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W.P. No. 2009-02-03
February 2009

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AHMEDABAD-380 015
INDIA

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Funded in part by a grant to the Regents of the University of California from the Foundation for the National Institutes of Health through the Grand Challenges in Global Health initiative

Abstract

Background

Health economists have traditionally quantified the burden of vector-borne diseases (such as chikungunya and dengue) as the sum of the cost of illness and the cost of intervention programmes. The objective of this paper is to predict the order of magnitude of possible reduction in tourism revenues if a major epidemic of chikungunya or dengue were to discourage visits by international tourists, and to prove that even a conservative estimate can be comparable to or even greater than the cost of illness and intervention programmes combined, and therefore should not be ignored in the estimation of the overall burden.

Methods

We have chosen three Asian economies where the immediate costs of these diseases have been recently calculated: Gujarat (an economically important state of India), Malaysia, and Thailand. Only international tourists from non-endemic countries have been considered to be discouraged, and a 4% annual decline in their numbers has been assumed. Revenues from these tourists have been calculated assuming that tourists from non-endemic countries would spend, on average, the same amount as all international tourists. These assumptions are conservative and consistent with the recent experience of Mauritius and Réunion islands. Non-Resident Indians (NRIs) have been considered half as likely to avoid travel to Gujarat compared to non-Indians. This paper reports inflation-adjusted expenditure figures as 2008 US$, assuming recent market exchange rates of 42.0 INR/US$, 3.22 MYR/US$, 0.68 EUR/US$, and 33.6 THB/US$.

Findings

A 4% decline in tourists from non-endemic countries would result in a substantial loss of tourism revenues – at least US$ 8 million for Gujarat, US$ 65 million for Malaysia, and US$ 363 million for Thailand. The estimated immediate annual cost of chikungunya and dengue to these economies is US$ 90 million, US$ 133 million, and approximately US$ 127 million respectively, indicating that impact on tourism revenues should not be ignored when calculating the burden of infectious diseases. The impact on Gujarat is relatively less because its share of world tourism receipts is just 0.04%, whereas Malaysia and Thailand have healthy shares of 1.64% and 1.82% respectively. A 4% decline in tourists to Gujarat from other Indian states would amount to US$ 9.6 million loss in domestic tourism revenues to Gujarat.

Interpretation

This paper shows that potential loss of tourism revenues due to a severe epidemic outbreak could be substantial. In some cases, ignoring this component could seriously underestimate cost-benefit results, forestalling promising interventions that could benefit the society as a whole or leading to inadequate investment of resources in prevention and public-funded control programmes. This would be to the detriment of especially poorer sections of the society, who may not be able to afford treatment costs. At present data are insufficient for us to make more than a preliminary estimate of the magnitude of the potential loss of revenues from tourism due to a major outbreak of chikungunya or dengue.

Key words: Chikungunya; Cost of illness; Cost of intervention programmes; Dengue; Disease burden; Epidemic outbreak; Gujarat; Malaysia; Thailand; Tourism revenues

Quantifying the Impact of Chikungunya and Dengue on Tourism Revenues

1. Research Problem

1.1 Immediate cost of vector-borne diseases such as chikungunya and dengue

Vector-borne diseases such as chikungunya and dengue have become a major public health problem in tropical and sub-tropical regions, especially in Asia and the Americas. For example, chikungunya affected a third of the population of the island of French Réunion during 2005-06 (Reiter et al. 2006), while India reported 1.5 million suspected cases during 2006-08 (Prajapati & Singh 2008). Dengue is the fastest growing vector-borne disease in the world (WHO 2006), which has put 55% of the world's population at risk in 124 countries (Beatty et al. 2007).

Health economists, for instance Haddix et al. (2002), have traditionally quantified the burden of vector-borne diseases as the sum of the *cost of illness* and the *cost of intervention programmes*. These two are the *immediate* costs of the disease; the overall burden includes other costs and factors as discussed in section 1.2. The cost of illness includes both direct and indirect costs associated with ambulatory and hospitalised cases, and it is also important to consider reported as well as unreported cases (Murtola et al. 2008). Direct costs comprise of medical costs (diagnostics, medicine, etc.) and costs associated with seeking healthcare (transportation, food, etc.), while indirect costs include the value of lost time entailing lost wages, lost schooldays, etc. (Shepard et al. 2006). The cost of intervention programmes for chikungunya and dengue would include research and development costs, a share of household insecticide expenditure (baits, coils, mats, aerosols, liquidators, etc.), and the cost of government vector control programmes such as space spraying with insecticides (fogging), microbial control of mosquito larvae using Bti, and public education initiatives known as ComBI (Communication for Behavioural Impact) or IEC (Information Education

and Communication). As there are no licensed vaccines for chikungunya or dengue, the cost of vaccination is not part of the intervention cost yet.

1.2 Other costs and factors

In addition to the immediate costs (c.f. section 1.1), vector-borne diseases also have other costs and factors such as mortality (Mavalankar et al. 2008), long-term morbidity and other effects on individuals (Lum et al. 2008; WHO 2008), adverse effects on education and economic growth (Bloom et al. 2004; Bloom & Canning 2006), reduced per capita income (Barro & Sala-I-Martin 1995; Bhargav et al. 2001), and reduced foreign direct investment (Alsan et al. 2006; Jones 1990). Mortality and morbidity are often quantified in terms of disability-adjusted life years or DALYs (Homedes 1996; WHO 2004) or lost GDP (for example Armien et al. 2008; Garg et al. 2008).

Both anecdotal and published evidence suggest that tourism can be affected by *Acts of God* (earthquakes, floods, hurricanes, tsunamis, etc., e.g. Sritama 2005), socio-political instabilities (terrorism, pogroms, riots, etc., e.g. Parsai 2002), and epidemic outbreaks (Air Mauritius 2006; Mauritius National Assembly 2006; Rogers and Company Limited 2007; Thomas Cook 2007; TUI Group 2007). Systematic quantification of the impact of various epidemics on tourism revenues is, however, still inadequately addressed in peer-reviewed literature.

2. Methodology

The objective of this paper is to predict the order of magnitude of possible reduction in tourism revenues if a major epidemic of chikungunya or dengue were to discourage visits by international tourists, and to prove that even a conservative estimate would be comparable to the immediate cost of these diseases. The emphasis of this paper is not on the accuracy or certainty of the value predicted, but on its order relative to the immediate costs of these diseases. We have chosen three Asian economies where the immediate costs of these diseases have been recently calculated: Gujarat (an economically important state of India), Malaysia, and Thailand. For these economies,

international tourist arrivals from non-endemic countries have been computed (Table 1) using data from reliable sources (Gujarat Industrial and Technical Consultancy Organization Limited 2008; Tourism Corporation of Gujarat Limited 2009; Tourism Malaysia 2008; Tourism Authority of Thailand 2008). Details of these computations are given in Appendices A, B and C.

In order to be conservative, we have made the following assumptions:

- Only tourists from countries which are not chikungunya- or dengue-endemic are considered to be discouraged. This assumption is also supported by precedents in Mauritius and Réunion (Vasan et al. 2009), and is illustrated in Table 1 for selected endemic regions in South/Southeast Asia, viz. the Indian state of Gujarat (pop. 56.4 million, area 196,077 km^2), Malaysia (pop. 25.3 million, area 329,847 km^2), and Thailand (pop. 66.4 million, area 513,115 km^2). For Gujarat, the number of arrivals of NRIs (Indian citizens who are non-resident or not ordinarily resident in India) were also included as some reports have suggested that their visits might also be affected by epidemics (for instance, Bhushan 2006). However, NRIs have been considered half as likely to avoid travel compared to non-Indians;

- We have assumed that the reduction in annual international tourist arrivals from non-endemic countries would be 4%, consistent with the findings of Vasan et al. (2009). These authors have calculated that a severe outbreak of chikungunya in the French Réunion which affected a third of the population during 2005-2006 led to 4%, 40% and 17% decline in international tourist arrivals from non-endemic countries during 2005, 2006 and 2007 respectively, and that a moderate outbreak that affected 1% of the population in Mauritius slowed down its annual growth in international tourist arrivals from non-endemic countries by 4% during 2006. Our assumption of a 4% annual decline is also comparable to the 15% decline in international tourist arrivals over at least a 3-month period following violence in Gujarat (Parsai 2002);

- Revenues from these tourists have been calculated assuming that tourists from non-endemic countries would spend, on average, the same amount as all international tourists. This would result in a conservative estimate because most affluent countries in Europe and North America are not chikungunya- or dengue-endemic (as illustrated in Appendix D).

Expenditure figures have been inflation-adjusted using annual data from the IMF (2008) and expressed as 2008 US$, assuming recent market exchange rates of 42.0 INR/US$, 3.22 MYR/US$, 0.68 EUR/US$, and 33.6 THB/US$. The revenue calculations are shown in full in Appendix A for Gujarat, Appendix B for Malaysia, and Appendix C for Thailand. The aforesaid conservative assumptions offset the fact that tourism revenues may not decrease as much as the decline in the number of tourists (e.g. Parsai 2002).

3. Major Findings

Table 2 quantifies the potential impact of a major chikungunya or dengue outbreak on tourism revenues assuming a 4% decline in tourists from non-endemic countries (and 2% for NRIs visiting Gujarat). We see that the loss of tourism revenues due to a major outbreak could be in the range of US$ 8 million for Gujarat, US$ 65 million for Malaysia, and US$ 363 million for Thailand. These values are comparable to the estimated immediate annual cost of chikungunya and dengue in these Asian economies, viz. US$ 90 million in Gujarat (Murtola et al. 2008), US$ 133 million in Malaysia (Lee et al. 2009), and US$ 127 million in Thailand (Vasan et al. 2009).

It is striking to compare the potential impact on tourism revenues to the immediate costs of these diseases (estimated by following the more traditional approach). The impact on Gujarat is relatively less because its share of world tourism receipts was just 0.04% in 2007 (Table 3). However, this paper is still very relevant to Gujarat because it aspires to increase its revenues from international tourists, and there is ample scope for growth in this sector. From Table 1, we see that the number

of international arrivals in Malaysia (14 million) and Thailand (11 million) are two orders of magnitude higher than the number of international arrivals in Gujarat (93 thousand).

Malaysia and Thailand also have similar and healthy shares of world tourism receipts (1.64% and 1.82% respectively), which constitute 9.4% and 7.4% of their respective GDPs (Table 3). However, only 16% of foreign tourists to Malaysia come from non-endemic countries as opposed to 70% in the case of Thailand (Table 1). This is because arrivals from Singapore (which is chikungunya- and dengue-endemic) constitute 56% of all international arrivals in Malaysia (1999-2007) but only 6% in Thailand (2001-2006). The average expenditure per foreign tourist is also less in Malaysia (US$ 716) compared to Thailand (US$ 1,150) (Table 2). These factors explain why Thailand's potential loss of tourism revenues is 5.6-fold that of Malaysia (Table 2) even though they are comparable in other aspects.

For a country like Thailand that has a large tourism sector (Table 3) and receives most of its tourism revenues from Europe, North America and other non-endemic areas, this impact could be nearly three times the immediate annual average cost of these diseases. This warning is supported by evidence from Réunion, whose tourism sector is also dependent on tourists from non-endemic areas, especially France (70% of international arrivals to Thailand and 86% to Réunion are from non-endemic countries, see Table 1). Réunion's actual loss of tourism revenues due to the 2005-2006 chikungunya outbreak has been substantial – estimated by Vasan et al. (2009) to be around US$ 339 million for the period 2005-2007.

Our analysis has the following limitations, which we hope will be addressed by future studies:

- The average expenditure per foreign tourist (latest available data) shown in Table 2 differs considerably among the three countries and cannot be explained by considerations of purchasing power parity. It is likely that the data sets (tourism revenues and average expenditure) were generated using different methodologies, and entailed different lengths of

stay, different expenditure patterns for business and leisure travellers, etc., so future work should focus on standardisation and comparability of data between countries. In India, we encountered two sets of data that can be reconciled only if foreign tourists spend just 1-2 days in Gujarat on an average. For instance, the Investment Commission of India (2008) and the Federation of Indian Chambers of Commerce and Industry (Press Trust of India 2007) have estimated the average spend per foreign tourist to be US$ 1566 and INR 65085 respectively – but these estimates are considerably lower than the US$ 700-1050 *daily* spend per foreign tourist reported by KPMG in India (2007) and the Gujarat Industrial and Technical Consultancy Organization Limited (2008). Rai (2007) has also pointed out that the average duration of stay of a foreign tourist in India is 26 days according to the official data, but only 12 days according to the Indian tourism industry. Similarly, Vasan et al. (2009) have also pointed out discrepancies between published sources (e.g. Euromonitor International report) and official data in the case of Réunion. When in doubt, we have always used the conservative of estimates in our calculations; however, discrepancies such as the ones illustrated above need to be resolved urgently.

- Our assumption of a 4% decline in international tourists from non-endemic countries (2% for NRIs visiting Gujarat) needs to be validated further for each economy. Countries that are visited by long-stay foreign tourists (e.g. India, see below) are likely to be more affected by a severe outbreak. We have also not distinguished between NRIs and non-resident Gujaratis (NRGs) due to lack of data (the latter may be less discouraged to visit Gujarat compared to other NRIs). Focus groups and surveys are likely to prove useful in the absence of data, and historical trends in tourism growth and revenues need to be analysed for each economy.

- We acknowledge that estimates for some countries (e.g. Malaysia) are likely to be significant underestimates compared to others due to our conservative assumption that foreign tourists from non-endemic countries would spend, on average, the same amount as all international

tourists. A better understanding of variation in spending patterns is crucial to refining our estimates. This factor can be important in some countries like India, where the average foreigner spends 12-26 days compared to 4.2 days spent in Singapore, and where long-stay tourists come from non-endemic affluent countries such as France, Germany, Switzerland, UK and USA (Rai 2007).

- We have ignored the impact on domestic tourism, which can be significant to a regional economy (e.g. Gujarat), especially within a large country (e.g. India). If domestic Indian tourists prefer visiting another Indian state to Gujarat, it may not constitute a loss in tourism revenues for the Indian economy as a whole; however, it would constitute a loss of tourism revenues for Gujarat, and would be of concern to the local tourism industry as well as policy-makers (e.g. Government of Gujarat). For example, 7,239,328 out of 34,572,143 (20.9%) domestic tourists who visited Gujarat during the period 2005-2007 came from other states (Tourism Corporation of Gujarat Limited 2009). Their daily average spend of INR 500 in 2006 (Tourism Corporation of Gujarat Limited 2009) translates to US$ 14.1 in 2008 terms, so a 4% decline would amount to US$ 9.6 million loss in domestic tourism revenues to Gujarat if the average number of days spent is seven (Patel 2009). This amount is more than the US$ 8 million potential loss in revenues from international tourists (Table 2).

- All our calculations are based on the status quo or anticipated growth without any new promotional initiatives (e.g. Medical Tourism, Incredible India, Vibrant Gujarat, Visit Malaysia Year 2007, etc.) that could boost tourism. Ideally, the impact of epidemic outbreaks on tourism revenues should be calculated on the basis of projections from these initiatives.

- We have not taken into account other changes over time in countries of origin and international travel which may affect tourism, such as varying economic conditions and changing perceptions about terrorism, air travel, etc. We have also not studied as to what extent the perception of an

enduring and consistent endemic disease level keeps international tourists away in the first place.

- We also acknowledge that tourism revenues may not decrease as much as the decline in the number of tourists (e.g. Parsai 2002); however, our conservative assumptions (mentioned above) are likely to offset this factor.

We believe that the limitations mentioned above do not seriously hamper the main argument put forth in this paper, viz. that the impact of major epidemic outbreaks on tourism-derived income can be significant.

4. Conclusions

Reasonable cost-benefit analyses of interventions (e.g. vaccine) to combat vector-borne diseases (such as chikungunya and dengue) are critically dependent on good estimates of disease burden and other impacts of these diseases. This paper shows that potential loss of tourism revenues could be substantial. In some cases, ignoring this component could seriously underestimate cost-benefit results, forestalling promising interventions that could benefit the society as a whole or leading to inadequate investment of resources in prevention and public-funded control programmes. This would be to the detriment of especially poorer sections of the society, who may not be able to afford treatment costs. 'Prevention is better than cure' may be a clichéd proverb, but we believe it is very relevant to policy-makers in countries that have significant inequalities in the distribution of wealth.

At present data are insufficient for us to make more than a preliminary estimate of the magnitude of the potential loss of revenues from tourism due to a major outbreak of chikungunya or dengue. Future studies should address the limitations listed in the previous section, refine the estimate of tourists who alter their travel plans due to epidemics, determine whether travel is cancelled or

postponed, study the link between lost revenues and lost economic output, and also examine decisions of tourists from endemic versus non-endemic countries.

References

Air Mauritius (2006) Annual Report 2005-2006. Retrieved 4 April 2007 from http://www.airmauritius.com/investors%5Cannualreport2006%5CMK%20Annual%20Report%202005-2006.pdf.

Alsan M, Bloom DE, Canning D (2006) The effect of population health on foreign direct investment inflows to low- and middle-income countries. World Development 34(4):613-30.

Armien B, Suaya JA, Quiroz EQ, Sah BK, Bayard V, Marchena L, Campos C, Shepard DS (2008) Clinical characterists and national economic cost of the 2005 dengue epidemic in Panama. Am J Trop Med Hyg 73(3):264-371.

Barro R, Sala-I-Martin X (1995) Economic growth. New York: McGraw-Hill.

Beatty ME, Letson W, Edgil DM, Margolis HS (2007) Estimating the total world population at risk for locally acquired dengue infection. Proceedings of 56th Annual Meeting of American Society of Tropical Medicine and Hygiene, Philadelphia, Pennsylvania, USA, 4-8 November 2007.

Bhargava A, Jamison D, Lau L, Murray C (2001). Modeling the effects of health on economic growth. J Health Economics 20(3):423–40.

Bhushan K (2006) NRI dilemma: to go or not to go to India? Nerve. 9 October 2006. Retrieved 28 August 2008 from http://www.nerve.in/news:25350016271.

Bloom DE, Canning D (2006) Epidemics and Economics. Program on the Global Demography of Aging Working Paper No. 9, Harvard Initiative for Global Health. Retrieved 1 August 2008 from http://www.hsph.harvard.edu/pgda/Working%20Papers/2006/BLOOM_CANNINGWP9.2006.pdf.

Bloom DE, Canning D, Sevilla J (2004) The effect of health on economic growth: A production function approach. World Development 32(1):1-13.

Directorate of Economics and Statistics (2008) State Income, Government of Gujarat. Retrieved 1 February 2008 from http://gujecostat.gujarat.gov.in/StateIncome.htm.

Garg P, Nagpal J, Khairnar P, Seneviratne SL (2008) Economic burden of dengue infections in India. Trans R Soc Trop Med Hyg 102(6):570-577.

Gujarat Industrial and Technical Consultancy Organization Limited (2008) Tourist flow in Gujarat, Annual reports 2006-2007 and 2007-2008 under the Tourist Flow Information System (TFIS), Gujarat, India. Retrieved 31 January 2009 from http://www.vibrantgujarat.com/detailed-sector-profiles/tourism.pdf.

Haddix AC, Teutsch SM, Corso PS (2002) Prevention effectiveness: a guide to decision analysis and economic evaluation. New York; Oxford: Oxford University Press.

Homedes N (1996) The disability-adjusted life year (DALY) definition, measurement and potential use. Human Capital Development Working Paper 68.

IMF (2008) World economic and financial surveys. World economic outlook database. April 2008 edition. Retrieved 25 January 2009 from http://www.imf.org/external/pubs/ft/weo/2008/01/weodata/index.aspx.

Institut national de la statistique et des études économiques (2008) Tableau Économique de La Réunion, Edition 2008/2009, Paris: INSEE, p. 155. Retrieved 31 January 2009 from http://www.insee.fr/fr/insee_regions/reunion/themes/dossiers/ter/ter2008_resultats_economiques.pdf.

Investment Commission of India (2008) Tourism overview. Retrieved 27 November 2008 from http://www.investmentcomission.in/tourism.htm.

Jones T (1990) The Panama Canal: A Brief History. Retrieved 1 August 2008 from http://www.ilovelanguages.com/tyler/nonfiction/pan2.html.

KPMG in India (2007) Accelerating growth in Gujarat: A discussion note by Udhas P, Aggarwal S, Agrawal N, et al. Retrieved 31 January 2009 from http://www.kpmg.co.il/Events/india/conference/thought%20leadership/Gujarat.pdf.

Lee HL, Vasan SS, Murtola TM, Field RW, Mavalankar DV, Gong HF, Ahmad NW, Hakim LS, Murad S, Ng CW, Lum LCS, Suaya JA, Shepard DS (2009) Estimated immediate cost of dengue to Malaysia. In: C.W. Ng & S.S. Vasan (Eds.), Proceedings of 4th Symposium in the Burden of Neglected Diseases (Theme: Refining the estimated burden of dengue and chikungunya in Malaysia), Clinical Auditorium, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia, 17 January 2009.

Lum LS, Suaya JA, Lian HT, Sah BK, Shepard DS (2008) Quality of life of dengue patients. Am J Trop Med Hyg 78:862-7.

Mauritius National Assembly (2006) Debate no. 6 of 25.04.2006: oral answers to questions (No. B/366). Retrieved 12 April 2007 from http://www.gov.mu/portal/goc/assemblysite/file/orans25apr06.pdf.

Mavalankar D, Shastri P, Bandyopadhyay T, Parmar J, Ramani KV (2008) Increased mortality rate associated with chikungunya epidemic, Ahmedabad, India. Emerg Infect Dis 14(3).

Mavalankar DV, Puwar TI, Murtola TM, Vasan SS, et al. (2009) Impact of chikungunya and dengue on tourism revenues of Gujarat (India), Malaysia and Thailand, Working Paper, Indian Institute of Management, Ahmedabad 380 015, India, February 2009.

Murtola T, Field R, Gong HF, Puwar T, Mavalankar D, Vasan SS (2008) A preliminary estimate of the immediate cost of chikungunya and dengue in Gujarat, India. In: Tyagi BK (Ed.) Proceedings of 2nd Conference on Medical Arthropodology, Hotel Sangam, Madurai, India, 15-16 December 2008.

Parsai G (2002) Gujarat violence hits foreign tourist arrivals. The Hindu, 11 April 2002. Retrieved 1 August 2008 from http://www.hinduonnet.com/2002/04/11/stories/2002041100450800.htm.

Patel RM (2009) Senior Consultant, Gujarat Industrial and Technical Consultancy Organisation Limited (GITCO), GITCO House, Opposite Sardar Patel Stadium, Navrangpura, Ahmedabad 380 009, India. Personal communication to Puwar TI (2009).

Prajapati PB, Singh A (2008) Current scenario of vector borne diseases in Gujarat, India. In: Vasan SS & Mavalankar DV (Eds.), Proceedings of 1st Symposium on the Burden of Neglected Diseases, Indian Institute of Management, Ahmedabad, India, 10 September 2008.

Press Trust of India (2007) Tourists spend more in India than France, 28 March 2007. Retrieved 31 January 2009 from http://www.livemint.com/2007/03/28113344/Tourists-spend-more-in-India-t.html.

Rai N (2007) A long haul, Business Standard, 2 February 2007. Retrieved 31 January 2009 from http://www.business-standard.com/india/news/a-long-haul/07/55/273326/.

Reiter P, Fontenille D, Paupy C (2006) Aedes albopictus as an epidemic vector of chikungunya virus: another emerging problem? Lancet Infect Dis 6:463-4.

Rogers and Company Limited (2007) Annual Report 2006. Retrieved 4 April 2007 from http://www.rogers.mu/UserFiles/File/ROGERS%20ANNUAL%20REPORT%202006.pdf.

Shepard DS, Suaya JA, Caram M, Lum LCS, Kongsin, S (2006) Dengue cost of illness studies: Status report to board of councillors, PDVI. Retrieved 28 July 2008 from http://www.pdvi.org/PDFs/BoC-Burden-4-17-06f.ppt.

Sritama S (2005) Tsunami damage: 800,000 tourist trips cancelled. The Nation, 5 May 2005. Retrieved 8 January 2008 from http://www.nationmultimedia.com/2005/05/05/business/index.php?news=business_17259824.html.

Thomas Cook (2007) Annual Report 2005/2006. Retrieved 4 April 2007 from http://www8.thomascook.de/tck/downloads/BPK2007_Annual_Financial_Report.pdf.

Tourism Authority of Thailand (2008) Tourism Statistics. Retrieved 21 July 2008 from http://www2.tat.or.th/stat/web/static_index.php.

Tourism Corporation of Gujarat Limited (2009) Udyog Bhavan, Block No. 16, 4th Floor, Sector 11, Gandhinagar, 382 011, Gujarat, India. Retrieved 31 January 2009 from http://www.gujarattourism.com/tcgl/tourist_arrival_data.html.

Tourism Malaysia 2008 Facts & Figures. Retrieved 18 July 2008 from http://travel.tourism.gov.my/corporate/research.asp?page=facts_figures.

TUI Group (2007) Annual Report 2006. Retrieved 4 April 2007 from http://www.tui-group.com/en/ir/reports/gb_2006/divisions/tourism.html.

UNWTO (2008) Tourism Highlights. 2008 Edition. Retrieved 1 February 2009 from http://www.unwto.org/facts/eng/pdf/highlights/UNWTO_Highlights08_en_LR.pdf

Vasan SS, Murtola TM, Field RW, et al. (2009) A preliminary estimate of the immediate cost of dengue to the ASEAN region. Manuscript in preparation.

Vasan SS, Murtola TM, Mavalankar DV (2009) Impact of the 2005-2006 chikungunya outbreak on tourism revenues of French Réunion. Submitted to the WHO Dengue Bulletin (Special Supplement on Burden of Chikungunya and Dengue).

WHO (2004) World Health Report 2004, Statistical annex. Geneva: World Health Organization.

WHO (2006) Scientific Working Group Report on Dengue. Geneva: World Health Organization.

WHO (2008) Chikungunya Fact sheet No. 327 (March 2008). Retrieved 1 August 2008 from http://www.who.int/mediacentre/factsheets/fs327/en/print.html.

Acknowledgement

Funded in part by a grant to the Regents of the University of California from the Foundation for the National Institutes of Health through the Grand Challenges in Global Health initiative. One of us (Nina Alphey) would like to thank the U.K. Biotechnology and Biological Sciences Research Council for financial support for doctoral studies. We thank all our colleagues who have provided extensive comments on the manuscript. We are also grateful to the organisers of the 2nd International Conference on Tourism (to be held during 8-10 April 2009 at the Indian Institute of Management, Lucknow, India) for selecting this work to be presented as an oral paper. This article has been accepted for publication in the book *Tourism in global village* edited by Devashish Das Gupta (Excel India Publishers, 2009).

Appendix A

Total revenues to Gujarat from NRIs and foreign tourists from non-endemic countries

Table A1 shows the data for annual foreign tourist and NRI arrivals. At least 48%, but no more than 98%, of the foreign tourists had a non-endemic country of residence (Table A2). Hence on average, 44,000-91,000 million tourists arrived from non-endemic countries in 2005-08 (up to first quarter of 2008). NRI arrivals numbered 110,000 annually. Expenditure per tourist in 2007 (INR 64,770) (Investment Commission of India2008) was inflation-adjusted to 2008 INR and converted to US$ using exchange rate 42.0 INR/US$. Expenditure per tourist was found to be US$ 1725. Total revenue from tourist from non-endemic countries, which was used to find the impact shown in Table 2), was calculated to be US$ 77-157 million p.a. (Equations A1 and A2) and the mid-point of this range, US$ 117 million p.a., was used in calculating Table 2. Total revenue from NRI was found to be US$ 190 million p.a. (Equation A3).

Equation A1

Total revenue p.a. = (44,000 tourists p.a.) x (US$ 1725 per tourist) = US$ 77 million p.a.

Equation A2

Total revenue p.a. = (91,000 tourists p.a.) x (US$ 1725 per tourist) = US$ 157 million p.a.

Equation A3

Total revenue p.a. = (110,000 tourists p.a.) x (US$ 1725 per tourist) = US$ 190 million p.a.

Appendix B

Total revenues to Malaysia from tourists from non-endemic countries

Table B1 shows the data for annual foreign tourist arrivals by country or region of origin. Each country/region was identified as either endemic or non-endemic. In the case of uncertainty (e.g. other, i.e. non-specified, country of residence) countries or regions were considered endemic, because this results in a conservative estimate for the impact of an outbreak on tourism revenues. On average, 2.3 million tourists arrived from non-endemic countries in 1999-2007. Expenditure per tourist was calculated by dividing tourist receipts in 2007 (MYR 46,070 million) (Tourism Malaysia 2008) by number of tourist arrivals in 2007. The result was inflation adjusted to 2008 MYR and converted to US$ using exchange rate 3.22 MYR/US$. Expenditure per tourist was found to be US$ 716. Total revenue from tourist from non-endemic countries, which was used to find the impact shown in Table 2), was calculated to be US$ 1,636 million p.a. (Equation B1).

Equation B1

Total revenue p.a. = (2.3 million tourists p.a.) x (US$ 716 per tourist) = US$ 1,636 million p.a.

Appendix C

Total revenues to Thailand from tourists from non-endemic countries

Table C1 shows the data for annual foreign tourist arrivals by country or region of origin. Each country/region was identified as either endemic or non-endemic. In the case of uncertainty (e.g. other, i.e. non-specified, country of residence) countries or regions were considered endemic, because this results in a conservative estimate for the impact of an outbreak on tourism revenues. On average, 2.3 million tourists arrived from non-endemic countries in 2001-2006. Expenditure per tourist was calculated by dividing tourist receipts in 2006 (THB 482,300 million) (Tourism Authority of Thailand 2008) by number of tourist arrivals in 2006. The result was inflation adjusted to 2008 THB and converted to US$ using exchange rate 33.6 THB/US$. Expenditure per tourist was found to be US$ 1,150. Total revenue from tourist from non-endemic countries, which was used to find the impact shown in Table 2), was calculated to be US$ 9,085 million p.a. (Equation C1).

Equation C1

Total revenue p.a. = (7.9 million tourists p.a.) x (US$ 1,150 per tourist) = US$ 9,085 million p.a.

Appendix D

GDP per capita in non-endemic and endemic countries

Table D1 shows a list of countries of tourist origin considered in this study. This table excludes Macao because of unavailable GDP per capita and countries listed as *others* in tourist arrivals data (see Appendices A to C). GDP per capita for each country is shown in the appropriate column depending on whether the country was considered non-endemic or endemic in this study. The calculated average and range figures at the bottom of Table D1 indicate that GDP per capita in non-endemic countries tends to be higher than in endemic countries. We acknowledge that weighted average (based on number of tourists from each country) would have been the ideal way to calculate the average for a given country, but we believe that Table D1 adequately makes the point that tourists from non-endemic countries would, on average, spend *at least* as much as tourists from endemic countries, making this paper's assumption conservative.

Tables

Table 1 Tourist arrivals

Country/ region	Data period	Average annual arrivals (international)	% from non-endemic countries
Gujarat	2005-2007	93,000[1]	48-98%[2]
Malaysia	1999-2007	14,000,000	16%
Mauritius	2002-2007	754,000	60%
Réunion	2002-2004[3]	429,000	86%
Thailand	2001-2006	11,000,000	70%

Table 2 Potential impact on tourism revenues

Country/ Region	Average expenditure US$ per foreign tourist (latest period)	Potential impact on tourism revenues (US$ million)	Estimated immediate cost[4] (US$ million) for comparison
Gujarat	1,725[5] (2007)	8	90
Malaysia	716[6] (2007)	65	133
Thailand	1,150[7] (2006)	363	127

[1] Foreign tourists only; considering non-resident Indians would add another 110 000 to this estimate
[2] Data on the country of origin of foreign tourists was incomplete for Gujarat (non-endemic countries: 48%, endemic countries: 2%, country of origin not specified: 50%) so a range is used instead of a point estimate
[3] Period 2004-2007 was analysed, but due to impact of chikungunya epidemic years 2005-2007 were excluded
[4] Immediate cost = cost of illness + cost of intervention programmes as defined in 1.1
[5] Investment Commission of India (2008)
[6] Tourism Malaysia (2008)
[7] Tourism Authority of Thailand (2008)

Table 3 Tourism receipts and their magnitude relative to GDP per capita in example countries

	International receipts US$ (million) in 2007[8]	Share of world tourism receipts in 2007	Receipts per capita (US$)	GDP per capita in 2006 (US$)	Ratio of receipts to GDP
Gujarat	359[9]	0.04%	6	828[10]	0.8%
Malaysia	14,047	1.64%	555	5,914[11]	9.4%
Mauritius	1,299	0.15%	1,031	5,043[12]	20.4%
Réunion	446	0.05%	556	20,417[12]	2.7%
Thailand	15,573	1.82%	235	3,166[12]	7.4%

Table A1 Foreign tourist and NRI arrivals in Gujarat
(Source: Gujarat Industrial and Technical Consultancy Organization Limited 2008)

	2005-06	2006-07	2007-08
Foreign	75,557	97,178	105,127
NRI	97,565	109,551	123,849

Table A2 Country of origin of foreign tourists (2007-2008)
(Source: Gujarat Industrial and Technical Consultancy Organization Limited 2008)

Country of Residence	Endemic	Percentage of foreign tourists
United Kingdom	no	16
USA	no	9
France	no	9
Australia	no	6
Germany	no	5
Japan	no	3
Singapore	yes	2
Others	?	50

[8] UNWTO (2008)
[9] Calculated based on tourist arrivals and expenditure per tourist
[10] Directorate of Economics and Statistics (2008)
[11] IMF (2008)
[12] Institut national de la statistique et des études économiques (2008)

Table B1 Tourist arrivals in Malaysia by country/region of origin (source: Tourism Malaysia 2008)

Country/Region of Residence[13]	Endemic	1999	2000	2001	2002	2003	2004	2005	2006	2007
East Asia		**6,670,294**	**8,437,995**	**10,519,786**	**11,188,564**	**8,862,005**	**13,718,593**	**14,348,364**	**15,122,453**	**17,212,648**
ASEAN[14]	Yes	5,947,009	7,194,965	9,208,136	9,885,938	8,042,189	12,491,030	13,238,898	13,856,726	15,620,290
China	No	190,851	425,246	453,246	557,647	350,597	550,241	352,089	439,294	689,293
Hong Kong	No	66,981	76,344	144,611	116,409	72,027	80,326	77,528	89,577	94,495
Japan	No	286,940	455,981	397,639	354,563	213,527	301,429	340,027	354,213	367,567
Macao	No						2,240	2,953	4,043	5,995
Mongolia	No						1,438	1,547	2,367	
North Korea	No						10,536	4,689	4,940	8,830
South Korea	No	41,650	72,443	66,343	64,301	46,246	91,270	158,177	189,464	224,867
Taiwan	No	136,863	213,016	249,811	209,706	137,419	190,083	172,456	181,829	201,311
Europe	**No**	**299,647**	**561,350**	**611,107**	**600,296**	**421,659**	**507,226**	**582,456**	**639,166**	**774,411**
Oceania		**152,039**	**256,126**	**252,233**	**218,951**	**163,489**	**227,908**	**299,192**	**311,890**	**361,732**
Australia	No	134,311	236,775	222,340	193,794	144,507	204,053	265,346	277,125	320,363
New Zealand	No	17,728	19,351	29,893	25,157	18,982	23,855	33,846	34,765	41,369
The Americas		**113,274**	**253,410**	**201,722**	**175,607**	**171,502**	**194,894**	**200,929**	**229,505**	**290,325**
Argentina	Yes	1,579	4,984	4,891	1,211	2,030	2,919	4,565	4,388	5,275
Brazil	Yes	870	2,423	2,255	2,560	2,184	1,924	2,235	2,995	4,750

[13] Countries are considered separately if there are endemic and non-endemic countries within a region
[14] Brunei, Cambodia, Indonesia, Laos, Myanmar, Philippines, Singapore, Thailand, Vietnam

Country/Region of Residence[13]	Endemic	1999	2000	2001	2002	2003	2004	2005	2006	2007
Canada	No	25,987	55,799	38,935	34,996	26,978	32,822	31,167	34,730	46,903
USA	No	83,260	184,100	145,827	127,920	131,071	145,094	151,354	174,336	204,844
Mexico	Yes	742	2,846	1,770	2,284	1,491	1,773	1,944	2,588	3,726
Venezuela	Yes	836	3,258	8,044	6,636	7,748	10,362	9,664	10,468	24,827
South Asia	**Yes**	**61,841**	**169,270**	**186,394**	**225,415**	**188,910**	**233,365**	**303,823**	**364,999**	**648,590**
Middle East	**No**	**21,373**	**43,418**	**116,174**	**123,245**	**77,735**	**122,644**	**144,113**	**175,474**	**232,164**
Africa	**Yes**	**12,167**	**13,661**	**28,725**	**21,534**	**17,877**	**21,871**	**21,982**	**26,674**	**31,886**
Other	**Yes**	**600,514**	**486,352**	**858,932**	**738,398**	**673,738**	**676,905**	**530,196**	**676,702**	**1,421,066**
TOTAL		**7,931,149**	**10,221,582**	**12,775,073**	**13,292,010**	**10,576,915**	**15,703,406**	**16,431,055**	**17,546,863**	**20,972,822**
Total non-endemic		**1,305,591**	**2,343,823**	**2,475,926**	**2,408,034**	**1,640,748**	**2,263,257**	**2,317,748**	**2,601,323**	**3,212,412**
% non-endemic		**16 %**	**23 %**	**19 %**	**18 %**	**16 %**	**14 %**	**14 %**	**15 %**	**15 %**

Table C1 Tourist arrivals in Thailand by country/region of residence (source: Tourism Authority of Thailand 2008)

Country/Region of Residence[15]	Endemic	2001	2002	2003	2004	2005	2006
East Asia		**6,095,979**	**6,564,664**	**6,199,719**	**7,070,994**	**6,692,982**	**7,942,143**
ASEAN[16]	Yes	2,393,712	2,623,031	2,654,502	2,936,673	3,099,569	3,556,395
China	No	695,372	763,708	624,923	780,050	761,904	1,033,305
Hong Kong	No	531,300	533,798	657,458	664,988	438,519	463,339
Japan	No	1,179,202	1,233,239	1,026,287	1,194,480	1,181,913	1,293,313
Korea	No	553,441	717,361	695,034	910,891	815,862	1,101,525
Taiwan	No	728,953	678,511	525,916	560,198	375,299	472,851
Others	Yes	13,999	15,016	15,599	23,714	19,916	21,415
Europe	**No**	**2,327,680**	**2,475,319**	**2,283,913**	**2,647,682**	**2,686,567**	**3,321,795**
The Americas		**613,897**	**650,195**	**586,147**	**702,675**	**739,707**	**825,118**
Argentina	Yes	5,674	2,380	1,585	3,018	2,690	3,814
Brazil	Yes	4,258	5,535	4,660	6,275	6,609	8,926
Canada	No	93,006	101,588	97,861	107,505	125,310	149,924
USA	No	494,920	519,668	469,165	566,726	585,476	640,674
Others	Yes	16,039	21,024	12,876	19,151	19,622	21,780
South Asia	**Yes**	**333,936**	**391,371**	**391,064**	**469,101**	**518,878**	**605,236**

[15] Countries are considered separately if there are endemic and non-endemic countries within a region
[16] Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Vietnam

Country/Region of Residence[15]	Endemic	2001	2002	2003	2004	2005	2006
Oceania		**430,806**	**427,014**	**347,849**	**471,493**	**501,882**	**627,246**
Australia	No	366,468	358,616	284,749	396,959	421,594	538,490
New Zealand	No	61,545	65,189	60,545	71,612	77,351	86,703
Others	Yes	2,793	3,209	2,555	2,922	2,937	2,053
Middle East	**No**	**239,200**	**274,878**	**206,234**	**292,680**	**304,047**	**405,856**
Africa	**Yes**	**91,011**	**89,535**	**67,183**	**82,788**	**72,873**	**94,408**
TOTAL		**10,132,509**	**10,872,976**	**10,082,109**	**11,737,413**	**11,516,936**	**13,821,802**
Total non-endemic		**7,271,087**	**7,721,875**	**6,932,085**	**8,193,771**	**7,773,842**	**9,507,775**
% non-endemic		**72 %**	**71 %**	**69 %**	**70 %**	**67 %**	**69 %**

Table D1 Countries of tourist origin considered non-endemic and endemic, and their GDP per capita (current prices in 2006) (source for GDP per capita: IMF 2008)

	Non-Endemic	Endemic
Country	**GDP per capita in 2006 (US$)**	**GDP per capita in 2006 (US$)**
Argentina		5,458
Australia	36,442	
Austria	39,190	
Bahrain	21,123	
Bangladesh		415
Belgium	37,614	
Brazil		5,742*
Brunei		30,626
Cambodia		513
Canada	39,115	
China	2,012	
Czech Republic	13,933	
Denmark	50,904	
Egypt	1,489	
Finland	39,828	
France	36,706	
Germany	35,433	
Hong Kong	27,499	
India		792*
Indonesia		1,641
Iran	3,197	
Ireland	51,800	
Israel	20,177	
Italy	31,802	
Japan	34,264*	
Jordan	2,519	
Korea	18,395	
Kuwait	31,014*	

* IMF estimate

	Non-Endemic	Endemic
Laos		573*
Lebanon	6,147*	
Luxembourg	89,923	
Macao		
Malaysia		5,914
Mauritius		5,043
Mexico		8,060
Mongolia	1,216	
Myanmar		232
Nepal		376*
Netherlands	41,046	
New Zealand	25,129	
Norway	72,768	
Oman	14,032	
Pakistan		817
Philippines		1,352
Poland	8,959	
Portugal	18,418	
Qatar	62,914	
Russia Federation	6,923	
Saudi Arabia	14,733*	
Singapore		31,028
South Africa		5,418
Spain	27,951	
Sri Lanka		1,364
Sweden	43,190	
Switzerland	53,245	
Syrian Arab Republic	1,844*	
Taiwan	15,978	
Thailand		3,166
Turkey	7,760	
United Arab Emirates	38,613	
United Kingdom	39,681	
USA	44,118	

	Non-Endemic	Endemic
Venezuela		6,834*
Vietnam		723*
Average[17]	**28,787**	**5,528**
Range (min-max)	**1,216-89,923**	**232-31,028**

[17] Not weighed with number of tourists, therefore only indicative of the overall trend