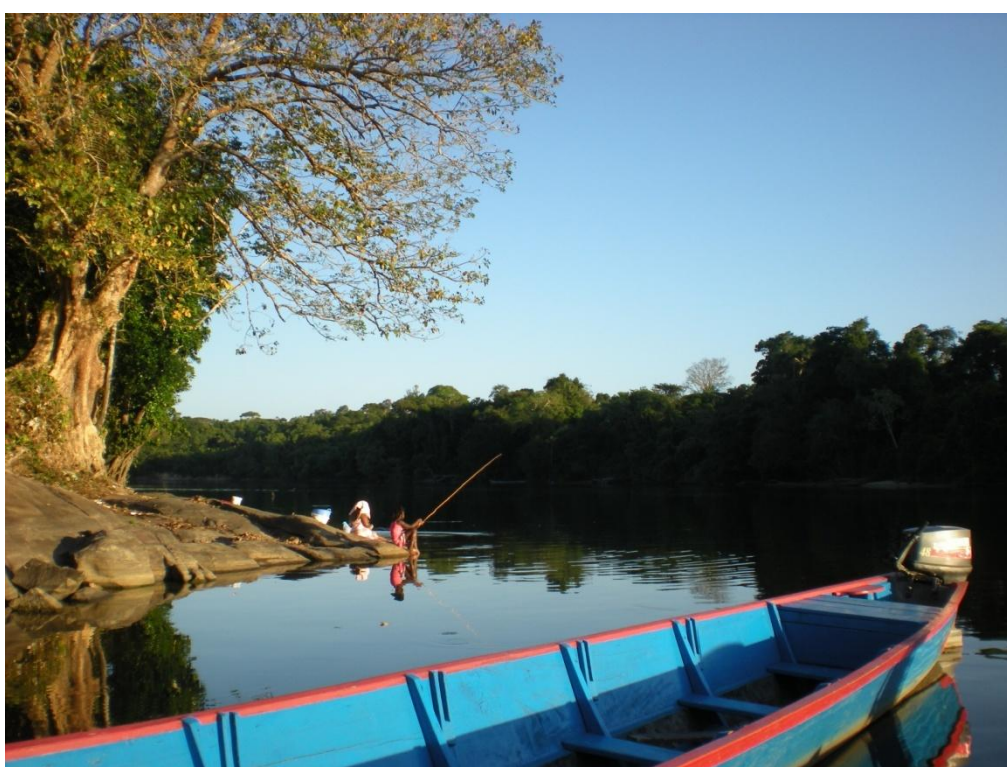


CARIBSAVE Climate Change Risk Profile for Suriname



Summary Document

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THE CARIBSAVE CLIMATE CHANGE RISK ATLAS (CCCRA)

A practical evidence-based approach to building resilience and capacity to address the challenges of climate change in the Caribbean

Climate change is a serious and substantial threat to the economies of Caribbean nations, the livelihoods of communities and the environments and infrastructure across the region. The CARIBSAVE Climate Change Risk Atlas (CCCRA) Phase I, funded by the UK Department for International Development (DFID/UKaid) and the Australian Agency for International Development (AusAID), was conducted from 2009 – 2011 and successfully used evidence-based, inter-sectoral approaches to examine climate change risks, vulnerabilities and adaptive capacities; and develop pragmatic response strategies to reduce vulnerability and enhance resilience in 15 countries across the Caribbean (*Anguilla, Antigua & Barbuda, The Bahamas, Barbados, Belize, Dominica, The Dominican Republic, Grenada, Jamaica, Nevis, Saint Lucia, St. Kitts, St. Vincent & the Grenadines, Suriname and the Turks & Caicos Islands*).

The CCCRA provides robust and meaningful new work in the key sectors and focal areas of: Community Livelihoods, Gender, Poverty and Development; Agriculture and Food security; Energy; Water Quality and Availability; Sea Level Rise and Storm Surge Impacts on Coastal Infrastructure and Settlementsⁱ; Comprehensive Disaster Management; Human Health; and Marine and Terrestrial Biodiversity and Fisheries. This work was conducted through the lens of the tourism sector; the most significant socio-economic sector to the livelihoods, national economies and environments of the Caribbean and its people.

SELECTED POLICY POINTS

- Regional Climate Models, downscaled to national level in the Risk Atlas, have provided projections for Caribbean SIDS and coastal states with enough confidence to support decision-making for immediate adaptive action.
- Planned adaptation must be an absolute priority. New science and observations should be incorporated into existing sustainable development efforts.
- Economic investment and livelihoods, particularly those related to tourism, in the coastal zone of Caribbean countries are at risk from sea level rise and storm surge impacts. These risks can encourage innovative alternatives to the way of doing business and mainstreaming of disaster risk reduction across many areas of policy and practice.
- Climate change adaptation will come at a cost but the financial and human costs of inaction will be much greater.
- Tourism is the main economic driver in the Caribbean. Primary and secondary climate change impacts on this sector must both be considered seriously. Climate change is affecting related sectors such as health, agriculture, biodiversity and water resources that in turn impact on tourism resources and revenue in ways that are comparable to direct impacts on tourism alone.
- Continued learning is a necessary part of adaptation and building resilience and capacity. There are many areas in which action can and must be taken immediately.
- Learning from past experiences and applying new knowledge is essential in order to avoid maladaptation and further losses.

OVERVIEW OF CLIMATE CHANGE ISSUES IN SURINAME

Suriname is already experiencing some of the effects of climate variability and change through greater rainfall variability leading to droughts, flooding and some landslides.

Detailed climate modelling projections for Suriname predict:

- an increase in average atmospheric temperature;
- reduced average annual rainfall; and
- increased Sea Surface Temperatures (SST).

And the extent of such changes is expected to be worse than what is being experienced now.

Detailed climate modelling projections were conducted for Suriname and primary data were collected and analysed to assess the vulnerability of the livelihoods of community residents in Maroon villages in the Boven Suriname Region and Amerindian villages in the West Suriname Region to climate change.

The sites were selected by national stakeholders and represent areas of the country which are important to the tourism sector and the economy as a whole, and are already experiencing adverse impacts from climate-related events.

Vulnerable community livelihoods in Boven Suriname

- The forest is a critical resource for food security and supporting livelihoods (craft, sale of produce and meat).
- Changes in temperature and rainfall are reducing crop output, affecting river quality and freshwater availability.
- In the 2006 floods, craft materials and crops were lost - resulting in food shortages.
- Village ancestors built on higher ground and also avoided low lying areas. Now this is not the case.

Vulnerable community livelihoods in West Suriname

- Both flooding and drought events have impacted the community in the past mostly through socio-economic impacts such as livelihood losses and food security rather than direct impacts on property.
- Heavy rains adversely affect the mobility of persons and their trade resulting in economic losses for households.
- Mosquito populations are now significantly greater during the dry season compared to previous years.

Climate change effects are primarily evident in the socioeconomic sectors which support tourism, such as agriculture, water resources, health and biodiversity.

CLIMATE CHANGE PROJECTIONS FOR SURINAME

The projections of *temperature, precipitation, and sea surface temperatures* for Suriname are indicated in Box 1 and have been used in making expert judgements on the impacts on various socio-economic sectors and natural systems, and their further implications for the nature-based tourism industry.

Stakeholders consulted in the CCCRA have shared their experiences and understanding about climate-related events, and this was generally consistent with observational data.

Box 1: Climate Modelling Projections for Suriname

Temperature: Regional Climate Model (RCM) projections indicate an increase of 4.8°C by the 2080s under the higher emissions scenario.

Precipitation: GCMs indicate overall increases and decreases, ranging from -61% to +19% per month by 2080, while RCMs are indicating decreases in mean annual rainfall by -34%.

Sea Surface Temperatures (SST): GCMs project annual mean SST increases of 1.0 to 3.1°C by 2080s across all 3 scenarios.

COMMUNITY LIVELIHOODS, GENDER, POVERTY AND DEVELOPMENT

A minority of the Surinamese population are scattered across the hinterland, more commonly referred to as ‘the Interior’, where eco-tourism is concentrated. The vulnerabilities of these small communities to the impacts of climate change are unique. Maroon villages in the Boven Suriname (Saramaka) Region and Amerindian villages in the West Suriname Region of the Sipaliwini District participated in our research which included vulnerability mapping, focus-groups and household surveys which were developed according to a sustainable livelihoods framework. The research provided an understanding of: how the community livelihoods are dependent on the natural resources and how they have been affected by climate related events; the community’s adaptive capacity; the complex factors that influence their livelihood choices; and the differences in the vulnerability of men and women.



Figure 1: Participants at the workshop in Boven Suriname

The natural resource base is crucial for the survival of these groups, for food security and support of livelihoods. Many households and residents do not have immediate access to a cash income, but this is not considered to be detrimental to their survival given the natural resources available and the strong social ties that allow groups to thrive.

Both groups have experienced changes in climate that have affected agricultural output, income from tourism, craft sales and their health (mainly from poor water quality issues and proliferation of mosquitoes). Also, both flooding and drought have seriously impacted both groups in the past.

The division of household and community responsibilities between men and women promotes the freedom and mobility of men, but restricts women to the community areas in most cases. Men typically possess several skills that can be transferred across various livelihood activities, whereas women are primarily responsible for family care and agriculture. This division of roles pre-disposes women to a higher level of risk – e.g. heavy involvement in agriculture which has suffered tremendously from flooding and drought impacts in the past; high migration of males increasing the number of single female household heads with large families and a high burden of care; and a lack of social protection services within the community. The clear distinction of gender roles in these Surinamese communities and the associated impact on livelihoods and poverty means that the comprehensive integration of these issues into climate change impact and vulnerability assessment and planning processes is essential to developing appropriate adaptation strategies.

Community Characteristics and Experiences: Maroon Village Case Study

The abundant natural resources in and around the community are used for agriculture, fishing, logging and construction; the forest being most important resource for food, fuel, construction and craft materials. Rivers are also important for food and transport. Agriculture, however, is the main stay activity as a source of food and income; and a few of the villages have some degree of tourism activity with basic accommodation facilities that employ a small number of villagers. Other villagers do embroidery and pattern-making to be sold to both tourists and locals in the villages and in the capital, Paramaribo.

The high dependence on natural resources for survival makes the communities vulnerable to climate change since climate extremes already affect productivity and result in livelihood disruptions. The term “climate change” was generally unknown and many observations and impacts were reported by residents:

- The weather is now unpredictable with warmer days and nights;
- Merging seasons and highly variable rainfall;
- The changes in temperature and rainfall are reducing crop output, affecting river quality and therefore freshwater availability, shifting the balance of food chains and encouraging more wild fires.
- Changes in biodiversity are very pronounced and fish populations, one of the main sources of food for the community, have declined drastically;
- Droughts have had severe consequences with river levels dropping so low in 2009 that boats, the main form of transportation, could not be used.

By facilitating freshwater catchment and storage initiatives villagers will have greater access to potable water for sanitation and consumption during the dry season and possibly even during drought periods. The use of fishing nets (not a traditional method) has become popular amongst villagers, but is proving to be more detrimental than beneficial, because all sizes of fish are caught and taken, prohibiting juvenile fish from maturing. There is a need for an awareness initiative for fishers on more sustainable fishing practices, including the use of nets with larger mesh sizes which can allow juveniles to escape, and possibly zoning to demarcate areas for extraction and non-extraction (e.g. establish fish nursery areas).

This community also has experience with flooding. The May 2006 flood severely affected agriculture, housing and properties; some residents lost all of their material possessions. A tourist eco-lodge in one of the villages was severely damaged, which resulted in its closure for two months, the subsequent loss of income for village employees and longer term impacts on arrivals after having been identified as being in a hazardous area.



Figure 2: Rivers are a main feature in daily activities of this Maroon community. This river level has dropped by several feet.

Women involved in embroidery lost materials and crops and soil were compromised, irreversibly in some cases, which resulted in food shortages. Insect populations (e.g. flies, mosquitoes) proliferated to unmanageable numbers, with the associated rise in several health threats. Villagers used herbs to repel insects and treat any health conditions that arose and have switched to more rice production because it is more tolerable of the new conditions. The community has expressed interest in the use of agro-technology to ease the burden of crop cultivation and improve the quantity and quality of yields. Farmers need irrigation systems and access to crop strains that are more resistant to

harsh climate and soil conditions.

In the past, village ancestors built on higher grounds because they were aware of flooding possibilities and they also avoided low lying areas. In Abenaston, the ancestors left a mark in the village indicating the height of the 1949 flood waters. Villagers believe that the mark was left to warn their descendants in anticipation of another flood 50 years later, but younger generations who have never experienced flooding have not taken heed and have built in hazard prone (low lying) areas, thereby putting themselves at risk. Following the 2006 flood, residents who were most affected relocated within their community where possible, retreating from water courses to avoid a re-occurrence. Similarly, less agriculture is now practiced in close proximity to water courses.

There is a clear concern about water quality and the importance of proper sanitation. Villagers are requesting assistance to build and install latrines in the village to deter use of rivers. This effort should be combined with an improvement in solid waste management in particular the promotion of recycling for plastic and bottles and encouraging the use of biodegradable materials where possible. There would be greater impact by involving several villages (especially those upstream). The village of Abenaston is interested in establishing a freshwater bottling enterprise using their well to create jobs and bring additional income. However, the village does not have the technical capacity to move forward with this project and is in need of assistance from either government or non-government entities in making this project a reality (e.g. feasibility and sustainability studies, groundwater testing, acquisition of required resources).

Community Characteristics and Experiences: Amerindian Village Case Study



Figure 3: Workshop with the Amerindian community

The Amerindian villages that participated are also surrounded by natural resources and depend on them heavily for subsistence and livelihood activities, primarily agriculture. Tourism is small scale, with a few accommodation facilities (mainly guest houses) and some villagers may sell craft to visitors in the community and in the city.

Residents in the community reported several observed changes in the climate and weather:

- Days feel much hotter;
- Severe thunderstorms have been occurring during dry seasons;
- More intense rainfall events have been observed during the wet seasons;
- The variability of rainfall has resulted in increased vector populations and mosquito populations are now significantly greater during the dry season compared to previous years with numerous implications for human health.

Changes in biodiversity have also been observed, but mainly as a direct consequence of human action (habitat destruction, environmental degradation) rather than climate change.

Both flooding and drought events have impacted the community in the past although mostly through socio-economic impacts (e.g. livelihood losses, food security) rather than direct impacts on property. Excess rainfall prevents loggers from working and transporting wood; craft vendors must send their products to Paramaribo because of fewer tourists visiting the village – and this is less profitable; and farmers are impacted by what they consider to be erratic and unpredictable weather.

Technical resources and training can be provided to farmers to assist their day-to-day activities, such as: irrigation systems (e.g. water storage devices and pumps) and tools to reduce the amount of manual labour needed; training on crop cultivation in swampy areas; and sustainable farming practices to maximise yield with minimal environmental impact. Other options include establishing agro-processing industries within the community, which can create value-added products from surplus agricultural produce that would have a longer shelf-life and create new job opportunities for some residents. Similarly there is room for expanding the market for some produce (e.g. pomtayer, a root vegetable similar to cassava), but assistance is required because it is expensive for farmers to go into the city with no guarantee of a sale. Farmers would benefit from establishing an organised group or co-operative to establish contacts with large or established entities (e.g. in food



Figure 4: Water-logged ground which inhibits logging and transportation

processing and tourism sectors in the city), but guidance will be needed to: determine the level of support in the city; establish a fully functional co-operative; negotiate agreements on produce quota, collection/delivery, compensation, etc.; and ensuring the continuity of the relationship for the benefit of both the farmers and customers.

Men and women in the Amerindian communities share duties in agriculture and when agriculture is not possible because of floods or drought farmers and fishermen may interchange livelihood activities, using the time to make repairs to their equipment and supplies and may assist women in their craft-making activities. Women occupy themselves with domestic chores, craft making and cultivating small kitchen gardens with herbs and vegetables as an additional small food source.

Other areas of concern for villagers are the absence of some emergency services, adequate tools and resources to be self-reliant, which makes them vulnerable. A feasibility study for establishing these services within the community could be undertaken, with the aim of trying to establish one or more units which can address or assist with multiple needs. This would also benefit in a disaster response scenario. Similarly issues of transportation and access arise during heavy rainfall events, therefore strong consideration should be given to improving the infrastructure: developing the road network; a roadside drainage system to deter water pooling and stagnation; and fortification of riverbanks especially in areas where the road runs immediately parallel to the river.

AGRICULTURE AND FOOD SECURITY

The agriculture sector represents a critical component of Suriname's national development as an important contributor to GDP, employment, foreign exchange earnings and rural livelihoods. Agro-tourism, where tourists can experience life on a rice farm for example, is a relatively new sub-sector of particular relevance to this study.



Figure 5: Cassava field near the village of Kwamalasamutu

(Source: www.mongabay.com)

Agricultural output has grown consistently between 2002 and 2010, but activities are concentrated in the coastal zone and are therefore vulnerable to a number of climate change impacts. The primary crops are rice (87% of production and 96% of agricultural land), bananas, vegetables and fruit. Rice is highly vulnerable to unevenly distributed rainfall and bananas produced mainly in the coastal districts of Saramacca and Nickerie, are affected by changes in rainfall patterns, high winds and SLR.

These changes result in higher costs to the farmers, as artificial irrigation and drainage have to be applied. The projected 34% decrease in mean annual rainfall can only exacerbate an already difficult situation.

The traditional practice of allocating agricultural land in areas which are not suitable for agriculture, such as on brackish clay soils, poorly drained and less fertile soils adds to the vulnerability of the sector.

In 2006 flooding caused estimated crop losses of SR \$42,238,703 (approximately USD 13 million). Cassava, the food staple of the majority of the agricultural communities in the interior, incurred the most damage

(SR \$20,698,768, approximately USD 6.4 million). Local farmers in Suriname have been taking actions to prepare for impacts caused by varying climate, particularly flooding and drought; and some have been trained in irrigation and drainage practices. But farm level adaptive capacity remains severely limited.

A structured programme for climate change sensitisation and adaptation training is needed to improve and increase national agricultural outputs in accordance with the agricultural policy. The Ministry of Agriculture, Livestock and Fisheries aims to make Suriname the main supplier of the basic foods consumed in the Caribbean and the policy focuses on guaranteeing food security within the country, increasing the income of small and medium-scale producers, increasing the contribution of agriculture to the domestic economy and developing a sustainable sector. It is therefore recommended that an “Agro-technology and Climate Change” project be developed that builds Surinamese farmers’ capacity to grow produce using good agricultural practices and introduces new technologies that will improve the quality and yield of their crops.

Another recommended project, “Prioritising Vegetables, Roots & Tubers Research” requires that the locally-based agricultural research institutions examine management practices with the potential to raise the yield of vegetables, roots and tubers grown under local pedo-climatic conditions. Specifically, the research agencies should investigate cultural practices that conserve water and protect staple crops such as cassava and vegetables from heavy rains, high temperatures and flooding.

ENERGY AND TOURISM

Tourism is an increasingly significant sector in energy use and emissions of greenhouse gases in the Caribbean. Existing estimates of per capita emissions in Suriname, 5.0 t CO₂, are higher than the global average of 4.3 t CO₂. However since the closure of an old power plant it is anticipated that the emissions are now somewhat lower.

Current tourism related energy use and associated emissions are estimated to be the equivalent of 4% of estimated national emissions of CO₂. Little appears to be known regarding current emission levels in various economic sub-sectors and also with regard to bunker-fuels, but the energy sector is reported to be the largest contributor of emissions (71%). Energy audits will help to identify major energy consuming sub-sectors and to develop appropriate strategies for energy and emissions reductions. If the sector’s emissions have been correctly calculated in comparison to national emissions, tourism may be of secondary relevance in reducing emissions and reducing Suriname’s energy dependency, though it is also clear that tourism is interconnected with many energy-consuming sectors (transport, waste). Aviation (60%) and accommodation (21%) were identified as the major direct consumers of energy and emissions.

In the case of Suriname a large percentage of visitors come from the Netherlands to spend time with family and friends. These visitors spend less than visitors who come purely for pleasure, have high emissions from the long-distance flight, but stay for a long time. Marketing efforts can be oriented to more local markets such as the Netherlands Antilles and wider Caribbean or South America where travel distances are shorter and visitors might be more inclined to spend more on accommodation for example.

Total installed capacity in Suriname is 389 MW with two main producers: the state-owned Energy Company Suriname (EBS) that supplies the capital and surrounding areas from 2 power plants and 9 diesel generators; and the aluminium company Suralco that operates a large hydropower plant to power the aluminium factory and sells the remaining power to the grid. Additional production is carried out in villages using small-scale diesel generators. The majority (95%) of electricity production is from hydro power. Small

reserves of fuel are being exploited and the country is close to being self-sufficient in fuel with a refinery of capacity 7,500 barrels a day.

The First National Communication is the only document found that provides strategies for addressing energy efficiency and reducing emissions of GHGs. There is an Environmental Framework Act under development, legislation on reducing exhaust gases and a number of initiatives have taken place to reduce emissions from logging as well as expand renewable generation. The National Communication suggests that the diesel generators in the hinterland could be partially replaced by either micro-hydropower systems or photo-voltaic systems. No mention is made of tourism, aviation or cruise ships, or the consumption of bunker fuels.

The cost of fuel was also raised as an issue by Surinamese farmers, affecting the final cost of production of local food. Also, climate change will likely result in the use of more energy to cool thermal power plants and a reduced volume of river water affecting both water availability for cooling and the efficiency of existing hydropower plants. Power generating stations and other major infrastructure located on the coastline are highly vulnerable to damage from flooding and inundation resulting from SLR and storm induced surges. These challenges must be considered in energy sector planning.

Alternative energy and energy efficiency measures should be implemented in the tourism sector to reduce operation costs and vulnerability to climate change impacts. Eco-resorts in the interior, especially, can explore solar and hydro-power as sources of electricity and this can be facilitated through a series of incentives and possibly by targeting international funding sources such as the Clean Development Mechanism, particularly as Suriname is in the process of establishing a CDM Bureau within existing structures by expanding the tasks of current staff. Simple energy management techniques can also be employed through education of both staff and tourists to reduce energy consumption, such as switching off A/C or operating the A/C at a higher temperature.

WATER QUALITY AND AVAILABILITY



Figure 6: A lady from the Malobi village using one of the 52 water-collection tanks installed there.

(Source: <http://watercharity.org>)

Suriname is considered a water rich country and potable water is primarily sourced from groundwater supplies, especially in the Greater Paramaribo area. The production and distribution infrastructure in the Greater Paramaribo region is old with poor maintenance resulting in leakages (30-40%) and water theft, leading to pump breakdowns, low pressure, intermittent supply and a high potential for contamination. These systems need updating and replacing to reduce water loss. Population growth, urbanisation and increased demand for agriculture are all expected to increase the demand for water in Suriname.

Rural areas either collect rain water or use surface sources. Additionally, sea level rise and increased sedimentation may cause water infrastructure including dams, dykes, sluices and pumping stations to not function properly^{iv}.

The following actions would contribute to an increase in the adaptive capacity of Suriname's water sector:

- an update of the Water Supply Master Plan for Greater Paramaribo and the Coastal Zones;
- development of a Water Supply Master Plan for the Interior; and
- development of a policy, legislative and regulatory framework for water services and assessment of current tariff structures and levels.

Rainwater harvesting and waste water recycling schemes can serve to reduce pressure on the potable supplies. These would be especially effective at the household and tourism facility level where grey water can be used for irrigation. The Malobi Clean Drinking Water Project which installed 52 water collection tanks in the Malobi village was successfully completed in June 2011 and can easily be replicated elsewhere in the interior.

Evidence though is little evidence of a decline in average annual rainfall in Suriname, the total in the summer months is decreasing. This trend is expected to continue, thereby likely resulting in an overall decrease annually. Droughts being experienced currently are typically associated with El Niño events as in 2003 when approximately 75% of crop land was irrigatedⁱⁱ. If the need for such significant extraction of water continues, this can change drainage patternsⁱⁱⁱ.

The tidal influence of the ocean can result in salt water intrusion to groundwater and rivers depending on the season and agricultural lands are expected to suffer from increased salinisation which affects not only crops, but livestock and horticulture as well. The 1938 regulation prohibiting the storage of rainwater should be revisited with a view to encouraging domestic and agricultural harvesting and storage of rainwater, especially since over-abstraction is already a problem. The viability of expanding the capacity of the van Blommenstein storage lake and the creation of new reservoirs should also be assessed^{iv}.

There are many institutions to address water resource management, but their roles and responsibilities do not overlap resulting in a number of gaps. These include:

- limited technical and financial resources to develop and execute policies;
- deficiencies in data and information networking; and
- a lack of dialogue and institutional networking^v.

Van Dijk and de Wolf (2008) noted that "field stations are lacking human capital for observations", so the Digital Water Portal for Suriname – Suriname Water Resources Information System (SWRIS) - was created in 2009 in an effort to strengthen database access for water resources^{vi}. It is recommended that groundwater computer models be developed to assist understanding of the aquifer system and the impacts of saline intrusion from SLR. These models could then be used to assess the feasibility of undertaking artificial recharge projects to reduce the vulnerability to drought associated with depleted groundwater supplies.

The development of mechanisms to facilitate Integrated Water Resources Management (IWRM) should also be considered. IWRM acknowledges that different users are interdependent and encourages a move away from a uni-sectoral water management approach to one which allows participatory decision making including different user groups. Such an approach allows an equitable management of water resources, which will be particularly important with declining water resources under climate change. IWRM requires that platforms be developed to allow different stakeholders to work together. Institutional and legislative frameworks at all stages of water planning and management should be revisited, assessed and, if necessary, amended to allow the implementation of IWRM.

There are no sewage treatment systems; most households use septic tanks and most rural villages use the rivers or bush for their toilet facilities, rather than using pit latrines. In general, improper sewage disposal practices threaten the quality of water supplies as in the Suriname River where septic tanks can leak sewage into water courses. Water infrastructure should be developed where possible to increase access to sanitation facilities.

Water courses are also threatened by: siltation and erosion as a result of deforestation activities for lumber exports and mining; pollution from cyanide and mercury used in mining; pollution from pesticides in agriculture; reduced supply to coastal wetlands; groundwater from inland activities and abstraction for irrigation. Farmers have been taking advantage of the training opportunities pertaining to pesticide use; integrated pest management, irrigation and drainage and soil fertilisation that should help alleviate some of the problems caused by the agricultural sector. There is no legislation for the management of groundwater abstraction or protection of abstraction areas. Robust land management and waste management policies are needed to reduce the discharge of pollutants and protect aquifers from surface contamination. Environmental pollution control legislation should be developed and enforced through penalties for discharging pollutants into drainage systems. Legislation should include the treatment and recycling of waste water and the safe management of hazardous waste and toxic chemicals^{iv}.

COMPREHENSIVE NATURAL DISASTER MANAGEMENT

Suriname faces various, unpredictable natural and man-made hazards that threaten its people and their livelihoods. The concentration of the population in the coastal area presents the difficult challenge of slow onset hazards, namely SLR, and fast onset hazards like floods. Recent flooding and El Niño events have impacted Suriname, particularly the Maroon and indigenous communities in the remote interior. The 2006 floods of the Tapanahony, Saramacca and Suriname rivers not only damaged housing, but also resulted in the loss of much of the subsistence agricultural land on which these communities and households depend. The economic impacts were therefore long lasting because individuals had to purchase food until their land was productive again; using up financial resources intended for other purposes.



Figure 7: Flooding damage in Suriname, 2006

(Source: PAHO, 2006)

The response activities in these remote areas were difficult and flooding of transportation routes further complicated the situation. The Suriname Government and the National Coordination Centre for Disasters (NCCR) therefore called upon the assistance of international non-governmental organisations (NGOs) and other countries for financial assistance and specific resources, including helicopters. With their support the NCCR was able to work with community members to provide shelter and basic food, health and sanitation services. Challenges included a lack of data (demographic primarily), lack of early warning system, difficulties in coordinating the many actors (and their agendas), as well as the need for cultural sensitivity^{vii}.



Figure 8: Village houses at risk from erosion.

The choice of building location and the materials used, expose many of these Maroon and indigenous groups to the threat of flooding and other hazards. As the population across Suriname grows and climate change generates more intense rainfall events, this risk to developments along rivers will undoubtedly demand growing attention. This is equally true for eco-tourism facilities located along rivers in the interior.

In contrast, climate change projections indicate that annual rainfall totals may decrease and temperatures shall increase, therefore drought conditions may become more common yet equally difficult to predict.



Figure 9: Isadou eco-lodge

The disaster management system in Suriname is regulated under laws created by the national administration with the District Commissioner playing a leading role^{viii}. The NCCR falls under the recently created Inter Ministerial Disaster Relief Commission and is housed in the Ministry of Defence, which lends itself to activities remaining more responsive. Work is underway to create district level roles for coordination within the Disaster Relief Plan^{ix}. Research showed that responsibilities are well defined and have been recently clarified during recent disaster responses. The absence of local level disaster organisations has been acknowledged as a shortcoming of recent disaster response efforts as was the minimal involvement of traditional authorities and structures in the planning and execution of disaster response^{viii}. Mainstreaming disaster risk reduction into all broader development goals and plans is one of the key recommendations of the Hyogo Framework for Action (HFA). Suriname has not yet reported their efforts towards the HFA priorities.

The next step in disaster management is to build on the mitigation and preparedness efforts that enhance resilience and reduce vulnerability to both extreme events and slow-onset impacts that result from climate change. The institutional shift that must take place in NCCR into prevention and preparedness requires greater attention to resources and public education efforts. Since 2007, the Government of Suriname has expressed the desire to *learn* the lessons that have been identified from recent disasters^{vii}. As such, public education messages will improve as specific lessons are internalised. For example, following the flooding of 2006, it was recognised that the Maroon and other tribes had developed their own evacuation procedures^x.

An interactive and innovative community education and capacity building initiative designed to reach all levels of Surinamese society, would enable individuals to manage their own risk levels and build resilience to natural hazard events. The use of traditional music genres, e.g. kaseko, with the support of a local artist is a possible strategy the NCCR should consider for their public awareness activities.

To aid in the preparedness and response to flooding and indirectly landslides, technological tools are also valuable investments. The use of an early warning system (EWS) is an effective communication tool only when the proper instrumentation for collection of the necessary weather data is present (i.e. rain gauges, tidal gauges, weather stations etc.). The Meteorological Service of Suriname collects weather and climate data from 21 stations, 5 synoptic stations, 11 climate stations and 2 automatic stations^{iv}. The need for improvements to the observation network is acknowledged but limited by financial and human resource availability^{iv}.

Following the flooding in 2006, 2008 and 2009, a project was executed under the NCCR to install 5 water level measurement devices in the Tapanahony River basin as part of the establishment of an Early Flood Warning System^{xi}. This project aimed to obtain community support and to develop a sense of co-ownership since a EWS is only helpful in reducing vulnerability if the people living in the risk area have the capacity to understand and respond appropriately to warnings. This is a positive step in the development of a national level network of flood warning gauges and the remote management aspect of the tool is necessary given that many of the areas at risk are in the interior of Suriname. The update of building regulations and enforcement by building inspectors with the responsibility of reviewing all construction in the country would contribute to the minimisation of loss. Flood hazards in the interior of Suriname along rivers is quite significant and demands that land use planning and building codes be created, monitored and enforced. The Maroon and indigenous communities have extensive knowledge and a support system that must be considered and incorporated into these community-specific plans and policies.

HUMAN HEALTH

Health is an important issue in the tourism industry because tourists are susceptible to acquiring diseases whilst travelling, but they are just as likely to act as potential carriers of diseases. The potential effects of climate change on public health can be direct or indirect: direct effects include those associated with extreme weather events such as heat stress, changes in precipitation, SLR and natural disasters; indirect effects are associated with changes in eco-systems and various sectors such as water, agriculture and the wider economy. The acquisition of an infection can have consequences for persons visiting a destination which can significantly affect the economies of small island and low lying coastal developing states because of a loss of reputation and avoidance of these destinations by tourists.

In addition to the direct threat of injury or death from a particular natural disaster such as floods, physical and capital damage to health facilities may also arise. Displacement of persons and loss of shelter are important because of the associated mental and physical impacts and increasing temperatures can result in heat stress; heat wave events have been found to be associated with short-term increases in mortality globally^{xii} as well as morbidity related to heat exhaustion and dehydration^{xiii,xiv}. Both locals and visitors should be provided with continued health education and promotion campaigns which will be crucial in sustainable disease prevention and may save lives during and after natural disasters.

Vector borne diseases, namely dengue fever, malaria and yellow fever are likely to increase in Suriname as a result of increased extreme precipitation events which create suitable habitats for mosquitoes to breed^{iv}. A significant drop in malaria cases in 2006 has been attributed to national malaria control policies and

strategies recommended by the World Health Organization introduced the same year. The Integrated Vector Management (IVM) Programme, developed by the World Health Organization (WHO), should be adopted to continue efforts against this and other vector-borne diseases. Research into the links between epidemiology of diseases in Suriname with climate data should be carried out, linking climate change, tourism and health. This would be supported by a collective information centre or Clearing House containing detailed information, such as temporal, environmental and climatological data for research purposes in the Caribbean.

Access to potable water presents other challenges and the number of persons in the interior that do not have access to potable water is estimated to be double that for urban areas^{xv}. Important diseases associated with water quality include gastroenteritis, shigellosis, salmonellosis, cholera and other food- and water-borne diseases that given rise to diarrheal illnesses^{xvi}. The first three of these are important to the tourism industry because aside from day care centres and in communities, outbreaks often occur in areas that tourists frequent such as hotels, restaurants and cruise ships.

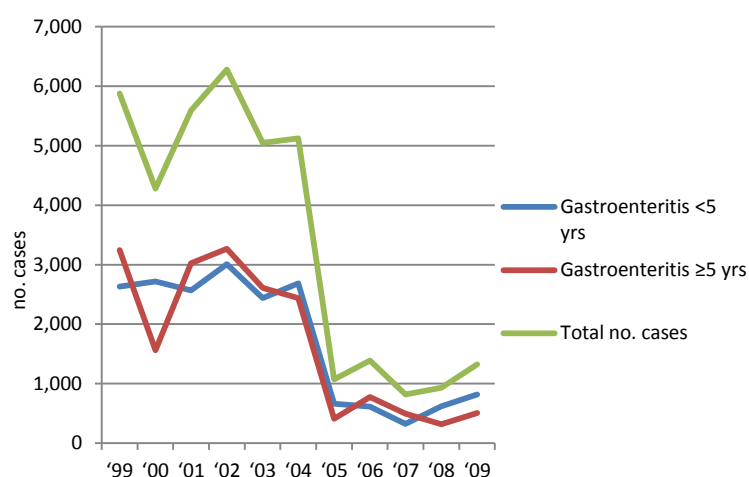


Figure 10: Cases of gastroenteritis in Suriname

The use of new technology such as early disease warning systems and better water storage and sanitation infrastructure should be prioritised.

Reduced food availability through drought and heat stress or flooding could have consequences for the health of the population, particularly the poorest sectors of the society. Dry spells and drought conditions often associated with El Niño events can increase particulate matter in the air, compromising air quality and possibly resulting in increased respiratory illnesses^{iv}. Other risk factors

or variables that affect incidence of respiratory diseases include temperature, relative humidity and Sahara Dust episodes^{xvii}. Flooding also has consequences for health due to contamination of water and inability to maintain high levels of sanitation, thus providing conditions suitable for the spread of diseases. Important diseases after flooding events in Suriname include typhoid, viral conjunctivitis and leptospirosis.

Government investment in the health sector has fluctuated with greater investments between 1996 and 2001. The cost of health care is rising while investment by the Government of Suriname is insufficient to cope with the challenges that present themselves as a result of the existing economic conditions and deficiencies in enforcement. There is a lack of financial resources for “pharmaceuticals, basic equipment, physicians [and] qualified nurses”^{xviii}. Suriname is however focusing on improving its health sector. As a former colony of the Netherlands the population has access to medical treatment from that country and many Surinamese health care professionals are trained in the Netherlands^{xviii}. The large forested area of Suriname has considerable medicinal value particularly in the Central Suriname Nature Reserve (CSNR) which was established in 1998^{iv}. A greater effort should be made by the Government of Suriname to have data analysed, peer reviewed and published thus improving the quality of data for research.

MARINE AND TERRESTRIAL BIODIVERSITY AND FISHERIES

Suriname is one of only 11 countries worldwide that can be categorised as “high forest, low deforestation”. An estimated 85% of Suriname’s land area is still forested, of which 13% is inside protected areas including a World Heritage Site. The country’s terrestrial and coastal eco-systems include an impressive number of species and new discoveries are still being made. An expedition through the highlands of Suriname in 2006 led to the identification of 24 new species including frogs, fish and beetles. Approximately 36 of the identified species of vertebrates and 200 of the identified species of plants are endemic to Suriname. The Reducing Emissions from Deforestation and Forest Degradation (REDD) initiative is a set of steps designed to use market/financial incentives to reduce the emissions of greenhouse gases from deforestation and forest degradation “co-benefits” such as biodiversity conservation and poverty alleviation. Although Suriname has not finalised its Readiness Preparation Proposal (RPP) for REDD+, it is actively involved in the programme and advocates for compensation for conserving forests and applying sustainable forest management^{xix}. REDD+ presents an important opportunity for Suriname to follow a sustainable and low-carbon development pathway while benefitting from financial assistance to increase the resilience and adaptive capacity of its forests, biodiversity and communities.

Suriname’s biodiversity supports its tourism sector through rainforest treks, wildlife and bird watching, adventurous river tours with the opportunity to see endangered river dolphins and community-based tourism in Amerindian and Maroon villages.

The projected changes in temperature and precipitation patterns will result in a contraction of vegetated areas, the displacement and/or loss of habitats followed by loss of plant and animal species. Reduced moisture could also result in forests becoming drier, potentially causing the death of many species and more frequent bush fires. This will have profound effects on Suriname’s biodiversity, rural communities and the eco-tourism sector being so heavily promoted.

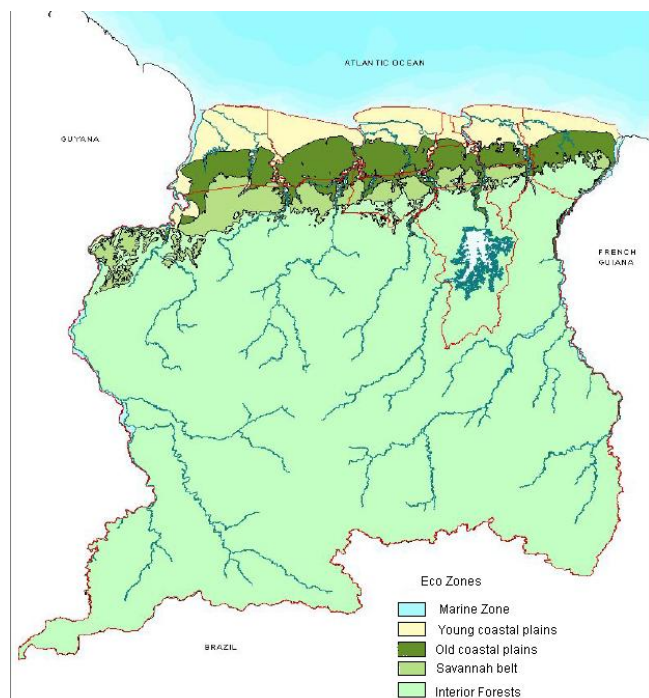


Figure 11: Eco-zones in Suriname (Source: ATM, 2006)

As part of the eco-tourism marketing efforts, education and awareness projects for residents and in-bound tourists could be developed. Short videos that encourage residents and visitors to be more conscious of their impacts on eco-systems can be shown on national TV networks and during in-bound international flights. The films should focus on positive actions that individuals can take to minimise their impact on the environment by decreasing energy and water consumption and wastage. They can also explain the importance of preserving and managing eco-system services in order to protect the livelihoods of communities.

While the impacts of climate change on Suriname’s marine fisheries are still poorly understood, fresh water fisheries are already being affected by more frequent and severe droughts that are thought to be associated with the El Niño-Southern Oscillation (ENSO). Oxygen depletion and high water temperatures in brackish-water lagoons, freshwater swamps and rainforest creeks caused the death of catfish, snook, tilapia, mullet and tarpon and disrupted the reproduction of three species of callichthyid armoured

catfish^{xx}. The fisheries sector in Suriname is however dominated by deep-sea fish and shrimp, with some aquaculture.

Suriname has a broad mix of legislation, policies and involvement in Multilateral Environmental Agreements (MEA) that are relevant to the physical environment and biodiversity. Legislation is currently scattered among laws pertaining to mineral resources, land use and ownership, occupational health and safety as well as other sectors and an environmental framework law has been prepared, but not yet approved. Similarly there are a number of agencies and Ministries with responsibility for different aspects pertaining to biodiversity. The Foundation for Nature Conservation in Suriname (STINASU) provides support in conservation and wildlife management and works with the tourism sector to improve environmental education, secure funds for research and to control hunting.

It is clear that legislation needs to be revised and updated, and there is a general lack of mainstreaming and integration of biodiversity issues into other sectors and a lack of scientific knowledge on biodiversity safeguards. A number of research and training programmes are available in Suriname, such as the National Herbarium and Zoological Collection, but lack of expertise, manpower and funds have impacted their effectiveness. Limited human and technical resources, combined with weak institutional arrangements and inadequate protective legislation are the main challenges facing the management of Suriname's biodiversity and these will need strengthening to ensure greater adaptive capacity in this sector.

It is recommended that Eco-system-based Adaptation (EbA) methods are used for environmental management initiatives since this is more effective in building resilience than a species-based approach. EbA takes into account not just species conservation, but the interactions with physical environment and gives consideration to the human component and the sustainable use of resources. Through integrated management of land, water and living resources, EbA aims to maintain and increase the resilience and reduce the vulnerability of eco-systems and people in the face of the adverse effects of climate change.

CONCLUSION

The extensive, low-lying coastal region of Suriname that contains the vast majority of the population and the drivers of the economy has already been identified as highly vulnerable to climate-induced SLR. The Government of Suriname has therefore undertaken extensive studies focussing on the promotion of sustainable livelihoods in the coastal zone and has also carried out an Integrated Coastal Zone Management Project. The focus of this research has therefore been on the socio-economic sectors as they relate to eco-tourism in the interior. The tourism sector in Suriname is only a small contributor to GDP, but is one of the only sectors that has achieved continuous growth in the last decade. It is also an important source of revenue for Maroon and Amerindian communities who host visitors in their villages and sell indigenous crafts. These groups also have peculiar characteristics that make them vulnerable to climate change. The strong eco-tourism focus means the industry is vulnerable to any changes in climate that will impact the natural resources that form the basis of the product.

The CCCRA explored recent and future changes in climate in Suriname using a combination of observations and climate model projections. Despite the limitations that exist with regards to climate modelling, this information provides very useful indications of the likely changes in climate characteristics and their impacts on socio-economic sectors. Every sector assessed is already experiencing the impacts of climate change with reports of changes in seasons affecting agriculture, livelihoods, water availability, health and bio-diversity.

Climate extremes such as droughts and floods have also resulted in impacts across sectors with the 2006 floods damaging houses, destroying agricultural land used for subsistence farming and interrupting transportation. International climate policy combined with rising energy prices threatens the tourism industry as international travel is likely to become increasingly expensive.

The Government of Suriname has already elucidated a number of guidelines and policy directions to be followed in order to adapt to climate change. A number of limitations have been identified that typically relate to a lack of financial and technical resources and a lack of data in areas such as energy use by sector, epidemiology of diseases and water abstraction rates and practices. There is also currently, inadequate legislation to protect the biodiversity that provides eco-system services, livelihoods and is the primary attraction for tourists. A number of initiatives have been proposed to address specific challenges and improve the ability of the country and its residents to adapt to the changing climate. Key amongst those are a number of education and training programmes to increase the capacity of both public sector departments, who in many cases must facilitate the wider population and the communities, who have provided clear insight to the types of assistance they need to reduce their vulnerability. Considerations for gender, economic security and livelihood activities must be considered in these education initiatives as not all persons are affected equally and would therefore need to respond differently.

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This document provides a synopsis of critical *sectoral* vulnerabilities and capacities and highlights challenges, opportunities and strategies for action. The complete, 250+ page, Climate Change Risk Profile for Suriname is also available from www.caribsave.org and provides detailed climate modelling for various climate parameters, sectoral assessments, and analyses using proven, scientific methodologies to inform pragmatic strategies specific to key sectors in Suriname.

Notes

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- ⁱ This component was not completed for Suriname as similar work has already been recently done.
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