The Regional Training Workshop on Methodologies for Coastal Inventories & Information Management

Appendix XVI

COUNTRY : **GUYANA**

PRESENTERS : **S.M. Khan & Z. Rahaman**

SUBJECT : **Coastal Inventories And Information Management.**

INTRODUCTION

Guyana lies on the North East Coast of South America between Latitude 1 to 6° North and Longitude 57 to 61° West. It is bounded by the Atlantic Ocean to the North, Surinam to the East, Venezuela to the West and Brazil to the South.

This country is divided into three distinct Geological Regions from North to South: The Coastal Plain, Hilly sand Belt and Mountainous regions. The map at Figure I shows the geological Divisions and other features.

The Coastal Plain which lies between half a meter to one and a halt meters below mean high tide sea level, is approximately four hundred and thirty kilometers long and extends inland between five and forty kilometers, giving way to the Hilly Sand Region. This Plain is composed of sedimentary clays which support a thriving agricultural industry from the times of earliest settlement in the fifteenth century. The capital Georgetown, in which lies the administrative seat of Government was established near the mouth of the eastern bank of the Demerara river and the settlement of people on the coast continued eastwards and westwards with the establishment of townships. Early settlers and even present ones waged constant battles to keep out the ever threatening risk of inundation from the Atlantic Ocean and flash flooding from excessive rainfall (the Coastal area receives over two thousand millimeters of rainfall annually).

Guyana's population is approximately seven hundred and eighty thousand. Interestingly, ninety percent of the citizens inhabit this low Coastal Plain where ninety five percent of the country's agricultural activities are concentrated.

AGRICULTURAL AND INDUSTRTAL DEVELOPMENT

G$53.6bln is the Gross Domestic Product (GDP) for 1997. A GDP of G$55.3bln projected for the year 1998, details are shown in Table 1. Contribution of some sectors to the economy is vital and hence the need for sustaining their viability cannot be over emphasized. Almost all of these income generating sectors are located within the Coastal Region.

Fishing is done about twenty kilometers off the coastline and yield enough for local consumption with excess channeled into the export markets. Drainage water from agricultural lands containing residual fertilizers have negligible effects on the fish population and other ecosystems.

Table 1 (Source. Guyana statistical Bulletin. Vol 6 - No 4. Dec 1977 (G$ Millions)

Sector	GDP (1997)	GDP (1998)
SUGAR	854	823
RICE	210	197
LIVESTOCK	111	117
OTHER AGRICULTURE	255	267
FISHING	146	155
FORESTRY	264	276
MINING AND QUARRYING	628	661
MANUFACTURING	367	383
DISTRIBUTION	417	436
TRANSPORTATION AND COMMUNICATION	453	477
ENGINEERING AND CONSTRUCTION	450	499
RENT OF DWELLING	88	93
FINANCIAL SERVICES	285	296
OTHER SERVICES	181	191
GOVERNMENT	651	658
TOTAL	5360	5530

PHYSICAL CHARACTERISTICS

Several large rivers flow from inland areas through the coast and into the Atlantic Ocean, they are listed below with their discharges to the Atlantic Ocean (Table 2). They are all affected by tidal influence for- varying distances and thus their water quality can be quite saline near their mouth. Although no measurements of their sediment load was done it is apparent that their contribution is quite substantial.

Due to the low nature of the coast, it has to be protected by a system of sea and river defences or dykes to prevent inundation during high tides. The foreshore areas are continually being subjected to erosion and accretion resulted from the continuous wave action generated by the North East Trades and influenced by the Oceanic currents that sweep along the coastline. These forces place tremendous burdens on the maintenance of the three hundred and sixty kilometers of sea and riverain defences. Due to the high cost and regularity of maintenance required, the funds not being readily available is the reason for the poor state and inadequacy of these defences. Highlighted, during the nineteen eighties and nineties when large sections of these wars collapsed and coastal defences were frequently breached.

The consequent flooding caused much loss and inconvenience to residents, in addition to the salt water inundation of agricultural lands.

Table 2 lists the rivers flowing through the Coastal Plain, with their respective average discharges. The rivers near our eastern and western border areas drain a large portion of agricultural lands in their vicinity. Figure 2, shows their locations along the Coast.

1 Table 2. (Source: Potential impacts of sea level rise on the Guiana Coast J.R.K Daniel, UG July, 1991)

River	Annual Average Discharge (m^3s)
Barima	200
Waiiii	200
Pomeroon	60
Essequibo	5,650
Demerara	220
Mahaica	30
Mahaica	30
Berbice	30
Berbice	**350**
Canji	100
Courentyne	1,500

DRAINAGE AND IRRIGATION

In order to maintain cultivation on the flat coastal plain Drainage and Irrigation systems had to be installed. There are two wet seasons and two dry seasons annually. The wet seasons are May to July and November - January. However, it is not unusual for the patterns to change. Climatological data describes occasional absences of these wet periods. These occur usually during El Niño years. On the other hand during La Nina years the dry seasons are shortened.

The coastal area is crisscrossed with many irrigation and drainage canals which exit to the sea and nearby rivers. These canals have sluices operated by employees daily to open and allow drainage by gravity, which is limited during low tide. Therefore, many pumps have been installed in densely cultivated areas to relieve the flooding during rainfall seasons when the duration to facilitate gravity drainage is

limited. Water resources problems initiated the implementation of conservancies to facilitate adequate supplies during the growing season and to prevent to some extent flash floodings during excessive rainfall. Several water conservancies, located at the boundary of the Coastal Plain and the Hilly Sand region have sluices and weirs to control storage limits so that the safe storage level would not be exceeded. This irrigation source and flood control system contributes greatly to the economic growth and benefits of the country. Figure 3, identifies some major agricultural areas, conservancies, sea defence structures etc.

GROUND WATER

The coastal areas are covered with sedimentary deposits of alternating layers of clay and sand with the presence of essentially three water bearing strata. Occurrence of the uppermost being about 30 to 60 meters deep and is phreatic. The high iron and sulphur content do not encourage use of this aquifer as a good source of domestic water supply. Some of the wells drilled in this aquifer have produced brackish water.

The other aquifer systems locally identified as the A and B Sands are found between 90-305m and 370-790m respectively. These are which are the main sources of domestic water supply on the coast, except Georgetown which gets about 20% of its supply from the East Demerara Water Conservancy. Local experts in the field are divided on whether a natural recharge zone exists in the Hilly Sand Region. Consequently, a systematic investigation is highly recommended to resolve this doubt. Notably, over the last several decades there has been huge losses of pizometric heads on these aquifers, over 20m. This suggests the mining of water, hence this continued extraction could cause salt water intrusion and possible subsidence as was suggested after a preliminary study by John Bassier (1976 re. Comacho 1988) that Georgetown was subsiding at a rate of 10 mm per year. Figure 1, shows Major Geological Groups and Coastal Artesian Basin.

NATURAL SYSTEM DATA PHYSICAL CHARACTERISTICS

Table 3 summarizes information on the natural and artificial physical characteristics of the Coastal area.

Table 3 (Source: Assessment of the vulnerability of coastal areas to sea level rise CZM Pub.No. 1)

TYPE OF DATA	UNIT	DATA VALUE
Natural Coast Types		
- flat/sandy (beaches/dunes	km	20

- flat/mus (salt marshes - mangroves swamps)	km	410
- estuarine/delta	km	60
Artificial coast types (incl. Island)	km	110
- sea dykes/seawall		
- river walls/revetments	km	30
- mangroves backed by earth dams	km	250
Local Subsidence at diff. Loc.		
- natural subsidence	mm/yr	Not available
- man induced subsidence	mm/yr	10
Design Water- Level	M+MSL	1.8+MSL
Flood prone area at design water level	km^2	2000
Average Tidal Range	m	1.8m

2 Table 3 (cont'd)

Seasonal fluctuation of MSL	m	Data not processed
Annual average wave climate, Hav near shore area.	m	..0.5
Design wave height, Hs at different locations (Hs for structural aspects)	m	0.8-1.2
Average annual river discharge (All rivers).	m^3/S	8,380
Area with salinity problems. (Potential)	km^2	16,000

The summary suggests that sandy beaches represent only five per cent of the entire coast, whereas marshes and mangroves ninety five per cent indicating the real extent of land to be protected from erosion and flooding if these are to be occupied. This ratio could be altered if land subsidence as a result of the extraction of groundwater, materialises. Further, when the projected sea level rise occurs these natural systems would be inundated, the existing sea walls would be overtopped at every high tide and coastal farmlands destroyed.

Figure 3 shows sea and river defences located on the Coast, by type and extent.

Table 4. Production use and Capital Values (Source: Assessment of the vulnerability of coastal areas to sea level rise CZM Pub.No. 1)

Type of data	Units	Data Value
Agricultural area in coastal zone	km^2	1,750
Industry (best guess)	km^2	10
Urban (best guess)	km^2	140
Production/capital values		
- agriculture area	MUS$/ km^2	2
- industry (best guess)	MUS$/ km^2	26
- urban	MUS$/ km^2	19

Note- the mid 1993 US$ to G$ exchange rate is I to128- MUS$1 =MG$128.

(Data derived from D.H.V. report "Econoic Feasibility Study on Reconstruction and Rehabilitation of Sea Defences " December 1992.)

Figure 4 shows the location of various Industries by type and number along the Coastal Area of Guyana. The concentration around Georgetown will be readily noticed as well as their extension East and West along the coast.

LOCATION OF FAUNA:

The series of maps of the Guyana Coastal area in Figure 5 show the habitats of different species of fauna. They are mostly present in the lesser populated regions, although some are hunted for meat, many are allowed to occupy their habitats peacefully.

IMPACT ZONES

In the event of a sea level rise and subsequent inundation of the Coastal Plain areas along the coast which have been identified will suffer adversely for varying distances inland: these are shown in Figure 6 which highlight these areas as zone I, II and III**.** The higher scale denoting greater land loss due to an expected higher sea level rise, hence further flooding inland. These projections are based on the prognosis of an accelerated sea level rise of 0.3 and 1.0m into the 21st century. (Source: Assessment of the vulnerability of coastal areas to sea level rise CZM Pub No. 1)

Tables 5 and 5.1 summarises the results of various factors that could be affected by an Accelerated Sea Level Rise of .3m and 1.0m respectively, under two types of scenarios.

Development Scenario zero, indicating no further development of Activities/Resources in the areas of impact while development scenario 1, allows for the continued growth and development of impact areas. These are further analyzed as no measures, that Is without expanding any efforts to protect threatened or vulnerable areas and then to put in place such measures or structures to alleviate the expected adverse impact on the areas. The tables above attempt to quantity these impacts under the different scenarios.

Table 6 depicts the constraints to implementation feasibility. A level of vulnerability is assigned to the four problem categories, these are Legislative, Institutional, Organisation,(LIO);Economic and Financial (ECF); Technical (TEC) and Cultural and Social (CSO). One of the major problems preventing implementation are the sourcing of funds necessary to protect and strengthen the existing coastal zone structures and operations, in the light of other demands for the scarce economic resources presently available.

And table 7, examines and rates the impact areas through the same constraints as outlined above.

CONCLUSION.

The Coastal area of Guyana is the most densely populated area of the country with the consequent location of several important income generating sections of-the economy. Hence, there is need to monitor all the factors that could adversely affect our occupation and resources in this section of Guyana.

There is great need for proper data collection and the sharing of relevant information to allow for decisions that would enhance development. Contingency plans too, need to be prepared in the event of projections being realised.

Table 5. VA Assessment option "No Measures"

IMPACT	DEV. SCENARIO 0		DEV. SCENARIO 1	
	ASLR 1	ASLR 2	ASLR1	ASLR2
VALUES AT LOSS				
1. Capital value	MED	HIGH	MED	HIGH
2. Subsistence value	LOW	MED	LOW	MED
VALUES AT RISK				
3. People	MED	LOW	HIGH	CRI
4.Capital value	HIGH	HIGH	HIGH	HIGH
5. Subsistence value	LOW	MED	LOW	MED
OTHER DAMAGES/IMPACTS				
6. Agri. Salinity	MED	HIGH	MED	HIGH
7. Financial damage	LOW	LOW	LOW	LOW
ECOLOGICAL				
8. Ecological area lost	MED	HIGH	MED	MED
9. Special area lost	LOW	LOW	LOW	LOW

Table 5.1. VA Assessment Option "Protect"

IMPACT	DEV. SCENARIO 0		DEV. SCENARIO 1	
	ASLR 1	ASLR 2	ASLR1	ASLR2
VALUES AT LOSS				
1. Capital value	MED	MED	LOW	MED
3. Subsistence value	LOW	LOW	LOW	LOW
VALUES AT RISK				
3. People	LOW	LOW	LOW	LOW
4.Capital value	MED	MED	LOW	LOW
6. Subsistence value	LOW	LOW	LOW	LOW
OTHER DAMAGES/IMPACTS				
6. Agri. Salinity	MED	MED	MED	MED
7. Financial damage	LOW	LOW	LOW	LOW
ECOLOGICAL				
8. Ecological area	LOW	MED	LOW	MED

lost				
9. Special area lost	LOW	LOW	LOW	LOW

Table 6. Constraints to Implementation Feasibility

IMPLEMENTATION ASPECTS	PROBLEM	PARTIAL PROBLEM	NO PROBLEM
VA-LIO			
LEVEL A (NATIONAL)			
• existing legislation			X
• existing instit./organisation		X	
• executive powers		X	
LEVEL B (AGENCY)			
• spec. tasks/respons.	X		
• communication struct.	X		
• staffing facilities	X		
• exist. czmp plan etc.	X		
LEVEL C (LOCAL/DEPARTMENTAL)			
• staff education level		X	
• knowledge/man. capab.		X	
• staff motivation	X		
VA-TEC			
LEVEL A (NATIONAL)			
• techn. knowl./experience		X	
• techn. institutions			X
LEVEL B (AGENCY)			
• operat. structures		X	
• staffing & facilities	X		
LEVEL C (LOCAL/DEPARTMENTAL)			
• staff education level		X	
• techn. qualif./capab.		X	
• staff motivation	X		
• data availability	X		
VA-ECE			
LEVEL A (NATIONAL)			
• nation econ. bearing cap.	X		
LEVEL B (AGENCY)			
• nat./reg. funding possib.	X		
• internat. funding possib.		X	

IMPLEMENTATION ASPECTS	PROBLEM	PARTIAL PROBLEM	NO PROBLEM
LEVEL C (LOCAL/DEPARTMENTAL)			
• fin. management capab.		X	
VA-CSO			
LEVEL A (NATIONAL)			
• cultural			X
• socio-econ.	X		
LEVEL B (AGENCY)			
• cultural programs			X
• socio-econ. programs	X		
LEVEL C (LOCAL/DEPARTMENTAL)			
• recent cult. Achievem.			X
• recent socio-econ. acheivem.	X		

LIO – Legislative/Institutional/Organisation
ECF – Economic and Financial
TEC – Technical
CSO – Cultural and Social

Table 7. Vulnerability to implementation feasibility for protection responses.

	LOW	MEDIUM	HIGH	CRITICAL
VA-LIO			X	
VA-ECF				X
VA-TEC		X		
VA-CSO			X	

LIST OF ABBREVIATIONS

bLn	billion
m^3/s	cubic meters per second
m	meter
km	kilometer
km^2	square kilometer
mm/yr	millimeter per year
m+msl	meter plus mean sea level
Hav	average height
Hs	specific height
MUS$	million united states dollars
ASLR	Accelerated Sea Level Rise
MED	Medium
CRI	Critical
VA-LIO	Vulnerability Assessment, Legislation, Institutional, Organisation
man	management
capab	capability
ECF	Economic and Financial
TEC	Technical
CSO	Cultural and Social