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Influence of Loose Urban Development Control on Domestic Wastewater System in Suleja, Nigeria

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Abstract*: Domestic water supply and wastewater management are essential indicators of urban quality of life globally, and yet remain major environmental issues in Nigeria. The rapid growth in population has resulted in a higher rate of wastewater generation in Nigerian cities. However, many city plans are unable to cope with these issues appropriately. As a result, the poor management of wastewater is an ever-present problem with its attendant risks to public health and environmental safety. Therefore, this study attempts to analyse the control of urban development and management of domestic wastewater in Suleja, Nigeria. The study critically examines the current urban planning systems and presents an overview of selected technologies adopted for the decentralised treatment and disposal of wastewater in emerging nations. To this end, a documented and dissertation based analysis technique was employed in this study. Firstly, the paper begins by providing a methodical framework for comparative examination of the centralised and decentralised systems. The legal setting and policy framework, present city plan, and wastewater management are also explained. The study finds that loose development control and organic growth of residential development have a strong influence on wastewater management in the community.

Keywords: Sanitation, waste, wastewater management, wastewater reuse, Suleja.

I. INTRODUCTION

The access to healthcare and provision of sanitation are essential indicators of quality of life [1]. However, most emerging nations, such as Nigeria are struggling to provide this basic necessity required to improve the quality of life due to many constraints. Numerous authors have attempted to assess the existing practices for the management of domestic wastewater employed by communities. The outcomes of such practices have caused adverse public health and environmental consequences. The low levels of sanitation in many cities can readily result in the transmission of diseases such as; ascariasis, cholera, hepatitis, polio, schistosomiasis, trachoma, and others [2].

In the midst of limited reports and lack of research on this issue, visual observations confirmed that adverse consequences are occurring in Nigeria. In other countries, analysis indicates the connection between the poor management of wastewater and public health-associated effects have confirmed numerous concerns. For example, there are growing instances of persistent cyanobacteria [3], toxic chemical substances[4], potential antibiotic-resistant bacteria [5], persistent pharmaceutical compound [6], among others. Based on these examples, it is safe to say that wastewater management is essential for improving the quality of life and a crucial area of research.

Therefore, this paper attempts to understand the influence of current urban planning policy and implementation on the wastewater treatment system facility implanted in the properly developed area of Suleja in Nigeria. The study employed a field survey, literature review, and perception acquisition of the local people in the study area. The field survey in this research project can be considered as a pilot survey towards a full-scale study. It is envisaged that the pilot survey will present accountable and reliable results despite the low cost, time-saving, and limited respondents involved in the study.

II. URBAN WASTEWATER MANAGEMENT

The management of urban wastewater is at a critical juncture around the globe. The poor disposal of wastewater from domestic sources is still a severe challenge in Nigeria. As a result, there are significant threats to humans and the environment through groundwater contamination and surface water pollution [7]. Over the years, the Transformation Agenda of the Federal Government has transformed Nigeria into the largest economy in Africa, as evident in the rapid growth in population, urbanisation, agriculture, and industrial development [8]. These rapid developments have significantly altered the rate and pattern of urban development, population growth, and the utilisation of natural resources[9]. Given this, many wastewater related technologies have emerged that employ various treatment processes, including aerobic and anaerobic, based on highly mechanised to non-mechanical processes [10].

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Typically, the removal of pollutants from wastewater employs the use of physical, chemical and biological techniques. In principle, these techniques classified as primary, secondary, and tertiary wastewater treatments, aim to achieve different efficiencies for removing pollutants.

Hence, the latest procedures for effective waste-water treatment require the integration of various systems. According to [11], the removal of particular pollutants and nutrients control requires more rigorous wastewater treatment techniques. Furthermore, many natural systems have been employed to treat wastewater in land-based applications. Typically, these techniques are exploited to manage the resulting sludge from the treatment of wastewater as well as dewater and reduce the organic content, which is required for disposal or recycling [5]. However, wastewater management systems in Nigeria (the study area) employ basic on-site treatment system. The personalised nature of such methods leads to different negative consequences.

Typically, centralised systems for wastewater management are utilised to treat wastewater streams from homes, whereas off-site or centralised wastewater treatment plants cater to commercial zones, industrial plants, and institutions [12]. Malaysia employs the latter, which is managed by Indah Water Konsortium. Throughout the twenty-first century, centralised wastewater management has been continuously extended to increasing urban areas. In industrialised countries, recent developments in the treatment technologies have been adapted to the changing needs of the population. Furthermore, the treatment methods are periodically adjusted to changing requirements concerning public health and environmental concerns [12].

In Nigeria, the national framework policy for wastewater management is guided by various legislations under the responsibility of various ministries, departments, and agencies. More importantly, the Environmental Management Act was gazetted as the National Environmental (Sanitation and Wastes control) Regulations, 2009: Environmental Impact Assessment Act of 1992: The Harmful Wastes (Special Criminal Provisions, etc.) Act. In general, the policy provides a fundamental framework for managing wastewater in the country [13]. Typically, emerging countries fraught with diverse challenges such as wastewater management are increasingly taking centre stage. Over the years, the poor administration of wastewater systems and insufficient wastewater disposal in emerging nations has been aggravated by increased suburbanisation. Therefore, the management of urban water is a priority issue that requires reforms to enhance the sustainability of future systems [14]. Besides, the rapid increase in the global population has expanded in peri-urban and urban areas. As a result, there is growing pressure on scarce resources such as land and water, resulting in significant pressure of water, waste management, and environmental pollution. Besides, the rapid growth in urban population growth has enhanced the proliferation of sparsely planned settlements within the vicinity of numerous major cities in Africa. Hence, there has been rapid growth in slum dwellings along with its attendant challenges such as unemployment, poverty, and crime, among others [15].

In Nigeria, the aquatic environment and open bare land in the vicinity of residential areas are increasingly being subjected to the voluntary discharge of human wastes. However, the lack of wastewater management and treatment infrastructure has considerable impacts on the quality of the natural environment and health of the citizens [16]. Another example is India, where the municipality of Mumbai has been unsuccessful in availing the citizenry with a sustainable sanitation solution particularly to residents of slums. Despite the soaring demand for sanitation facilities, residents typically choose open defecation instead of using dirty public toilets. Hence, community engagement in the planning, execution, and management has been established to mitigate the shortcomings of current sanitation systems. Hence, the managers charge once-a-month fees to the residents to use the established sanitation facilities. According to [17], most providers are reaping financial benefits and recouping their expenses from the scheme with the added benefit of the improved communal sanitation.

Typically, the decentralised systems present a substitute method for availing urban areas with water, wastewater, and stormwater services [14]. Lately, the idea of incorporating wastewater and water systems has been proposed. The objective is to independently collect different streams of water and wastes for treatment or recovery of precious water, nutrients, and energy. This approach addresses the restrictions of the centralised method by providing an ecological and economic system(s) for the management of water and wastewater streams, as outlined in Table 1.

Table 1: Comparison between centralised and decentralised systems

Factor	Centralised system	Decentralised system
Collection scheme	Big diameters, extended distances	Minor diameters, small distances
Space Requirements	Big areas in a single place	Several small areas
Process and preservation	Requires Permanent technical staff	Fewer demands and allows remote monitoring
Water Consistency	Many categories of water	New or even water
Grade of dilution	Fewer regulation on stormwater with added mixing	Added regulation over the stormwater, more intense
Risk Factor	Risk on a larger scale	Risk distributed
Transfer of water	Water transmission requirement is high	Water is utilised or reutilised locally
Social regulator	No social control	High social control
Scale-up	Expensive and complexity implementation	Cheap and less complicated implementation

Reuse Potential	Water is concentrated centrally	Reuse of water is local

Source: Adopted and modified from CODESAB (2011)

From the sustainability viewpoint, wastewater reuse is essential to the management of water demand.

The process protects high-quality freshwater, reduces environmental contamination, and the overall cost of supply [18]. However, reprocessed water is also utilised for services alternating from irrigation (scenery and agriculture) to domestic (or industrial) applications [19]. In areas lacking alternative water resources, wastewater reuse is a potential alternative, amid prohibitive processing cost [20]. Meanwhile, community reception has been observed as a problem in executing reuse schemes, and so the emphasis has been principally on persuasion [19].

For example, the use of treated wastewater for irrigation has positive and negative environmental impacts. Despite the plant nutrients and organic matter found in wastewater, it also reportedly contains objectionable chemical components and dangerous microbes that pose risks to human health, safety, and the environment [18]. Besides, wastewater utilisation can result in elevated heavy metal uptake by plants, thereby affecting food quality and the safety of humans [4]. However, purposeful planning and management can ensure the environmentally beneficial application of treated wastewater in farming. Marleni et al., (2012) established that global recycling of water is a progressively common constituent of water resource planning. With the rising costs of wastewater disposal, the prospects for developing conventional water supply are declining. Hence, authorities must outline the critical visions and clear objectives required for community recycling programmes. This vision should include the long term needs of recycling and determine specific sectors in which wastewater is suited for allocation. If water recycling is considered as an advanced phase of a wastewater treatment system, then the current practices of domestic wastewater management in Suleja, Nigeria are primitive. Hence, the people continuously practise these outdated methods without full knowledge of the long term health and environmental consequences. These methods are more or less influenced by current planning and implementation of urban development control, which is characterised by lax control of urban and residential development.

III. URBAN PLANNING AND URBAN DEVELOPMENT IN NIGERIA

From a legal viewpoint, the sole institution in Niger State mandated to design, execute, and manage developmental activities is the Niger State Urban Planning and Development Authority (NSUPDA). Besides, the agency is charged with law enforcement and general control of the city under the statutes of the Nigerian Urban and Regional Planning Law of 1992 (Decrees No.85/1992 amended to No.18/1999) [22].

In Nigeria, the State Government or the Governor is the custodian of the entire lands in the region. Hence, the incumbent's authority permits the state to assign or take possession of any land under the jurisdiction of the state in the public interest [23]. Hence, the application for the procurement of lands by individuals is supervised by the Land, Survey, and Country Planning Ministry. However, the Governor grants the final permission after due consideration of the terms of the agreement filed by the aspirant. As proof of proprietorship, the aspirant is granted an occupancy certificate valid for 99 years [24]. However, land ownership can also be granted through an old-fashioned manner by traditional rulers [25]. An oral or official contract conventionally grants ownership on paper before several onlookers from the two groups. However, the proprietorship is restricted by law and occasionally such agreements are regarded as unlawful by the regional authority.

With the various land title available, individuals may build their home on the land-based on their preferred design and financial capability. However, property development by professional developers rarely happens. By this condition, the property development, including its facilities, are planned, designed, and built by individuals. Even though the local government issues the building permits, the slow and opaque bureaucracy and ubiquitous bribery hamper the processing and issuance of the building permits [26]. Hence, property development and the city begin to grow organically and uncontrollably. Likewise, the sanitation facilities such as wastewater treatment systems are individually prepared with elementary knowledge and low technology, usually without proper guidance and supervision from local government. As a result, the improperly designed on-site wastewater treatment system flourishes as exhibited in Figure 1.

So far, neither the Niger State Government nor the Federal Government of Nigeria can provide appropriate services for wastewater treatment in the form of a centralised wastewater treatment plant, as it is easily found in all planned residential areas (Taman) in Malaysia. This is because of the following reasons: (1) no legal foundation or legal standing to implement (2) no financial capacity of both Federal and State Government (3) wastewater treatment system is not a development priority even though Sustainable Development Goals address it (4) level of economic development of the country, e.g. high rate poverty. Consequently, people exert significant efforts to individually provide wastewater treatment based on existing knowledge and capacity without proper guidance from the local authority. Ultimately, the situation results in improper practices or systems for wastewater treatment with severe potential impacts on public health and the environment.

IV. RESULTS AND DISCUSSIONS

The problem of wastewater management in Nigeria is countrywide, although the concentration differs from region to region. For example, the state of Lagos produces 1.5 million m^3 of wastewater daily [27]. Lagos state has been faced with challenges of indiscriminate discharge of wastewater into the drains due to lack of adequate land for siting wastewater treatment infrastructure.

As part of the effort to proffer solutions to wastewater management problems in the State, the Odo Iyalaro Wastewater Treatment Plant project was initiated. The projects serve as a contemporary wastewater treatment infrastructure designed to serve 250,000 populations equivalent in the catchment areas of Maryland, Anthony, Mende and Arowojobe [28].

The problem is more prominent in northern Nigeria and as a result, needs immediate attention [29] The challenges of wastewater management are due to both human and natural factors. However, the collective indifference of people in Niger state to environmental sanitation leaves much to be desired [30]. Rapidly growing cities will significantly aggravate existing wastewater disposal problems since urban development is mostly unplanned and informal nature. This scenario is ascribed to the opportunistic tendencies of community members and informal-sector developers who exploit the regulatory incapacity of administrative establishments [29].

The general problem of domestic wastewater management has several dimensions. Many groups including the United Nations and non-governmental organisations (NGO) promote a cohesive method for wastewater management. Typically, the approach seeks to identify significant participants, definite topics (that include vital "stumbling blocks"), and offer suggestions according to suitable know-hows, indigenous data, and persistent human and environmental health concerns [31].

Wastewater management in cities should not be limited to the prevention of environmental damage and preserving public health, but also an alternative resource for water and nutrient. The efficient administration of such resources is essential to water security in cities [32]. This is crucial mainly in cities that lack sewage treatment plants or rely on the channelling of toilet wastewater into soakaway systems or septic tanks [33]. Further liquid domestic-based wastes are mostly discarded directly into open channels, surroundings or onto the roads. Ultimately, the discarded wastewater penetrates various water streams through the washing action of rainstorms [34]. Due to the close arrangement of building structures, individuals within the study area utilise septic tank and soakaway system as a primary means for on-site wastewater treatment and disposal, while others employ different methods [34]. Septic tanks and soakaway systems used for collecting toilet wastewater frequently pollute the critical source of shallow groundwater available to low or mid-income inhabitants [35]. The faecal pollution of the water and ecosystem in Suleja, due to inefficient wastewater control, is a major hygiene concern [30].

The ethnographic and documentary investigation of this study revealed that the public health and wastewater management sector in Suleja is hampered by low political ranking, which is additionally obscuring already multifaceted problems. For example, weak regulation and enforcement arising from poor governance restrict the abilities of public establishments and service suppliers. Furthermore, the inadequate attention to processes and preservation has resulted in the malfunctioning and failure of systems designed to provide shared or public use facilities. The results also found at least six human-induced factors from the perceptions of the citizens. These factors include (1) Inadequate financial and personnel capacity of local authority (2) Poverty (3) Weak urban planning, e.g. loose development control including building permits (4) weak law enforcement (5) Lack of political priority on wastewater infrastructure, and (6) Ubiquitous corruption in the local authority.

The perceptions of citizens towards current wastewater systems and practices were also evaluated in this study. Due to the nature of the pilot study (before the full-scale study), only the perceptions of 153 respondents were acquired. The most common means of wastewater treatment by the respondents is the soakaway or septic tank system. Since most houses lack planned drainage amenities from the onset, the wastewater and sewage waste flows beside the streets, which creates an eyesore [30]. The perceived factors that influence current wastewater systems and practices are shown in Table 2.

Table 2: Perceived Factors Associated with Wastewater Treatment system at Locality

Factors	Frequency	Per cent	Cumulative Percent
Poverty	58	37.9	37.9
Weak law enforcement	35	22.9	60.8
Inadequate financial and personnel capacity	33	21.6	82.4
Weak urban planning	12	7.8	90.2
Corruption	11	7.2	97.4
Lack of political priority	3	2.0	99.3
No answer	1	0.7	100.0

Source: Authors field survey, 2018

Table 2: shows that the poverty factor is the highest frequency of the perceived factors, i.e. 37.9%. It is inarguably the most persistent and pertinent cause, as current average household income in the study area is about US$ 80 per month. Next, this factor, along with given natural factors such as geographical condition and climate, were considered. The effect of field investigation on the procedure and relevant documents found that loose urban development control is one of the possible causes of current wastewater treatment practices. This finding is augmented by perceived factors by respondents as shown in table 2, which counts for 22.9% i.e. weak law enforcement on urban development control particularly building permits issuances and weak urban planning. This finding confirmed that loose urban development control influences the current practice of wastewater treatment.

V. CONCLUSION

This paper examined the influence of loose urban development control on domestic wastewater management in the urban area of Suleja in northern Nigeria. The findings revealed that wastewater treatment systems are influenced by factors such as poverty, corruption and inadequate financial capacity.

Hence, proper urban planning and development are crucial factors that can improve the status of wastewater treatment systems in Suleja.

Hence, law enforcement must be augmented, whereas the development of conventional wastewater treatment subsidised by the government must be implemented. Effectiveness of the legal documents towards a controlled urban development and management is as a result of the using regulations and laws to address the physical planning problems identified in the urban areas. Effective planners learn to anticipate changes in policy direction and build strong organisations capable of managing rapid changes in direction. For Planning authorities in Nigeria to be more effective the following should be considered; rejecting the negative image, to be proactive towards constraints, not allowing caution to become inertia, avoiding contradiction and making people relevant in decision making.

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