

Assessing the Adaptive Capacity of Coastal Communities in Guyana to Climate Change

Monique Williams and Michelle Kalamandeen*

Department of Biology, Faculty of Natural Sciences, University of Guyana, Turkeyen Campus, Guyana, South America

Abstract

The impact from climate change may be more severe in developing countries, such as Guyana, where there is a high level of poverty, creating potential risks like damages to ecosystems, water resources and coastlines, impacts on food resources, particularly food crops, and health. At the community level, climate change damages are often centred on the environment, which is the main source of livelihood for rural communities. Livelihood opportunities are often instituted in traditional activities such as agroforestry, hunting, gathering, fishing or non-traditional activities such as tourism, monoculture agriculture and large-scale fishing. This research identifies hazards and vulnerabilities to climate change faced by two indigenous communities of Santa Rosa and Waramuri along the coast of Guyana; documented climate change vulnerabilities that are linked to communities' livelihood; and identified historical and current indicators as well as potential coping strategies to climate change used by these communities.

Keywords: Adaptive capacity; Climate change; Coastal community; Guyana

Introduction

Global average surface temperatures have increased by 0.6°C within the 20th Century, with the 1990's being the hottest decade in the last millennium [1]. The progressive nature of climate change can be seen in many countries, affecting human societies and economies. Rising sea levels, flooding of low lying coastal areas, fluctuations in precipitation leading to increase droughts and rainfall phenomena such as El Nino and La Nina, increase in diseases, and loss of biodiversity are examples of the impacts from increasing greenhouse gases emissions (Ibid).

For developing countries with poor economies, weak government and socioeconomic structures and frail market access, climatic phenomena such as El Nino and La Nina have especially grave consequences. Furthermore, a disproportionate share of the GDP of developing countries is in climate sensitive sectors such as agriculture. This is compounded by the fact that the majority of the world's poor live in developing countries and as such, bears the brunt of climate change. The irony is that most developing countries have low greenhouse gas emissions. Developing countries produce approximately 7% of global emissions versus emission from developed (45%) and emerging (48%) countries such as China and India [2].

Consequently, adaptation strategies to cope with the impact of climate change will be crucial [3]. The availability and access to the necessary human, social, natural and financial resources determines the strength of a community, their vulnerabilities and their adaptive capacity¹ [4]. Poor communities often do not have access to all or some of these vital resources, augmenting the vulnerability² to climate change [5]. For example, poor communities often thrive on agricultural resources. Warmer temperatures lengthen growing seasons and increase carbon dioxide in the air which produces higher crop yields while simultaneously decreasing soil moisture which creates shifts in production patterns and the need for man-made irrigation systems

¹Adaptive capacity refers to the ability of a system or a community to adjust to climate change effects, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences [3].

²Vulnerability is the degree to which a system (or a household or a community) is susceptible to, and unable to cope with, adverse effects of climate change [3].

³This assessment is based on the Enumeration District Marginality Index (EDMI) and the Living Conditions Index (LCI) [10].

[6]. Fluctuation in weather patterns can increase food prices, a social and financial dilemma for the poor. Globally, a 2°C rise in temperature could cost about 1% of the world's GDP [7].

In Guyana, temperatures have transcended the norm within the last century (1909-1998) with an increase by 1°C in mean annual temperature [8]. Impacts from climate change create potential risks such as damages to food and water resources, flooding of populated coastlines, and the impairment of ecosystem services [9], and the latter being the basis for many traditional livelihood opportunities such as agroforestry, hunting, gathering, and fishing. Of the poor communities within the ten (10) administrative regions of Guyana, communities in Regions 1, 8 and 9 were deemed the poorest³ [10] as their main economic livelihood is derived from agriculture and forest sectors. As such, communities within the above regions have a high probability of being incapable of dealing with any drastic changes in the environment that may arise from a climatic crisis. McGuigan et al. [11] highlighted that a good indicator of how communities respond to drastic changes in weather patterns can be observed via El Niño and La Nina phenomena.

In 1998, the Government of Guyana declared a state of emergency due to the unprecedented drought conditions produced by El Niño. Rainfall was 50% below normal in 1997 and 85% below usual in March 1998. The impact of the El Niño phenomena resulted in severe water shortage affecting 80% of the Guyanese population (759,000 inhabitants), which reduces food supplies as sea water moved upstream into agricultural areas and crops failed.

According to Wahlström and Weber [12]:

“The most severely affected areas are Region 1 (north-west) and Region 9 (south-west), home to some 23,000 indigenous Amerindians,

*Corresponding author: Michelle Kalamandeen, Department of Biology, Faculty of Natural Sciences, University of Guyana, Turkeyen Campus, Guyana, South America, E-mail: michellek@bbgy.com

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where, in addition to drought, fires have been raging. Crops and livestock have suffered, significantly reducing food supplies. People employed in mining, agriculture (especially subsistence farming), forestry and fishing are seriously affected.”

Communities were unprepared for the drought conditions generated by El Nino. Damages estimated by the Guyana Rice Board and the Guyana Sugar Corporation totalled approximately USD 30 million (Ibid). Other impacts to the GDP were not calculated. The Government of Guyana’s response was limited, committing approximately USD 1 million to an emergency programme to deliver clean drinking water to the most affected areas of Greater Georgetown and USD 350,000 for the hinterland communities. International and regional assistance was also requested to aid communities.

In 2011, news reports acknowledged the adverse effects of La Nina in Guyana through abundance of rainfall, which resulted in flooding of coastal areas, namely large sections of the capital city, Georgetown, islands in the Essequibo River, and along the West Coast of Berbice. The impacts on communities in Guyana were reported locally and regionally [13,14]. The geographic location that brings weather hazards like high rainfall variability combined with the low incomes, inadequate health provision and low quality public services in developing countries such as Guyana enabled numerous vulnerabilities and make adaptation to climate change quite difficult [8].

If climate change is unpredictable, it is difficult to do preventative adaptation. Adaptation by communities is largely local, so the focus is primarily on future local climate and its impacts. Because this is decidedly uncertain as climate models are not very specific to an area, it is exceedingly probable that reactive adaptation rather than preventative adaptation will occur as seen by the responses to El Nino and La Nina phenomena in Guyana. As such, community’s response to climate change will depend significantly on its resilience, access to resources to limit its vulnerabilities and adaptive capacities by accessing traditional knowledge of past coping techniques [4].

Communities throughout history have developed traditional ways of coping with climatic change [15]. These practices may be linked to knowledge about agriculture, hunting, fishing, foraging, use of medicinal plants and the best methods to combat extreme climatic variations. For example, villagers of Surama Community in Guyana cope with environmental changes by dividing chores between men and women [16]. The coping strategies of men included decreased food consumption, seeking of additional jobs in Brazil and in mining and logging areas, improved farm management and increased labour input. Those of women included diversification of food sources and change of family diet. An example of this was the use of the forest cockrit⁴ to make porridge. Women worked as domestic help and got involved in other income generating activities such as weeding, craft, embroidery and sewing until the men returned, collection of government aid, and alternative income sources (for example, casual labour as maids) were sought, and sharing of resources (Ibid).

All adaptation strategies may not fit all communities. This knowledge may be vital for the present time. Although these traditional activities may not provide a solution to global change, they may be effective in the community setting. Adaptation options will evolve as knowledge relating to climate change increases, and information is gathered on the success or failure of adaptation options [18].

⁴Cockrit or cocorite is a palm fruit. The fruits are small and bright orange in colour with a light, sweet taste. The tree can number over 1,000 fruits to one bunch [17].

Methodology

Because traditional knowledge is fragmented, and to some extent, neglected, learning of the different coping strategies by indigenous communities is limited [19]. The aims of this paper are, therefore, to document the climatic vulnerabilities that are linked to communities’ livelihood; and identify historic and current indicators and potential adaptive strategies to climate change used by two (2) indigenous communities within the poorest region (Region 1) of Guyana. The two (2) communities, Waramuri and Santa Rosa, were selected based on their dependence on climate sensitive livelihood activities such as subsistence farming, fishing and hunting; proximity to the coast, population; potential vulnerability and accessibility.

The methodology used for this research was the Climate Vulnerability and Capacity Analysis (CVCA) methodology [20]. The CVCA allowed for analyses of vulnerability to climate change and the adaptive capacity at the community level through a combination of community knowledge and scientific data to yield a greater understanding about local impacts of climate change and devising solutions. This method also assesses the role of local and national institutions in facilitating adaptation. CVCA was considered very interactive, allowing for participatory actions from community members in an informal setting using local dialect. In essence, “*everyone sits and talks*”. Establishment of focus groups in each community (one per community) was essential. This allowed for other tools to be implemented by the authors including:

1. Construction of a hazard map: a map outlining threats and resources;
2. Creation of a seasonal calendar: to identify periods of stress, hazards, diseases, hunger, debt, vulnerability, etc.;
3. Development of a community historical timeline: to allow insight into past hazards, changes in their nature, intensity and behaviour;
4. Development of a community vulnerability matrix: to determine the hazards that have the most serious impact on important livelihoods resources; and
5. Creation of an institution participation Venn diagram: to understand which institutions are most important to communities.

For the purposes of this research, the CVCA method did not allow engagement of individuals within the community. The CVCA method treated the community as a whole. The authors found that this strategy was not practical when dealing with communities that are spatially and geographically widespread as is often the case with indigenous communities in Guyana. As such, an additional questionnaire was developed to garner inputs from individual community members.

Other methods such as the CRiSTAL: Community-based Risk Screening Tool–Adaptation and Livelihoods [21] and “A resilience approach to social assessment” [4] were reviewed for efficiency, adaptability and outputs to communities in Guyana. The CVCA methodology was chosen above other methodologies due to its comprehensiveness and adaptability of use in Guyana’s communities.

This research was conducted in Waramuri and Santa from June–July, 2011 by the authors with a total of 100 individuals targeted per community by questionnaires and the CVCA method. Respondents to the questionnaires in Waramuri and Santa Rosa were mostly between the ages of 15–40 years. There were few respondents over the age of 60. Comparative analysis was conducted using graphical illustrations on the data collected for each community.

Results and Discussion

Hazard mapping, seasonal calendar, historical timeline and vulnerability matrix

In Waramuri and Santa Rosa, food is acquired by fishing, hunting, farming and shops. Few individuals participated in livestock farming in both villages, while subsistence farming is conducted by a majority within the villages. The main crop planted in the villages was cassava. Other crops include plantain, peas, potatoes, peanut, ginger, ochro, corilla, and cucumber. Farmlands are considered common pool resources in both communities.

From the hazard maps developed by Waramuri and Santa Rosa Villages, it was noted that the collective resources that are potentially at risk from the impacts from climate change included the forests, the Moruca River, farms, wells, dams and community infrastructures such as houses, shops, schools and the medical centre. Hazards currently faced by both communities can be seen in Table 1.

Pest increase was the highest reported change seen in the environment over the past 10 years followed by a decrease in the number of animals and fish in Waramuri and Santa Rosa. Residents of Santa Rosa (52%) and Waramuri (96%) highlighted that changes in weather pattern was noticeably hotter and drier over the past ten years, with 2011 being hotter than the previous years.

Farmers from Santa Rosa and Waramuri, and individuals living within the Haimaracabra islands and the forested Para division in Waramuri Village were considered more at risk from the above identified hazards. In Guyana, indigenous communities are often granted communal land titles, which increase their vulnerability to climate change. Individual households lack private property rights which limited access to secure markets and reduce investments in the land as incentives are shared communally. Additionally, access to loans for development of farms is non-existent in Guyana as commercial banks do not accept communal land title when awarding loans. This may prevent communities from effectively adapting to climate change by decreasing the investment required to diversify crops and develop the land.

The vulnerabilities experienced currently within the community

Hazards	Waramuri	Santa Rosa	Impacts
Health issues	✓	✓	Malaria, typhoid, diarrhoea, dengue, deaths
Flooding of Farmlands	✓	✓	Stunted plant growth, less food available for use, rotting of cassava crop
Drying up of farmlands	✓	✓	Stunted plant growth, less food available for use, rotting of cassava crop
Heavy, erratic rainfall	✓	✓	Flooding of farmlands, stunted plant growth, less food available for use (e.g. fish, crops), rotting of cassava crop, overtopping of dams, affect commuting, affect health outreach programmes and other social activities.
Socioeconomic issues	✓		Conflicts of land, issues with transportation, access to certain services
High temperatures		✓	
Pests: mosquitoes and Acushi ants.	✓		Diseases; malaria, typhoid, dengue Damage crops

Table 1: Hazards compared in Waramuri and Santa Rosa and their impacts on resources.

were different than those experienced 10 years ago due to the unpredictability of the weather. The safest place identified in the mapping for Waramuri was the village office located on a small hill. Santa Rosa community could not identify a place in the community that was safe from hazards.

Coping strategies developed were relatively little. For example, farmers continued to work on their farms regardless of whether condition (Table 2 for seasonal calendar and activities conducted throughout the year in Waramuri and Santa Rosa Villages). Providing access to capital and markets and establishing secure property rights which will encourage investments may lead to positive responses to climate change. However, it is difficult at present to determine what each household should do to adapt to climate change.

Currently, community activities and festival are in sync with weather patterns, for example, planting of crops occur within the Dry Season. When changes in climate occur, poor communities are often constrained by financial resources and as such implement inexpensive adaptation strategies (Tables 3 and 4 for historical and current coping actions for Waramuri and Santa Rosa respectively) as compared with rich individuals who can consider more options. In Waramuri and Santa Rosa adaptation strategies used included use of thatched roof homes, planting a diversity of crops, digging drains during the wet season, digging of wells during the dry season, men leaving the village for extensive periods to seek employment in the cities and in mining camps at Port Kaituma; individual households creating small businesses such as selling cassareep and crafts; and housewives making changes to meal preparations within the home. For example, cassava bread may be used in the morning and evening for meals, while rice is prepared during the lunch period.

The extent to which climate affects households and the options available for adaptation will determine which outcome is best suited for each individual instead of as a collective. Communities such as Waramuri and Santa Rosa are not homogenous, with individuals participating in various livelihood activities, ranging from environment-dependent jobs such as farming and fishing, to public employment such as teachers, nurse, assistants, and so forth. Designing a response programme for adaptation requires a comprehensive understanding of the local conditions and the needs of the targeted community.

Institutional participation

Recognising the engagement of different groups within the community will provide an understanding of which institutions are most important to the communities and provide insight into the accessibility of services and availability of social safety nets. For effective adaptation strategy, access to services is essential. By developing nonmarket assets, it provides resources for households to cope with climate change, and become less reliant on climate sensitive sectors such as agriculture. Public service is limited in Waramuri, with the only service readily available being the medical centre. As such, households resort to using oil lamps and those who can afford it, utilize generators. Access to public services in Santa Rosa was high and included medical, financial (Moruca Credit and Development Trust), garbage, electric (Moruca Power and Light), counselling, religious and phone services. These services were considered relatively accessible to community members, though some were unaware of services such as garbage collection and financial support. Developing nonmarket resource also has the advantage of lifting communities out of poverty, decreasing their vulnerability as mentioned in Section 5.1, Table 1.

A number of organisations work with the community but their level of contact is varies with some villagers being hired or trained (Figures

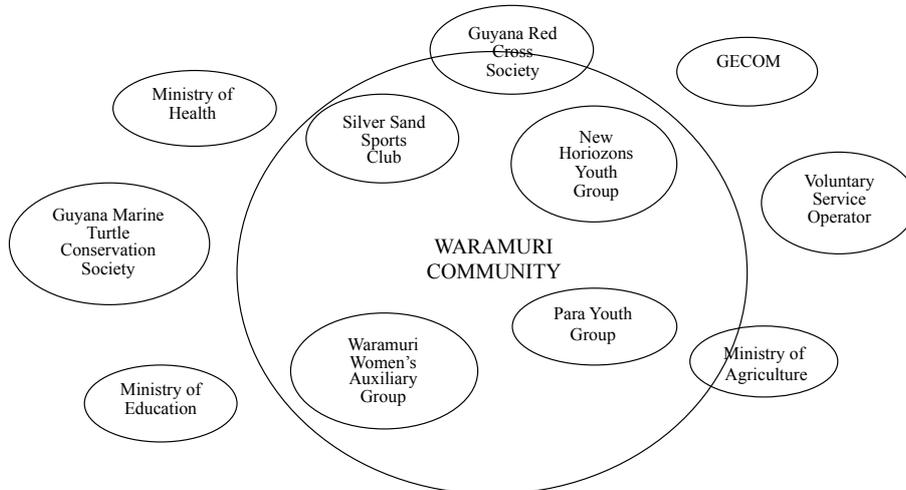


Figure 1: A Venn diagram showing the organisations functioning within the Waramuri Community.

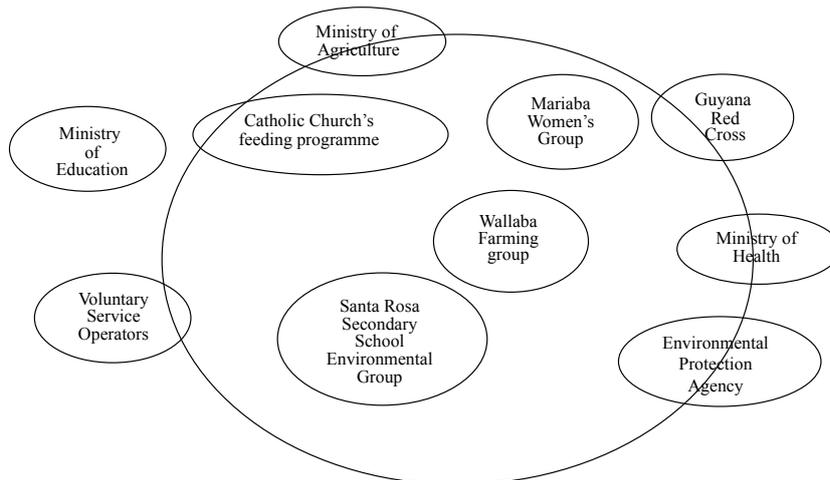


Figure 2: A Venn diagram showing the organisations functioning within the Santa Rosa Community.

Events	J	F	M	A	M	J	J	A	S	O	N	D
Dry Season		x	xo	xo					xo	xo		
Wet Season	x					xo	xo			o	x	o
Tourist	o	o	o	o	o	xo	o	o	xo	o	o	xo
Season Festivals (St. John's Day, Heritage, Moruca Day, Easter Time, Christmas)				x		xo	o	z	xo			x
Planting	o	o	xo	xo	xo	o	o	o	o	o	o	o
Business rush	o	o	o	xo	o	o	o	o	xo	o	xo	xo
Local industrial activities (Cassareep making, cassava bread, sewing, craft making)	xo											
Crab season						x	xo	xo				
Illness/Funerals	xo	o	o	o		x	x			o	o	o
Migration								o	o			

Table 2: Calendar of events in Waramuri and Santa Rosa Communities.

1 and 2 for organisations functioning within Waramuri and Santa Rosa respectively). Organisations include the Guyana Marine Turtle Conservation Society (GMTCS), the Guyana Election Commission (GECOM), Volunteer Service Organisation (VSO), Ministry of

Environmental Changes	Your ancestor's actions	Your action
Drought	Dig ponds, farming of provisions, do fishing, changing of livelihood, stop planting & just prepare farms, use different methods of planting, use pond water domestically, move to different area	Dig ponds, construct wells, farming of provisions, wait for rain, treat turbid water, changing of livelihood, stop planting & just prepare farms, use different methods of planting, use pond water domestically, use tanks, move to different area, do fishing
Flooding	Dig drains, seek out higher ground, do hunting, fish, practice contour farming	Practice contour farming, dig drains, seek higher ground, fish, build higher houses
Hotter weather	Use thatched roofs in homes, dig ponds, slash and burn, plant trees in the area, use pond water in homes	Use thatched roof, dig pond, wear protective gear, use fans, stay indoors, plant trees in the area and use pond water in the home
Less fishes available	Do hunting, search other waters, buy from other community	Salt and store in freezer, buy from elsewhere, fish in the ocean
More fishes available	Smoke and dry fish, use small seine	Sew and sell, smoke and dry fish, avoid overfishing, fish daily, use small seine
Less animals available	Do fishing, do farming, increase hunting grounds, hunt elsewhere, buy from elsewhere, use meat solely for domestic purpose	Do fishing, do farming, rear poultry, hunt elsewhere, buy from elsewhere, use meat solely for domestic purpose, sew and sell
Changes to farming	Practice rotational farming, followed the weather in farming, Move to different areas, farm and fish during dry season,	Use fertilizer , go with the flow,
Changes to fishing	Use lines and hooks	Use fish nets
Mangrove deterioration	-	Replant

Table 3: Traditional and current knowledge of coping strategies in Waramuri Community.

Environmental Changes	Your ancestor's actions	Your action
Drought	Dig ponds, move to areas with eater, walk in search of water, wait on rain to come	Dig ponds, construct wells, fetch water for plants, use tanks, buy water , stop planting
Flooding	Dig drains, seek out higher ground, make bridge or dam, wait on water to run off	dig drains, seek higher ground, fish, clear water ways, make bridge, wait on water to run off
Hotter weather	Use thatched roofs in homes, dig ponds, farm instead, tie hammock under tree,	Use prefab materials, dig pond, water plants regularly, use fans, tie hammock under tree
Less fishes available	Do farming, do hunting, preserve for use, migrate	Go further in the river to fish, go hunting, preserve, change livelihoods
More fishes available	Preserve	Preserve, catch and sell, eat more fish
Less animals available	Do shopping, do farming	Farm more , change livelihoods
Changes to farming	No chemicals	Use chemicals
Changes to fishing	Use lines and hooks	Use fish nets
Mangrove deterioration	-	Replant

Table 4: Traditional and current knowledge of coping strategies in Waramuri Community.

Education, Ministry of Agriculture, the Catholic Church, and Guyana Red Cross Society.

All organisations are not selective of gender. The Waramuri Women's Auxiliary Group has access only to women. The men, however, help in the transportation of crafts and home made products for sales at festivals and in the cities. Other groups are found within the churches in the community. There are no groups that are excluded from membership or service for the organizations. Support is offered sometimes to the communities from the different Ministries and organisations. Information is communicated to and from these organisations via radio set, letters, and cell phones.

Conclusion

Control, access and use of resources are important in determining the capacity for communities to adapt to climatic changes. For example, in both communities all members have access to common pool resources such as fishing ponds. However, there is little responsibility of assigning management strategies such as quotas during droughts. The use of resources in an efficient and sustainable way facilitates adaptation [4]. Additionally, common property resources where there are poorly protected individual property rights and market diversification failure, adaptation to climate change becomes more difficult as dependence on climate sensitive sectors such as agriculture and forest increases.

From the data, it can be seen that the theory that rural communities are less resilient, more sensitive, and hence, more affected by climate change and the impacts it harbours, holds true. Seeing as adaptation is fostered through the security of livelihoods [22] in order to secure food, and hence life, it is fair to say that Waramuri is most sensitive to climate

change than Santa Rosa. This is due to heavy reliance on land-and-water resources for farming, fishing and hunting; lack of diversification of income generating livelihoods, and access to nonmarket services to assist in the adaptation process.

In order to solve these issues, institutional response via access to nonmarket and marketable services are required. Additionally, response to climate change and therefore adaptation may have to occur on an individual/household basis rather than as a collective, i.e. treating the community as homogeneous, particularly in Guyana. Creating incentives for individuals may help thrust public adaptation strategies. Incorporating both traditional and modern ways of adaptation can help in alleviating individual and collective impacts from climate change.

References

1. Intergovernmental Panel on Climate Change (IPCC) (2007) The Physical Science Basis, Cambridge University Press, Cambridge, UK.
2. Rapier R (2012) Climate Change and Developing Countries. Consumer Energy Report.
3. Regmi BR, Morcrette A, Paudyal A, Bastakoti R, Pradhan S (2010) Participatory Tools and Techniques for Assessing Climate Change Impacts and Exploring Adaptation Options. Livelihoods and Forestry Programme, Nepal, pp51.
4. Maguire B, Cartwright S (2008). Assessing a community's capacity to manage change: A resilience approach to social assessment. Commonwealth of Australia.
5. Adger WN, Huq S, Brown K, Conway D, Hulme M (2003) Adaptation to climate change in the developing world. Progress in developmental studies 3: 179-195.
6. Schahczenski J, Hill H (2009) Agriculture, Climate Change and Carbon Sequestration (AATRA).
7. Stern N, Peters S, Bakhshi V, Bowen A, Cameron C, et al (2006) The Stern Review on the Economics of Climate Change. HM Treasury, London.

8. Guyana Chronicle (2010) The Impacts of Climate Change on Guyana and the World at large.
9. Caribbean Natural Resources Institute (CANARI) (2010) Assessing the impacts of climate change on community-based sustainable use of forest resources in the Caribbean. The United Nations Development Programme, Barbados.
10. Skoufias E (2005) A poverty map for Guyana: Based on the 2002 population and housing census. Guyana Government.
11. McGuigan C, Reynolds R, Wiedmer D (2002) Poverty And Climate Change: Assessing Impacts In Developing Countries And The Initiatives Of The International Community. London School of Economics Consultancy Project for the Overseas Development Institute.
12. Wahlström M, Webber G (1998) Guyana: El Nino Drought. Red Cross.
13. Caribbean 360 (2011) Flooding In Guyana Increasing. Caribbean 360 News around the Caribbean.
14. Stabroek Staff (2011) South Leguan hit by flooding. Stabroek News.
15. Macchi M (2008) Indigenous and Traditional Peoples and Climate Change. IUCN.
16. Bynoe P (2009) Case Study on the Impact of Climate Change on Agriculture on an Indigenous Community in Guyana. UNDP, Barbados.
17. Calaman D (2009) Types of fruit only found in the Caribbean. Helium.
18. Postnote (2006) Adapting To Climate Change in Developing Countries. Parliamentary office of Science and Technology.
19. Laureano P (2007) Traditional Knowledge Helps Combat Climate Change. Traditional Knowledge World Bank.
20. Daze A, Ambrose K, Ehrhart C (2009) The Climate Vulnerability and Capacity Analysis. handbook, (1stedn).
21. <http://www.iisd.org/cristaltool/>
22. Klein RJT (2004) Approaches, Methods and Tools for Climate Change Impact, Vulnerability and Adaptation Assessment.