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Flood Mitigation Mapping from the Space. A Case Study of Damaturu Town, Yobe State Nigeria

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ABSTRACT

One of the natural disasters being experienced in world is flooding, particularly, areas within flood plains. There are Numerous research conducted by scholars in mitigating flood occurrences to minimise loses in lives and properties. However, there is little study on flood mitigation in the north-east part of Nigeria. This study use satellite data to prepare a flood mitigation map of Damaturu Town northeast Nigeria. The map shows highly vulnerable flood area covering approximately 2,669 hectares. The moderate and less risk areas have and area of 10,313 hectares. Only 3,438 hectares of land that has little or no risk of flooding. The flood mitigation map created will be used as a decision-making process by the town planners and engineers for proper planning for flood mitigation. Hence, contributing towards the realization of Sustainable Development Goal (SDG) Target 13.1.3 Implementation of local disaster risk reduction strategies; and 11.1 ensuring access for all to adequate, safe, and affordable housing and basic services and upgrade slums.

Keywords: Flood, Elevation model, Built up area, Roads

1.0. Introduction

Flooding in Damaturu metropolis recently has caused loss of human lives and properties, destroyed crops, livestock were lost, and health conditions of the populace deteriorates due to waterborne diseases. In the past, there are many measures taken by the state government on how to mitigate flood occurrences. These include construction of drainage system across the lowland areas in the town and creating waste dump sites in many suitable locations for minimising dumping waste in water channels. Despite all these measures, the metropolis is still experiencing flooding.

Several studies were conduction on flood mitigation and mapping. Flood maps were created for decision making processes (Bonasia and Lucatello, 2019; Korah, and Cobbinah, 2017). Different approaches of flood mitigation mapping were introduced by researchers to tackle specific flood problem of a particular area (Mudashiru, et al., 2021; Ahmed, et al., 2021). Studies were also conducted in Yola that delineates properties that were liable to flood (Isa and Musa 2014). However, despite the persistent flooding in Damaturu town, there is little, or no studies conducted on flood mitigation mapping for the town.
This study uses the techniques of satellite remote sensing and Geographic Information System (GIS) and identifies flood vulnerable areas. An elevation model was generated from Shuttle Radar Topography Mission (STRM) data and was integrated with Built up areas and road network. The datasets were analysed in ArcGIS10.3. The result show areas that are highly vulnerable to flood and

those areas that has less risk to flooding. The result of this study will serve as a decision-making tool that can mitigate flood disaster in Damaturu town. Town planners and Engineers will find this information useful for planning and development.

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2.0. Methodology

2.1. Study Area

The site of this study was Damaturu, the capital of Yobe state Nigeria. It lies between the latitude 11° 42'N and 11° 47'N and between the longitude 11° 54'E and 12° 02'E. Figure 2.1 shows the map of the study area.

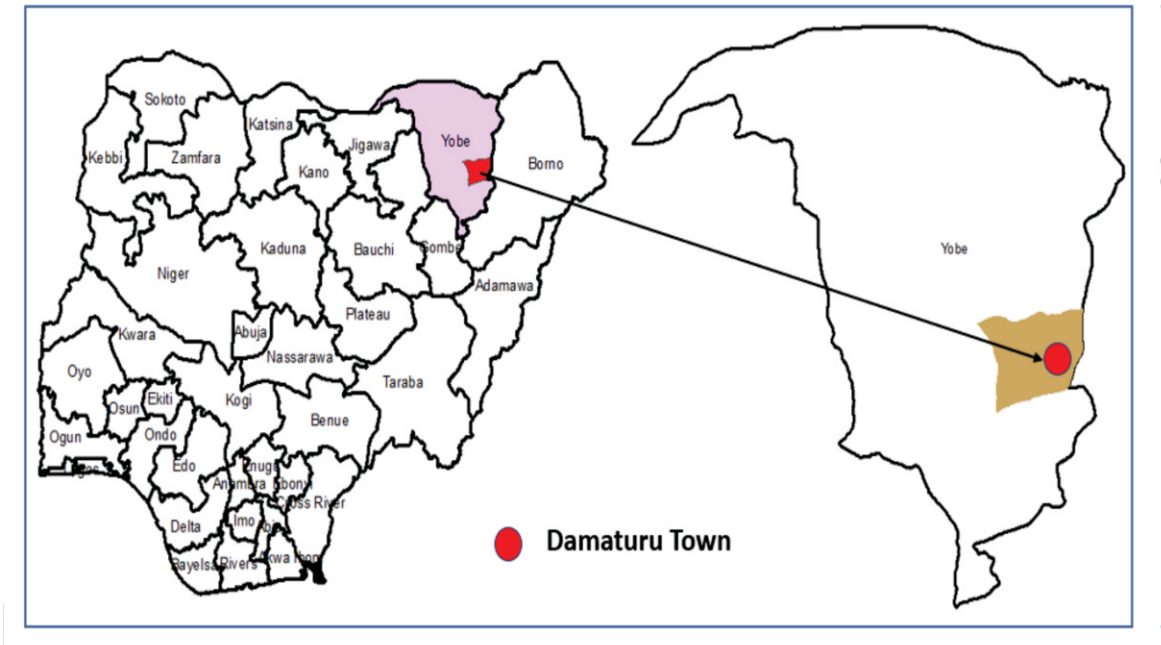

Figure 1: The study area.

2.2. Materials

The main materials used are two datasets namely, (a) elevation data, and (b) building and roads network of the study area. The elevation data was derived from SRTM. It uses radar signals to collect the elevation of predefined points at 30m intervals. It was accessed via Earth Explorer.

Buildings and roads of the study area were acquired from BBBike database. It is a database that comprises the necessary information on roads, railway, water ways, buildings, points, and other natural features. It started as a route planner for cyclists in Berlin. It was now extended to cover other cities in the world. It allows user to extract details within the areas of interest from Planet.osm in Esri shapefile and other formats.

2.3. Methods

Creation of buildings and road network data sets were done using Arc catalog. New Personal Geodatabase was created and was named flood. From flood Geodatabase, two datasets were created. These were buildings as polygon features and roads as linear features. Projected coordinate system was selected as UTM WGW1984 Zone 32N. Vertical controls system is Africa, Lagos 1955.

Built up area and road network of Damaturu Township were added into the two created datasets. The roads within the town serve as an aid in determining the its boundaries. Figure 2. is the added built up areas and road network.

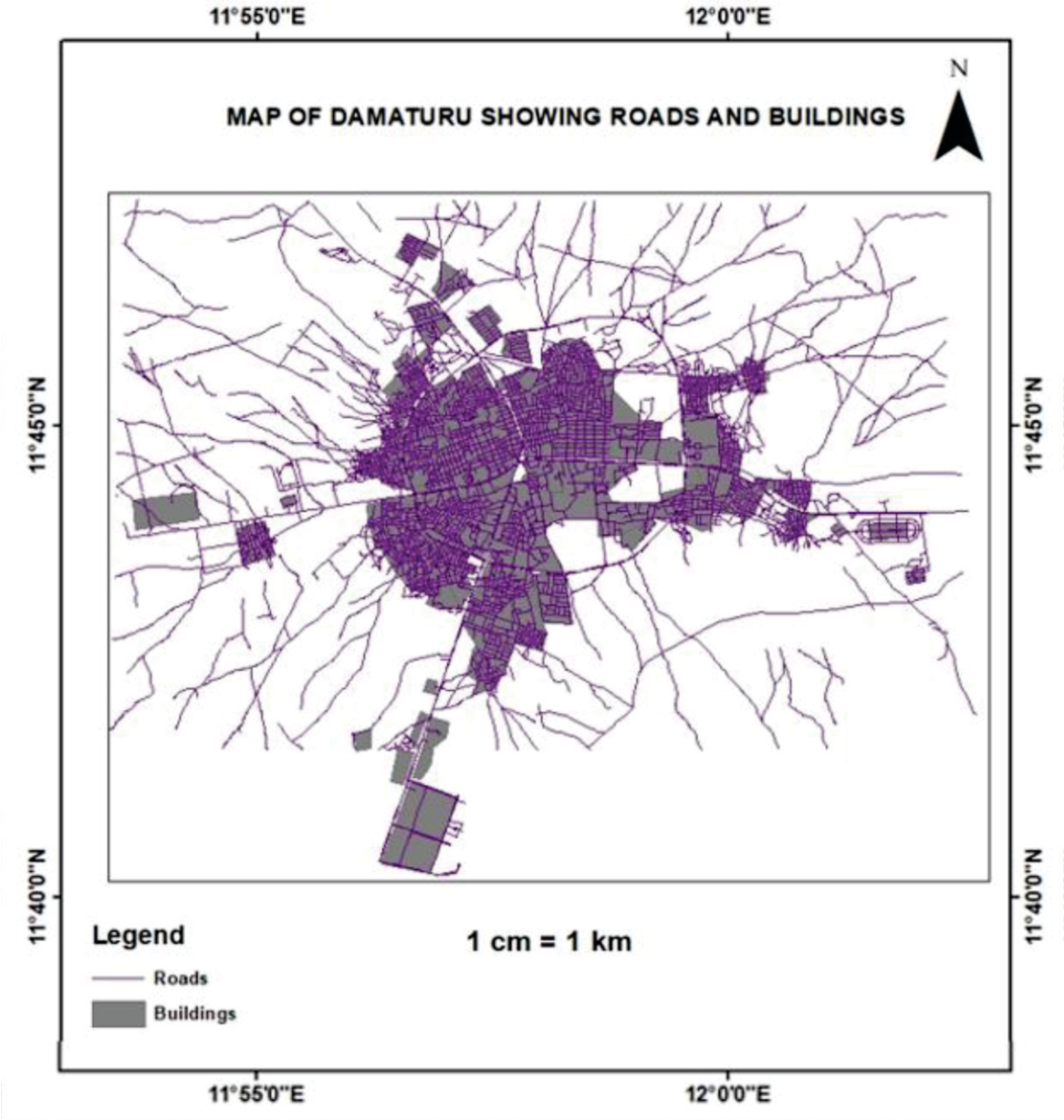

Figure 2. Damaturu Built up area and road network

The elevation model was generated from the STRM data. Damaturu area has a highest altitude above mean sea level (MSL) as 421 meters and 358 as the lowest. Figure 3. is the STRM data covering Damaturu Town.

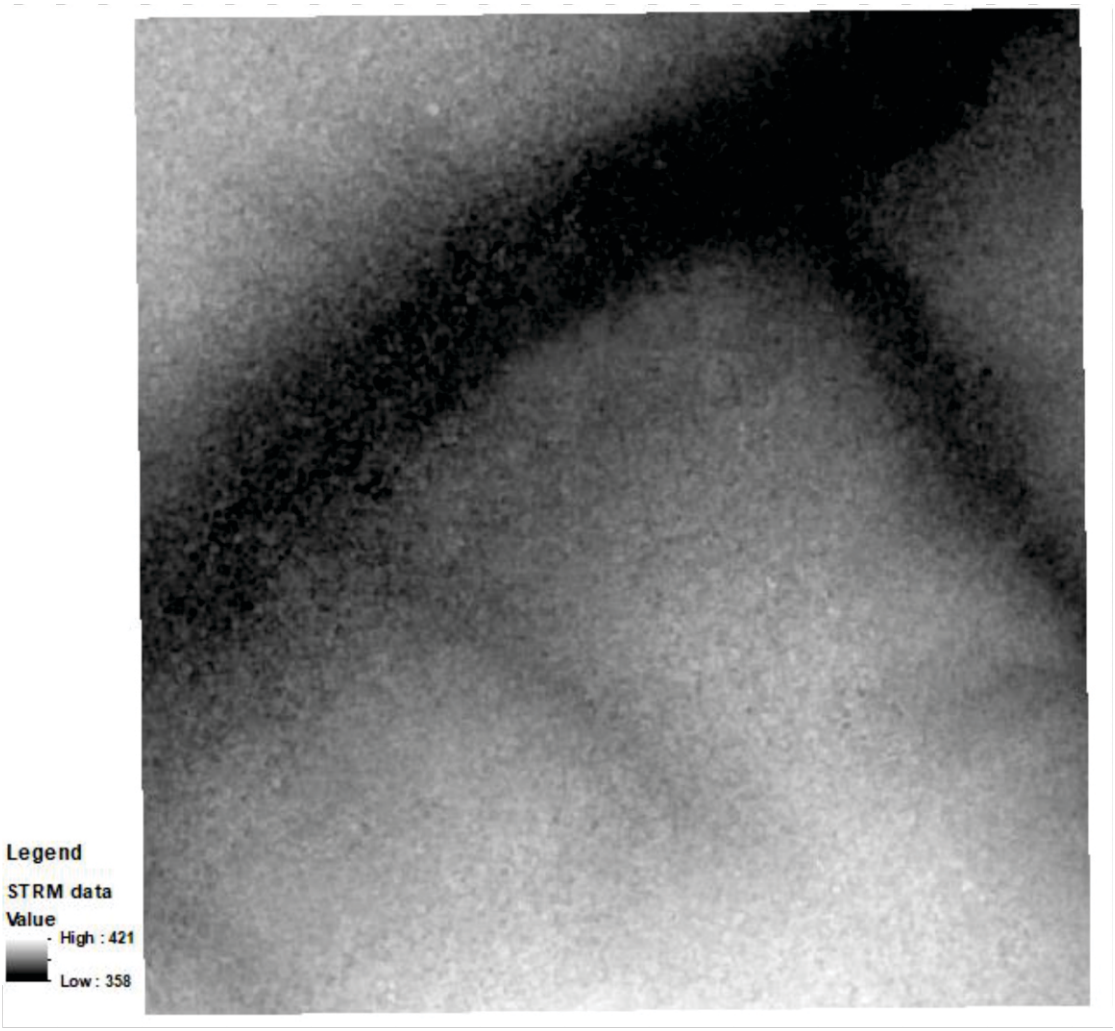

Figure 3. STRM data of Damaturu Town

The spot heights were classified into five groups at an interval of 15 to 18 meters. The classes range from the highest (403m – 421m) to the lowest (358 m– 373m). The lowest plain is the most flood vulnerable area while the highest plain is the safest area in terms of flood. Figure 4. is the classified STRM data.

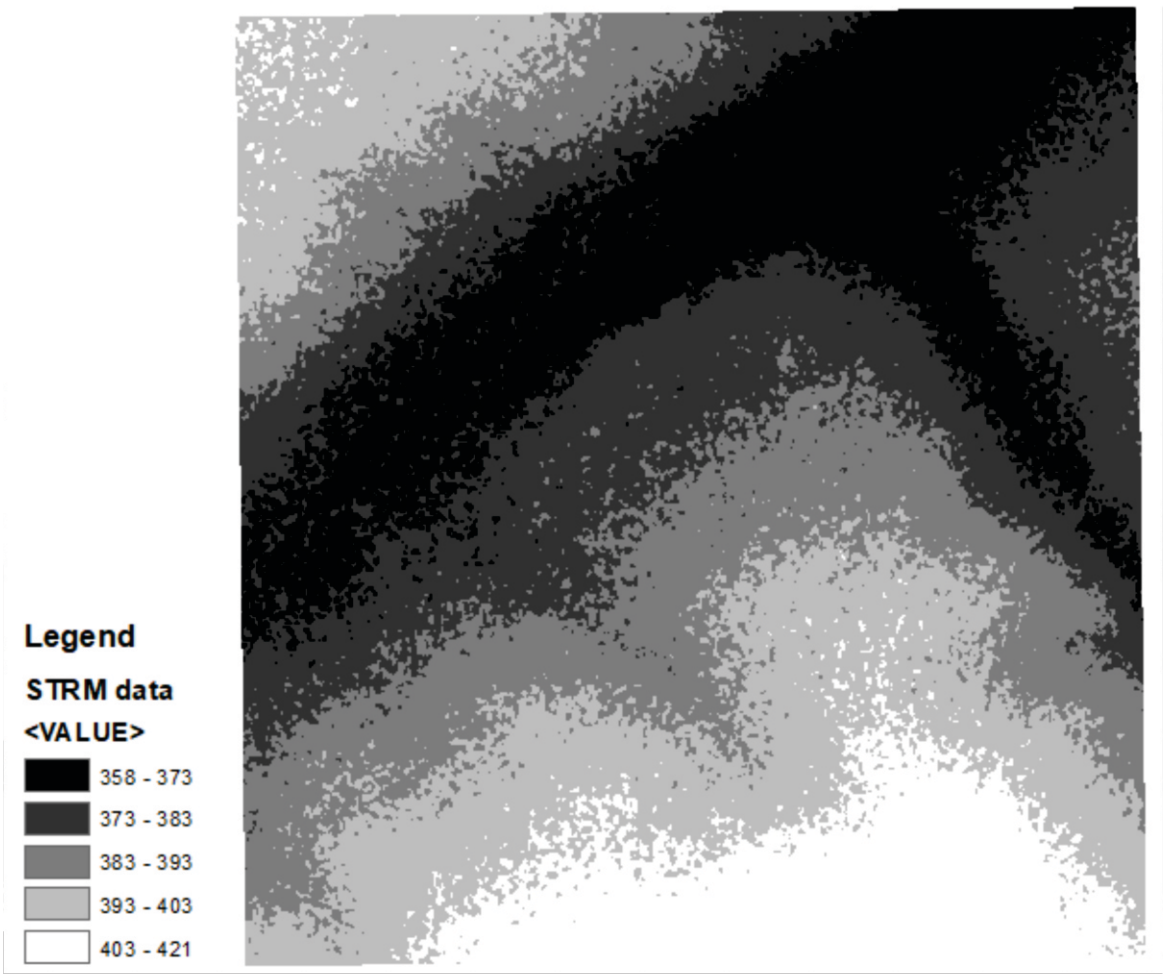

Figure 4. Classified STRM data

From the derived SRTM elevation model, the lowest area was selected as the highest flood vulnerable area (flood plain/lowland). Built up areas and roads were overlaid on the lowland area to know those features (buildings and roads) that lie in the flood plain and which features that lies outside the flood plain. This was done using the analyst tool from the Arc Toolbox. Fairly and low risk flood areas were also identified and mapped out.

3.0. Results and Discussion

3.1. Results

Damaturu town has 7 wards. These wards are Gwange, Pompomari, Maisandari, Bundigari, Damaturu central, Dikumari and Nayinawa. Figure 5. depicts the seven wards in Damaturu town.

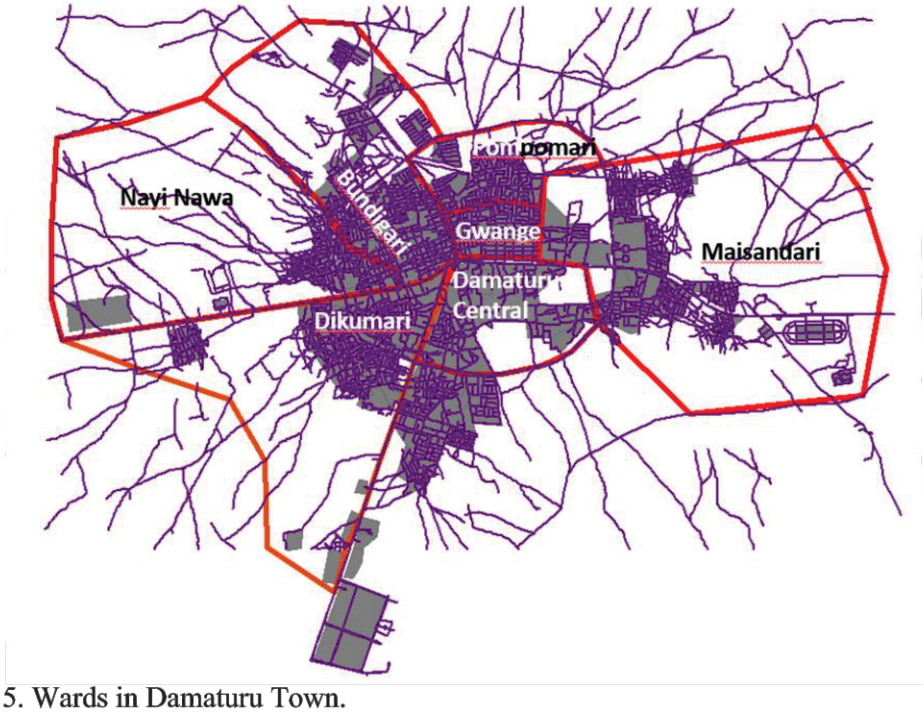

Figure 5. Wards in Damaturu Town.

The buildings and road network of Damaturu Township that were overlaid on the elevation model was presented as Figure 6. The north-eastern part of the town comprising of Sunsunma and part of Waziri Ibrahim extension in Maisandari ward fall within the high-risk flood plain. The southern part of the town has less risk of flooding.

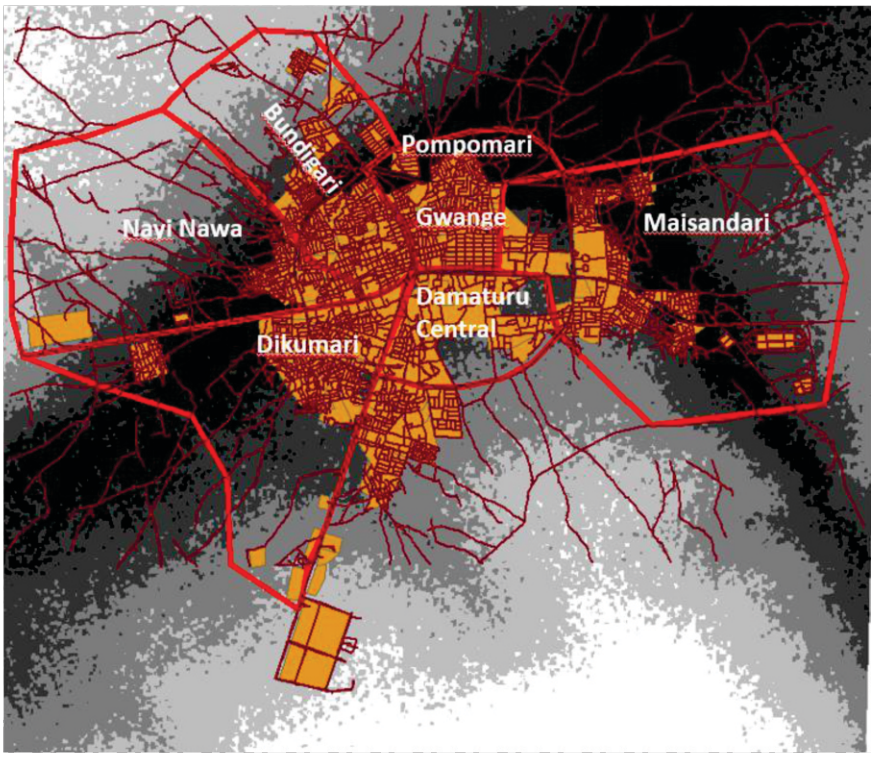

Figure 6. Analysis of areas liable to flood.

The level of flooding was categorized into high risk, fairly risk and less risk areas. The features within the red flood plain are the highest risk area of flooding. This includes all areas within centre of the town tending towards the Northwest part. This includes part of Bundigari, Gwange, Pompomari and Maisandari wards. They were presented in red in Figure 7. The features presented in yellow were fairly at risk of flooding. Those in navy blue has less risk of flooding. The safest areas were located within the southeast part of the town.

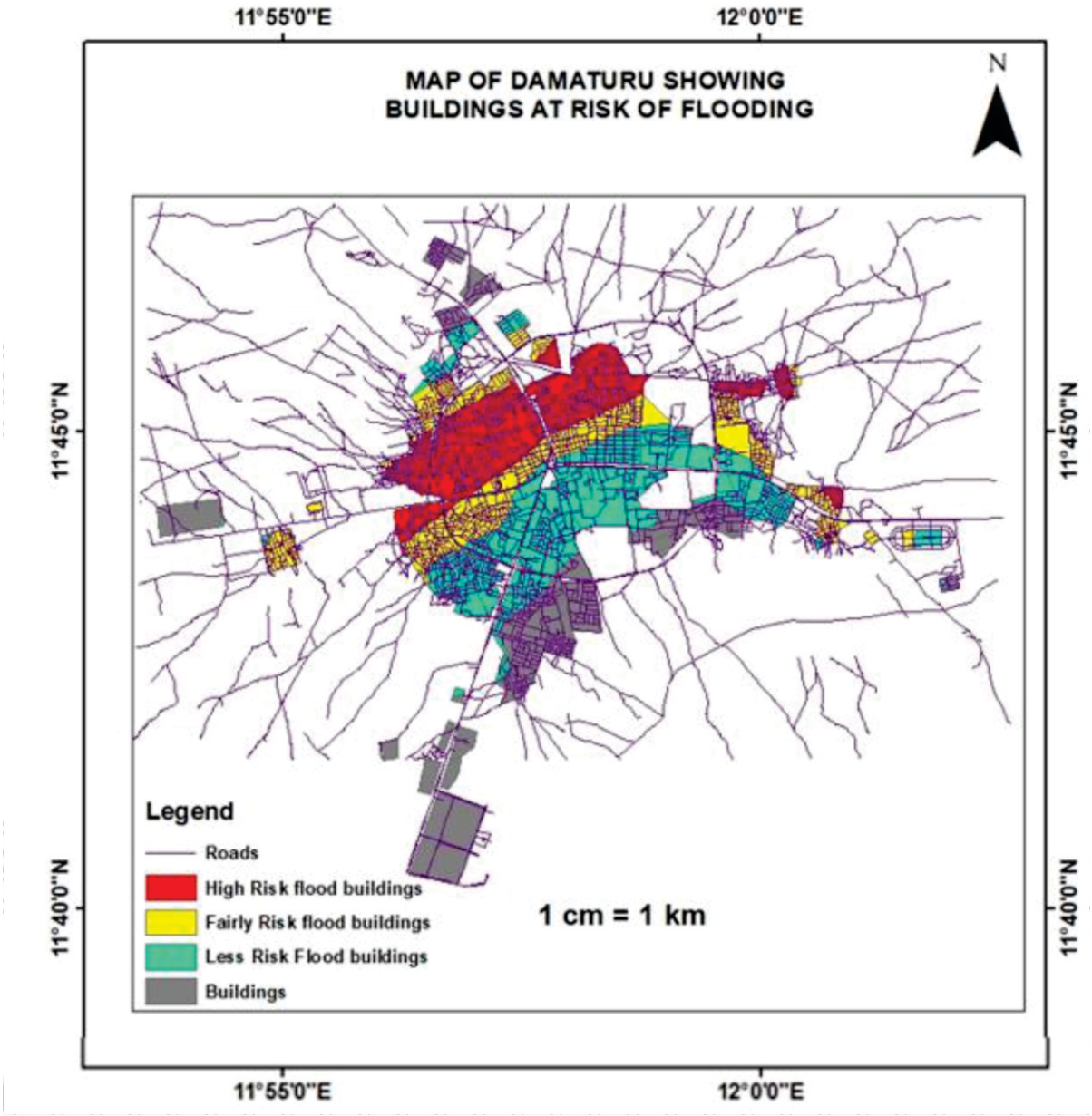

Figure 7. Flood mitigation map.

3.2. Discussion

Damaturu Town lies on an elevation of range from 421 to 358 meters above the MSL. Most of buildings in the town are vulnerable to flooding. The highly risk area covers 2,669 hectares. These are areas that

lies within an elevation of 383 to 358. Pompomari and Gwange were the wards that that were most affected. The fairly and less risk flooding areas has an extent of 10,313 hectares. Half of the buildings in NayiNawa and Bundigari was within this flood plain. From the results, only few buildings in Damaturu township that was safe from floods. Sourtheastern part of the town can be used as evacuation centres since it is at an elevation level of 393 to 421meters above the MSL. These areas have little vulnerability to flooding and has an approximate area of 3,438 hectares.

This study shows that one can successfully integrate elevation model with topographic data to generate a flood mitigation map of a specific area of interest. This will serve as an early warning mechanism in safeguarding humans and materials. It will also assist in mitigating flood disaster. Thus, flood mitigation map is vital to the overall planning, development, and mitigation of flood.

4.0. Conclusion

Flood mitigation map of Damaturu town was created by integrating Digital Elevation Model with built up areas and road network. From the result, it was concluded that larger part of the town lies within a floodplain. The area that was not vulnerable to flooding is the south-eastern part of the town covering only 3,438 hectares. This information will be used as an early warning mechanism for flood management. It can also be used in the developmental planning of greater Damaturu as well as contributing towards the realization of Sustainable Development Goal (SDG) Target 13.1.3 Implementation of local disaster risk reduction strategies. and 11.1 Making cities and human settlements inclusive, safe, resilient, and sustainable.

Acknowledgments

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References

Ahmed, N., Hoque, M. A. A., Howlader, N., & Pradhan, B. (2021). Flood risk assessment: Role of mitigation capacity in spatial flood risk mapping. *Geocarto International*, 1-23.

Bonasia, R., & Lucatello, S. (2019). Linking flood susceptibility mapping and governance in Mexico for flood mitigation: A participatory approach model. *Atmosphere*, *10*(8), 424.

Isa, M. Z., & Musa, A. A. (2014). Delineation of built-up areas liable to flood in Yola, Adamawa State, Nigeria using remote sensing and geographic information system technologies. *FUTY Journal of the Environment*, *8*(1), 20-30.

Mudashiru, R. B., Sabtu, N., Abustan, I., & Balogun, W. (2021). Flood hazard mapping methods: A review. *Journal of Hydrology*, *603*, 126846.

Korah, P. I., & Cobbinah, P. B. (2017). Juggling through Ghanaian urbanisation: Flood hazard mapping of Kumasi. *GeoJournal*, *82*, 1195-1212.

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