo	Hir-imo	Fabaceae
30	*Capsicum annum* L.	Pepper	Mkem	Solanaceae
31	*Celosia leptostachya* Benth.	Yellow Toreador.	Yiawoo	Amaranthacea
32	*Cenchrus biflorus* Roxb.	Hedgehog grass	Alufu	Poaceae
33	*Ceratotheca sesamoides* Endl	False sesame	Neer	Pedaliaceae
34	*Chamaecrista mimosoides* (L.) Greene	Japanese tea	Agenga	Caesalpinaceae
35	*Chrysanthellum indicum* DC	African wild daisy	**Huebar**	Compositae

36	*Chromolaena odorota* (L.) R.M. King & Robinson	Siamweed	Abokpali	Asteraceae
37	*Cochlospermum gillivraei* Benth	Yellow silk cotton tree	Kpavande	Bixaceae
38	*Cochlospermum planchoni* Hook.f.	False cotton	Kpavande	Cochlospermaceae
39	*Cochrorus olitorius* L	Jew's Mallow	Atiever	Tiliaceae
40	*Colasia isertii* C.C. Townsend		NA	Amarantheceae
41	*Colosia leptostachya* Benth	Yellow Toreador	NA	Amarantheceae
42	*Combretum hispidum* Laws.	Sierra Leone: Manding	NA	Combretaceae
43	*Commelina benghalensis* L	Tropical spiderwort	Iwyarwyar	Commelinaceae
44	*Conyza sumatrensis* (Retz.) Walker	Fleabane	NA	Asteraceae
45	*Cormelina diffusa*	Spreading dayflower	Iwyarwyar	Commelinaceae
46	*Costus afer* Ker Gawl	Ginger lily, bush cane	Ayande	Costaceae
47	*Crossoptyx fabrifuga* (Afzel.) Benth.	African bark;	Irkwaa	Rubiaceae
48	*Crotalaria macrocalyx* Benth.	Rattlepod or rattlebox	Tsua-tsua	Fabaceae
49	*Crotalaria retusa* Linn.	Rattlebox	Tsua tsua	Fabaceae
50	*Cumunis melon* L.	Melon	Ichegher	Cucurbitaceae
51	*Cuscuta australis* R.Br.	Dodder	Gbaaondo	Cuscutaceae
52	*Cynadon dactylon* (Linn.) Pers.	Bahama grass	Kirikiri	Poaceae
53	*Cyperus esculentus* Linn.	Yellow nutsedge	Ishoho	Cyperaceae
54	*Cyperus iria* Linn.	Ricefield flatsedge	Ishoho	Cyperaceae
55	*Dactylactenium aegyptum* (Linn.) P. Beauv.	Crowfoot-grass	Akangeraka	Poaceae
56	*Daniellia oliveri* (Rolfe) Hutch. & Dalz	African copaiba balsam	Chiha	Caesalpiniaceae
57	*Desmodium salicifolium* (Poir.) DC.	Senegal: Fula-Pulaar	Chancha	Leguminoseae
58	*Detarium senegalense* JF Gmelin	Tallow tree, dattock,	Lyenegh	Caesalpiniaceae
59	*Dialium guineense* Wilid.	Black velvet tamarind	Koondu	Caesalpiniaceae
60	*Digitaria horizontalis* Willd.	Digitgrass, crabgrass	Yaiyoghul	Poaceae
61	*Dioscorea alata* L.	Water Yam	Agbo (Iyough)	Dioscoreaceae
62	*Dioscorea bulbifera* L.	Aerial yam	Ajie	Dioscoreaceae
63	*Dioscorea dumetorum* (Kunth) Pax	African bitter yam	Inumbe	Dioscoreaceae
64	*Dioscorea rotundata* Poir	White GuineaYam	Nwange (Iyough)	Dioscoreaceae
65	*Echininochloa crus-pavonis* (Kunth) Schult	barnyard grass	NA	Poaceae
66	*Echinochloa spicanus* A. Canus	Cockspur grass.	Alufu a jande	Poaceae
67	*Eclipta alba* (L) Hassk	False daisy	Chigh ki usu	Asteraceae
68	*Eclipta prostrate* Linn.	False daisy, Prostrate Eclipta	Chigh ki usu	Asteraceae
69	*Encinochloa obtusiflora* Stapf.	Hippo grass	NA	Poaceae
70	*Elaeis guineensis* Jacq.	African Oil Palm	Ikye, ule, ivile	Arecaceae
71	*Eleusine indica* Gaertn.	Goosegrass	Akangeraka	Poaceae
72	*Elytrophorus spicarus* (Wild) A. Camus	Spikegrass	NA	Poacea
73	*Entada abyssinica* Steudel ex A. Rich.	Tree Entada	Nune-ikyar	Fabeceaa

74	*Eragrosis tenella* (Linn.) P.Beauv. ex.Roem & Schult.	Featherly lovegrass	NA	Poaceae
75	*Euphorbia cyathophora*	Wild poisetia, Milkweed	Tondo kpan	Euphorbiaceae
76	*Euphorbia heterophylla* Linn.	Spurge weed	NA	Euphorbiaceae
77	*Euphorbia hirta* Linn.	Australian asthma herb	Tyough kpoghuloo	Euphorbiaceae
78	Euphorbia milii L.	Christ's thorn	Usaa	Euphorbiaceae
79	*Ficus experata* Vahl.	Sandpaper tree	Hon	Moraceae
80	*Ficus asperifolia* Vahl	Sandpaper tree	Hon	Moraceae
81	*Ficus sur*	Wild fig, Broom cluster	Tur	Moraceae
82	*Fuirena ciliaris* (Linn.) Roxb.	Umbrella grass,	NA	Cyperaceae
83	*Gmelina arborea* Roxb	Beechwood, white teak	Malina	Verbenaceae
84	*Grewia venusta* Frese	basham (Ar)	Hueza	Tiliaceae
85	*Hackelochloa granularis* (Linn.) O. Kuntze	pitscale grass	NA	Poaceae
86	*Heliotropium indica* Linn.	Indian helistrope	NA	Boraginaceae
87	*Heterosis rotundifolia (Sw.) Jacq.-Fél.*	Monk's pepper	Azande	Melastomaceae
88	*Hibiscus asper* Hook.f.	Jamaica sorrel, Egyptian hibiscus tea	Ashwe ishoho	Malvaceae
89	*Hydrolea palustris* (Aubl) Rausch		NA	Hydrophyllaceae
90	*Hyparrhenia involucrate* Stapf.	Roofing grass	Acho	Poaceae
91	*Hyparrhenia rufa* (Nees) Stapf	Thatch grass	Azenga	Poaceae
92	*Hypoestes cancellata* Nees	Ferry		Acanthaceae
93	*Hyptis suaveolens* (L) Poit	Bush tea, Mintweed	Zenda imunan	Lamiaceae
94	*Imperata cylindrical* (Linn.) Raeuschel var. Africana (Anderss) C. E. Hubbard	Swordgrass	Ihira	Poaceae
95	*Indigofera tinctoria* L.	Indigo	Beba	Fabaceae
96	*Ipomoea asarifolia* (Derr.) Roem & Schult.	Salsa or ginger-leaf morning-glory	NA	Convolvulaceae
97	*Ipomoea batatas* (L.) Lam	Sweet potato	Atsaka	Convolvulaceae
98	*Ipomoea eriocarpa* R.Br.	Tall Morning-glory	NA	Convolvulaceae
99	*Ipomoea involucrate* P.Beauv.	Morning glory weed	NA	Convolvulaceae
100	*Ipomoea triloba* Linn.	Three-lobe Morning-glory	NA	Convolvulaceae
101	*Irvingia gabonensis,* (Aubry-Lecomte ex Ororke) Baillon	African bush mango	Ive, Anzamber-u Kunav	Irvingiaceae
102	*Isoberlina doka* Craib & Stapf.	Doka	Akovur	Caesalpinaceae
103	*Khaya grandifoliora* Welw	Mahogany	Haa Tamen	Miliaceae
104	*Khaya senegalensis* A. Juss	Mahogany	Haa Kiriki	Miliaceae
105	*Kigelia africana* (Ram) Bent	**African sausage tree,**	Ityembegh	Bignoniceae
106	*Kyllinga squamulata* Thorn. Ex.Vihl	Asian Spikesedge	NA	Cyperaceae
107	*Laportea aestuans*(Linn.) Chew	Tropical nettleweed	NA	Urticaceae
108	*Leonotis nepetifolio* (L.) Ait.f.	Bird honey, Lion's Ear	NA	Lamiaceae
109	*Leucas martinicensis* (Jacq.) Ait.f.	Wild tea bush	NA	Lamiaceae
110	*Lonchocarpus laxiflorus* Guill. & Per	Lancepod	Gbagbongum	Fabaceae

111	*Lophira lanceolata* Tiegh. ex Keay	English red oak, dwarf red	Hookura(Ikyura- i-nomso)	**Ochnaceae**
112	*Loudentia arundinaceae* (Hochst. ex. A. Rich.) Steud	Feathergrass, Senegal: Wolof	Aper	Poaceae
113	*Luffa cylindrical* (Linn.) M.J. Roem	Loofa gourd	Kileyongu	Cucurbitaceae
114	*Lycopersicon esculentum* Mill.	Tomato	Tumatu	Solanaceae
115	*Mangifera indica* L.	Mango	Mangulu	Anacardiaceae
116	*Manihot esculenta* Crantz	Cassava	Alogo	Euphorbiaceae
117	*Manihot utilissima* Pohl	Cassava	Alogo (danwari)	Euphorbiaceae
118	*Mariscus longibracteacus* Cherm		Shoho	Cyperaceae
119	*Melastomataceae capitatum* (Vahl) A.& R. Fem	Capitata	NA	Melastomataceae
120	*Melochia Corchorifolia* Linn.	Chocolate Weed	NA	Sterculiaceae
121	*Merremia aegyptia* (Linn.) Urban	Hairy woodrose	NA	Convolvulaceae
122	*Mimosa invisa* Mart. Ex. Collia	Giant sensitive plant	Ageva	Mimosoceae
123	*Mitracarpus villosus* (Sw.) DC.	Tropical girdlepod	Tyough- kpoghuloo	Rubiaceae
124	*Momordica charantia* Linn.	African cucumber	NA	Cucurbitaceae
125	*Monechma ciliatum* (Jacq.) Milne Redhead	Black mahlab (Eng)	NA	Acanthaceae
126	*Mucuna pruriens (L.) DC.*	Devils beans	Imo	Febaceae
127	*Musa acuminate* Colla	Edible banana	Banana (Ayaba)	Musaceae
128	*Musa paradisiaca* L.	Common Banana	Banana (Ayaba)	Musaceae
129	*Nicotiana tabacum* L.	Tobacco	Taav	Solanaceae
130	*Nymphaea latus* Linn.	Water lilly	Tav-kar-mngerem	Nymphphaeaceae
131	*Oryza barthii* A. Chev.	African wild rice	Beem	Poaceae
132	*Oryza longistaminata* A,Chev.&Roehr	Wild rice	NA	Poaceae
133	*Oryza sativa* L.	Rice	Ichinkafa	Poaceae
134	*Palisota hirsute* (Thumb.) K. Schum.	yellow nutsedge	NA	Commelinaceas
135	*Panicum laxum* Sw.	Guineagrass	NA	Poaceae
136	*Panicum maximum* Jacq.	Guineagrass, buffalo grass	Wuanor	Poaceae
137	*Parkia biglobosa* [Jacq.] Benth.*,*	African locust bean	Nune	Mimosaceae
138	*Paspalum conjugatum* Berg.	Sourgrass, Buffalo grass	NA	Poaceae
139	*Paspalum scrobiculatum* Linn.	English bastard millet; ditch millet; koda millet	NA	Poaceae
140	*Pennisetum pedicellatum* Trin.	Kyasuma grass, deenanath grass	Awoo	Poaceae
141	*Pennisetum purpureum* Schumach.		Awoo	Poaceae
142	*Pennisetum violaceum* (Lam.) Rich.	feathery pennisetum	Alufu	Poaceas
143	*Pentadon pentadras* (Schum. & Thonn.) Vatke		NA	Poaceae
144	*Pistia stratiotes* L.	Water cabbage, Water lettuce	Chigh ki mkungu	Aracaceae
145	*Phyllanthus amarus* Schum. & Thonn.	Chanca piedra, stone-breaker,	NA	Euphorbiaceae
146	*Physalis micrantha* Linn.		Tampue	Solanaceae
147	*Physalis peruviana* L. Wild tomato	Wild Cape gooseberry	Tampue	Solanaceae

148	*Piliostigma thonningii* (Schum) Milne-Redhead	Camel's foot (Enqg.), Monkey bread	Gyaan-kpande	Fabaceae
149	*Plantago major* L.	Plantain	Kookombu	Plantaginaceae:
150	*Platostoma africanum* P. Beauv.	Manding-Bambara (Senegal)	Yiawoo	Lamiaceae
151	*Polycarpaea corymbosa* (Linn.) Lam.	Oldman's Cap	NA	Caryophyllaceae
152	*Polygonum lanigerum* R.Br. var.africanum Meisn	Pink Knotweed	NA	Polygonaceae
153	*Prosopis africana* (Guill., Perrott. and Rich.) Taubert	African Mesquite	Gbaaye	Mimosaseae
154	*Protulaca quadrifida*	Ten o' clock plant	Hwerbar	Portugalaceae
155	*Pterocarpus erineceus* Poir	Barwood, rosewood	Ngaji, Tsakomo	Fabaceae
156	*Pyysalis angulata* Linn.	Slender wildcape gooseberry	Tampue	Solanaceae
157	*Raphia farinifera*	Raffia palm	Ichor	Aracaceae
158	*Rhynchospora corymbosa* (Linn) Britton.	Beaksedge	Suswam	Cyperraceae
159	*Ricinus communis L.*	Castorbean	Jija, Shoor	Euphorbiaceae;
160	*Rostraria cristata* L.	Cats' tail grass	Zerbua	Poaceae
161	*Rottboellia cochinchinensis* (Lour.) Clayton	Itchgrass	Ayangeraya	Poaceae
162	*Saccharum officinarum* L.	Sugarcane	Likye, yelegh	Poaceae
163	*Sarcocephalus latifolius (*Smith) Bruce	*Savanna Nauclea*	ikyura- ukase	Rubiaceae
164	*Scleria verrucosa* Willd.	Bush knife	Suswam	Cyperaceae
165	*Senna obtusifolia* (L.) Irwin & Barbeby	Sicklepod.	NA	Fabaceae
166	*Senna occidentalis* (L.) Link	Coffee sena, coffeeweed	Tsetsa	Fabaceae
167	*Senna alata* (L.) Roxb	Ringworm bush	Kuha-indyar	Fabaceae
168	*Sesamum alatum* Thonning	Gazelles sesame	Neer	Pedaliaceae
169	*Setaria barbata* (Lam.) Kunth	Bristly foxtail	NA	Poaceae
170	*Sida acuta* Burm.f.	Broomweed	Chancha	Malveceae
171	*Sida cordifolia* Linn.	flannel weed, heart leaf sida	Chancha	Malvaceae
172	*Solanum melongena* L.	Eggplant	Ihyolugh, (Mngishim)	Solanaceae
173	*Solanum nigrum* L.	Black nightshade	Nyakoo	Solanaceae
174	*Sorghum arundinaceum* (Desv.) Stapf.	Wild Sorghum	Wuanor	Poaceae
175	*Spondias mombin* L.	Hog plum, yellow mumbin	Konkwaa	Anacardiaceae
176	*Spigelia anthelmia* Linn.	West Indian pinkweed	NA	Loganiaceae
177	*Sporoboros pyramidalis* P. Beauv.	Giant Ratstail Grass	Dzerbua	Poaceae
178	*Symphoricarpos albus*	Snowberry tree, wormwood	Yagheragum	Caprifoliaceae
179	*Sterculia africana* (Lour.) Fiori	Rough-barked Sterculia	Kumendur	Sterculiaceae
180	*Striga hermonthica* (Del.) Benth.	Purple witchweed	Lisha	Scrophulariaceae
181	*Sygygium guineensis* Keay	Waterpear,	Mho	Myrtaceae
182	*Tectona grandis* Linn. .	Teak	Luagher	Verbenaceae
183	*Tephrosia bracteolate* Guill. & Perr.	hairy indigo	Agenga	Fabaceae
184	*Terminalia avicennioides* Guill. & Perr.		Kuegh	Combretaceae
185	*Terminalia catapa* L.	Narrow long leafed Terminalia	Kuegh	Combretaceae .
186	*TithoniaDiversifolia* (Hemsl.) A.. Gray	Mexican sunflower		Asteraceae

187	*Trianthema portulacastrum* Linn.	Horse parlance	NA	Aizoaceae
188	*Tridax procumbens* Linn.	Coatbuttons	Ambi-a-ikomon	Asteraceae
189	*Triumfeta cordifolia* A. Rric.	Chinese bur, bur bush	NA	Tiliaceae
190	*Uapaca togoensis* Pax	Savanna uapaca	Ishase uagh	Euphorbiaceae
191	*Urelytrum muricatum* Hack.		Acho	Poaceae
192	*Urena lobata* Linn.	Hibiscus bur, caesar weed	Shoho	Malvaceae
193	*Uvaria charmea* MS	finger root	Ikyo	Annonaceae
194	*Vervonia cinerea* (Linn.) Less.	Little iron weed	NA	Asteraceae
195	*Vitalleria paradoxa* C. F. Gaertn	Shea butter	Chamegh	Sapotaceae
196	*Vitex doniana* (Joris de Wolf, Patrick. Van Damme, Diego Van Meersschaut).	Black Plum	Hulugh	Verbenaceae
197	*Waltheria indica* Linn.	Sleepy Morning, Basora Prieta	NA	Sterculiaceae
198	*Zanthoxylum zanthoxyloides* Lam	Candlewood,	Ikinaka	Rutaceae
199	*Zea mays* L.	Corn, maize	Ikyuleke	Poaceae
200	*Zingiberaceae officinale* Roscoe	Ginger	Seta	Zingiberaceae

NA= Not available
Source: Field Survey (2013/2014

Table 2. Families and number of flora species sighted at brick sites in Benue State

S/No	Family of Plant Species	No of species Sighted in family	Percentage of species by family
1	Acanthaceae	3	1.50
2	Aizoaceae	1	0.50
3	Amaranthaceae	4	2.00
4	Anacardiaceae	2	1.00
5	Annonaceae	2	1.00
6	Arecaceae	3	1.50
7	Asteraceae	11	5.50
8	Bignoniceae	1	0.50
9	Bixaceae	1	0.50
10	Boraginaceae	1	0.50
11	Caesalpiniaceae	7	3.50
12	Caprifoliaceae	1	0.50
13	Caryophyllaceae	1	0.50
14	Cochlospermaceae	1	0.50
15	Combretaceae	3	1.50
16	Commelinaceae	5	2.50
17	Compostae	1	0.50

18	Convolvulaceae	6	3.00
19	Costaceae	1	0.50
20	Crusalaceae	1	0.50
21	Cucurbitaceae	3	1.50
22	Cuscotaceae	1	0.50
23	Cyperaceae	7	3.50
24	Dioscoreaceae	4	2.00
25	Euphorbiaceae	12	6.00
26	Fabaceae	17	8.50
27	Hydrophyllaceae	1	0.50
28	Irvingiaceae	1	0.50
29	Lamiaceae	4	2.00
30	Leguminoseae	1	0.50
31	Loganioceae	1	0.50
32	Malvaceae	5	2.50
33	Melastomataceae	2	1.00
34	Miliaceae	3	1.50
35	Mimosaceae	3	1.50
36	Moraceae	3	1.50
37	Musaceae	2	1.00
38	Muscutaceae	1	0.50
39	Myrtaceae	1	0.50
40	Nyctaginaceae	1	0.50
41	Nyphaeaceae	1	0.50
42	Ochnaceae	1	1.00
43	P ortugalaceae	1	0.50
44	Papilionaceae	1	0.50
45	Pedaliaceae	2	1.00
46	Plantiginaceae	1	0.50
47	Poaceae	38	19.00
48	Polygonaceae	1	0.50
49	Rubiaceae	3	1.50
50	Rutaceae	1	0.50
51	Sapotaceae	1	0.50
52	Schrophulariaceae	1	0.50
53	Solanaceae	8	4.00
54	Sterculiaceae	3	1.50
55	Tiliaceae	3	1.50

56	Urticaceae	1	0.50
57	Verbanaceae	3	1.50
58	Zingerberaceae	1	0.50
	Total number of species	**200**	**100.00**

Table 3. Names, ranking and sources of fuel wood tree species used in brick production in Benue State by local government area

S/N	Fuel wood species	Local Name (Tiv)	Frequency of respondent	Perce-ntage (%)	Scale of prefe-rence	Local Government Area(s)	Area from which harvested
1	*Prosopis africana*	Gbaaye	728	91.00	1	a,b, c, d, e, f, g, h,	Farmland
2	*Khaya senegalensis*	Hagh	616	77.00	2	a,b, c, d, e, f, g, h,	Open woodland
3	*Vitellarlia paradoxa*	Chamegh	552	69.00	2	a,b, c, d, e, f, g, h,	Open woodland
4	*Parkia biglobosa*	Nune	458	57.26	4	a, c, d, e, g, h,	Farmland
5	*Isobslina doka*	Mkovul	372	46.50	5	a, c, d, e, g, ,	Open woodland
6	*Anogeissus leiocarpus*	Maaki	410	51.26	3	a, b, c, d, e, f, g, h,	Open woodland
7	*Lophira lanceolata*	Hookula	502	62.76	4	a, b, c, d, f, g,	Open woodland
8	*Entada abyssinica*	Nune-ikyar	284	35.50	5	a, b, c, d, e, f, g, h,	Open woodland
9	*Afzelia africana*	Yiase	310	38.75	3	b, c, d, e, g, h,	Open woodland
10	*Sygygium guineensis*	Mho	347	43.38	3	a, b, c, d, e, f, g, h,	Open woodland
11	*Mangifera indica*	Mangulu	328	41.00	4	a, b, c, d, e, f, g, h,	Open woodland
12	*Daniellia oliverii*	Chiha	486	56.60	5	a, b, c, d, e, f, g, h,	Open woodland
13	*Detarium senegalensis*	Lyenegh	210	26.25	4	c, d, e, f, g,	Open woodland
14	*Pterocarpus erineceus*	Ngaji	216	27.00	2	a, b, c, d, e, f, g, h,	Open woodland
15	*Lonchocarpus laxiflorus*	Gbagbongum	182	22.75	3	a, b, c, d, e, f, g, h,	Open woodland
16	*Crossoptyx fabrifuga*	Irkwaa	205	25.63	4	a, c, d, e, g, h,	Open woodland
17	*Terminalia catapa*	Kueg**h**	325	48.63	3	a, b, c, d, e, f, g, h,	Open woodland
18	*Azadirachta indica*	Dogonyaro	128	15.74	4	b, c, d, e, f, h,	Farmland/ residence
19	*Tectona grandis*	Luagher	48	6.00	4	c, d, e, g, h,	Forest
20	*Vitex doniana*	Hulugh	218	27.25	4	a, b, c, d, e, f, g, h,	Open woodland
21	*Anacardium occidentale*	Ishase	85	10.63	5	a, b, d, e, f, g,	Farmland
22	*Uapaca togoensis*	Ishase uwagh	197	24.63	5	a, b, c, d, e, f, g, h,	River bank
23	*Irvingia gabonensis*	Ive	12	1.50	4	g, h,	Farmland
24	*Dacryodes edulis*	Mzembe	12	1.50	4	e, g, h,	Farmland
25	*Bambusa vulgaris*	Songugh	4	0.50	5	F	River bank/residence

Key (a)-Local Government Area
a = Buruku b= Gboko c = Gwer-West d = Konshisha
e = Kwande f= Makurdi g = Ushongo h = Vandeikya

Key (b)- Scale of preference
1= Most prefer 2= More preferred 3 = preferred
4= Used Occasionally 5 = Hardly used

Source: Field survey, 2012

DISCUSSION OF RESULTS

Effects of the presence of vegetation on soil

Apart from intercepting rain before it reaches the soil surface, plants help determine the proportion of water that runs off and that which percolates into the soil. Vegetation and surface residues of perennial grasslands and forests protect the porous soil structure from the beating action of raindrops. This encourages water infiltration and reduces the chances of erosion through run-off water. Little run-off occurs from land under undisturbed forests or well-managed grassland, however, differences in plant species, even among grasses can influence run-off (Brady and Weil, 1999).From soil as source, water moves up to roots, to stems to leaves and into the atmospheric sink. The plant is a smooth transmitter of water and the removal of brush, and trees as well as the clear-cutting of forests multiples run-off, soil leaching and stream flow (Jenny, 1980).

When tended and managed as part of a controlled programme, trees and woodland can act to rehabilitate derelict land including landfill sites (French et. al., 2006). Planting of trees adjacent to contaminated land can help to reduce the off-site mitigation by reducing runoff by reducing wind erosion and trapping airborne contaminated soil. Trees and woodland reduce the mobilisation and leakage of contaminants that have potentials of polluting surface and ground water. Trees actively take up contaminants and fix them in woody biomass (Dickenson et. al., 2009).Trees aid in enriching the soil with organic matter which is vital in immobilising contaminants (Hutchings, 2002). Trees and vegetation generally reduce surface runoff/ground water recharge and thus the potential for leaching of contaminants to water. They provide a semi-permanent cover thereby decreasing the threat of soil disturbance and erosion.

Impacts of removal of vegetation cover

The impacts of site clearing and soil excavation span beyond nutrient removal as this can upset nutrient cycles until vegetation cover is re-established to restore litter supply to the top soil. Soil excavation and vegetation clearing can individually and collectively destroy soil structure. This results in altering of soil physical, chemical and biological properties. Clearing and excavation expose the soil surfaces and triggers surface runoff and eventual loss of dissolved nutrients. The exposed soil surface in consequence, receives greater insolation which in turn increases soil temperature and accelerates rapid breakdown of organic matter (Nwoboshi, 2000) Soil excavation also tends to increase bulk density of soils since excavation tends to remove top soil rich in organic matter thus decreasing organic matter pools.

Deforestation or removal of large areas of natural vegetation increases runoff rates, decreases infiltration, and also reduces recharge of natural aquifers. These can promote deleterious agricultural, ecological and urban crises since man's sources of water stand the risk of experiencing acute shortages. Other impacts of vegetation removal are as follows:

(a) **Soil Crusting:** Falling drops of water during heavy rains or sprinkler irrigation beat apart the aggregates exposed at the soil surface Nwoboshi (2000). Sometimes, the dilution of salts by rain water stimulates the dispersion of clays. The dispersion of aggregates, small particles and dispersed clay tend to wash into and clog the soil pores. In consequence, the soil surface soon becomes covered with a thin layer of fine structureless materials (surface seal). The seal inhibits water infiltration and increases erosion loses. The dried surface seal forms a hard crust which tends to inhibit easy germination of plant seeds. Thus the formation of a crust soon after a crop is sown may permit few seeds to emerge, making replanting of seeds imperative. Improved management of organic matter and use of certain soil amendments can 'condition' the soil and help prevent clay dispersion and crust formation (Brady and Weil, 1999).

(b) **Organic Residue Degradation:** Poor aeration following vegetation removal slows down the rate of decay as portrayed by the relatively high levels of organic matter in poorly drained soils. The nature and rate of microbial activity is determined by the oxygen content of the soil. In the absence of gaseous oxygen, anaerobic organisms take over. The excavation of aerated top soil, leaving behind poorly aerated sub-soil therefore tends to leave behind at the brick-laying site a wide variety of only partially oxidized products such as ethylene gas (C_2H_4) alcohols and organic acids many of which can be toxic to higher plants and to many decomposer organisms (Brady and Weil, 1999). The later effect helps account for the formation of Histosols in wet areas where inhibition of decomposition permits thick layers of organic matter to accumulate. Thus the absence or presence of oxygen gas modifies completely the nature of the decay process and it affects plants growth in the area.

Soil surface exposure, organic matter depletion and use of some crop nutrition and protection products, de-vegetation or removal of vegetative or thrash cover allows raindrop impacts to disperse soil particles, leading to puddling of the soil and ultimately compaction. The single act of tillage may accelerate the rate of organic matter breakdown of some types of organic matter in the soil which are required to bind soil particles together.

CONCLUSION

The sum of 200 flora species was identified at burnt brick sites in Benue State belonging to 58 families. The Poaceae family had the highest number of species (38) followed by the Fabaceae Family which had 17 species. Altogether, 25 tree species were found to be used in burning of bricks in the study area. *Prosopes africana* was the most preferred fuelwood tree specie with a preference scale of 1. *Khaya senegalensis*, *Vitellaria paradoxa* and *Pterocarpus erineceus* had a preference scale of 2 and were among the more preferred fuelwood tree species. *Isobslina doka, Daniellia oliveri, Uapaca togoensis, Anacardium occidentale, Entada abyssinica and Bambusa vulgaris* had aa scale of preference of 5 and belonged to the hardly used fuel wood species. Apart from intercepting rain before it reaches the soil surface, plants help determine the proportion of water that runs off and that which percolates into the soil. Vegetation and surface residues of perennial grasslands and forests protect the porous soil structure from the beating action of raindrops. This encourages water infiltration and reduces the chances of erosion through run-off water. Little run-off occurs from land under undisturbed forests or well-managed grassland, however, differences in plant species, even among grasses can influence run-off Vegetation clearing for burnt bricks production in the study area seriously undermined the usefulness of cleared flora species in riparian buffer strip protection, so no buffer strips were preserved along rivers and streams adjourning burnt brick sites. Due to rapidly changing environmental conditions (land clearing, logging operations, soil erosion, deforestation, water logging, soil mining, farming, bush fires, use of general herbicides et cetera), some of these plant species and families are at risk of extinction in the study area due to burnt brick production and other human dimensions to ecological disturbance

RECOMMENDATIONS

1. Afforestation should entail selection of hardy, tolerant fast- growing flora species suited to the properties of minesoil, and establishing them quickly under harsh conditions, for the purpose of of controlling erosion.
2. Species of trees preferred for use as fuel wood need to be planted by brick producers and members of the public to ensure that these tree species do not go extinct
3. Research into the sourcing, production and use of alternative energy sources to reduce dependence on extensive use of woody biomass for curing of bricks should be encouraged.
4. Participatory approaches to Community-based Natural Resource Planning should be adopted by the three tiers of government,
5. Wastage of good quality agriculturally productive soils in brick making can be reduced by: promoting deep mining of clay for brick making instead of surface mining and utilising waste materials like fly ash, boiler ash, and stone dust in brick making

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