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Siddiqui MFMF
Assistant Professor, Department of Veterinary Medicine, College of Veterinary and Animal Sciences, MAFSU, Parbhani, Maharashtra, India

Digraskar SU
Professor and Head, Department of Veterinary Medicine, College of Veterinary and Animal Sciences, MAFSU, Parbhani, Maharashtra, India

Shaikh SR
M.V.Sc. Scholar, Department of Veterinary Medicine, College of Veterinary and Animal Sciences, MAFSU, Parbhani, Maharashtra, India

Sakhare MP
Assistant Professor, Department of Veterinary Medicine, College of Veterinary and Animal Sciences, MAFSU, Parbhani, Maharashtra, India

Ajabe S
M.V.Sc. Scholar, Department of Veterinary Medicine, College of Veterinary and Animal Sciences, MAFSU, Parbhani, Maharashtra, India

Correspondence
Siddiqui MFMF
Assistant Professor, Department of Veterinary Medicine, College of Veterinary and Animal Sciences, MAFSU, Parbhani, Maharashtra, India

Application of GIS in animal disease monitoring and surveillance

Siddiqui MFMF, Digraskar SU, Shaikh SR, Sakhare MP and Ajabe JS

Abstract
Animal disease patterns are changing day by day under climate changing scenario and there is continuous occurrence of new and emergence type of diseases. So, new and modern types of tools are essential for monitoring and surveillance of these diseases. Geographic information systems (GIS) provide the easy access, utilization and manipulation of geospatial information. The advantage of GIS is mapping the many different locations of farms and other facilities with animals on a single map which helps in better monitoring and surveillance. Also, detailed studies are possible with respect to diseases forecasting, prediction of outbreaks, identification of disease cluster or hotspot and to evaluate different strategies to prevent the spread of infectious diseases. GIS provide ideal platform for the convergence of disease-specific information and their analyses in relation to population settlements, surrounding social and health services and the natural environment.

Keywords: Animal diseases, epidemiology, GIS, surveillance

Introduction
A geographic information system (GIS) is a computerised information system in which user can capture, store, manipulate, analyse, manage, present, retrieve and share all types of spatial or geographic data. GIS is more user friendly computer software which can show many different kinds of data on one map and enables user to analyse and interpret data on different locations plotted on map to understand relationships, patterns, and trends. GIS provide ideal platform for the convergence of disease-specific information and their analyses in relation to population settlements, surrounding social and health services and the natural environment and provide data which are highly suitable for analysing epidemiological data, revealing trends and interrelationships that would be more difficult to discover in tabular format [1].
Surveillance is a mechanism applied to collect and interpret data on the health of animal populations, to accurately describe their health status with respect to specific diseases of concern. In general, surveillance is aimed at demonstrating the absence of disease or infection, determining the occurrence or distribution of disease or infection, while also detecting as early as possible exotic or emerging diseases.
Animal health surveillance is an essential tool to detect disease or infection, to monitor disease trends, to facilitate the control of disease or infection, to support claims for freedom from disease or infection, to provide data for use in risk analysis, for animal and/or public health purposes, and to substantiate the rationale for sanitary measures. Animal Disease Surveillance is a key for improving disease analysis, early warning and prevents the spread of diseases [2].
Surveillance is used for the detection of new or exotic diseases while monitoring is aimed at detecting changes in established or endemic infection levels that may signal the recurrence of a disease outbreak. Monitoring of the epidemiological patterns (animal, place, time) of diseases and pathogens within populations provides a vital system for the identification of changes in disease status within this population (whether this relates to all animals worldwide, or those within a single country, region, village or farm). For this reason, most countries have systems in place for the intermittent collation of data relating to animal diseases.

Animal Disease Surveillance and GIS
GIS is being used to visualize disease foci, monitor newly infected or re-infected villages, and identify populations at risk, target cost-effective interventions, and monitor eradication efforts. GIS have been used in territorial cross-sectional and longitudinal parasitological surveys in order to experiment new applications to plan sampling protocols and to display the spatial

distribution of infectious disease data to understand natural habitat and pattern of disease caused by infectious agents to animals [10].

The visual display of spatial phenomena provides a very effective descriptive analytical tool. This method is used to describe the spatial occurrence of different strains of *Mycobacterium bovis* in a wild animal population which allowed inferences on the importance of specific disease transmission paths [9]. GIS is used to display the distribution of brown ear ticks in southern Africa, retrospectively comparing the eco-climatic favourability of particular locations for *Rhipicephalus appendiculatus* with the occurrence of East Coast fever [3].

Recording and reporting disease information

GIS can be used to produce maps of disease incidence, prevalence, and mortality, morbidity on farm, region, or national levels. The information is more easily understood when visualised on a map. Because information on diseases often tends to be aggregated (from information on each individual herd to municipality or county level) the information loses some of its value. If the information is mapped at the farm level, value of data is maintained, also small parts of a region can be visualised at the same time. Another way to describe the incidences of diseases in a defined area can be to create density maps by using the density function. The density function creates a grid with a defined cell size and gives each cell in the area a density value of the infected farms. To adjust for the underlying population, a density map of the whole population at risk is created with the same cell size. The density maps are then divided to provide a map that shows the incidence of the particular disease in each area unit at the time unit chosen. This function can further provide maps which show the spread of the disease by displaying the maps as a movie. The GIS can also be incorporated in a real time outbreak notification, as done in an eradication program of the Aujeszky's disease in North Carolina [6].

GIS is the better tool for study and application of the Global Early Warning System (GLEWS) that formally brings together human and veterinary public health systems and application of environmental data for study of diseases like avian influenza and Rift valley fever which offers the capability to demonstrate vector-environment relationships and potentially forecast the risk of disease outbreaks or epidemics [2].

Epidemic emergency

In case of an outbreak of an infectious disease, 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. It has been used to strengthen data collection, management, and analysis, develop early warning systems, plan and monitor response programs, and communicate large volumes of complex information in a simple and effective way to decision makers to epidemiologist. 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 have been driven or around market places. Further, the maps can assist the field veterinarians to plan their work in the current situation, and for the veterinary authorities in how to handle a potential outbreak.

Analysis of clustering of diseases

By using spatial components of diseases, Dr. John Snow combined geospatial information to analyse the cholera deaths and found clusters around water pumps [7]. To analyse whether a disease is clustered in space, time or in time and space other programs still have to be used because this is not yet a standard tool in the freely available GIS-packages. Once all of the desired data have been entered into a GIS system, they can be combined to produce a wide variety of individual maps, depending on which data layers are included. Any GIS data layer can be added or subtracted to the same map and provide easy analysis of particular cluster disease on that map. The visualisation of the disease rates on digital maps can be misleading because the eye tends to interpret point patterns as clusters more often than what is real. Therefore, a cluster analysis should be carried out for an objective evaluation of the reported disease cases. The results of some of the cluster analyses can, thereafter, be imported into a GIS to visualise the location of clusters or cluster areas.

A GIS was constructed and landscape feature data together with paramphistome positive survey records from 197 geo-referenced ovine farms with animals pasturing in an area of the southern Italian Apennines and study done using variables Normalized Difference Vegetation Index (NDVI), land cover, elevation, slope, aspect, and total length of rivers. All these variables were then calculated for "buffer zones" consisting of the areas included in a circle of 3 Km diameter centred on 197 farms [10].

Model disease spread

Simulation models using programmes packages such as at Risk (Palisade Corporation, Newfield, NY, USA) can be integrated within a GIS. Such simulation models can incorporate farm information such as herd size, production type as well as spatial factors like distance to the source of outbreak, population density and climate conditions, vegetation and landscape, all of which have been defined as risk factors for the spread of the modelled disease [12]. It has developed a model of a potential outbreak of foot and mouth disease in New Zealand. GIS technology have been used also to identify environmental features that influence the distribution of paramphistomosis in sheep from the southern Italian Apennines and to develop a preliminary risk assessment model for better understanding about spread of paraphistomosis [10]. Freely available geospatial algorithms with simulation models are implemented in software packages like Python language and R language.

Planning disease control strategies

GIS technology has many features which make it ideal for use in animal disease control, including the ability to store information relating to demographic and causal factors and disease incidence on a geographical background, and a variety of spatial analysis functions. The neighbourhood analysis function can be used to identify all adjacent farms to an infected farm. It is a function that identifies all adjacent features with a certain criteria to a particular feature. Contact patterns such as common use of grasslands or sources of purchasing etc. could be visualised with a so-called spider diagram. This could provide insight into the possibility of transmission of infectious diseases between herds.

In the planning of eradication of diseases, GIS has the possibility to perform superimpose analysis to find high or low risk areas for diseases which depend on geographical features or conditions related to the geography. Studies of trypanosomiosis [11] and theileriosis [8, 4] are just some examples of how to use GIS to plan eradication of diseases depending on habitats of vectors or wild animal population. GIS could also be used to find areas with a low density of other farms [5, 6].

References

1. Bhatt B. Joshi Janak. GIS in Epidemiology: Applications and Services. National Journal of Community Medicine. 2012; 3(2):259-263.
2. Kshirsagar DP, Savalia CV, Kalyani IH, Kumar R and Nayak DN. Disease alerts and forecasting of zoonotic diseases: an overview, Veterinary World. 2013; 6(11):889-896.
3. Lawrence JA. Retrospective observations on the geographical relationship between Rhipicephalus appendiculatus and East Coast fever in southern Africa. Veterinary World. 1991; 128(8):180-183.
4. Lessard P, L'Eplattenier RL, Norval RAI, Kundert K, Dolan TT, Croze H, *et al.* Geographical information systems for studying the epidemiology of cattle diseases caused by *Theileria parva*. Veterinary Record. 1990; 126:255-262.
5. Marsh WE, Damrong Watanapokin T, Larntz K, Morrison RB. The use of geographic information system in an epidemiological study of pseudorabies (Aujeszky's disease) in Minnesota swine herds. Preventive Veterinary Medicine. 1991; 11:249-254.
6. McGinn TJ, Cowen P, Wray DW. Intergrating a geographic information system with animal health management. Proceedings of the 8th International symposium on veterinary epidemiology and economics in Paris in. Epidemiologie et santé animale. 1997; 12::31-32.
7. McLeod KS. Our sense of Snow: The myth of John Snow in medical geography. Social Science and Medicine. 2000; 50 (7-8) 923-935.
8. Perry BD, Kruska R, Lessard P, Norval RAI, Kundert K. Estimating the distribution and abundance of *Rhipicephalus appendiculatus* in Africa. Preventive Veterinary Medicine.1991; 11:261-268.
9. Pfeiffer DU. The role of a wildlife reservoir in the epidemiology of bovine tuberculosis. Unpublished PhD Thesis, Massey University, Palmerston North, New Zealand, 1994; 496.
10. Rinaldi L, Cascone C, Sibilio G, Musella V, Taddei R, Cringoli G. Geographical Information Systems and remote sensing technologies in parasitological epidemiology. Parassitologia. 2004; 46(1-2):71-4.
11. Rogers DJ. Satellite imagery tsetse and trypanosomiosis in Africa, Preventive Veterinary Medicine. 1991; 11:201-220.
12. Sanson RL, Ster MW, Morris RS. Interspread- A spatial stochastic simulation model of epidemic foot-and-mouth disease. The Kenyan Veterinarian. 1994; 18(2):493-495.