

Environment: elevation, rivers and forest cover

The topography of the region is by no means uniform (Figure 5). The physical environment ranges from alluvial river estuaries to coastal plains, to inland rice field expanses, to foothills, to high mountains. There is a general trend towards higher elevation going northwards from the coastal plains, with a steep rise to high mountains in the northern part of Yunnan. There are substantial areas of moderate elevation in Viet Nam, Lao PDR, Myanmar and Thailand, with smaller areas in western Cambodia, in Guangxi and in Hainan. However, only in northern Yunnan does the degree of elevation reach heights where it is difficult for malaria mosquito vectors to breed successfully.

A series of rivers flow through valleys between the mountains and foothills: major rivers are denoted in Figure 5. These arise in the foothills or in the high mountains in China and flow south or east to the coast where they form fertile deltas as they enter the sea. Each river is important to the country or countries through which it flows, in terms of water for drinking and for agriculture, for transport and in some cases for hydro-power generation. That part of the Yangzi river system which passes through northern Yunnan aside, the largest river in the region is the Mekong itself. The Mekong arises in the high mountains of China and flows through all six countries: with its tributaries and branches the Mekong forms one of the key river systems of Asia, indeed of the world. It also forms part of the international border between Lao PDR and Thailand, and between Lao PDR and Myanmar (borders are shown in white in Figure 5).

Each of the rivers plays an important role in the life and the economy of the respective countries through which it flows. Indeed, the fertility of the region depends greatly on these rivers. The whole watershed also plays a critical role in the transmission of infectious diseases in the region, especially those carried by mosquito vectors, such as malaria, dengue, Japanese encephalitis, filariasis, and other water-related diseases such as schistosomiasis, diarrhea.

An important role is also played by forests, plantations and the whole spectrum of agriculture. In this context satellite imaging is instructive (Figure b). The extent of afforestation is still quite impressive, just as also is the extent of deforestation e.g. in northeastern Thailand. The satellite picture shows also the important areas of intensive cultivation in what, especially, is one of the world's most productive rice growing regions. Forests, plantations and rice fields all play a part in transmission of

mosquito borne diseases, especially malaria, since different mosquito breeding habitats are encountered in these differing ecological niches.

This is a single glimpse only at the power of remote sensing to provide information about the physical environment of relevance to a wide range of questions. By time series analysis the distinction can be drawn between rice fields, arid salt pans, recent deforestation: issues that are of great importance to the transmission of vector borne infectious disease. Even the present glimpse facilitates interpretation of the environment in which malaria flourishes.

Against this environmental background is the critical element of change. The drive towards economic growth is accompanied by major alterations in the environment of the region, in some countries more than in others, but none can escape the effects of this change. Logging of the forests, conversion of forested land to cultivation and to plantations alters the breeding sites of vectors, eliminating some, expanding others. Conversion of rice fields to factories changes both the ecology and the types of employment opportunities, hence the population distribution. Construction of highways opens up forest land to cultivation, increases population mobility and the chances of disease spread among shifting populations.

Maps such as these which are presented in this monograph at very small scale/ low resolution help greatly to monitor the pace and nature of change. These maps are at macro level to give a regional overview: clearly environmental monitoring and satellite imaging at more local levels can play an important role in continuing assessment and prediction of the effects of economic change. So too can this technology assist in delineating change in environmental factors that affect exacerbation or abatement of infectious diseases.

Malaria is primarily a disease of rural areas where vector mosquito habitats are found. The human populations in malaria endemic areas tend to be relatively poor. Environmental mapping highlights the logistic difficulties involved in case finding and management: remote areas, inaccessibility to health services leading to delayed diagnosis and treatment, with consequences for morbidity and mortality.

Data sources: Elevation data were derived by ACASIAN from United States Geographical Survey global map databases. Forest cover maps were derived from the Remote Sensing Division, National Research Council of Thailand.

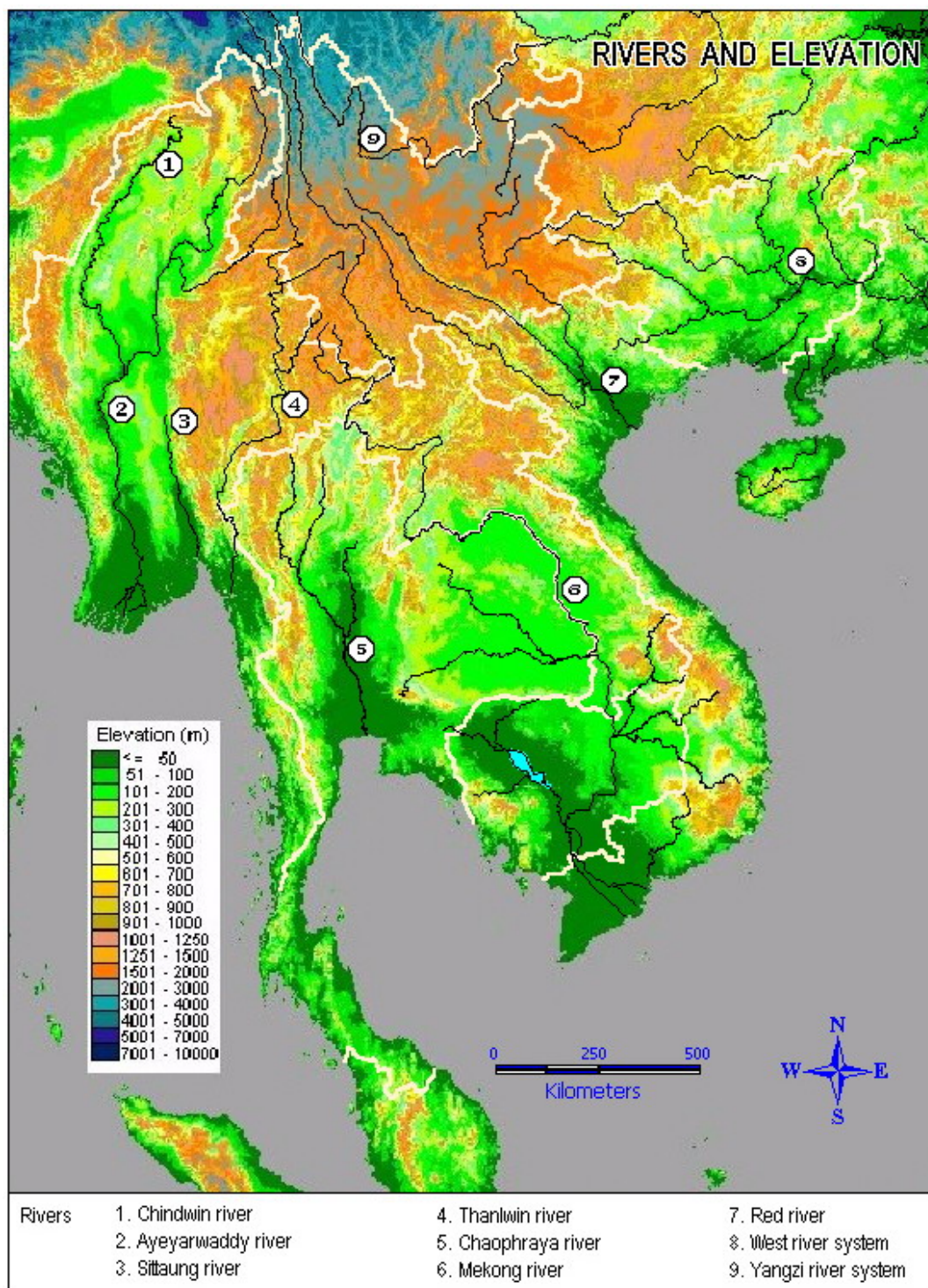


Figure 5.

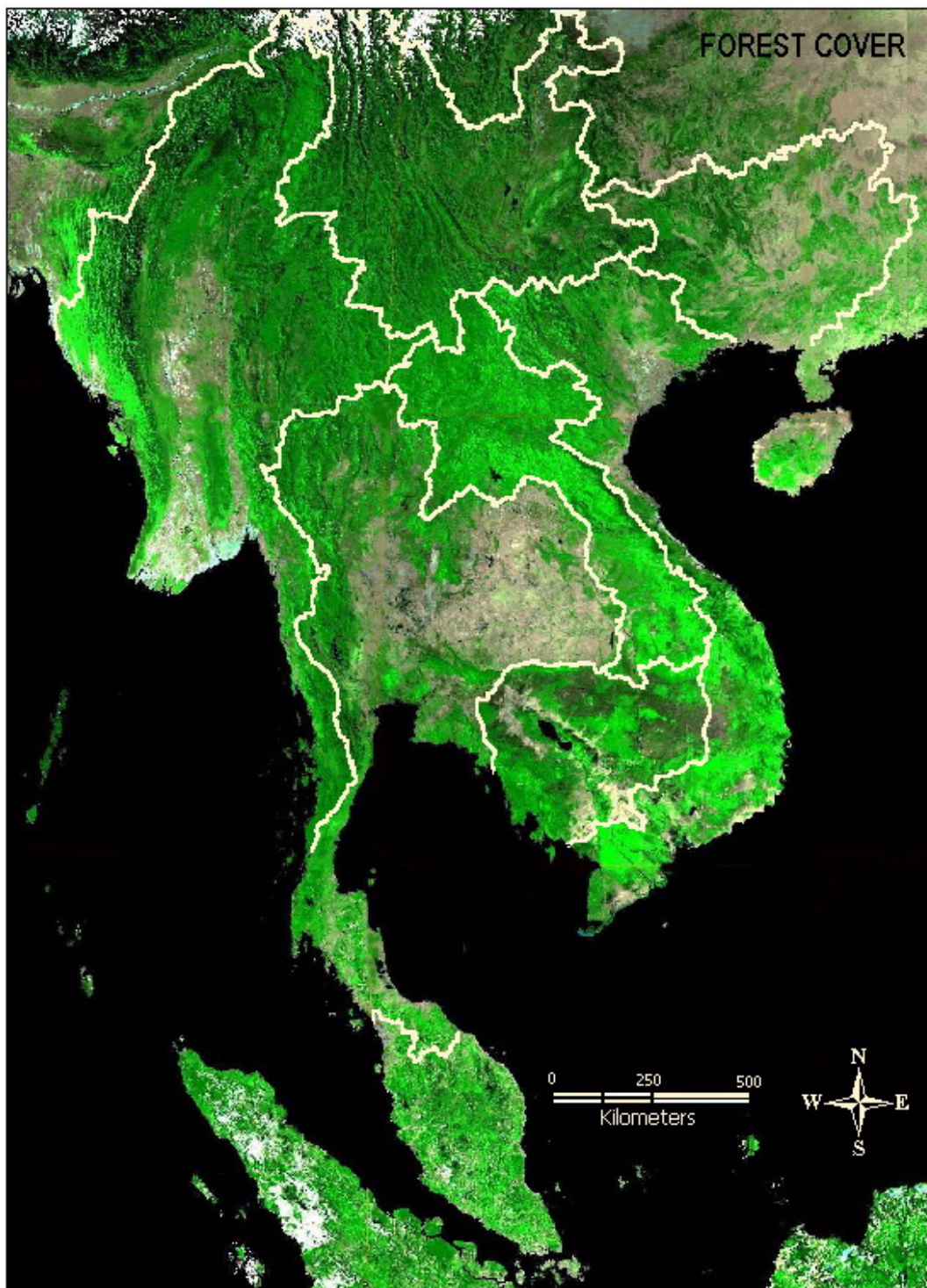


Figure 6.