

Original Research Article

SPATIAL DISTRIBUTION OF FILLING STATIONS WITHIN AFIKPO METROPOLIS USING GIS AS A TOOL

Abstract

The use of petrol, diesel and kerosene in fuelling of generators and automobiles or for domestic cooking cannot be ruled out irrespective of the many researches on the use of biotechnology and Solar system etc. Hence, constant visit to filling stations is necessary at one time or the other. Visitors and even residence of an area are sometimes faced with the problem of where to buy fuel whenever there is a reduction in the fuel level of the tank. The question of where to buy fuel can be appropriately answered using Geographic Information System (GIS). A GIS is an automated information system for capturing, storing, analysing, displaying and managing data and associated attributes that are spatially referenced to the earth. This study focused on creating a GIS database for the spatial distribution of filling stations within Afikpo, in Ebonyi State Nigeria. The result of the study includes a GIS database of the filling stations from where queries were created to determine the types of service/ product available per station, number of fuel pumps per station and spatial distribution of the filling stations. The database created will provide the necessary information on filling stations within the area and help policy makers (regulatory agencies) in planning, management and effective monitoring/supervision.

Keywords: Database, Filling Station, GIS, Map

1.0 INTRODUCTION

A filling Station is a place where fuel and lubricants for motor vehicles are sold. They are commonly situated along major streets in Nigeria for many reasons such as easy accessibility, security e.t.c. According to [1], there are three major products sold in Nigeria filling Station. There are: AGO-Automotive Gasoline Oil (Diesel), PMS-Premium Motor Spirit (Petroleum), DPK- Dual Purpose Kero (Kerosene). Despite the many researches on the use of biofuel from biotechnology and solar power e.t.c., as alternative power source, the use of petrol, diesel and kerosene in fuelling of generators and automobiles or for domestic cooking cannot be completely ruled out. Especially in a developing country like Nigeria, where epileptic power supply is the order of the day (notwithstanding the many efforts made by the federal government to improve power supply). Hence, constant visit to filling stations is necessary at one time or the other. There are other several reasons for the universal acceptance of petroleum based fuels. The fuel occurs in liquid forms, which made it easy and convenient to be transported through virtually all the fuel transportation modes including pipelines, trucks, tankers (land, water and air) etc.[2].

Filling station is a significant contributor to traffic problems like traffic congestion, pollution, fire and explosion. The extent of these problems depends on the criteria or variable such as location, size and set back from road and so on [3]. There are many aspects to consider when storing petroleum products at petrol filling stations. Due to the close interaction with the public, it is important that the necessary controls are in place so that products such as petrol or diesel are stored, transferred and handled appropriately [4]. According to [5], the following conditions must be met before storage and sales licence can be granted:

- i. A minimum of three (3) underground storage tanks (one each for PMS, DPK, and AGO.)
- ii. A minimum of three (3) dispensing pumps (one each for PMS, DPK and AGO)
- iii. Office building: Two (2) offices, sales room, toilet, lube bay/store (Optional)
- iv. Well concreted forecourt "IN/OUT" drive way inclusive
- v. Wall fence demarcating the station (minimum height of 1.5m high)
- vi. Good drainage Network
- vii. Safety facilities (Fire Extinguishers, Sand Buckets, strategic display of "NO SMOKING" warning signs.
- viii. Station Sign post/logo of company/outlet.
- ix. Standard canopy over PMS pumps (mandatory) with company name and logo boldly written.
- x. Standby Generator.
- xi. Accessible Potable water source.
- xii. Standard (51" x 30") price bill board with changeable price mechanism

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A Geographic Information System (GIS) is an automated information system for capturing, storing, analysing, displaying and managing data and associated attributes that are spatially referenced to the earth. GIS is a tool that allows users to create interactive queries (user created searches), analyse the spatial information, edit data, maps, and present results of all these operations [6]. The use of a GIS database provides a stored 'intelligent' record of the derived observations and accurately depicting their spatial location on a map.

A map is defined as a representation on a plane surface of the physical features, both natural and artificial, of some parts or whole of the earth's surface at a given scale, by the use of signs and symbols with the method of orientation indicated. It is a means of conveying geographic information. Maps are universal medium for communication, easily understood and appreciated by most people regardless of language or culture [7].

The aim of this study is to carry out spatial analysis of the distribution and location of filling stations within Afikpo metropolis using GIS techniques, the objectives will therefore be to produce a digital map of Afikpo

63 showing the spatial distribution of filling stations within the area, create a database for the filling stations and
64 carry out selected queries.

65 With the problem of indiscriminate location of filling stations taking place almost in every cities in Nigerian,
66 Spatial analysis of the location and distribution of filling stations will help to point out operators who may have
67 fallen short of the standard required. Hence, the study is will provide the necessary information on filling
68 stations within the area and help policy makers (regulatory agencies) in planning, management and effective
69 monitoring/supervision as a guide for tourist or visitors, as a base and reference for further research work.

70 **2.0 MATERIALS AND METHODOLOGY**

71 **2.1 Study Area**

72 Afikpo (Ehugbo) is the second largest town in Ebonyi State, Nigeria. The population is approximately half a
73 million people and growing. The local language (Okwu Ehugbo) is a dialect of Igbo, which is the common
74 language among the five south eastern states (Abia, Anambra, Ebonyi, Enugu and Imo states) of Nigeria [8]. It
75 lies between Latitude $7^{\circ} 55' 17.4''\text{N} - 7^{\circ} 56' 35.4''\text{N}$ and Longitude $5^{\circ} 53' 12''\text{E} - 5^{\circ} 53' 59.4''\text{E}$. It is bounded to
76 the north by the town of Akpoha, to the south by Unwana and Edda in Ubeyi and Afikpo South Local
77 Government Areas respectively, to the East by the Cross River and to the West by Amasiri. Afikpo spans an
78 area approximately 164 square kilometers in size [9].

79 **2.2 Method**

80 A topographic map covering the study area (Afikpo N.E, Sheet 313NE at scale 1:50,000) was obtained from the
81 Office of the Surveyor General of the Federation (OSGOF) Abuja Nigeria, to serve as the base map. This
82 topographic map was scanned using a scanner in order to allow the map to be imported into a Computer (with
83 software ArcGIS 9.3 installed on it). The Topographic map (already Scanned) was imported into the ArcGIS
84 environment from where different layers were created using the ArcCatalog, it was Georeferenced and thereafter
85 digitised using the ArcMap.

86 The names of the various filling stations within Afikpo metropolis were obtained from the Department of
87 Petroleum Resources (DPR) and verified on site. A Handheld Global positioning System (GPS) receiver
88 (Garmin 76), was used to acquire the location coordinates of the filling station and also the coordinates of some

points of interest for the purpose of map updating, owing to the fact that the base map used was produce some years ago (produced by the British Government’s Ministry of Overseas Development, Directorate of Overseas Survey 1965) there was the need to update the map. The Database of the filling stations was created in the ArcGIS environment. A map showing the distribution of the filling stations was produced and different queries were created.

3.0 RESULTS AND ANALYSIS

The study revealed that there are five (5) independent marketers (filling stations) within Afikpo metropolis with no major marketer within the area. The list of the independent marketers is shown in the table 1. The number of pumps for each filling station is shown in fig. 1, with Ebiri Nig. Ltd and Precious Codoris Global Ltd having the highest number of four (4) petrol pumps, followed by Jekwu Oil Ltd with three (3) petrol pumps, while Tongadas Investment Nig. Ltd and D.A. Ugwu and Sons both have two (2) petrol pumps each. The spatial distribution of the filling stations is shown in fig. 2. Some queries were also created an example of such queries was to determine filling stations with petrol pump more than two (2). The result of this query is shown in fig. 3 below.

Table 1: List of the Independent Marketers within Afikpo Metropolis.

NAMES	PETROL PUMP	KEROSENE PUMP	DIESEL PUMP
Tongadas Investment Nig. Ltd	2	1	0
D.A. Ugwu and Sons	2	1	1
Jekwu Oil Ltd	3	1	1
Ebiri Nig. Ltd	4	1	1
Precious Codoris Global Ltd	4	1	1

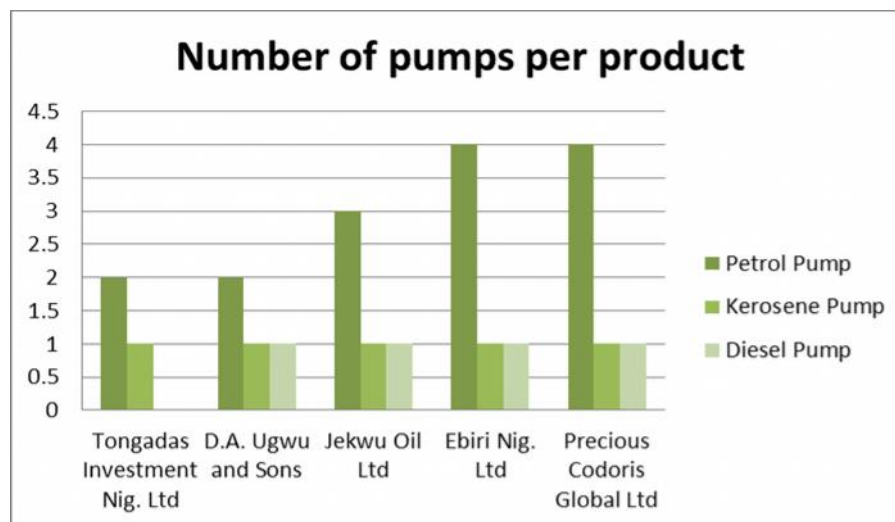
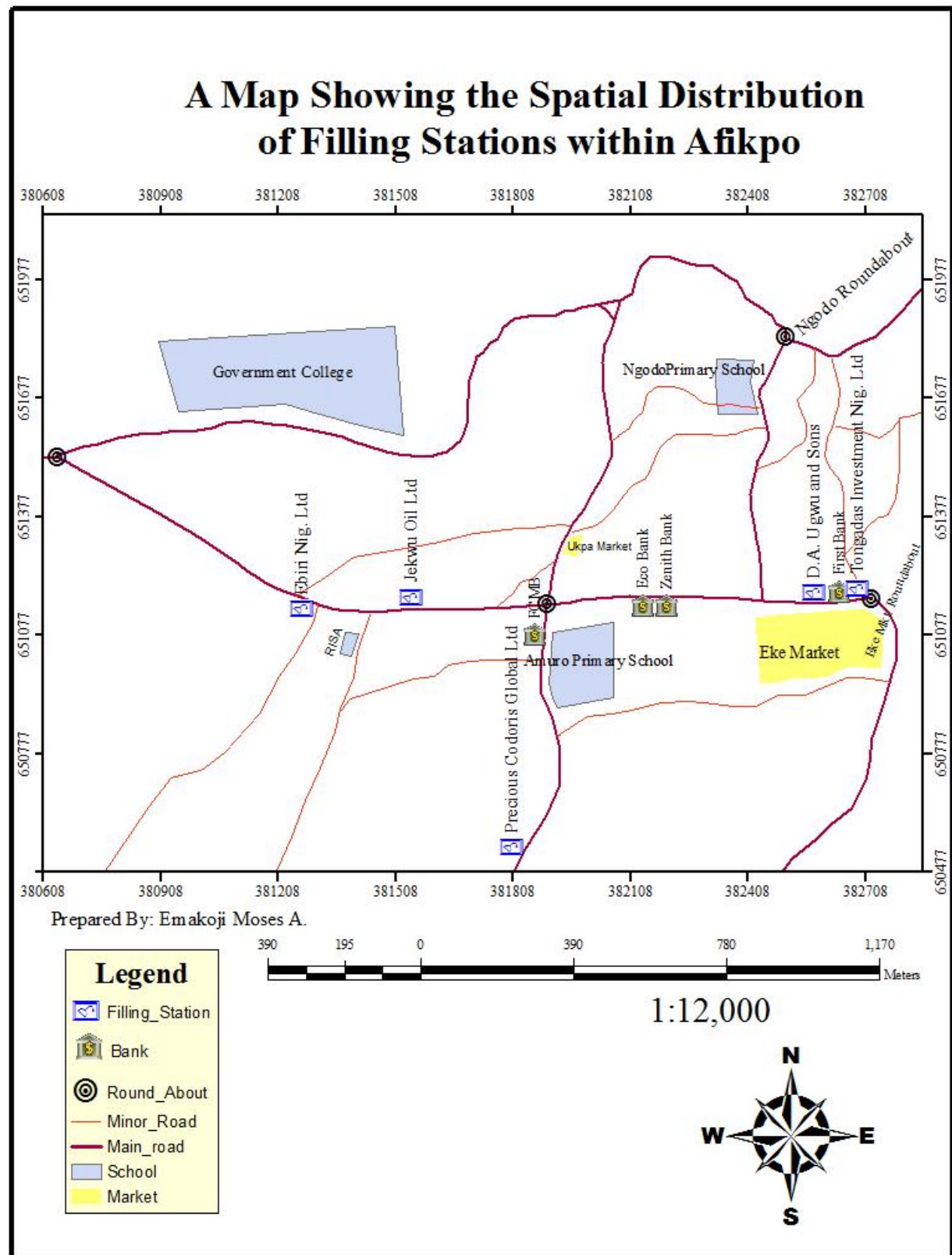
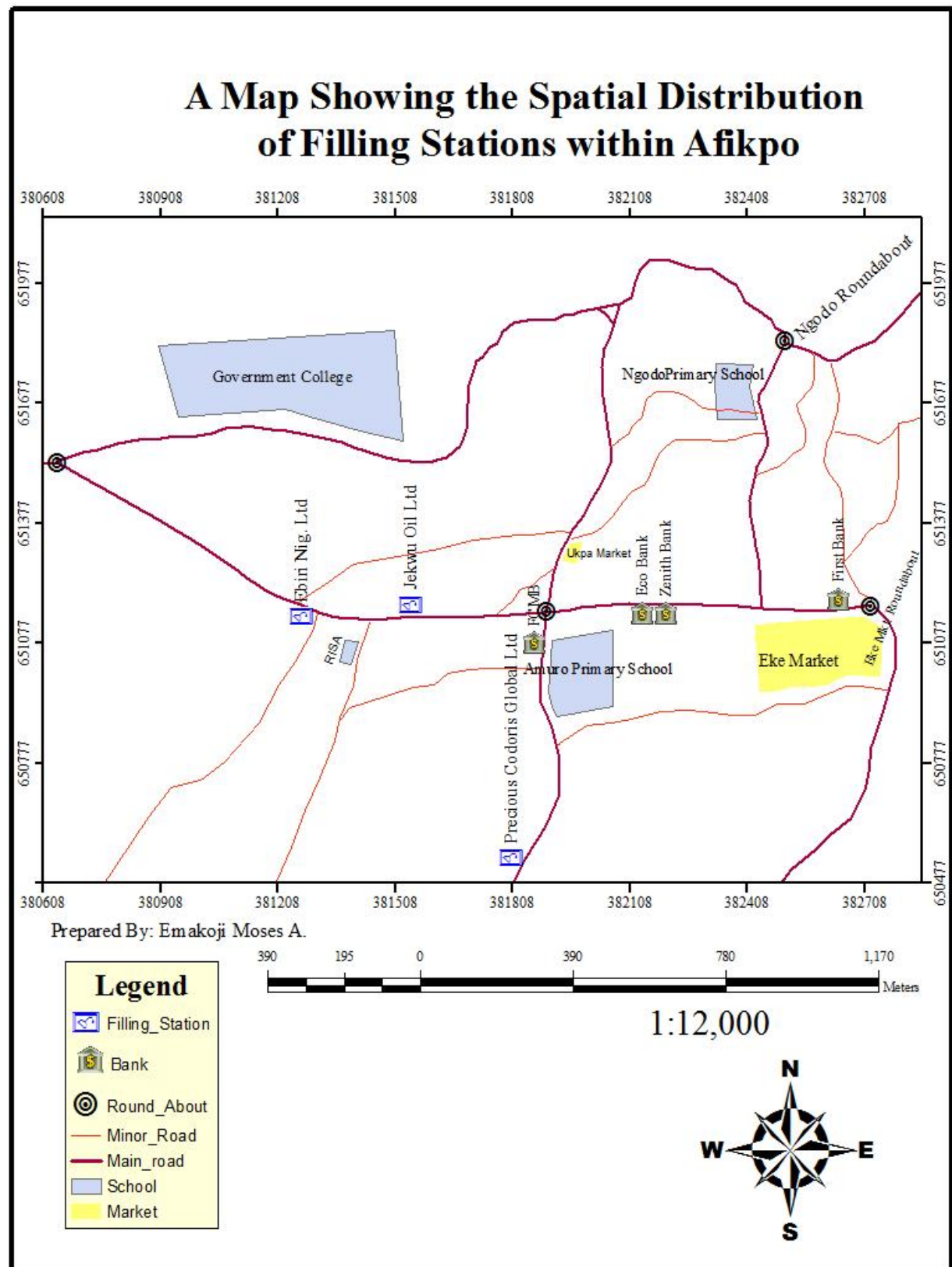


Figure 1: Chart showing Independent Marketers within Afikpo Metropolis.



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108 Figure 2: Spatial Distribution of Filling Stations within Afikpo Metropolis



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110 Figure 3: Result of Query Showing Filling Stations with more than two (2) Petrol pumps.

5.0 CONCLUSION AND RECOMMENDATION

This study has further demonstrated the effectiveness of GIS to capture, store analyse and display and manage geographic and non-geographic related data. The database created will no doubt help to serve a base for further studies. It will also provide the necessary information on filling stations within the area and help policy makers (regulatory agencies) in planning, management and effective monitoring/supervision. Since the focus of this paper was the creation of GIS database for filling stations, further research needs to be done, with a view to analyse the siting and location of these filling stations whether they be in conformity with the guidelines and code establishing them.

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