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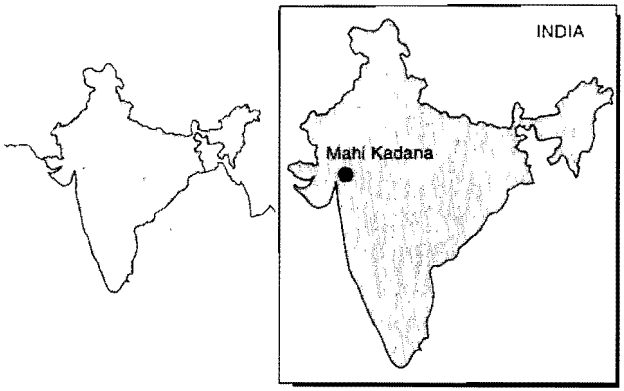

The importance of the spatial and temporal dimensions in the relationship between malaria incidence and water-related environmental factors has been long recognized though difficult to quantify. Studies seeking to examine the relationship between malaria and irrigation have revealed a complex picture with a high degree of site-specificity. In some situations, incidence of malaria is increasing while in others it is decreasing, or remains unchanged following irrigation development. In some areas, irrigation may only have a seasonal effect by extending the transmission season into the dry season, while the contribution from irrigation during the rest of the year may be limited in comparison to the mosquito breeding habitats created by rainfall precipitation. Variations in irrigation water management practices and differences in the design of irrigation infrastructure will also create very different breeding opportunities.

Today, GIS offers a good opportunity for researchers in the field of health and irrigation, in facilitating the integration of spatial dimension in the analysis. The advantages in using GIS in that field will be illustrated through two case studies carried out by IIMI in 1996.

MALARIA TRANSMISSION IN THE MAHI KADANA IRRIGATION SCHEME, GUJARAT INDIA

The studied area is located in the Bay of Cambay, with an average rainfall of 780 mm, a population of 1.2 million, and a cultivable command area of 212,000 ha. Malaria incidence was recorded at 15 parent primary

health care centers (PPHC). Water-related factors included in the study were: rainfall recorded at 7 stations within the area; rice intensity and irrigation density for the 39 distributaries in the command area; depth to groundwater recorded in 1988. Analysis of the relationships was run for the entire area on an annual basis for 1981 and 1991. A timely (seasonal) analysis was also run for the Nadiad thaluka, one of the seven administrative units within the area, from July 1990 to June 1993. Ultimately, data analyses were performed on a specific statistical software package, after being prepared on the GIS software.

Results of the analysis are somewhat mixed. In brief, the variability considered in this study cannot explain the variation in malaria incidence between different PPHC catchment areas. Although rainfall, in some years, explains variation, the inconsistency in the findings makes this parameter less conclusive. It was only for the Nadiad thaluka that factors under irrigation management control were found to be of importance in explaining the variation in incidence.

Regarding the methodology followed in that study, GIS appears to be very useful in many instances:

- spatial interpolation of data recorded on limited points (rainfall)
- spatial visualization of the variables within the area and visual comparison of the environmental factors and malaria incidence, before working on correlation analyses
- overlay process in multi-criteria analyses to create a composite environmental indicator
- identification of catchment around primary health centers to spatialize the incidence levels
- aggregation of environmental data at catchment level around each health center

PROGRESSION OF MALARIA FROM WATER BODIES IN A VILLAGE IN SRI LANKA

Environmental and socioeconomic risk factors for malaria were studied in a village in Sri Lanka. Over a period of a year all 49 households in the village were visited every other day to obtain information on malaria episodes. In this survey, 280 residents participated. The buildup of populations of Anopheles culicifacies (the major vector of malaria in Sri Lanka) before the start of the transmission season had taken place in a stream near the village.

The use of GPS (Global-Positioning-System) on-site was of great importance to locate the houses of malaria patients. Then GIS was used to create a series of maps of the disease cases within the area at different time intervals. It showed a clear progression of malaria from the stream throughout the village during the first month of the transmission. It also showed that the second water body, a tank on the other side of the village, was of little importance. This visual interpretation on GIS was confirmed later on by statistical analyses.

GIS was found useful in many ways:

- to calculate distance from homestead to areas presenting high risk, such as streams, tanks, cattle sheds
- to identify spatial clusters of diseases not distinguishable by classical analyses
- to visualize the progression of the malaria incidence throughout the area

BIBLIOGRAPHY:

Mutuwatte, L.P., F. Konradsen, D. Renault, S.K. Sharma, O.T. Gulati, and W.A.U. Kumara. 1997. *Water-related environment factors and malaria transmission in Mahi Kadana, Gujarat, India.* Colombo, Sri Lanka: International Irrigation Management Institute. IIMI Working Paper No. 41.

Van der Hoek, W., F. Konradsen, D. S. Dijkstra, P.H. Amerasinghe, and F. P. Amerasinghe. 1997. Risk factors for malaria: A microepidemiological study in a village in Sri Lanka. (Submitted to Transactions of the Royal Society of Tropical Medicine and Hygiene.)

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