

Environmental Impact of Urbanization in Nigeria

ABSTRACT

This review revealed that there are several evidences of environmental impact of urbanization in Nigeria. The linkages between urbanization process and the environment are profound that the major components of the environment-air, water and land are adversely affected by the daily anthropogenic activities of urban residence and in the process of exploiting the natural resource base. The goal of ensuring environmental sustainability is greatly threatened by urbanization, which has created several serious environmental problems, such as pollution, deforestation and wetland destruction, erosion and flooding, urban sprawl, slum and squatter settlements, heat island and aesthetic degradation that have had negative impacts on man and other living organisms in the environment. If the threats posed by urbanization in Nigeria are not adequately managed, the capacity of the environment to continuously support life may be jeopardized with dire consequences on human life.

Keywords: Environmental Impact, Nigeria, Pollution, Urbanization

1. INTRODUCTION

Man continues sustenance on earth and the quality of his living is heavily dependent on the environment. The major components of the environment-air, water and land are supporting pillars of man, which he depends on directly or indirectly for his survival and well being. Unfortunately, man seems to be at war with his environment, which is evident in his over exploitation and inadequate management of the basic components of the environment. This unsustainable exploitation of the natural environment has posed serious challenges and great threat to Nigeria's natural resource base. One of the major threats to the Nigeria environment is urbanization. Mabogunje [1] stated that urbanization is a process of human agglomeration in multi-functional settlement of relatively substantial size. Urbanization process is one of the most powerful and visible anthropogenic forces on earth [2]. This process, as explained by [3], has been responsible for transforming towns, cities and metropolitan areas, while at the same time depopulating the rural setting through a process of direct rural-urban migration.

Studies have shown that rapid urbanization has greatly accelerated economic and social development, and global cities are engines of economic growth and centres of innovation for the global economy and

28 the hinterlands of their respective nations [4]. Hence, the world continues to experience high rates of
29 urbanization, especially in developing countries like Nigeria, which has an estimated 5.3 per cent annual
30 growth rate. The United Nations [5] noted that 30 per cent of the global population lived in urban areas in
31 1957; while the figure reached 50 per cent in 2008, and an estimated 70 per cent is projected for the year
32 2050. It stated further that in the foreseeable future, virtually all of the world's population growth will be
33 absorbed by the urban areas of the less developed regions, whose population is projected to increase
34 from 2.4 billion in 2007 to 5.3 billion in 2050. Today there are over 400 cities in the world with populations
35 of over 1 million people [6]. In Nigeria, the Human Development Report (2004) cited in [7] observed that
36 of the 2002 estimated population of 120.9 million people, 45.9 per cent of the population resides in urban
37 centers. According to [8], residents of urban centers in Nigeria in 1950 were less than 15 per cent of the
38 population; while it rose to 23.4 per cent and 43.3 per cent in 1975 and 2000 respectively; with an annual
39 urban population growth rate of 4.8 per cent. He also noted that Nigeria has 359 urban settlements of at
40 least 20, 000 people according to the 1991 National Population Census.

41
42 The high influx of people into the urban centres from the rural areas to take advantage of the perceived
43 opportunities offered by these urban centres, without adequate planning and effective management
44 strategies to accommodate this influx by the government, results to serious pressure on both the socio-
45 economic supporting infrastructure and the environment. For instance, urbanization has been identified
46 as the cause of numerous environmental problems, which include and not limited to air, water, land and
47 noise pollution, deforestation, local climate alteration, and traffic congestions, which ranges from local to
48 the global scale [9; 10; 11; 12; 13].

49
50 In Nigeria, [9] cited in [14] identified several types of environmental problems classified as ecological,
51 poaching and habitat loss, increasing desertification and soil erosion. These are further subdivided into
52 pollution, deforestation, global warming, slum development, etc. Nigeria's coastal regions are currently
53 experiencing widespread contamination from petroleum exploration (gas flaring, oil spillage) while the
54 general poor living conditions in urban areas in the country constitutes an affront to human dignity [14].
55 These environmental problems continue to increase as the urban growth rate continues to rise.

56 The National Population Commission [15] observed that most urban areas in Nigeria have grown beyond
57 their environmental carrying capacities and existing infrastructure. For instance, data from the National
58 Population Census (2006) revealed that most of the urban areas in Nigeria with small land mass have
59 already exhausted or have extremely limited capacities to accommodate further increase in population
60 [16]. With a population figure of more than 140 million and land mass of about 924,000 Km², current
61 estimates indicated that 10 per cent of the land area accommodated 28 per cent of the country's total
62 population [17]. The implication of this is that there is disequilibrium between the population and the
63 environment, and this has adversely affected the carrying capacity of the urban areas in the country;
64 hence the increasing poor quality of the living conditions and the low livability index of urban areas in
65 Nigeria [14].

66

67 The goal of ensuring environmental sustainability is greatly threatened by urbanization, which has created
68 several serious environmental problems that have had negative impacts on man and other living
69 organisms in the environment. If the threats posed by urbanization in Nigeria are not adequately
70 managed, the capacity of the environment to continuously support life may be jeopardized with dire
71 consequences on human life.

72

73 In spite of the importance of the environment for human sustainability, not much study has been carried
74 out in Nigeria to investigate the fundamental linkages between the environment and urbanization. Past
75 studies on impact of urbanization are broad based, focusing on socio-economic and environmental issues
76 [14; 18), which have created gaps in the in-depth analysis of environmental and urbanization linkages.
77 However, without an adequate understanding of the intricate linkages between the environment and
78 urbanization process, it would be difficult to propose effective and efficient strategies to resolving or
79 ameliorating the plurality of the impacts of urbanization on the environment. Hence, this study was aimed
80 to fill the gap in the understanding of the environment and urbanization linkages through a comprehensive
81 review. It is hoped that this understanding will prove valuable to Nigerian policy makers, urban developers
82 and environmentalists in the sustainable management of the environment and urbanization linkages to
83 the benefit of man and other living organisms. This review is presented under the following subheadings:

84 introduction, pollution, deforestation and wetland destruction, erosion and flooding, urban sprawl, slum
85 and squatter settlement, heat island, aesthetic degradation, conclusion and **recommendations**.

86 87 **2. POLLUTION**

88
89 Human activities generate tremendous amount of waste materials, which increases as production and
90 consumption activities increases, especially in urban areas as population agglomerates. The waste
91 generated may find their way into the major components of the environment (air, water and land) bringing
92 about environmental pollution. Environmental pollution is an undesirable change in the physical, chemical
93 or biological characteristics of air, water or land that will be or may be harmful to human and other life,
94 industrial process, living conditions and cultural assets or cause wastages of our raw material resources
95 [19].

96 97 **2.1. Water Pollution**

98 In most Nigerian urban areas, waste management is a big challenge, which has brought about severe
99 pollution of the major environmental components, with dire consequences on the inhabitants. For
100 instance, [20] reported that rain water in Warri metropolis contain a high level of acidity due to the high
101 emission of particulate matters and gases into the urban atmospheric environment. He stated further that
102 the resultant acid rain pollutes both surface and groundwater sources with negative effects on the health
103 of the inhabitants. Similarly, [21] reveals that some of the selected quality parameters of hand-dug wells
104 in Warri-Effurun metropolis have concentrations, which are not within the World Health Organization
105 (WHO) thresholds. For instance, pH concentrations in all the sampled well water are not within the 6.5-8.5
106 WHO thresholds for drinking water, as all the values are below the minimum 6.5 WHO range. This shows
107 that well water supply in the metropolis is acidic, (which agrees with [20]). Also, the report revealed that all
108 well water samples contain total coliform counts, as against the WHO zero thresholds. This indicates that
109 there might be the presence of disease causing pathogenic bacteria, which may pose a threat to human
110 health if such water is consumed without treatment [21].

111
112 This scenario in Warri metropolis is not different from what is obtainable in other urban areas in Nigeria.
113 For instance, a study by [22] reveals that some of the selected quality parameters of borehole water in

114 Yenagoa metropolis, have concentrations above the WHO thresholds for potable water. They reported
115 that turbidity values in all the sampled water were above the WHO 5 NTU thresholds; while 46.67%
116 samples have pH values below the WHO minimum value of 6.5, indicating acidity.

117

118 Studies have identified several human activities that cause water pollution. These activities pollute both
119 surface and groundwater resources in Nigerian urban centres. One of the major sources of water
120 pollution in the urban areas of the Niger Delta is oil spills, which has brought about massive pollution of
121 the water resources in this area, killing aquatic lives and rendering the affected water sources unsafe for
122 human consumption. In addition, buried chemical waste and poorly maintained dumpsites, which are
123 common features in most Nigerian cities can pollute both surface and groundwater sources. The poor
124 sewage treatment and solid waste disposal in most cities in Nigeria, is another veritable source of water
125 resources pollution (Plate 1). Unrestricted use of pesticides, insecticides, herbicides and indiscriminate
126 dumping of refuse, excreta and animal dung as well as spillages from refineries, large scale bush burning
127 are identified as some of the leading factors of environmental pollution in Nigeria [23; 24]. Furthermore,
128 soil erosion, siltation, salinization, irrigation, saltwater incursion and pollution from urban and municipal
129 sources each pose grave threats to Nigeria's freshwater resources. In times of drought, and/or with areas
130 confronted with desertification these threats are even more exacerbated. In the dry land areas of the
131 north, human habitation relies heavily on groundwater resources that are recharged from freshwater
132 percolation and runoff during the rainy season. Anything that upsets this balance threatens the livelihoods
133 and economy of the people who live there [25].

134

135 A major source of water pollution in Nigeria urban areas is fertilizer used in agriculture. Urban agricultural
136 practices make extensive use of fertilizers, which usually contain large amounts of nitrogen and
137 phosphorus. When it rains the fertilizer is washed into streams, rivers and creeks, which pollutes and
138 facilitates the process of eutrophication that degrade the quality of the surface water, which makes it unfit
139 for human consumption.

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141

142 **2.2. Air Pollution**

143 In Nigeria, ambient air pollution emanates from three major sources-energy generation, industry and
144 transportation-all of which increase with population and economic growth. Rapid urbanization is a major
145 contributing factor to all the three major sources. Degraded air quality in key urban centers, such as
146 Lagos, Port Harcourt, Kano amongst others, is as a result of the heavy dependence on oil-dominated
147 transportation. Motor vehicles produce more air pollution than any other single human activity [26].
148 Transportation requires huge amounts of energy. Globally, 20% of all energy produced is used for
149 transportation. Of this, between 60 and 70% goes toward transporting people, and the rest toward moving
150 freight [27]. In addition, power plants, factories, and other stationary sources including the thousands of
151 privately owned petrol and diesel generators used for power failure backups degrade the air quality of
152 major urban centres in Nigeria.

153
154 The situation is compounded by poor urban transportation planning as manifested by congestion in both
155 large and small cities of Nigeria. Clogged city streets exact a major toll on economic productivity and
156 exacerbate air pollution. In highly congested city centers, traffic can be responsible for as much as 90 to
157 95% of the ambient carbon monoxide levels, 80 to 90% of the nitrogen oxides and hydrocarbons and a
158 large portion of the particulates, all posing a significant threat to human health and natural resources [26].
159 Nigeria's current use of leaded gasoline contributes to the high levels of lead in the ambient air.
160 Producing the energy required to run modern urban systems often involves burning fossil fuels, which
161 releases such greenhouse gases as carbon monoxide, carbon dioxide, and nitrogen oxides. These
162 emissions lead to global warming, which can cause destruction of the ozone layer, climate change, rising
163 sea levels, changes in vegetation, and severe weather events [25].

164 165 **2.3. Land Pollution**

166
167 Several studies have identified industrial and agricultural activities, indiscriminate waste disposal and oil
168 spills as major causes of land pollution in Nigeria [28; 29]. **In urban areas in Nigeria, there are more**
169 **concentrations of industrial activities and high level of waste generation, coupled with poor disposal and**
170 **management (Plate 1), which increases the probability of land pollution.** For instance, the World Health

171 Organization [30] observed that almost all industrial activities cause some pollution and produce waste.
172 However, relatively few industries (without pollution control and waste treatment facilities) are responsible
173 for the bulk of the pollution. Adebisi and Fayemiwo [29] identified three kinds of industrial pollution, which
174 affect the land. They include construction debris, petrochemicals from transport and fuel and heavy
175 metals and chemicals. Industrial wastes and emissions contain toxic and hazardous substances, most of
176 which are detrimental to human health [31; 32].

177
178 In most urban centres in Nigeria there are heaps of municipal solid wastes unattended to (Plate 1); and
179 many of the objects that are thrown away contain toxic substances, which leach into soil and water
180 affecting the health of plants, animals and humans. Electronic waste contains mercury, lead, arsenic
181 cadmium, chromium and other metals that have environmental health implications. Construction waste
182 may contain asbestos, fossil fuel derivatives, and other toxic substances. Measures to control these
183 substances are hampered by the fact that they are dispersed within less toxic trash in millions of tons,
184 making their removal very problematic [33]. As a result, some of these toxic wastes linger in the soil
185 surface for a long time and makes it unsuitable for human use.

186



187
188
189 Plate 1: Indiscriminate Disposal of Municipal Solid Waste, Court Road
190 Gyadi-gyadi, Kano

191
192 Source: Adapted from Butu, A. W and Mshelia, S. S (2014)
193

194 **3. Deforestation and Wetland Destruction**

195
196 The threats to biodiversity, tropical forests and the rest of the many ecosystems and natural habitats in
197 Nigeria are overwhelming and escalating. A key feature of Nigeria's ecology is its large and burgeoning
198 human population and the increasing pressure this population growth is putting upon the natural
199 environment. Urban areas are congested and growing, without adequate environmental safeguards [25].

200
201 Most land areas in Nigeria have been converted to agricultural or pastoral uses and agricultural
202 encroachment threatens the natural areas that remain. In addition, the escalating practices of overfishing,
203 uncontrolled logging, and many other unsustainable uses of the natural resources pose serious threats to
204 the survival of significant component of Nigeria's biodiversity [25]. Echoing the same view point, [34]
205 stated that agricultural development, urban growth, industrial expansion and pressure from an increasing
206 population have reduced the extent, diversity and stability of the Nigerian forest. Unfortunately, the
207 capacity to integrate environmental concerns into economic development planning and activities is
208 extremely weak in Nigeria.

209
210 Mba [9] cited in [14] identified deforestation resulting from road projects, subsistence activities, **lumbering**,
211 mining, and dam construction as constituting the greatest threat to environmental sustainability in Nigeria.
212 In the loss of biodiversity, for instance, [14] reported that the World Fact Book (2005) identified Nigeria as
213 one of the countries with the highest rates of forest loss (3.3 per cent) in the world. Since 1990, the
214 country has lost some 6.1 million hectares or 35.7 per cent of its forest covers. The record also indicated
215 that Nigeria's most **biologically diverse** ecosystems are fast depleted at an unbelievable rate. For an
216 example, between 1990 and 2005, the country lost a staggering 79 percent of these forests and since
217 2000 Nigeria has consistently been losing an average of 11 percent of its primary forests per year. These
218 constitute serious challenge to environmental sustainability. The various species of plants and animals
219 that are required to establish and sustain the various food webs and chains as well as natural cycles are
220 systematically being depleted and thus resulting in ecological imbalance and threatening the survival of
221 man in the environment [14]. Ajibola [35] noted that urbanization is a major cause of loss of coastal
222 wetlands. Urbanization impacts wetlands in numerous direct and indirect ways. For example, construction

223 reportedly impacts wetlands by causing direct habitat loss, suspended solids additions, hydrologic
224 changes and altered water quality. Indirect impacts include changes in hydrology and sedimentations
225 which substantially alter wetlands. It also exerts significant influences on the structure and function of
226 coastal wetlands, mainly through modifying the hydrological and sedimentation regimes, and the
227 dynamics of nutrients and chemical pollutants. The loss and degradation of wetlands has resulted in
228 increased risks from coastal storms and tidal surges, leading to unintended consequences for both
229 human and natural systems [35]. The hydrological changes caused by urbanization process have the
230 potentials of exerting severe stress on a wetland's sustainability.

231

232 **4. Erosion and Flooding**

233 Flooding and erosion are common environmental challenges in southern Nigeria. Flooding had forced
234 millions of people to leave their homes, destroying lives and properties, polluting water resources and
235 increasing disease outbreaks. These environmental challenges are attributable to urbanization process.
236 Environmental conditions in cities have gradually deteriorated due to the rapid growth of the cities and the
237 attendance inability of social services and infrastructures to keep pace with the rate of growth. Inadequate
238 storm drains, dumping of refuse in drainage lines and construction of houses close to and even on the
239 natural water channels have been shown to be responsible in that order for the increasing cases of flood
240 in the urban centres [36]. Also, the concrete nature of urban land surface accentuates runoffs, which is a
241 veritable aid to erosion and subsequent flooding.

242

243 Furthermore, when forest is cleared, the soil is exposed to erosion devastation, floods occur, and rivers
244 and lakes, are filled up with silt. The water becomes dirty and impure for mankind. The removal of tree
245 canopy (particularly the leaves) has effect on the rainfall of that area, as there is less leaf surface area for
246 the transpiration of water, which in turn affects the relative humidity of the atmosphere [34].

247

248

249

250

251 **5. Urban Sprawl, Slum and Squatter Settlements**

252 Sprawl is the spreading out of a city and its suburbs over more and more rural land at the periphery of an
253 urban area. This involves the conversion of open space (rural land) into built-up, developed land over
254 time (<http://www.sprawlcity.org/defining.html>). Increasing urban population necessitates the provision of
255 more roads to accommodate an ever growing number of vehicles, thereby creating sprawling
256 metropolises. This situation is very common in Nigerian urban centres, due to lack of **effective planning**.
257 This claim is supported by [33] in their study of **Kano State, where they** observed that urbanization affects
258 land use and when not properly controlled causes emergence of illegal structures and neighbourhoods,
259 which is the characteristics of some quarters within Kano metropolis. This has affected the city master
260 plan, thereby affecting social services such as waste collection, and eventually leading to indiscriminate
261 dumping of waste in illegal areas

262
263 Sprawl has directly contributed to the degradation and decline of natural habitats such as wetlands,
264 woodlands and **associated** wildlife. It also reduces farmland and open spaces. Sprawl is used as an
265 aesthetic judgment about a general urban development pattern. Generally, sprawl is widely known as
266 ugly development with tendency to discontinuity and haphazard layout [37].

267
268 Urbanization in Nigeria is characterized by city slums with serious environmental **and social**
269 consequences. According to [36] millions of Nigerians live in sub-standard and sub-human environment,
270 plagued by slum, squalor and grossly inadequate social amenities. The result is manifested in growing
271 overcrowding in homes and increasing pressure on infrastructural facilities and rapid deteriorating
272 environment. The problems of slum formations and urban degeneration in Nigeria are common
273 occurrence in major cities-particularly, in Lagos and Ibadan which are probably among the largest cities in
274 the country [38]. Over the past decades, these problems have constituted major challenges to sustainable
275 urban development [39]. Similarly, [8] stated that today's Nigerian city is typified by substandard and
276 inadequate housing, slums and lack of infrastructure. **This situation has given rise to poverty, broken**
277 **families, poor educational system, malnutrition, along with parallel economics linked to gangs,**
278 **prostitution, drugs and high crime rates, which are indication of the degraded social conditions in such**

279 unplanned developments. It is in such environments that the urban poor rotates back and forth between
280 these slums and the rural areas, where they poach/mine the rural natural resources in a subsistence
281 mode, thinking only of today and not the long-term consequences of their actions.

282

283 The environmental problems in urban centres outweigh the experience in the countryside, as the
284 environmental problems are seen as the results of human activities which are higher in the urban centres
285 [18]. Slums developments in urban centres deplete the physical environment, increases crimes and
286 violence. In the same vein, [18] noted that the proliferation of these slums, which he refers to as
287 shantytowns results in the unwieldy expansion of the urban centers which poses a major planning
288 problem as provision and management of roads, drainage and sewage systems among other
289 infrastructure, proves very difficult. Furthermore, shantytowns, a consequent of urbanization, cause
290 increases in the incidence of urban poverty, diseases and epidemics, environmental pollution, urban
291 conflicts and crimes.

292

293 **6. Heat Island**

294 Urbanization leads to alterations of the local climate, and in particular creates a significant urban heat
295 island (UHI) effect [41; 10]. Urban development, including land use changes, dense building
296 developments, heat emissions, human activities, etc., have a great impact upon the local climate of a city.
297 Urban areas are often jungles of asphalt, concrete, brick and other dark materials for the construction of
298 roads and buildings. All of these man-made materials have a low reflectivity, and function to absorb
299 incident solar radiation [42]. This effect causes the city to become 2^o F to 10^o F (1 to 6^o C) warmer than
300 surrounding landscapes, which reduce soil moisture and intensification of carbon dioxide emissions [43].
301 In addition, it may lead to thermal physiological discomfort of people living in the affected areas.

302

303 **7. Aesthetic Degradation**

304 Aesthetic degradation or visual pollution occurs, when the outer ambient atmosphere contains materials
305 in concentrations which are harmful to man and affect the aesthetic value of his environment. There are
306 several sources of aesthetic degradation in Nigeria, which include urban sprawl, indiscriminate waste

307 disposal, billboards amongst others. Although signs and billboards are works of graphics which have
308 contributed immensely to the development of Nigerian cities [44], however, it has contributed to visual
309 pollution in Nigerian cities. There are several instances where billboards are pulled down and destroyed by
310 wind, torn or have peelings and are not replaced for years; which constitute visual environmental pollution
311 (Plate 2). According to [45] such billboards project visual disorder and visual clutter perpetuating visual
312 pollution, visual chaos and visual obstruction which tend to diminish aesthetic sensibility and visual
313 literacy in Nigerian cities. He stated further that environmental pollution of billboards is assuming global
314 magnitude, and its frontiers are no more confined to any particular part of our planet.

315

316 Indiscriminate wastes disposal, which are common occurrence in most Nigerian urban centres harbours
317 pests and rodents and produce foul odour that degrades the aesthetic quality of the environment [46]. In
318 addition, the indiscriminate erections of communication masks and other unsightly structures degrade the
319 aesthetics of the urban environment.

320



321

322

323 Plate 2: Urban Aesthetic Degradation: A Billboard Constituting
324 Visual Pollution, Akure, Nigeria.

325

326 Source: Adapted from Oladumiye, E. B. (2013)

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329

330 8. CONCLUSION AND RECOMMENDATIONS

331
332 This review highlighted the linkage between urbanization and the environment and revealed that the
333 linkage is profound. Hence, there is the need for a proper understanding of this linkage in other to
334 effectively and efficiently develop programmes and strategies that will enhance the drive towards
335 sustainable environmental management. In Nigeria, urbanization process has created severe negative
336 environmental impacts, such as pollution, deforestation and wetland destruction, erosion and flooding,
337 urban sprawl, slum and squatter settlement, heat island and aesthetic degradation, which have had dire
338 consequences on both human and other living organisms. In order to be on the desirable path to
339 sustainable environmental management, urbanization process should be controlled and managed
340 effectively, without exceeding the carrying capacity of the environment. This can be achieved by
341 fashioning rural development strategies, which could reduce rural-urban migration. In addition, other
342 anthropogenic activities, which have negative impact on the environment, should be effectively and
343 efficiently managed.

344
345 Air, water and land pollution is most widespread and potent in the Niger Delta region of Nigeria. This is
346 due to unbridled exploitation of oil resources by multinational oil companies and activities of oil bunkers.
347 Quantitatively, there is dearth of data on pollution in Nigeria, and indeed the Niger Delta region. The
348 environment of the Niger Delta region has been abused and degraded by oil exploration and other human
349 activities which include forest resource extraction and demographic change. The ecosystem of the region
350 faces imminent extinction if current policies and behavioural patterns are not immediately evolved to curb
351 the menace.

352
353 There are two broad long term strategies necessary for the mitigation of the negative impact of pollution
354 in the Niger Delta cities in particular and other Nigerian cities in general. These strategies include:
355 (i) Stemming the tide of rural-urban migration via rural development programmes with three main
356 elements as follows:
357 • accelerated output growth through technological, institutional, and price incentive changes designed to
358 raise the productivity of small farmers;

359 • rising domestic demand for agricultural output derived from an employment-oriented urban
360 development strategies; and

361 • diversified, non-agricultural labour-intensive rural development activities that directly and indirectly
362 support and are supported by the farming community.

363

364 (ii) There is a dire need to control the activities of man in the Niger Delta region to curtail the unbridled
365 degradation of the environment. This objective can be achieved by strengthening the enforcement
366 mechanism of the Ministry of Environment to implement the provisions of the existing Environmental
367 Impact Assessment (EIA) Degree 86 of 1992 to the letters. With this done, it becomes mandatory for
368 developers to submit an (EIA) report to the relevant ministry and applications for development granted
369 only if operators whose activities pollute the environment are made to bear the cost of their negative
370 externalities. For instance, the oil companies will be legally bound and under obligation to clean-up oil
371 spills land and regenerate same through a long-term programme of phyto-remediation. In the same vein,
372 polluted water can be purified through a long-term programme of water treatment/chlorination project.
373 Urban heat occasioned by human activities such as deforestation and construction can be mitigated via a
374 long-term programme of “greening”- afforestation in rural areas and tree planting in cities.

375

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