

GIS's possibility as a tool of historical study of medicine and disease in colonial Taiwan (1895-1945)

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ABSTRACT

This paper is aimed to reveal GIS's possibility as a tool of historical study of medicine and disease in colonial Taiwan. During the colonial era (1895-1945), many public health investigations have been performed. Thus abundant records as well as statistical data exist. These historical resources were extensively used and analyzed in former studies, but little attention was paid to the space aspect. This paper gives a systematic introduction to the important historical resources of medicine and disease. By using GIS as a tool to integrate, visualize and analyze these data, this paper also provides case studies to discuss the establishment of medical network, the distribution of endemic disease, and the relationship between medicine, disease and environment in colonial Taiwan.

1. Introduction

GIS has long been considered as a powerful tool in various disciplines. Since the 1990s, GIS has drawn the attention of humanities researchers, which even invented the term "Historical GIS". In fact, the structural elements of the Historical GIS, including software, hardware and database, are no different from that of ordinary GIS. The reason for the invention of such a term is to emphasize that the contents of the database for Historical GIS are mainly collected from historical materials, including ancient maps, archives, statistical data or data collected from field study; and it is a big challenge to collect, interpret, establish, integrate and manage such data in various formats with GIS. In the process of mapping or spatializing these historical materials, however, the spatial consciousness often neglected by historians emerges. Such a process allows historians to see the functions of time and space in history. Besides, GIS can quickly turns historical materials or phenomena into maps, which are sometimes clues for making assumptions or tools for strengthening interpretations.

2. Spatialization of Historical Materials of Medicine and Disease

Historians with GIS training have different realizations for historical materials. GIS-processed spatial information falls into graphic and attribute data. In the familiar language of history, historical maps are the common form of graphic data; and stories on every point, line and plane in the map are attribute data. Conversely, documents or statistics that history researchers usually use are the sources of attribute data, which mostly contain information that can be spatialized. Historical maps of different periods of time provide a reference coordinate for time-space for attribute data to locate the corresponding time and position.

During the Japanese colonial rule, Taiwan could be considered as the most investigated colony both in detail and in scale. A large amount of statistical data and investigation reports

were compiled continually every year, including data concerning medicine and diseases. When statistic data were aggregated by districts, or when investigation reports include spatial information, such as path, distribution and position, they can be integrated by GIS. These historical materials of medicine and disease can be classified into four categories by nature:

(1) Regular Death Records

In early colonization period, survey of population was conducted by the military police. The first nationwide census was conducted in Taiwan in 1905, and conducted every 5 or 10 years since then. The colonial government also established a set of household regulations in 1905, and the residents were obliged to report the dynamic data, including birth, death, marriage and movement. The population policies leave us the detailed record of life of individuals during the colonization period. On the other hand, these individual or household data also form the basis of regular aggregation data. For example, statistics of causes of death by county are published in the *Taiwan Jinkō Dōtai Tōkei* [*Vital Statistics in Taiwan*] (1905-1943) and the *Taiwan Sōtokufu Tōkeisho* [*Statistic Book of the Government of Taiwan Governor-General*] (1898-1944) edited by the Taiwan Sōtokufu every year. Statistics by smaller unit such as district/city, town/village were also published every year in the local statistic books.

(2) Regular Patient Records

Since 1896, the Taiwan Sōtokufu began establishing government hospitals in different parts of Taiwan and dispatched physicians to set up public dispensaries in local areas. In general, government hospitals were often established in urban areas for medical purposes, and most patients were Japanese. Public dispensaries were opened in appointed locations, mostly rural or remote mountainous areas, and most patients were Taiwanese. Either government hospitals or public dispensaries were obliged to report the amount of patients treated every year. Therefore, statistics on patients by disease in different counties are included in the *Taiwan Sōtokufu Tōkeisho*. Besides, physicians of the public dispensaries needed to supervise local public health in addition to providing medical consultations. Some “government physician monthly reports” still survive in the *Taiwan Sōtokufu Kōbun Ruisan* [*Archives of the Taiwan Sōtokufu*]. These reports recorded the condition of epidemics in the early colonial period.

On the other hand, the Taiwan Sōtokufu announced a law in 1896 specifying that cholera, plague, dysentery, smallpox, typhus, typhoid fever, diphtheria and scar Latin as legal infectious diseases. While detecting these infectious diseases in a diagnosis or autopsy, physicians must immediately report to the police. Therefore, the amount of patients and number of deaths as a result of legal infectious diseases in different counties every year were recorded in the *Taiwan Sōtokufu Tōkeisho*, and local statistics were recorded in some statistic books edited by local government.

(3) Abnormal Disease Investigation Reports

Unlike regular records, abnormal records were usually published as a result of health policies or the outbreak of a particular infectious disease. For example, in order to display at the World Exposition Paris 1900 the Japanese Empire’s governance of Taiwan, the Taiwan Sōtokufu decided to edit the *Records of Endemic Diseases in Taiwan*, and thus ordered all public physicians to submit reports on endemic diseases in 1898. Also, since the early Meiji Period, every time when an epidemic of acute infectious disease broke out, local governments would edit the *Records of Epidemic* to record the paths of disease transmission and patient

distribution. In colonial Taiwan, the Taiwan Sōtokufu has edited the *Records of Epidemic Pest in Taiwan* for 1896, 1898 and 1899. Two *Records of Epidemic Cholera* recording the cholera that broke out in 1902, 1919-20 survive. After the plague and cholera were under control in 1920, the severity of typhoid was marked out. *General Situation and Control of Epidemic Typhoid* of Taipei city and Keelung city was edited during 1927-34. Similar reports include control programs and situation investigations of some endemic or chronic diseases, such as malaria and opium intoxication.

The *Reports of Public Health Investigation* is another product as a result of the health policy in the 1920s. Public health investigation was first done in Japan since 1918. In the 1920s, the same policy was implemented in Taiwan. The Taiwan Sōtokufu thus ordered county governments to select several towns/villages or section determined as “healthy” and “unhealthy” to conduct detailed public health investigations in these selected areas. During 1921-31, there were 10-12 investigations conducted in each county in west Taiwan, and 3 investigations were conducted in east Taiwan.

(4) Abnormal Disease Investigation Reports

In addition to the records of large-scale statistics and investigations mentioned above, there are survey reports produced according to clinical observations, child health checkups and onsite investigations conducted by physicians and medical researchers in colonial Taiwan. The results were published in *Taiwan Igakukai Zashi* [*Journal of the Formosan Medical Association*], the most authoritative medical journal in colonial Taiwan; and some survive in the *Taiwan Sōtokufu Kōbun Ruisan*, hospital annual reports or medical journals published in Japan. Also, local government health officials also published pamphlets describing general sanitary conditions, such as *General Sanitary Situation in Keelung City* or *General Sanitary Situation in Kaohsiung County*.

In terms of geographical information, historical materials of the four said natures fall into two categories. First is the point-based data with accurate locations, such as the physical condition of a person (for example, deafness, muteness, blindness) recorded in the household register, the patients’ individual data recorded in the *Records of Endemic Diseases*, or the address of anti-malaria station published in anti-malarial investigations. These data can be represented accurately with points in a map. Another one is the area-based data, including all the data aggregated by counties, districts, cities, towns, villages and section. The problem is, where was the address or the administrative districts located in historical period? In this case, we need the assistance of graphic data in order to “put” these data on the correct positions in the map.

Here, Taiwan history studies display again the advantages for developing historical GIS. With modern technology, over 25 sets of basic topographic maps of colonial Taiwan have been made. In other words, these maps have provided accurate references for the 2-dimensional coordinate of every point, line and area on the timeline. More fortunately, thanks to the National Digital Archives Program in recent years, historical maps are collected by various research institutions which have even been digitized in grid form or vector form. Base on those graphic data, the historically correct unit area boundaries in colonial period have been established. Even the location of historical address could be accurately known. The point-based data can be mapped out by the application of historical cadastral maps with GIS.

3. GIS for Historical Study of Medicine and Disease

Then, what good is GIS as a tool for historical study of medicine and disease? In fact, GIS has become an indispensable method for analyzing the spatial model and control of diseases in the areas of public health and epidemiology nowadays. In terms of methodology, GIS assists epidemiological studies in the following process: “Representation” (making hypotheses, collecting related information and presenting information in appropriate thematic maps), ”Analysis” (analyzing neighborhood relationships and regional differences), “Evaluation” (inferring potential causes and diffusion model of diseases, forecasting the risk of a particular place, or evaluating potential impacts of health policies) and “Decision” (making health decisions or establishing medical institutions in the most appropriate spot)”. To historians, though they are unfamiliar with evaluation and decision, the convenience that GIS brings to historical studies is unquestionable. That is, GIS presents the omnipresent spatial information in history, thus making historians concentrating on time dimension consider the spatial factors inherited in historical events.

To historians, representation with GIS has at least three meanings. First, just the spatialization of qualitative or quantitative materials alone allows historians to ask more questions that have been overlooked. Figure 1 shows the results of spatialization of the said endemic disease report of 1898. Text in the report describes the variety of endemic diseases that public physicians saw in towns/villages. With the help of GIS, we can map out the exact locations of these public dispensaries. Besides the status of endemic diseases, Figure 1 also provides information concerning the dispatching network of public physicians. With such information, we can understand the places that the colonial government considered as important infection control areas in the beginning of colonization. On the other hand, as shown in the appointment and dismissal archives of public physicians, the movement of government physicians was very frequent in the beginning of colonization. Some resigned even in less than a year. The representation of the public dispensaries can help historians explore geographical factors affecting the frequent movements in some areas.

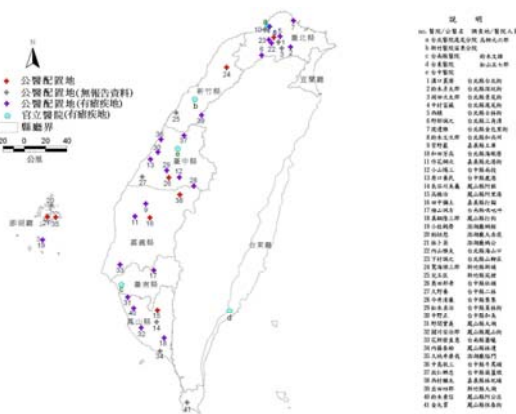


Figure 1. Distribution of public dispensaries in 1898



Figure 2. Overlaying map of demolished building in 1913 to modern road maps

Second, GIS can overlay maps of different themes and different periods. By presenting past and present maps with the overlaying feature of GIS, historians can find out the modern location of the scene of a historical event or a disappeared historical place for a field study. Taking the bubonic plague as an example again, the Taiwan Sōtokufu began a full-scale anti-plague action in 1902. In addition to mobilizing citizens to catch rats and mice, clean and disinfect the environment thoroughly, the colonial government launched an injunction to demolish old-style buildings, which were considered as favorable for rats and mice to nest and hide. As Pu-a-ka Street in Chiayi County was believed to be the prime plague zone,

nearly 2000 buildings were demolished. Records of most demolished buildings are maintained. As the cadastral number of these buildings is recorded, we can accurately map out the exact location of every demolished building with the cadastral maps. This way, we can explore how the Japanese to reform a “pre-modern” streets into a “civilized” one through the anti-plague policy. Furthermore, a map in 1912 showed when the Japanese demolished “unsanitary buildings” in different areas. After overlaying these maps to modern road maps as shown in Figure 2, we can confirm the locations of these reformed buildings for onsite survey.

Third, GIS can help historians to re-present past space “from nothing”. In the absence of historical materials, it is necessary for historians to conduct a field study to collect data. For example, temples can be considered as a physical representation of diseases in Taiwan in the past. Temples worshipping the god of plague and god of smallpox in different parts of Taiwan reveal the spatial characteristics of disease to a certain extent. If historians use GPS on field trips to record these locations of ancient temples, GIS can display the distribution of these temples to provide evidence for the spatial distribution of plagues in history.

In addition to representation, GIS also inspire thinking and reinforce the reasonability of inferences to prove the interpretation of history. In a study concerning malaria, the author examined malaria in colonial Taiwan as a 'developo-genic disease', from the viewpoint of environmental history. GIS was used as a tool to infer the extent to which economic development was linked to the incidence of malaria. In the Meiji period, malaria was defined as the “national enemy” under the slogans fukoko kyohei (rich nation and strong army) and shokusan kogyo (nurturing and stimulating domestic industrial development). And malaria was thought to be a by-product of the intrinsically hostile environment in Taiwan by Japanese colonizer. However, based on modern malaria studies, the author believes that water resource development and the spread of malaria are interrelated, and thus conducted a study based on the Chianan Irrigation System, the largest in Taiwan during the colonial period. The construction of the irrigation system began its construction in 1921 and was in full service in 1930 to improve the rain-fed paddy fields in Dongshih, Sinying, Zhengwen, Sinfeng and Sinhua districts in Tainan county. The irrigation canal changed the agriculture from beans and sweet potatoes into rice and sugar canes. Figure 3 indicates that the malaria death rate increases rapidly in districts with irrigation improvement after the completion of the Chianan Irrigation System. GIS map has helped to strengthen the reasonability of the hypothesis on the interrelations between malaria and irrigation development, thus allowing the author to verify the cause-effect relationship of both factors with more historical materials. From a comprehensive examination of statistics for illness and death, it was possible to indicate the likelihood of a close relationship of cause and effect between economic development and malaria.

GIS also help reinforce the interpretation of history. In 1911, the the Taiwan Sōtokufu convened a special meeting to decide the direction of malaria control and a series of laws were promulgated in 1913. The laws gave the Governor-General and local commissioner the right to create anti-malaria districts. The local police and a local self-policing system called the hoko were used to carry out ”human approach” to malaria control in these districts. Policemen and headmen of hoko were to round up residents and visitors and force them to take blood tests. Anyone whose blood was found to carry plasmodium was to take quinine for 18 days in the presence of a policeman. Although the human approach continued to be implemented until the end of the colonial period, it was never widely employed. The size of the population that accepted blood tests had never exceeded 10% of the total population in

Taiwan. Figure 4 shows the anti-malaria districts and malaria mortality rate maps overlaid with GIS. The dots represent the distribution of anti-malaria districts respectively in the 1930s where the human approach was practiced. The shaded areas show different levels of malaria mortality in each district. As can be seen, those focused control areas do not necessarily overlap with the areas with high malaria death rate. This indicates that the colonial government's interest in the human approach was wedded to the development of natural resources, rather than to considerations of relieving the suffering of victims of the disease, or to attempts to extend its control over the people of Taiwan.

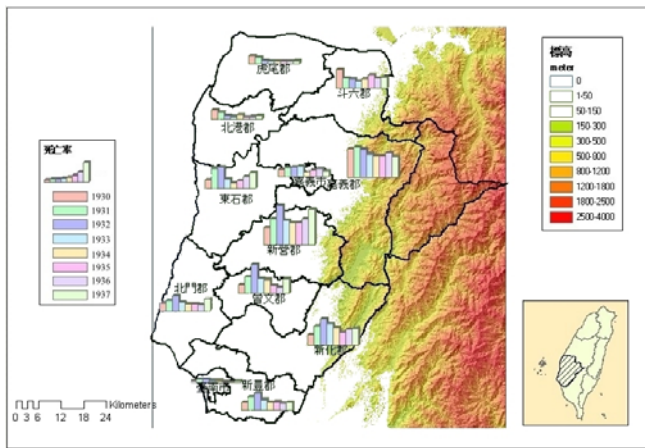


Figure 3. Malaria mortality rates in Tainan county (1931-1937)

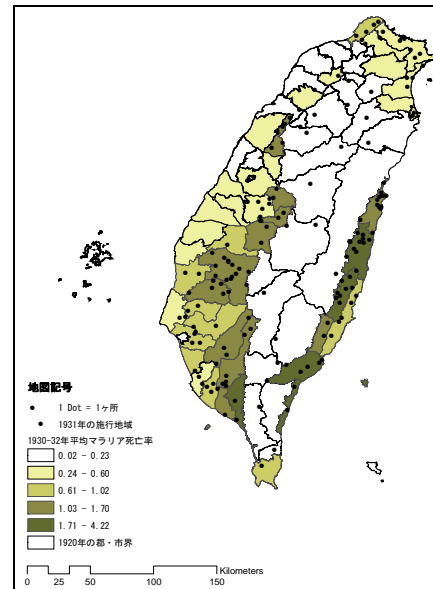


Figure 4. Anti-malaria districts and malaria mortality rates in 1930s

4. Conclusion

This paper is an example of exploring the possibility to apply GIS in the historical study of medicine and disease in colonial Taiwan. History studies in Taiwan display the advantages for developing historical GIS because of abundant basic topographic maps and related historical materials in colonial period.

Although the above examples employed only the basic mapping and overlaying functions of GIS, they have proven that GIS can help historical study of medicine and disease and help researcher to ask new questions in history based on old historical materials. GIS is also an effective tool to reinforce inferences and interpret history. Nonetheless, GIS has more powerful spatial analysis functions, which are very important to natural sciences are rarely used in history. These applications are waiting for future development.

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