The Role of Geosciences in Sustainable Development of an Expanding Urban Region: A Case Study of the Jos–Bukuru Urban Region, North Central Nigeria.

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ABSTRACT

The Jos–Bukuru Urban region, like many other growing urban areas, has witnessed population growth from about 650,839 in 1991 to over 1 million in 2006. The influx witnessed many people of diverse backgrounds (skilled and unskilled, educated and uneducated individuals) who view the city as a base upon which to build their lives. The local and National governments seem unprepared and ill equipped to provide the influx with viable and critically needed infrastructure, and as a result we have poor water supply and sanitation. Similarly, people build on hilltops with no source of public water supply or other amenities. The quality of urban environment is under threat from the activities of man in urban cities such as loading of the earths crust, disposal of waste on land and into deep wells, and constant air pollution. The proper application of geoscience and its principles can ameliorate some of the problems associated with urbanization. It is a ready tool in sustainable development when advantage is taken of the geologic and engineering properties of earth materials in solving environmental problems.

(Keywords: waste, pollution, geosciences, urbanization, industrialization, tailings)

INTRODUCTION

Urban areas are usually cities with large settlements and major population centers organized as a community (Onyeku, 2007). In recent times, the issue of urban environmental quality has become a major subject of concern to urban dwellers, institutions, governments, professionals, and all stakeholders, both in the developed and developing countries, and has become an issue of great public concern. This can be attributed to the growing rates of urbanization, rapid industrialization, increasing development of science and technology, and rural to urban population drift among other issues. The implication is that urban life will continue to dominate human society now and in the foreseeable future, and the urban environment might be the worse for it in terms of degradation.

In Nigeria and other developing countries, socio-economic, political, and demographic forces are responsible for urbanization and dangerous population growth of cities. The local and national governments seem unprepared and ill-equipped to provide the influx of new residents with viable and critically needed civil works and infrastructure, with the resulting burgeoning population density rapidly overwhelming whatever facilities exist and placing the entire city population in jeopardy.

The World Resources Report (Lynn, 1999) estimated that 25.50% of urban inhabitants in developing countries live in impoverished slums and squatter settlements with little or no access to adequate water, sanitation, or refuse collection. In such situations, environmental quality as well as human health and well being are at risk

THE JOS–BUKURU URBAN REGION

The Jos–Bukuru urban region is one of the most populous regions within Plateau State. It is located on latitude 09^0 47' and 10^0 00' and longitude 08^0 50' and 09^0 00' and covers part of four local government areas that form the Jos-Bukuru urban area. They are Jos North, Jos South, Jos East, and Bassa. Figure 1 shows the location of the Jos – Bukuru urban region.

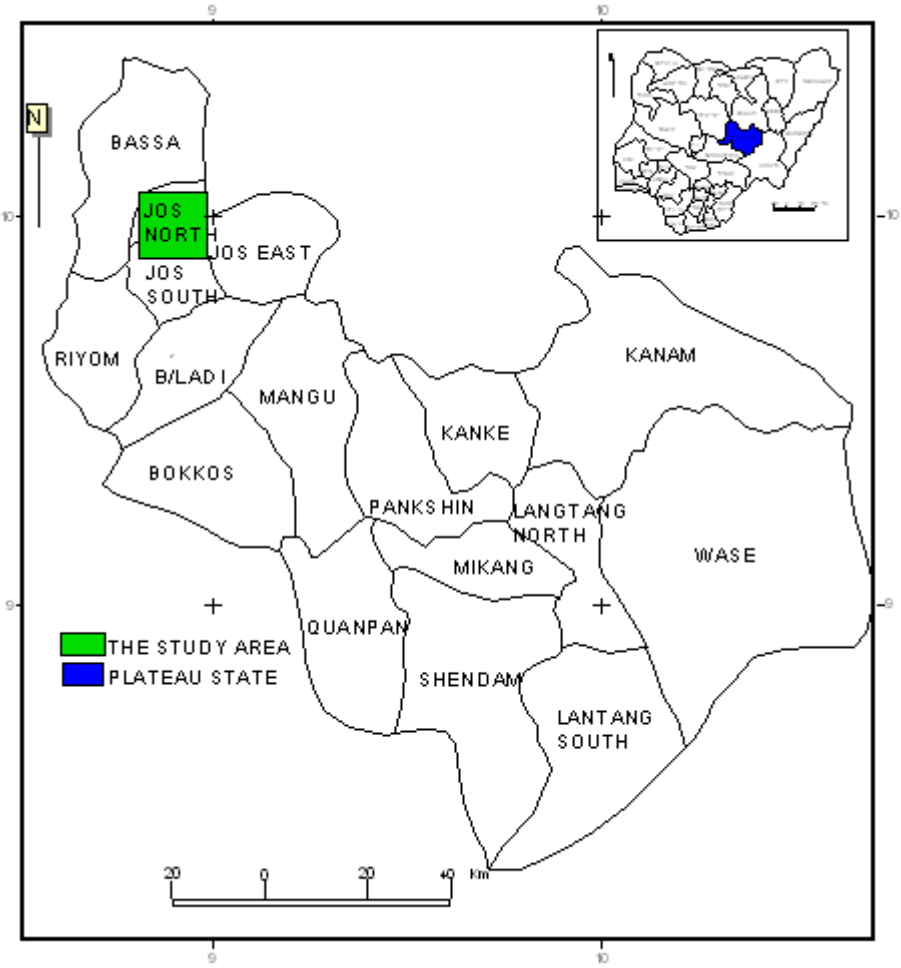

Figure 1: Map of Plateau State showing the Jos-Bukuru Urban area.

The urbanization of this region is closely associated with the commencement of tin mining activities. The impetus to urbanization of the area was given by the construction of a narrow gauge railway from Zaria to the mining areas (Schoeneick, 2000), aimed at evacuation of tin ore through Zaria and Kaduna to Lagos and then to smelters overseas. The area then began to grow as service center for all the mining industries scattered in western part of the Jos Plateau.

The Royal Niger Company was credited with locating tin deposits of the Jos Plateau, which also attracted the formal inception of modern mining industry activities in Nigeria (Gotan, 2004). Foreign metal merchants, mostly British, followed the tin trade route from the North African markets into Nigeria to Plateau where the multinational companies that dominated the industry were joined by small local private mining companies.

They became great employers of labor, which saw to the influx of workers to the area, while others came in as traders and business men, adding to the original population. When Jos was upgraded from a district and provincial capital to the capital of Benue Plateau State, a wave of civil servants and other businessmen added to the original population. Today, with the location of several federal and state government institutions, the Jos–Bukuru urban region has continued to witness population growth. It has continued to grow in population from 650,839 in 1991 to over 1 million in 2006(NBS), which is about 32% of the entire population of the state. Figure2 shows the population of the Jos-Bukuru urban area.

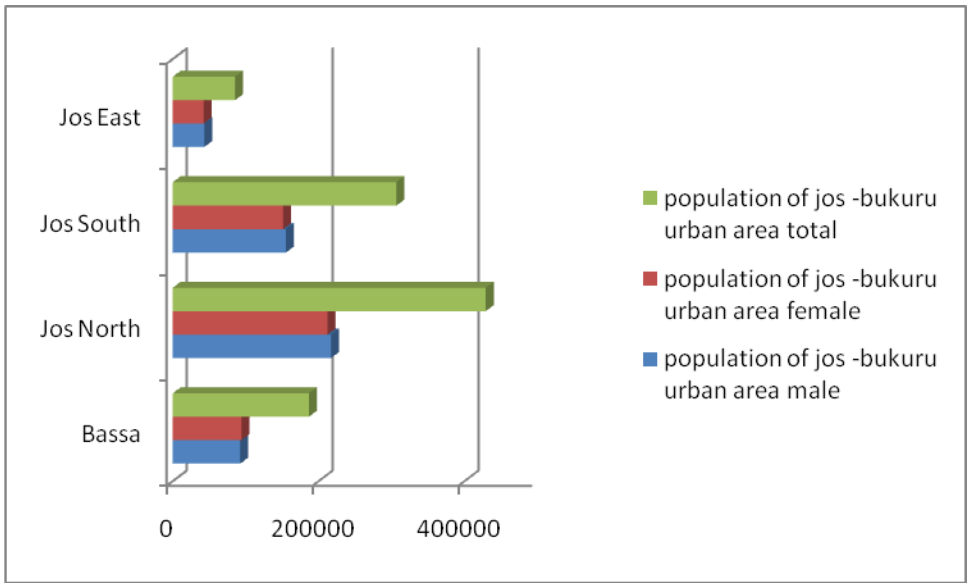

Figure 2: Population of the Jos-Bukuru Urban Area.

This urban region has continued to draw people closer together to increase the flow of goods, services, ideas, and of course for good jobs; all to improve livelihoods. With the increase in population comes an increase in waste generation by households and industries. These wastes are disposed of indiscriminately. The Jos-Bukuru urban has been a magnet for people of diverse backgrounds and from the rural areas who see it as a place where cultural and economic opportunities abound and where available services ensure for them an enhanced quality of life. Unfortunately, some of these people end up being disappointed, while the population explosion overstretches the public amenities or infrastructure provide by the local and national governments. This growth in population has overwhelmed the facilities that exist with most of the population living in impoverished Slums and squatter settlements, with inadequate provision for water supply, sanitation and drainage. The lives and health of the people are under threat.

Some of the inhabitants of this urban region build houses on rock or hill tops without any public water sources. They do this because they cannot afford the cost of land on plain or flat surfaces. Such areas can be seen around Bauchi Ring Road, Tudun Wada, Angwan Rukuba, and Gangare. Similarly, squatter settlements can be seen in the Federal capital territory where the population explosion far exceeds facilities provided for by the Government. The result is the indiscriminate disposal of waste and poor water and sanitary conditions as can be witnessed in areas like Gwa-Gwa, Karimo, and even Kubwa.

Most of the people in the satellite areas cannot afford to stay in choice areas of the city, and as we all know, poverty is the world's most powerful pollutant. Those who have little hope for the future cannot be expected to care for the environment. This is manifest particularly in water and land pollution as can be seen in parts of the Jos-Bukuru urban where people sink shallow wells very close to sewage systems with little or no concern for pollution. In a survey of ground water quality in hand dug wells in Jos metropolis and environs, Becka et al. (2009) observed nitrate values which exceeded the threshold value of 3.0mg/l while some exceeded the WHO health standard of 45mg/l. The high nitrate values were attributed to sewage, pit latrines and refuse dumps. Figure 3 below shows waste disposed of on a popular street in the heart of Jos City.

Figure 3: Waste Disposed on a Popular Street in the Heart of Jos.
(Photograph taken on 13:06:2008)

Geosciences

Geosciences are a group of related disciplines focused on the earth and its systems, history and resources. These disciplines include geology, geophysics, geochemistry, hydrogeology, engineering geology etc. The tasks performed by the geoscientists include geological surveys, exploration and exploitation of solid mineral and fossil fuel resources, earth foundation studies etc. It provides knowledge and understanding of how energy resources such as oil and gas, coal and uranium and other mineral resources are formed and where they can be found. It also provides key information for the design of cost effective exploration and water exploitation programs.

PROBLEMS OF URBANIZATION

Urbanization increasingly threatens the delicate balance between sustainable earth processes under and around cities. These disturbances may cause or aggravate hazards such as landslides, erosion, land deterioration, or land subsidence. Within the Jos–Bukuru urban area, as stated earlier, the population grew from 650,839 in 1991 to over 1 million in 2006 due mainly to movement of mostly rural sub-populations into the urban cities in the quest for better life. Such significant population shifts cannot occur without consequences, considering the increasing demand for food, water, and construction materials, with resultant tremendous impact on the physical environment. In the search for potable water which may not be provided by the government, people sink shallow wells to provide drinking water and even to support farms within residential areas. This practice, commonly known as urban agriculture (Figure 4), could pollute the ground water in shallow wells as a result of leaching of fertilizer.

Figure 4: Urban Agriculture within a Residential Area Close to a Hand Dug Well.

Since the price of land in cities rises regularly, buildings become taller with greater loads placed on the foundations. When such foundations lack the strength to bear the load, collapsed buildings can result. This has been witnessed in Rayfield, Jos, and along Bauchi Ring Road where a residential building and office building for filling station collapsed in the year 2009. Similarly, we have had reported cases of collapsed buildings in Lagos and Abuja.

Urbanization also increases the impact of Natural hazards on human society. In 1995 a flood washed away houses, vehicles, and even human beings along the Angwan Rukuba and Nasarawa areas of Jos. This happened because the houses were built on flood plans on river channels. This is because the people could not afford land on other better areas. Because urbanization means also that increasingly large investments will be made in cities, more and more people will be attracted to the cities, and many more will be living in less suitable parts of urban areas (Muller et al. 2001). This means once a major hazard occurs; there will be more likelihood of injuries and casualties among the urban population.

Ground water abstraction by individuals, governments, or communities through the use of boreholes, hand dug wells, etc. in the urban area for drinking water is a common occurrence in areas where public water supply is not available. However, proliferation of these boreholes can lead to subsidence; a case in hand is the September 11 tremor in Ibadan. This tremor was attributed to the proliferation of boreholes in the city.

Furthermore, population growth has had a profound impact on the fresh water resources of parts of the Jos Plateau, with water quality deteriorating due to sewage and industrial effluent. High nitrate value in Ground water of the study area is attributed to latrines, sewage and refuse dumps (Becka et al, 2009). Similarly, industrial effluent discharged by industries directly into streams can be observed on the Jos –Bukuru urban area. A case in hand is the NASCO household industry located in Anglo Jos. It discharges its effluent directly into a stream channel behind the factory. The water in the stream is used by unsuspecting farmers for irrigation with little or no regards as to the effect of the water on the crops or its consumers. Nigeria is said to be among nine countries at the start of the 21st century with around 35% of the world's population with less than 2000 cubic meter of renewable freshwater available per capita per year (Lynn,1999).This indeed is an indication of water scarcity.

Not until the late 1990s was air pollution a problem in the Jos–Bukuru area as there were fewer cars and industries than are now available. Today, areas that witness traffic congestion include Ahmadu Bello Way, Gada Biyu, Terminus, Bukuru, and Bauchi Road. The increase in vehicular traffic and emission from power generating sets used by industries contribute to carbon emission in the environment. These emissions contribute to global warming because they can raise the temperature level of the Earth's atmosphere through the green house effect. This has the tendency to result in sea and ocean level rise, flooding, climate change and alteration of natural vegetation.

Similarly, acid rain occurs as a result of burning of fossil fuels in urban areas. The emission of sulfur dioxide and nitrous oxides into the atmosphere from motor vehicles and power plants can also cause this phenomenon. The combination of sulfur dioxide and nitrogen compounds with water in the atmosphere normally produces rain with low pH value. The result is that rivers, lakes, forest and other terrestrial and aquatic environments are under serious treats of the effect of acid rain. The economic cost of air pollution is estimated at 0.5 to 2.5% of the world's gross national product or some $150 – $750 billion every year (Toepfer, 2002).

Because of the disproportionate number of people living in urban areas, and the resultant growth outstripping local resources, environmental problems, social segregation, and economic inequality among inhabitants arises. This has given rise to squatter settlements and slums on the one hand, and the "millionaire's quarters" on the other hand. Social problems arise because people coming from rural areas in search of jobs and better life end up being disappointed because the available jobs cannot keep pace with the arrival of new job seekers. Angwan Rogo, Tudun Wada, Rayfield, and Liberty Boulevard in Jos are common examples.

Furthermore, mineral processing companies now in the city centre and sited near residential areas dispose of their waste openly (tailings) along the streets and within their premises. These tailings (from tin processing) which are radioactive and carcinogenic (Solomon, 2004) are used by uninformed members of the public in search of cheap building materials to plaster their homes. Figure 5 shows mine tailings within the premises of a mineral processing factory in Jos.

Figure 5: Mine Tailings within the Premises of a Processing Factory.

ROLE OF GEOSCIENCES

The effect of urbanization increasingly threatens the delicate balances between the sustainability of earth processes under and around cities. The disturbances may cause or aggravate hazards such as landslides, erosion, land deterioration or land subsidence. Geoscientists understand these processes and are best equipped to predict them. At the same time, geoscientists can predict the occurrence of portable water, thereby helping to produce the needed drinking water in urban areas, and properly site the drilling of productive and non polluted boreholes. They can also explore for and exploit the needed construction materials (e.g. marble and granite rocks for construction and building in expanding urban cities). Geoscientists can also assist in selecting the best sites for urban expansion and waste disposal.

Water is the world's most important natural resource, and much of it comes from underground water supplies. Geoscientists study the movement, behavior, and quality of ground water and potential sources of pollution, and can design exploration programs for new water supplies, especially in Nigeria, and other developing countries of the world. Furthermore, seepages from land fill sites are known to pose serious problem for the local water supply, while old mine workings may present a threat to buildings or cause pollutions especially during floods. Geoscientists can offer expert advice on whether any selected site will be sufficiently safe.

Similarly to prevent structural failures in urban projects, geoscientific investigation of local ground conditions will have to be carried out which will form basis for engineering design parameters. Finally, the geoscientist explores and exploits the mineral raw materials needed for the rapid industrial development, associated with urban areas. The cement used in building construction is derived from lime stone, shale and gypsum, all of which are sourced by the geoscientist. Geoscience can also be used as a ready tool in sustainable development, as proper application of geological information can be used in solving environmental problems relating to geologic and engineering properties of earth materials. For example, different minerals, rocks and soils behave differently for various land use. Clay soils and compaction shale are generally poor foundation materials for large engineering structures, while granite with few fractures is satisfactory for most purposes

CONCLUSION

Urbanization can be seen as a sign of modernization; however, it is a big threat to the quality of urban environment. Problems of squatter settlements and slums, poor water quality and sanitation, as well as the elevation of natural and urban hazards, global warming, acid rain, air pollution, and indiscriminate disposal of waste and other social problems are on the increase. Geoscience and its principles can ameliorate some of the problems associated with urbanization. It is a ready tool in sustainable development when advantage is taken of the geologic and engineering properties of earth materials in solving environmental problems.

Understanding geosciences, therefore, can help lessen or prevent damage to the environment, just as it can be used to find the resources in the first place. The study of geoscience data can give us an enormous amount of information of practical value, while revealing much about the world in which man lives.

RECOMMENDATIONS

For urban areas to be safe and sustainable, it is obvious from the foregoing that the general public and the local and national governments must be aware of the inter relationships between geologic processes and the urban environment including its effect on the population, and in turn the effect of the population on the environment. There is need for environmental education and awareness on the role of geosciences in expanding urban centers, especially in developing countries, while environmental objectives must, as a matter of policy, be incorporated into economic development plans and processes. This can be achieved when authorities concern work with the relevant geosciences professionals.

With urban population on a continuous increase, there must be the political will to make societies better. For best results in achieving this objective however, a multidisciplinary approach is recommended which will include professionals like civil engineers, ecologists, environmentalists, and public health experts, with each profession bringing its own concern and concepts to address

the problem of sustainable development of urban areas.

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