Patterns of Urinary Schistosomiasis Infection in Akure North Local Government Area of Ondo State, Nigeria.

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Abstract
This study used geographic information system as a tool to further understand the epidemiology of urinary schistosomiasis in Akure North Local Government Area (LGA) of Ondo state. Spatial, disease and demographic data were integrated using ARCGIS 10.0 to determine infection patterns of urinary schistosomiasis.
A total of 463 randomly selected households were screened for urinary schistosomiasis of which 31.7% households harboured at least one individual positive for schistosomiasis. Spatial statistics showed infection pattern to be clustered. The hot spot revealed areas that contributed most to the clustered pattern of infection. The entire study area is endemic for schistosomiasis with low to high risk of infection.
Keywords: GIS, Urinary Schistosomiasis, Households, Infection Pattern

1. Introduction

Schistosomiasis is a major water related disease, second to malaria in its prevalence and public health implications [6, 9]. It is endemic in 76 countries and continues to be a global public health concern in the developing world. Schistosomiasis has been classified as a neglected tropical disease (NTD) and an estimated population of 779 million people in the world are at risk for it according to relatively recent surveys [7, 8].

The parasite responsible for urinary schistosomiasis is the fluke *S. haematobium*. High morbidity with symptoms ranging from haematuria, dysuria to proteinuria has been associated with *S. haematobium* infections [10]. Infections occur during contact with infested water bodies containing the infective stage of the parasite, the cercaria which penetrates the skin and mature in the human body. The control of schistosomiasis involves health education, supply of safe drinking water, establishment of functional health facilities, diagnosis, treatment, and management of the environment and control of the intermediate hosts [11].

Geographical Information Systems are increasingly being used in epidemiological and ecological studies of diseases including schistosomiasis. In order to effectively plan, monitor and assess the efficacy of control programs and interventions, geographic information system can be applied to determine spatial patterns of infection, populations at risk and predict likely disease outbreaks at local and global levels. One of the hindrances to effective and total control of schistosomiasis in Nigeria is the lack of reliable data on the geographic distribution of the disease especially at the units mostly targeted for heath intervention such as the LGAs or states. Majority of local studies on schistosomiasis in Nigeria have not used satellite imagery or spatial statistics and the few that used it did so at state and national levels thus resulting in the generation of state and national maps [1, 5].

In the present study, spatial studies was conducted to study the pattern of schistosomiasis using satellite imagery and spatial statistics at a local level in a Local Government Area of Ondo state, Nigeria where the disease is endemic.

2 Materials And Methods

2.1 Study Area

The study was carried out in Akure North LGA situated in the heartland of the tropical rainforest belt of Western Nigeria. The Local government is composed of five major communities. The climate is humid minor small seasonal and daily variations. It lies between latitudes $5^{0}6'$N and $8^{o}2'$N and longitudes $4^{0}17'$N and $6^{o}17'$N. The rainfall is concentrated during the months of May to October with a short break in August and considerable variations from year to year.

Study Population and Sample

2.2 Geo-Referencing

The digital satellite imagery of Akure North Local Government was geo-referenced in order to be able to carry out spatial analysis operations. The geo-referencing was achieved by using a coordinate system.

2.3 Extraction of Earth Features

The buildings and rivers features were converted into spatial data by hand tracing of polygons and lines with a computer mouse in order to collect the coordinates of buildings and water bodies. The spatial data was recorded in a vector format.

2.4 Urine Sampling Technique

Sample collection was preceded by an interactive meeting of the researcher and community heads during which the purpose of the survey was explained. Participation was entirely voluntary and the people were made aware of the study procedure and its benefits. Each participant was given a clean $50cm^3$ wide-mouthed, screw-capped specimen bottles to provide terminal urine between 10:00am and 2:00pm. Each bottle was labeled to correspond to the number of the person on a pre-designed epidemiological form. The names, sexes, ages and weights of the subjects were entered against the appropriate number on the pre-designed epidemiological form on submission of the urine samples. The samples were preserved on collection by adding 5ml of 10% formalin at the point of collection and carried to the Public Health laboratory in the Federal University of Technology, Akure for analysis. 2.5 Urine Microscopy

In the laboratory, each sample bottle was agitated to suspend the ova evenly in urine after which 10ml of urine was transferred with a sterile disposable syringe to a centrifuge tube and centrifuged for 5 minutes at 1500rpm. The supernatant was discarded and the sediment was transferred onto a microscope slide. A drop of Lugol's iodine was added and neatly covered with a cover slip. The slide was examined under the microscope for eggs of S. haematobium. When present, the individual was classified as positive for schistosomiasis. Houses with at least one infected person were also categorized as positive for infection.

2.6 Data Analysis

Analysis of relationships between household infection prevalence, spatial and demographic data was carried out using appropriate software (ARCGIS 10.0). The average nearest neighbour and hotspot analysis was used to determine the infection pattern.

3 **Results**

3.1 Prevalence of schistosomiasis

Infection status data were analyzed for buildings in Akure North LGA. A total number of 463 households from five communities were examined for individuals infected with schistosomiasis of which 147(31.7%) of sampled households harboured infected individuals. Due to the absence of a ward map, the prevalence data was aggregated into clusters delineated by major roads.

Iju was divided into four clusters. Cluster 4 had 12% of sampled households harbouring at least one infected individual while clusters 1, 2 and 3 had 21%-40% households with infected individuals. Hotspots were found in all the clusters (Figure 1 &2)

Ita Ogbolu was delineated into five clusters. Percentage households harbouring infected individuals ranged from 21%-40% households in clusters 2 & 3, 41%-60% in cluster 4, 61%-80% households in cluster 5 and 81%-100% in cluster 1. There were hotspots in all the clusters with high concentrations in clusters 1 and 5 (Figure 3 & 4).

Igoba community was outlined into four clusters. The percentage of households harbouring infected individuals ranged from 0%-20%, 21%-40%, 21%-40% and 41%-60% in clusters 4, 3, 2 and 1 respectively. Hotspots were concentrated in cluster 2 (Figure 5 & 6).

Oba Ile community was delineated into four clusters. All the clusters fell within 0%-20% households with infected individuals (Figure 7 &8).

Ogbese community was outlined into four clusters. Cluster 1 and 4 had 41%-60% households with infected individuals, cluster 2 and 3had 21%-40%. There were hotspots in all the clusters (Figure 9 & 10).

3.2 Infection pattern of schistosomiasis

The Z-score outcomes calculated by the ESRI average nearest neighbour statistics were categorized as clustered (hotspots) at 5% significance level (Table 2). The spatial clusters (hotspots) obtained from the Hot spots *Gi** statistics for *S. heamatobium* infection in Akure North LGA are shown in Figure 2,4,6,8 & 10.

Table I: Household Prevalence of *S. haematobium* infection

Communities	No examined	No (%) infected
Ogbese	124	46 (37.1)
Igoba	105	22 (21.0)
Iju	73	19 (26.0)
Ita Ogbolu	104	55 (52.9)
Oba Ile	57	5 (8.8)
Total	463	147 (31.7)

Table II: Infection Pattern of sampled communities.

Location	Z score	Pattern @ 5% significance level
Iju	-8.12	Clustered
Ita Ogbolu	-13.93	Clustered
Igoba	-8.77	Clustered
Oba Ile	-4.28	Clustered
Ogbese	-12.98	Clustered

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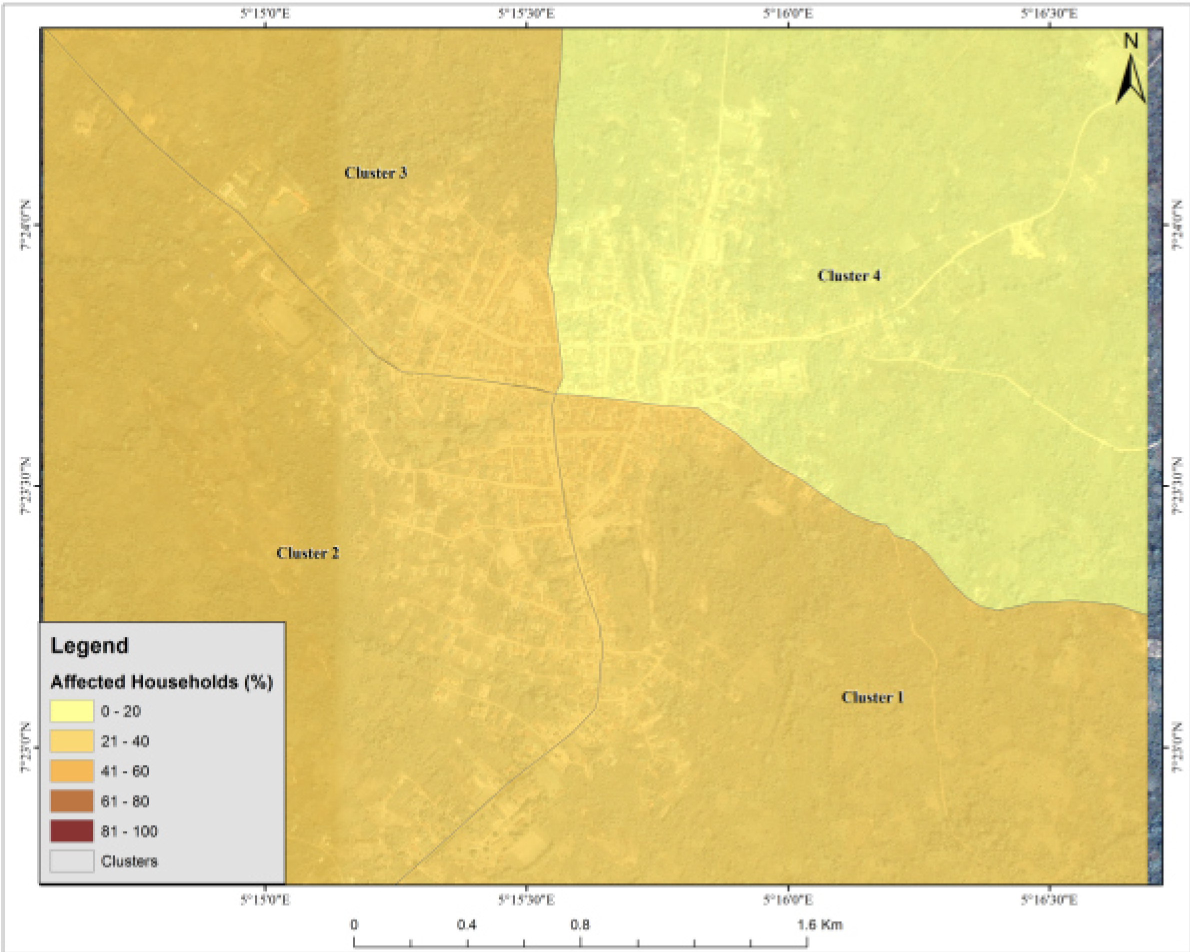

Figure 1: Map showing percentage of affected buildings in Iju clusters.

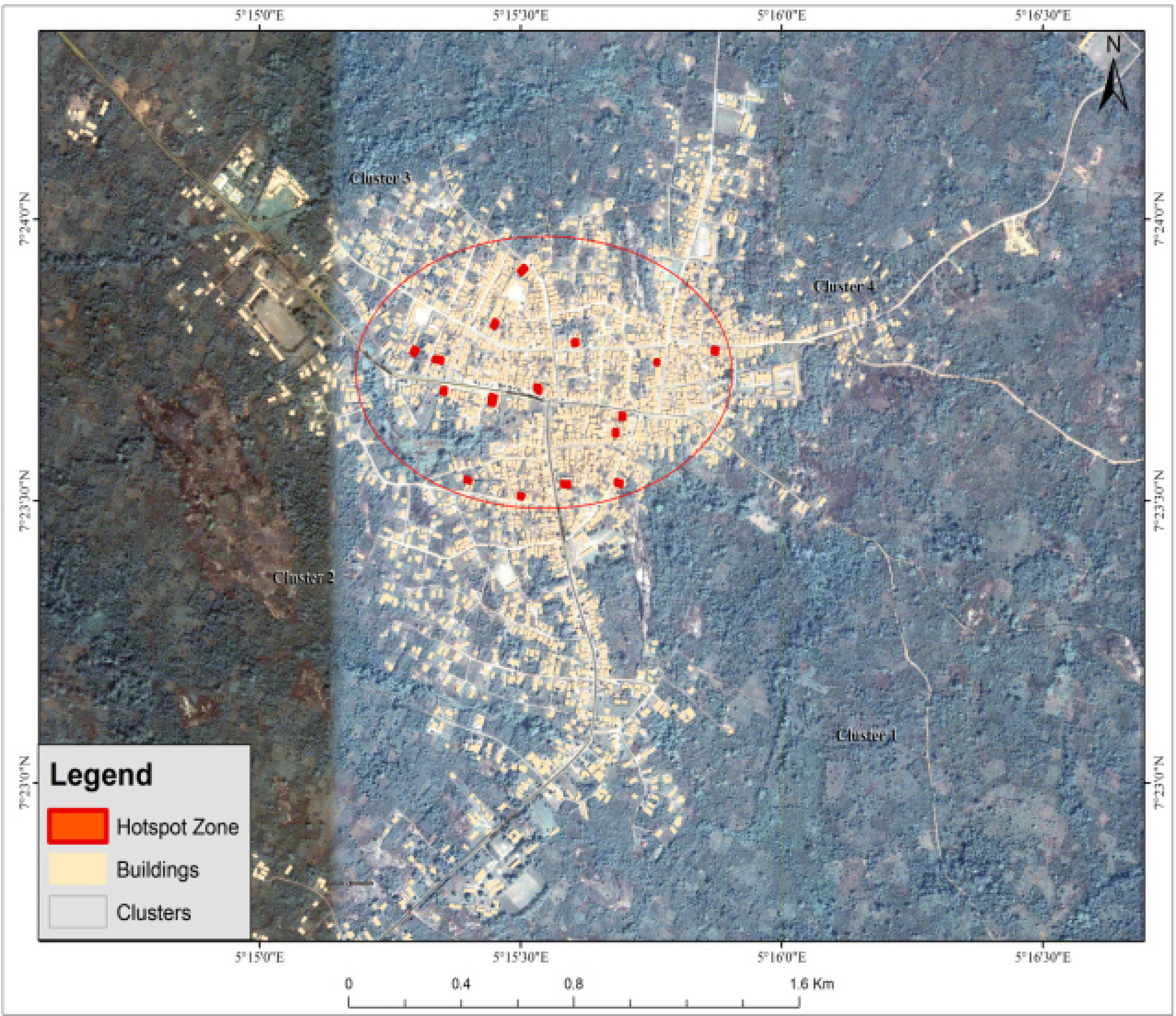

Figure 2: Map showing hotspots in Iju clusters

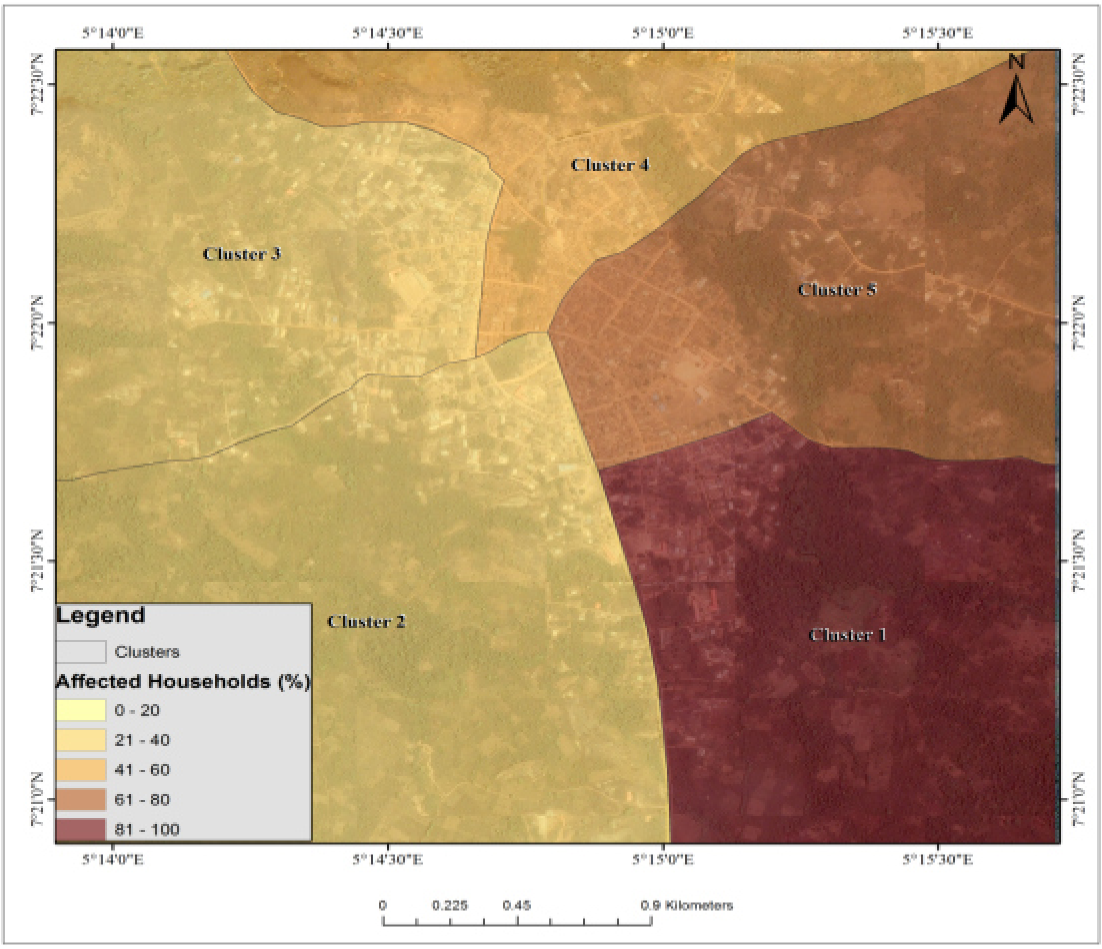

Figure 3: Map showing percentage of affected buildings in Ita Ogbolu clusters.

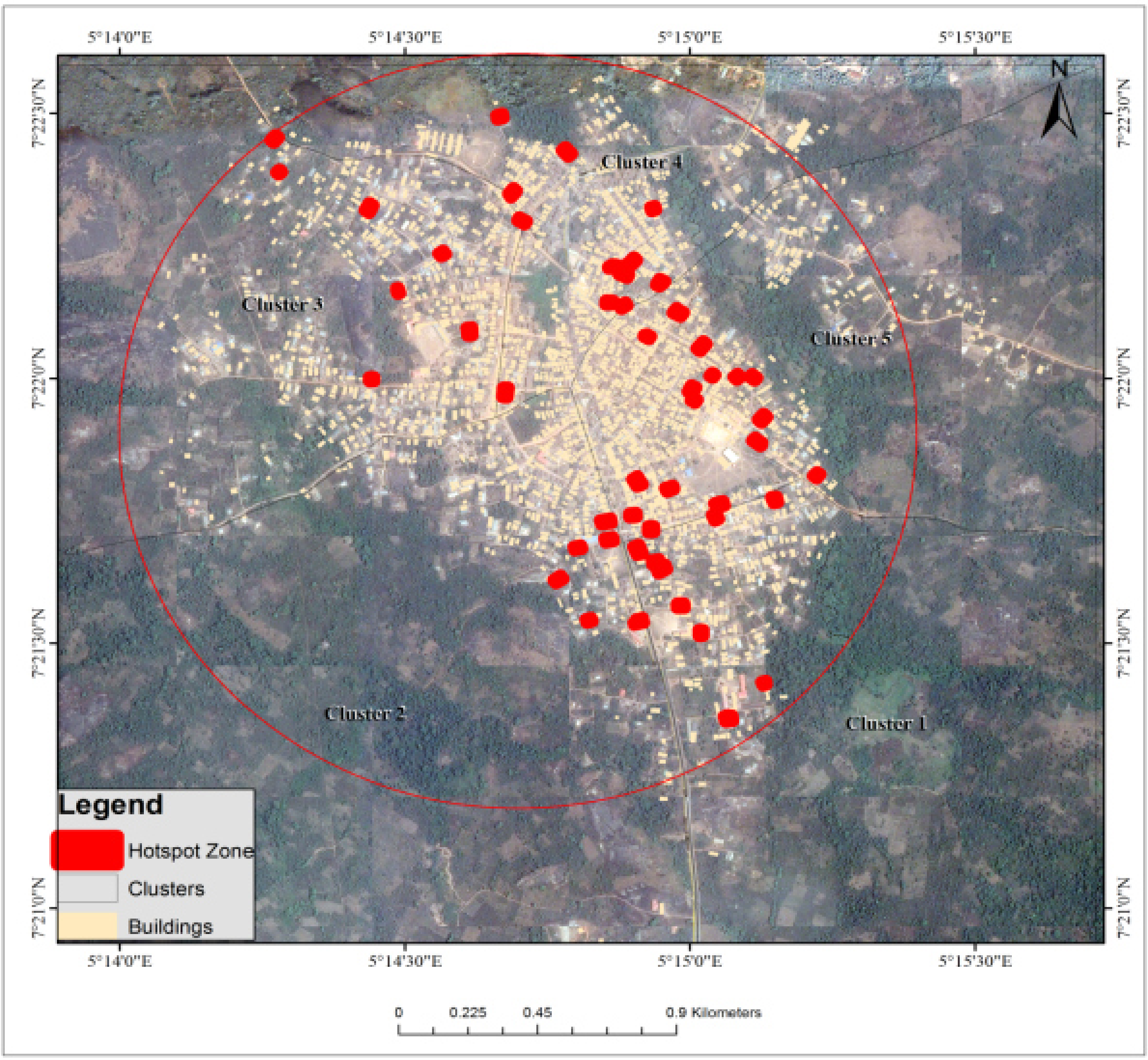

Figure 4: Map showing hot spots in Ita Ogbolu clusters.

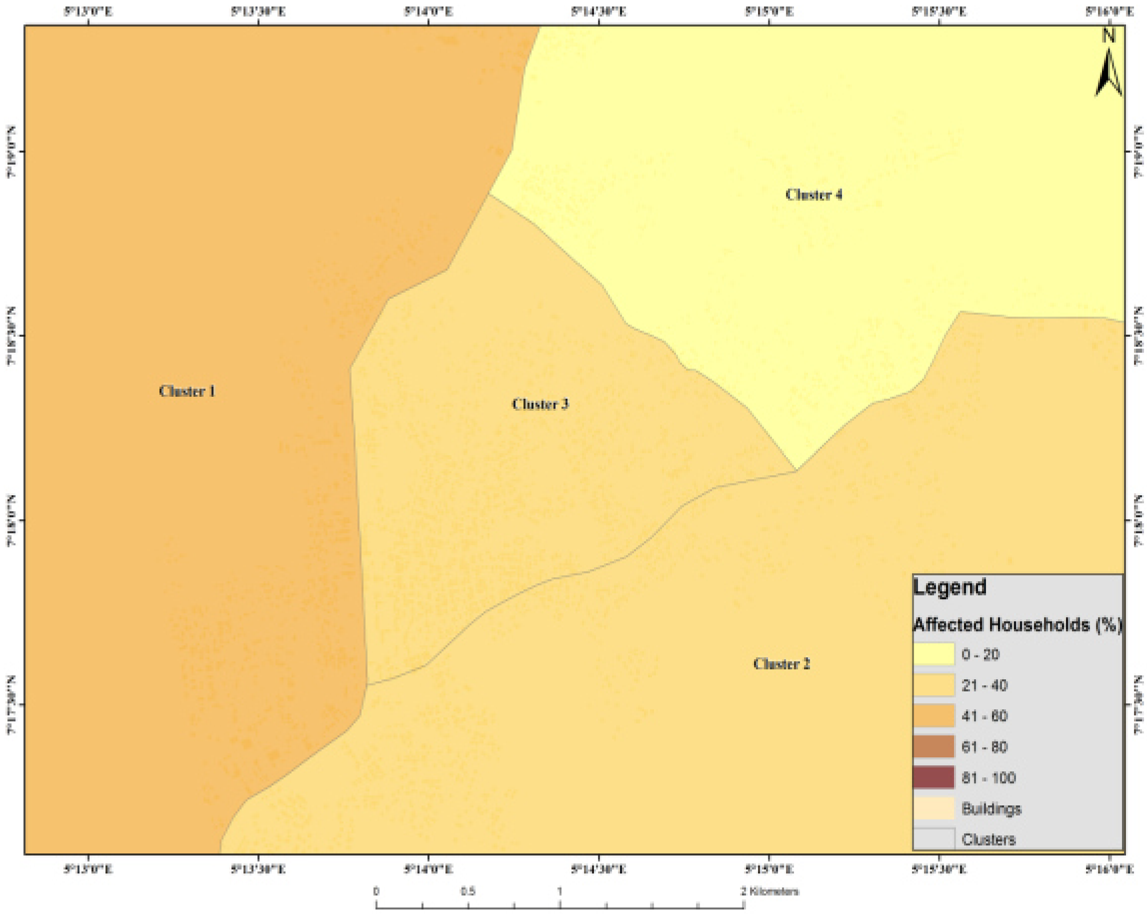

Figure 5: Map showing percentage of affected buildings in Igoba clusters.

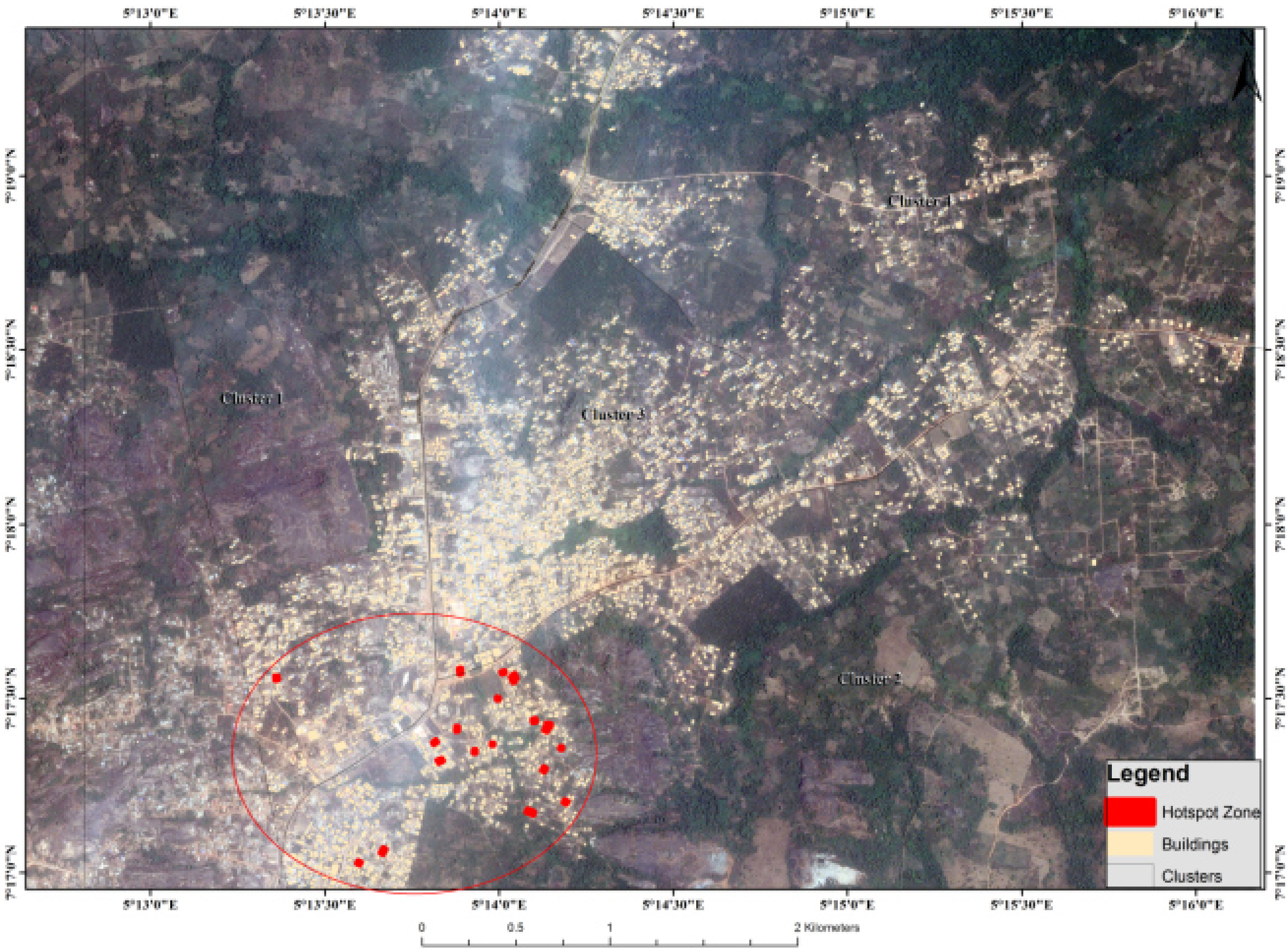

Figure 6: Map showing hot spots in Igoba clusters.

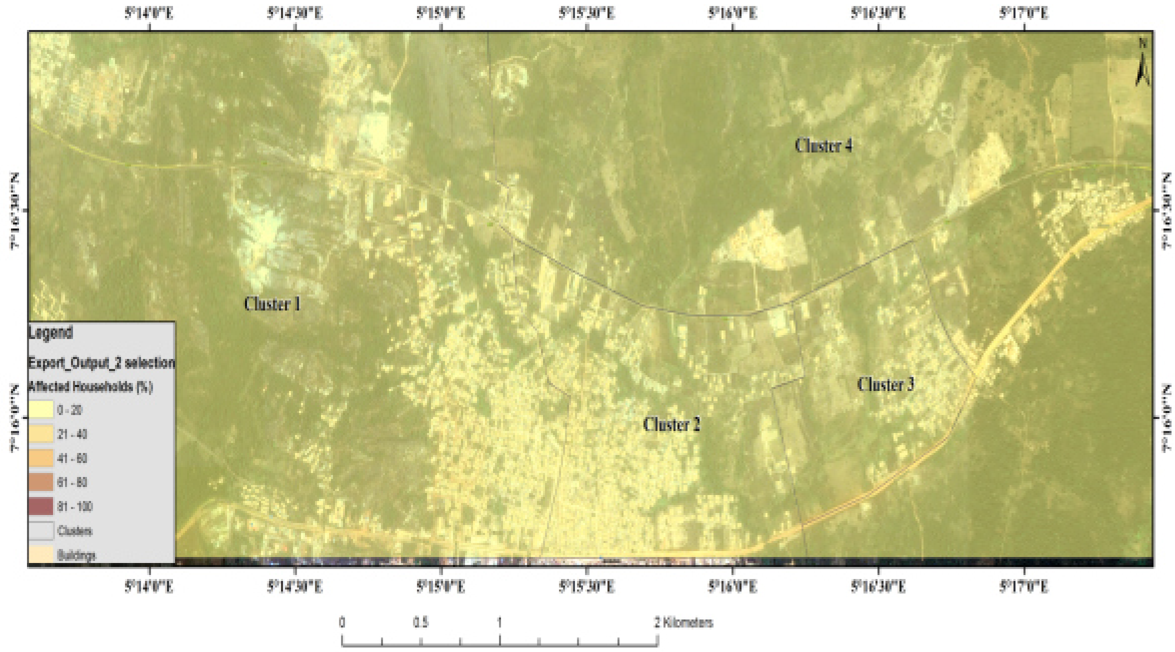

Figure 7: Map showing percentage of affected buildings in Oba Ile clusters

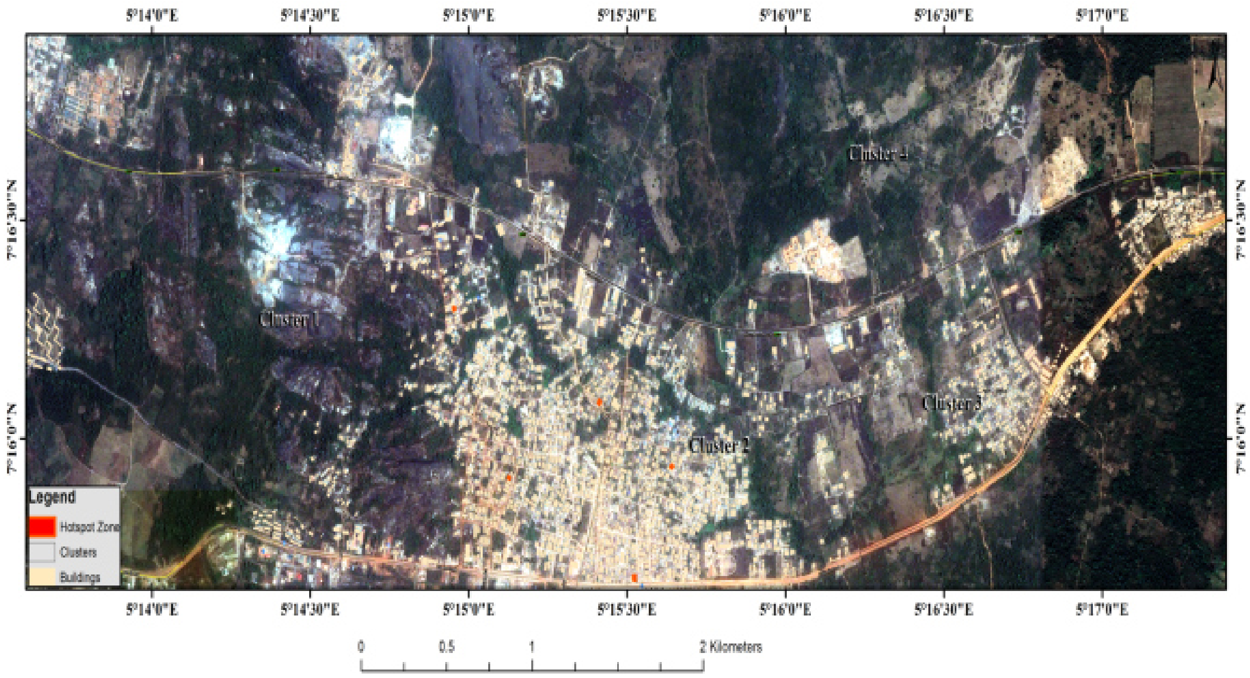

Figure 8: Map showing hot spots in Oba Ile clusters

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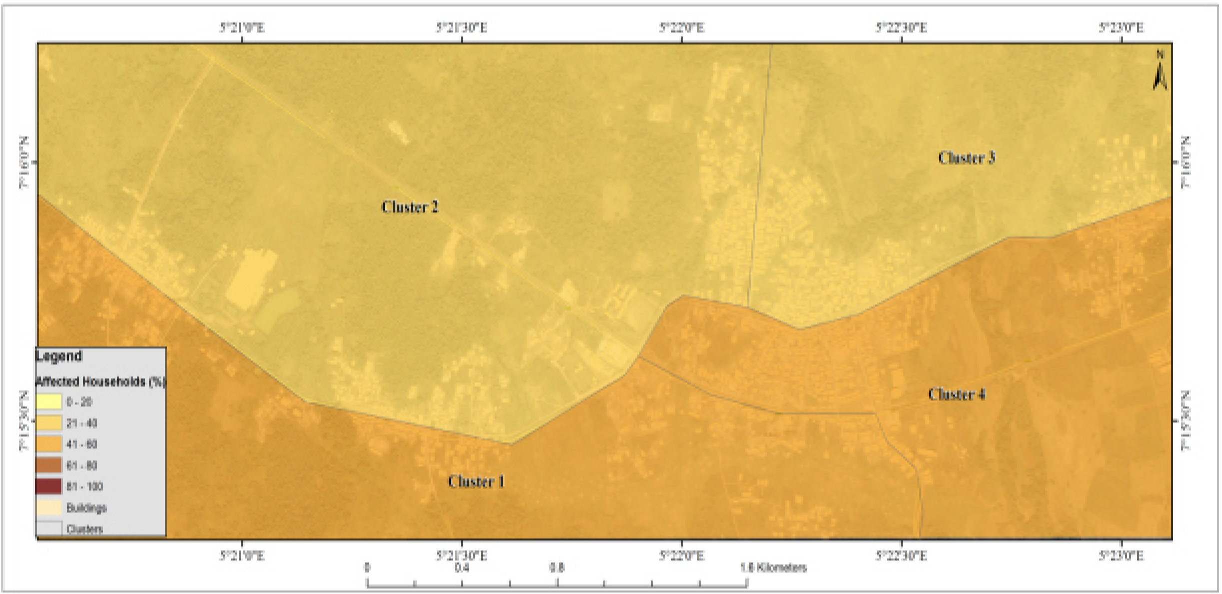

Figure 9: Map showing percentage of affected buildings in Ogbese clusters

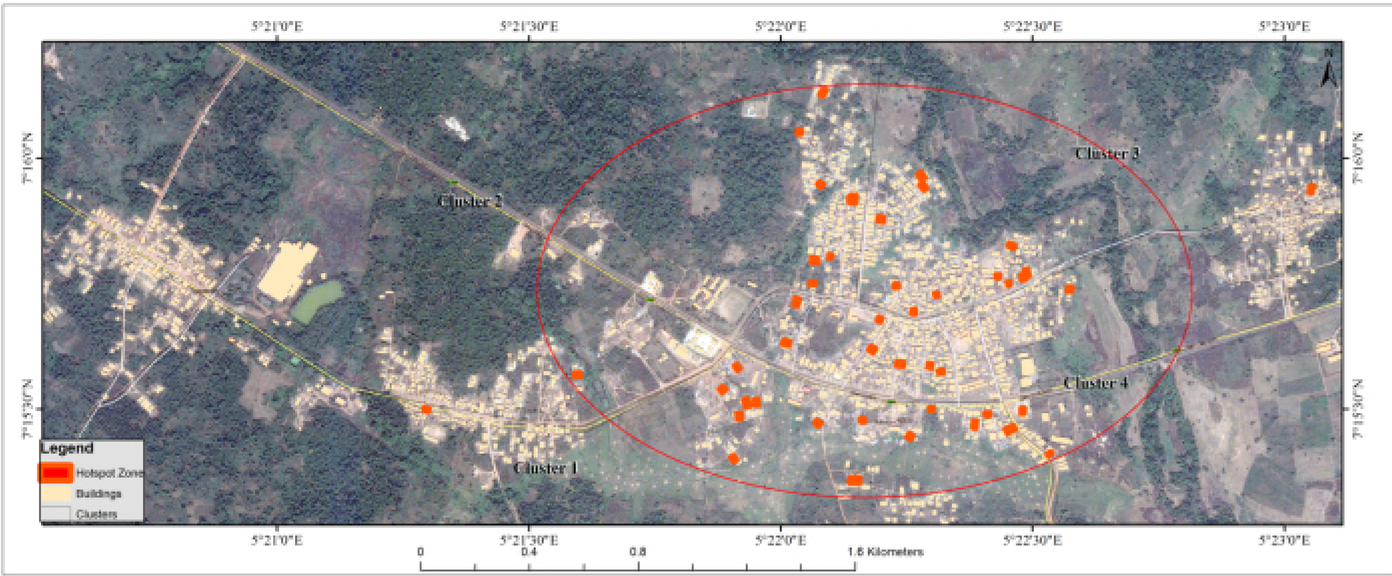

Figure 10: Map showing hot spots in Ogbese clusters

4 Discussions

The prevalence of infection based on residential building was high which confirms the endemicity of schistosomiasis in the study area. The prevalence of households having at least one person infected with schistosomiasis within the clusters ranged from 0% to 86%. The household infection pattern was found to be significantly clustered, this suggest that there are specific variables responsible for the disease prevalence. The clustering could be a function of the distribution of contaminated water sources in the study area. This is in line with the report of Barley and Catrell (1995) and Ekpo and Mafima (2004). Zhijie Zhany *et al.*, (2008) have also suggested that the diversity in the distribution of high-risk area may result in the clustering of infection pattern. Households situated at proximity to infected rivers contributed most to the clustering pattern of infection. In a study by Clennon *et al.*, (2004) to detect household clustering of schistosomiasis infection, results shows high levels of schistosomiasis infection have a significant focal distribution around a known infection site.

In this study, *Gi**(Hot spot) statistics was used to detect the local spatial autocorrelation of schistosomiasis in all the sampled communities, the hot spots was more in Ita Ogbolu and Ogbese than in the remaining communities. Oba Ile had very few. This shows that active transmission and infection with *S. heamatobium* is taking place in the two communities earlier mentioned. High water contact activities was observed in Ogbese at the Ogbese river where the under bridge serves as bathing and washing point for traders especially the Hausas. Oba Ile is an urban community situated close to Akure, the state capital and enjoys a fair share of social amenities and good living conditions. This explains why only a few hot spots were found in the area.

The hotspot analysis permitted the identification of specific locations with low or high level of infections and the specific households that contribute most to the clustering pattern of infection in the study area. This study also shows that the annual school children chemotherapy has no serious impact on the continuous cycle of schistosomiasis transmission.

4.1 Conclusion

The endemic community highlighted in this study is still in need of integrated control which could consist of mass chemotherapy (not school children alone), provision of potable water, restriction of access to infected water bodies and health education. A predictive risk map needs to be developed for the whole of Ondo state which will be of great value in planning treatments and intervention programmes.

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