

Geographical Information System (GIS) in Veterinary Epidemiology: Bangladesh Perspective - *Md. Aminul Islam, DVM, MS-TAH*

Veterinary epidemiology deals the principles of describing the frequency of disease occurrence and how disease, productivity and welfare of animal population are affected by the interaction of risk factors. The veterinary profession in Bangladesh is confronted to different sets of problems in recent years compared to previous two decades particularly avian influenza and anthrax outbreaks severely threatened the promising poultry and livestock sector, respectively and both are of public health concerned. Agro-ecological practices and geo-climatic conditions of Bangladesh favor the abundance of bacterial, viral, parasitic diseases of poultry and livestock as well as emerging zoonoses. Inadequate nutrition and management errors has worsened the situation more. To establish sustainable livestock farming system overcoming the health hazards encountered, it is important to develop a strong epidemicsurveillance network through every corners of the country. To this end GIS can suitably be implemented as a powerful technical aid.

What is GIS?

Answering the simple question “What is GIS?” is not straightforward. Depending on the users’ point of view different replies will be given, each of them focusing on the aspect of GIS (Geographic Information System) which is the most crucial for him/her (spatial data visualization, storage or analysis). As quoted in Bailey (1990) the Association of Geographic Information has defined GIS in terms of a computerized databases management system for “capturing, storing, validating, maintaining, analysing, displaying and managing spatially referenced data... with a primary function to integrate data from variety of sources.” The GIS technology works with four major functional component like input (digitizing, scanning), storage (data structure), manipulation (analysis, modelling) and output (plot, print, display) and currently numerous commercial software packages like Manifold, ArcGIS, ArcView, MapInfo etc. offer GIS functionality within different computer operating systems.

Concept of GIS application in epidemiology

Since we are discussing the applications of GIS in an epidemiological context, we will refine the question to “What means GIS in epidemiology”. Therefore, we start in the early beginnings of spatial epidemiology. There is a novel history in behind the concept of GIS applied in epidemiology. In 1854, the community of Broad street, Soho district in London had the most terrible outbreak of cholera led more than six hundred people died which ever occurred in the United Kingdom. During that period the prevailing “maisma theory” stated that diseases such as cholera or the Black Death were caused by pollution or a noxious form of "bad air". John Snow, the father of modern epidemiology reasoned that if cholera was spread by bad air, then the cases should be uniformly distributed along the streets. By talking to local residents, he identified location of cholera victims and plotted each case on a spot map. This map revealed that cases of cholera were distributed in a tight cluster around a public water pump located on Broad Street. Snow went to the pump, took a water sample and observed under microscope. He wondered that the water contained bacteria that he had not seen before. He also made a solid use of statistics to illustrate the connection between the quality of the source of water and cholera cases. Snow then went back to the pump and removed the pump handle. The Broad Street cholera outbreak stopped almost literally overnight (Frerichs, 2003). Thus it became a legendary example of how maps can be used in the understanding of, and the fight against epidemiological diseases.

Trends of GIS application in veterinary epidemiology

Durr & Gatrel, (2004) reviewed that, Reif and Cohen published one of the first environmental epidemi

-ological studies for companion animals in Fort Collins, USA in 1970. With the hypothesis that “urban air pollution may be a risk factor for chronic pulmonary disease (CPD)” they selected dogs from both urban and rural areas and confirm CPD cases by X-ray and constructed a simple map of atmospheric dust concentration in the study area with four ranks showing the cluster of positive cases in order to determine the effect of living in cities on CPD in dogs. Although GIS technologies were developed around 40 years ago, it was not until the early 1990s that there were successful uses in epidemiological projects (Clarke et al., 1996). However, in recent year GIS is generally accepted by the scientific community of developed country to be a major tool contributing to the understanding of epidemiological processes between disease, vector, host and environment. There is a fivefold increase observed in publishing scientific articles on GIS based epidemiology during last two decades. In recent years GIS has been widely used in the surveillance and monitoring of vector-borne diseases, water borne diseases, in environmental health, quantifying lead hazards in a neighborhood and the analysis of disease policy and planning elsewhere in the world. However, in Bangladesh epidemiological study of livestock and poultry diseases based on GIS and spatial analysis is very limited till date in spite of having great prospects except so far only few international collaborations.

Scopes and importance of GIS in veterinary epidemiology

Veterinary epidemiology being a holistic approach aimed at coordinating the use of different scientific disciplines and techniques during an investigation of disease and their causation, impaired productivity or welfare of animal population (Pfeiffer, 2002). In this context, the spatial as well as the temporal dimension of disease occurrence is important to measure. GIS technology show the power and potential of spatial analysis capabilities for addressing important health issues at the international, national, and local levels. The application of GIS in Veterinary epidemiology is twofold: used in a research oriented environment to understand a disease (risk factor determination, spatial disease modeling and distribution and prevalence studies) and as a powerful tool in controlling the disease i.e. emergency response, disease detection, operational optimization of the response etc.

Among the exploratory methods for epidemiology and public health facilitated by GIS project, some important tasks are to visualize the space-time **clusters** or **hotspot** of disease of interest, determining the zones of relative risk around clusters, describing the outbreak (what, when, who and where), analyzing the outbreak (why and how), identify areas in need of resources which can ultimately contribute in planning, controlling and implementing preventive measures of disease concerned. GIS has the ability to combine geo-referenced data generated by global positioning systems (GPS) with ecological data and data from surveillance and management activities for identification and mapping of environmental factors associated with low or high disease prevalence which make it particularly useful for disease surveillance and monitoring of ongoing control efforts (Madelaine, 2001).

In case of an outbreak of infectious disease like Avian influenza and Anthrax, Bangladesh has experience of both in recent years, GIS can provide an excellent tool for identifying the location of the case farm and all farms at risk within a specified area of the outbreak. Buffer zones can be drawn around those farms and with a link to tables of the addresses of the farms at risk; the farms can be informed within a short time after a notified outbreak. Buffer zones can also be generated around other risk areas or point sources, such as roads where infected cattle or birds have been driven or around market places. Further, the maps can assist the Department of Livestock Services under the Ministry of Livestock and Fisheries in how to handle a potential outbreak as well as for the field veterinarians to plan their work in the particular situation.

Concluding remarks

Since GIS requires high expense for software packages and retrieval of data, training, and a climb up learning curve, initiatives from the Government level is of prime importance to increase skilled professionals and for the development and management of geo-referenced database. . It is the time of institutionalization of GIS in the field of veterinary epidemiology and public health to fight against the current and upcoming threat of infections in livestock, poultry and human as well. For better utilization of GIS in the field of veterinary epidemiology, primary step would be to digitalize all the registered Government as well as private farms (dairy and poultry) in Bangladesh with geographic coordinates of farm, animal and herd profile to yield the spatial database that would further be used as

input for need based GIS project.

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