INTERNATIONAL POPULATION MOVEMENTS AND PUBLIC HEALTH IN THE MEKONG REGION: AN OVERVIEW OF SOME ISSUES CONCERNING MAPPING

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Abstract. Geographical Information Systems (GIS) have many important applications in local, regional and global situation analysis, especially in relation to planning and implementation thereof. The complex issues involved in population movement between neighboring countries offer a good example of the assistance that GIS applications can provide to transborder public health planning. The Greater Mekong Subregion (GMS) involves 6 countries, among which greatly increased population movement is occurring for a variety of reasons. This movement carries with it high risks of disease dispersal and thus presents a major challenge to disease control. This paper addresses the questions of sources, access and presentation of a wide variety of data that is needed by planners to develop more appropriate cooperative approaches to public health management in the GMS, with the main focus on contributions from mapping.

INTRODUCTION

Much of rural public health planning focuses on settled village communities, whereas in reality large segments of populations in many countries are highly mobile, presenting a quite different set of definable problems. This article will describe and discuss the relationship between movements of people across international land borders and public health concerns - particularly disease spread - in the Greater Mekong River Subregion (GMS) in Southeast Asia. For purposes of this paper, the GMS consists of 6 countries: Thailand; Lao People's Democratic Republic (Lao PDR); Myanmar; Cambodia; Vietnam; and the People's Republic of China. In the case of China, the paper will cover only Yunnan Province. The Mekong River (called the Lancang Jiang in China) runs through or along the borders of all 6 countries; it is ~4,800 km long, originating in the mountains of Qinghai Province and Xizang Autonomous Region (Tibet) and ending in the delta on the southern coastline of Vietnam.

This paper only concerns land-crossing points along national borders. A land-crossing point can include a border running along a river and does not need to be an official border crossing point as defined by a national government.

The paper also focuses on geographical issues in the analysis of population movements and public health concerns, particularly disease spread. Beyond including maps of the border regions listed above, the paper examines how maps can be a useful tool for analysis, policy-making by national governments, and the design and implementation of programs to prevent or reduce public health problems. In particular, the paper explores the advantages (and potential pitfalls) of using computers to associate data directly with geographical areas; *ie* the technics behind Geographical Information System (GIS) technology and thus serves as a background for specific GIS analyses in the region.

GENERAL ISSUES CONCERNING INTERNATIONAL POPULATION MOVEMENTS IN THE GREATER MEKONG SUBREGION

International migration has become and will remain an important phenomenon in the Greater Mekong Subregion. Thus, all the GMS countries are targets for a wide variety of changes that will directly affect the desire, need and motivation to migrate across an international border. The planned investments in the GMS - by private firms, governments, and international organizations - cover a broad array of activities, especially transportation infrastructure, natural resource extraction, tourism, communications infrastructure, energy production, manufacturing, commerce and trade. The existing

investments in these activities have already created vast income disparities and business opportunities that fuel much of the international migration within the GMS. New forms of trade, tourism, and employment will continue to emerge, leading to new types of population movements that will grow more consequential than traditional forms of movement (*eg* migration based on ethnic/family ties).

Second, the trend in the GMS is towards increasing economic openness. One facet of this openness is the willingness of governments to use official land border checkpoints to promote trade, the movement of goods, and tourism. In the past few years, every GMS country has either opened new land border checkpoints or implemented regulations to ease the movement of people and goods across national borders. When the volume of migration and trade increases, local economies tend to expand, thereby creating vested interests among those benefiting from the growth. Closing a border checkpoint may require considerable political will or power; once closed, pressure will always exist to re-open it.

Third, various governments of GMS countries have enhanced the infrastructure at crossing points during the past few years and most of them have projects underway to make further improvements. For example, Thailand and the Lao PDR opened the first "Friendship Bridge" over the Mekong River at Nong Khai - Vientiane in April 1994, followed by the second "Friendship Bridge" over the Moei River (Thai - Myanmar border) at Mae Sot - Myawaddy in August 1997. In addition, governments are improving transportation infrastructure between border areas and internal regions of their countries. The Asian Development Bank is leading efforts to designate the transportation infrastructure priorities in the GMS and to facilitate funding, though it has achieved little so far.

Lastly, migration has become a critical element of a number of GMS economies, generating a heavy reliance on migrants in some areas. Until its recent economic crisis, Thailand hosted roughly one million migrant workers from Myanmar, Cambodia and Lao PDR, employed as unskilled labor in many sectors of the Thai economy. Chinese migrants reportedly exercise major economic influence in northern Myanmar, especially trade between China and Myanmar. The same is evidently true to some extent in northern Lao PDR. Vietnamese women populate many of Cambodia's lucrative commercial sex establishments. When migrants make these sorts of inroads, it is very difficult to limit their influence.

PUBLIC HEALTH CONCERNS AND POPULATION MOVEMENT IN THE GREATER MEKONG SUBREGION

The countries comprising the GMS have differing economic/health indices and different public health organizational structures. In all six countries, the spectrum of communicable and non-communicable diseases is qualitatively similar, however the incidence of particular diseases varies considerably, as does the extent and effectiveness of disease control programs. In regional terms it is the patterns of communicable diseases which are of greatest importance, since it is in this context that sharing of borders most clearly invokes the need to consider the mutual impact of the effectiveness of efforts and investment in communicable disease management at international borders.

A number of specific communicable diseases can be readily dispersed from one country to another by mobile populations, so altering the patterns of disease incidence and disease management. In this category the following examples can be considered to be of particular importance in the GMS at this time:

- multi-drug resistant falciparum malaria
- sexually transmitted diseases
- HIV/AIDS
- tuberculosis
- severe diarrhea due to a number of different agents
- dengue hemorrhagic fever

While each of these involves multiple factors in disease spread, the movement of infected individuals internally and between countries in the region contributes significantly to changing epidemiological patterns and complicates control planning and implementation.

Another major consideration is the matter of who is responsible for patient management and disease control: the country of origin or the country to which the mobile populations migrate. The infectious reservoirs in the travelling populations are a reality and these contribute to dissemination of infection in the recipient country, so affecting control strategy and associated economics. Additionally there is the matter of cost, as often the migrants

cannot pay for treatment in the private sector.

The first step in developing concerted approaches to the public health implications of inter-country disease flow is to identify the extent and nature of the population flow, in a context that allows planners to develop improved information systems and to develop more appropriate infrastructure to handle it. Mapping technology offers one helpful ingredient in this complex scenario.

BORDER MAPPING AND RELATED INFORMATION

Pertinent data have been derived from a variety of official and unofficial sources to provide limited information about various land borders in the GMS, along with maps of these borders. These maps have utilized regional map profiles developed by the Australian Center of the Asian Spatial Information and Analysis Network (ACASIAN) (Stern and Crissman, 1998). The maps were created using MapInfo, one of many commercially-available GIS software packages.The borders covered are as follows:

- Thailand – Lao PDR
- Thailand – Cambodia
- Thailand – Myanmar
- Cambodia – Vietnam
- Yunnan – Lao PDR
- Lao PDR – Vietnam
- Myanmar – Yunnan
- Yunnan/Guangxi – Vietnam

Due to a paucity of readily accessible information, relatively little population movement, and limited infrastructure, this paper will not cover two borders: Lao PDR – Cambodia and Myanmar – Lao PDR.

The maps have some deficiencies. First, they do not show all geographical features readers might find significant (*eg* mountain ranges, forests). Second, they do not show all major infrastructure. Third, they do not show every regularly-used border crossing point. Cataloging all these crossing points would be a major task and marking them all would leave the maps almost unreadable. In addition, many of these crossing points are unofficial and publicizing their locations may endanger the migrants who use them. Lastly, the rivers, transportation infrastructure, *etc* are not always exactly to scale or shown in their entirety.

The borders shown are not always authoritative in their entirety. A number of countries have unresolved border disputes and the borders in this paper should not be taken as finally accepted legal boundaries.

Statistics presented in this section – both the official and unofficial figures – should be taken cautiously. The sources of these statistics often do not describe how they obtained or collected the figures. There are also few indications of whether the figures of border crossings, trade, *etc* are underestimated or overestimated. The figures for population movements sometimes fail to distinguish clearly between stocks of people (*eg* the number of Myanmar labor migrants in Thailand at the end of 1996) and flows of people (*eg* the number of Myanmar labor migrants who crossed the border into Thailand at some moment during 1996).

1. Thailand - Lao PDR

The Thailand - Lao PDR border (Fig 1) is 1,754 km long (CIA, 1996), divided along much of its length by the Mekong River. The only bridge across the Mekong River at the Thailand - Lao PDR border is the Thai-Lao Friendship Bridge at Nong Khai - Vientiane, opened in April 1994. Though there are many official checkpoints along the border, undocumented crossings are common. This is due in part to the strong presence of many population groups who have ethnic or kinship ties that

Fig 1–Thailand - Lao PDR border area.

span the border. In addition, there are deep linguistic and religious links between the people of Lao PDR and the people of northeastern Thailand.

Population movements are closely linked to Thai-Lao border trade and the presence of Lao migrant workers in Thailand. The border trade mainly involves Thailand exporting manufactured and consumer goods and Lao PDR exporting timber and some agricultural products. The many markets along the border witness a steady stream of border crossings, often Laotians entering Thailand to purchase consumer goods which are unavailable or more expensive in Lao PDR. Regarding labor migration, many Lao people take temporary jobs in Thailand, sometimes seasonal agricultural labor. Other Lao are day laborers, entering in the mornings and returning home at night. Some young Laotians seek apprenticeships in various vocations. Young Laotians women may end up as factory workers, maids or commercial sex workers. Nobody knows how many Laotians work in Thailand but as of 5 June 1997, 11,594 Lao had received work permits under a 1996 Thai government policy to register illegal migrant workers.

Lao people will sometimes come to Thailand for health care because Thailand has much better hospitals and clinics. There are reports that a number of Thai hospitals at border areas are running deficits because they care for Laotians who cannot pay the full costs of the services provided. In 1995, for example, Loei Hospital spent 1.2 million baht to provide medical care for poor Lao patients. From November 1994 through March 1995, Nan Hospital had 1.8 million baht of unpaid medical bills from Lao patients (Anonymous, 1996b). The Ministries of Health in Lao PDR and Thailand agreed in September 1996 to establish a joint committee on public health to address the spread of infectious diseases along the Thai-Lao border (Anonymous, 1996c). It is unknown what this committee has accomplished.

2. Thailand - Cambodia

The Thailand-Cambodia border (Fig 2) is 503 km long (CIA, 1996), dominated by small mountain ranges. The Thai military maintains a strong presence along the border and restricts access to certain areas. With the exception of the Aranyaprathet - Poipet checkpoint, all official border crossings allow only Thai and Cambodian citizens to cross.

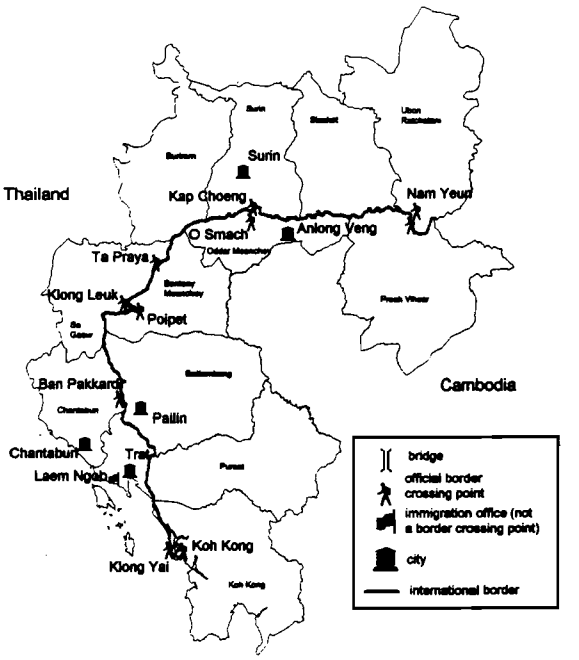


Fig 2–Thailand - Cambodia border area.

There is an extensive cross-border trade (legal and illegal) that leads to substantial cross-border movements, mainly Cambodians entering Thailand. The large numbers of Cambodian migrant workers in Thailand are mostly illegal, either because they enter Thailand illegally or because they enter legally using a border pass and stay beyond the one-day limit of the pass. Many work in Thai provinces not at the Thai-Cambodia border. As of 5 June 1996, 25,568 Cambodians had received work permits under a 1996 Thai government policy to register illegal migrant workers. Cambodians tend to work near the border or in Bangkok, primarily in agricultural labor, woodworking (particularly making furniture), construction work, and at shipyards. Some migrants are beggars in Thailand, under the control of Thai gangs who help the migrants with transportation and housing.

Recent armed fighting between political factions in Cambodia has led thousands of Cambodians to flee into Thailand seeking refuge from the conflict. As of mid-September 1997, approximately 22,000 Cambodian persons fleeing conflict were in Kap Choeng, Surin Province and as of 22 October 1997, 40,030 Cambodians were in Trat (Waewkhaihong, 1997). The Thai Ministry of Interior supervises the camps where most of the Cambodians stay.

Some Cambodians seek health care in Thailand, though they may not have enough money to cover the costs of the treatment. At the Khlong Yai District Hospital during January - May 1997, there were 2,831 in-patients of which 1,213 were Cambodians and 23,340 out-patients of which 10,457 were Cambodians (Anonymous, 1997b). The head of the Kap Choeng Hospital in Surin Province believes that better health provision for disease prevention in Cambodia will help Thailand. For example, the hospital recorded 7 cases of malaria in August 1996 and 70 cases of malaria in August 1997, an increase attributed to a higher incidence of malaria among Cambodian migrants. The Surin health authorities were cooperating with Cambodian authorities on prevention and education programs about one month before the internal hostilities in Cambodia arose (Anonymous, 1997b).

3. Thailand - Myanmar

The Thailand-Myanmar border (Fig 3) is 1,800 km long (CIA, 1996). Thai and Myanmar citizens normally only need border passes to cross at Thai-Myanmar checkpoints. At the Mae Sai - Tha Che Leik and Ranong - Kawthaung crossings, other nationalities can cross using a passport. The majority of crossings consist of Burmese entering Thailand.

The significant border trade in some areas spurs substantial cross-border population movement. The Thai immigration authorities in Mae Sai estimate that Mae Sai generates roughly 200 million baht of business per weekend. An official from the Tak Chamber of Commerce estimated that cross-border trade at Mae Sot - Myawaddy was worth 300 million baht per month just before the "Thai-Myanmar Friendship Bridge" opened on 15 August 1997 (Hutasingh and Kasem, 1997). However, the major form of movement is labor migration and it is estmated that at any time during 1997, Thailand hosted approximately one million labor migrants, the majority of whom entered and/or worked illegally. As a result of recent economic difficulties, the Thai authorities currently have a policy to repatriate illegal migrant workers, though the success of this effort remains unknown. Myanmar labor migrants work in many economic sectors, particularly the fisheries industry, construction, and agriculture. In addition, one source estimates that Thailand has a minimum of 60,000 foreign women and girls in the sex trade, the majority of whom are from Myanmar (Archavanitkul and Gertsawang, 1997).

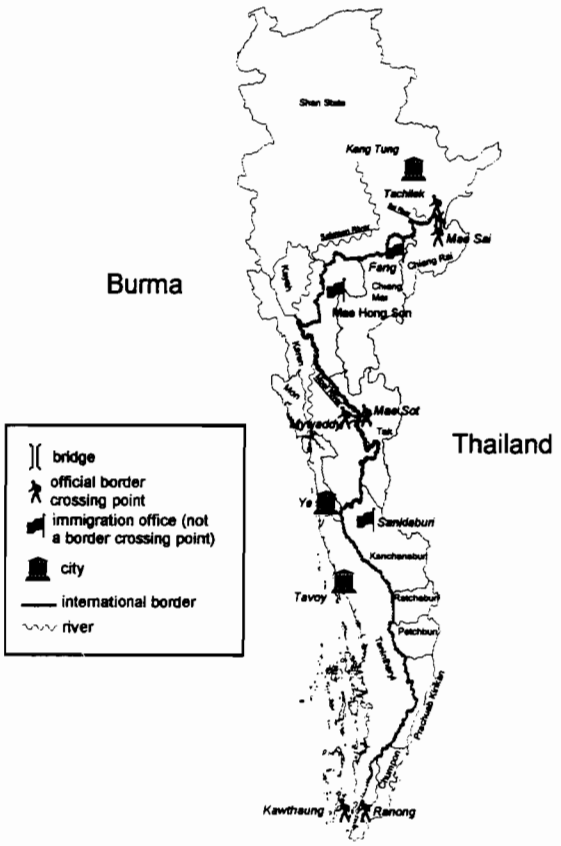


Fig 3–Thailand - Burma/Myanmar border area.

An estimated 100,000 - 120,000 members of Myanmar's ethnic minority groups stay in camps along the Thai-Myanmar border and receive assistance from international aid organizations. The majority are Karen but there are also Karenni and Mon. They are displaced persons, not having received formal refugee status from the Thai government and the United Nations High Commission on Refugees (UNHCR). There may also be some Shan (Tai Yai) displaced persons, though they are not in camps because the Thai government does not allow the formation of such camps for the Shan. All these minority groups fear the human rights abuses they will face if they return to Myanmar, including forced labor, forced relocations, rape, torture and arrest, and extrajudicial killings.

Some government health officials in Thailand report that significant numbers of Myanmar migrants carry communicable diseases like malaria,

filariasis and polio. In 1996, an estimated 5% of the 500,000 Myanmar thought then to be living in Thailand had filariasis (Anonymous, 1996a). Mae Sot Hospital reported that during 1992-1995, the incidence of malaria among Myanmar migrants tested was double that of the Thai population in the area. The Ministry of Public Health collected data on the health of migrant workers who registered with the Thai authorities as part of a 1996 Thai government policy. The health check was a requirement of the registration process. According to one report, 843 had syphilis, 514 had tuberculosis, 357 had filariasis and 58 had malaria (Vanaspong, 1997). It is unclear if Myanmar migrants have rates of disease higher than local Thai populations. A number of Thai hospitals at border areas are running deficits because they care for Myanmar who cannot pay the full costs of the services provided. In 1995, Ranong Hospital paid 1.3 million baht for medical costs of Myanmar patients who were unable to afford their treatment (Anonymous, 1996b).

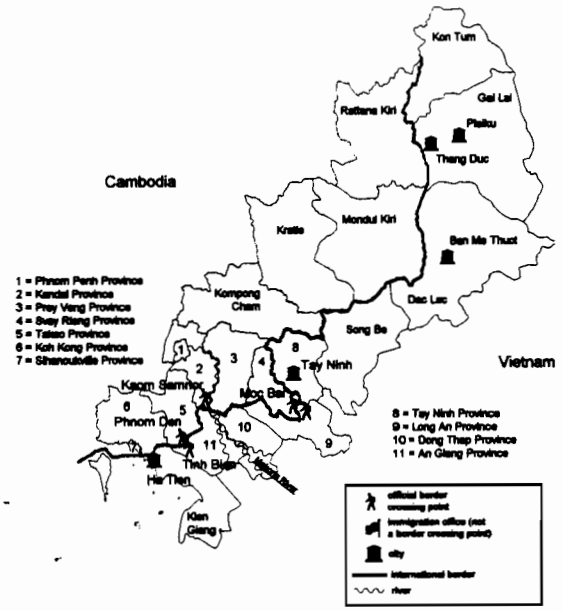


Fig 4–Cambodia - Vietnam border area.

4. Cambodia - Vietnam

The Cambodia-Vietnam border (Fig 4) is 1,228 km long (CIA, 1996). There are centuries-old and ongoing claims and counterclaims by Vietnam and Cambodia concerning the border, including many periods of armed conflict (Loan and Binh, 1996). Cambodia enacted an immigration law in August 1994 aimed at discouraging immigration from Vietnam and not guaranteeing Cambodian citizenship to Vietnamese who have lived in Cambodia for many years (Anonymous, 1994). Many Vietnamese in Cambodia are fluent in Khmer, have identity cards issued by previous Cambodian governments, and have spent most of their lives in Cambodia (Minority Rights Group International, 1993).

There is trade and movements of traders between Cambodia and Vietnam, though the full extent remains unknown. There are some Vietnamese laborers in Cambodia but the best-known groups of Vietnamese labor migrants in Cambodia are commercial sex workers who number in the hundreds, possibly thousands (Hien *et al,* 1997). A May 1997 report found that half the Vietnamese women trafficked into Cambodia were aged 11-22 years (Cambodian Women's Development Agency, 1997).

5. Lao PDR - Yunnan

The Lao PDR - China border (Fig 5) is 423 km long with Yunnan as the only Chinese province bordering the Lao PDR. During 1995, there were 144,000 crossings at the main official border checkpoint near Mengla, Yunnan (Provincial Governor's Office, Yunnan, 1996).

Trade between Yunnan and Lao PDR sometimes follows a route encompassing Mengla, Udomsay, Pakbeng and Huaysai. Chinese manufactured goods are also sent to Luang Prabang and Vientiane (Walker, 1995). During 1995, 32,000 tons of goods worth 280 million yuan passed through Mengla (Provincial Governor's Office, Yunnan, 1996). As part of the trading process, some Chinese enter northern Lao PDR, even traveling as far as the Thai-Lao border to enter Thailand. The extent of other forms of population movement, particularly labor migration, is unknown.

6. Lao PDR - Vietnam

The Lao - Vietnam border (Fig 6) is 2,130 km long (CIA, 1996). While there is a great deal of undocumented movement across the border, the most active official checkpoint appears to be Daen Savanh in Savannaket Province, Lao PDR. According to official figures, in 1996-97 a total of 66,518 persons (29,613 female) crossed into Lao PDR at Daen Savanh. During the same period, a total of 67,707 persons (30,738 female) crossed from Daen Savanh, Savannaket Province, Lao PDR

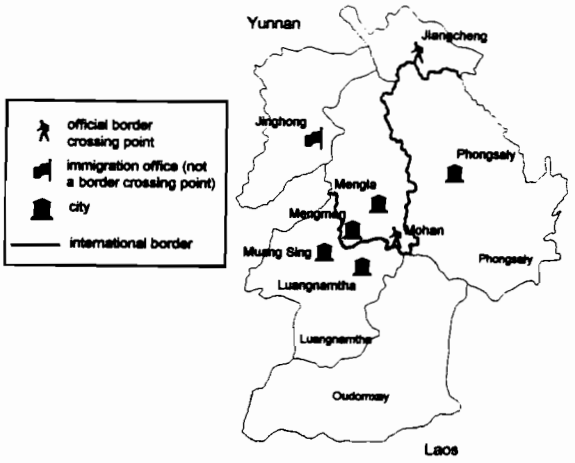


Fig 5–Yunnan Province, China PRC - Lao PDR border area.

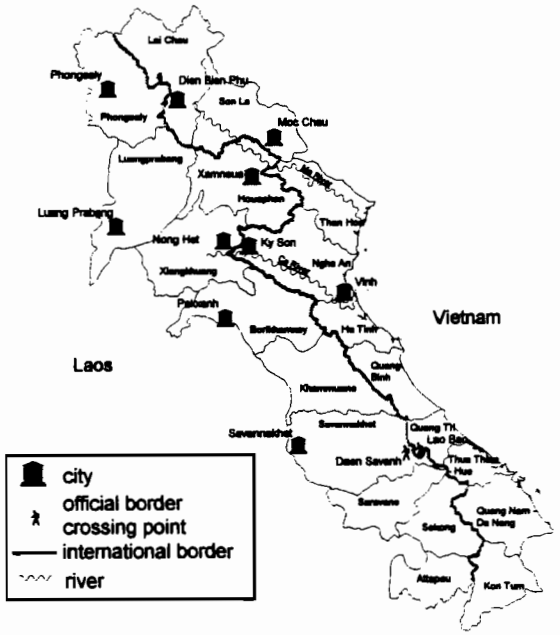


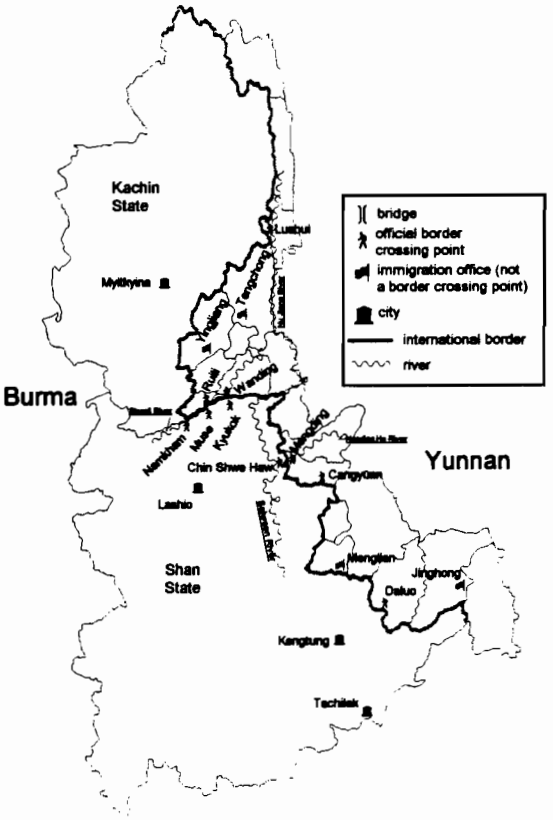
Fig 6–Lao PDR - Vietnam border area.

into Vietnam. 95% of the people who cross are Vietnamese (Care International, Lao PDR, 1998).

Vietnamese traders come to Lao PDR in search of forest products and animals for medicine shops in Vietnam or China (Evans, 1993). Others come to sell consumer items like kitchen utensils and clothing. Vietnamese business people control the major businesses in Pakse, Champassak Province, Lao PDR (Chaipipat, 1997). According to one estimate, there are 3,000 Vietnamese labor migrants living in Lao PDR, average earnings approximately US$100 per month. According to official figures, approximately 5,000 Vietnamese travel to Lao PDR for temporary work each year. Vietnamese account for 90% of all foreign workers in Lao PDR and most work in the construction and transport sectors. There are no reports of Lao going to work in Vietnam.

7. Yunnan - Myanmar

The Myanmar-China border (Fig 7) is 2,185 km long (CIA, 1996), with a wide array of geographical features and relatively little transportation infrastructure. Millions of people live near the border areas and extensive numbers of people cross regularly at official and unofficial crossing points. For example, during 1995, there were 1,090,000 crossings at Wanding and 2,737,000 crossings at Ruili, two of the most active official checkpoints (Provincial Governor's Office, Yunnan, 1996).



Fig–7–Burma/Myanmar - Yunnan Province, China border area.

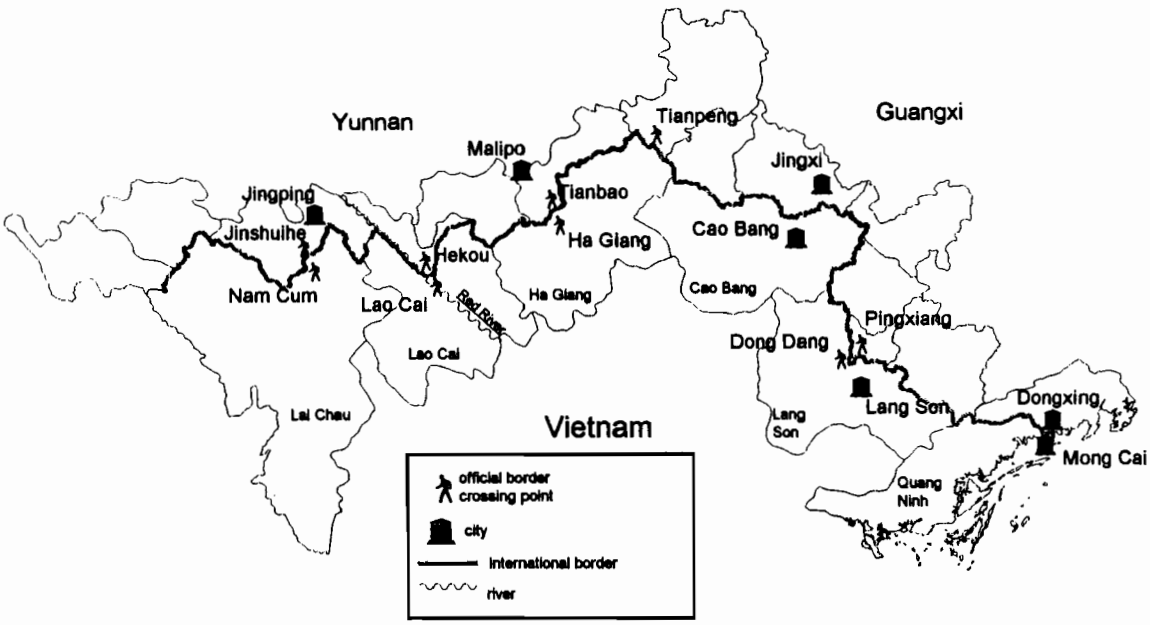


Fig 8–Yunnan Province and Guangxi Province, China PRC - Vietnam border area.

Myanmar and China "regularized" their trade (*ie* signed official agreements) in October 1988. According to one report, Myanmar exports mainly agricultural products and fish products to China, while it imports mainly agricultural machinery, tools, and electrical goods from China (Roberts, 1998). Recent economic problems in Asia have adversely affected Myanmar-China border trade, especially because of the fall in the Myanmar currency (kyat) relative to the Chinese yuan. There is also some labor migration between the two countries in both directions. Chinese labor teams have been employed for some projects. According to a trader in Muse, before the onset of the Asian economic crisis in mid-1997 Ruili had at least 2,000 Myanmar people working in restaurants, selling jade, or working as commercial sex workers. As of early 1998, there were fewer than 700 such Myanmar people in Ruili (Roberts, 1998). In addition, women and girls from Yunnan pass through Myanmar on the way to Thailand and other destinations where they work as commercial sex workers. Some are deceived by gangs who claim they will take the women to travel or to work in stores, factories, *etc.* Others come voluntarily. They often pass through Kengtung (Mahatnobon, 1996).

8. Yunnan - Vietnam

The Vietnam-China border is 1,281 km long (CIA, 1996), involving both Yunnan and Guangxi Provinces (Fig 8). The most important official border checkpoints between Yunnan and Vietnam are Jinshuihe - Nam Cum, Hekou - Lao Cai, and Tianbao - Ha Giang. According to official data, during 1995, there were 124,000 crossings at Jinshuihe and 97,000 crossings at Tianbao (Provincial Governor's Office, Yunnan, 1996).

In November 1988, Vietnam issued a Directive on Border Trade between Vietnam and China. This Directive officially opened its 6 provinces on the border to cross-border trade and permitted visits across the border in both directions (Womack, 1994). The official figure for trade volume at Hekou was US$60 million per year in 1995. Widespread smuggling makes this figure a significant underestimate of the actual trade. In 1995, China exported bulk minerals, rubber, and a wide variety of manufactured goods. Vietnam exported timber, lacquerware, and agricultural products. The illegal trade also included drugs and endangered animals (Mellor, 1996). During 1995, 9,870 tons of goods worth 66.3 million yuan passed through Jinshuihe and

21,000 tons of goods worth 128 million yuan passed through Tianbao (Provincial Governor's Office, Yunnan, 1996). While labor migration is likely very small across the Yunnan - Vietnam border, the Vietnam Women's Union has stated that at least 12,000 Vietnamese women have been sold into Chinese brothels or forced into marriages with Chinese men since 1991. The women are mainly from 12 northern Vietnamese provinces near the Chinese border. Some women married Chinese men in hopes of escaping poverty in Vietnam (Anonymous, 1997a).

DISCUSSION

Population movement challenges to public health operations

Some broad trends and concerns regarding population movements and public health can be discerned despite the paucity of data:

a. Vulnerability of migrants

Since much of the GMS cross-border migration is illegal and/or undocumented, migrants are potential victims of various human rights abuses. They can be victims in their own countries or when they are abroad. Given the scale of cross-border migration and the extent of land borders in the GMS, it is evident that hundreds of thousands of migrants endure an array of problems such as:

- unsafe working conditions
- lower pay than local people performing similar work
- constant fear of arrest and a general lack of basic legal rights
- lack of access to formal educational facilities
- inadequate health care
- deception into prostitution

The high mobility of many cross-border migrants in the GMS and the degree of corruption among government officials in many areas with large concentrations of migrants makes addressing these sorts of problems very difficult. These problems can create a host of obstacles for public health officials:

- lack of regular access to migrant populations, particularly those engaged in illegal activities
- inability to convince employers of labor migrants to improve working conditions
- little or no money available in migrant communities to make health care and prevention programs sustainable without substantial outside funding
- difficulty coordinating with government officials from other agencies
- trouble implementing long-term programs when migrants do not stay in certain areas for very short periods of time or do not return to certain areas regularly (especially for follow-up treatment, education, or survey work)

b. Lack of information

Despite the millions of migrants crossing the GMS land borders annually, very little academic research on population movements in the region is available, particularly in English. Stern and Crissman (1998) indicate the fragmented and incomplete picture of international migration in the GMS. Without more detailed information, all parties attempting to prevent and/or alleviate public health problems will not succeed except in limited geographic areas or for very specific public health predicaments (*eg* a distinct vector for a certain disease).

c. Urbanization

A common phenomenon in internal migration is the movement from rural to urban areas. These rural-to-urban movements are also an important facet of international cross-border migration in the GMS. Though many migrants stay in border areas, many travel farther into the receiving countries to seek jobs or conduct business. Typically, they head to major urban centers because these areas offer employment and business opportunities unavailable in many border areas. As noted for Myanmar, Keng Tung and Mandalay attract large numbers of Chinese from Yunnan. Vietnamese prostitutes make up a significant portion of the prostitutes in Phnom Penh brothels, possibly as high as 30%. According to the Thai Ministry of Labor, Bangkok hosts the largest number of illegal labor migrants.

From a public health perspective, a large concentration of migrants in an urban center has potential advantages and disadvantages. The main advantage is the geographic proximity of the migrants, instead of a highly dispersed migrant population. It may be easier to organize public health

programs in areas with large migrant populations and for the programs to reach a greater number of people. On the other hand such large groups of migrants can strain limited public health resources.

d. National policies versus local realities

There are often major gaps between the terms of national policies governing migration and what actually happens at border areas. First, national policies may not account for many vested interests in border areas. Thai law requires people from neighboring countries to cross at official immigration checkpoints and to have a passport or border pass. However, this does not stop thousands of Myanmar, Lao, and Cambodians from simply walking or taking a boat across the border at a variety of places with no government officials in sight. Second, corruption among officials concerned with population movements is well known, despite national pronouncements to the contrary. Smuggling of goods to avoid taxation, the drug trade, illegal log exports, and the trafficking of girls and women for the sex trade could not occur without substantial bribes and payoffs. Third, national policies often ignore the strong historical links at border areas that impel migration. The often arbitrary creation of national borders can split communities with strong kinship and other ties, where national borders are essentially lines that show up on maps but not on the ground. Since the borders do not reflect the need for these communities to remain in contact, the members of these communities often visit one another illegally by crossing without the proper documentation.

From the public health perspective, the key lesson emerging from the paragraph above is that implementing agencies must understand the dynamics of local areas before initiating any sorts of programs. Such a lack of understanding can lead to wasted resources and in some cases harmful results for migrants and others.

e. Population mobility is not only bilateral

When discussing cross-border migration, analysts tend to view the movements bilaterally, as though they involve only two countries. One growing pattern of cross-border migration in the GMS is that movements span 3, 4 or more countries. There is now a small but well-established flow of labor migrants from Myanmar into Thailand and then into Malaysia. Traders from Yunnan move goods across Lao PDR to the Thai-Lao border at Chiang Khong and Chiang Saen. Since the 1980s, women from Yunnan have entered Myanmar then passed into Thailand to work as commercial sex workers.

Beyond the problems facing public health personnel with regard to the high mobility of migrants who move across 3 or more international borders, such movement often means multilateral cooperation between more than two countries. Coordinating efforts between 3 or more countries inevitably adds to the complexity of efforts to address public health difficulties.

Role of maps and geographical information systems

It is common in research publications concerning population movements and/or public health issues to see simple maps showing points of interest and perhaps some data for various countries. The previous section consists of these sorts of maps. Such maps augment the contents of the research to some extent but do not take advantage of the full analytical power of mapping technology to display information in various forms and combinations. This is the main benefit of GIS, a key element of which involves associating data with an computerized representation of a physical space.

As a simple analytical tool, GIS allows the display of a single variable on a map; *eg* the provinces of Vietnam in which the government tested STD patients for HIV seroprevalence in 1995 (see Fig 9). As a more sophisticated tool, GIS enables a person to work with multiple variables, setting the exact conditions to display only the areas of the map that fit those conditions. For example, Fig 10 shows a map of Thailand that highlights only the provinces that fit the following conditions for the year 1991: less than 700 hospital beds, forest area less than 500,000 hectares, and less than 4,000 legally registered labor migrants from Myanmar, Cambodia and Lao PDR. Disregarding questions about the accuracy of the data or the value of seeing a relationship between the variables displayed, the point of including the map is to demonstrate the ability of GIS software to quickly identify the areas that meet the conditions set by the user, a potentially powerful analytical tool.

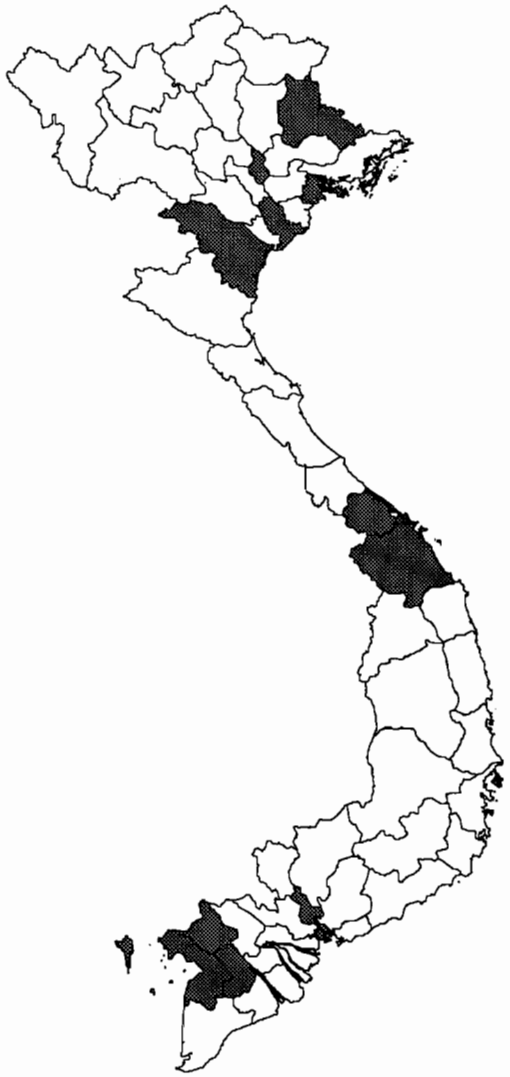


Fig 9–Provinces in Vietnam in which STD patients were tested for HIV prevalence.

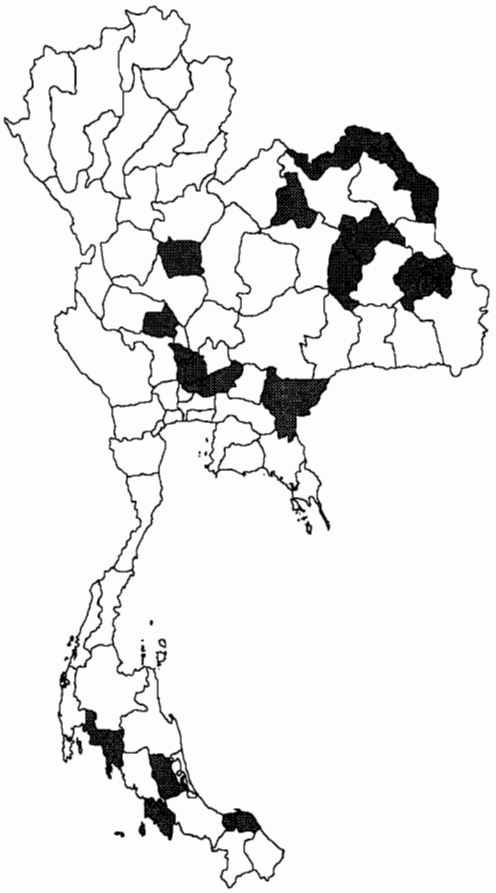


Fig 10–Mapping of Thai provinces satisfying a number of specific health criteria.

If the goal is to understand how a situation has changed over time, a series of maps with information at different time intervals can provide a quick picture of the changes in a way that those unfamiliar with the situation will easily comprehend. A country wishing to have early warning of outbreaks of communicable diseases could develop a system in which information from around the country is stored in a frequently-updated database connected to GIS software. The government officials then use the GIS software to display new maps every time new information arrives, thereby giving a dynamic picture of the situation around the country as changes occur.

With all the advantages GIS offers as a tool for analysis, it has one major potential pitfall. A map is only a useful analytical tool if the data behind it are of good quality. As with charts, graphs, and other sorts of figures that newer statistical software can create with a few clicks of a mouse, GIS software can create some very impressive maps. Yet if the data the maps display are inaccurate or Incomplete, the map can provide an erroneous picture of the situation. In the hands of a decision-maker who does not see the map's faults, the map can become a liability, or in the worst cases cause harm.

As pointed out earlier, the data for populations movements in the GMS are very limited, fragmented, and often inaccurate. Therefore, to make GIS and mapping practical and worthwhile, ana-

lytical tools will require more than just the proper equipment and knowledge of the software. It obliges users to share their existing data, explain the characteristics of these data, and collect new data regularly. It is likely that any major program intended to link databases with GIS technology will spend the minority of its budget on computer equipment/software and training in the use of this equipment/software. The major cost of such large-scale programs concerns efforts to ensure a continuous flow of reliable data. In the Greater Mekong Subregion these efforts require implementing formal coordination between countries, convincing participating agencies to share their data, improving existing systems for public health data collection, and developing new collection programs where key public health data are not yet available.

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