

## Assessment of the determinants of existing vacant lands in Jos Metropolis, Nigeria

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World Journal of Advanced Research and Reviews, 2025, 26(03), 2050-2061

Publication history: Received on 26 April 2025; revised on 11 June 2025; accepted on 13 June 2025

Article DOI: <https://doi.org/10.30574/wjarr.2025.26.3.2185>

### Abstract

The study analyzed the determinants of existing vacant lands in Jos metropolis, Nigeria. This is based on the understanding of the fact that, though several studies have been carried out on land values in Nigeria, studies on existing vacant lands are rare. Again, most of the prior studies used data obtained from occupants of developed properties and questionnaire survey administration; this study utilized Remote Sensing and Geographical Information System (GIS) Techniques. Google Earth Engine was used to obtain and analyze the Landsat satellite imagery and Digital Elevation Model (DEM) of the study area to produce the land use/land cover map, which enabled the extraction of the variables analyzed. This was then validated and updated through ground truthing and the use of high-resolution satellite imagery. While other data were identified from literature, estate agents, and the authors' knowledge of the local area, resulting in a comprehensive view of the causative factors of urban vacant lands. The study was able to answer these pertinent questions through the following specific objectives: to identify some land uses within the study area; to evaluate the factors that determine the existing vacant lands; to examine the policy that guides the vacant land. The results showed that there is significant vacant land within the study area, covering up to 67.77 km<sup>2</sup> (8.16% of the study area), and the vacant lands are sparsely distributed. Based on the planning regulations and implications, this is not expected, especially in a planned metropolis where every land is assigned a land use. This total vacant land includes widely varying types of land ranging from undisturbed open space, undeveloped land, rocks, bare surface, mining pond, gully erosion, and alluvial deposits. The DEM shows that Jos South has the highest elevation of 1514m and Jos North with the lowest of 886 m. We therefore recommend that there should be a reliable database of urban vacant land in Nigeria. It is also recommended that the government conduct an extensive survey of urban vacant lands on a quarterly basis and publish a list of urban vacant lands at the end of each quarter. Based on the survey information, strict supervision of urban vacant lands could be implemented. These factors should be given due consideration in planning and policy formulation for the future development of the metropolis.

**Keywords:** Vacant land; Land policy; Land Use; Digital Elevation Model; Factor of Vacant Land

### 1 Introduction

Cities and settlements are changing over time and need new insights to meet these challenges (Yahaya, 1988). The incessant increase in the formation of informal settlements in Nigerian cities generated additional problems in terms of non-inclusive cities, abuse of land use, and as well as improper utilization of vacant lands, paving the way to criminals' hideout points and other security threat areas.

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Jos metropolitan area is not an exception it's generally noted that these unprecedented city changes have agglomerated and added problems, such as urban vacant lands. Hence, a call to revive urban planning processes and challenges to make it more suitable and effective in solving most of these evolving contemporary urban issues. The prerequisite is to assess the factors that determine the existence of vacant lands in the Jos metropolitan area.

Vacant land is a term of reference that has different interpretations for different people. Chicago Metropolitan Agency for Planning (CMAP) 2010 defined vacant land as land in an undeveloped state, with no agricultural activities or protection as open space. Some call undeveloped land in urban areas that is not dedicated to development, such as housing, commerce, or industry. However, this study defines vacant land as land that has no building, drainage, telecommunication mast, perimeter wall, borehole, or anything of value placed on it within a built-up environment.

Vacant lands can be ubiquitous and an important urban phenomenon. Increases and decreases in vacant lands and abandoned structures can help determine a city's future (Bowman and Pagano, 2000; Newman and Saginor, 2014). Also, too many vacant lands may strain a city's finances and contribute to urban decline (Combes, 2000); whereas too few can limit a city's development potential (Berger, 2007) and sometimes lead to increased desiccation congestion (Hollander, 2010). Consequently, vacant lands represent a crucial issue confronting the Jos metropolis.

### **1.1 Statement of Problem**

Population growth and urbanization in the study area, Jos metropolis, have significantly led to demand for parcels of land, development (Adekola 2018). Though in spite of the increasing demand for land, there is still a substantial parcel of vacant land inside the study area (Oladokun and Adeniyi, 2015). The presence of these vacant lands poses a challenge to a sustainable city, ineffective usage of resources, and degradation of the environment (UN-Habitat, 2016).

A study has revealed that vacant lands can also lead to increased crime rates, reduced land values, and other adverse effects on public well-being (Kelling and Coles, 1996). Similarly, the causes of vacant lands in Jos Metropolis are multifaceted and complicated, including factors for instance land use development, economic growth, and environmental considerations (Adelekan, 2016).

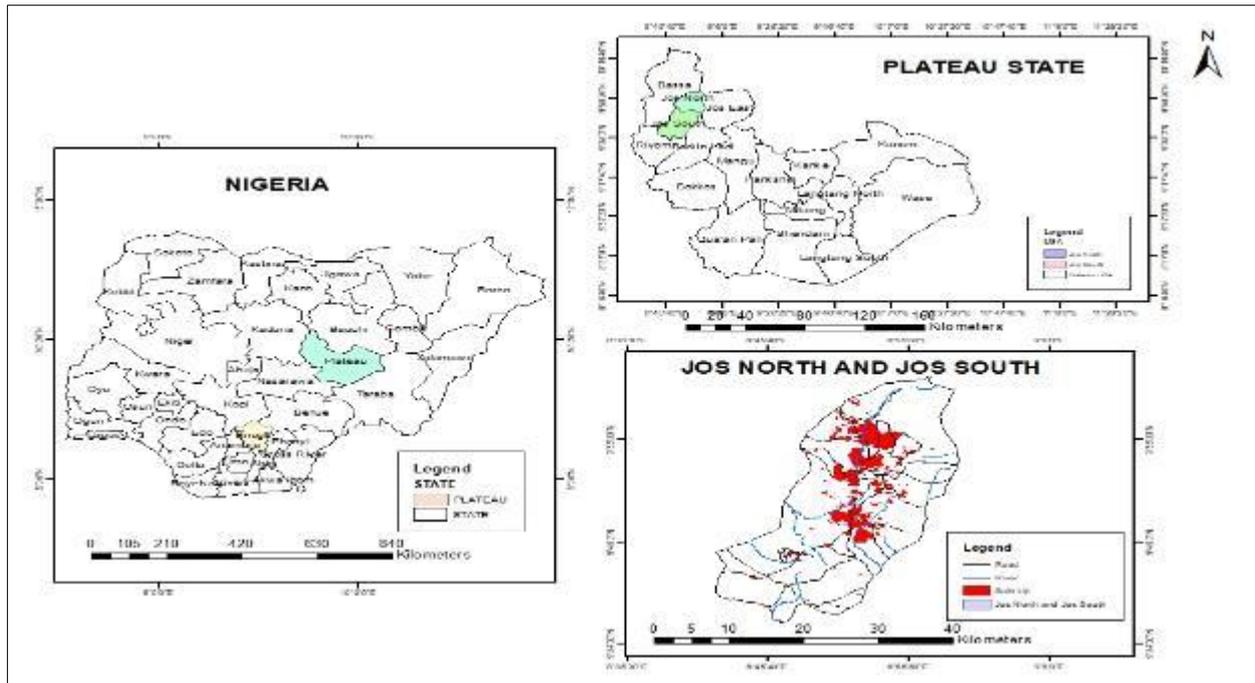
### **1.2 Aim/Objectives**

The aim of this research is to assess the factors that determine the existence of vacant lands in the Jos metropolitan area. The following are the specific objectives

- To identify some land uses within the Jos Metropolis
- To evaluate the factors that determine the existing vacant lands in Jos Metropolis
- To examine the policy guiding vacant lands in Nigeria

### **1.3 Study Area**

The study area comprises Jos South and Jos North LGAs, with their headquarters in Bukuru and Jos, respectively. It is located between Latitudes ( $9^{\circ} 0' 54''N$  and  $10^{\circ} 0' 10''N$ ) and Longitudes ( $8^{\circ} 0' 48''E$  and  $9^{\circ} 0' 30''E$ ). The area is situated within the Northern senatorial zone of Plateau state, and is bounded by Barkin Ladi and Jos East to the east, Riyom to the South, and Bassa LGAs to the West. The area coverage for Jos North is 291 km<sup>2</sup> and Jos South is 510 km<sup>2</sup> on an elevation of 1250m above sea level, with Shere Hills having the highest peak of 1,777m above. The population of Jos North is 429,300, and Jos South is 306,716 as at the 2006 census, projected to 660,568 and 471,947 respectively in 2022, with a growth rate of 2.73%.



Source: Author

**Figure 1** Map showing the location of the study area

#### 1.4 Data and Methodology

The following table highlights various data and sources of the research objectives.

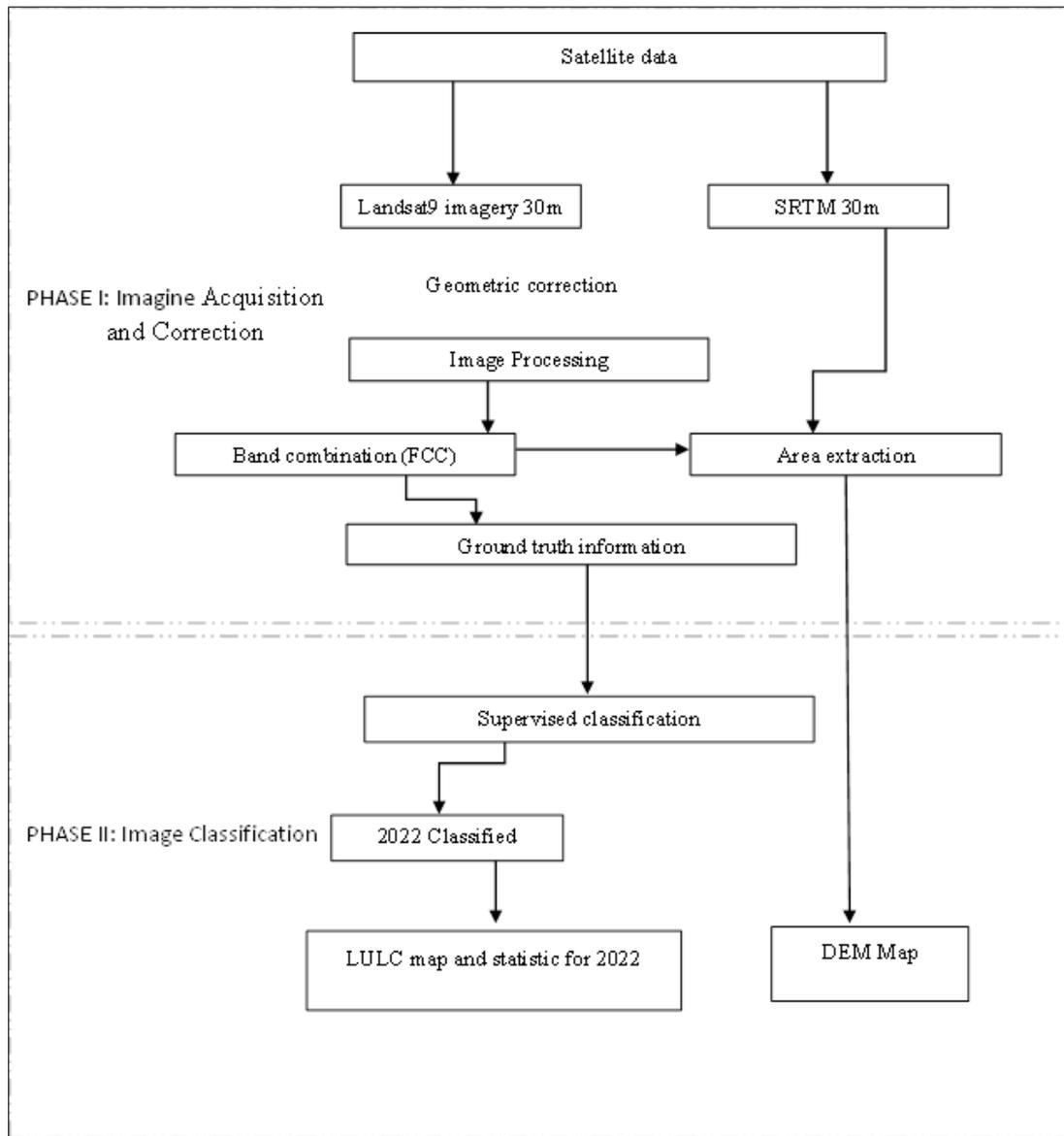
**Table 1** Data description

| DATA                                     | SOURCE  | RESOLUTION | DATE        |
|--|---|------------|-------------|
| Landsat 9 imagery                        | <a href="https://earthexplorer.usgs.gov/">https://earthexplorer.usgs.gov/</a> | 30m        | 2022        |
| Landcover reference                      | Field work  | -          | August 2022 |
| Shuttle Radar Topographic Mission (SRTM) | <a href="https://earthexplorer.usgs.gov/">https://earthexplorer.usgs.gov/</a> | 30m        | 2022        |

Source: Author GIS Analysis

## 2 Methodology

Google Earth Engine (GEE) was used to obtain and analyse the satellite imagery of the study area to produce both a land use/land cover map and a digital elevation model (DEM). Training samples were selected for each of the five land use/land cover classes using point-based digitization in GEE. Eight spectral bands of Landsat ETM+ were used for the Land cover mapping (bands 2, 3, 4, 5, 6, 7, 8, 11, and 12). Means of the eight bands were generated for the entire 2022 Landsat ETM+ archives above a 70% cloud cover threshold. The land use/land cover was produced using the training samples, the mean spectral bands generated, and smile random forest classifier in GEE. The land use/land cover was then analysed and validated through onsite sample points collected and, the use of high-resolution satellite imagery using cross validation (Olofsson et al. 2014), achieving 89%, 82%, and 85% producers', users and overall accuracies, respectively. Interviews were conducted and literatures were critically analysed as secondary data to obtain a comprehensive view of the causative factors of urban vacant lands. Furthermore, land policies such as the Land Use Act 1978, Urban and Regional Planning Law 1992, and Nigerian Town and Country Planning Law 1946 were reviewed.



Source: Author

**Figure 2** Methodological Framework of the Study

### 3 Results

This chapter underscores the presentation of results and the discussion of research findings from the objectives.

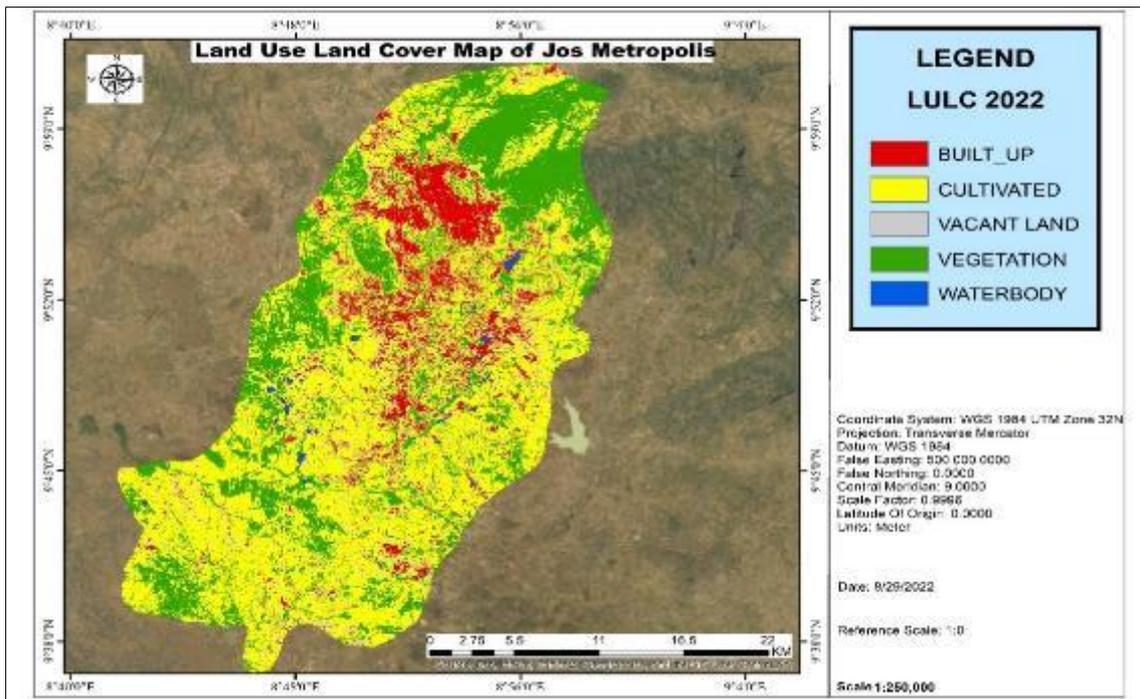
#### 3.1 Land Use Classification of the Study Area

The land use classification: shows the following land use/land cover distribution: The cultivated area has the highest with 437.0589 km<sup>2</sup> with a percentage of 52.65%, Vegetation is the second highest having 235.6173 km<sup>2</sup> with a percentage of 28.38%, water body has the lowest having 5.211sq km with a percentage of 0.63%. Built-up area is having 84.4344 km<sup>2</sup> with a percentage of 10.17%, while the vacant land is having 67.7718 km<sup>2</sup> with a percentage of 8.16% (see table2). This proves that there is a significant amount of undeveloped vacant land across the study area due to various factors which, provides a potential opportunity for future city expansion.

**Table 2** Land Use/ Land Cover of the Study Area

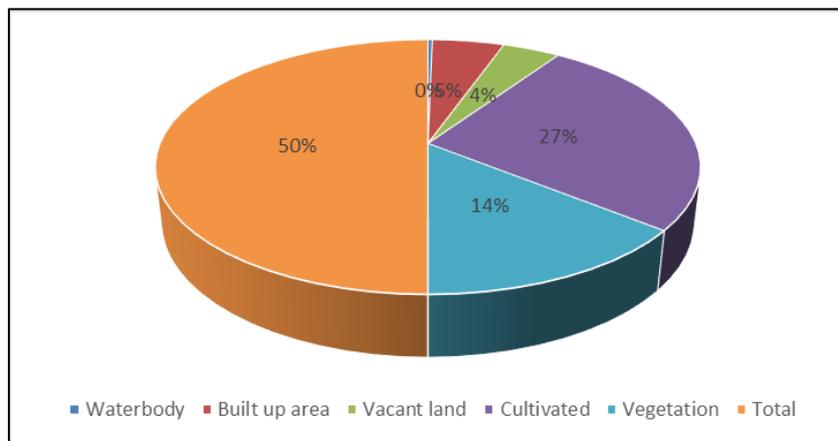
| Classes     | Area (SQKM) | Percentage |
|-------------|-------------|------------|
| Waterbody   | 5.21        | 0.63       |
| Built-Up    | 84.43       | 10.17      |
| Vacant land | 67.77       | 8.16       |
| Cultivated  | 437.06      | 52.65      |
| Vegetation  | 235.62      | 28.38      |
| Total       | 830.09      | 100        |

Source: Authors' GIS computation



Source: Author Google Earth analysis.

**Figure 3** Land Use /Land Cover Map of Jos Metropolis



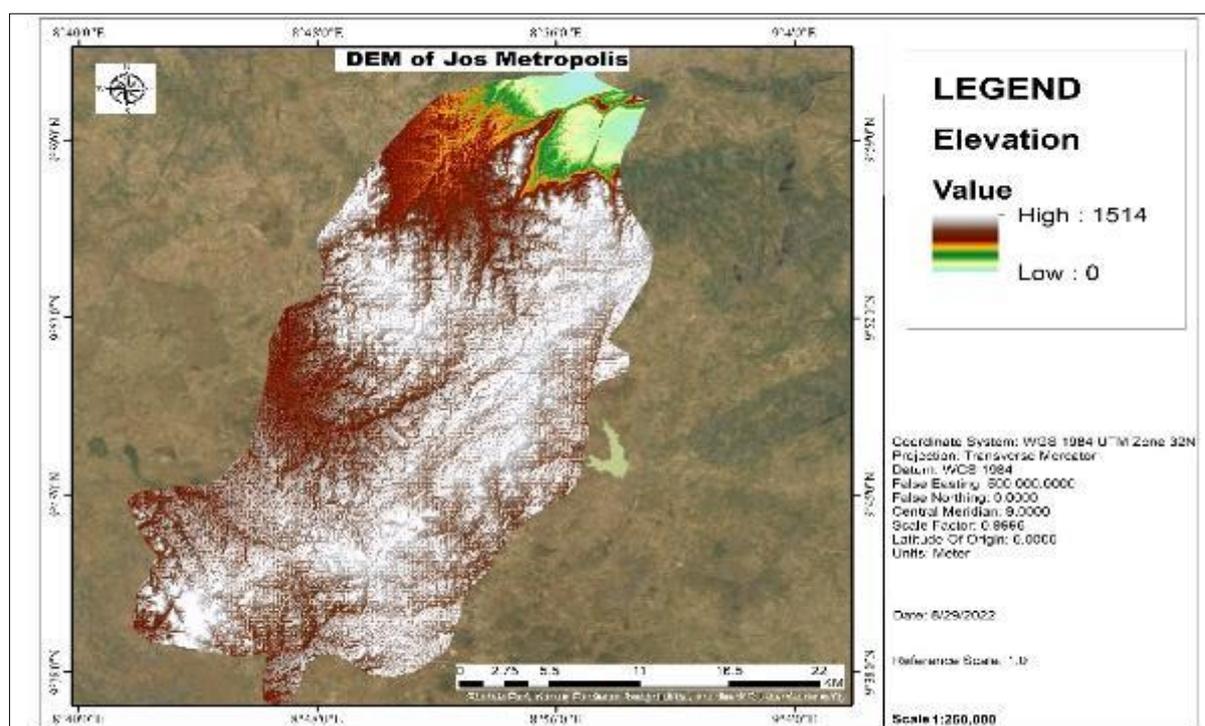
Source: Author

**Figure 4** Percentage of Land Use/ Land Cover of the Study Area

Based on the above findings, the planning implications depict that the vacant land is in existence with a significant figure of 8.16% of the study area, which is not expected of a planned metropolis where every land is assigned a use.

### 3.2 Digital Elevation Model (DEM)

The DEM shows that Jos South has the highest elevation of 1514m and Jos North with the lowest of 886m. The DEM denotes that the vacant land is sparsely distributed across the study area of Jos Metropolis due to the slopy and hilly nature of the land. The DEM analysis reveals that vacant land within Jos Metropolis is unevenly and sparsely distributed, and so also the built areas (Figure 3), largely as a result of the area's undulating and hilly terrain. Steep slopes and irregular elevations impose significant physical and economic limitations on land development. Such topographic constraints increase construction costs, reduce accessibility, and often require additional engineering interventions, making these areas less attractive for residential, commercial, or infrastructural development (Ogunleye et al., 2011; Akinbamijo, 2013). Consequently, flatter and more accessible lands are preferentially developed, while sloped regions tend to remain vacant or underutilized. The hilly areas are also flashpoints for gully erosion, and also lack road connections and thereby constraining accessibility.



Source: Author.

**Figure 5** Elevation Map of Jos Metropolis

### 3.3 Factors Determining Vacant Lands

3.3.1 *Natural / Environmental Factors: These are the physical characteristics.*

Table 3. highlights the absence of established structures as a significant factor.

The suitable types of development might also hinge on the geometry of the land. More specialized results are needed for irregularly shaped tiles or linear parcels than for conventional rectangular shapes. Compared to slightly sloping, level parcels of land with a grade of 5% or less, steeply sloping land is more challenging to manage. Clean slate is understood as a vacant lot without any structures, making it easier to redevelop; nevertheless, it can also convey its own conventional challenges compared to a parcel of land that requires demolition, which is typically easier to handle. The standard revealed is a parcel size of 0.8 hectares or 2 acres. Analyses of larger parcels, show they have a tendency to offer additional opportunities for multi-tiered housing or marketable developments, while smaller parcels of land have more limited potential.

More challenges and costs are linked with grading and construction on steeper slopes. Soil permeability above 5% grade restricts and influences drainage abilities both in terms of housing and road construction.

Drainage capacity is impacted by soil permeability. Equated towards permeable soils, non-permeable soils required more expensive drainage structures prior to development. Unmaintained appearance, thick vegetation on the parcel of vacant land, may be signs of land that has remained vacant or abandoned for a long period. Waste presence and debris area, which indicates problems with unlawful dumping of waste, requires higher cleanup expenses prior to any new uses. A detailed profile of the physical state, limitations, and possible opportunities of the vacant parcel can be created by evaluating these factors.

**Table 3** Natural Factors and Description

| Natural Factors | Description   |
|-----------------|---|
| Structure       | Presence or absence of physical structure             |
| Size            | Smaller or larger than 0.8ha                          |
| Shape           | Rectangular, irregular or linear                      |
| Slope           | Gentle slope less than 5% or steep slope more than 5% |
| Soil            | Permeable or non-permeable                            |
| Maintenance     | Visible or non-visible                                |
| Waste presence  | Presence of debris or not                             |

Source: authors' computation

### 3.3.2 Cultural Factors

Table 4 presents specific cultural factors relevant to the assessment of vacant land in the Jos metropolis area; see also the discussion on how these cultural factors might be applied in that local context.

- Land Use/Zoning; Zoning regulations dictate that (residential, commercial, industrial, etc.) are permitted on a vacant parcel. This is a critical factor in evaluating reuse options. Some vacant lands are non-conforming uses based on current zoning, requiring rezoning or zoning variances for redevelopment.
- Ownership; some vacated land is owned by the government or someone else (which affects the process of redevelopment/approvals needed, purchase cost of public vs private property). Public ownership makes municipal redevelopment quick and easy as opposed to having to purchase/assemble parcels owned by someone else.
- Property Values: looking at assessed land values and land values of neighboring properties provides an insight into the market conditions and development conditions in that area; higher values mean affordable housing may not be possible without subsidies, whereas lower values may force priority on particular areas for empowerment zone investments.
- History of site; Historical information on former uses (such as industrial, residential, or other uses) might indicate potential environmental contamination issues to be investigated further. Sites of great historical/cultural value may require preservationist requirements.
- Safety and Crime level; perceived unsafe conditions or higher crime rates discourage investment and community use. Consideration should be given to the use of Crime Prevention Through Environmental Design (CPTED) principles in redevelopment strategies.
- Illegal activities, evidence of illegal dumping, trespassing, drug activity, etc., on vacant parcels cause a safety or blight problem to be remedied.
- Community Asset: Where a vacant lot has become an informal community green space or may have other Peace-Based Assets benefits, planning will need to balance that with future redevelopment.
- Large Buildings; Vacant lots with designated historic landmark buildings present additional constraints and preservation requirements.

**Table 4** Cultural Factors and Description

| <b>Cultural Factors</b>          | <b>Description</b>  |
|----------------------------------|---------------------|
| Land use/                        | Zoning              |
| Ownership                        | Public or private   |
| Property values                  | Values              |
| History of site                  | Asset               |
| Safety of site                   | Safe or unsafe      |
| Crime level                      | Low or High         |
| Illegal activities               | Presence or absence |
| Community asset                  | Presence or absence |
| Significant structure (landmark) | Presence or absence |

Source: authors' computation

### 3.3.3 Causes of Vacant Land

Surveys have it that Topography poses a significant problem to vacant land because of its varying terrain, shapes, and steep which makes land inappropriate for development, creating room for vacant land.

- High Taxes; land owners are discouraged from land development due to high property taxes, which contribute to the existence of vacant land in Jos metropolis.
- Owners will; land owners speculate results on the existence of vacant land in the study area by intentionally keeping land to anticipate better land market value in the future.
- Demand; low interest in some setting land due to location reduces market demand and encourages vacant lands in the study area.
- Distribution, desirability, and potential development of parcels can be affected by geographic land distribution, therefore causing vacant lands.
- Amount: Exorbitant price tag for parcel of land discourages demand for land, making the land vacant.
- Economic course; high cost of development material and which can lead to economic meltdown as a result of poor policies. Regulatory and Institutional:
- Natural obstacle; the survey has it that natural disasters like earthquakes, floods, rivers, and mountains hinder development, therefore creating vacant land.

**Table 5** Causes and Description

| <b>Causes</b>                  | <b>Description</b>                               |
|--------------------------------|--|
| Topography                     | Varying terrain                                  |
| High Taxes:                    | Economic factor                                  |
| Will of the Owner:             | Speculation                                      |
| Distribution                   | Feature  |
| Character                      | Topography, size, shape, location, and condition |
| Amount                         | Quantity of land                                 |
| Financial causes:              | Economic factors                                 |
| Regulatory and Institutional:  | Blueprint  |
| Physical Barriers              | Physical features hindering development          |
| Excessive land division        | Geometric features                               |
| Irregularly shaped land parcel | Several lots are divided due to scarcity         |

|  |                       |
|--|-----------------------|
| Decreasing resident population and deindustrialization | Migration, Insecurity |
|--|-----------------------|

Source: authors' computation

### 3.4 Policy/ Land Law

Planning law provides a legal platform for the profession. Examples: Nigerian town and country planning law 1946, Urban and regional planning law 1992, Land use act Decree No. 6 1978. In Nigeria, these are established and they serve as a tool guiding the process for effective physical planning through the planning authorities and agencies constituted to carry out planning activities to bring about growth and development in the most urban metropolitan areas (Oyesiku 2004, Ekop and Uyanga 2007).

**Table 6** Policy and Land Laws in Nigeria

| Laws / Policies                           | Decrees          | Year promulgated |
|---|------------------|------------------|
| Nigerian town and country planning law    |                  | 1946             |
| Land Use Act                              | The Decree No. 6 | 1978             |
| Nigerian Urban and Regional Planning Act, | Decree No. 88    | 1992             |

Source: authors' computation

**The Nigerian town and country planning law of 1946 (NTCPL)** was modelled on the United Kingdom Town and Country Planning Act of 1932. This law contains the major provisions for planning and development in Nigeria and guides the usage of land within individual spaces.

**The land use act The Decree (No. 6 of 1978)** known as the land use act has some broad objectives which enhances the effective control, management and administration of land in Nigeria, it vested all land in the hand of governor of each State for the use and common benefits of its citizens thus, provides great opportunity to planning and development in terms of accessibility to the land, and also curb the incidence of rising land price arising from the activities of speculators.

**The Nigerian urban and regional planning act, (Decree No. 88 1992)** was promulgated and published in the Federal Republic of Nigeria official gazette (No. 75, vol. 79) on the 15<sup>th</sup> (December 1992. No 74) of the law states that there is a Maintenance of wasteland: vacant site or/an open land, the control department shall serve on the occupier or owner of such land a notice requiring such step for abating an injury as may be specified in the notice to be taken within such period of time as may be specified. It also talks about all land placed in the custody of the governor, which led to government failure in nationalizing lands.

## 4 Key findings

Our findings show that an average of 8.16% of the study area was deemed vacant. This total includes widely varying types of land ranging from undisturbed open space, undeveloped land, rocks, bare surface, mining pond, gully erosion, and alluvial deposits.

This research also highlight that natural factors (terrain, gentle slope less than 5% or steep slope more than 5%), biological factors (Number of trees), Cultural factors (Land use/zoning, ownership, historic sites), socio-economic factor (taxation, regulation) are significant factors influencing vacant lands in the study area.

This research examines the various policies and laws (Nigerian town and country planning law 1946, Urban and regional planning law 1992, Land use act Decree No. 6, 1978. In Nigeria, that governs the use of land and effective planning for sustainable growth.

## 5 Conclusion

Vacant land has rarely been surveyed and supervised; as a result, there is no reliable database of urban vacant land in Nigeria. Considering the high unpredictability of urban vacant land, it is recommended that the government conduct a

special survey of urban vacant land on a quarterly basis and publish a list of urban vacant land at the end of each quarter. Based on the survey information, strict supervision of urban vacant land could be implemented.

### *Recommendation*

- Effective and periodic vacant land mapping to ascertain potential benefits or constraints for comprehensive use and redevelopment.
- Evaluation and bring up-to-date land use planning, policies and regulation to encourage vacant land redevelopment and discourage land speculations and incentivizes development.
- Encourage public private partnership and community initiative to drive reuse of urban vacant land in agriculture, recreational parks, and affordable housing.
- Prioritize redevelopment of vacant lands to prevent illegal activities and crimes by applying principle of crime prevention through sustainable urban planning.
- Planning authorities should collaborate and engage with communities, stakeholders, to design comprehensive plans that address development of urban vacant lands that preserve cultural and historic asset and promote inclusive and equitable growth.

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## **Compliance with ethical standards**

### *Acknowledgments*

This work was funded by Town Planners of National Center for Remote Sensing, Jos. National Space Research and Development Agency. Abuja, Nigeria, University of Jos, Nigeria, and Geography Department, Humboldt-Universität zu Berlin, Germany.

### *Disclosure of conflict of interest*

The authors declare no conflict of interest.

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- Conceptualization, Nate. B. P; Paul. E. E
- Methodology, Paul. E. E., Kalidai. G. M., Liman. A. M., Nate. B. P., Esther. S. I and Haruna. W.;
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- Formal analysis, Nate. B. P., Paul. E. E., Kalidai. G. M., Clara. I. M., Liman. A. M., Esther. S. I. and Haruna. W.;
- Investigation, Paul. E. E., Nate. B. P. and Kalidai. G. M.,
- Resources, Nate. B. P., Kalidai. G. M., Clara. I. M., Liman. A. M., Paul. E. E., Esther. S. I and Haruna. W.;
- Data curation, Nate. B. P. and Esther. S. I.; Paul. E. E.,
- Writing—Original draft preparation, Paul. E. E., Nate. B. P., Kalidai. G. M., Clara. I. M., and Haruna. W.;
- Writing—review and editing, Nate. B. P., Kalidai. G. M., Clara. I. M., Liman, A. M., Paul. E. E., Esther. S. U.;
- Visualization, Nate. B. P and Esther. S. U.;
- Supervision, Prof. Samuel D.W., and Nate. B. P.;
- Project administration, Prof. Samuel D.W., Nate. B. P., and Esther. S. I.;
- All authors have read and agreed to the published version of the manuscript.

### *Funding*

This research received no external funding.

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