Coast fever, pp. 155–57 (886).

NORVAL, R.A.I. Tick control in relation to the epidemiology of theileriosis, pp. 111–120(882).

PERRY, B.D., LESSARD, P., MUKHEBI, A.W. and NORVAL, R.A.I. Epidemiology and decision-making in theileriosis control, pp. 137–43 (883).

PERRY, B.D., LESSARD, P., NORVAL ,R.A.I., L'EPLATTENIER, R., DOLAN, T., GRANDIN, B.E. and IRVIN, A.D. The risk of East Coast fever to livestock in Africa on a geographic basis, pp. 144–148 (844).

The following papers appear in:
SUTHERST, R.W, ed. (1987). Ticks *and Tick-Borne Diseases: Proceedings of an International Workshop on the Ecology of Ticks and Epidemiology of Tick-Borne Diseases, Held at Nyanga, Zimbabwe, 17–21 February 1986.* ACIAR Proceedings No. 17. Canberra: Australian Centre for International Agricultural Research, 159 pp.

IRVIN, A.D. Monitoring patterns of distribution of *Rhipicephalus appendiculatus* and *Theileria parva, p.* 65 (585).

IRVIN, A.D. Performance and productivity of cattle following immunization against East Coast fever *(Theileria parva)* infection, p. 121 (586).

IRVIN, A.D. The impact of vaccination against tick-borne diseases on future strategies for tick control, p. 148 (587).

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Geographic information systems

The development of powerful yet inexpensive microcomputers in the 1980s is dramatically influencing scientific research, including studies of livestock diseases. Alongside the new generation of desktop computers, a wide range of specialized scientific software is being developed. In the 1970s, geographic information systems (GIS) were run on mainframe and minicomputers, but in the last ten years software has been developed to run these systems on microcomputers. Now, with the advent of the 80386 microchip, running at speeds of up to 33 megahertz and using 32-bit words, many geographic information systems can be run on microcomputers with speeds approaching those of the larger computers of only a few years ago.

Geographic information systems are computer programs that allow one to store, analyse and display large amounts of spatial information, that is, data that are associated with locations. The original data are usually in the form of maps, but any data with a spatial component, such as aerial photographs and satellite images, data recorded by meteorological instruments, data obtained in ground surveys, and data entered in standard computer text and data files, can be fed into a GIS, which then enables one to manipulate the spatial information.

The importance of the geographic information systems is their speed and the large amount of data they can handle: with these programs we can, for example, create map overlays that would take a cartographer a prohibitively long time to produce using traditional methods. Using the computer, we can rapidly evaluate, compare and combine maps, and then create new maps that illustrate relationships among the variables.

Graphical elements on a GIS map are linked to a considerable body of information held in a database manager. For example, we might have five years' worth of weekly recorded data regarding the incidence of ECF in a land registration unit in Uasin Gishu District, the data including information on the species of the tick vector present, the strains of *Theileria* that occur in the cattle population, the prevalence of *T. parva* in the cattle population, the dominant cattle types present, the size of farm, the types of crop and cattle management systems in use, the vegetation, climate, rainfall and humidity of the area, and so on. These data are kept in a database that can be 'interrogated' by a researcher so that this selected information is displayed on the computer screen. The display typically takes the form of overlays, which, laid on top of one another, illustrate the interaction of the many variables (Figure 3).

It is important to be able to produce high-quality hard copies of the results of analyses made with the help of a GIS. Slides or prints can be taken directly from the computer screen with a 35-mm camera attachment. Black-and-white maps can be sent to dot matrix printers; filled colour plots can be sent to inkjet printers. Pen plotters are useful for producing coloured line maps. The results of numerical analyses of various map attributes by area, such as histograms and statistical tables, can be sent elsewhere for manipulation and analyses, such as to printers, statistical programs, graphics programs or computer models.

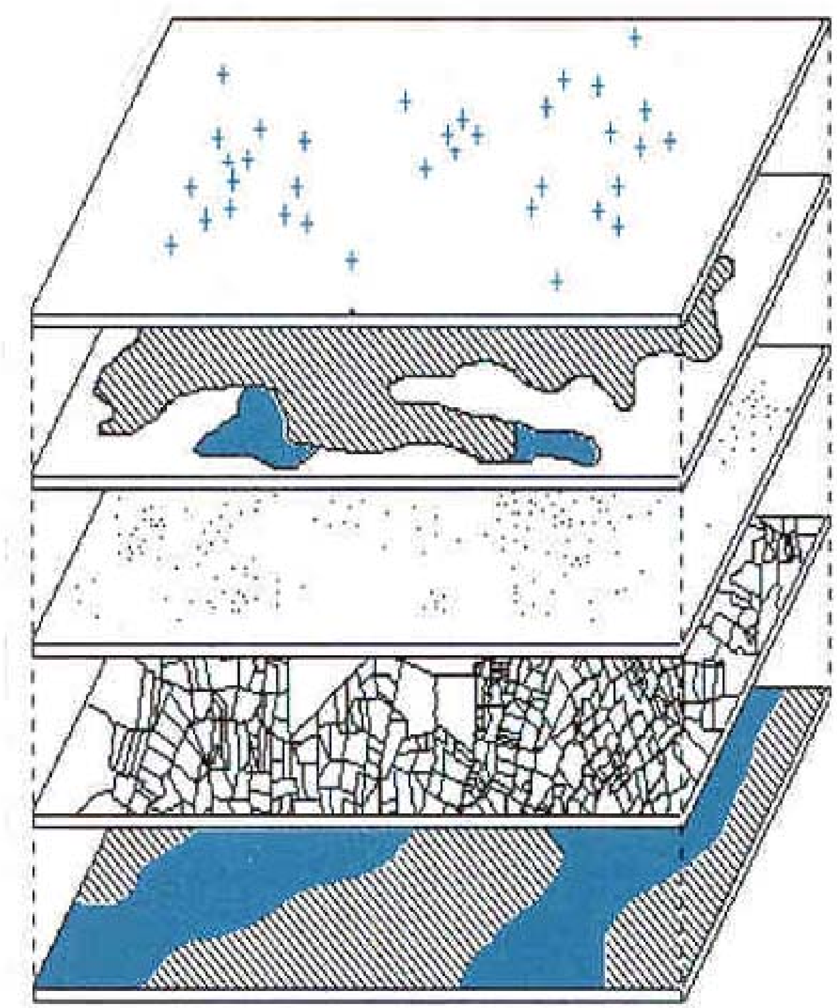

FIGURE 3. *Diagram illustrating the ability of a geographical information system to help researchers examine interactions among different sets of data, or variables, that impinge on livestock disease control in a given area.*

Top layer. incidence of fast Coast fever, second layer. distribution of the tick that transmits the disease-causing parasite, third layer. distribution of cattle, fourth layer: farm boundaries, bottom layer. agroecological zones.

In collaboration with staff members of the Global Environmental Monitoring System, a service provided by the United Nations Environment Programme (Kenya) to manage global environmental information, the ILRAD epidemiology and socioeconomics team has been using GIS to gain a better understanding of the geographical variation in theileriosis epidemiology in Africa on a continental basis and at country and district levels.

The map in Figure 4 is an example of the results of this collaborative work. The map shows the climatic suitability of areas throughout eastern Africa for the tick *Rhipicephalus appendiculatus.* To create the map, temperature, humidity and rainfall data from about 5,000 meteorological stations in Africa were interpolated using a distance-weighted formula corrected for altitude to provide an estimate of each climatic parameter on the African continent on a 25-km grid. The climatic data for each of the 44,000 grid cells were fed into CLIMEX, a software program developed by R. Sutherst and G. Maywald, at the Commonwealth Scientific and Industrial Research Organisation, in Australia. The CLIMEX program was then used to calculate an ecoclimatic index indicating the suitability at each of the grid cells for *R. appendiculatus* survival and development.

ILRAD scientists are collaborating with scientists at the Australian National University to refine this system by developing an improved interpolation at a resolution of approximately 5 km. Predictions made by using the model will then be tested at study sites in Kenya and Zimbabwe.