

The power of GIS emanating from its ability to relate different information in a spatial context was exploited. In the GIS combinations of related mapped variables together with their attributes and other data set was achieved. This allows analysis of the spatial dynamics of malaria incidence and prevalence within the metropolis to be conducted in a digital environment. For example the linking of the administrative, the land use and the Health Service centre layers with data set of reported cases of malaria obtained from the EPID Unit generated a visual display of areas high clusters of malaria cases vis-à-vis the

areas that were adequately served or under served with provision of HSC.

The variables output generated comprises set of thematic maps, charts and other statistics reports. There is also the facilitation for some spatial queries and manipulation, analysis and modeling with data. Distances between points of reported incidence, the HSC and the identified potential vector habitat were analyzed. The spatio temporal relationship of insecticide spray (dates and locations) and the malarial incidences on a chosen time scale were analyzed.

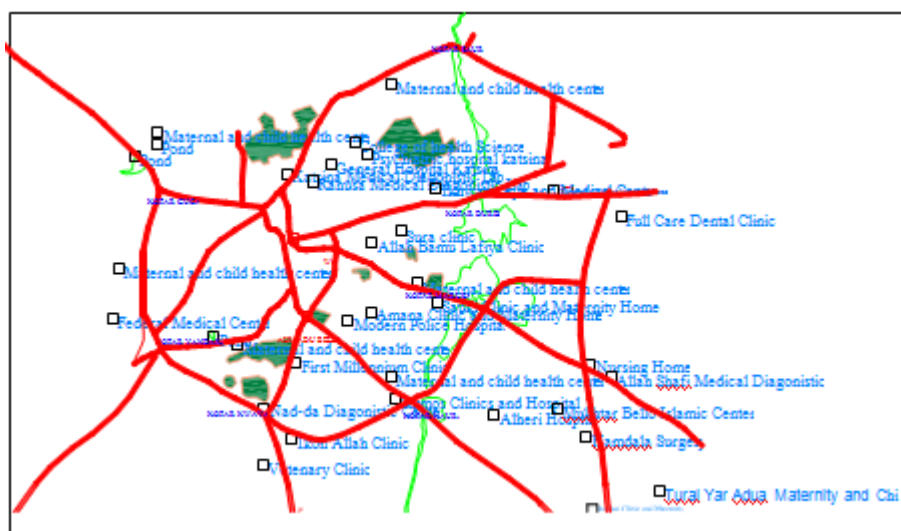


Figure 6: Map of the locations potential mosquito Breeding areas and Some Health Centres in Katsina Metropolis Dec. 2009

6. Discussions

Challenges

The challenges of GIS for malarial Control programme have been fully by [12]. A peculiar case that posed a major challenge to this pilot project at the onset (Year 2010) has to do with fact that there were no existing GIS in Katsina. There was a problem in the way and manner of disease reporting in the State. Most people do not go to Hospital for malaria treatment; they often resort to self medication. There is reluctance and failure of most private clinics to report malaria cases to the relevant authority. Technically this results in data limitation. Other challenges include the lack of technical infrastructures and specialists to give training to the field staff or to perform the analysis. Thus this pilot project for the application of remote sensing and GIS in the State's malaria control program was initiated.

Some of the additional challenging factors for the project include the need to;

1. Increase improve data integrity and quality
2. Increase speed of information distribution
3. Prevent duplication of efforts
4. Investigate the spatial dynamics of malaria transmission
5. Estimate the spatio- temporal magnitude of the disease.
6. Provide avenue of assessing the effectiveness of the control measures

7. Create condition for an efficient planning, implementation and evaluation of the resources
8. Minimize cost

Achievements

Some of the major achievements of this work include:

- a) The establishment of a malarial database in a spatial context for analysis.
- b) Incorporation of the modern techniques of Remote Sensing and GIS into the State's Malaria Control Programme
- c) Providing clearer means of identification of the areas of high incidence and prevalence of the disease
- d) Increasing awareness and further capacity buildings
- e) Enabling the provision of accurate and up to date information for the MCP management and planning application.
- f) Establishment of unified standard for documentation and information dissemination

By creating a map covering the entire Metropolis in a digital format, it is now possible to accurately define the locations, proximity and extents of the identified high potential mosquito breeding, malaria incidence and prevalence areas, as well as the locations of the various gathering centers of large crowd of people such as Market places, Primary and Secondary schools and the health service facilities in the metropolis. The map makes it possible to learn which areas are served, not served and

underserved in the provision of health service delivery service within the metropolis. It also enable the accurate identification of the vector habitat within the metropolis which makes a significant contribution to the disease control effort as it facilitates ease of targeting of eggs and larva of the vector.

The visual display of spatial clusters of malaria cases and their corresponding tabular records of the disease in the computer based GIS platform, provide powerful analytical tools to establish and confirm spatial relationships among the various data sets and the selection of priority areas. These allow for trends analysis and tactical planning for effective resource allocation and hence cost reduction.

7. Results and Conclusions

The results of this pilot study confirmed the usefulness of the application of the Remote Sensing (RS) and Geographic Information System (GIS) technology as a possible cost effective way to improve evaluation of the malaria, its vector and the disease's spatial distribution in a given study area.

Remote sensing data serves as a tool for surveying large areas to identify vector habitats, areas of high malarial incidences, and help direct control measures. The data when made available in digital format could easily be amenable for computer analysis and integration with other digital databases in a GIS.

The spatially analyzed outputs provided by this approach are of direct assistance to the evaluation of malaria control programs. The final map produced and the statistical analysis carried out could provide a platform for effective control and strategic planning based on reliable geospatial information.

The controls include issues relating to the suitable choice of water ways and ponds to be filled or drained and the densification considerations for hospitals and clinics where there is critical need, also, Time scheduling for the insecticide re-spraying and other monitoring and evolutions.

Thus understanding the relationship between location and malaria incidences can significantly help us in understanding, controlling and preventing the disease, and in better Malaria Control programme planning, with more efficient and effective resource utilization. This should ultimately lead to better healthcare outcomes and improved health for everyone.

However due to numerous constrains ranging from insufficiency of the required data, data flow and its transparency, inadequate infrastructures, skilled staff to manned the GIS and funding limitation, the Statewide application of this approach, as of now, is not warranted.

It suffices to recommends that some of the other major urban centres of the State (Funtua, Malumfashi, Daura, and Dutsin-Ma) respectively, could be consider in the future efforts towards spatially enable malaria control strategy for the State.

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