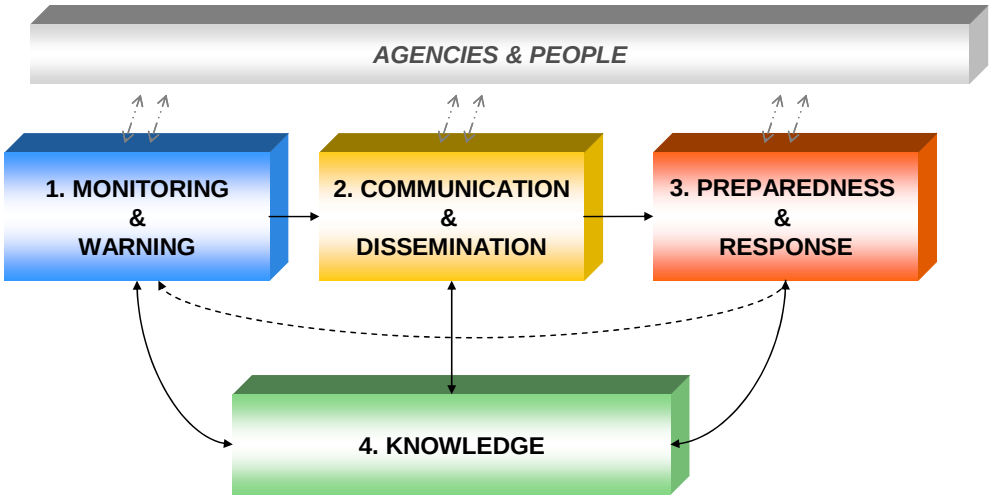
Guyana Lands and Surveys Commission
United Nations Development Programme
Global Environment Fund

Early Warning System Study

Final Report



March 2010

Early Warning System Study

Final Report

For *GLSC – Guyana Lands and Surveys Commission*
UNDP – United Nations Development Programme

Under the Capacity Development and Mainstreaming for Sustainable Land Management Project

March 2010

Prepared by *Dr. Stéphane Flasse and Dr. James Williams*

Flasse Consulting

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ACKNOWLDGEMENTS

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ACRONYMS

CARICOM	Caribbean Community and Common Market
CAP	Conservancy Adaptation Project
CCC	Crisis Coordination Committee
CDC	Civil Defence Commission
CDEMA	Caribbean Disaster Emergency Management Agency (ex CDERA)
CIMH	Caribbean Institute for Meteorology and Hydrology
CMO	Caribbean Meteorological Organisation
DRR	Disaster Risk Reduction
ECLAC	Economic Commission for Latin America and the Caribbean
EDWC	East Demerara Water Conservancy
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Agency
EWC III	Third International Conference on Early Warning
EWS	Early Warning System
FAO	Food and Agriculture Organization
FEWS NET	Food Early Warning System Network
GCI	Guyana Citizens Initiative
GCM	Global Circulation Models
GDF	Guyana Defence Force
GEF	Global Environment Fund
GFC	Guyana Forestry Commission
GFS	Global Forecast System
GGMC	Guyana Geology & Mines Commission
GINRIS	Guyana Integrated Natural Resources Information System
GIS	Geographical Information System
GLSC	Guyana Lands & Surveys Commission
GPF	Guyana Police Force
GS&RD	Guyana Sea and River Defence Department
GS&WC	Georgetown Sewerage and Water Commission
GuySuCo	Guyana Sugar Corporation
GuyWA	Guyana Water Authority
GWI	Guyana Water Inc.
Hydromet	Hydrometeorological Department
IADB	Inter-American Development Bank
IFRC	International Federation of Red Cross and Red Crescent Societies

INPE	National Institute for Space Research (Brazil)
IRI	International Research Institute for Climate and Society, University of Columbia
ISDR	International Strategy for Disaster Reduction
ITU	International Telecommunication Union
JRC	Joint Research Centre of the European Commission
MACC	Mainstreaming Adaptation for Climate Change
MoU	Memorandum of Understanding
NARI	National Agricultural Research Institute
NDIA	National Drainage and Irrigation Authority
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NSC	National Steering Committee
NWP	Numerical Weather Prediction
PPEW	Platform for Promotion of Early Warning - United Nations
SDMIS	Sea Defence Management Information System
SEEC	Strategic Emergency Engineering Committee
SIDS	Small-Island Developing States
SLM	Sustainable Land Management
TFIR	Task Force for Infrastructure Recovery
ToR	Terms of Reference
TSG	Technical Support Group
UN/ISDR	United Nations International Strategy for Disaster Reduction
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UNITAR	United Nations Institute for Training and Research
UoG	University of Guyana
WMO	World Meteorological Organization

1. OVERVIEW SUMMARY

The people of Guyana would benefit considerably from establishment of a national Early Warning System (EWS) to help mitigate impacts from relatively frequent floods and droughts.

Present arrangements under the Commission for Civil Defence (CDC) need augmentation.

Formal establishment of an EWS is recommended, with adequate organisation, legislation, mandates and funding. No new institutions are required.

The main unresolved issue concerns sustaining top-level technical support for the EWS. Government of Guyana may need to encourage CARICOM to ensure that quality regional EWS support services are always available.

2. BACKGROUND TO THIS STUDY

Guyana is moving towards formal establishment of an Early Warning System (EWS) as part of a national disaster risk reduction. This has been recommended in a number of reports, after previous droughts and floods, and is the subject of the present consultancy: the Guyana Early Warning Systems Study.

The objective of the Guyana Early Warning Systems Study is *'to provide decision makers with a comprehensive analysis based set of options for the introduction of early warning systems appropriate to the Guyana situation, while enhancing the local knowledge base in such systems*'.

As stated in the terms of reference (see Annex 1), the Study's process is required to:

1. Analyse existing climatic and other spatial and temporal data to ascertain key vulnerabilities in Guyana.
2. Undertake a situation analysis that identifies potential areas where early warning systems can be applied in Guyana.
3. Identify appropriate early warning systems that may be applied in Guyana.
4. Conduct one training seminar on early warning systems and their application.
5. Facilitate a Stakeholder consultation to present and discuss the findings of the draft final report.

This Final report is the result of the first four Actions above, as the basis for the stakeholder consultation, Action 5.

The report focuses on requirements for an appropriate **national** early warning system for Guyana. The terms of reference and circumstances in Guyana clearly call for a national rather than a 'bottom-up' community-based approach to EWS. But communities comprise the fabric of society and their needs must be central within the national system.

The findings in this Report result from consultations with stakeholders (see the Study *Situation Analysis Report*), analysis of copious literature (see Section 9), discussion of issues during a two-day training workshop (see list of participating institutions in Annex 9) and extensive experience from working with early warning systems in other countries.

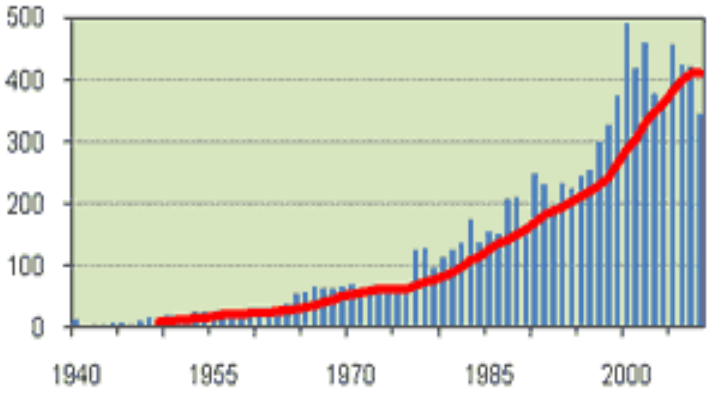
3. CONTEXT FOR CONSIDERATION OF EARLY WARNING SYSTEMS

The main purpose of having an EWS is usually to protect lives and livelihoods from known hazards, while minimising negative impacts on economy and environment. An effective EWS constitutes one of the key elements of any disaster reduction strategy.

3.1. Global context

The frequency of disasters and losses (people and assets) is increasing globally and is expected to increase further with climate change (greater frequency of extremes).

Many countries around the world now have EWS, partly as a result of the increase in disasters and their impacts, partly as a result of shared best practice through the UN International Strategy for Disaster Reduction (UNISDR), and partly because modern EWS have become so much more effective at saving lives & livelihoods and making national economies more resilient in the face of periodic disasters. Hence the terminology and approach used in this document is aligned with that of UNISDR [11.2][11.4].



Weather Related Disasters
Source OFDA/CRED International Disaster Database - www.emdat.net

3.2. EWS Terms, Concepts and Components

The term “Early Warning System” can mean different things to different people. It is much more than “the technology” used for monitoring and prediction. An effective EWS warns people in advance of likely hazards, and enables risks and losses to be mitigated through suitable preparatory measures and response actions. The technology used must be complemented by other essential components in order for it to be effective.

> In practice an EWS must be considered as a
>
> ***Complete Early Warning, Preparedness & Response System***.

Definition: Risk = (Hazard x Vulnerability) / Capacity to intervene

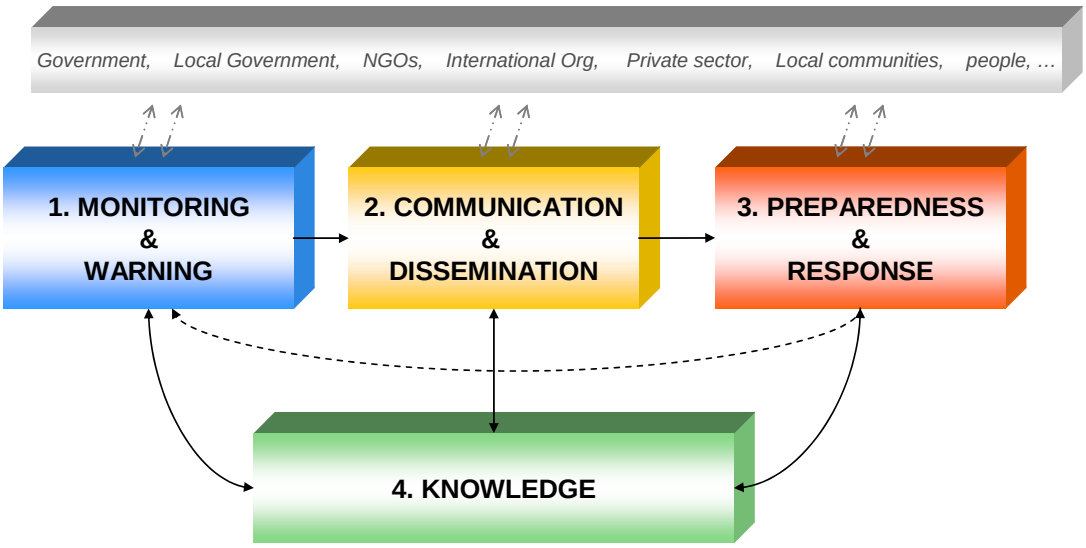
Risk	= expected loss
Hazard	= probability of occurrence
Vulnerability	= potential damage
Capacity to intervene	= response

Four EWS Components: Experience shows that effective early warning systems are people-centred and integrate four essential components:

(i) **MONITORING AND WARNING**
(ii) **DISSEMINATION AND COMMUNICATION**
(iii) **PREPAREDNESS & RESPONSE**
(iv) **KNOWLEDGE**

Weakness in any one of these components can result in failure of the whole Early Warning System.

Monitoring & Warning	**Dissemination & Communication**	**Preparedness & Response**
Technical hazard monitoring and warning service	Communicate risk information and warnings timely and appropriately	National and Community preparedness & response capabilities
Knowledge Understand the hazard, the vulnerability and the risk, and collect data & prepare information as a foundation to all other components		



3.3. Important Characteristics of EWS from International Best Practice

Basic Culture: An EWS exists to provide a quality knowledge service for all its many stakeholders. A *'service provider'* attitude is absolutely essential, within a framework of best practices in knowledge management. This culture must be developed in all the components and institutions involved. [*Note: knowledge is a resource and it needs to be managed intelligently, just like human resource management, or financial resource management.]*

High Profile: The whole system must work effectively to provide increased personal security, and also *it must be seen to work effectively*. Once an EWS exists, people's expectations are raised and their behaviour may be modified accordingly.

Multi-hazard EWS - Early warning systems should address all major hazards. Economies of scale, sustainability and efficiency can be enhanced if systems and operational activities are established and maintained within a multipurpose framework that considers all hazards and end user needs. Further, multi-hazard early warning systems will also be triggered more often than a single-hazard warning system, and therefore should provide better functionality and

reliability for events that occur infrequently. Multi-hazard systems also help the public better understand the range of risks they face and reinforce desired preparedness actions and warning response behaviours. Early warning systems improve only through use and practice.

National Context: Effective early warning procedures should be part of the national institutional and legislative framework for disaster management. Early warning must be complemented by professional services, training, and capacity-building activities and the allocation of resources to enable timely actions to be taken to avert loss.

Multiple Stakeholders: An effective early warning system requires the contribution and coordination of an extremely wide range of individuals and groups. Herein, lies its complexity.

Existing Institutions: Most EWS are based on existing institutions taking on additional roles rather than creating a specific EWS institution that has little or no function most of the time.

Institutions and their roles [11.4]

Communities, particularly those most vulnerable, are fundamental to people-centred early warning systems. They should be actively involved in all aspects of the establishment and operation of early warning systems; be aware of the hazards and potential impacts to which they are exposed; and be able to take actions to minimize the threat of loss or damage.

Local governments, like communities and individuals, are at the centre of effective early warning systems. They should be empowered by national governments, have considerable knowledge of the hazards to which their communities are exposed and be actively involved in the design and maintenance of early warning systems. They must understand advisory information received and be able to advise, instruct and engage the local population in a manner that increases public safety and reduces the possible loss of resources on which the community depends.

National governments are responsible for high-level policies and frameworks that facilitate early warning and for the technical systems that predict and issue national hazard warnings. National governments should interact with regional and international governments and agencies to strengthen early warning capacities and ensure that warnings and related responses are directed towards the most vulnerable populations. The provision of support to local communities and governments to develop operational capabilities is also an essential function.

Regional institutions and organizations play a role in providing specialized knowledge and advice which supports national efforts to develop and sustain early warning capabilities in countries that share a common geographical environment. In addition, they encourage linkages with international organizations and facilitate effective early warning practices among adjacent countries.

International bodies can provide international coordination, standardization, and support for national early warning activities and foster the exchange of data and knowledge between individual countries and regions. Support may include the provision of advisory information, technical assistance, and policy and organizational support necessary to aid the development and operational capabilities of national authorities or agencies.

Non-governmental organisations play a role in raising awareness among individuals, communities and organizations involved in early warning, particularly at the community level. They can also assist with implementing early warning systems and in preparing communities for natural disasters. In addition, they can play an important advocacy role to help ensure that early warning stays on the agenda of government policy makers.

The private sector has a diverse role to play in early warning, including developing early warning capabilities in their own organizations. The media plays a vital role in improving the disaster consciousness of the general population and disseminating early warnings. The private sector also has a large untapped potential to help provide skilled services in form of technical manpower, know-how or donations (in-kind and cash) of goods or services.

The science and academic community has a critical role in providing specialized scientific and technical input to assist governments and communities in developing early warning systems. Their expertise is central to analysing natural hazard risks facing communities, supporting the design of scientific and systematic monitoring and warning services, supporting data exchange, translating scientific or technical information into comprehensible messages, and to the dissemination of understandable warnings to those at risk.

Improving performance: An EWS must aim for continual improvement, learning from both its successes and its failures, overcoming limitations, extending its reach while maintaining the confidence of all stakeholders.

Finance: EWS require finance to operate, to respond quickly to events, and to develop new capacities and improve performance (e.g. evaluation, training, practice alerts). Routine operational costs are minimised if the EWS is based on existing institutions.

4. EWS REQUIREMENTS IN RELATION TO GUYANA

Analysis of the situation with information from many parties together with pertinent documents and reports (Section 9) provides the following context for development of an EWS appropriate for Guyana (see also Annex 2 or see the *Situation analysis report* from this study).

4.1. Hazards

In Guyana, the five (5) main disaster hazards are:

1. Flood from excessive rainfall
2. Flood from breach or over-topping of the sea wall
3. Drought from insufficient rain over an extended period
4. Intense storms and high wind-speeds affecting people and property
5. Risks of wild fire and extent and rate of land degradation.

All these hazards are weather and climate related, and likely to get worse with climate change. They are all eminently open to treatment within a single 'multi-hazard' EWS.

Consideration should be given towards inclusion of a number of additional hazards in the EWS – health epidemics, and agricultural pests and diseases may become more problematic and require resources beyond the capacity of normal services.

4.2. Vulnerabilities

Peoples' susceptibility to a given hazard is determined by the extent to which they can anticipate, cope with, respond to and recover from all impacts [13.2]. There are many vulnerabilities to the above hazards throughout Guyana, that would be open to mitigation through an appropriate EWS.

The extent of the economic, social and environmental impacts from these hazards, and the likelihood of increased frequency of hazard occurrence in a more hostile future climate, overwhelmingly justify significant investment in improved disaster early warning and response in Guyana (see following).

While an early warning system will not stop flood or drought from occurring, timely warning can allow preparedness and response actions to minimise the economic, social and environmental impacts.

4.2.1. Economic and Infrastructural Vulnerabilities

Table 41 Summary of damage and losses				
Sector and subsector	**Damage and losses**			
	Total	**Total**	**Direct**	**Indirect**
	Millions of US dollars	**Millions of Guyana dollars**		
Total	465.1	93,022.9	83,659.5	9,363.4
Social sectors	278.3	55,665.9	55,247.2	418.7
Housing	275.6	55,120.8	54,842.6	278.2
Education and culture	1.9	371.7	352.1	19.6
Health	0.9	173.4	52.5	120.9
Productive sectors	137.3	27,458.6	20,945.0	6,513.7
Agriculture	54.5	10,894.3	10,018.8	875.5
Commerce	72.4	14,476.1	10,213.1	4,263.0
Tourism	5.6	1,126.8	47.0	1,079.8
Manufacturing	4.8	961.5	666.1	295.4
Infrastructure	45.7	9,143.3	7,452.2	1,691.1
Drainage and irrigation	6.6	1,311.1	194.8	1,116.4
Water supply and water disposal	19.7	3,943.7	3,763.7	180.0
Road transport	17.6	3,529.0	3,349.0	180.0
Telecommunications	0.8	152.7	91.3	61.4
Electricity	1.0	206.7	53.4	153.3
Environment	0.1	15.1	15.1	
Emergency expenditures	3.7	740.0		740

Source: ECLAC 2005 [7.1]

While significant economic losses arise from both flood and drought, losses from flood predominate. According to the ECLAC [7.1] Assessment of the major flood in 2005, the total cost to Guyana was around G$93 billion, most of which was damages to housing (see table below).

Drought: The economic impact from the 1997-98 drought, probably the largest drought on record – was not so marked. Agricultural production decreased (particularly rice, see *Appeal box* on next page) and many farmers were adversely affected. But for sugar cane, the effects of flood are much worse. Inundation kills sugar cane plants requiring a replant, and salt water

Extract from the ***"Appeal for assistance of victims of drought"***

(GUYANA El Niño Drought OCHA Situation Report No. 1, March 1998)

1. *Guyana is subject to a period of unprecedented drought caused by the El Niño phenomenon that has been found responsible for as much as 90 per cent of the deficiency in rainfall in September and October 1997 and for the complete failure of a rainy season in mid-November 1997 to mid-January 1998.*

2. *There is a severe shortage of drinking water throughout the country. The most affected areas are Georgetown, where the population is also faced with unsafe drinking water and the risk of water borne diseases, and hinterland areas where springs and wells have dried up.*

3. *Agricultural production, particularly of rice and sugar which are major export crops has been severely affected. The total area sowed with rice was reduced by 35 per cent, and the Guyana Rice Development Board reports that El Nino effects will cause rice production for the spring season to fall by 37 per cent. Sugar production for the same period will fall by 13 per cent according to GuySuCo's estimates.*

4. *Those most seriously affected by the drought will be farmers who have invested resources in planting, but will have no yield to harvest. This phenomenon will affect 1,300 rice growers' families and 1,000 sugar cultivators' families, numbering some 11,000 people in total.*

4.2.3. Environmental Vulnerabilities

The main environmental vulnerabilities lie in (a) pollution that may occur with flooding, (b) poor drinking water quality during both flood and drought, and (c) the prospect of wild fire and much accelerated rates of land degradation with drought.

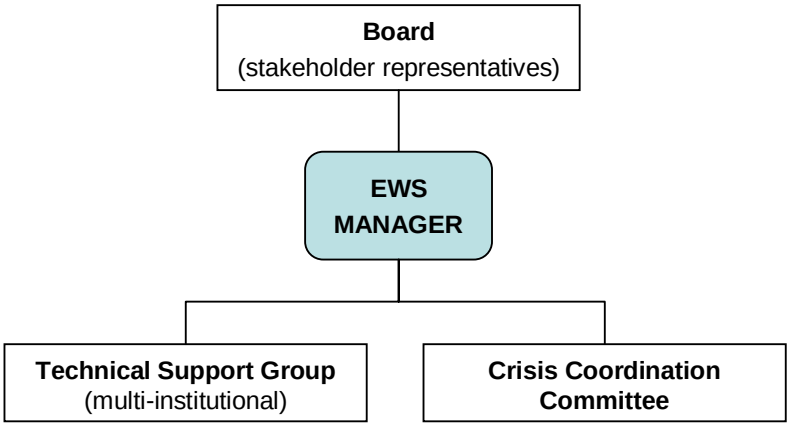
The much greater risk of wild fire with drought and climate change is highly pertinent to the Government of Guyana's Low Carbon Development Strategy, both in forest areas and in wetlands (dried out conservancies).

4.3. Institutions and Capacities

In terms of institutions in Guyana, those required for an appropriate EWS exist already. System functionality with the four (4) essential components can be provided without the need for any new institutions to be created. While basic capacities are good, all four (4) components will need to be improved in due course. In some cases, technical and logistical capacities will need to be strengthened. Guyana, however, is a small country with limited human resources: retaining trained manpower is a problem. Consequently, regional and international collaboration to provide support and ensure continuity may be essential. The primary requirement is to develop a suitable structure with arrangements to ensure that the many organisations involved can and do work together more effectively.

Structure: Most early warning systems comprise of the following:

- a **Board** or senior management team (with broad stakeholder representation) to provide oversight and overall direction
- an early warning system **Manager** responsible for making the system work
- a multi-institutional **Technical Support Group** (TSG) (or groups) to provide the know-how for each of the components, and to assist the manager with operations.
- **Crisis Coordination Committee** (CCC) to ensure coherent and effective response whenever a problem arises



The Civil Defence Commission currently covers some of the functions of an EWS Board.

Legal: Legislation will be required to mandate pertinent institutions to work in specific EWS areas, either alone or together.

Culture of Service Provider: It is important that institutions involved in the EWS are able to provide the kind of practical services required by all the different stakeholders. Such services need to be based on good knowledge management practices. Training may be required to enable units (that currently see themselves as primarily technical) become proficient in such service provision. This applies in weather and climate forecasting, risk and vulnerability assessment, data sharing, communication and warnings, coordination of agencies, management of resources and assessment of climate change.

Finance: Currently several Departments / Ministries carry an allocation for disaster response in their annual budgets. This will need to be supplemented with a direct budget for independent operation by the EWS (routine operation, initial rapid response, to develop new capacities and to improve performance.

4.4. Governance and Policy Context

'*One of the fundamental and widely accepted roles of governments through the ages has been the protection of their people from external threats including those derived from natural hazards'* [11.2].

In this respect, the TOR for this study (Annex 1) emphasise the pertinence of an EWS for the National Development Strategy (2001-10), the National Poverty Reduction Strategy and the National Action Plan for Combating Land Degradation.

Creation of an EWS is also pertinent to policies addressing other aspects of sustainable development, climate change and the Low Carbon Development Strategy, disaster risk reduction and institutional reform.

5. CONCLUSIONS

1. There is an extremely strong case for formal establishment of a national EWS in Guyana.
2. The need is evident. With suitable early warning, there would be major benefit to people throughout the country, to the national economy and to the environment from better preparedness towards five main hazards.
3. The national policy environment is most favourable to establishment of an EWS.
4. The essential institutions needed for an early warning system already exist in Guyana. No new institutions are required.
5. While the present (*ad hoc*) system works already to some extent, significant benefits could be derived from:
    a. A formal organisational structure for EWS
    b. Improved Working Together: better coherence, coordination and communication throughout the institutional chain, building on synergies

c. Improved technical capabilities in pertinent institutions – with capacity strengthening and better use of 'global goods' to enhance operational effectiveness

d. Arrangements for regional back-up, and support for long term improvement

6. ISDR best practices in early warning are highly pertinent in Guyana. The overall situation vis-à-vis vulnerability to weather disasters in Guyana is sufficiently similar to that pertaining in a number of other countries where EWS are already operational.

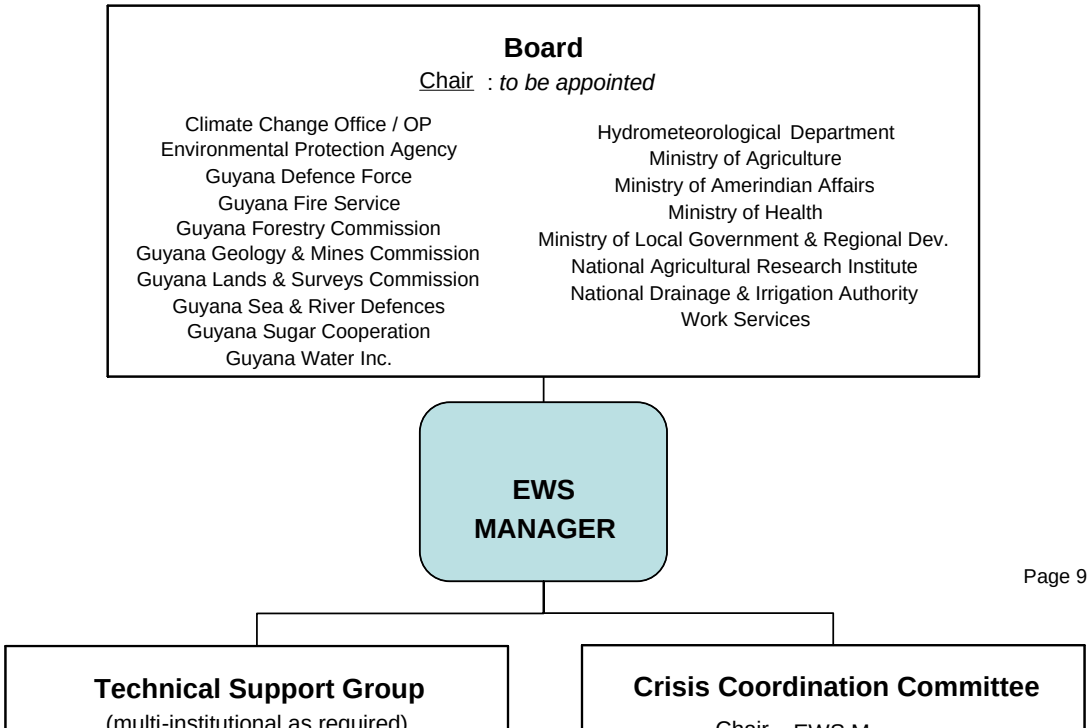
6. MAIN RECOMMENDATIONS

Generic Recommendation: It is recommended that throughout the process of EWS establishment, operation and improvement, great attention be given to similar experience from other countries and reported in ISDR publications [11.2-5]. There is much to be gained in such an approach: Guyana does not need to make the same costly mistakes that have been made so frequently elsewhere.

With that in mind this study recommends establishment of a standard ISDR multi-hazard nationwide EWS, with 4 components and 3-level structure, based on already existing institutions.

6.1. It is recommended to the Government of Guyana that:

1. An Early Warning System should be developed as soon as practical. It should be resourced in proportion to the high vulnerability of both livelihoods and the economy to natural hazards in Guyana.
2. An overarching legislative framework for an EWS should be developed urgently, within which all the participants can work more efficiently (mandates, data policy, roles and responsibilities, liabilities …).
3. The EWS should comprise a) a **Board**, b) a **Manager**, c) a **Technical Support Group**, and d) a **Crisis Coordination Committee**:



4. The overall **Board** should be mandated to oversee **all aspects** of EWS development and operation within the new legislation (i.e. significantly larger than CDC's current mandate: see note (a) below).
5. An **EWS Manager** be appointed and made responsible for development and operation of the EWS and all its components.
6. A **Technical Support Group** (TSG) should be established representing key stakeholders.
7. The current Emergency Operations Centre should be strengthened as befits a national **Crisis Coordination Committee** (CCC).
8. A **budget** be allocated for the EWS manager to carry out his/her mandate.
9. All roles, responsibilities and lines of command and communication for partners and stakeholders should be made clear, consistent and effective.

Notes

a. **Role of CDC:** The Government must decide on the future role of the Civil Defence Commission, in relation to the EWS. Currently, CDC oversees disaster response among other responsibilities. As proposed here, the EWS Board and Crisis Coordination Committee would carry out much of the present work of the CDC, and more. Government must choose whether (a) to expand the mandate of CDC to cover all Early Warning and Disaster Risk Reduction activities – i.e. for CDC to become the proposed EWS Board, or (b) to create the EWS Board anew, refocusing CDC responsibilities in other areas or abolishing it altogether. These matters were discussed with stakeholders during the Consultancy. Some felt there would be value in a new start as part of the government's institutional development programme, to demonstrate its commitment to making the EWS really effective.

b. The Government should ensure that all departments, donors and other regional and international stakeholders work to create a **unified platform** for early warning and disaster risk reduction in Guyana. There needs to be a coherent approach integrated into mainstream development activities. The EWS should also be integrated under UNFCC, UNCCD and the UNISDR.

c. The Government will need to ensure that full use is made of opportunities within a **regional approach** to disaster risk reduction. Sustaining the technical capacity to operate the EWS most effectively without external support will be challenging. Within CARICOM there are several institutions (CDEMA, CMO, CIMH) that could considerably strengthen EWS operations in Guyana, as elsewhere.

6.2. Risks

It is recommended that all persons involved in implementing the EWS should be made aware of the five (5) main reasons for EWS not delivering their potential elsewhere [11.4],

(a) Inadequate Political Commitment
(b) Insufficient Investment
(c) Insufficient Coordination
(d) Lack of Participatory Approaches
(e) Inadequate identification and sharing of methodologies and good practices, as well as cross discipline collaboration

All the above risks were identified as pertinent to Guyana during the study and must be fully appreciated and acted on, in order to make the Guyana EWS a success from the beginning.

7. SPECIFIC RECOMMENDATIONS

EWS's are complex processes because everybody in the country has a stake and many institutions are involved in the multiple processes. Any failures tend to be high profile. It is absolutely essential that roles and responsibilities are carefully mandated and backed up by appropriate legislation and decision making.

7.1. EWS Functionality: Roles and Responsibilities

7.1.1. EWS Board

The role of the EWS Board is oversight. It should delegate authority for everyday decisions to the Manager supported by the TSG and CCC. The Board should track progress through the reporting channels and be open for stakeholders to report their concerns. The Board should participate in appointing the EWS Manager, and ensure an appropriate institutional base for efficient operation. The Board should also request independent review of EWS processes and potentials, at least every five (5) years, in order to keep the EWS at optimum effectiveness.

7.1.2. EWS Manager (much more than a national disaster coordinator)

The Manager has overall responsibility for operation and improvement of the EWS. This role is much more than that of national disaster coordinator. The appointee must be senior enough to reach decision makers and have strong support from Government through the President's Office, and the Board.

The Manager's activities include:

1. Developing the basic EWS and four components to operational status as soon as possible. This will include
    a. using the EWS,
    b. testing the system progressively to ensure all elements and linkages are fully functional,
    c. evaluating operations – and addressing weaknesses: EWS improve iteratively.

2. Managing
    a. the Technical Support Group
    b. the Crisis Coordination Committee and any disasters that may occur
    c. the budget
    d. any support staff.
3. Reporting to the Board (quarterly and annual EWS progress reports)
4. Making sure that all partners are aware of their roles and responsibilities.
5. Implementing mechanisms to promote communication and understanding between EWS partners.
6. Collaborating with partner institutions to
    a. Establish base line data sets required for early warning and response, and to make them available as required;
    b. Ensure coherence and compatibility of data from and for various participants by establishing standards and protocols, for example, for vulnerability assessment and response needs.
    c. Develop clear, simple and user-friendly protocols, procedures and manuals to ensure rapid uptake by new staff.
7. Making sure appropriate training is available for key staff in partner institutions.
8. Organising research actions to improve methods and effectiveness.
9. Seeking opportunities to strengthen the EWS, for example, through regional services.

The manager, together with any support staff, must function as the main **EWS coordination unit.** Tasks should include coordination of all the relevant activities of participant institutions, building on synergies, promotion of ownership and collaboration, and ensuring coherence and operational effectiveness.

7.1.3. Technical Support Group (TSG)

The TSG is the main technical unit of the EWS, supporting all four components. Its role is to sustain and improve all the operational components and functions of the EWS. Its main function is as a knowledge service provider for all stakeholders. It is recommended that it operate much as follows:

Meetings: The TSG would meet regularly, adapting the frequency according to the situation (e.g. once a month during non-crisis periods, daily or more during a crisis). The EWS Manager would normally be the chairperson. The meetings would exchange pertinent information on any hazards, report progress on upgrading and improving services, identify other actions that may be required to fill gaps, assess evaluation reports, prepare for practice events, arrange capacity strengthening, etc. During crisis events the TSG would contribute regular updates on the whole situation to the Crisis Coordination Committee.

Composition: The institutions attending TSG meetings would vary depending on the agenda. During non-crisis periods it would comprise the technical monitoring and warning representatives, and other partners working to improve functionality reporting on their progress. During crisis periods, participation in meetings might expand to include representatives of all operational institutions, for two way exchange of latest information and coordination of actions (i.e. merge with the Crisis Coordination Committee) depending on circumstances.

An important role for this group is to control information quality. It enables scientists and technical experts to assess and review the accuracy of risk data and other information developed and exchanged.

7.1.4. Crisis Coordination Committee

This would function much as the Emergency Operations Centre does at present, in times of crisis, but with greater emphasis on coordinating the actions and plans of all partners. Its terms of reference should be reviewed in conjunction with development of legislation and mandates.

7.2. Component 1: Recommendations for Monitoring & Warning

The aim of the Monitoring & Warning component of an EWS is to produce reliable, accurate and timely information about the possible occurrence of a hazard.

Characteristics of the Monitoring & Warning component include:

- Routine observations of relevant hazard indicators
- Routine interdisciplinary analysis of indicators
- Routine production of quality warning information

Note: Annex 3 provides an assessment of existing monitoring capacity and gaps in Guyana.

Priority Recommendations for improving *Monitoring & Warning* for the EWS Manager:

1. The EWS must ensure reliable access and use of the **best possible advance information** for mitigating disasters, and in particular with regards to climate and weather information:
    a. The Hydrometeorological Department must be able to provide top class forecasts of exceptional weather, based on global Numerical Weather Prediction outputs. This may be achieved with internal expertise (suitably trained) or as part of a regional service by (e.g.) the Caribbean Institute for Meteorology and Hydrology (CIMH) or possibly in collaboration with Brazil.
    b. Guyana EWS must have access to, and make full use of top class Climate Prediction products (in particular ENSO prediction). CIMH already publish some IRI products and may improve their service. Another possibility is to engage with current regional model development (IRI-Brazil).
    c. Guyana EWS make full use of other information services on-line (e.g. swell and sea surge forecasts)
2. The Hydrometeorological Department must develop its capacity in providing useful **public services**, especially as concerns disasters. It needs to understand better the particular needs of its diverse user communities and develop the required services.
3. The Hydrometeorological Department must be strengthened in order to meet its hydrological mandate, and in particular to research and develop an **operational flood forecasting** service based on hydrological modelling. Many hydrological models exist world wide. Collaboration should be sought, preferably at regional level,

in order to build relevant expertise for Guyana. Again the Caribbean Institute for Meteorology and Hydrology would appear to be ideally placed to provide this kind of service for the region. However hydrology and climatology do not appear to be high priorities for this organisation, and pressure may need to be applied on the Caribbean Meteorological Organisation with support from CARICOM, or it will never happen.

4. Guyana must carefully consider the benefits of working within a **regional approach** to monitoring hazards for early warning, much as described above. It is very difficult for a small country to train and retain personnel in all these advanced techniques, and one good regional centre could service multiple needs most effectively.

7.3. Component 2: Communication & Dissemination

The aim of the Communication & Dissemination component of an EWS is to ensure that decision makers and vulnerable people & communities everywhere receive timely warning of impending hazard events and can take suitable action. It should also facilitate national and regional coordination and information exchange.

Characteristics of the Communication & Dissemination component include:

- Reliable, accurate and timely service with continuous upgrade in warnings through regular communication.
- User friendly - so the warning can be understood and acted upon
- Redundancy must be in place to ensure the message reaches all concerned even when some communication means are failing
- Knowledge that the information has been received

Note: Annex 4 provides an assessment of existing communication & dissemination capacity and gaps in Guyana.

Priority Recommendations for *Communication & Dissemination* for the EWS Manager:

1. **Legislation** and **mandates** must define roles and responsibilities of each actor in the dissemination chain, as well as relevant procedures and protocols, including:
    a. Recognized authorities empowered to disseminate warning messages (e.g. meteorological authorities to provide weather messages, health authorities to provide health warnings).
    b. Roles and responsibilities of regional or cross border early warning centres defined (if appropriate).
2. The **warning communication system** should have the following characteristics:
    a. reliable, accurate and timely
    b. continuity in time (always there)
    c. at least 5-day severe weather outlook
    d. straightforward levels of warning (about 4)
    e. regional differentiation.
3. There should be built-in **redundancy** in communications: multiple channels with a return link for critical points (radio, media, cell phone, Internet ...)
4. The full warning system should be hosted on a **website** in order:
    a. to serve as a reliable point of reference for the whole communication system
    b. to ensure continuity (always there) and frequent updates

c. to serve as the primary reference for partners in the EWS itself, allowing them to pass the information on with appropriate means
d. to serve as reliable reference for anybody else. Access to Internet in Guyana is increasing rapidly with new technology.

5. The EWS should work to enable the **media** to fulfil a full role.

7.4. Component 3: Preparedness & Response

The aim of the Preparedness & Response component of an EWS is mitigate the impact of hazards (whether warnings were communicated or not).

Characteristics of the Preparedness & Response component include:

- Preparedness & Action under crisis
- Community participation
- Coordination of partners and action
- Response in proportion to the event
- Usually 3 days are available to get organised after a large disaster, then things tend to fall apart.

Note: Annex 5 provides an assessment of existing preparedness and response capacity and gaps in Guyana.

Priority Recommendations for *Preparedness & Response* for the EWS Manager:

1. Clarify **roles** and **responsibilities** with **legislation**.
2. Clarify **points of engagement.**
3. Clarify **lines to donors.**
4. Improve the **coordination between responders** (government, agencies, NGOs) both centrally and locally.
5. Improve **drought response** decision making.
6. Examine **response methodologies** used in other countries to determine best practice for Guyana.
7. Investigate **Insurance options** for local farmers. At government level there is the Caribbean Catastrophe Risk Insurance Facility established by the World Bank.
8. Clarify and legislate mandates between **Guyana Defence Force** and **Guyana Fire Services**.
9. Set legislation between **Guyana River & Sea Defences** and **National Drainage and Irrigation Agency** for setting sluices into river defence walls.

7.5. Component 4: Knowledge

The aim of the Knowledge component of an EWS is to ensure availability and access to all the "knowledge" required for the effective operation of the other components, i.e. Monitoring and Warning, Communication & Dissemination, and Preparedness & Response. The Knowledge component is the foundation for all the other components to function properly, and they rely on it.

The knowledge required includes:

- Hazard understanding and trend of occurrence
- Reference and base line information (e.g., infrastructure, services & facilities, hydrography, population distribution, settlements, administrative boundaries, assets, land use)
- Tools and techniques for hazard monitoring
- Vulnerability, response capability and risk to hazard for effective preparedness and response

Characteristics of the Knowledge component include:

- Research, development and capacity building where improved knowledge is required
- Collection of data and preparation of baseline information / maps
- Ensuring information and data is ready, available and easily accessible (sharing)
- Ensuring data and maps use recognised standards to ensure compatibility and transferability (sharing)

Note: Annex 6 provides an assessment of existing knowledge capacity and gaps in Guyana.

Priority Specific Recommendations for *Knowledge Component* for the EWS Manager:

1. **Base line information.** Make sure that the appropriate base line information is ready, available and easily accessible (within a few hours) for planning response. A first step towards this could be to take up MapAction's offer of training in the area.
2. **Data and information complementarities.** Mandate specific institutions for the production of specific master reference and baseline data and information, to avoid duplication and ensure up-to-date and precise data.
3. **Data and information sharing.** Improve mechanism for data sharing and put in place appropriate procedures/policy to ensure readiness, availability and timely accessibility. Data sharing at regional level should also be improved.
4. **Vulnerability assessment & reference mapping.** The Red Cross approach for vulnerability and capacity assessment should be a good start and adapted to the Guyana situation. In addition, awareness should be raised for all to benefit from vulnerability knowledge. Reference maps (or situation maps) should be created to support all components of EWS (e.g. assets, land use, population & settlements,…)
5. Develop links and capacity to use **satellite data and other global goods**.
6. **Land subsidence rates.** Investigate land subsidence rate in relation to changing vulnerability and sea level rise.
7. **Raising coastal land levels.** Promote a feasibility study to determine the extent that coastal land levels could be raised by extracting Amazonian silts from the ocean, as an alternative to moving Georgetown away from the threat of rising sea levels consequent on climate change. (see 7.7 following).

7.6. Institutional and other cross cutting issues

An EWS can only work as a complete and effective system (with all its components and many participating institutions) within appropriate and supportive institutional, legislative and policy frameworks. Such frameworks are essential.

Priority Specific Recommendations for *Institutional and cross cutting issues*:

1. Government, auxiliary, NGO, private sector need to **all be working together**.
2. Overcome institutional weaknesses through **Institutional reform** and Government programme.
3. **Strengthen links** between disaster risks, climate change, development programmes and poverty reduction (Government Sustainability Committee).
4. **Clarify institutional roles and responsibilities**, and officialise them through MoUs (although not always honoured), policies, and preferably legislation & acts.
5. Improve understanding and **effective communication** of climate risks and weather warnings to all relevant decision makers, especially local Government.
6. Ensure **clear and user-friendly procedures**, good practice and manuals to mitigate the lack of institutional memory and problems with staff continuity.
7. Establish a clear **data policy** (mandates, sharing).
8. **Engaging Communities**: Volunteer network trained and empowered to receive and widely disseminate hazard warnings to remote households and communities, to help strengthen community capacity to deal with disasters, and communities empowered as a source of information (including traditional knowledge).
9. **Promoting research** to strengthen EWS, e.g., watershed flood modelling or river and sea defences with Suriname, use of new Brazilian climate prediction model, …

7.7. EWS - Long Term Outlook

In the longer term, climate change is expected to increase risks and vulnerabilities addressed by the EWS. This is likely to happen as a result of sea level rise, increased climate and weather variability and possibly changes in seasonal rainfall quantity as well as temperature. Two particular disaster risks, coastal flooding and forest degradation through fire, demand large scale mitigation strategies proportional to the size of the growing challenge.

Firstly, as **sea levels rise with global warming**, the EWS will become more and more important for the safety of people living near the coast [3.5]. The more that sea level rises, the higher and more extensive the sea walls will have to become (e.g. along the rivers as well) in order to protect people, their homes and agricultural areas - and the higher the underlying water table will become. The higher the walls, the greater will become a) the costs of construction, maintenance and pumping: b) the risks of really major flooding with loss of life, and c) the costs of recovery - as Hurricane Katrina and New Orleans so clearly demonstrated.

One approach to reducing this risk could comprise building up the level of coastal lands at a greater rate than sea level rise. This might well be undertaken using suitable material extracted from the seabed (much as has been done for example with the Palm Islands in Dubai). In Guyana's case, there is reported to be vast quantities of silt from the Amazon and other local rivers moving close offshore [1.1 chapter 18]. Such material should be highly fertile if pumped onto the land and then rinsed of salt – in much the same way that present coastal soils were formed. The more sandy components might well be suitable for raising land levels for construction purposes. An ideal solution might involve using wave-power to drive a number of offshore pumps over many years, steadily piping material over the sea wall and depositing it to raise the land level of the coastal kilometres. An alternative might be hydropower, with a

scheme large enough to meet the nation's requirements for (non-carbon) electricity and surplus to pump silt from the sea.

Although the scale and complexity of such a task may be daunting, it is exactly the kind of action that must be considered by countries seeking to sustain their development in the face of long term climate changes. Feasibility studies and execution should be financed with assistance from the main polluting countries as part of global adaptation funding. Such actions, undertaken over (say) 50 years, could reduce sea-flood risk from large areas of the coastal plain and sustain long term habitation, industry and agriculture.

Secondly with increased evapo-transpiration (from higher temperatures) and more frequent/severe droughts, the **risk of large scale wild fires in dried out forest lands** is likely to grow much larger than at present. The resulting widespread land degradation will affect both people's livelihoods and the Government of Guyana's low carbon strategy. The EWS must therefore keep on top of the situation with routine monitoring of fire occurrence and annual assessments of land use change. In parallel, Guyana must work on fire management strategies (including fire prevention) and strengthen its control capabilities, before it is overwhelmed again as happened in 1998.

8. WAY FORWARD – FIRST STEPS

STEP 1: Create a platform where stakeholders (including donors) can work together, so that any future development, projects or capacity building are integrated and complementary.

To some extent this platform already exists through actions by Government of Guyana, UNDP and the IADB in securing funds for EWS through CDC.

STEP 2: Establish *de facto* a first stage EWS with all its components and management structure suitable for Guyana - Government action.

STEP 3: Once the *'whole system'* is operational in basic form, then the four components can be improved both individually and together to optimise overall system performance. The key issue of sustaining service quality by means of operational support from within the Region should be high on this agenda.

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