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Flood Mapping of Fadama Areas in Ile Ife, Nigeria Using Geospatial Techniques

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Authors' contributions

This work was carried out in collaboration among all authors. Authors JEA and SAO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SAS and MOA managed the analyses of the study. Author OF managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Flooding is a serious, common, and costly hazard that many countries face regularly, therefore a global concern. Vulnerability to flood hazards is likely to increase unless effective flood mitigation and management activities are implemented. Flooding is one of the most common environmental issues in the southern and the eastern part of Nigeria alongside with deforestation and erosion.
There is need to have information on flood risk and basis for priority setting on political decision on risk mitigation and management of fadama farmers in the study area and since there is lack of information on these, hence the study.
The study mapped out fadama areas in the study area (Ife East and Ife Central), identified areas susceptible to flooding, studied the effect of flooding on fadama production in terms of economic and social implication and examined the mitigating efforts of farmers.

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Eleven Fadama points were mapped out and almost all are in the low elevation (3.5–7.1% slope) which made them prone to/or at risk of flooding during high peak of rainy season. Majority of the fadama farmers have a means of militating against flood by dredging the water ways but no government intervention has been done to assist them. All Fadama farmers are literate, therefore any assistance by the government would be embraced and not misunderstood.

Keywords: Flooding; vulnerability; mitigation; fadama.

1. INTRODUCTION

Flooding is a serious, common, and costly hazard that many countries face regularly. It is therefore a global concern and not specific to an area. Flood by nature are complex events caused by a range of human activities and climate variability. The majority of flood disasters' victims are poor people living in the flood plain [1]. Vulnerability can be viewed from the perspective of the physical, spatial or locational, and socio- economic characteristics of a region. Vulnerability to flood hazards is likely to increase unless effective flood mitigation and management activities are implemented.

The assistances and aids on the disaster mitigation in the developing countries should be operated from a multidisciplinary perspective including sociology, economics, agriculture, environmental studies, science, engineering, and education [2].

Floodplain soils constitute the back bone of arable crop production in the semi-arid and arid savannah agro-ecological zones where precipitation (rainfall) is limited for agricultural productivity [3]. Flood plains are predominantly flat floored inland valleys bordering or adjacent to the banks of major rivers and streams. They form part of a larger group called the wetland soils [4]. The flood plains also known as "Fadamas" in northern Nigeria have become very prominent because of their use for intensive agricultural production [4]. Fadama soils usually have low gradient and are liable to seasonal flooding at the peak of rainy season [5]. The Fadama soil vary widely in morphological and chemical characteristics both within and between valleys owing to differences in morphogenesis, location, hydrological regimes, lithologic origins and climatic condition, therefore they could be rich or very poor in fertility [6].

Fadama is a Hausa word meaning low-lying swamp area consisting of fluvial deposits and containing extensive exploitable aquifers [7]. The word also refers to a seasonally flooded area used for dry season farming. It has been reported by Esu [7] that fadama-like lands are described in Igbo language variously as "ani uro, ude or uda" other language groups have their own words that describe lands under this water affected area.

Afolabi [8] said that Fadama farming in the southern part of the country is prevalent along river banks and other wetland areas and the crops mainly grown are vegetables and maizes. Vegetable crops are of various types and may be classified according to botanical requirement. Vegetable of which the leaves and stem parts are used are called leafy vegetable, cabbage etc. Those which the underground parts are used are referred to as root vegetables e.g. garlic, onion, sweet potatoes, carrot etc. while those whose fruits or seeds are used includes okra, pepper, pumpkin, cucumber.

Despite the opportunity for Nigeria to be self-sufficient in food production, it is unfortunate that there are a lot of factors affecting agricultural development in the country. These include amongst others instability in government policies and the change of the economy from an agricultural driven economy of the 1960's/early 1970s to oil (crude oil) driven economy, leading to the neglect of agricultural sector.

Apart from the economic shift to the oil sector, it is to be noted that agricultural production in Nigeria is dictated by climatic and edaphic conditions. These factors determined the range of crops planted and the efficiency of the crop production is rain fed, thus determining the agricultural production season.

Flooding is one of the most common environmental issues in the southern and the eastern part of Nigeria alongside with deforestation and erosion [9]. It has caused serious danger to people's lives and properties across the world; resulting into about one third of all deaths, injuries, and one third of all danger from natural disasters [10].

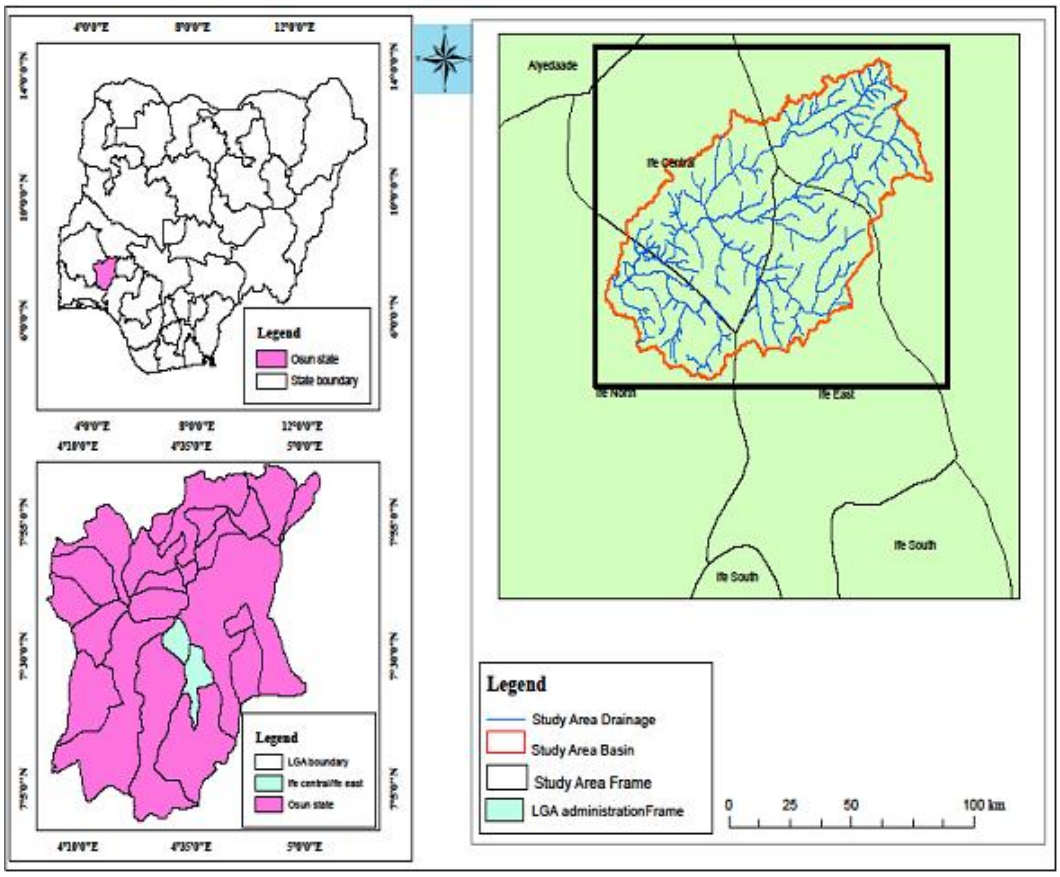

Fig. 1. Study area

In order to have an effective tool available for information on flood risk, as well as a valuable basis for priority setting and further technical, financial and political decisions regarding flood risk mitigation and management, there is need to have a baseline study of the fadama farmers in the study area and since there is lack of information of these, hence the study.

1.1 Aim and Objectives

The aim is to study the effect of flood on fadama production in the study area with the following specific objectives;

i, Map out fadama areas in the study area;
ii, Identify areas susceptible to flooding;
iii, Study the effect of flooding on fadama production in terms of economic and social implication and;
iv, Examine the mitigating efforts of farmers.

1.2 The Study Area

Ife East Local Government Area in Osun State lies between Longitudes 4º32'E and 4º40'E and Latitudes 7º15'N and 7º35'N, while Ife Central Local Government lies between latitudes 7º28^{1}43.5' N and 7º37^{1} 51.41' N and spans between 4º27^{1} 22.5'E and 4º35^{1} 40.61'E.

2. METHODOLOGY

Primary data for this study was collected through questionnaire and GPS receiver to capture the location of Fadama site while the Secondary data includes Land use land cover of the area, Digital elevation model, rainfall data, soil map and high resolution image.

All spatial data were captured in the GIS platform for geospatial analysis. Analysis was done in the ArcGIS platform to obtain Fadama points, Flood Vulnerability, Digital Elevation Model and Land Use Land Cover. The procedure used to achieved the set objectives are illustrated in Fig. 2.

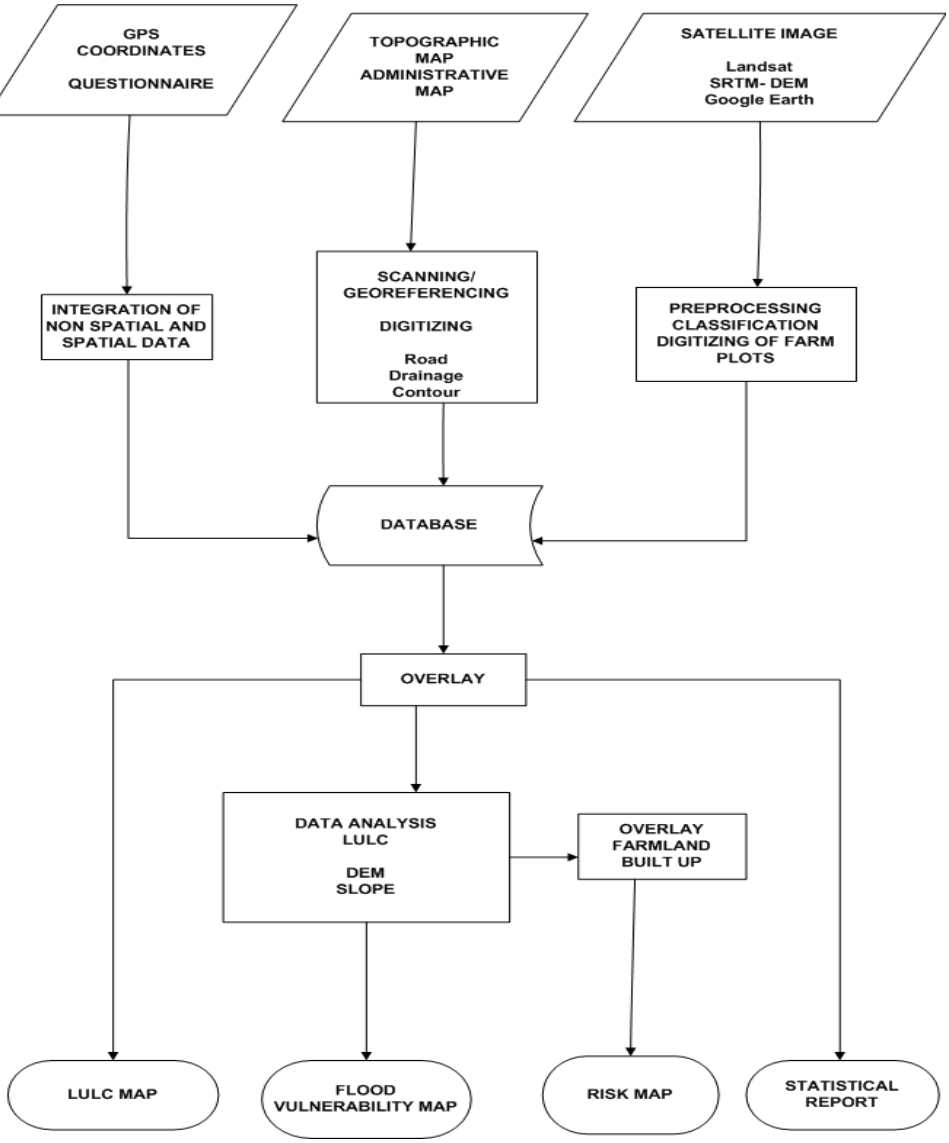

Fig. 2. Flow chart of the study

3. RESULTS AND DISCUSSION

Fig. 3 shows the Fadama points in the study area, eleven fadama points were mapped out from the two local government areas (five from Ife East and six from Ife Central Local government areas). All the farmers cultivate vegetables ranging from Green vegetable, Amaranthus, Ugwu and other types of vegetable local to the community.

The Fadama points in the study area fall within the moderately and highly vulnerable areas of less than 3.56 and 7.13% of slope. This shows that they are vulnerable to flooding during high peak of rain intensity and this corroborate with Ogbaji [5].

Majority of the respondents are literate, adult and have experience on fadama farming, hence they are not new in the business. It therefore shows that any form of assistance or intervention by the government will be well understood, not misinterpreted and accepted.

From Fig. 5, the Fadama points are located at low elevation or low gradient and this is in line with Ogbaji [5]. It also a known fact that water flow from a high elevation to a low elevation. The

lowest elevation in the study area is less than 250 m, while the highest is greater than 350 m. All the Fadama points fall within the range of less than 250 m and 280 m.

This shows clearly that the Fadama points are within the built-up area in the study area, this might be because of easy access to the farmland without the need of spending money on

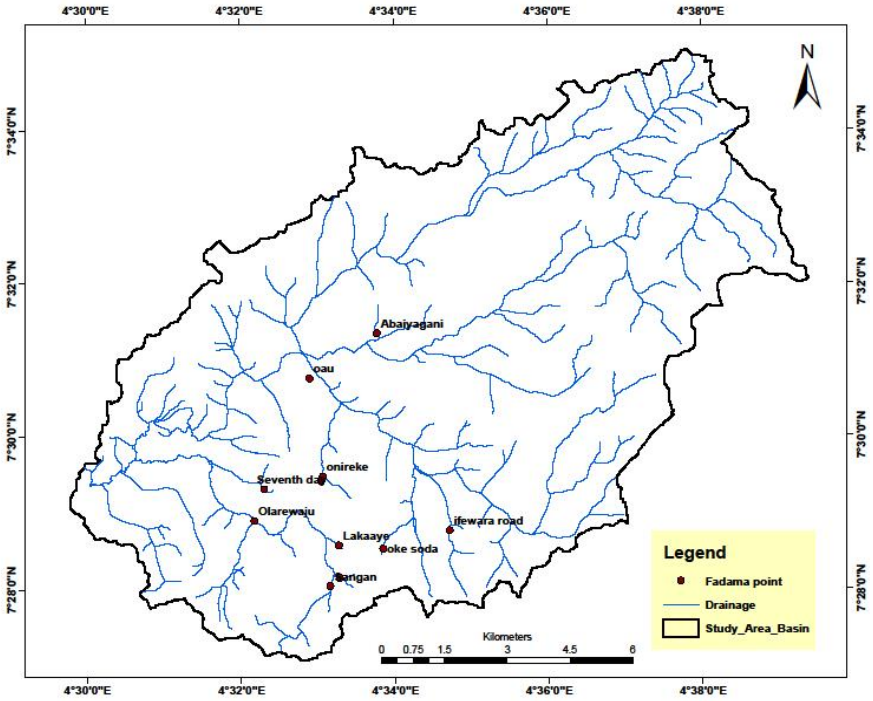

Fig. 3. Fadama points of the study area

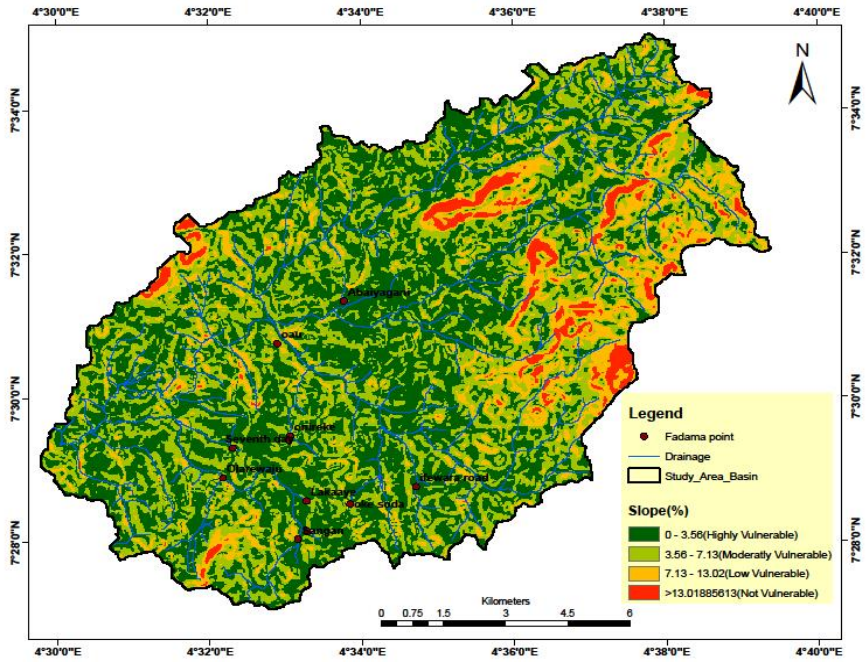

Fig. 4. Flood vulnerability map of the study area

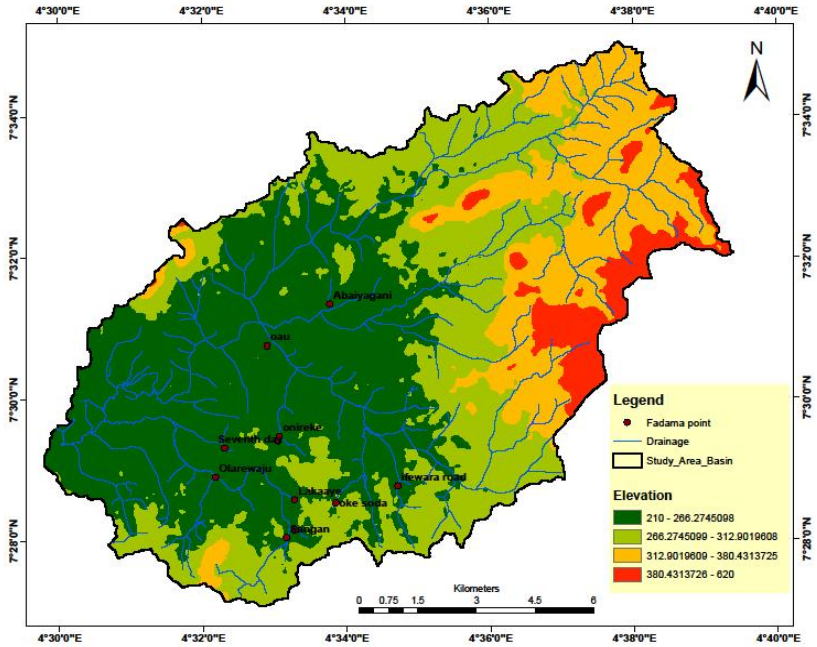

Fig. 5. Digital elevation model

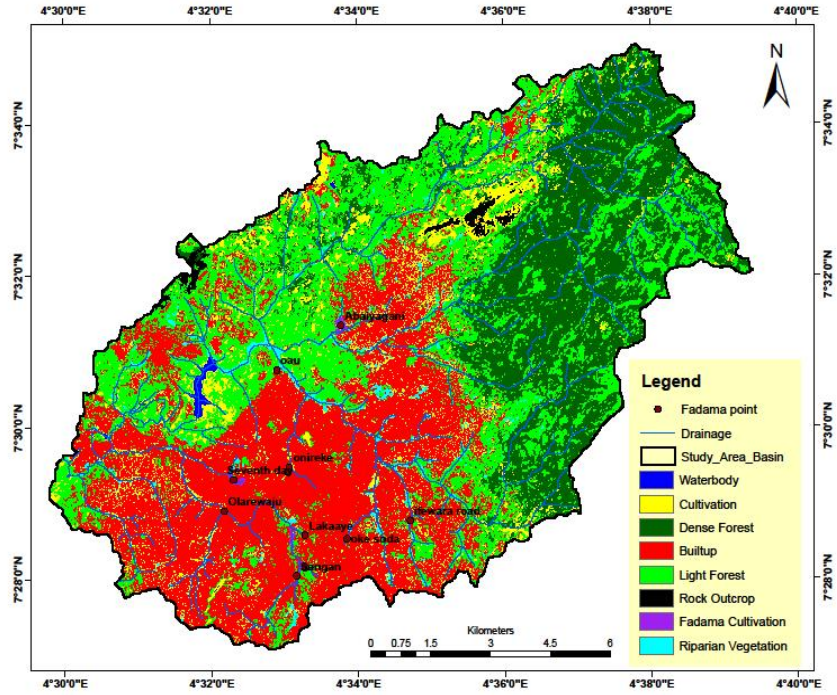

Fig. 6. Land use land cover

transportation and the crops mainly cultivated on Fadama land is vegetable [8].

The Table 1 shows that 1.45 km^2 (0.2%) is attributed to Fadama Cultivation, while water body is 1.62 km^2 (0.28%) and Built – up has the highest of 194.52 km^2 (34.05%) of the whole area while the other classes take the remaining numbers as in the table.

Table 1. Classes with area covered

Classes	Area (km^2)	Percentage (%)
Waterbody	1.62	0.28
Cultivation	49.60	8.68
Dense Forest	131.13	22.96
Built up	194.52	34.05
Light Forest	176.60	30.92
Rock outcrop	3.88	0.68
Fadama Cultivation	1.46	0.26
Riparian Vegetation	12.43	2.18
Total	**571.23**	**100**

4. CONCLUSION AND RECOMMENDATION

Majority of the respondents are literate, adult and have experience on fadama farming. Any assistance by the government will be well understood and accepted.

There had not been any government intervention in assisting them to mitigate against flood.

All of the respondents as a means of mitigating against flood, dredge the drainage but this is not sufficient in time of heavy rainfall.

It is therefore recommended that Government should come to the assistance of these farmers in dredging the drainage with a dredging machine instead of the manual labour being used by these farmers. This will invariably increase their production during this period, thus increase income.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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