Vulnerability to Dengue Fever in Jamaica

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Vulnerability to Dengue Fever in Jamaica\textsuperscript{1}

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1. Introduction

Dengue fever is one of the most important arboviral infections of man and is responsible for more illness and deaths among humans than any other arboviral disease (WHO, 1997). More than 2.5 billion people live in areas where the disease is endemic, and this includes more than 100 countries in Africa, the Americas, the Eastern Mediterranean, Southeast Asia, and the Western Pacific. Southeast Asia and the Western Pacific are the most seriously affected areas (WHO, 1997).

The vector of the disease is different species of the \textit{Aedes} mosquito—\textit{Aedes aegypti} in the Caribbean. This is a tropical and subtropical species of mosquito usually found between latitudes 35°N and 35°S, an area that roughly corresponds to the winter isotherm of 10°C for January (or July in the Southern Hemisphere). Although the vector has been found as far as 45°N and 40°S, such invasions in the warm season have not survived the winters (Tabachnick and Powell, 1979). The influence of temperature on \textit{Aedes aegypti} and on the transmission of dengue is manifested in several ways. Temperature affects the rate of

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larval development, adult survival, vector size, and efficiency (Wilson, 2001). In addition, temperature affects the extrinsic incubation period, which is the time needed for viral multiplication and invasion of the salivary glands of the mosquito. This must occur before the next infectious blood meal can take place (Wilson, 2001).

The vector is highly domiciliated and breeds in water storage containers and receptacles found within the home. It thrives in urban environments where environmental sanitation is poor; where water collects in blocked drains, improperly discarded tires, bottles, and coconut shells (WRI, 1998). Its larvae are also encountered in tree holes and herbaceous plants in which rain water collects. So rainfall is necessary for breeding in outdoor habitats. The eggs can resist desiccation for up to one year and hatch when sites are flooded with water. This explains why the mosquitoes can emerge as if from nowhere at the end of long, dry spells.

The disease is caused by any of the four serotypes of the arbovirus known as dengue-1, dengue-2, dengue-3, and dengue-4. These four serotypes are epidemiologically similar but genetically and antigenically distinct. Infection with one serotype leads to protection against homologous reinfection but provides only brief protection against heterologous infection (WHO, 1997). Sequential infection increases the risk of acquiring the more deadly dengue hemorrhagic fever/dengue shock syndrome (DHF/DSS) because of the severity of antibody response (Valdes et al., 2000). The propagation of the virus appears to be dependent on human populations with a sufficient number of susceptible members to support infection (Ehrenkranz et al., 1971).

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The symptoms of the disease appear within four to six days of being bitten by an infected mosquito, and in the early stage, it may be nonspecific and may be very easily mistaken for illnesses such as influenza. There is a sudden onset of high fever, headaches, severe muscle and joint pains, and pain behind the eyes. These symptoms can last up to 10 days, but complete recovery can take up to one month. These symptoms are mild compared with those of DHF, in which the blood vessels can leak, causing bleeding of the nose and gums and can eventually collapse giving rise to the oft fatal dengue shock syndrome (DSS), which has a fatality rate of 5 percent.

It is believed that the fever has been present in the Caribbean for the past 200 years and has been responsible for large epidemics, but there was no virological evidence of the disease until the 1950s (Ehrenkranz et al., 1971). In 1953–1954, the dengue 2 virus was repeatedly isolated in Trinidad, probably indicating a high degree of endemicity there. Ten years later, an epidemic of dengue 3 swept through much of the Greater and Lesser Antilles, and this was quickly followed in 1968 by an epidemic in which dengue 2 and 3 were isolated (Ehrenkranz et al., 1971). Dengue 1 was first isolated in Jamaica in 1977. In that year, there were 60,000 reported cases, but it was estimated that there were about 105,000 cases in the capital city alone. From Jamaica, the outbreak spread to virtually every island in the Caribbean, as well as to the Caribbean rim of South America (Pan American Health Organisation, 1997). The last of the viruses to appear, dengue 4, emerged in 1981, causing a series of outbreaks in the region. With all four viruses in circulation, an outbreak of DHF, which affected almost a half of the population of Cuba
in 1981, was not unexpected. This is considered one of the most important events in the history of dengue in the Americas (CAREC, 1997). In almost every year since this outbreak, there have been confirmed or suspected cases of DHF in the American region. All four dengue serotypes are currently circulating in Jamaica, and the Caribbean and the last large epidemic in Jamaica occurred about 10 years ago.

There is, therefore, much justification for the concern over the danger posed by climate change. There is some agreement that climate change will have important implications for vector-borne diseases such as dengue fever since the development, dynamics, abundance, and geographical distribution of the vectors, as well as the viruses are affected by elements of climate (Martens et al., 1997). As far as the virus is concerned, it is expected that an increase in temperature will shorten the required incubation period, and this will translate into potential higher transmission rates (Watts et al., 1987). It has already been demonstrated that increasing temperatures are altering the geographic range of A. aegypti, which are now appearing at elevations at which it was previously absent (Suarez and Nelson, 1981; Koopman et al., 1991). Previously limited to 1000 m in elevation, dengue appeared for the first time at 2000 m in Colombia in 1980 (Suarez and Nelson, 1981) and at 1700 m in Mexico in 1986 (Koopman et al., 1991). Hales (2002) has also shown that with higher temperatures, the disease has the potential to spread into higher latitudes.

The situation is a bit more complex for countries such as Jamaica, where conditions are already favorable for the vector and virus. Focks (1995) estimated that with higher
temperatures, *Aedes aegypti* will become infective more quickly, reproduce more rapidly, bite more frequently—conditions that could all increase transmission in areas where the disease is currently endemic. Endemic areas may also face increased risk of DHF (Patz et al., 1998; WHO, 2002). Preliminary studies have shown a link between El Niño Southern Oscillation and the incidence of dengue in some Pacific island nations where the phenomenon has a strong effect on weather (Hales et al., 1999). For such countries, it is crucial to assess present vulnerability, to identify those groups that are at risk and the factors that put them at risk as a prerequisite to the adoption of efficient and feasible mitigating strategies.

In this paper, an attempt is made to assess the vulnerability of the population of Jamaica to dengue fever and to identify the specific factors that put communities at risk. It will examine the ability of the country to respond to stressful events in general, as well as to an increase in the transmission of dengue fever.

2. Background

Retrospective analysis of the climatic data by the Climate Studies Group, Mona (CSGM) at the University of the West Indies showed that the Caribbean region experienced a warming trend during the past two decades (Peterson et al., 2002). A similar upward trend was noted for a number of rainfall indices also calculated for the Caribbean over the past four decades (Peterson et al., 2002), but these did not appear to be statistically significant.
Analysis of the disease data obtained from the Caribbean Epidemiological Centre (CAREC) in Trinidad and Tobago for the corresponding period showed that the incidence of dengue in the Caribbean was higher in the 1990s than in the 1980s and that the majority of the outbreaks occurred in El Niño and El Niño +1 years (Table 1 and Figure 1). The association of the epidemic with El Niño events may be due to the existence of warmer temperatures and drier than normal conditions during the latter part of the El Niño years and wetter than normal conditions during the first half of the El Niño +1 year (Chen and Taylor, 2002; Taylor et al., 2002).

![Caribbean- Reported Cases](image)

Figure 1. Variation of annual reported cases and rate of change. Key: En, El Niño; W-En, Weak El Niño; En+1, El Niño +1; Ln+1, La Niña +1.

Table 1. *Distribution of epidemic peaks among ENSO phases (1980–2001)*
<table>
<thead>
<tr>
<th>Region</th>
<th>Total</th>
<th>El Niño and El Niño+1</th>
<th>La Niña</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caribbean</td>
<td>8</td>
<td>7</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>8</td>
<td>6</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Barbados</td>
<td>6</td>
<td>5</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Jamaica</td>
<td>5</td>
<td>4</td>
<td>–</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Climate Studies Group, Mona, University of West Indies.

Seasonally, the epidemic peaks in the latter part of the year after a few months of warming, and for the most part, when the rain is receding. Also, there is a lag between climatic parameters and the epidemics. An example is the pattern shown in Figure 2 for Jamaica. Throughout the Caribbean, the association of the disease with temperature is stronger and the lag with temperature is greater than that with rainfall, as indicated by statistical correlations. The intra-annual variability of the disease appears to depend on both temperature and rainfall, but the onset of the disease appears highly sensitive to temperature.
Mean temperature projections for stations in Jamaica, as well as Trinidad for the years 2020, 2050, and 2080, using statistical downscaling methods indicate a possibility of increased warming in the next century (Climate Studies Group Mona). Two scenarios were considered, Special Report on Emissions Scenarios (SRES) A2 and SRES B2, and the results of both agreed fairly closely with an increase of nearly 2°C by 2080. The trend in rainfall is not as pronounced (CSGM).

Analysis of retrospective climatic data revealed a warming trend in the past two decades. Preliminary results from statistical downscaling techniques signal further warming in the coming decades. These conditions may enhance dengue transmission rates. Although
there have been several small outbreaks of dengue in Jamaica during the past few years, the last large outbreak occurred almost 10 years ago, and immunity may be low. However, there are individual and contextual circumstances that could modify vulnerability, which could make communities more or less susceptible, and these are the issues that are investigated in this paper.

3. Methodology

The United Nations Development Programme (UNDP) defines a country’s generic adaptive capacity, as the institutions and environment that would enable it to adapt to a range of stresses, including environmental and economic change. A high generic capacity was associated with high levels of income, employment, good existing health, and the existence of support networks, all of which were likely to make a society resilient to a variety of stresses (UNDP, 2003). Conversely, low generic adaptive capacities rendered societies less resilient to shocks. Generic adaptive capacity provides the foundation for adaptation. Elements of high adaptive capacity were viewed as having synergies with human development including, for example, institutions for the sustainable use of resources, access to health care, decentralized decision making processes, and an established scientific base. Such institutions would be more likely to allow the country to make appropriate responses to weather and climate hazards (UNDP, 2003). Consideration of adaptive capacity should begin with national-level assessments, as trends at this level would reflect the ability of a country to respond to any shock, and this, in turn would have significant implications for its ability to respond to a specific disaster, that is, its specific capacity.
Therefore, the problem was approached at two levels. At the macro level, current economic and social trends in the island were examined, and particular emphasis was placed on the manner in which these conditions impacted on the most vulnerable. In addition, interviews were conducted with the heads of those agencies that were responsible for the policy document *Jamaica’s First National Communication to the United Nations Framework Convention on Climate Change*, which outlined the concerns of the country insofar as climate change was concerned. They were the National Environmental Planning Agency, the National Meteorological Division, and the Office of Disaster Preparedness. The purpose of these interviews was to assess how these organizations interpreted their roles, how prepared they were for the challenges that climate change would bring, and what efforts they were making to sensitize the public about climate change and its implications. The activities of these institutions are directed to the sustainable use of resources and so can facilitate appropriate responses to hazards.

At the specific level of investigation, there were interviews with six officials in key positions in the Ministry of Health. They were the Principal Budget Holder, Medical Officers in the Surveillance Department, the Environmental Health Officer, Chief Public Health Officer, and Health Educator. They were seen not only as key informants but as stakeholders who were being given the opportunity to become involved in the planning stage, to share research results, and to use those results for the benefit of the constituents they served. The interviews were, therefore, seen as bidirectional communication, a mechanism for involvement and sharing. Interviews were also conducted with scientists in the Climate Change Group of the University of the West Indies.
In addition, a local-level study was incorporated into the analysis to provide a more comprehensive assessment of the island’s vulnerability to dengue fever. An attempt was made to select a community that had been the focus of outbreaks in the past, but this was hampered by the fragmentary nature of the medical records. In the absence of complete data, the researcher had to see whether the data on dengue occurrence in any one year formed a recognizable spatial pattern, and on the basis of the pattern, which was obtained in 1998, a section of the parish of St. James in the northwest of the island was selected. In that parish, there was a concentration of cases within the city of Montego Bay and sporadic cases within proximity of a permanent stream with associated seasonal streams and gully banks. (Figure 3). Three communities were selected along this hydrological feature:

![Dengue Cases 1998 - St James](image)

**Figure 3:** Distribution of dengue cases in St. James, Jamaica, 1998.
Granville/Pitfour, a suburb of the parish capital Montego Bay; Retirement, immediately beyond the boundaries of the urban area; and rural Johns Hall. A questionnaire was administered to a 10 percent sample of heads of households in the three communities (Table 2). The questionnaire solicited information on the socio-economic

**Table 2. Sample Size**

<table>
<thead>
<tr>
<th>Community</th>
<th>Number of households</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granville/Pitfour</td>
<td>1507</td>
<td>151</td>
</tr>
<tr>
<td>Retirement</td>
<td>485</td>
<td>49</td>
</tr>
<tr>
<td>John’s Hall</td>
<td>572</td>
<td>57</td>
</tr>
<tr>
<td>Total</td>
<td>2564</td>
<td>257</td>
</tr>
</tbody>
</table>

conditions of the householders, support systems, their knowledge of the disease, and cultural practices that might have important implications for the spread of dengue fever.

**4. Generic Capacity**

The massive inflow of capital associated with the development of the bauxite/alumina industry in Jamaica in the 1950s served to expand a market that hitherto had been dominated by the export of agricultural products. However, the boom came to an end in the early 1970s, and the island experienced a series of crises which forced it to seek the support of the International Monetary Fund (IMF). There is support for the assertion that the adjustment measures recommended by the IMF were felt most keenly by the poor because of job loss, the increases in prices consequent upon devaluation and the removal of subsidies on basic items, and the deterioration in the social services upon which they depended (Witter and Anderson, 1991; Anderson and Witter, 1992; Freckleton, 2003;
Alleyne and Karriagianis, 2003). No real economic growth has occurred in the country over the past three decades.

Poverty line studies show the incidence of poverty in the island fluctuating annually. It reached its highest point in 1991, 45 percent (PIOJ/STATIN, 1993), and since then, it has been fluctuating downward. Rural rates are persistently higher than urban. In addition, one study explored levels of poverty in Kingston’s inner city areas (www.idpm.man.ac./uk/crpc) and argued that despite a reduction at the macro level, the situation remains the same in these areas. Annual remittances to the island have shown a remarkable increase (Figure 4), and although its effects on poverty have not been measured, it was the most frequently cited source of income mentioned in Levy’s study of inner city communities (Levy, 1996).

![Remittances 1990 - 2001 Jamaica](image)

**Figure 4.** Remittances ($US million) to Jamaica from 1990 to 2001. Source: Statistical Institute of Jamaica, 2002.
4.1 Interviews

The presence of organizations with an interest in sustainable development is considered to be indicative of high generic capacity, as these are some of the institutions whose work can facilitate adaptation. A number of these organizations in the island were responsible for articulating the country’s position on climate change, and therefore, the heads of these organizations were interviewed. The primary interest was in the scope of their activities and the extent to which they saw health as an outcome of sustainable development.

The Office of Disaster Preparedness and Emergency Management has a mandate to manage all aspects of disaster management and risk reduction. It does so by an inclusive approach, working in partnership with other agencies. It is an approach that allows it to pursue programs that would be impossible to carry out in isolation and also to influence national risk reduction. The informant from this organization cited sea level rise and the inundation of coastal areas with resulting population displacement as areas that were of great importance. However, although the agency felt that it ought to be communicating its concern about climate change to the public, it had not included it in their public education campaign because

“climate change is not a simple topic to grasp. The average man cannot relate to it as it seems very far-fetched to him … its effects are long term and … individuals don’t care about things that do not affect them immediately …”

These organization heads knew little about the possible health effects of the change, but health was not seen as a part of their mandate. Besides, they said, there were resource constraints.
The National Environment and Planning Agency’s (NEPA) mission is to promote sustainable development by ensuring protection of the environment. The issue of climate change was addressed indirectly in their public education programs but “the term was not used with the general public as it would be difficult to understand. The attitude of this agency mirrored that of The Office of Disaster Preparedness and Emergency Management (ODPEM). Instead of looking for ways of communicating the message of climate change to the public, they presumed a lack of intelligence and avoided the issue altogether. They, too, saw no need for the inclusion of the health threats in their mandate.

The National Meteorological Service saw its role as far as climate change was concerned in terms of conducting research for adaptation by those sectors that may be affected by the phenomenon and communicating the information to the stakeholders, as well as the public. Unlike the officials at the other agencies, the expert here demonstrated a full appreciation of the health implications of climate change—those related to stress, respiratory diseases, and the effects of increased transmission of vector-borne diseases. The public, he thought, should have access to information on the potential health consequences. With more resources, health impacts might be addressed by his organization although, he said, sea level rise would take precedence.

What was curious about these three interviews was the narrow interpretation of their mandates and the unwillingness to acknowledge health as a part of their purview even when it clearly was. Since its establishment in 1980, ODPEM has been called upon to deal with three types of hazards – hurricanes, landslides and floods occasioned by intense
rainfall. Displacement of population resulting from hurricanes and floods have been accompanied by outbreaks of communicable diseases in shelters managed by ODPEM (Bailey, 1989), and this is one of the most critical areas in shelter management. Yet there was no acknowledgment of interest in diseases resulting from hazards. Moreover, much of the experience gained in hazard management occurred as a result of the occurrences of hurricanes and floods. These have been increasing in frequency and intensity, and the island is being severely affected. Yet, the informant did not see the increased frequency of these events as some of the possible products of climate change and as more immediate threats than the effects of sea level rise.

Insofar as NEPA was concerned, it was interesting that although the direct link between the health of the environment and that of the population was explicit in their mission statement and that the monitoring of effluent discharge and water quality had as their stated goal the protection of human health (www.nrca.org/publications), the position of the informant was that there was no interest in health. The literature produced for the public education campaign of the Meteorological Service contained information on health impacts. This was at variance with the insistence of the interviewee that there were no plans to incorporate health impacts into the education program of the organization. In all of the organizations, there was this preoccupation, almost fascination, with sea-level rise. Health was the business of the Ministry of Health, and the Meteorological Service’s reluctance to see itself in partnership with the Ministry of Health and to interpret its remit and roles in the broadest sense limit the extent to which it could be regarded as providing a broad foundation for adaptation.
5. Specific Capacity

5.1 Ministry of Health

Key informants at the Ministry of Health comprised the Principal Budget Holder, two Medical Officers in the Surveillance Department, the Environmental Health Officer, a Public Health Inspector, and the Health Educator. They were all aware that climate change in the Caribbean could produce increasing temperatures and precipitation. Most saw the possibility that these changes could increase dengue transmission. One of the officials, however, thought that increased transmission was a remote possibility and could see no reason for a dengue alarm in the island. In spite of the majority opinion, no long-term strategies had been put in place or were being considered to cushion possible negative impacts. Dengue fever is classified as a Class 2 disease and was given significantly less priority than Class 1 diseases, especially HIV/AIDS, which is life threatening. There was repeated reference to the problem of inadequate funding and the resulting need to establish priorities. They cited cuts in budgetary allocations and an overall resource problem, which have resulted in a reactive approach to dengue control and prevention.

There is a growing feeling, however, that the competition between HIV/AIDS and diseases such as dengue is not so much for financial resources as for attention. Large sums of money are flowing into the country from the Global Fund, and this is having the unfortunate effect of diverting attention and manpower from other areas of the health sector. Alliance for Health Policy and Systems Research, an initiative of the Global
Forum of Health Research and WHO, is encouraging research on the manner in which money disbursed by funding agencies such as the Global Fund to fight HIV/AIDS affects the broader health system. The research focuses on the policy environment, public/private mix, human resources, pharmaceuticals, and commodities. This initiative is extremely important in view of the large amounts of new resources that are targeting specific diseases, as disease-focused programs have a variety of direct and indirect effects on health care systems in general (Alliance for Health Systems Policy Research/WHO, 2005). Moreover, the many bottlenecks in the under-resourced health system are proving to be constraints on the effectiveness of programs that target HIV/AIDS (Alliance for Health Systems Policy Research/WHO, 2005).

At the moment, there is no vaccine which prevents dengue or DHF, and the only effective method of prevention is the elimination of the vectors and their breeding places. The WHO has very clearly outlined priorities for control, and a very important measure is epidemiological surveillance, which includes both entomological surveillance and monitoring of the types of human behaviors that contribute to larval habitats (WHO, 2002). In addition, according to WHO guidelines, health authorities are expected to improve emergency preparedness and response and strengthen national control programs; to promote behavioral change through the development of guidelines for the sustainable prevention and control of vectors at all levels; and to encourage/accelerate research programs with an emphasis on pathogenesis, transmission dynamics, and the building up of partnerships internationally and at all levels of the society (WHO, 2002).
These actions are represented as priorities by WHO, but for a variety of reasons, the requirements are difficult to meet. Informants reported a staff shortage of as high as 50 percent at various levels in the Ministry, including entomologists and public health inspectors. The situation is not expected to improve in the near future since, speaking of the position of public health inspectors one of the officials at the Ministry stated:

“…it will be difficult to find one; the salary is unattractive, the workload is heavy, and they do not get the respect that they deserve.”

There is one underequipped virology laboratory in the island, and this prevents the swift identification of dengue cases. Samples have to be sent to Trinidad and Tobago for identification.

Individuals, too, have a role to play in vector control. They must ensure that their premises are free of the preferred habitats of *Aedes* and use source reduction techniques. They must also facilitate the application of residual insecticide and participate in community action to control larval habitats. Methods of achieving these ends must be communicated through public education programs. Such programs will facilitate individual action and also increase the effectiveness of public-sector programs of vector control. The importance of this type of input can be illustrated by the results of a recent study. Community spraying is sometimes undertaken in response to complaints of high levels of infestation. The habits of the vector require that all doors and windows be left open during this exercise, but the study revealed that roughly 44 percent of respondents said that they close their doors and windows (Heslop et al., 2005). Individual and community action is of paramount importance in control, but the government must take the lead; they must establish partnerships with communities.
An informant in the Ministry of Health in the parish of St. James stated that as far as vector control was concerned, they operated on a zero budget. There was no routine exercise, but knee-jerk responses to reports of heavy infestation in specific communities or to special circumstances. She cited the preparation for the regional Caribbean Common Market (CARICOM) Heads of Government meeting held in Montego Bay, St. James, in 2003. The cost of the attempt at vector control in a small area around the hotels was J$ 289,400. On occasions such as these, geographical coverage is so restricted as to be little more than a palliative.

The position of the Ministry of Health was summed up by one of the informants. Environmental sanitation was the responsibility of members the community because they were the key players in the existence of mosquito breeding sites. Government intervention could result in a shift of responsibility from the community to the state. Gubler (2002) has in fact reported that governments’ intervention and reassurance that they can control epidemics in Asia and the Americas have resulted in a false sense of security by the public, which then do nothing to control breeding sites. A lot depends on the manner in which the message is transmitted. For effective control, the message must be couched in terms of a partnership and, as the WHO insists, the surveillance and monitoring of behaviors to ensure that communities are adhering to their commitments are a part of the responsibility of the government. Community structures that would facilitate collective action are often lacking in situations where they are most needed. In
addition, in Jamaica, the financial problems have also curtailed the public education program that must underpin efforts to make communities more responsible.

One informant, however, highlighted several positive aspects to the current situation. The country, she pointed out, has a well-organized system of primary health care, based on a nested system of health centers, offering different levels of care. An exercise was undertaken in the late 1970s and early 1980s to ensure that there was a health center within five miles of every community in the island (Figure 4), for this was the pillar on which the system of care rested. Moreover, health services have been decentralized, and the island divided into four health regions (Figure 5) to enhance the delivery of care and to allow the participatory decision making that is important to adaptation.

It should be pointed out, however, that notwithstanding the overall reach of primary health care services, there are some rural areas that are disadvantaged both in geographic and socio-organizational terms. The services that are most needed are not always physically accessible.
Figure 5: Health Centers in Jamaica

Source: Ministry of Health, Jamaica

Figure 6: Health Regions in Jamaica

. Source: Ministry of Health, Jamaica
Another positive aspect is the recent decentralization of the health system. Until 1995, the island’s health sector was highly centralized, with the Ministry of Health responsible for both policy making and day-to-day operations. With decentralization, four regional authorities were created with mandates to carry out health interventions in their respective regions (Figure 6). The Ministry of Health now functions more in a regulatory capacity rather than in its traditional role as centralized manager. Regions now have autonomy in meeting their identified health needs. There is, therefore, greater sensitivity to local needs, and there should be greater responsiveness in the event of outbreaks of epidemic diseases. Although the health system is affected by financial constraints, there is a strong network that could be mobilized in emergency situations.

Moreover, the interviewee continued: The Ministry of Health in the island has a long tradition of involvement in policy oriented research. This is unquestionably true. Few research projects in health with policy implications are undertaken at the University of the West Indies (UWI) without the involvement of the Ministry of Health. There are occasions in which the research/policy collaboration has been initiated by the Ministry with a view toward investigating the effects of its policy on vulnerable groups (Gordon-Strachan et al., 2005). In fact, an official from the Ministry of Health is working closely with the Climate Change Group at the University of the West Indies on this dengue project. The work of this group is undoubtedly a positive element on the landscape, and the collaboration of the ministry would facilitate an easy flow of research evidence to policy makers.
5.2 Communities

Granville/Pitfour is a community of just over 6,300 persons on the outskirts of the tourist center of Montego Bay. It is a low-income community comprising a mix of formal and informal structures. Most of the informal structures consist of one-roomed dwellings, and this community has the highest room densities (4.2 persons per room) of the three under study. Heads of households were self-employed or worked in the service sector in Montego Bay. A few miles away is Retirement, a lower middle-income community of 1,783 persons with few obvious informal dwellings. Heads of households were also employed in the service sector in Montego Bay and in the public service. John’s Hall is a poor community of rural squatters. It consists of small crudely built houses, most lacking basic amenities and scattered over rugged terrain. Few heads of households were employed in agricultural pursuits even for their own subsistence, which can be partly explained by the fact that roughly 60 percent of the households were headed by women. The women were of low educational attainment and lacked skills training. This placed them at a disadvantage in the labor market, and those who were employed were in domestic service and petty trading, activities that attracted incomes at the minimum wage or below. Male heads shared similar characteristics and were employed as gardeners and laborers on construction sites. Unemployment in this community stood at 33 percent.

Wisner (1993) advocates a resource-based approach to measuring vulnerability, one that begins by asking questions about the situation in which people find themselves and the characteristics of groups. One needs to know about access to a variety of resources—physiological, social, and economic. Using this approach, a matrix of social indicators is
derived that can ultimately form part of a vulnerability profile that include gender, disability, access to resources, and locational patterns. Responses given in the questionnaire survey were used to construct a vulnerability index based on a number of indicators identified in the literature. Although composite indices of this sort are useful in that they give a single value measure of vulnerability, it is recognized that the choice of variables is based on subjective judgements, which affect results, and that averages can conceal divergences.

Effective public education campaigns are recognized as an important strategy to reduce vulnerability (WHO, 1997), and there were questions designed to assess the respondents’ knowledge of the disease, its symptoms, and the use of protective measures. (Morens et al., 1978; Dantes et al., 1988; Ko et al. 1992). There are a number of socio-economic measures that are used to identify levels of resilience or stress. Among these are variables that are indicative of access to resources such as employment status, female household headship, and the need to employ coping strategies; access to critical infrastructure and services, as well as an attitudinal dimension captured in a measure of willingness to accept responsibility for vector control (Liverpool School of Tropical Medicine and Hygiene, 2003).

Gender has become recognized globally as extremely important in explaining poverty. Women face a bewildering array of social, economic, and cultural discrimination that limit their access to economic resources and political participation. Data from Jamaica seem to indicate that the gender dimension of poverty is not as significant as in many
other regions, for there is an almost fifty-fifty split among men and women living in poverty (Le Franc, 2000; Planning Institute of Jamaica/Statistical Institute of Jamaica, 2002). However, the situation changes drastically when one examines single parent households living in poverty, that is, the condition of many of the households in the study area. In 2002 (Planning Institute of Jamaica/Statistical Institute of Jamaica, 2002), of the number of single parent households living in poverty, just over 66 percent were headed by females.

The level of vulnerability is a function of coping capacity, and several questions were asked to assess coping mechanisms of households in the sample—the frequency with which households were forced to borrow money or take food on credit, had to rely on relatives or friends, and limited food intake. Responses were combined to form and index of coping, and the general picture obtained was one in which large numbers were “struggling to make ends meet.”

Households in which there is no piped water are more at risk than those with a piped supply because water storage becomes necessary. In the three communities, 23 percent had no water piped into their homes or yards, and even when there was a piped supply, respondents said that the supply of water was irregular, necessitating storage of some sort. However, the degree of risk varies with the mode of storage. Focks and Chadee (1997), working in Trinidad and Tobago, found that the outdoor drum was one of the most productive *Aedes* breeding containers and these were most commonly found in homes where there was no access to a piped supply. The authors found that four types of
containers, the outdoor drum, tubs, buckets and small containers accounted for more than 90 percent of all aegypti pupae discovered. They concluded that the provision of an adequate water supply system and targeted source reduction had the potential to reduce more than 80 percent of pupal production in the country. In the survey in St. James, 54 percent of the respondents stored water in drums and, in the majority of cases, the drums were left uncovered both to facilitate the entry of rain water and for easy access to the stored water.

Many of the respondents did not know the vector of dengue and therefore the habits of the mosquitoes, and this put them at risk. The Aedes species bites in the early mornings and at dusk, and bednets that are so effective in the fight against malaria are ineffective in controlling dengue fever. The best forms of protection have been found to be screens or mesh on windows and doors (Ko et al., 1992). The mosquitoes must be kept out of the homes. Studies in Taiwan have shown that screens could eliminate as much as 63 percent of dengue infection, and in Puerto Rico, the absence of screens showed a strong correlation with the occurrence of dengue fever (Dantes et al., 1988; Ko et al, 1992; Morens et al., 1978). Repellents and mosquito destroyers are more accessible to low-income households, but they often force them into cupboards and other hiding places from which they later emerge. Screens were used on some of the houses in the formal settlement in Granville/Pitfour and Retirement. Eight percent of the sample used repellents, but the majority used no form of protection at all.
Households consisting of disabled or ill members are considered more vulnerable since this translates into the number available for productive labor and puts a strain on household resources (Kouri et al. 1989; Nyong et al. 2003). The strongest association has been found with chronic illnesses, which are often incapacitating and require strict adherence to therapeutic and dietary regimes. Overall, 50 percent of household heads in the survey suffered from chronic illnesses, mainly hypertension and diabetes. Rapid access to health facilities can minimize vulnerability, and if access were measured in geographic terms, Granville/Pitfour was most fortunately positioned in relation to the comprehensive public-sector services offered in Montego Bay, and John’s Hall, least.

There is also the question of responsibility for vector control. Communities and the Ministry of Health have a responsibility for vector control, and some communities accept this responsibility, especially when it becomes apparent that the government is opting out of a situation, which they have no resources to manage. However, when responsibility is diffuse and especially when there is a culture of dependence nurtured in low-income communities by a political system based on patronage and largesse (Stone, 1983), members of communities may not appreciate the importance of their role in disease prevention. Seventy-eight percent of the respondents felt that dengue control should be the responsibility of the government.

Table 3 shows the scores obtained by the three communities and their ranking on each of the indicators. A score of 1 was given to the community that ranked lowest on each of the vulnerability indicators and 3 to the community that ranked highest.
Table 3. Composite of Ranking for Communities in St. James

<table>
<thead>
<tr>
<th>Vulnerability indicators</th>
<th>Johns Hall (%)</th>
<th>Score</th>
<th>Retirement (%)</th>
<th>Score</th>
<th>Granville/Pitfour (%)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No knowledge of dengue fever</td>
<td>52.6</td>
<td>2</td>
<td>53.1</td>
<td>3</td>
<td>42</td>
<td>1</td>
</tr>
<tr>
<td>No knowledge of disease symptoms</td>
<td>72</td>
<td>3</td>
<td>69</td>
<td>2</td>
<td>59</td>
<td>1</td>
</tr>
<tr>
<td>No protection</td>
<td>95</td>
<td>3</td>
<td>92</td>
<td>2</td>
<td>89</td>
<td>1</td>
</tr>
<tr>
<td>Income MW or less</td>
<td>68</td>
<td>3</td>
<td>33</td>
<td>1</td>
<td>61</td>
<td>2</td>
</tr>
<tr>
<td>Not coping</td>
<td>63</td>
<td>3</td>
<td>51</td>
<td>2</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>No pipe at home</td>
<td>46</td>
<td>3</td>
<td>12</td>
<td>2</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Water storage in drums</td>
<td>65</td>
<td>3</td>
<td>53</td>
<td>2</td>
<td>44</td>
<td>1</td>
</tr>
<tr>
<td>Chronic illness</td>
<td>53</td>
<td>2</td>
<td>37</td>
<td>1</td>
<td>54</td>
<td>3</td>
</tr>
<tr>
<td>Distance from health facility</td>
<td>70</td>
<td>3</td>
<td>49</td>
<td>2</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Female household headship</td>
<td>60</td>
<td>3</td>
<td>47</td>
<td>1</td>
<td>55</td>
<td>2</td>
</tr>
<tr>
<td>Public health responsibility for dengue control</td>
<td>56</td>
<td>3</td>
<td>47</td>
<td>1</td>
<td>51</td>
<td>2</td>
</tr>
<tr>
<td>Total Score</td>
<td>31</td>
<td></td>
<td>19</td>
<td></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

Source: Authors’ fieldwork. 1, least vulnerable; 2, vulnerable; and 3, highly vulnerable.

Like poverty, vulnerability increased outward from the urban area. The score was lowest for Granville/Pitfour and highest for John’s Hall. The difference between Granville/Pitfour and Retirement was small, an indication of the extent to which the informal community in Granville depressed its scores. Thus, average scores do not tell the entire story. The question is what makes some groups more vulnerable than others? For this purpose of differentiating these groups, a vulnerability index was constructed using scores of 0 and 1. A respondent who displayed vulnerability on a particular index,
who, for example, had no knowledge of the vector, was assigned a score of 1. Where no vulnerability was displayed, a score of 0 was assigned. A test of normality (mean ± 3 standard deviations) was applied to the results, and this revealed that the data were normally distributed with a mean of 5.7 and standard distribution of 1.96. This made it possible to use the mean and standard deviation to create five groups displaying varying degrees of vulnerability (Table 4). The most vulnerable group (Group 5) comprised 24 respondents or 9 percent of the sample. The least vulnerable group accounted for 14 respondents or more than 5 percent of the sample. Most of those who fell in the most vulnerable group lived in the community of John’s Hall. On the other hand, 64 percent of those classified as least vulnerable lived in Granville/Pitfour (Table 5). The conditions that characterize the vulnerable are the hallmarks of ignorance, poverty, and exposure. Most households headed by women are at risk. The breadwinners eke an existence working as vendors, household helpers, or seem to have no gainful occupation. The overwhelming

<table>
<thead>
<tr>
<th>Group</th>
<th>Vulnerability</th>
<th>Total</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Most vulnerable</td>
<td>24</td>
<td>Mean +1.5 SD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;8.64</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>67</td>
<td>Mean + 0.5 SD to Mean + 1.5 SD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.68 - 8.64</td>
</tr>
<tr>
<td>3</td>
<td>Average</td>
<td>51</td>
<td>Mean ± 0.5SD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.72 – 6.68</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>101</td>
<td>Mean -0.5SD – to Mean -1.5SD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.76 – 5.72</td>
</tr>
<tr>
<td>1</td>
<td>Least Vulnerable</td>
<td>14</td>
<td>&lt; Mean – 1.5SD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;2.76</td>
</tr>
</tbody>
</table>

Normality Mean ± 3SD
Mean = 5.7
SD = 1.96
Mean ± SD = 0.18 -11.58

Table 4. Identification of Vulnerable Groups
Table 5. Characteristics of the Most and Least Vulnerable Groups

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Group 5 (%)</th>
<th>Group 1 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No knowledge of vector</td>
<td>92</td>
<td>7</td>
</tr>
<tr>
<td>2. No knowledge of dengue symptoms</td>
<td>96</td>
<td>14</td>
</tr>
<tr>
<td>3. No Protection</td>
<td>92</td>
<td>57</td>
</tr>
<tr>
<td>4. Minimum wage or less</td>
<td>92</td>
<td>21</td>
</tr>
<tr>
<td>5. Not Coping</td>
<td>83</td>
<td>0</td>
</tr>
<tr>
<td>6. Female headship</td>
<td>83</td>
<td>21</td>
</tr>
<tr>
<td>7. Storage in drums</td>
<td>79</td>
<td>21</td>
</tr>
<tr>
<td>8. Piped Water</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>9. Distance from health facility</td>
<td>79</td>
<td>7</td>
</tr>
<tr>
<td>10. Chronic disease</td>
<td>79</td>
<td>21</td>
</tr>
<tr>
<td>11. No personal acceptance for dengue control</td>
<td>83</td>
<td>7</td>
</tr>
</tbody>
</table>

Community with highest proportion

<table>
<thead>
<tr>
<th></th>
<th>Group 5</th>
<th>Group 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johns Hall</td>
<td>67%</td>
<td></td>
</tr>
<tr>
<td>Granville/Pitfour</td>
<td>64%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors’ fieldwork.

majority had no knowledge of the disease, its symptoms, and mode of transmission and this ignorance, together with their poverty mean that they are not in a position to protect themselves from the vectors of the disease. To most, protection against the vector is seen as protection against a mosquito nuisance. It is likely that if there were an association with the disease, a greater effort would be made to take some responsibility for environmental sanitation.

Table 6 shows the characteristics of those falling in groups 4 and 2, and this table is interesting for what it illustrates about the community of Granville/Pitfour. Respondents
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Group 4 (%)</th>
<th>Group 2 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No knowledge of vector</td>
<td>75</td>
<td>21</td>
</tr>
<tr>
<td>2. No knowledge of dengue symptoms</td>
<td>83</td>
<td>48</td>
</tr>
<tr>
<td>3. No Protection</td>
<td>100</td>
<td>89</td>
</tr>
<tr>
<td>4. Minimum wage or less</td>
<td>69</td>
<td>38</td>
</tr>
<tr>
<td>5. Not Coping</td>
<td>75</td>
<td>37</td>
</tr>
<tr>
<td>6. Female headship</td>
<td>69</td>
<td>44</td>
</tr>
<tr>
<td>7. Storage in drums</td>
<td>54</td>
<td>44</td>
</tr>
<tr>
<td>8. Piped Water</td>
<td>31</td>
<td>10</td>
</tr>
<tr>
<td>9. Distance from health facility</td>
<td>48</td>
<td>16</td>
</tr>
<tr>
<td>10. Chronic disease</td>
<td>70</td>
<td>36</td>
</tr>
<tr>
<td>11. No personal acceptance for</td>
<td>63</td>
<td>39</td>
</tr>
<tr>
<td>dengue control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community with highest proportion</td>
<td>Granville/Pitfour-48%</td>
<td>Granville/Pitfour -69 %</td>
</tr>
</tbody>
</table>

Source: Authors’ fieldwork.

in this community formed the majority in both groups. Granville/Pitfour has the majority of the least vulnerable but also groups that are vulnerable to dengue fever. Therefore, vulnerability mirrors the dual nature of a community of formal and informal settlements and highlights the situation of squatter settlements in the island.

6. Conclusion

Results obtained from the work of the CSGM at the University of the West Indies have established an association between climate variability and the occurrence of dengue fever outbreaks. Peaks in occurrences are associated with warmer conditions, and the seasonality of the epidemics suggests that temperature and precipitation have some explanatory value. The prospective study is under way, but preliminary results indicate a continuation of the warming trend. Caribbean islands, therefore, should brace themselves for increasing outbreaks of a disease, which is debilitating, and which, in its DHF manifestations, can cause loss of life. The study has shown that a substantial number of
people living in conditions that are conducive to the proliferation of the vector and virus are vulnerable. It has demonstrated the vulnerability of those living in informal settlements. The precise number of persons who now live in such settlements in Jamaica is not known, but it has been estimated that the percentage for Montego Bay is 60, or between 55,000 and 60,000 persons (Ministry of Environment and Housing, 1997). It is clear that Jamaica faces a problem of great magnitude. Beset with competing claims that are more urgent, the country does not see preparation for the possibility of a large outbreak of dengue as a priority and does not have the capacity to deal with such an occurrence.

Not unexpectedly, the poor were the most vulnerable. In 2002, 15 percent of the population of the island lived below the poverty line, and because poverty was more prevalent in rural areas (PIOJ/STATIN 2002), these communities, which account for roughly 48 percent of the population, are more vulnerable. The poor are not necessarily unemployed. Many of the poor work as domestic workers or workers in the garment industry (Clarke, 2002; Henry-Lee, 2002). These are the groups that earn the minimum wage. Many poor households are also headed by women, and this explains the vulnerability of female headed households in the study.

There is merit to the view of the Ministry of Health that communities must take some responsibility for vector control. But this has to be a policy position rather than a defensive posture. As policy, it must be supported by initiatives aimed at empowering communities to assume control. Public education is necessary to address the knowledge
gap revealed in the study. More than a half of those interviewed in the communities could not say what causes the disease, and the overwhelming majority had no knowledge of its symptoms (Table 3). Vulnerable groups, therefore, do not have the tools to protect themselves from outbreaks of dengue fever. In addition, responsibility is shared, and the government’s responsibility is clearly outlined by WHO (1997). An important area that must be targeted in an education program is the risk associated with improper water storage. Many rural areas do not have access to pipe-borne water. Squatter communities in urban areas are not supposed, by law, to have a pipe-borne supply. The problem of water has to be tackled on two fronts—the provision of low-cost, secure drums, and the granting of security of tenure to those who, because of their status, are denied access to running water.

There are public sector organizations that have been given the mandate to mitigate hazards in the island and to promote sustainable development. These organizations seem obsessed with the threats posed by sea level rise. No one can deny the threat posed by this phenomenon to small islands that have their most valuable assets and most of its people on low coastal plains. This is a more attractive, more seductive area of focus than a health threat, especially when the disease is known. But it is difficult to see why all of the public sector agencies should become so absorbed with the gradual encroaching of the sea to the exclusion of more imminent threats. They should be persuaded to broaden their concept of a hazard; to realize that the threat of an increase in the occurrence of a debilitating and possibly deadly disease is not incompatible with their mandate; to see threats to health as threats to sustainable development and include these issues in their
public education programs. The Ministry of Health, by itself, is in no position to meet the challenge of increased disease transmission in the island. There is need for a concerted effort of collaboration with various public and private sector environmental organizations. These are elements in the country’s generic capacity which constitute the foundation for adaptation.

References


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