

GREATER MEKONG SUBREGION (GMS): CONTEXT

Abstract. The epidemiology and outcome of malaria control initiatives are affected by a great diversity of factors including environment, economy and politics, to name but a few. Nowhere is this more obvious than in the GMS, where the rapid pace of economic development that has occurred over the past decade has brought with it a raft of changes to environment, employment, transport, communication, and demography and wealth patterns. The GMS, as a subregion, continues to gain increasing political and economic significance and has the potential to become one of the fastest growing regions in the world. While the pace of change is impressive, it has also brought with it new challenges in the fight against malaria. On the one hand, improvement in transport networks such as roads and railways, facilitates increased cross-border trade and development, on the other hand such improvements are likely to result in a massive increase in population movements across borders. As travel becomes easier the numbers of migrant workers moving between areas of high and low transmission, also expands, further increasing the risk of the spread of resistant malaria strains. In addition, the increase in large infrastructure projects such as the construction of dams, as well as agricultural plantations, also potentially lead to changes in vector behavior with unknown consequences for malaria transmission. Effectively addressing the new challenges to malaria control will require renewed commitment, coordination and better collaboration between all sectors from governments and non government organizations in the GMS.

Keywords: Greater Mekong Subregion, malaria control, environment, economy, forest coverage, population density

The Greater Mekong Subregion (GMS) is the region linking the six countries/regions that share the Mekong River:

Kingdom of Cambodia

The Yunnan Province of the People's Republic of China^a

Lao People's Democratic Republic (Lao PDR)

Union of Myanmar

Kingdom of Thailand

Socialist Republic of Viet Nam

The GMS covers 2.6 million km² and has a combined population of around 326 million. The geographical relationship between the countries is shown in Fig 1.

^aThe official Greater Mekong Subregion from a geo-political viewpoint includes the Guangxi Province of the People's Republic of China. That malaria-free province is not included in the Mekong Malaria region.

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ECONOMIC CONTEXT OF MALARIA: GMS, ASEAN AND INTER-COUNTRY RELATIONS

The epidemiology and outcome of malaria control initiatives are affected by a great diversity of factors including environment, economy and politics, to name but a few. Nowhere is this more obvious than in the GMS, where the rapid pace of economic development that has occurred over the past decade has brought with it a raft of changes to environment, employment, transport, communication, and demography and wealth patterns. In order to place these monumental changes within context, it is important to review the history of the GMS, other regional bodies and the current status of progress, before turning to the implications for malaria.

The GMS subregional program of economic cooperation was established in 1992 with assistance from the Asian Development Bank. Over the past two decades, the GMS has gone from strength developing a diversity of new linkages, alliances, and interdependencies in mainland Southeast Asia. Indeed, the GMS is increasingly being perceived as a region rather than a subregion (Wade, 2010). The GMS comprises three economic corridors (Fig 2): East-West Economic Corridor (EWEC), North-South Economic Corridor (NSEC) and the Southern Economic Corridor (SEC). In June 2011, a GMS forum was held in Vientiane, Lao PDR, with GMS member countries, private sector representatives and development partners, to discuss measures to accelerate the development of these corridors. Following this forum, in August of the same year, representatives of the GMS countries met in Cambodia at the 17th GMS Ministerial Conference to review and finalize the GMS Strategic Framework for 2012-2020. More recently, in December 2011, the Regional Cooperation Operations Business Plan for 2012-2014 (RCOBP), which is consistent with the Strategic Framework, was approved and adopted by the member countries. The RCOBP outlines an approach to transforming the GMS transport corridors into economic corridors, which will involve:

... multisector investments, such as urban development in corridor and border towns, integrated area and rural development along corridors, feeder and secondary roads, logistics and multimodal transport, along with a greater emphasis on complementary policy and institutional reforms. This includes development of a regional power market, for which a regional coordination center is being created. In transport and trade facilitation, a USD25 million initiative of the Government of Japan for technical assistance (TA) to modernize customs will augment the work of other development partners active in the area, such as the Australian Agency for International Development. The 4th GMS Summit will also endorse sector strategies included in the Core Agricultural Support Program 2, Core Environment Program—Biodiversity Corridors Conservation Initiative 2, and a refocused tourism sector strategy (ADB, 2009).



Fig 2—GMS Economic Corridors (ADB, 2012).

Thus the GMS as a subregion continues to gain increasing economic and political significance. Indeed the ADB believes that the GMS has the potential to become one of the fastest growing regions globally.

In addition to the GMS, the Association of Southeast Asian Nations (ASEAN) is the other significant political and economic organization for the region. Both ASEAN and the GMS reiterate that the organizations complement, rather than compete, with each other as they share many issues of common interest – such as cross-border trade, investment and security, for example. To ensure common understanding and continuous interaction, ASEAN organized regular high level meetings with Chinese, Japanese and Republic of Korean counterparts (ASEAN3+). A key goal for ASEAN is to transform itself into an economic community (AEC) by 2015 as outlined in the 2008 ASEAN Economic Community Blueprint. The blueprint was developed with the goal of transforming ASEAN into a single market and production base, and making it a highly competitive economic region of equitable economic development, and a region fully integrated into the global economy (ASEAN Secretariat, 2008). In addition, ASEAN is also working on the development of a Master Plan of ASEAN Connectivity in order to enhance regional linkages, integrated production networks; enhance intra-regional trade; attract investments and promote deeper ties among ASEAN people by fostering cultural and historical bonds (Pushpanathan, 2010).

How these two organizations continue to develop and cooperate will have important consequences for the region – and for the management of malaria. The GMS is promoting the region as a single tourist destination and the recently developed ASEAN Tourism Strategic Plan 2011-2015, also acknowledges the substantial benefits of a single tourist visa for facilitation of travel in the region. However the strategy also states that the establishment of such a visa is not likely to occur within the next five years as a result of technology barriers, political issues, concerns of sovereignty and security and the different visa systems in the Member States (ASEAN Secretariat, 2010). Whatever the time frame, it is clear that there will be significant increases in population movements across the GMS and ASEAN countries, with potentially significant implications for the spread of malaria.

Relations between countries

While there is undeniably rapid progress in the development of improved economic relations, transport and tourism linkages between the GMS countries, there are still a number of challenges for the GMS to contend with including political tensions involving cross-border issues (territorial disputes, cross-border crime, customs and quarantine) as well as issues around natural resource extraction, burgeoning energy needs and environmental impact. Indeed the nexus between environment and political tension is well demonstrated by the recent

suspension of the 3,600 megawatt Myitsone Dam project on Myanmar's Irrawaddy River in Kachin State. The construction of the dam was met with widespread protest by Myanmar's citizens when a leaked environmental assessment warned of serious environmental and social problems and recommended the project be cancelled (BANCA, 2009). Indeed, the Kachin Independence Organization (KIO) broke a 17-year ceasefire after warning it would fight to block the dam's construction as the proposed dam was located in an area of great cultural and ecological significance on the confluence of the Mali and N'Mai. The Myanmar government halted the construction of the USD3.6 billion dam project financed by China Power Investment Corporation (International Rivers, undated).

However, Myanmar is not the only country to see protests against dam construction. Most of the protests against dam construction in the GMS countries are fuelled by unequal distribution of benefits and environmental and social concerns (such as forced relocation). This may however be the first project of this scale that has been halted in many years. The implications for relations between China and Myanmar are not insignificant and the action has been interpreted by some as demonstrating a willingness to mend relationships with the US and not be overly reliant on China. Another example of public outcry against a dam's construction is the 1,260 MW dam planned by Ch. Karnchang, one of Thailand's largest construction companies, on the Mekong River's mainstream at the Kaeng Luang rapids, 30 km from Xayaburi town. Due to the significant environmental and social impact of the proposed dam, regional governments' approval was sought through the *Procedures for Notification, Prior Consultation and Agreement (PNPCA), facilitated by the Mekong River Commission (MRC)* (Herbertson, 2012). In December 2011, Cambodia, Lao PDR, Thailand, and Viet Nam agreed to delay the Xayaburi Dam, the first of eleven dams proposed for the Mekong River, pending further study on the impacts of the proposed Mekong mainstream dams. However on April 17, 2012 Ch.Karnchang informed the Stock Exchange of Thailand that the contract for the Xayaburi dam had been signed with Lao PDR with construction commencing on 15 March 2012 (CK News, 2012). This move prompted a response by the Cambodian government protesting Lao PDR's decision to move forward unilaterally.

In addition to hydropower-related tensions, territorial boundaries have been another source of dispute in the region. For example, the century-long dispute between Cambodia and Thailand was reignited in June 2008 involving the area surrounding the 11th-century Preah Vihear Temple, located in the Dângrêk Mountains between the Choam Khsant District in the Preah Vihear Province of northern Cambodia and the Kantharalak District (*amphoe*) in the Si Sa Ket Province of northeastern Thailand. The tensions boiled over into armed conflict and continued until an agreement was reached for troop withdrawal in December 2011.

Implications for malaria control

Relations between countries inevitably affect the way in which malaria control programs can be implemented. As malaria is a disease that knows no physical boundaries, the successful control and eventual eradication of malaria is highly dependent upon close cooperation and collaboration among affected countries. While much progress has been made on cross-border initiatives in the GMS during the past decade, there have also been a number of challenges that have directly affected malaria control programs. The border dispute between Cambodia and Thailand mentioned above is one example. Internal conflict in Myanmar is another.

In addition to political challenges, in the past few years the GMS countries have, without exception, experienced a range of natural disasters with far-reaching and often devastating consequences. Such disasters include tsunamis, cyclones, floods, trans-boundary animal and plant diseases and also drought. Some notable examples are the 2011 floods in Thailand triggered by the tropical storm Nok-Ten that affected 65 of Thailand's 77 provinces and an estimated 13.6 million people. In neighboring Myanmar, Cyclone Nargis in 2008 devastated the Ayerwaddy Delta region and affected around 2.4 million people (IFRC, 2011). Two years later in 2010, Cyclone Giri hit the western coast of Myanmar, affecting another 200,000 people. Typhoon Haima hit Lao PDR in June 2011 and caused heavy rain, widespread flooding and serious erosion, affecting close to 100,000 people (Government of Lao PDR, 2011). In Viet Nam, Typhoon Ketsana caused widespread damage in 2009 and subsequent flooding. More recently in November 2011, floods in the central and southern provinces of Viet Nam affected more than half a million people. China experienced its most severe drought in sixty years, beginning in late 2010 and continuing well into 2011. The drought affected eight provinces across the north of the country and more than five million hectares (12.4 million acres) of crops were damaged – an area equivalent to half the size of Korea. The drought affected approximately 35 million people, including 4.2 million who faced a drinking water shortage. Later in 2011, floods hit thirteen provinces in the east of the country affecting more than five million people.

In addition to the social impact, the financial implications of natural disasters for the GMS region are significant. Indeed the numbers of natural disasters which are widely believed to be a result of climate change are of serious concern for future agriculture development and food security in the GMS region. In February 2012, a conference on this theme was held in Bangkok bringing together policy makers and experts from the food, water, energy, environment, academic and private sectors. The conference, *GMS 2020: Balancing Economic Growth and Environmental Sustainability International Conference*, focused on the projected food demand from the Mekong River Basin (projected

to increase by 20% to 50% by 2030) and demands on the use of water for agriculture, energy production, and domestic and industrial use which is increasing exponentially, while ground and surface water sources are depleting and degrading. GMS leaders have already committed to greater economic and environmental cooperation and effective implementation of such commitments will be critical for the continued growth and development of the GMS.

SOCIO-ECONOMIC CONDITIONS IN THE GREATER MEKONG SUBREGION

Regional profile (Figs 3-15)

Remarkable progress has been made in the reduction of poverty in Asia Pacific countries over the past decade however there are still over 945 million people living in poverty in the region (UNESCAP, 2011a). The relationship between poverty and illness, including malaria, is well established with socio-economic factors playing an important role in the occurrence, spread and severity of the disease (Saini *et al*, 2010). Poor sanitation and habitation, frequency and length of exposure to vectors, as well as the ability to purchase protective supplies such as ITNs and mosquito nets are key factors. In addition, the ability of patients to seek and receive timely and quality care is dependent upon a number of factors including income, location, transportation, health-seeking behaviors and availability of qualified health staff and quality medicines. Per capita GDP and public health expenditure remain key determinants in the incidence of malaria not only in the Mekong region, but globally. While programs should continue to be proactive in utilizing proven effective interventions to reduce transmission rather than waiting for “better” options, it is clear that continued socio-economic improvements (including adequate infrastructure and surveillance systems that engage local communities, improved housing, transportation and coverage of services) will improve malaria control and elimination options.

Country profiles

Cambodia. With a population of approximately 14.30 million (UNDP, 2011a), Cambodia is classified as a low income country ranked 139 out of 187 countries in the 2011 Human Development Index Report. Cambodia experienced one of the highest rates of annual GDP growth at around 10% for the period 1998-2008 (Fig 3) (Guimbert, 2010) driven largely by an expansion in the garment sector, construction, agriculture, and tourism sectors (approximately 2 million tourists per year). In addition, oil deposits were discovered in Cambodia’s territorial waters in 2005, which are a potential source of revenue for the country. In the country’s north, mining opportunities for bauxite, gold, iron and gems mining are another

potential sources of revenue. Currently, Cambodia's garment industry accounts for approximately 70% of exports, and employs almost 300,000 people (CIA, 2012). Cambodia has made significant progress since it emerged from over two decades of war in 1992. For example, the under 5 mortality rate has decreased from 121 per 1,000 live births in 1990 to 51 in 2010 (UNICEF, 2012). However, poverty and inequality remain big obstacles. Over 80% of the population lives in rural areas and the economic progress experienced in the cities has not flowed to the countryside. In addition, the private sector will need to create jobs to address the demographic imbalance Cambodia faces with over 50% of the population under 25 years of age (CIA, 2012).

Although the country has received substantial amounts in foreign aid, basic infrastructure, especially in rural areas, remains an area requiring urgent development. In response to this need, in February 2012, the ADB announced a loan for the Provincial Roads Improvement Project, financed by a USD52 million loan from its Special Funds and a USD17 million loan and grant from the Pilot Program for Climate Resilience (PPCR), (ADB, 2012). The project will be used to rehabilitate about 150 km of unpaved provincial roads in Kampong Chhnang, Kampong Speu, Prey Veng and Svay Rieng provinces, home to a large number of the country's rural poor. The project will also address growing road safety and climate change challenges. In addition, the Cambodia Railway Rehabilitation Project supported by AusAID and ADB, will result in 650 kms of railway, including stations and terminals, rehabilitated or reconstructed in Cambodia (AusAID, 2011). The railway runs south from Phnom Penh to the seaport in Sihanoukville over Takeo and Kampot, and north from Phnom Penh to the Thai border in Poipet over Pursat, Battambang and Sisophon. The project will support regional economic integration and could form an important element of the proposed Singapore – Kunming rail network, in which Phnom Penh would connect Bangkok and Ho Chi Minh City.

China. China is currently the world's fastest growing economy experiencing an average GDP of 10% for the past 3 years (as well as a period of 11% growth from 2003-2007). Although it remains a low-income country and is ranked 101 out of 187 in the Human Development Index in 2011, China is above the regional average and is continuing to experience rapid growth having shifted from a centrally planned to a market-based economy. In 2010, China's GDP was 10.3% and it also became the world's second largest economy (World Bank, 2011a). Despite the rapid gains and progress in dramatically reducing poverty over the past 3 decades, China also faces the challenge of widespread inequality. The 12th Five Year Plan (2011 - 2015), recently approved by the National People's Congress, sets out 5 priority areas which include (among others) goals of increasing incomes, reducing poverty and improving the living standards and quality of life; more balanced rural-urban development; expanding access to basic public services and increasing the educa-

tional level of the population. Balancing the rapid development of hydropower dams and other large-scale infrastructure projects with environmental concerns is also an issue of domestic concern for the Chinese government that is one of the 5 priorities in the 12th Five Year Plan.

Lao PDR. Lao PDR has recently graduated from a lower economy country status to a lower-middle income economy reaching a GNI per capita of USD1,010. Lao PDR has experienced a GDP growth rate of an average of 7.1% per year from 2001-2010, indicating a sustainable development path that has reduced poverty and stimulated growth (World Bank, 2011b). From 2011-2015, GDP is predicted to increase to 7.6%. Despite these impressive gains, Lao PDR also faces the challenge of addressing rural-urban inequality. A lack of basic infrastructure, sanitation and clean water are serious challenges for Lao PDR. In addition, the country has one of the highest maternal mortality rates in the region. Much of the country's development has occurred in the hydropower and mining sectors which together accounted for almost one third of the country's economic growth between 2005 and 2010. The country's natural resources including forests, agricultural land, hydropower, and minerals are critical for the continued growth. How these resources are managed will also be important to sustained development. Although environmental legislation has evolved quickly in Lao PDR, inconsistencies have surfaced in different legislation as a result of different ministries leading the development of sectoral legislation. According to the World Bank the principal inconsistencies include conflicting provisions, overlapping mandates given to different ministries, and lack of implementing regulations and supporting environmental standards (World Bank, 2005). The Government is working to address these issues, and to formulate a national system for standardizing and enforcing environmental regulations.

Myanmar. Myanmar is a low-income country with a population estimated to be between 48 and 50 million, although population estimates vary widely as the country's last census was conducted in 1983. However, a national population and housing census is planned for 2014. The country's first general elections in 20 years were held in November 2010. Since the elections, a number of social, economic and political reforms have been implemented and a peace initiative was launched to resolve the on-going 60-year ethnic conflict. A by-election held in April 2012, opened the way for previously excluded opposition parties to enter into parliament, resulting in a progressive easing of sanctions by a number of donors including the EU, US, Canada, Australia and others. The easing and eventual lifting of restrictions is likely to have a significant impact upon Myanmar's economic prospects for the future.

The second largest country in Southeast Asia, Myanmar is endowed with extensive

natural resources including natural gas, oil, timber, precious stones and a diversity of minerals. The GDP growth has been variable over the past decade slowing to around 3.6% in 2008 from 5.5% in 2007 (ADB, 2010). The impact of Cyclone Nargis in 2008 combined with regional economic slowdown and a sharp decline in commodity prices were contributing factors to the decline in GDP. The following year in 2009, GDP increased to approximately 4.4% and declined to around 3.5% in 2011 (US Department of State, 2011). Myanmar was not directly hit by the global financial crisis as a result of its limited trade and financial linkages with industrial countries, though such linkages are likely to change significantly in the future. Poverty reduction remains a major challenge for the country. In mid-2011, the Government launched a series of national and regional level workshops on poverty reduction and established the Rural Development and Poverty Alleviation Central Committee, chaired by President U Thein Sein (United Nations Country Team, Myanmar, 2011). The Government's Rural Development and Poverty Reduction Strategy outlines a number of key areas to address including agricultural production, livestock and fishery, rural productivity and cottage industries, micro-saving and credit enterprises, rural cooperative, rural socio-economy, rural energy, and environmental conservation. In addition to poverty reduction initiatives, a number of policy reforms have also been implemented including major policy reforms including anti-corruption, currency exchange rate, foreign investment laws and taxation.

Thailand. Thailand is a middle income country that has experienced rapid economic growth and development in the past decade with an average annual GDP of 8.9% from 1985-1995. Following the 1997-1998 economic crisis, GDP growth rate slowed to an average of 5% for the period 2002-2007 (World Bank, 2011c). From 2007 onwards Thailand has faced a number of financial, economic, and political challenges. However, despite these challenges, the World Bank recently upgraded Thailand's status from a lower-middle income country to an upper-middle income country due to the country's ongoing progress in social and economic development. The government has placed great emphasis on the development of physical infrastructure, strengthening the domestic capital market, and improving the enabling environment for private sector investment.

Poverty and inequality remain important issues to address. Although absolute poverty has declined dramatically over the past 40 years, inequality has increased and rural dwellers are disproportionately affected by poverty, particularly those in the north and northeast of the country who experience disproportionate rates of poverty (World Bank, 2011c).

Viet Nam. Viet Nam's economy has grown exponentially over the past 15 years with the shift from a centralized planned economy to a socialist-oriented market economy – indeed the

World Bank refers to—Viet Nam's growth as "one of the most spectacular success stories in economic development" (World Bank, 2012). Viet Nam has made significant progress in addressing poverty which has fallen from 58% in 1993 to 14.5% in 2008 (World Bank, 2012). The country's GDP has averaged 7% for the past ten years and the country has graduated to lower middle income status. Viet Nam's Micro, Small and Medium Enterprises (MSMEs), account for almost 85% of all registered enterprises and have made a significant contribution to the economic success of the country, generating the majority of jobs over the past decade. Viet Nam is known for its high-quality but low-cost labor force and has been very competitive manufacturing high-quality garments, footwear and wood products for export that have underpinned Viet Nam's rapid economic growth. Agriculture as a share of GDP declined from 27% to 21% during 1995-2005 while industry rose from 29% to 41% during the same period. Viet Nam joined the World Trade Organization in 2007 becoming the 150th member. A key challenge for the country will be to address the social and economic disparities particularly between the urban and rural populations, although significant progress has already been made in this area. Further measures to address this issue include working with the IMF and World Bank to implement a comprehensive poverty reduction strategy as well as supporting innovative approaches to agricultural development.

Socio-economic indicators

Examining the socio-economic indicators and health indicators for the GMS region reveals a generally promising trend of improved health and economic status across all countries over the past decade. However there are still many areas that require improvement, although the specific areas vary from country to country.

Health expenditure

Health expenditure per capita in the Mekong countries varies considerably from USD2 in Myanmar (2009) to USD261 in Thailand (2009) (UNESCAP, 2011a). An analysis of the per capita expenditure on health in the region (Fig 15) and malaria incidence per capita indicates that the countries that have failed to increase investment in health have not seen a substantial decline in malaria incidence. While several endemic countries have made considerable progress in reducing malaria morbidity and mortality, it is also important to note that Southeast Asia (which includes the GMS countries) still accounts for the largest proportion of malaria deaths in the Asia-Pacific region at 55% (UNESCAP, 2011b). Continued success remains contingent upon sustained political commitment and ensuring that adequate resources for malaria control and prevention are available, particularly as the number of malaria cases decline. In the Asia-Pacific region, public funding for health care programs remains inadequate to ensure equitable access to essential services and in the GMS region,

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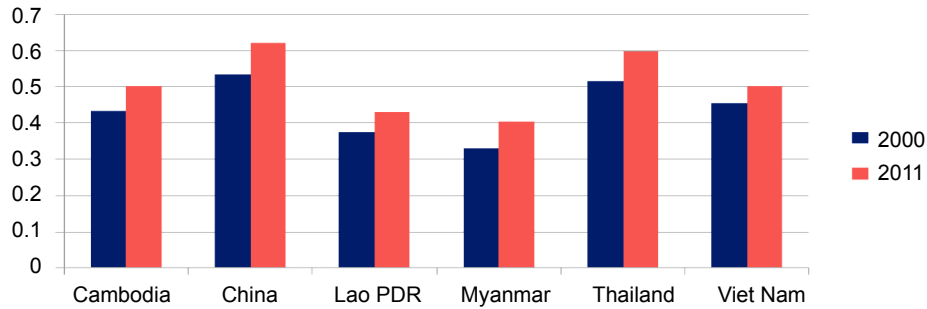


Fig 3—Education index, expected and mean years of schooling (UNDP, 2011a).

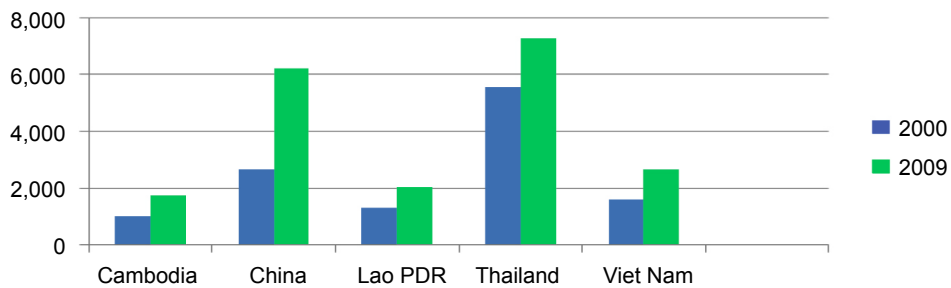


Fig 4—GDP per capita in PPP terms^a (constant 2005 international USD) (UNDP, 2011a).

^aData for Myanmar not available.

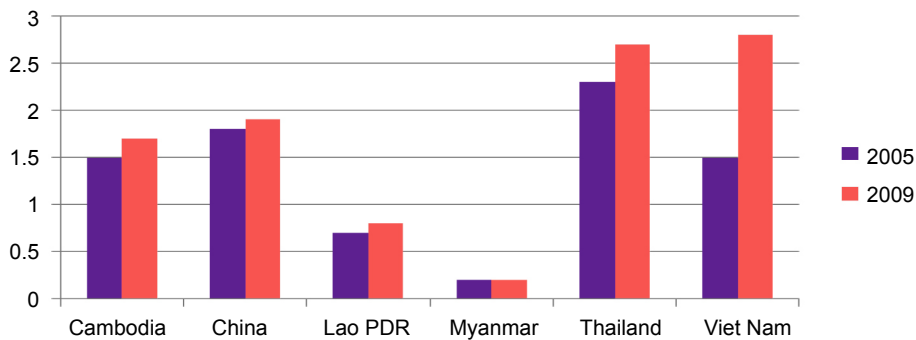


Fig 5—Expenditure on public health^b, % of GDP (UNDP, 2011a).

^bPublic health expenditure consists of current and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds.

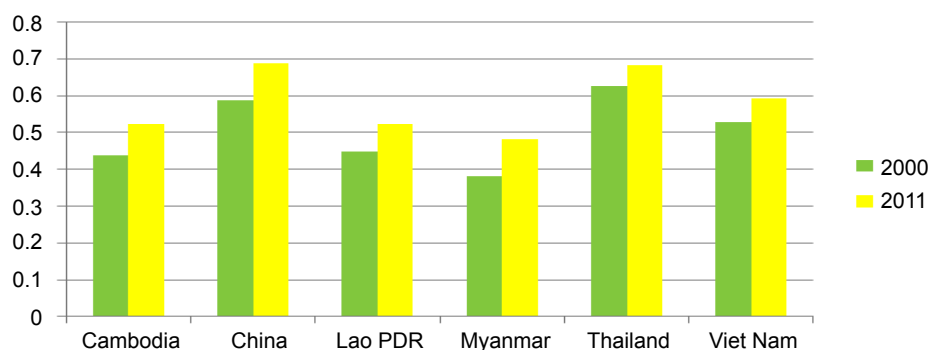


Fig 6—Human development index^a (UNDP, 2011a).

^aHuman Development Index (HDI) value: A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living (UNDP, 2011b).

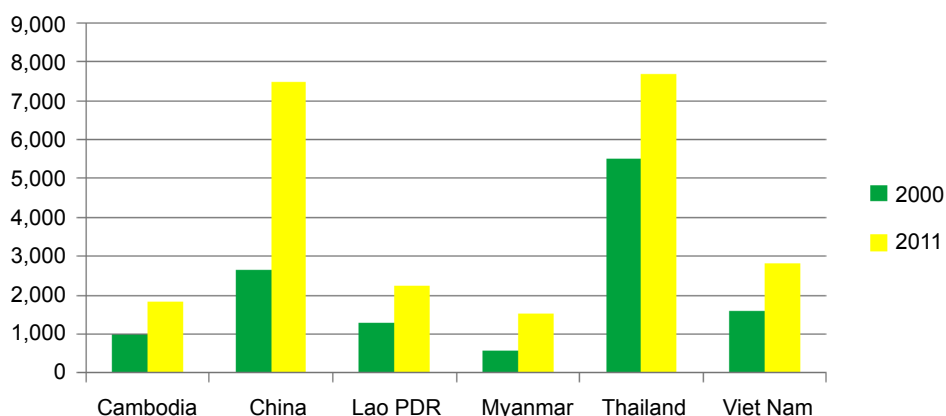


Fig 7—GNI per capita in PPP terms^b (constant 2005 international USD) (UNDP, 2011a).

^bAggregate income of an economy generated by its production and its ownership of factors of production, less the incomes paid for the use of factors of production owned by the rest of the world, converted to international dollars using purchasing power parity (PPP) rates, divided by midyear population.

Demographic indicators

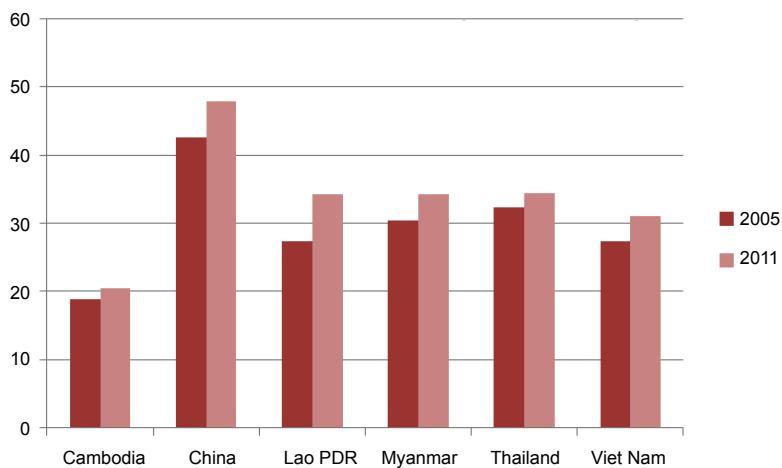


Fig 8—Urban population (% of total).

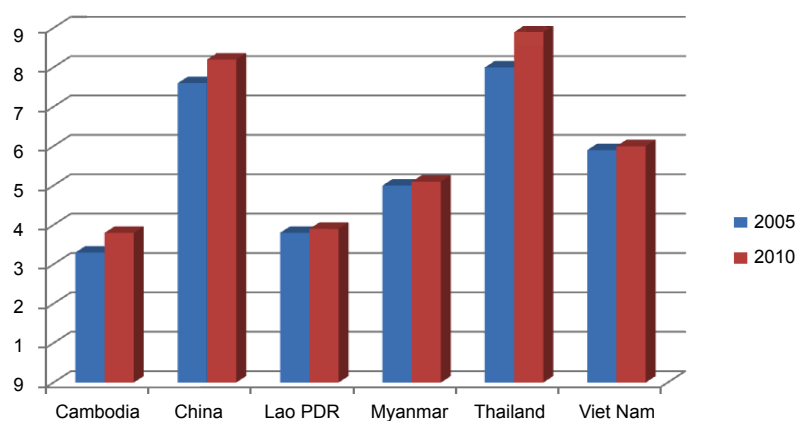


Fig 9—Population over 65 years (% of total).

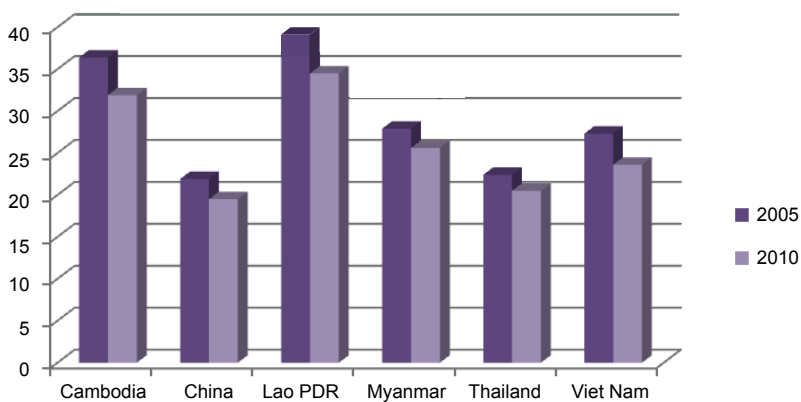


Fig 10—Population under 15 years (% of total).

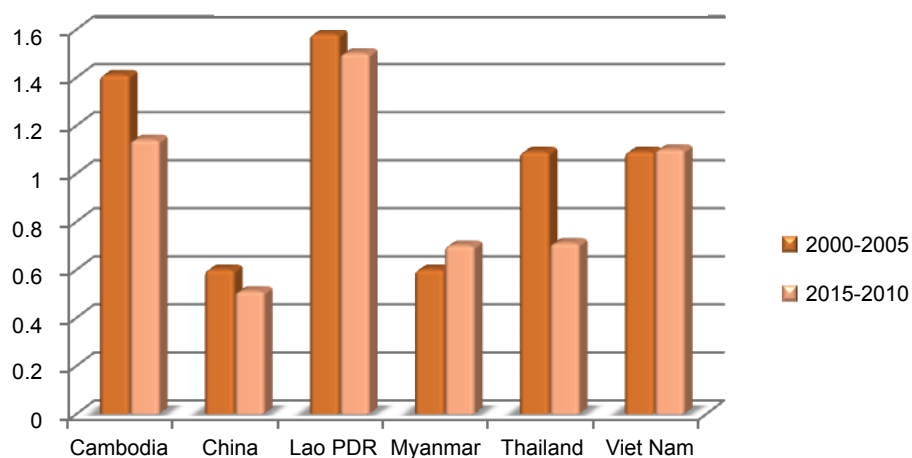


Fig 11–Population growth rate (Available from: URL: http://esa.un.org/wpp/unpp/panel_indicators.htm).

Health indicators

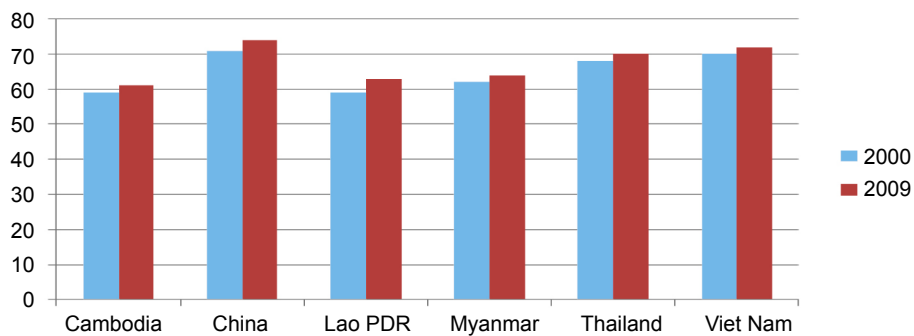


Fig 12–Life expectancy at birth 2000/2009.

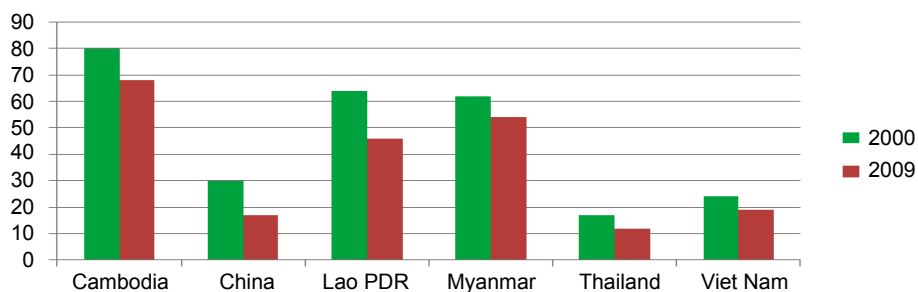


Fig 13–Infant mortality rate, deaths per 1,000 live births.

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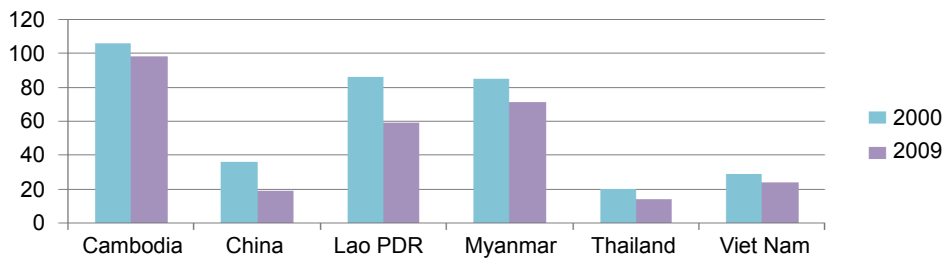


Fig 14—Under five mortality rate per 1,000 live births.

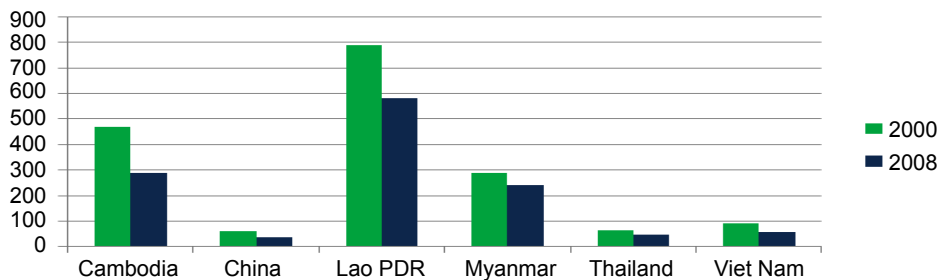


Fig 15—Maternal mortality rate: deaths per 100,000 live births 2000/2008 (WHO, 2011c).

public expenditure on health care varies markedly. Expenditure directly affects coverage of health services which is an important factor in case detection and management.

In the Asia-Pacific region from 2000-2009, total expenditure on health declined from 6.3% to 6.0% and this was the only region globally where this occurred (UNESCAP, 2011a). However, aggregate expenditure by subregion as a share of total GDP is influenced by the share of GDP for each country in the subregion. The decrease in the subregional average can then be attributed to the increasing weight of China in the subregional averaged coupled with the decreasing weight of Japan in the same figure (UNESCAP, 2011a). Another noticeable trend in the region is the increase in private expenditure on health and the decline in total expenditure on health. In Lao PDR and Myanmar, private expenditure on health increased between 2000 and 2009 placing a higher burden on patients, but declined in Viet Nam, Thailand, Cambodia and China (Fig 16). For malaria funding specifically, getting a complete picture of the domestic public resources available presents some difficulties as much of the

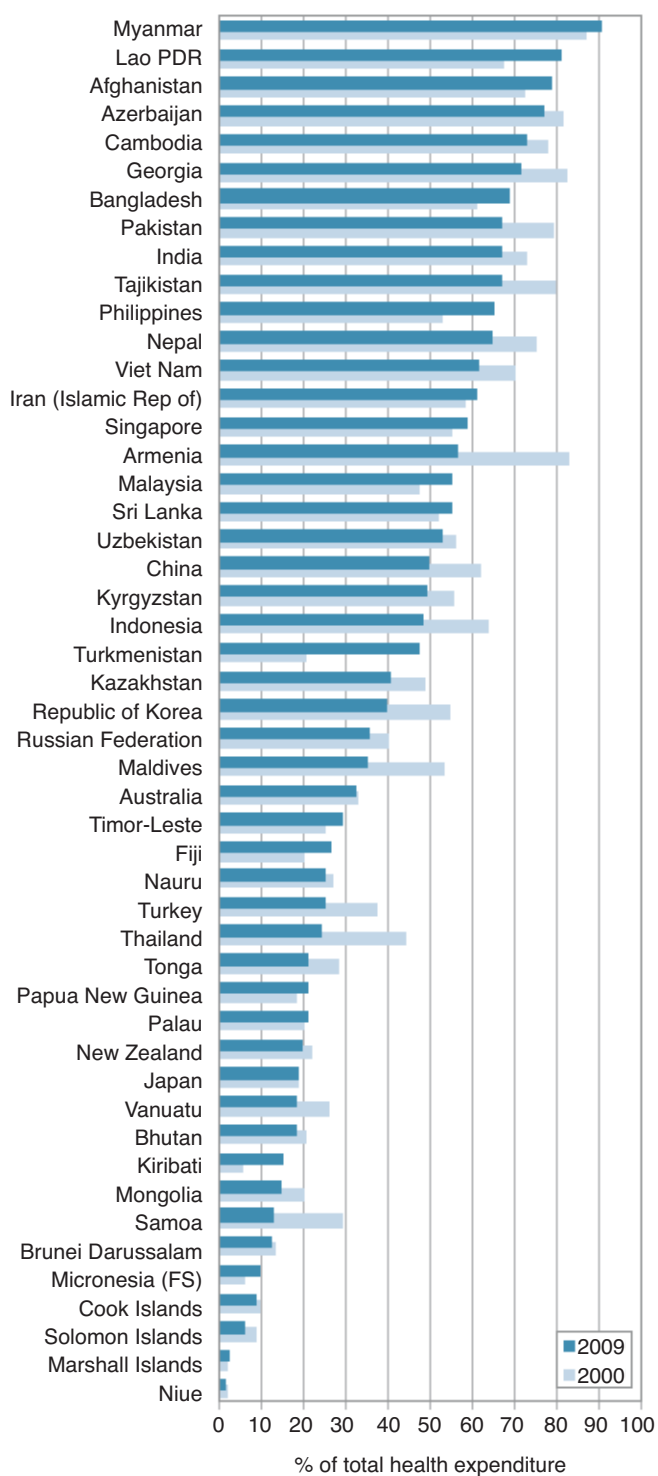


Fig 16–Private health expenditure, Asia and the Pacific, 2000/2009 (OECD, 2010).

Table 1
Domestic and external funding sources of National Malaria Control Program Thailand
2006-2010^{a,b}.

Sources of funding	Budget (Million USD)				
	2006	2007	2008	2009	2010
Government budget					
Country budget	40,000	46,065	48,842	59,142	53,125
Public health budget	1,548	1,833	1,919	2,182	2,192
Disease control program budget	81	92	100	106	100
Malaria control program budget	12	11	3	0.51	0.44
External funding					
The Global Fund Grant	0.04	0.03	4.86	5.09	3.28
Kenan Institute Asia	0.01	0.01	0.14	NA	NA
WHO	0.05	0.004	5.013	7.07	5.79
Total external funding	0.1	0.044	5.013	7.07	5.79
Grand total for malaria control program	12.1	11.044	8.013	7.58	6.23

^aUSD 1=THB 34; ^bBVBD, 2011

resources available are drawn from existing health systems. In addition, the move towards more integrated health programming, though very welcome, also makes it more difficult to extrapolate dedicated malaria funding. Table 1 provides an overview of malaria funding for Thailand.

For Lao PDR, according to the National Strategy for Malaria Control and Pre-Elimination 2011-2015, Lao PDR is implementing malaria control activities supported by national funds and Global Fund (GF) grants (from rounds 4 and 7). The budget from the Lao government allocated for the NMCP is approximately USD 594,912 (2008). Phase 2 of GF Round 7 is expected to provide NMCP with a total of USD 16 million for the period 2010 - 2013. While the national budget supports 3%, GF support covers 97% of the malaria funding for the country.

A summary of GFATM grants with time period and budgets is summarized below:

GF Round 1	2003 -2007	12 million
GD Round 4	2006-2010	14 million
GF Round 7	2008-2013	6.7 million (Phase 1)
		16 million (Phase 2) ^a

^aSubject to GFATM approval

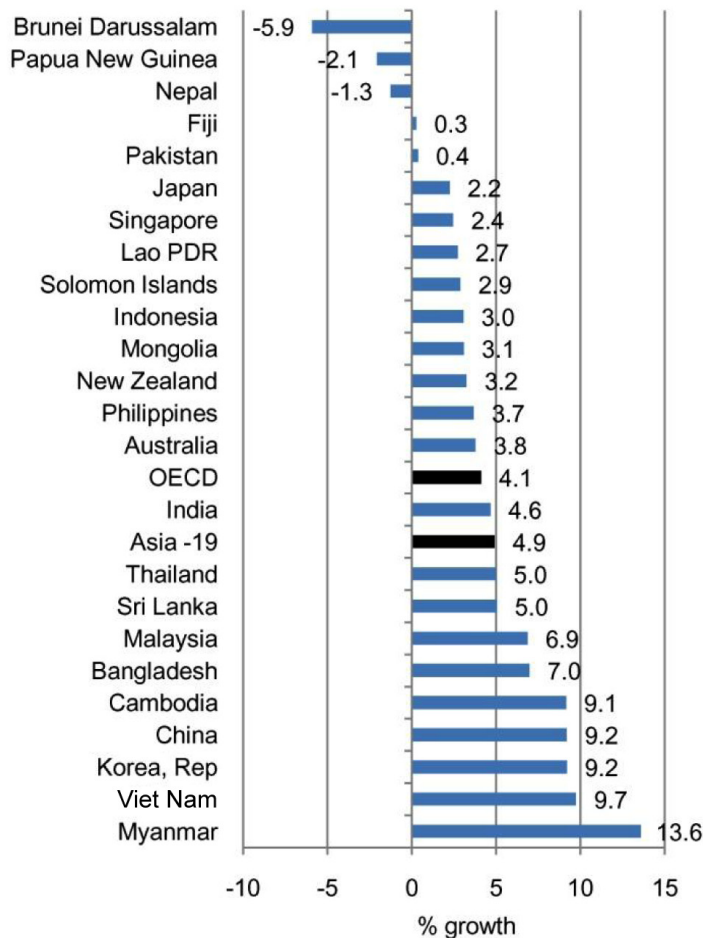


Fig 17—Annual Average Real Growth in per capita health expenditure – 1998-2008 (OECD, 2010).

According to the 2011 World Malaria Report, international funding for malaria control appears to have peaked at USD 2 billion in 2011. From 2012 to 2013 it is projected to remain relatively stable, but then decrease to USD 1.5 billion in 2015. The Global Fund remains the single largest source of funding for malaria control globally, with a peak in disbursements over 2009-2011. DFID, PMI, the World Bank and other donors accounted for 49% of total disbursed funding in the year 2010. PMI contributions rose from USD 385 million in 2009 to USD 585 million in 2010. With the exception of the Global Fund, information on disbursements is not available for years after 2010 (WHO, 2011a).

Figs 18 and 19 provide an example of the differences in service coverage in the GMS countries.

ECONOMIC CONTEXT OF MALARIA

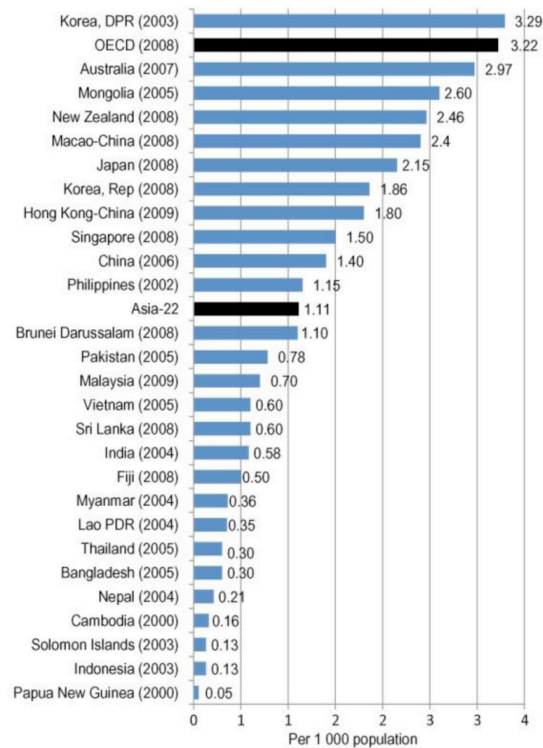


Fig 18–Doctors per 1,000 population, latest year available (OECD, 2010).

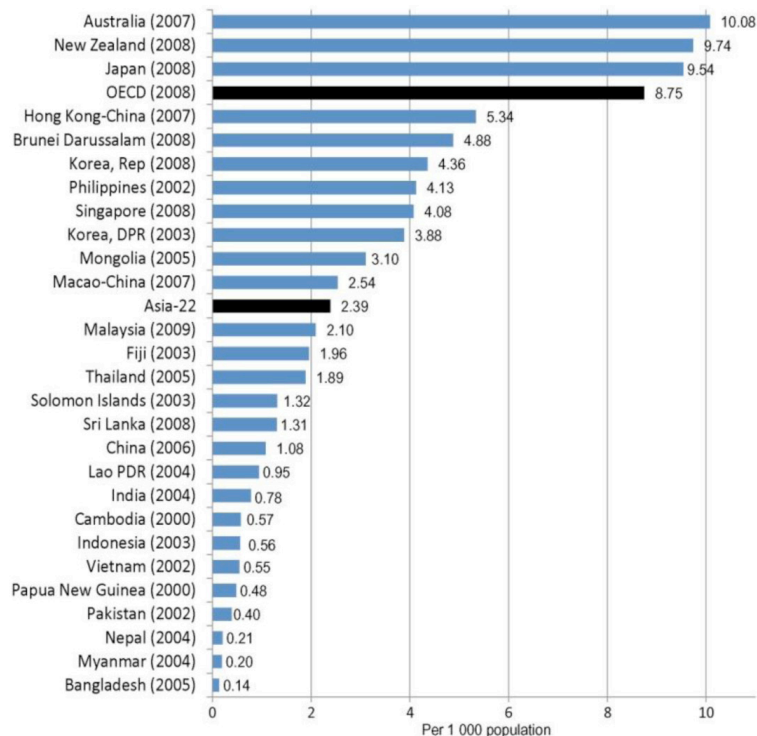


Fig 19–Nurses per 1,000 population, latest year available (OECD, 2010).

INFRASTRUCTURE DEVELOPMENT AND LAND USE PATTERNS IN THE GMS

Infrastructure development has undoubtedly played an important role in economic development and poverty alleviation in the GMS region and rapid development has occurred over the past ten years (ADB, 2010). Huge investments have been made to improve transportation links between the GMS countries, commencing with the Cross Border Transport Agreement and the GMS Transport Master Plan in the early 1990s. The Master plan identified priority transport links (mostly roads) that would improve connectivity, reduce travel time and costs and boost economic trade and development. In addition, nine economic corridors have been proposed for the GMS region since 2005, with the goal of facilitating trade and improved logistics for better access to global markets (Figs 19-21). Another important road under development is the Asian Highway which is a 141,000 km highway network involving 32 Asian countries with linkages to Europe. It is one of the three pillars of the Asian Land Transport Infrastructure Development (ALTID) project, endorsed by ESCAP Commission in 1992, comprising 1) Asian Highway, 2) Trans-Asian Railway and 3) Facilitation of land transport projects. Around USD 26 billion has already been invested in improving and upgrading the highway. Besides road construction, large-scale railway, hydro dam, plantation and mining projects have also been given priority in the region. What then are the implications for malaria?

While better infrastructure brings increased trade, employment opportunities, improved access to health and other services, and greater access to high-quality goods, there is also a cost to such rapid development. Displacement of local populations, influxes of foreign workers and changes in vector ecology are some of the concerning implications of rapid infrastructure development. The income for governments for hydropower projects, for example, can be substantial, but it is critical that approaches to improve the ability of lowland and upland farmers to adapt to change, safeguard their natural resources, and help them take advantage of new income-generating opportunities are implemented in preparation for new infrastructure projects. Bottom-up strategies, such as developing markets for niche agricultural products and ensuring community land rights, combined with top down strategies to improve government transparency and revenue collection and management capacity, need to be prioritized and scaled-up (International Rivers, 2008).

Dams have long been promoted as an important means of meeting perceived needs for water and energy services and as long-term, strategic investments with the ability to deliver multiple benefits (WCD, 2000). When managed well, dams may indeed bring a diversity of benefits. However, in the Mekong region, many hydropower projects have cross-boundary impacts and as such, there is a real need for harmonized treatment of environmental issues

in the GMS (King *et al*, 2007). Dams can also result in the creation or elimination of new mosquito breeding sites and together with associated demographic changes, alter human-vector-parasite contact patterns. As the Mekong region has become one of the most active regions for hydropower in the world, the cumulative effects on tributary river flow regimes must be considered as well as on fish passage, water quality and sediment flow. This cumulative impact will become increasingly important as the number of dam projects in the Lower Mekong Basin continues to increase in the foreseeable future (Mekong River Commission, 2010). Additional consequences of hydropower dams include a potential threat to long-haul and cross-border river transport on the Mekong. In addition, all barriers, such as dams, interfere with fish spawning and migration (Mekong River Commission, 2010). The major hydropower dams planned or in progress include the following: in the upper basin, China is implementing a cascade of up to eight projects which will significantly redistribute flow from the wet to the dry season. In the lower Mekong, new dams are being planned on both the mainstream and tributaries. Of the total of 124 existing, under construction and potential tributary projects identified in the MRC hydropower database in 2009, more than 70% are in Lao PDR and 10% are in Cambodia. In addition, private sector proposals for new hydropower schemes include at least 11 dams on the lower Mekong mainstream (Mekong River Commission, 2010).

Similarly, rubber plantations could lead to increased mosquito density and disease incidence. Roads and railway networks also open up opportunities for changes in vector behavior and opportunities to spread the disease. Climate change, rapid deforestation and illegal logging in the GMS have led to changes in land use patterns with large-scale plantation development where the impact on different malaria species remains unknown (Malaria Consortium, 2010). There is concern amongst experts in the GMS region to see current surveillance systems strengthened to capture these changes. In addition, as migrant workers seek employment in new locations many travel from highland to lowland areas where they have low immunity and no protection when they engage in forest work where the risk of transmission is high. Further, the risk of resistant malaria strains spreading also increases when migrants travel between low and high transmission settings. As many migrant workers in the Mekong countries self-medicate, they are therefore more vulnerable to substandard antimalarials and monotherapies which jeopardize their own health and in turn contribute to resistance.

One of the findings of the Malaria Operational Research Symposium held in Cambodia in October 2010 was that the GMS region needs *pro-active* strategies in order to predict the likelihood of a disease outbreak and to initiate control programs *before* the population becomes affected. Developing proactive strategies will require obtaining improved information about

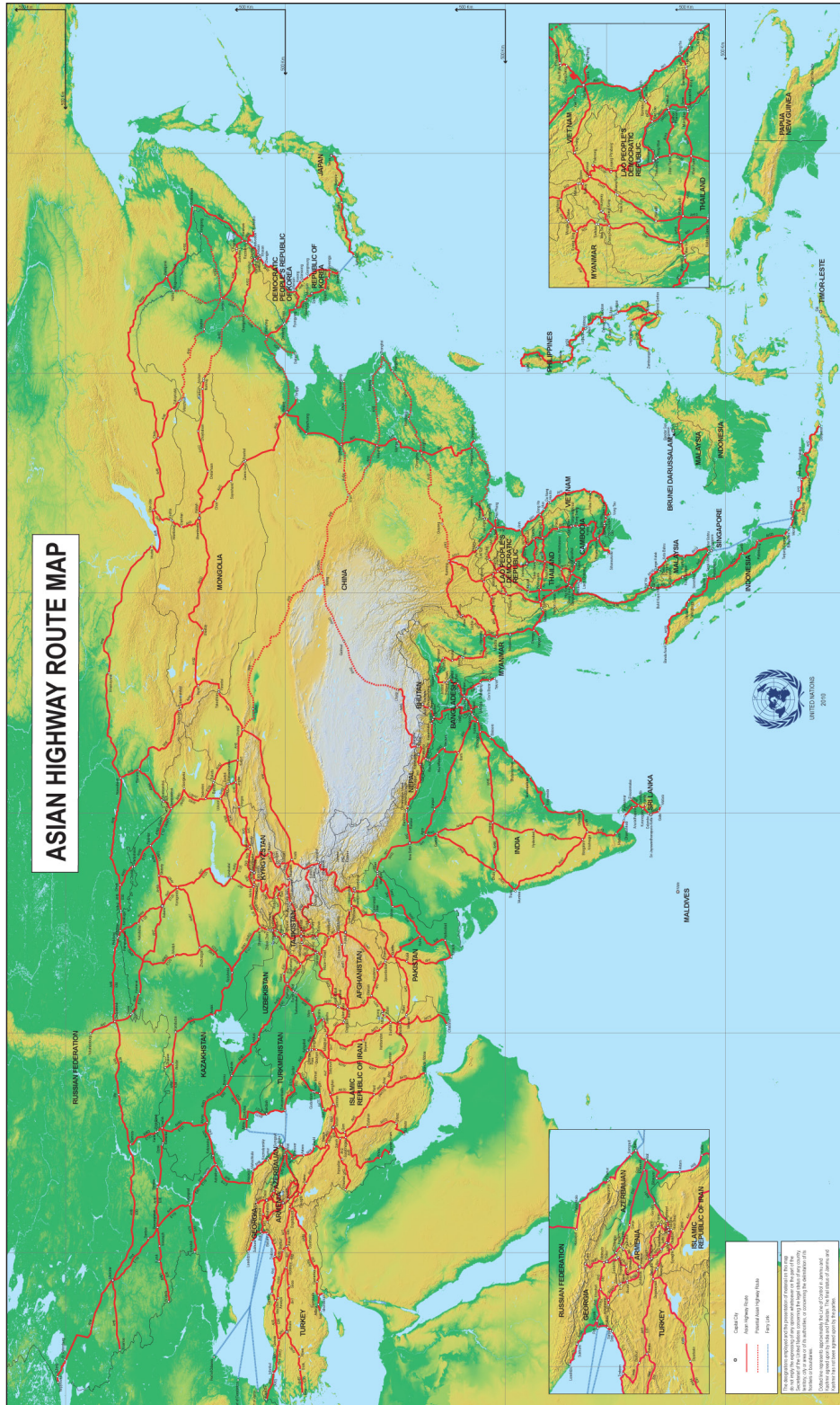


Fig 20–Asian highway route map (UNESCAP, 2010a).

planned infrastructure projects, many of which are funded by the ADB, World Bank, ASEAN, other regional bodies and also the Private Sector. As many of the infrastructure projects funded by donors such as the ADB and World Bank, do have a socio-economic dimension, (for example, integrating HIV/AIDS in new transport projects), advocacy to include malaria prevention and treatment in Social, Economic and Health impact assessments related to large-scale infrastructure projects in the GMS is an important area to pursue. On approval of projects, however, the responsibilities for construction and operation phase management vary depending on whether it is a public, private or public-private project. Further, the actual responsibilities of construction companies and hydropower operators for environment and social mitigation and management vary considerably according to the different laws and regulations in each country.

Figs 20-21 provide an overview of existing and proposed major infrastructure projects in the GMS.

POPULATION NUMBERS AND POPULATION DENSITY

The total population estimates for the Greater Mekong Subregion countries given in Table 2 indicate the percentage of population living in rural and urban areas together with the population density and rate of natural increase in population. These numbers are distributed over differing areas of land, giving rise to differing overall population densities from one country to another.

Table 2
Total population and additional population statistics (2010).

Country	Population (Million)	Population density (population per km ²)	Percentage living in urban areas	Population growth rate, 2005-2010	Projected population 2020-2025
Cambodia	14.13	78	20.4	1.14	0.98
Yunnan Province of China ^a	45.96				
Lao PDR	6.2	26	34.3	1.5	1.06
Myanmar	47.96	71	34.3	0.7	0.58
Thailand	69.12	135	34.4	0.71	0.22
Viet Nam	87.84	265	31	1.1	0.61

Source: United Nations Department of Economic and Social Affairs, Population Division, Population Estimates and Projections Section, 2012.

^aYunnan population figure from National Statistics.

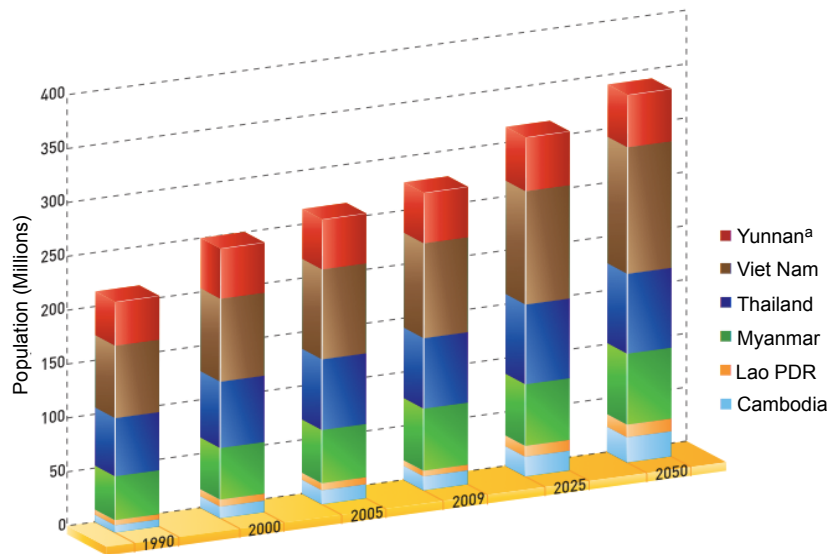


Fig 22–Population growth across the GMS (FAOSTAT, 2009; World Gazetteer, 2009).

^aYunnan figures calculated from total population for China and apportioned using the Yunnan population from 2009.

However, a summary table gives only a broad macro impression whereas the decentralized distribution pattern gives a much better sense of population profiles in each country. Substantial clustering of populations is evident in specific areas of each country. For example, in Myanmar, clustering is evident in the central area, while in Viet Nam clustering occurs in the Red River Delta and Mekong River Delta and in major urban areas in all countries.

The spatial distribution of populations and settlements across a country and their interconnectivity and accessibility from urban areas are important for delivering healthcare, distributing resources and managing the economic burden in relation to malaria and other disease control programs. In terms of population density, Viet Nam is the most densely populated country in the region while Lao PDR has a considerably lower population density than other countries in the subregion. However, while Viet Nam's population density is high, the rural proportion remains far higher. China's population density remains relatively low when compared with other countries globally, though considerably higher than Cambodia, Lao PDR and Myanmar. Thailand's population density pattern is similar to that of Viet Nam, also with a higher proportion of population in rural areas.

Although fertility rates in the GMS countries have been declining, the total population of the GMS Subregion is still expected to reach 315 million by 2025 and exceed 340 million by 2050 (IWMI, 2010). Rising populations combined with dietary changes and urbanization

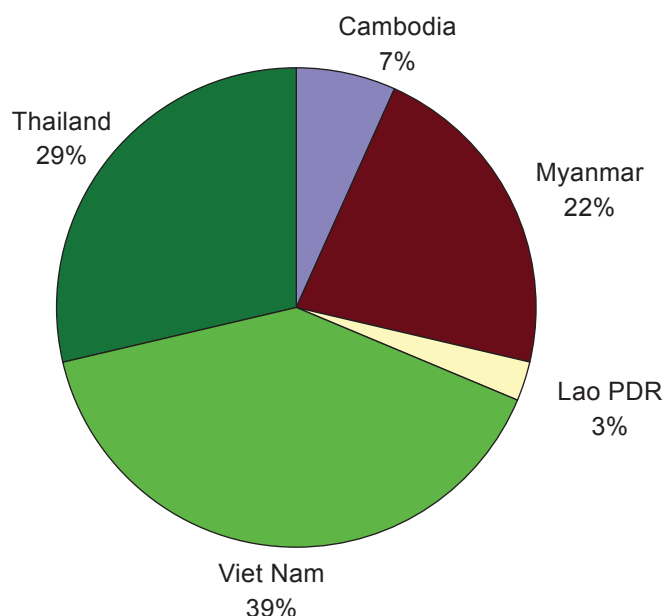


Fig 23–Population distribution among GMS countries, 2010 (FAO, 2010).

Table 3
Age distribution of population, GMS countries (2010).

Country	Percent of population below 15	Percent of population over 65
Cambodia	31.9	3.8
China	19.5	8.2
Lao PDR	34.5	3.9
Myanmar	25.6	5.1
Thailand	20.5	8.9
Viet Nam	25	6

Source: UN Population Division. Available from: URL: http://esa.un.org/wpp/unpp/panel_indicators.htm

have a significant impact on food security – and current predictions based on population growth alone – indicate that food demand in the GMS will rise by at least 25% by 2050 (IWMI, 2010). The implications for the health of GMS population are significant given that despite improvements in levels of nutrition since 1990, undernourishment remains widespread in all countries in the GMS. Agricultural patterns in the GMS are changing rapidly with increasing levels of socio-economic development. Subsistence-based economic systems are giving

way to increased industrialization and service delivery while rates of rural to urban migration are accelerating. The resultant depopulation of rural areas will affect the way that land is used. Depopulation in itself will not necessarily result in increased re-growth of forest area or arable land, as this will also depend upon land tenure systems, policy environments and enforcement (FAO, 2010).

The age distribution of populations in the GMS countries is also an important factor for the working population. Current age distribution is presented in Table 3. The rapid ageing trend in the region is predicted to result in a 14% increase in the non-working population by 2020. However, a 24% increase in the working population is also expected which may bring about a more balanced age structure (FAO, 2011b).

Population distribution (Fig 23) will continue to be affected by the rapid expansion in infrastructure development in the GMS region. For example, there is likely to be considerable disparity in growth patterns between different provinces and regions within and between countries, as infrastructure development is focused in specific areas. For example, the IDE-GSM model predicts that the provinces surrounding Bangkok, as well as the other provinces and cities such as Ho Chi Minh City, Dongguan, Vientiane and Krong Preah Sihanouk, will all see a significant increase in population. In contrast, other areas of Thailand and some areas of China will lose population (Kugami, 2008). This model also predicts that the top five fastest-growing areas in the GMS will be: Ba Ria-Vung Tao in Viet Nam, Rayong and Samut Sakhon in Thailand, Krong Preah Sihanouk in Cambodia, and Phnom Penh in Cambodia.

FOREST COVER IN THE GMS

In recent years, forests and biodiversity have gained increasing attention around the globe as they impact heavily upon many aspects of economic and social development (UN-ESCAP, 2011b). Additionally, forests play a major role in the mitigation and attenuation of climate change, as well as providing habitats for around two thirds of all species on earth and nearly 80% of all terrestrial biodiversity (World Bank, 2008). Forest cover also plays an important role in the transmission of vector-borne diseases, particularly malaria, since differing mosquito breeding habits are encountered in different ecological environments. Deforestation and conversion of logged land for cultivation and cash crop plantations affects the breeding sites of vectors, eliminating some and expanding others. As mentioned earlier, the rapid economic growth and subsequent increase in infrastructure projects in the GMS region have significantly impacted the ecology of the region, as well as employment opportunities and population mobility. In turn, changes in migration patterns have altered the spread of disease patterns amongst highly mobile populations. Although malaria remains a

disease predominantly in rural areas, the changes in ecology and human migration patterns potentially affect the patterns of disease spread.

During the past two decades, primary and total forest cover expanded in the Asia Pacific region, however at the same time, two-thirds of countries in the region experienced an increase in the number of threatened species (UNESCAP, 2011a). Between 1990 and 2010, the forests of the GMS (excluding Viet Nam) contracted in size by 12.5 million hectares, an area greater than half that of Lao PDR (FAO, 2011b). Losses were proportionally highest in Cambodia and Myanmar, while Viet Nam reported an increase in forest area of 144,000 hectares per year and Thailand also reported an increase of 15,000 hectares a year (FAO, 2010). Overall, the annual rate of forest loss, however, fell from -0.8 to -0.6% (FAO, 2011a). China has invested heavily in plantation and natural regeneration of forests and since 1990, has seen a 5.4% increase in the area under forest cover. In addition, in 2010, planting rates in China were the highest in the world. However it is not only the proportion of forest cover within countries that is important. The proportion of forest cover that is primary forest is a key indicator of ecosystem health (UNESCAP, 2011b). Even if a country's total forest cover is not declining (or is even expanding) the loss of primary forest can still pose a threat to ecosystem health (UNESCAP, 2011b). Although forest cover in some areas of the GMS is increasing, forests are generally becoming further degraded also threatening the livelihoods of many who depend upon them.

Between 2000 and 2010, forest area designated for conservation in the GMS increased by 241,000 hectares/year while forest designated for protection fell by 96,000 hectares/year (FAO, 2011b). The area of forest designated for production fell by 385,000 hectares/year. These trends indicate a gradual shift from production of forest products to production of services together with a reduction in the area of forest, and natural forest in particular. The area of other wooded land increased by 23 000 hectares between 2000 and 2010, although this has been at the expense of total forest area (FAO, 2011b).

Projected changes in forest cover to 2020

The FAO has predicted that forest cover in the Greater Mekong Subregion (GMS) will fall by 0.9% between 2010 and 2020 (FAO, 2011b). In Cambodia, the projected rate of forest loss does not substantially differ from the last decade. On a positive note, the implementation of Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD)-related strategies could potentially slow the rates of forest cover loss. In China, the government has announced its intention to increase forest cover to 40 million hectares over the next decade as part of its commitment to cut down its intensity of carbon emissions by 40 to 45% per unit of GDP by 2020 (compared to 2005 levels). President Hu Jintao has

committed the country to increasing the total forest cover to 23% by 2020. According to the World Bank, China's forest cover increased from 12% to 18% in the past 20 years, indicating that this is an achievable goal (World Bank, 2010). However given that China has among the lowest per capita and per hectare concentrations of forests in the world, it is important that this progress continues.

In Lao PDR, the rate of forest cover is predicted to decline as a result of increased forest conversion driven by an expansion of agriculture, unsustainable agriculture techniques, road and dam construction and mining and unsustainable logging and poor governance. As is the case with Cambodia, the implementation of REDD-related activities could have a positive impact on slowing the rate of forest cover loss. Myanmar is currently not engaged in any REDD-related activities, though there is much hope riding on the current political reform process. Projections based on the current situation indicate a poor future for Myanmar's forests with heavy reliance on extraction of natural resources, particularly timber export which remains unregulated. Uncontrolled logging remains a significant barrier to forest stabilization as does the ambiguity pertaining to land-use rights, responsibilities, access and ownership. Conversely, across the border in neighboring Thailand, forest cover is projected to increase gradually to 2020. However many concerning issues remain including forest encroachment due to population pressure at the local level as well as the demand for land for industrial crop production. Perhaps the most positive projected outcome is for Viet Nam, where forest cover is projected to increase at a high rate due to a decline in rural population density and an expansion of afforestation programs. One concern is the current pace of forest land allocation which is not proceeding as quickly as expected (FAO, 2011b).

Progress towards sustainable forest management in the GMS – Governance issues

Although there have been encouraging signs such as the expansion of forest cover in Viet Nam and Thailand, the pressures on forests in the GMS remain and are predicted to increase. The rapid expansion of road networks across the region that provide improved access for forest workers to markets, also frequently intrude into primary forest areas resulting in increasing pressure on forest resources. However, this is more common in countries in earlier stages of development, and particularly where regulatory quality is low. In contrast, both Viet Nam and Thailand have high road density but are still increasing forest coverage each year indicating that relationships between population density, road length and forest cover are not linear.

Hydropower dams have also had a detrimental effect on forests, particularly regarding erosion control, and water quality management. Further, the expansion of infrastructure and investment in agriculture and the establishment of cash crop plantations has become a primary driver of forest conversion (FAO, 2011a). Deforestation and loss of canopy cover

has been particularly intense in Myanmar while smaller scale forest loss has occurred in Lao PDR, Viet Nam and Cambodia. The production of rubber, cashew nuts, coconut and sugar cane has been a major cause of forest conversion while in coastal areas shrimp ponds and agriculture have resulted in the loss of mangroves. Rubber and oil-palm have been important crops in terms of forest conversion. In northern areas of the subregion rubber plantations are being established, particularly in sloping areas, and in southern Thailand and southern Myanmar, oil-palm establishment has been an important cause of forest conversion. However, the consequences of rapid infrastructure development have been well recognized globally including in the GMS. As a result, GMS countries have for the past decade, adopted a Sustainable Forest Management (SFM) approach to forestry. SFM supports reduced exploitation of natural forests, increased establishment of plantation resources and greater inclusion of community groups and the private sector in forest management and forestry.

Governments globally are under increasing pressure to improve the regulatory framework governing natural resource management (which includes forests) as well as the application of these laws. During the past decade, there have been successes in the shifting of policy goals in the GMS away from timber extraction only to protection of forests, devolution and multi-purpose management (FAO, 2011b). While regulatory frameworks have improved (though vary considerably from one country to another), the implementation at field level

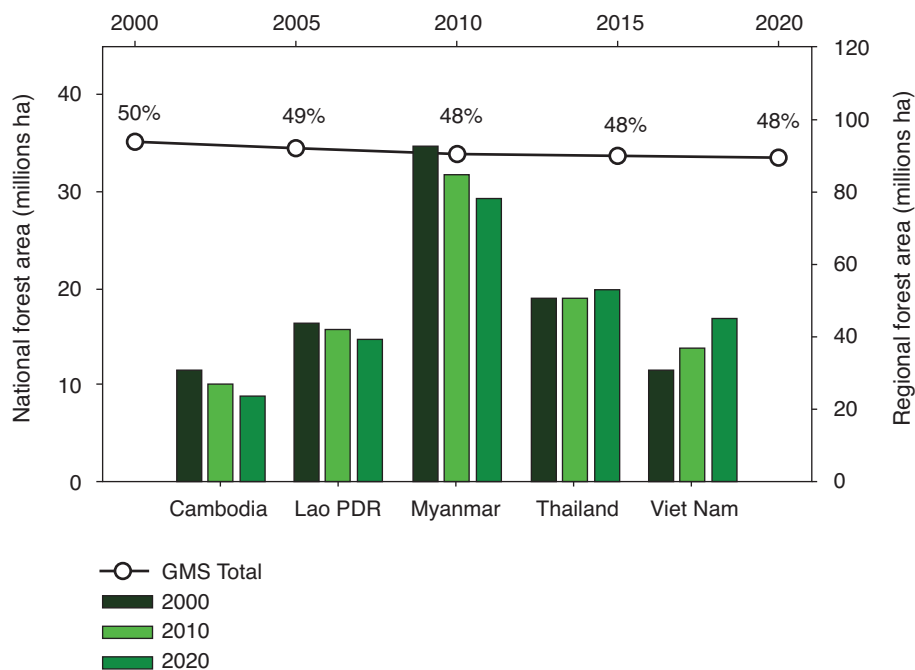


Fig 24—Forest area in GMS countries (FAO, 2011b).

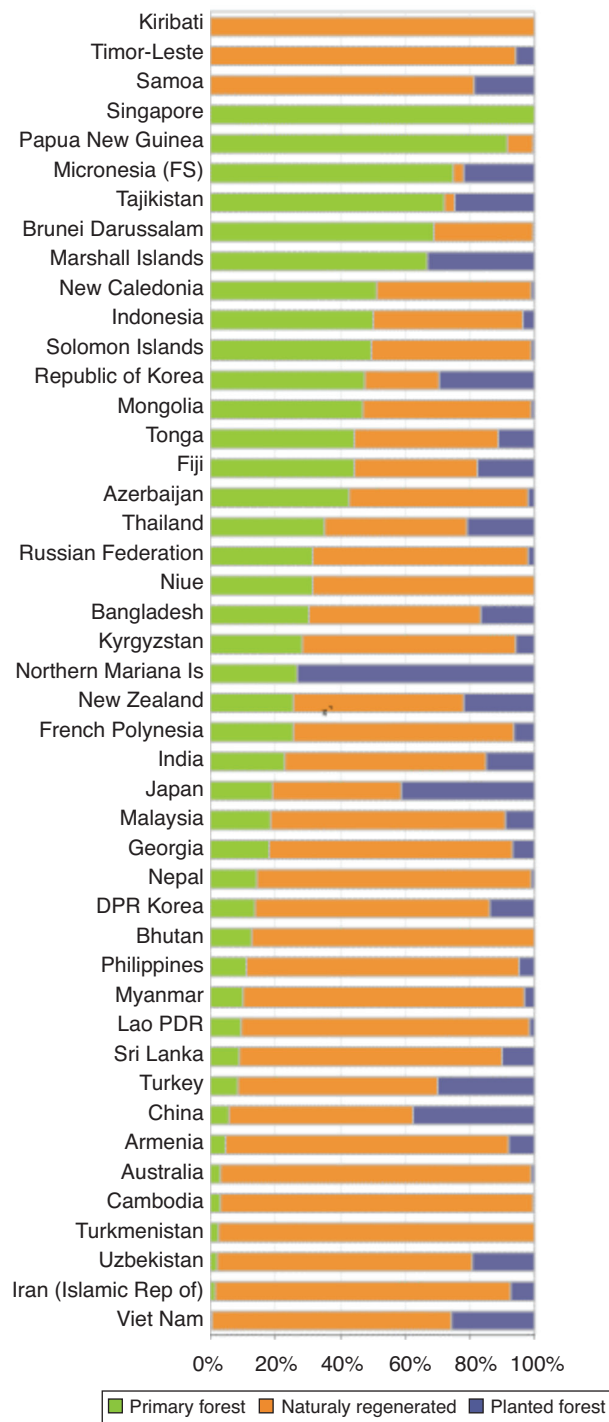


Fig 25—Proportion of primary, naturally regenerated and planted forest, Asia and the Pacific, 2010 (UNESCAP, 2011a).

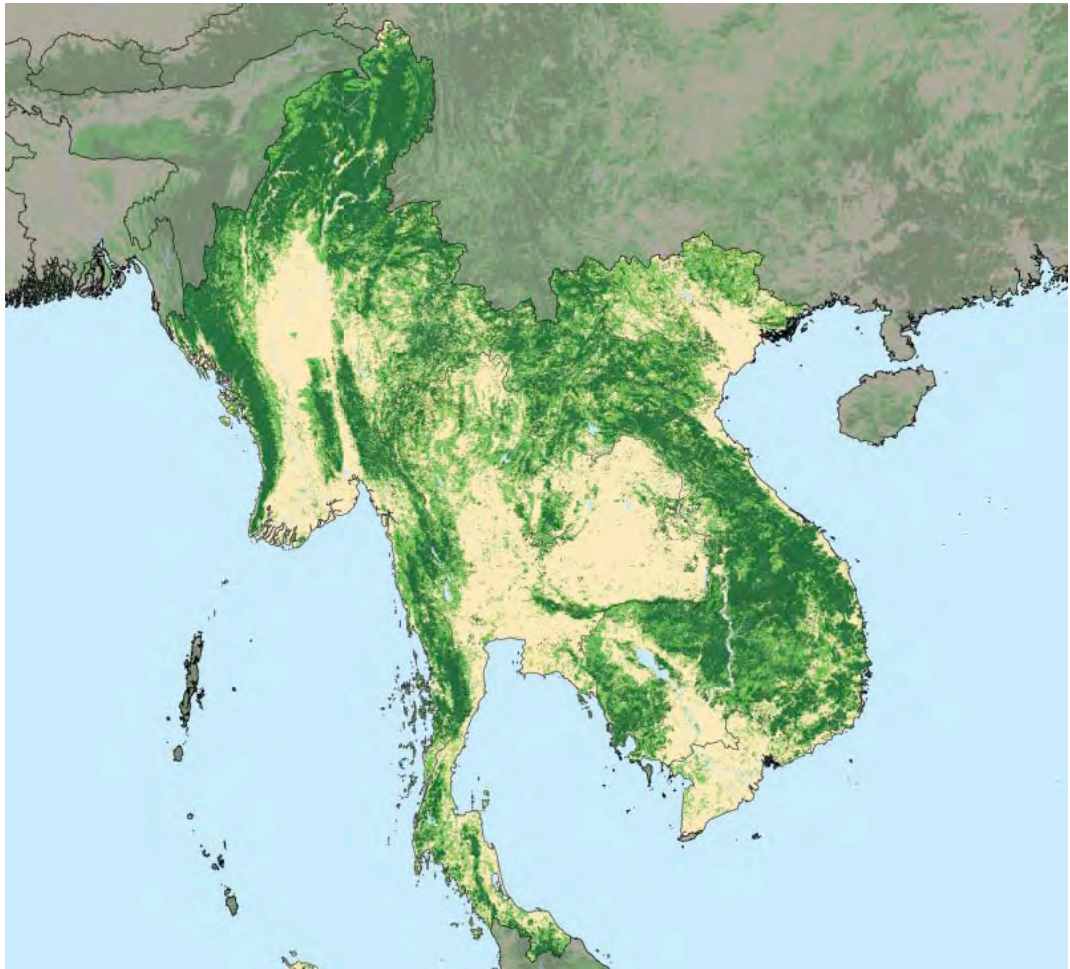


Fig 26—Forest cover in Southeast Asia, 2005 (FAO, 2011a).

has remained a challenge. Key obstacles include high demand for forest land and forest resources, limited sources of alternative employment and low human resource capacity, poor governance and low demand for alternative outcomes. Regional and international measures to improve forest protection in the GMS include collaboration to tackle illegal logging and trade in several countries and efforts are beginning at the regional level to better enforce forest law and improve forest governance.

In addition to revising regulatory frameworks, external factors such as structural changes in economies (particularly the shift away from agriculture to urban-based manufacturing and services), changes in employment patterns with an increase in migration from rural areas to urban centers, calls for increased social justice and economic justice and a re-thinking of land allocation and tenure also drive change in forestry in the GMS (FAO, 2011b).

Regional frameworks

A number of regional frameworks addressing forestry in the GMS have been developed to enhance coordination and implementation of forest conservation in the GMS. Some of the key networks are included below:

- Asia Pacific Network for Sustainable Forest Management and Rehabilitation;
- GMS Forests and Biodiversity Program;
- Asia Pacific Forestry Commission;
- Asia Pacific Network for Global Change Research.

SITUATIONS OF INCREASING RISK

Multiple factors contribute to the increased risk of malaria transmission in the Greater Mekong Subregion. Geography and environment (proximity to forest and fringe forest areas), employment that increases proximity and exposure to malaria vectors (such as the case of forest workers or rubber plantation workers who are exposed to night- time vectors), all affect transmission patterns and risk. In addition, deforestation and changing land use patterns – including large-scale infrastructure projects including dams, roads and railways are contributing factors to the increased risk of transmission.

Health factors also contribute to increased risk of malaria transmission. For example, pregnant women or those who are infected with the human immune deficiency virus are more vulnerable to malaria. Pregnant women are disproportionately affected by malaria and in most endemic areas of the world constitute the main adult risk group for malaria (Roll Back Malaria, n.d.). While the symptoms of the disease are intensified during pregnancy there are also additional concerns as the risk of maternal anemia, stillbirth, spontaneous abortion, low birth weight and neonatal death are all increased. Pregnant women living in areas of low or unstable malaria transmission are at a two-or threefold higher risk of developing severe disease as a result of malaria infection than are non-pregnant adults living in the same area.

In addition to the factors outlined above, children in areas of high transmission are also highly vulnerable. Social and cultural issues may also affect malaria transmission. For example, teenagers watching television programs outside until late into the evening are more at risk of being bitten than those who are indoors.

Changing land use patterns (including deforestation and large-scale plantations) as well as the development of large-scale infrastructure projects pose perhaps the most significant risk for increased transmission in the GMS. Such activities can result in changes in vector ecology (predominant species and biting times); result in an increase in resistant strains with the increase of foreign workers on development projects, many of whom self-medicate; and

increased vulnerability of highland populations with low immunity who seek work in lowland areas and have little or no protection.

Much of the GMS was plagued by serious flooding in 2011, with Viet Nam, Cambodia, Lao PDR and Thailand and Myanmar all experiencing serious flooding with a collective death toll (including the Philippines) of 1,000 people. Besides the human toll, much agricultural land was swamped. Malaria outbreaks following floods often occur because of the expansion in the range and number of vector habitats, changes in human behavior (such as increased exposure to mosquitoes while sleeping outside, a temporary pause in disease control activities, overcrowding), large pools of stagnant water, or changes in the habitat which promote mosquito breeding (landslide, deforestation, river damming, and rerouting). Drought has also affected many GMS countries over the past decade and can also potentially increase malaria outbreaks as the mosquitoes that are transmitting the disease have better conditions to breed, reproduce, and transmit the disease. Many regional health programs are now including a climate change dimension (such as the Lower Mekong Initiative) as climate change, changes in land use patterns, large-scale infrastructure development and migration are all involved in a complex interplay that affects the patterns and distribution of malaria.

Increasing risk of artemisinin resistance

Artemisinin resistance remains another critical issue as the failure to contain resistance will have serious consequences for the region and is also a potential global threat. While significant progress has been made in containing the spread of artemisinin resistance in the GMS the need for ongoing vigilance remains. In the recent update on artemisinin resistance, WHO expressed concern over reduced parasite clearance times in parts of Cambodia, Myanmar and Viet Nam (WHO, 2011b). It is still unclear whether the new foci in southeastern Myanmar, western Thailand and in Binh Phuoc Province in Viet Nam represent spread or *de novo* emergence of artemisinin resistance. To ensure that any gains made thus far are not lost, routine monitoring of the therapeutic efficacy for artemisinin-based combination therapies (ACTs) remains essential so that timely changes to treatment policies can be made. Additionally, routine monitoring can assist the detection of early changes in *Plasmodium falciparum* sensitivity to artemisinins. WHO currently recommends a change of treatment regime when the treatment failure rate of a 28 or 42-day follow-up study exceeds 10%.

The chapter on drug resistance provides detailed information on and results from therapeutic efficacy studies performed in the GMS during the last 5-years.

Cross-border migration

The huge achievement of reduced malaria morbidity and mortality in the GMS region over the past decade has been due in part to cross-border collaboration, as much of the

malaria burden in the GMS region is concentrated along border areas. Migration patterns vary markedly in the GMS region. For example, Myanmar migrants tend to settle for longer periods becoming longer-term migrants while Cambodian migrants are more likely to be highly mobile. Given the high levels of internal and external migration in the GMS, from highly endemic areas to low endemic zones and vice-versa, targeting migrant populations has become a cornerstone of many malaria programs. To date, most of the programs have been reactive in terms of targeting migrant populations, but more recently there has been a call to work more closely with stakeholders beyond the malaria world to start to predict migration patterns and potential malaria hotspots (Gopinath, 2011). In this way, prevention activities could be put in place in advance of potential outbreaks. Pro-active control strategies require information about large-scale development projects and large scale agricultural plantation/ farming and logging in endemic areas *before* they are underway. However, this information is often highly sensitive and/or not readily available to most malaria/disease control programs (Gopinath, 2011).

As the International Organization for Migration stated in the World Migration Report 2010, international migration is likely to *transform in scale, reach and complexity, due to growing demographic disparities, the effects of environmental change, new global and political dynamics, technological revolutions and social networks* (IOM, 2010). Although there are many positive aspects of international migration, migrants frequently lack access to quality health care, education and other essential services. Although migrants contribute positively to the social, cultural and economic development of countries of origin and destination, they are frequently marginalized. In the Asia-Pacific region, migration is characterized by temporary labor migration, where migrants are often unregistered and therefore more vulnerable and harder to reach. The 6 Mekong countries/ regions are signatory to the Bangkok Statement on Migration and Development (2010) which recommended that “*assistance to migrants in all aspects of their health and welfare be increased...enhancing access to information on health matters with a particular focus on those in vulnerable situations...*” and that “*efforts be strengthened to collect and share migration data on health and sex and age disaggregated data*” (UNESCAP, 2010). The malaria programs of the GMS countries have made important progress in working towards these goals. Cambodia, Thailand and Lao PDR have all implemented BCC malaria interventions with high levels of community engagement that specifically target migrant workers. These programs involve both private and public sector providers, though there is a need to scale-up the engagement with private providers.

This subject is discussed extensively in the section on migration and malaria.

Counterfeit and sub-standard medicines

A critical component of addressing artemisinin resistance in the GMS over the past de-

cade has been the move to eliminate oral artemisinin-based monotherapies and to address the problems of substandard and counterfeit medicines (SCMs) which remain a regional public health concern. Counterfeit drugs are responsible for loss of life and sub-standard drugs (genuine drug products with specifications outside the authorized and specified standards, eg, insufficient quantities of the active ingredients) may contribute to antimalarial drug resistance as the parasite may still survive and develop resistant strains (WHO, 2009). In May 2007, the World Health Assembly issued a resolution for a ban on artemisinin-monotherapies and governments of the Mekong countries have been working towards elimination of these medicines, with different degrees of success. A huge amount of work to combat the supply and distribution of SCMs has occurred in the GMS over the past decade. In 2002, a medicines quality monitoring network was established to regularly collect samples of antimalarial drugs in selected provinces in all 6 countries (Delacollette *et al*, 2009). The rate of progress to set up or consolidate quality monitoring mechanisms and action backed up by National Drug Regulatory Authorities has been quite different in each Mekong country and remains a challenge. The set up of the monitoring network was followed by the establishment of an international multidisciplinary group in 2006-2007 which conducted a joint investigation on counterfeit artesunate in the Mekong countries. This group comprised WHO officials, doctors, scientists, United States Pharmacopeia Drug Quality and Information program and INTERPOL. A sample of 391 artesunate tablets collected between 1999 and 2006 in the 6 countries showed a wide variety of fake artesunate, claimed on label as manufactured in China. Evidence was presented to the Chinese authorities who conducted a criminal investigation of the manufacturing sites and subsequently made arrests (Newton *et al*, 2008).

Cambodia has taken the lead issuing a ban in 2008 on all oral artemisinin monotherapies (as monotherapies threaten the therapeutic life of ACTs by fostering the spread of resistance to artemisinin) (WHO, 2010). The government then undertook aggressive actions to enforce the ban through medicines regulatory measures and activities. Efforts to strengthen regulatory capacity and enforcement (including QA of antimalarial medicines and combating counterfeit medicines) included training for police to identify and investigate counterfeit anti-malarials and enforce ban on oral artemisinin monotherapies and improved collaboration between medicines regulatory authorities, police and customs. On February 9, 2011 Cambodia signed the Cotonou Declaration against falsified drugs, a week before inaugurating the Central Office for the Fight against Trafficking in Counterfeit Goods, which brings together civil and military police, customs officers, and health inspectors in Phnom Penh. In April 2011 the French Ministry of Foreign Affairs established the Priority Solidarity Fund Project to support the national authorities of Lao PDR, Cambodia, Thailand, and Viet Nam in the fight against counterfeit products in the GMS. In Myanmar, the Food and Drug Administration has stopped

issuing registration certificates for new oral ART monotherapies and will not renew the validity of those that become expired. The FDA medicines quality monitoring and post-marketing inspection and regulatory actions will be strengthened.

Public awareness raising about the dangers and issues of SCMs in the GMS has been one of the activities led by the Promoting the Quality of Medicines (PQM) program to promote both public awareness and advocacy to engage policymakers through regionally-produced documentary films, televised public service announcements (PSAs), posters and leaflets, radio spots, and other IEC materials.

Regional initiatives to address counterfeit medicines have included the establishment of a strategy by USP PQM (a successor of USP DQI) to Build Regional Expertise in Medicines Regulation and Enforcement (BREMERE) which prioritizes the development of training modules for medicine registration, the development of local expertise in medicine regulation, the sharing of technical resources and expertise in problem-solving and the promotion of south-south cooperation. The development of an Online Medicines Quality Database was officially launched in April 2011 which lists authenticity testing results for 8,700 drug samples to date, including key anti-malarials medications obtained from street vendors, pharmacies, stores and clinics worldwide. The database is freely accessible online, and contains critical quality data such as the time and location of drug sampling. A key feature of the database is that it identifies the location of where counterfeit drugs are being manufactured, allowing countries to identify which drugs are being counterfeited in neighboring countries and increasing awareness of products of concern (<http://www.usp.org/app/worldwide/medQualityDatabase/terms.html>). In the GMS, results of surveys conducted by various partners coordinated by national programs, such as ACTWatch, have shown that fewer counterfeit and substandard antimalarials were marketed in 2010 than in previous years, indicating some measure of success (ACTwatch, 2009; Delacollette, 2011).

As a result of efforts made by the Roll Back Malaria Initiative partners and the WHO, and United States Pharmacopeia in particular, most funding proposals for malaria control supported by the Global Fund To Fight AIDS, Tuberculosis and Malaria now include a strategic component to monitor counterfeits and substandard drugs (Delacollette, 2011). Governments have received extra technical and financial support for regulation and law enforcement, including capacity building to monitor imports and the distribution of medicines, vaccines and laboratory reagents.

Despite advances, problems continue to persist in the form of sporadic availability of poor-quality pharmaceuticals, either manufactured in-country or imported illegally. In addition, GMS countries suffer greatly from the following key constraints:

1. Human resources: National experts and civil servants remain inadequately trained in the quality assurance and quality control (QA/QC) of medicines, many of whom are over-extended with multiple responsibilities but low salaries.

2. Limited institutional capacity: Implementation of rules and regulations regarding pharmaceuticals is complicated by the non-alignment of regulations from multiple institutions. For example, customs agents examine whether or not a pharmacy complies with financial requirements (eg, paying taxes), while the Ministry of Health examines qualifications of the staff operating the pharmaceutical establishments.

3. Poor coordination among in-country law enforcement agencies: Ineffective mechanisms for sharing information on SCMs in a timely manner results in limited concerted enforcement action.

4. Weak inter-country and regional cooperation: Cooperation, collaboration, and coordination of information-sharing, collective investigation, and enforcement on SCMs found in the region remains weak and limited.

5. Continuing limited public awareness about SCMs: Neither regional public education campaigns nor an effective rapid alert system has been put in place in the GMS.

Thus, further strengthening of institutional capability and collective enforcement of legislation and regulation are of paramount importance.

Recently WHO and ASEAN groups on communicable diseases and pharmaceutical development have joint effort to boost action to address above mentioned issues. A meeting was organized in Bangkok on April 24-26, 2012 with concrete action points to be further endorsed by high level decision-makers (WHO, 2012).

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