Protecting Our Watersheds and Coastal Areas

Community Tools for managing **Land** and **Water** resources in the Caribbean

IWCAM
Integrating Watershed and Coastal Areas Management in Caribbean Small Island Developing States

GEF

CEHI

UNEP

UNDP

Protecting Our Watersheds and Coastal Areas

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We forget that the water cycle and the life cycle are one.

Jacques Yves Cousteau

Prepared by Link International Productions Inc. for the Global Environment Facility-funded Integrating Watershed and Coastal Areas Management in Caribbean Small Island Developing States (GEF-IWCAM) Project.

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Foreword

Water is known to be abundant in nature but we cannot take it for granted that water will always be available to support our existence. We are challenged world-wide as we seek to meet growing demands for this scarce natural resource. This challenge is being faced daily by both developed and developing countries, including those in the Caribbean, as evidenced by the drought of late 2009 to early 2010.

But who should be responsible for taking up this challenge? Public participation is essential in grappling with the important issues related to water management. We must not believe that water management is the responsibility of others. The management of water is everybody's responsibility. In the Caribbean context, farmers are good examples of resources managers. Their farming practices (such as slash and burn or overuse of pesticides), in the upper reaches of watersheds, unless properly managed (by these same farmers), can compromise the quality and quantity of water. They are however only one of the many groups who could be considered resource users, and by extension, resource managers. Tourist operators, industries, and individuals all have roles to play. But how?

Traditional solutions propose funding, at the level of governments. Beyond funding, however, empowerment of individuals is key. The interest of individuals in Union Island, St.. Vincent & the Grenadines, in becoming more empowered with respect to monitoring of their water resources was in fact the catalyst for preparation of this manual.

In this publication, you will find a series of tools which can be used to empower groups and communities to take matters into their own hands, in relation to water management. The publication has been designed to be highly interactive, taking advantage of the latest technology and recognizing that today's youth need a different type of stimulation, if they are to show interest in environmental education.

The publication is engaging, visual, and informative. It encourages and facilitates group activities and sharing of ideas, towards identifying solutions to common water resource management problems of SIDS. It is however not an academic text book. Nor is it designed for technocrats. It focuses primarily on communities and schools and seeks to make science "fun". It also uses real-life examples from the Caribbean region to bring the topics "down-to-earth". This guideline document, although prepared with the Caribbean in mind, can be used in other SIDS regions, as a reference document when engaging groups in discussions on water management.

It has been produced through the Integrating Watershed and Coastal Areas Management in Caribbean SIDS (IWCAM) Project with funding from the Global Environment Facility (GEF). It is however a "work in progress" and can be improved or otherwise augmented by others over time. The GEF, through support for development of tools and aids such as this, seeks to promote collaboration in order to address issues of global significance. It is our hope that this publication contributes to the global effort to improve management of water and coastal areas.

Vincent Sweeney
Regional Project Coordinator

Acknowledgements

The GEF-IWCAM Project is grateful to a number of partners for their valuable contributions to **Protecting Our Watersheds and Coastal Areas: Community Tools for Managing Land and Water Resources in the Caribbean**.

First and foremost, this toolkit was built on the work of two exemplary organizations – Live and Learn Environmental Education and the Sandwatch Project. The training manuals produced by them - the River Care Manual and the Sandwatch Manual – were essential in the development of this toolkit. We are thankful to both for sharing their important work with us and for allowing us to adapt it to address the specific approach of integrating watershed with coastal areas management for small island developing states.

We are very appreciative to the staff of the Caribbean Environmental Health Institute for their input on content, as well as their participation in the extensive review process. CEHI staff not only field tested many of the approaches in the kit, they also provided us with much of the vision and direction that has shaped the toolkit. Susanna De Beauville-Scott also contributed to the coastal section of the manual, both in terms of content and field testing, for which we are thankful.

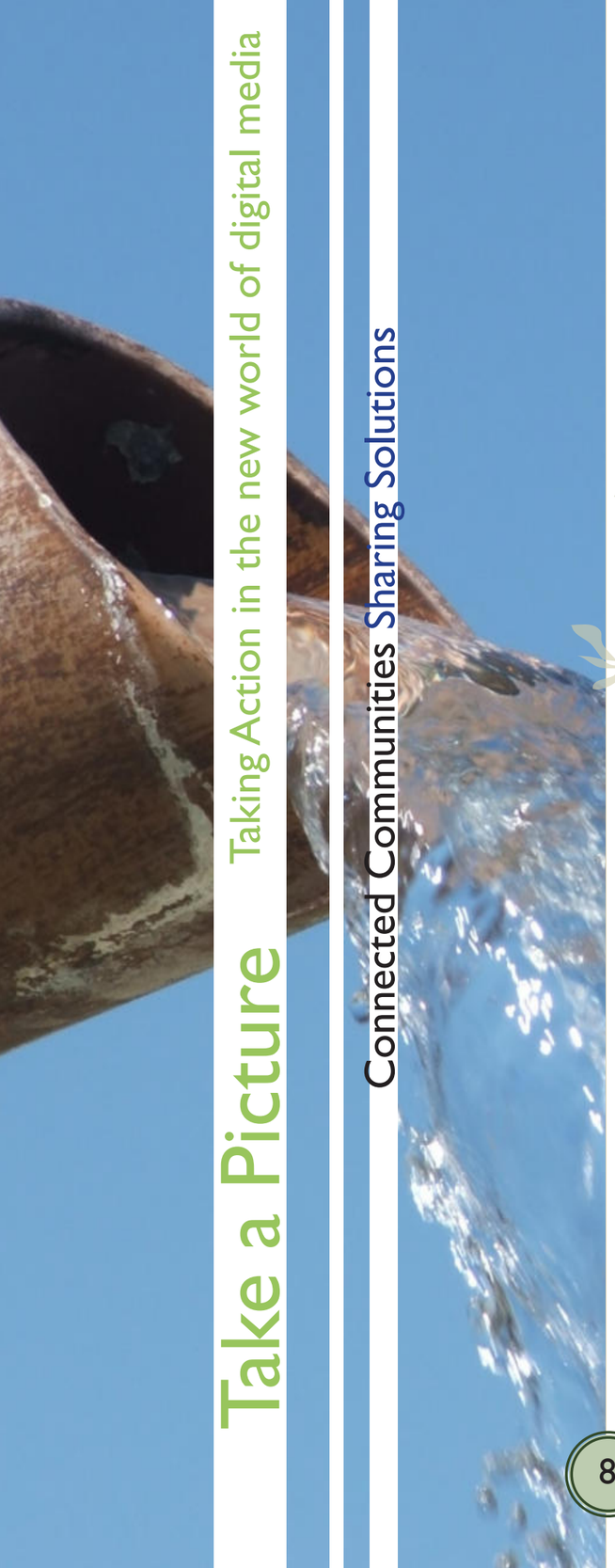
Our thanks to the Institute of Marine Affairs of Trinidad and Tobago for providing us with photographs used throughout the manual, and also included in the instructional DVD and web-site modules.

When LINK International Productions Inc. embarked upon this partnership with the GEF-IWCAM Project to develop this set of tools, neither realized either the scope or complexity of the task. We thank them, not only for their skill and vision, but also for their patience as we sought to develop a tool that is both instructive and interactive.

Finally, we wish to acknowledge the group that started this whole process, the Union Island Environmental Attackers, an NGO committed to the sustainable development of their small community in St. Vincent and the Grenadines. Their suggestion that we develop tools to help community based groups in the field has been a constant inspiration as we sought to develop a resource which would empower communities and be of practical use in their work to build sustainable futures, while caring for the precious, and increasingly threatened, land and water resources of the Caribbean.

Filthy water cannot be washed.

African Proverb



Taking Action in the new world of digital media

Connected Communities Sharing Solutions

Take a Picture

Taking action to protect our Natural Resources

What's Wrong with this Picture?

These port facilities are located very close to low income settlements. Their industrial waste has a negative impact on human health.

Location: Lower Haina Watershed, Dominican Republic

Each one of us has the power to help protect the natural environment. Learning about and protecting our natural resources (land, fresh water & coastal resources) is key to protecting the health of our communities, and to ensuring the livelihoods of our people. This Manual has been created in the new media world of digital media and web 2.0, which support interactive online experiences that build connected communities through the internet. This will be a powerful tool for learning and community organizing. This manual is part of a multi-media set of tools that are all connected; A PDF Manual, Web Modules, an Interactive DVD, & Trainers' Guide are all introductory tools for learning about integrated water resource management in your community. We take this information one step further, and provide communities with the tools for creating social networks around these issues, for sharing their own images, ideas and solutions, and providing access to information far beyond the scope of these materials. This program will encourage and enable groups to use the new social networking tools to build relationships for Sharing Solutions and Taking Action on important issues in their communities.

The TOOLS

The PDF Manual is designed to provide the introductory information in an engaging and entertaining format that is highly visual (with activities & links to explore further). For those who want more in-depth information on any subject, there are appendices attached in the PDF Manual and Trainer's Guide and for the DVD and web tools, there are clickable live links to content online. (Look for the red mouse or red text)

WHAT kind of Environment do You want in 5 Years?

The world around us changes every day, and sometimes it can change very quickly and beyond recognition. If you "TAKE A PICTURE" of a natural site today; that stream, this forest area, that beach, that hillside over there, you will have the first and most important tool for understanding how to protect your environment: Taking a picture or drawing a map of a natural site, is the first step to understanding its condition, how things are changing there, and what is causing this change. Taking pictures is key to determining the condition of our natural resources and to making the right choices about taking Action to ensure a healthy environment today and for the future.

This Manual is designed to be a tool to help community-based organizations & schools take these first steps. It is designed to help groups monitor and assess the land & water resources in their communities. "Environmental Stewardship" can only happen when people care about their natural resources and believe and understand how they can make a positive difference through MEASURING, and MONITORING the environment then TAKING ACTION.

GET CONNECTED:

LIVE LINKS TO ONLINE CONTENT

GET CONNECTED TO CONTENT BY CLICKING ON THE RED LINK, OR WHEN YOU SEE THE RED MOUSE:

THIS MANUAL provides approaches and examples of how Community Groups and other interested persons can identify problems first hand and come up with creative and sustainable solutions themselves. In this way, people can feel empowered and this promotes environmental responsibility.

Going Viral - use Online tools

The purpose of this Manual

The purpose of this manual is to provide basic information about land and water resources, and simple methods to monitor & assess the condition of these resources in your community. This manual is a tool that can help take us through this process of assessing our land and water resources. The manual was developed for use in the Caribbean Small Island Developing States (SIDS) based on materials taken from other training resources. (The CBRA, River Care, Sandwatch..) It was designed to be used by community members, resource users and students.

This Manual takes participants through the key concepts of IWRM (Integrated Water Resource Management), understanding the factors of land and coastal degradation, water pollution and how to monitor conditions and spot problems. It includes suggestions and "best practices" for taking action.

There are 3 KEY Steps to ensuring a Healthy Environment, and a Healthy Community

1. **MEASURE** - taking samples & taking measurements and recording the measurements: this becomes "data"
2. **MONITOR** -collecting data over time in a systematic way, so that you can track changes in the environment over time.
3. **TAKE ACTION** -determining what actions could be taken that could lead to solving problems or making improvements in the environment.

HOW TO USE THIS MANUAL

This manual is divided into 4 Learning Modules:

Module 1: INTRO - introduces Integrated Water Resource Management, and outlines the importance of a Watershed. Part 1 also introduces KEY CONCEPTS and the pressures on our water supplies. The activities in Module 1 are designed to help bring home these concepts to the group – to get people thinking & talking about what stresses are affecting the water resources in their own community. In subsequent modules we explore each area of the watershed.

Module 2: RIVERS & LAKES explores the importance and role of rivers & lakes in the watershed, and the impact of pollution on our fresh water resources; Understanding "Indicators" to spot problems; An introduction to "Mapping" & Selecting Testing Sites; Then, the 3 Steps to protecting Rivers & Lakes.

Module 3: LAND explores the importance and role of land in the watershed, and the impact of pollution on our land-based resources; Identifying "Indicators" & the 3 Steps to protecting Land resources.

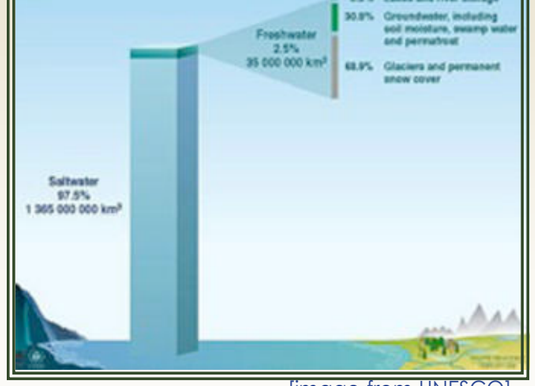
Module 4: COASTS explores the importance and role of coastal areas in the watershed, and the impact of pollution on our coasts; Identifying "Indicators" & The 3 Steps to protecting Coastal areas.

There are many useful resources, tips and strategies to share with your group. These are found in the Appendix at the end of the Manual, and through "clickable links" in the DVD & web modules (also look for the red mouse)

We are all connected. Our bodies are all 80% Water and about 70% of the earth is covered in Water. And when you take a closer look, you will find that not all water is the same.

Only 1% of the world's fresh water is available for human use!

Total Global Salt Water & Fresh Water Estimates



[image from UNESCO]

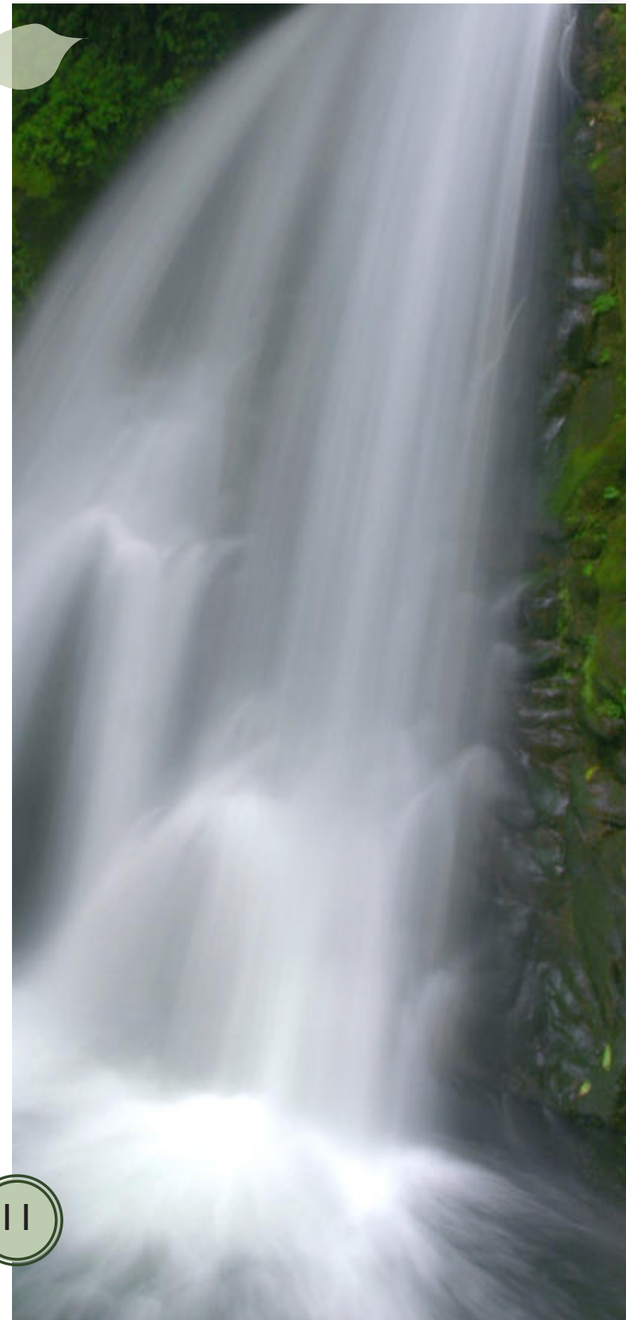
….with so much WATER everywhere, why is it often in SHORT SUPPLY?

THE WATER CYCLE

Understanding the water cycle is key to understanding the natural processes that regulate/ control our land & water resources.

(go to Page 19 for full Explanation)

Status of the World's Water
Link to Document Here
(see Annex 4)



Integrated
Water Resource Management

People cross a flooded river in Jamaica after Hurricane Omar.

Integrated Water Resource Management calls for all stakeholders and various sectors to come together to make decisions and plan so that water, land and other resources are used sustainably. IWRM encourages stakeholders to work together to develop a shared vision and joint action. This is captured in an IWRM Plan. IWRM planning can have significant benefits for the environment, for agriculture, and for water supply and sanitation. Sustainability is key: So, the IWRM plan clearly lays out how we go about ensuring that adequate water is available for basic human needs in our community, including for food production and for maintaining healthy ecosystems (such as forests, mangroves, coral reefs).

An IWRM Plan Aims To..

1. "PICTURE THIS" - Bring Attention to (raise awareness of) the benefits of IWRM

2. Identify ACTIONS that will help solve the problems (like pollution, soil erosion) & address the threats to human health & the health of the environment

3. Bring together RESOURCES & PARTNERS to launch specific projects that can tackle these problems and threats on human health & the environment

What's Right with this Picture?

Meet Mr. Sarduy,
of Sarduy Farms in Cuba

Mr. Sarduy is chief of the Sarduy Farm, CUBA.
The Sarduy Farm is using a variety of techniques to promote soil conservation.
This is sustainable agriculture.
The Sarduy farm is a **GEF-IWCAM** Demonstration Project in the Province of Cienfuegos, Cuba.

How Can We Get There?

Sustainable Agriculture can lead to better crop yields, and healthier soil. It is a key component of IWRM. Sustainable agriculture includes eliminating harmful pesticides, rotating crops, planting live barriers, and using efficient irrigation practices. For this farm in Cuba, these techniques have increased its productivity, providing more food for the workers and for sale. Another benefit: it has helped to reduce soil and pollutants flowing into rivers.

SAMPLE IWRM Road Map
CLICK HERE
(see Annex 5)

Take a Picture

Why do we need to monitor our water resources?

Water resources are under stress..

This community (photo above) may not be so far away from yours. It's a community in Port-au-Prince, on the island of Haiti. The first obvious problem here is the **solid waste** management issue. The other main issue is the serious **soil erosion**. Building on riverbanks can cause erosion. Soil, which washes into the water, then pollutes drinking water and damages river habitats.

Cause: The building of unplanned settlements on river banks can have a destabilizing effect on the soil, thereby hastening erosion.

There are many other communities in the Caribbean where water resources are severely under stress. Without a clean, reliable water supply, life as we know it would be impossible. So, we need to ensure that our water resources are maintained in a healthy condition.

Q: How do we determine the health of our waters?

A: By monitoring and measuring the quality of the water and comparing it to standards that are determined to be safe.

Key to Monitoring is finding or identifying **"INDICATORS"**. Indicators (such as temperature or turbidity: i.e. the level of "murkiness" of the water) are used to provide us with specific measurable things that offer an "indication" of the state of the environment. In this manual we will be focusing on "Environment Status Indicators".

What puts PRESSURE on our water resources?

Housing

Agriculture

Tourism

Commercial & Industrial Development

Natural Disasters

Climate Change

Is Your Community WATER STRESSED?

A community is described as water-stressed when the amount of available water is below 1,000 cubic meters per person per year. There may be other Indicators that your community is Water Stressed...

Consider This:

Q: How many days per month does your public utility interrupt the water supply to your home? More than 5?

Q: Are any households in your community not on the public water supply?

Q: Do people in your community suffer from stomach ailments periodically?

Q: Does your community experience serious flooding every wet season?

If the answer to any of the above questions is YES, then your community is water stressed.

What do you do to conserve water at home?

Fast Facts About Water DID YOU KNOW...?

Barbados ranks among the **driest** countries in the world in terms of available water per inhabitant, whereas Jamaica is among the wetter countries (www.iadb.org/idbamerica/index.cfm?thisid=2793)

Of the 6 billion people on earth, 1.1 billion do not have access to safe, clean drinking water. (www.charitywater.org)

The water and sanitation crisis claims more lives through disease than any war claims through guns. (www.water.org)

Can you picture your community without a reliable supply of fresh, clean Water?

We in Caribbean Islands are very vulnerable because of our small size & high population densities. We have the least water available per capita as compared to other island regions

What is a WATERSHED?

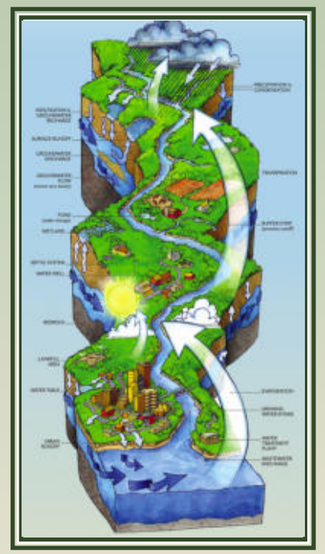


Image Credit: Conservation Ontario

WATERSHEDS:

Healthy rivers and streams require good land use practices. A watershed is the land area that drains to a common outlet, such as a stream, wetland, lake, or the sea. A watershed is the sloping land area over which water, from rainfall, flows downhill to a coast. On our small Caribbean islands, many watersheds run all the way from the centre of the island to the coastal zone. When human activity in the watershed produces waste and pollution, this has a direct and harmful effect on the quality of our water resources, and on the health and well-being of our communities.

What is a **Water Catchment**?

Think of your community's catchment as a drainage basin that acts like a funnel, collecting all the water within the area covered by the basin and channelling it into a waterway. These "basins" / catchments can be used by our public water utility companies to collect fresh water for drinking & household use. A variety of activities, which are reducing the quantity and quality of the water, might be going on in your community's water catchments. Cutting down trees for farming and for making charcoal, logging, building, manufacturing, and road construction negatively affect the water quality and flow of the rivers and streams that run through the catchment. Taking out trees and construction activity causes sediment, pollutants and other materials to be washed into the catchment area. The loss of trees and vegetation cover mean that less water is captured and absorbed by the land. This is because forests act like "sponges"; soaking up the rainfall then slowly releasing it into the water-ways. Without vegetation cover, water exposed on bare land to the hot Caribbean sun is quickly lost through evaporation and ultimately less water ends up in the catchment. This type of human activity can lead to the drying up of our rivers and streams, and can threaten the entire catchment. (Take a look at examples of severely stressed and destroyed water catchments - see pg. 10)

There are **3** critical Areas in our watershed. Each will be explored in this Manual: (click on the areas below & go directly to each Module)

RIVERS & LAKES (pg. 18)

LAND (pg. 38)

COASTS (pg. 48)

Forests & Waters: the essential LINK

- Forests absorb rainfall, & this helps reduce flooding
- Forests help reduce soil erosion, keep water in the ground, refill aquifers (groundwater)
- Forests filter pollutants from river water, (pollutants such as sediments, pesticides & fertilizers)
- Forests provide habitat & shelter for wildlife & help maintain the diversity of species

The United Nations has declared this "A Decade of Education for Sustainable Development" (2005 to 2014) and UNESCO is the Lead Agency. Education for Sustainable Development (ESD) is a dynamic concept that encompasses a new vision of education that seeks to empower people of all ages to take responsibility in their communities for creating and enjoying a sustainable future.

CLICK for LINK to UNESCO ESD Site:
http://www.unesco.org/en/esd/

Take a Picture

Rivers & Lakes

A Story of a River

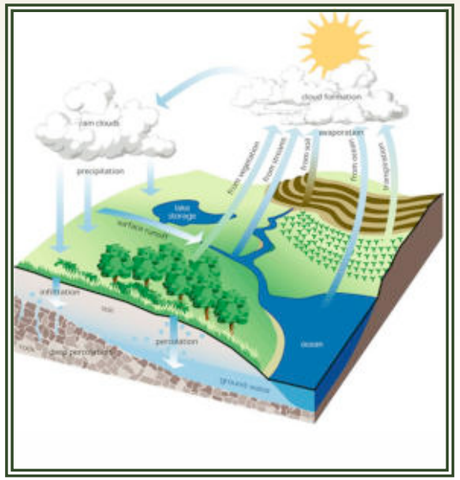
Walking along the rocks, is a tall man holding the hand of a young boy. The man has been imagining this day for the last 10 years, since the day his son was born. He has wanted to take his son to the spot in the river where his mother used to do the laundry in a deep cool pool. He was a small child then and would swim in the cool waters all day long with his friends.

A part of him had regretted "going foreign" to work and live abroad. But now he had a chance to introduce his son to his island home, and the abundant nature that was all around him when he was growing up. They jump together, one rock at a time, leaping their way up the river bed....but there is something wrong. There is only a trickle of water among the rocks, where there was once a big, flowing river full of crayfish. Father and son go further and further up the dry river bed, looking for the deep, cool pool ...but they will never find it, as it disappeared long ago...

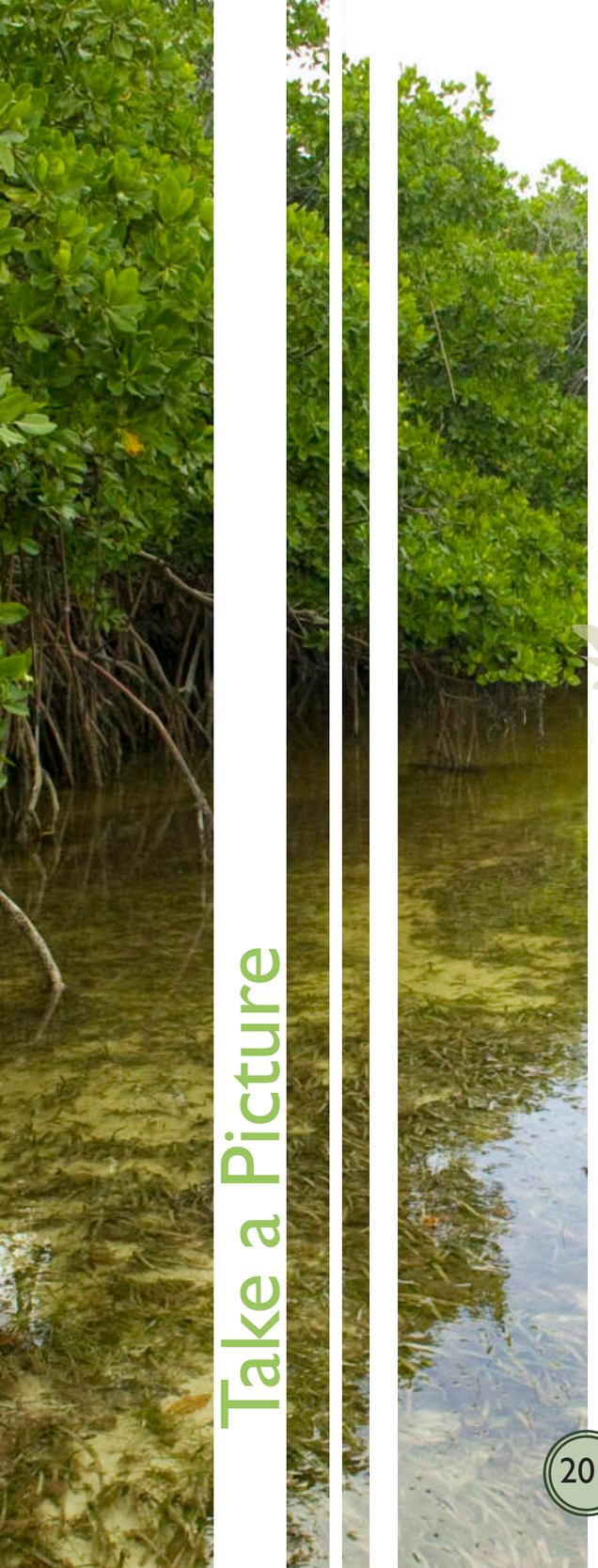
THE WATER CYCLE

The Water Cycle simply describes the pathways water takes as it moves through the environment after having fallen on the land surface as precipitation (rainfall). The sun provides the energy that starts the process. The heat from the sun causes water to evaporate from the surface of the sea or the surface of the land. Plants and trees also release water from their leaves in response to the heat of the sun, a process called evapotranspiration. The water in the form of water vapour rises into the atmosphere where it cools; forming clouds and condensing to fall back to earth as rain.

This rain then travels through many different paths. Some of it falls on plant leaf surfaces and is immediately evaporated back to the air with the heat of the sun. Some of the water that falls on the land surface is also evaporated. The remainder of the water trickles into the soil and is stored within the soil and rock layers. Some of this water percolates through the rock and emerges as springs that form the source of rivers. What does not get stored in the ground flows over the land as "surface runoff" and eventually finds its way into streams and rivers and out to the sea. The cycle of water is repeated when the sun evaporates the water from the sea and land surface.



The Water Cycle



Take a Picture

Rivers & Lakes

"The notion that we'll have water forever is wrong.."

"The world is running out of fresh water.."

These statements may seem dramatic and extreme. But they are starting to come true. We are experiencing more and more negative effects. There have been long-term declines in river flows. The streams that ran through villages and communities, providing fresh water, are less abundant. Our rivers are the "life-blood" of the watershed. All the water that flows through the hills, fields, playgrounds, residential areas, towns & cities and flood plains, as well as the rain that falls ends up here.

The quantity and quality of water in our rivers & lakes will tell us much about the health of our water catchment. If the water is dirty and polluted by the time it ends up at the mouth of the river, just before the sea, this provides a PICTURE of what is happening within the watershed.

Drivers River, Jamaica

What's Wrong with this Picture?

A Stream polluted by phosphates*

Why Should I Care?

This is not just a polluted stream, isolated in the middle of nowhere. This is one of countless polluted streams in our world, and the pollutants in these streams and rivers circulate throughout the globe. The pollutants from THIS STREAM, and from streams and rivers like it can be found in the fish that you buy from your local market. These same pollutants can be found as far away as the North Pole, in polar bears and seals.

Polluted rivers and streams are the result of human activity on land. Everything that we dump on land is eventually washed into our rivers and streams, and this is carried to the sea.

*(Phosphates are found in household products such as laundry detergents and fertilizers used in farming. Phosphates encourage algae growth, and this has a negative impact on fish and other aquatic animals.)

Whatever is happening in your watershed has a direct impact on the quality of the nearby water.

Take a Picture

Pollution
What Stinks?

Pig Farming in the Fond D'Or Watershed, St. Lucia:

This pig sty is actually located on a river bank. Water is poured over the pen to clean it regularly, causing pig waste to go directly into the river, untreated. This results in dangerously high levels of fecal coliform bacteria, which has a negative impact on our drinking water, human health, agriculture, & fisheries.

What Next?

The St. Lucia GEF-IWCAM Demonstration Project is working with pig farmers to establish "sustainable piggeries". These would use practices like composting, biodigesting, and wetlands filtration.

Main Types of Pollutants:

- Sediment (wind & water erosion of soils)
- Nutrients (fertilizer, animal wastes, sewage treatment plants)
- Animal wastes (Fecal coliform bacteria from livestock & septic systems)
- Pesticides (herbicides, insecticides, fungicides, etc.)
- Solid waste (poor disposal of garbage)
- Toxics (manufactured and refined products such as oil, chemicals, paints)

Why Should I Care?

Long-Term Effects of Water Pollution:

Health Problems:
- Disease caused by polluted water (e.g. viral hepatitis, dysentery, typhoid fever)

Water Supplies:
- Low water yields
- Inadequate drinking water, increased cost to produce
- Insufficient water for irrigation

Farming:
- Low crop yields
- Water-borne diseases affecting crops

Fisheries:
- Fish kills, or reduced fish catches, unhealthy fish, contaminated food

Tourism:
- Contaminated beaches and recreational areas

HEALTHY RIVERS & LAKES sustain:

- **biodiversity-** the variety of species, populations, habitats and ecosystems.

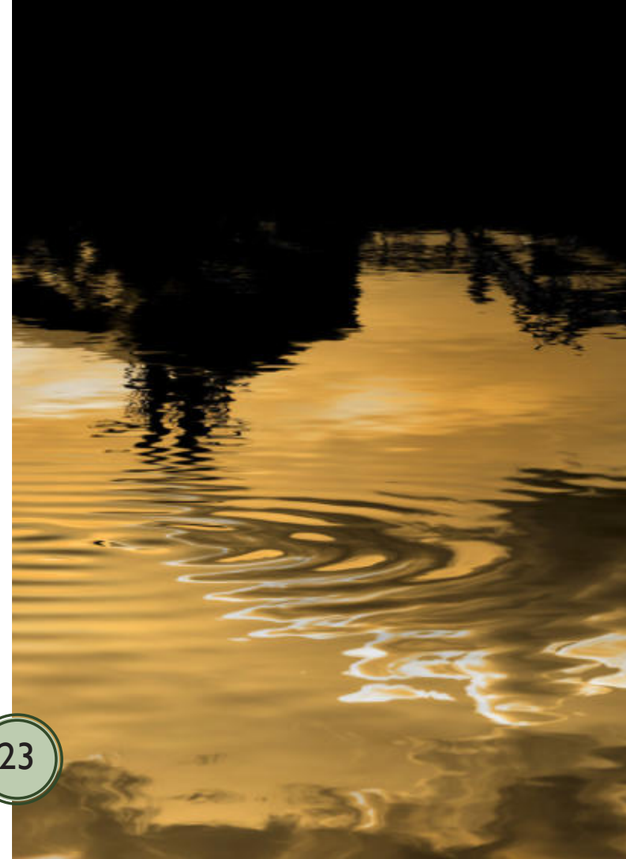
- **balanced ecosystems-** the general health and resilience of natural life-support systems, including their ability to assimilate wastes and withstand stresses such as climate change.

- **natural capital-** productive soil, fresh water, forests, clean air, the ocean, and other renewable resources upon which human communities depend for survival and livelihoods.

The NATURAL FLOW

Before we start to measure the negative impacts of human activities on our rivers and lakes, we first need to understand the natural pattern or natural changes that occur in rivers and lakes as they move from their point of origin in the hills or mountains, towards the ocean. It is important to know the conditions of a healthy watershed, so that we have a baseline (baseline: a clearly defined starting point). We can then measure changes or problems brought on by human activity. When we get to the testing & measuring stages, in order to interpret our test results (to understand what they mean) we need to have some idea of the natural changes that occur in rivers and lakes as they pass through a catchment. Once these natural changes have been identified, we can focus on the changes that have occurred due to human activities.

The **vast majority** of **pollutants** that enter our waters are the result of **human activities** on land.



Take a Picture

Ecosystems

Why should I care?

A stream or river habitat is the area surrounding the stream, including the bank and the flowing water. A healthy stream or river habitat helps to ensure a healthy watershed. The stream habitat is a complete "ecosystem", a network of living plants, animals and natural features that all depend on each other. If one area of the habitat experiences severe changes, for example, erosion on a facing bank, this can create problems for other areas of the habitat and set off a "chain reaction of negative events".

How **one change** in the Environment can lead to a **chain reaction** of negative events.

Here's a Scenario:

- A farmer clears an area at the top of the bank above a stream, cutting down trees and shrubs to plant vegetables. He uses fertilizers and pesticides regularly.
- Over time, the top soil washes away and slides down the face of the bank, as there are no roots to hold it in place anymore.
- Soil erosion sets in.
- Large amounts of sediment and pesticides begin to accumulate in the stream bed & water
- The water becomes turbid, the chemicals stilmulate algae growth
- The increased algae aborbs the oxygen and the river plants and small aquatic animals struggle to survive
- The increased turbidity raises the temperature of the water, and the river plants and animals begin to die
- Animals that depended upon the aquatic flora and fauna for food start to leave the area in search of alternatives.
- As warmer stream water flows downstream, eventually reaching coastal waters, it can hurt coastal ecosystems and the lives they support.

Taking Pictures of a stream or river ecosystem over time will give you an understanding of what changes are happening.

Zones of River Habitat:

River ecosystems change as one moves from the source to the mouth of the river. A river's **Upper Reach** is high up in the watershed, close to the river source. Here the river is narrow, flows down steep slopes over boulders and rocky streambeds. Rapids and waterfalls are common. Riverbanks are usually heavily forested, shading the river and contributing large quantities of leaf litter to the river. Lower down in the watershed in the **Middle Reach**, the river widens, more sunlight penetrates the water and there are more aquatic plants. The gradient of the land is gentler and there may be flooding along the river. The **Lower Reach** is close to the mouth of the river and is where material transported from the upper and middle reaches is deposited. Flooding is also common in the lower reach.

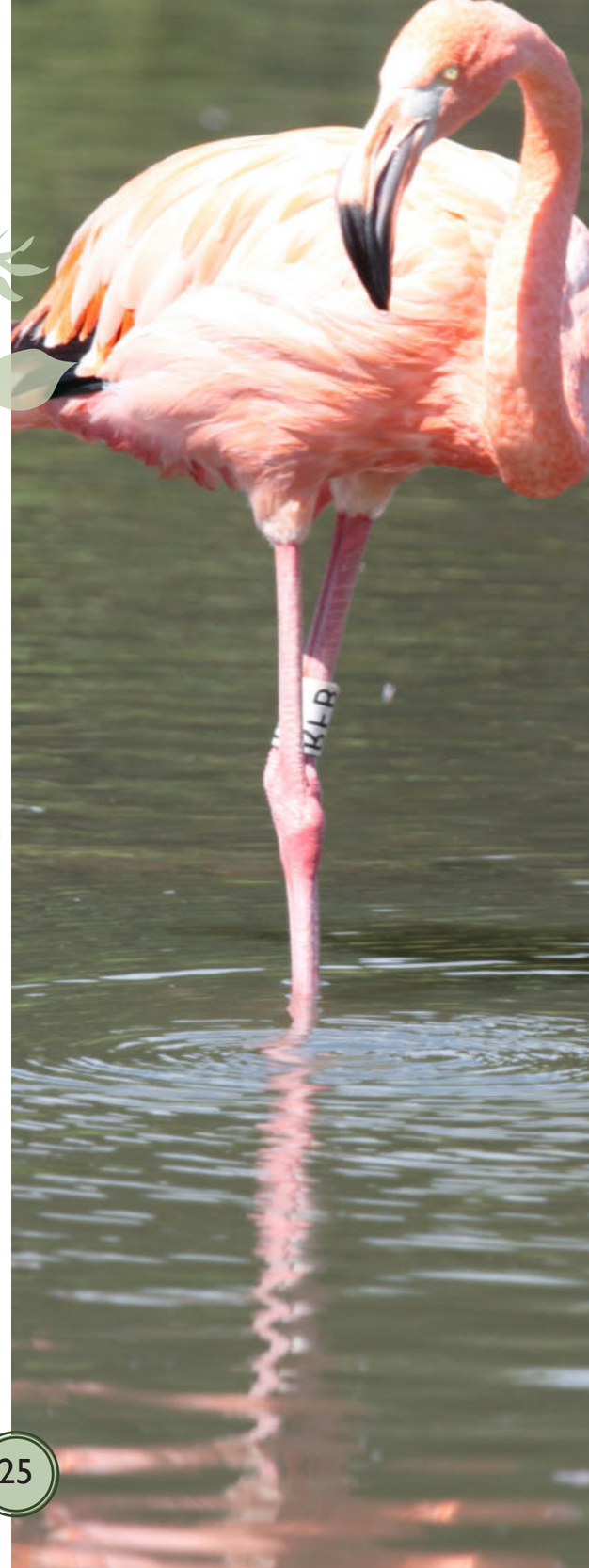
Physical Assessment

After doing a "Visual" Assessment of the Habitat, it is useful to do a Physical Assessment to get more specific information about the condition & physical properties of the river or stream water. These physical properties are good indicators of whether the river is polluted or not.

(for Water Quality Indicators, click HERE
Annex 1 pg. 60)

Stream habitat in Dominica

When we know the measurements of these Indicators, we will have a better understanding of how the plants & animals in the water are being affected and we can know with more certainty how the "chain reaction" could play out. Remember, that most aquatic animals are sensitive to even slight changes in the physical factors of the stream or river.



Take a Picture

Water flow

What's the Big Deal?

This boy is riding his bicycle over a bridge in the Dominican Republic. **Garbage & solid waste** can really clog up a river, causing the water to change it's course. It can also cause stagnation or flooding.

Location: Lower Haina Watershed, Dominican Republic

WATER FLOW: What's the big deal?

River flow varies naturally depending on weather patterns. During the dry season flows are low, meaning that overall there is less water in the river channel. The water moves slowly and may even be stagnant. During the rainy season flows are high, so that there is a higher volume of water in the river channel moving at a faster rate. High flows may result in flooding of the areas close to rivers, which are called floodplains. High and low flows are part of the natural river cycle and aquatic and floodplain plants and animals are adapted to this normal variation in flow. Changes in flow may also be needed to complete the life cycle of some plants and animals, e.g. flooding disperses the seeds of trees along river banks.

While flooding is a natural process, when humans live, build and farm on riverbanks they may lose their homes, crops or lives during extreme flooding events. People can also unintentionally cause more flooding e.g. when they throw garbage into the river, clogging up the waterways and leaving the water no place to go but over the riverbanks. People can also modify flow through dam construction, dredging or water diversions. If water is diverted from the river for community water supplies, the remaining low volume in the rivers may not be enough to support aquatic life.

While human needs have to be taken into consideration, river managers generally try as far as possible to maintain natural river flow patterns.

Storm surge from Hurricane Omar creates flooding in Antigua (2008)

The Green Low Cost Water Monitoring Kit (LaMotte)

The Green Water Monitoring Kit is a simple tool for measuring water quality. It is easy to use and provides reliable data about the substances in the water. The results tell you whether the river or stream is polluted or not and the types of pollution present.

The kit allows you to Test for:

- Dissolved oxygen (10 tests)
- Biochemical oxygen demand (10 tests)
- pH (10 tests)
- Nitrates (10 tests)
- Phosphates (10 Tests)
- Coliform bacteria (3 tests)
- Temperature (unlimited number of tests)
- Turbidity (unlimited number of tests)

The kit comes with an instruction book that gives clear instructions on how to collect a water sample and how to carry out the different tests.
CLICK HERE for videos of water testing

Selecting your Rivers & Lakes

Measuring stream velocity, Dominica

Selecting your test site is the first step. You are then able to prepare for monitoring and measuring.

What Matters Most in Selecting Your Site?

Your site must be SAFE and EASY TO ACCESS. Site selection is a very important part of the process. If your site is not properly selected, the results or your entire project could be ruined.

Specific Places to Measure:

1. Point Source Pollution:
   Defined: WHERE exactly is it coming from? What is the **starting point?** We can pin-point the source to a particular site.

Sample Sites should be at the pollution source:

- approximately 50 meters upstream

and

- approximately 50 meters downstream

2. Non-Point Source Pollution

Defined: This means there may be several or diffuse (widely spread out) areas that are contributing to the source of the pollution.

Taking these samples can provide an indication of how the pollutant disperses or remains persistent in the water.

Samples Sites should be:

- Far upstream, as close to the natural condition as possible

Test Site

RECORDING HOW THINGS LOOK:

Before we start to measure - OBSERVE. How things LOOK at a monitoring site can give valuable information, and can make interpreting (understanding) other data easier and more meaningful. It is always useful to Take a Picture of your test site before you begin.

The Field Data Monitoring Sheets will guide you through this process:

On the Field Data Sheets, you will need to Record the following at your Site:

- Weather conditions

- Water & air quality measurements

- General observations (animals grazing, housing, etc)

- Coastal or river systems present

- Types of ecosystems present

Field Data Sheets Are Used to Record Data In the Field. These Sheets are in the Annex 2 of this Manual
CLICK HERE to view Sheets: Annex 2, pg 74.

Testing for turbidity with "Green Low Cost Water Monitoring Kit"

Take a Picture

What is Mapping?

Mapping is similar to **TAKING A PICTURE** of what you see around you. It involves drawing a detailed sketch of your site area, which includes the important features that might be affecting the catchment or habitat and water quality at the site. Important features could be things like a factory, an eroded bank, a sandbar, a trail or road, farmers' fields, and enclosures for animals.

Why Map?

A "bird's eye view" sketch is often the best way to start mapping your site, as it will give you information about the flow of the river, the nearby land-use patterns and some of the human activities and elements that may be affecting the environment. A Map will give you detailed information about what is happening at your site. It will provide you with the following information:

1. Land use patterns
2. Industries and factories
3. Environmental problems – location of eroded areas, littering, deforestation, channeling etc.
4. Other landmarks – buildings, roads, fences, bridges, drains, schools, fields, playgrounds etc.
5. Your sampling sites – location of your sampling sites

This information will help you to:

- Decide which location will be best for sampling
- Determine the best way to monitor the water quality in your area
- Track positive and negative changes that happen in the site area
- Create a reference map – starting points - for planning and taking action

Don't forget to also TAKE A PICTURE of your site. Along with your map, pictures are an excellent way to record and document the features and condition of your site.

HOW TO MAP

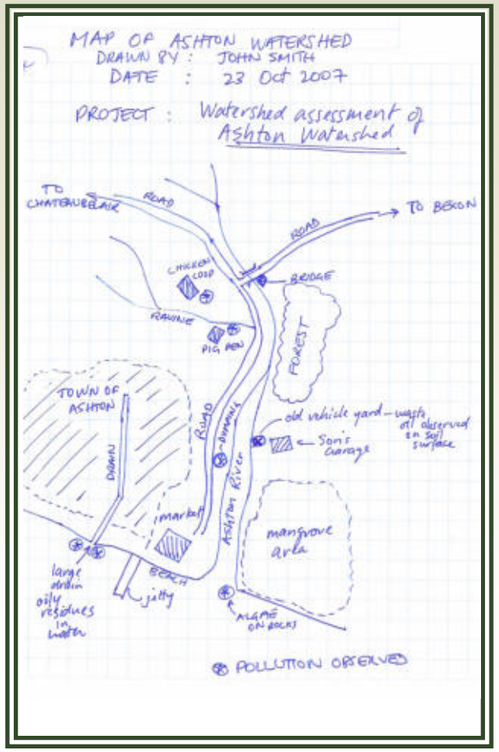
1 Draw a sketch of the area selected for your sampling.

2 Mark all features of the stream onto the map

3 Add a scale and arrows for directions

4 Mark the exact location of your sampling site

5 Add further details such as land use patterns, etc.



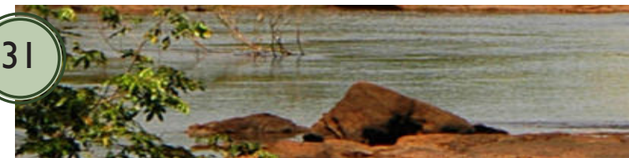
Sample hand-drawn map

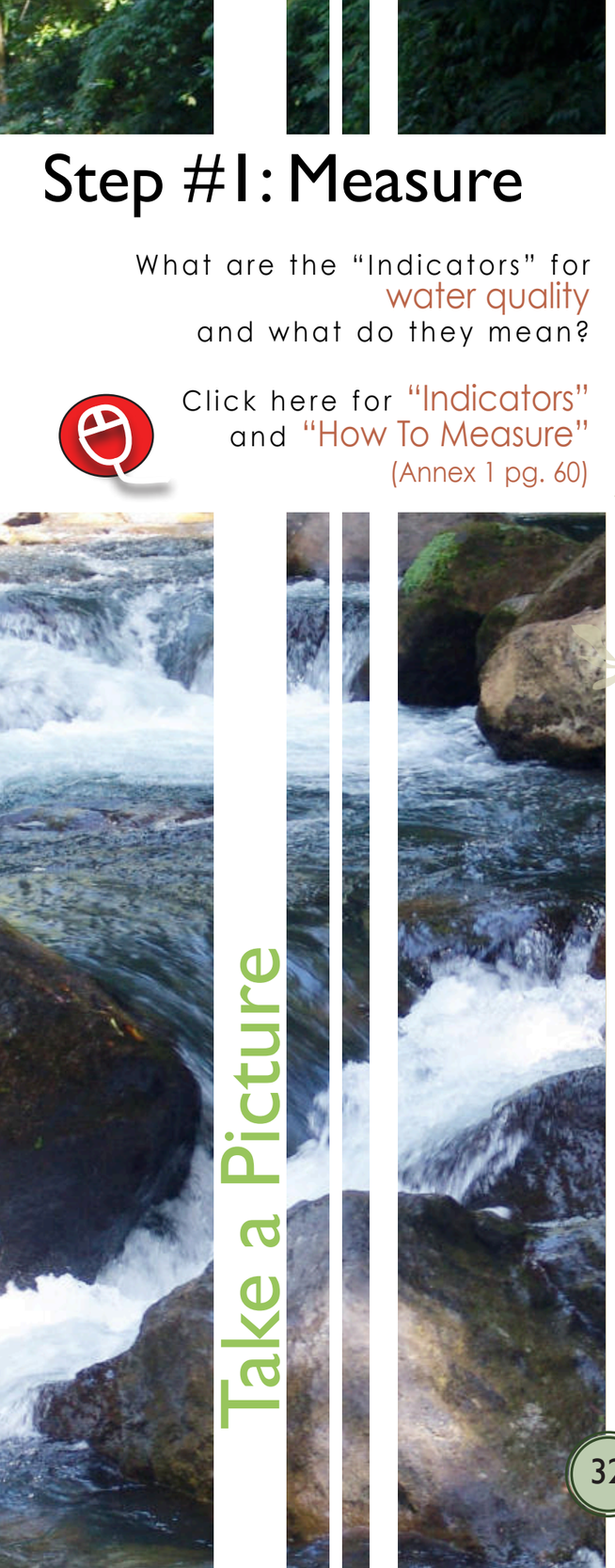
Problem Solving – A Key Concept:

The first step in solving each problem is defining it – Is there a Problem in the first place? And if so, how serious is it?

First questions to ask and answer:

- Is the problem a result of natural conditions, or is it caused by human activities?
- Where is the problem – what areas does it affect? (along the coast, or certain sections of the river or stream?)
- Does the problem occur seasonally, or year round?





Step #1: Measure

What are the "Indicators" for water quality and what do they mean?

Click here for "Indicators" and "How To Measure" (Annex 1 pg. 60)

Take a Picture

Step #2 Monitor

How to design your Monitoring Plan.

Monitoring is the process of gathering data over a period of time. The monitoring plan is a simple one-page document describing what you are testing, when and where, and why you are doing this monitoring.

Your monitoring plan needs to define:
- reasons for monitoring the land degradation and water quality.
- what tests you are going to do
- where and how often you will do your tests
- what you will do with your results.

1. What are your objectives?
- What is the purpose of this plan?
- What is the plan going to be used for?

(The objectives of the plan should be clearly defined, in consultation with all members of the group)

2. What is the project targeting?
- surveying water bodies to assess their current condition,
- identifying areas where land degradation and water pollution exists,
- identifying causes of land degradation and water pollution,
- providing a database of water quality data to analyze trends and changes in water quality and
- indicating areas where land management and water quality needs improvement and ways in which this can be achieved.

3. What will you be testing?
There are a variety of tests that can be done under the project. You can choose the tests that you want to carry out. (Please refer to sidebar Step #1)

4. How often will you test? (A critical step)
Decide how often the land degradation and water quality should be tested. This depends on weather, availability of resources, number of members in the group, type of stream and the tests to be done. Tests could be weekly, monthly, once a term. Physical and chemical parameters may require frequent testing (weekly/monthly) while land degradation may be done less often. It is suggested to test water quality during both dry and wet seasons, as pollutants can become more or less concentrated, depending on river flow due to rainfall. Frequency of testing is important because any trends in the water quality and land management can be easily analyzed. This is why this step is critical for the monitoring plan.

5. How will you select your testing site?
- choose two sites, one in the upper and one in the lower watershed.

6. What will you do with your results?
- a brief explanation of what you intend to do with your results. This should reflect the objectives of testing and will also lead to your **Action Plan.**

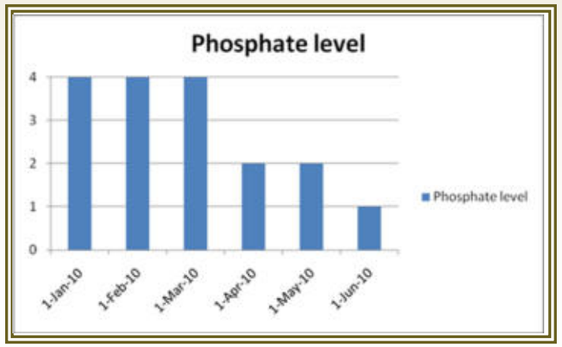
7. Do you have an "Accident Management Plan"?
- the actions you will take to prevent accidents while testing
- actions you would take in the event of an accident while testing.

Displaying Your Results

During the sampling period, you will gather many readings (test results) depending on the number of tests you do in the field.

After obtaining these results it is important to analyze them so that you can understand the condition of the stream or river you have been monitoring. Perhaps the easiest way to look at trends in the data you collect is to use bar-charts. A bar chart will show the pollutant concentrations as they change over the times you have monitored. An example is shown below.

You can plot on a chart the pollutant concentration against another "parameter" value that may be related to the pollution you are measuring.



The vertical axis is ppm (parts-per-million)
Higher phosphate levels may indicate "wastewater"

Making a graph in this way allows you to see how one parameter affects the pollution level. In our graph we have plotted phosphate levels against time. We see that the phosphate level has gone down over the six-month period.

WATER QUALITY ASSESSMENT WORKSHEETS (Annex 2, pg 79)

Step #3 Take Action

Community Involvement

Create Your Action Plan..

This project is not just about monitoring and testing, it is about taking effective action with the aim of improving the conditions of our natural resources, or preventing further degradation of the watershed. The monitoring results are a powerful tool for taking positive environmental action.

1. Forming Your Group
In our collective efforts to protect watersheds and coastal areas, the first step is to establish a monitoring group. This will allow the community members to participate and claim ownership of a section of the river and address problems that may be facing the school or community. You might:
- develop a mission statement
- identify desired goals (e.g. cleanups, re-vegetation, writing letters to suspected factories, etc.)
- identify ways the whole community can be involved in maintaining natural resources

3. Deciding on your projects...start with easy wins
Coming up with a small environmental project, for instance:
- river bank re-planting
- monthly stream or coastal area clean-up campaigns
- awareness workshop/open day presentations to teachers, parents etc
- distributing information about water pollution e.g. community awareness
- preparing a newsletter
- establishing a network with other monitoring groups
- "Anti-Littering" campaigns

4. Identifying pollution "HOT SPOTS"
- identify cause of pollution
- make a site assessment
- identify sources
- investigate the problem
- make tests along the river
- use the test kit (see pg 28)
- compile your data
- take responsibility
- take ownership of the problem
- plan your form of action
- implement your action plan

...then put your plans into ACTION!

5. Inform the appropriate people
Whatever form of pollution is found, you need to inform the people responsible e.g.: if the pollution is chemicals from farm runoffs, farmers could be approached. If factory waste is detected, factory managers could be informed. In some cases, it might be best to inform your local authority.

6. Who to Involve in Your Projects?
You may decide to Involve businesses and/or farmers in your projects. Here are some pointers:
- Approach the local businesses and/or farmers for a session.
- Inform them of your project by means of data and analysis presentation.
- Ask them about their waste disposal plan and land use practices. What other steps could they take to minimize pollution of rivers and waterways?
- Ask them to work together on their future plans and to be part of your action group. This will encourage healthy dialogue and support for your effort to maintain the quality of watersheds.

7. Communication and consultation
Communication of test results and findings to other groups, agencies, government departments, non-governmental organizations and community groups is an important part of the project. Regular communication with these agencies and groups will be useful in coming up with effective actions and projects to undertake. It is also useful in gaining their support for your projects and future plans.

8. How to work with the media
The best way to work with the media is to be prepared. Have a press package ready. Have all of your information together. Have pictures, have letters, have video if possible. Have your points summarized. Journalists are often overworked and the more work you can do for them the more likely they are to cover your story.
The media is a very powerful ally. But knowing how and when to use the media is important.
There can be negative stories. i.e. focusing on negligent businesses and farmers in the watershed.
There can be positive stories. i.e. a strong, well organized community works together with local business to clean up a problem.
A positive story is often far more effective and longer-lasting than a negative one.

This man is a farmer in Finca San Juan, Cuba. He uses composting and other soil conservation techniques.

Saint Lucia's Fond D'Or Watershed Management Project:

"A Model Approach"

The GEF-IWCAM Saint Lucia Demonstration Project developed a model approach to community participation in the management of the Fond D'Or Watershed. The Project Management Unit (PMU) worked closely with the community, through the Watershed Management Committee (WMC), which is made up of community members, government representatives, a representative of the water utility and other key stakeholders.)

It was recognized that a water quality monitoring programme was necessary to obtain data against which the effectiveness of management interventions could be assessed.

The PMU, through the WMC, involved the community in its river water quality monitoring programme. In this way, it sought to improve public awareness and educate as well as ensure that some level of awareness and testing could continue beyond the life of the project.

What were they looking for?

It had been observed that several pig pens were located near the river and that waste was being disposed of directly into the river.

1. How were sites selected?
Monitoring sites were selected based on observed land use above, and immediately next to, the sample point.

2. How was the plan designed?
Plans were developed by the PMU in consultation with the WMC, and with the help of consultants who met regularly with the group for their input and approval. The Caribbean Environmental Health Institute (CEHI) agreed to analyze the samples collected.

3. How was data collected and recorded?
Data on stream water quality and distribution of pig pens was collected by project staff and community members who were trained by CEHI on how and when to collect some data and water samples in the field. There was agreement on how often, and on which days, samples should be collected. The "Green Low Cost Water Monitoring Kit" was used for taking water samples.

Participants used the "Field Data Sheets" to record data.

4. How did group briefings work?
Project staff met monthly to look at the results of the sampling. These were then shared with the WMC at their regular meetings (once or twice a month).

Charts were used to show comparisons between water quality at different sampling sites in the wet and dry seasons. See example chart below:

TABLE 13: COMPARISON OF MEAN *E.COLI* RESULTS BETWEEN SEASONS

SAMPLE SITE	GEOMENTRIC MEAN FOR WET SEASON	GEOMETRIC MEAN FOR DRY SEASON
IBD Bridge	5 500	1 400
La Pelle Bridge	23 000	16 000
La Resource Bridge	12 000	1 200
CADI	63 000	4 400
Belmont Bridge	16 000	1 700
Bassin Noir	100	58
Tourness Bridge	780	130
Fond D'Or Estuary	6 300	770

What did they do with their results?

Data on the location of piggeries as well as the water quality sample points results were then plotted on maps. These results informed management decisions. They also helped the WMC to decide what activities should take priority.

Map of Fond D'Or Watershed with points plotted: see side panel pg 37:

Take a Picture

Land

A Burning Issue

Each year the dry season comes. Each year, our green hills slowly turn brown and the moisture drains from the leaves of the trees and is stored in the roots. Each year the grass turns grey and the smell of smoke is in the air. This is also "the burning season". Many farmers use the dry season to quickly and easily clear their land of grass and shrubs, in preparation for planting. My father taught me this practice. "...cleared in a few hours... if you just put the fire on it!", he would say. He knew sometimes this action would unintentionally set fire to the trees around the field, but he felt that was a small price to pay for all the time it saved. What my father didn't know was that every time he burned the ground, the fire would "kill" the top layer of soil, destroying important nutrients. He didn't understand that the soil's nutrients are made up of living bacteria and small organisms that keep it healthy and these are essential for healthy plant growth.

In this year's dry season, just 10 years later, I walk our land and no crops grow here anymore, not even the grass. This land that once helped to feed our family now seems as lifeless as sand. In the wet season, when there is heavy rain, the land turns into rivers of mud and flooding surrounds us.

"This is a photo of farmers training at Sarduy Farm in the province of Cienfuegos. The farmers at Sarduy were teaching other local farmers about methods they were using to conserve the soil and prevent erosion. The field in the foreground is planted along the contour and there are contour drains. This helps to prevent the water from flowing directly down the slope, by diverting it into the drains. This technique helps to prevent soil erosion, resulting in more fertile and productive fields as well as less sedimentation in nearby waterways."

The Sarduy Farm is a medium-sized farm, with about 10 agricultural workers. It is being used as a pilot in the GEF-IWCAM Project in Cuba to demonstrate best agricultural practices. Their hard work is yielding impressive results. The leader of the farm, Mr. Sarduy, told a visiting group that they have noticed that some of their crop yields (most notably tomatoes), have increased substantially. They are even getting extra (unexpected) crops in each season.

In addition to composting, the workers at the Sarduy farm are also using live barriers, shifting the orientation of their crops to better follow the contour of the land, and increasing the efficiency of their irrigation practices. Mr. Sarduy is proud of the work of the farm and is eager to share this information with others, having already hosted one training session for nearby farms and looking forward to more. His enthusiasm for the work is contagious - he has already recruited much of his family to work with him, including his previously retired 76 year old father.

The lessons learned at the Sarduy farm, and the seven other demonstration farms included in this component of the demonstration project, are being documented, with help from the Institute of Soils in the Ministry of Agriculture.

Coffee Plant at Farm in Finca San Juan, Cuba

Take a Picture

A critical part of the Watershed

Why?

A boy runs next to a pile of garbage in the "Belt of Misery" (Cinturon de Miseria) or "shanty town"
Lower Haina Watershed,
Dominican Republic

What are the Main Sources of Pollution?

Who are the Biggest OFFENDERS in Your Community?

Take a Quick Look..

1 Landfill or Dump___ 2 Industrial Waste___
3 Septic Tanks ___ 4 Excess Sediments___
5 Fertilizer Runoff___ 6 Sewage Treatment____
7 Livestock Waste___ 8 Cutting of trees for Charcoal or lumber__ 9 Mining Pollutants___ 10 Pesticide in Farming___ 11 Oil Pollution___ 12 Household garbage___

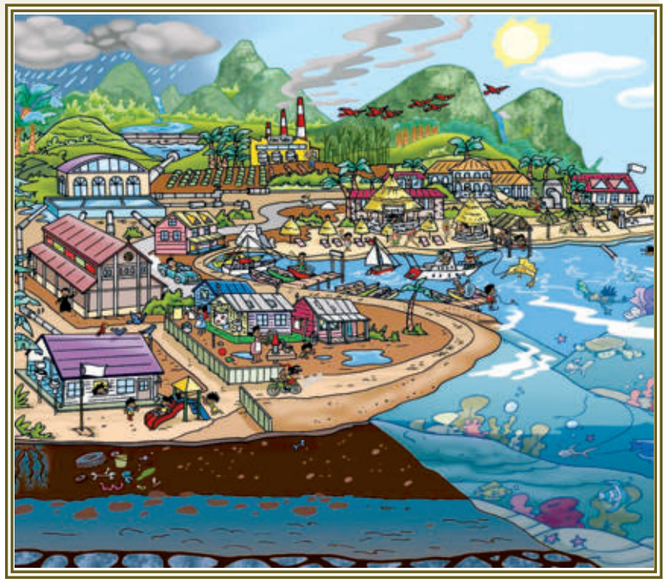


Image credit: UNESCO.

Why Is LAND a critical part of the Watershed?

If our rivers and streams are the life-blood of the watershed, then our land is the body. When a body isn't clean, the water running over it becomes dirty. The land is where all fresh water first meets the earth, and as the water begins its flow towards the coasts, it will take along with it whatever is on the land to loose soil, cow manure, pesticides, plastics, toxic waste, everything. All of this and much more can end up in our drinking water, in the water we bathe in and use everyday.

So what is happening on the land is of great importance, and can tell us a lot about the health of our water catchment. Cutting down trees for farming, for making charcoal, or for logging; burning vegetation to clear fields for planting; the construction of homes, roads and bridges are all activities that have a significant impact on the land. When these activities are done unsustainably (that is in ways that can severely deplete or exhaust our natural resources) they cause our water resources to become polluted. Land degradation damages our streams, rivers and fresh water habitats and eventually pollutes our coastal waters and coral reefs.

Land Degradation

Why should I care?

Land degradation monitoring and training in St. Vincent & The Grenadines

What's the BIG DEAL?

Erosion on land causes silt to build up in streams & rivers, which MEANS:

- Increased risk of floods during a heavy rain: "siltration" in river channels reduces the amount of water the river can carry, and during heavy rains, this can spill over the banks and lead to flooding.
- Problems for water treatment facilities: Silt eventually builds up in pipes and at water treatment facilities leading to blockages and interruptions in your water supply. This can lead to higher maintenance and greater costs for treating and distributing clean, safe drinking water.
- The murkiness of the water, due to the presence of silt, does not allow as much light to penetrate; reduced light can slow the growth of aquatic plants, which affects all animals along the food chain.
- Silt ends up in the coastal waters, smothering coral reefs and sea grass , which need light to grow. This disrupts the food chain affecting all life in the sea.
- Nitrates and phosphates can enter the water and cause algal growth, which consumes the oxygen, causing aquatic plants and animals to suffer.

Long-term Effects of Pollution on Land:

Pollutants left on the landscape can be harmful to the environment and humans. These pollutants come in many forms and from many sources, for example, used oils from garages, toxic chemicals from manufacturing industries, agro-chemicals from agricultural fields, including household waste from drains and faulty septic systems.

Pollutants can have a range of impacts on human health and on the services we derive from our land.

Health: Of note are bacterial pollutants that can come from sewage and other waste that is improperly disposed of. Harmful bacteria once ingested can lead to stomach ailments which can be life-threatening. Cancer and other illnesses are sometimes linked to long-term exposure to certain kinds of toxic chemicals.

Farming: Lands that have been excessively treated with agro-chemicals can become "fatigued" and lose the ability to sustain agricultural productivity. Agro-chemicals typically harm useful soil organisms that play a role in enriching the soil by releasing nutrients. Harmful agro-chemicals may also pollute waterways and pose a threat to aquatic organisms.

Fishing: Pollution in the form of excessive sediment that washes off the land that is being degraded smothers coral reefs and other coastal habitats that are important as food and shelter for fish, some of which are economically important for coastal communities. Wastewater from households and commercial enterprises may be high in nitrates and phosphates which, when dumped into waterways, will lead to rapid algal growth (referred to as algal blooms) within coastal habitats that also tend to smother these habitats reducing their ability to support fish production.

Tourism and recreation: The impacts of land-based pollution on our important tourism sector are most evident when the waters along our shoreline become muddied by sediment from rivers and degraded lands. Algal blooms can damage reefs' aesthetic and economic value, which is associated with dive tourism, sport fishing, and other recreational activities. Health issues, like those listed above, also have a negative impact.

The vast majority of pollutants that end up on LAND are the result of human activities on land.

Take a Picture

Not always so CLEAR cut?

Land degradation is not always easy to understand or to measure. In Jamaica for instance, old landslide scars are noted for supporting better crops and more intensive agricultural possibilities than nearby land, which has not been affected by landslides, especially when the new soil comes from less weathered rock materials, such as mudstones.

So, **we can't always assume** that dramatic or degrading changes to the landscape, especially if they are naturally occurring changes, will be negative for land-users.

Soil scientists, for instance, see "rills" (channels on slopes of bare earth with no vegetation coverage) as symptoms of severe erosion and indicators of a need for better vegetation coverage. In practice, however, farmers might find that rills are useful drainage channels which prevent waterlogging, as well as convenient places to throw weeds.

Land slide in Dominica

Try the Erosion Game: http://www.peelregion.ca/pw/waterstory/pdf/activities/erosion-flood.pdf

(See Annex 6)

Indicators:

We use Indicators to help us decide if there is a problem. As we have seen in earlier modules, indicators are variables, which ***may*** show that land degradation has taken place. They are not necessarily the actual degradation itself. The piling up of sediment against a downslope barrier may be an 'indicator' that land degradation is occurring upslope. Similarly, decline in yields of a crop may be an indicator that soil quality has changed, which in turn may indicate that soil and land degradation are also happening.

The condition of the soil is one of the best indicators of land degradation. The soil supports a variety of important processes involving vegetation growth, overland flow of water, infiltration, land use and land management. Soil degradation is, in itself, an indicator of land degradation. In the field, additional variables are used as indicators of the occurrence of soil degradation.

Click to go to "Indicators" section (Annex 1 pg. 66)

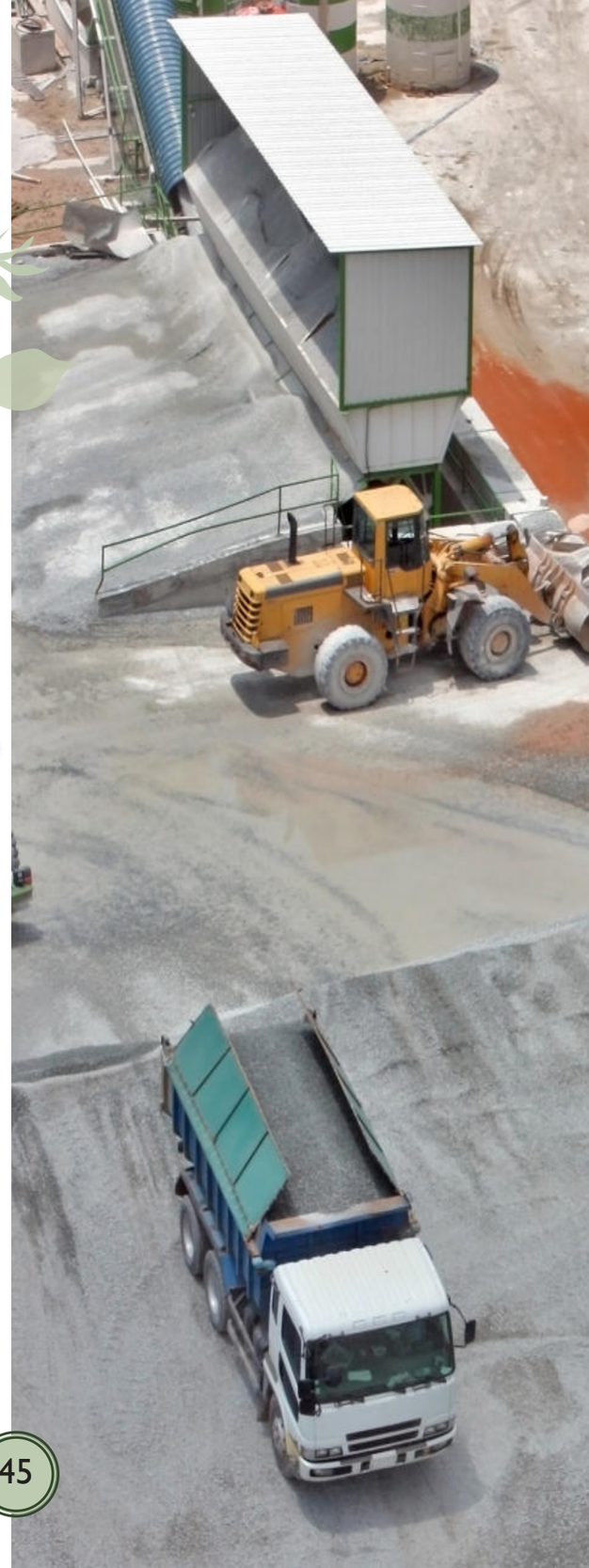
HEALTHY LAND sustains:

- **biodiversity:** the variety of species, populations, habitats and ecosystems
- **healthy ecosystems:** the general health and resilience of natural life-support systems,
- **natural capital:** the stock of productive soil, fresh water, forests, clean air, ocean, and other renewable resources that underpin the survival, health and prosperity of human communities.

A **HUGE CHANGE** happens when we lose our forests.

Forests act like "green reservoirs" conserving water in leaf litter on the ground and soil. Once forests are cut down and replaced with crops, grazing animals, or housing, the ability of the land to filter pollutants and absorb water is severely and negatively affected. The ground is less able to absorb water quickly so more water flows over the land surface, carrying sediment and loose stones with it. The land cannot retain as much moisture as before and erosion sets in.

Even when land has lost most of its original forest, or in places that were never forested at all, it can still be healthy and support the watershed, provided there is adequate vegetation.



Step #1: Measure

What are the "Indicators" for land degradation and what do they mean?

Click here for "Indicators" and "How To Measure"
(Annex 1 pg. 66)

Take a Picture

Step #2 Monitor

Community Involvement in the GEF-IWCAM Jamaica Demonstration Project

The Driver's River Watershed Management Area in Jamaica is a GEF-IWCAM Demonstration Project geared towards development and implementation of a model Watershed Area Management Mechanism (WAMM) for Eastern Portland. It incorporates the lessons and experiences gained in other Watershed Management Units and Small Island Developing States. The project used a participatory approach very effectively. Stakeholders were initially involved in a Stakeholder's Workshop, which began the process of strategic planning. Sub-Committees were fielded early from amongst Project staff as well as stakeholders.

The Environmental Monitoring Committee (EMC)

The Environmental Monitoring sub-Committee (EMC) oversees water quality, stream flow and meteorological monitoring within the Project area. Water quality sampling is carried out by trained volunteers from the communities. Analysis is done by the National Environment and Planning Agency (NEPA), and the EMC makes decisions for actions to be taken. This sub-committee consists of a number of state agencies as well as community stakeholders and has the technical expertise to guide the proper management of the watershed. The EMC meets monthly to discuss the results of monitoring. Hotspot communities are selected. A town meeting is then held informing communities of the results and engendering solutions, which almost always lead to a clean-up of some kind. This mechanism for informing the community of water quality results means that data collected is put to practical use.

The Water Resources Authority measures stream flow while Meteorological Services is responsible for rainfall data. The EMC receives reports on these efforts and deals with matters such as the training of new volunteers (as some are lost over time).

Step #3 Take Action

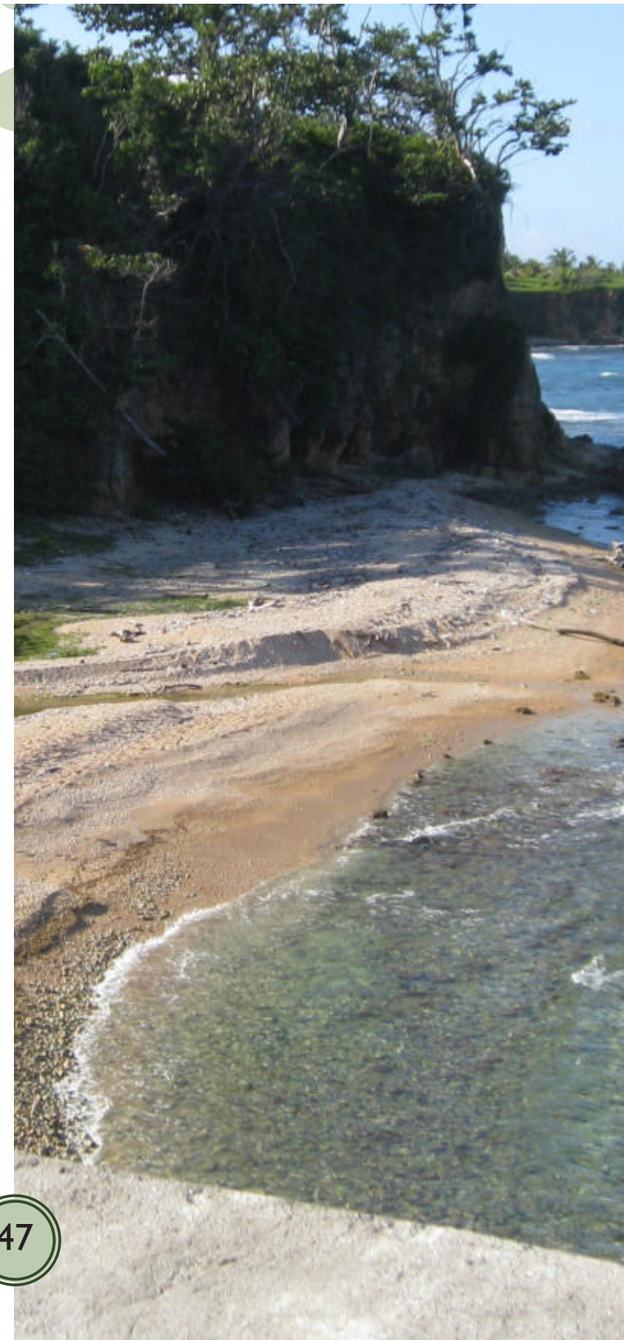
International Coastal Clean-up Days

The EMC took the lead on **International Coastal Cleanup Day (ICCD)** which was marked with an event which took place 20 — 21 September 2008 in Manchioneal and Long Bay. Over the two days, 174 volunteers participated including members of the community, students, Peace Corps and National Youth Service (NYS) volunteers.

The Public Awareness Committee leads a range of public awareness and educational activities within the Demonstration Project area. These include: debating and poster competitions in schools; day camps for children and project awareness initiatives around certain themes or events (e.g. National Wood and Water Days, Farmer's Field Day, and the planning of a "Town Cry"). In addition, the Committee helps to publicize and plan for meetings and events. Although a particular committee may take the lead on a specific issue, all committees and stakeholders are involved in a number of cross-cutting events.

This garbage skip (above) is one of several funded by a small grant provided to a community group under the **GEF-IWCAM Jamaica Demonstration Project**. The group is working to address the problem of poor solid waste management.

Land Degradation Assessment Worksheet
(click here for Annex 2 pg. 74)



Take a Picture

Coasts

A Turtle Story

"A leatherback turtle emerges from the waves and makes its way slowly up the beach, the same beach where she hatched from an egg more than 40 years ago. She has made the long journey back to nest.

But her search for a clear spot takes quite a long time as her path is blocked by debris encountered along the way; plastic bottles and containers among other things. She persists and finally settles on a spot. She begins to dig, but stops....the sand is not deep enough. Over the years, truckloads of sand for construction have been removed from this beach and it is now not deep enough to allow her to dig a hole suitable for her eggs. After covering her tracks again, she returns to the sea. She has not been able to lay her eggs. An ancient ritual, necessary for the survival of her species has been disturbed..."

What is a beach?

"A beach is a zone of loose material extending from the low water mark to a position landward where either the topography abruptly changes or permanent vegetation first appears."

As a complete ecosystem, the beach represents a community of plants, animals and micro-organisms that are all linked by energy and nutrient flows that interact with each other and the physical environment.

When we talk about coastal areas, we're not just talking about the beach or shoreline, but also the land directly behind the beach, and in the other direction, the "offshore zone" (to a water depth of about 40 feet or 12 meters). This offshore zone is where sea grass beds and coral reefs lie, and they supply sand to the beach. The land and slopes behind the beach receive the sediment and pollutants that are brought to the beach.

SAND MINING:
This is the removal of large or small quantities of sand from the beach by machine or by hand, usually for building purposes.

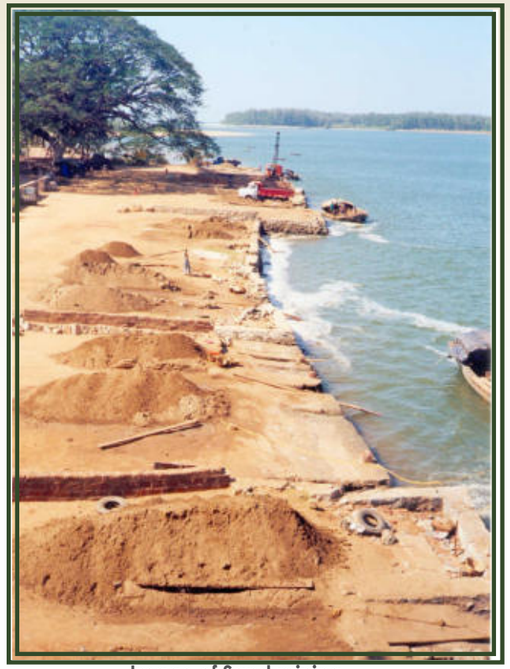


Image of Sand mining.
source: www.equitabletourism.org

A critical part of the Watershed

Why?

Coastal Zones

Why are COASTS a critical part of the Watershed?

Our COASTS are where the land meets the sea, and as you step down past the tree line, step on to a powdery sandy beach, rocky outcropping, or cliff edge over the sea, you have entered an entirely new ecosystem. It is an ecosystem that is complex and rich in biodiversity.

When you TAKE A PICTURE of a coastal area, you are capturing what is happening on the beach, but you will also get a sense of what might be happening further inland, or in other parts of the watershed. If there is a lot of algae on the rocks, this may be an indication that the water has high levels of nitrates flowing from the land and through the streams and rivers into the sea. Our coasts are directly linked to all other areas of the watershed. What happens on the land, has a tremendous impact upon the health of the coastal areas.

Coastal degradation is the result, or the evidence of **serious problems** on the land. Coastal degradation is usually caused by damaging practices on the land. Polluted water reaching the coast via rivers and drains also has a negative effect upon coastal water quality.

Threats of Climate Change

Climate change is a noticeable shift in weather and temperature patterns, which eventually start to affect the way various systems of nature interact. Climate change can be naturally occurring or caused by human activity, such as deforestation and the burning of fossil fuels (oil, gas, and coal). The impact of climate change can be:

- greater frequency and intensity of extreme weather events (e.g. hurricanes, droughts)
- rising sea levels
- coral bleaching & destruction
- changing migration patterns
- depleting fish resources

What's Wrong with this Picture?

Algae on rock
Colihaut, Dominica.

Why Should I Care?

Algae can quickly overgrow coral reefs, smothering and killing them in the process.

Marine algae, such as in this photo above, can be found on many of our beaches in the Caribbean. You might think it's pretty, but it's usually a **"warning sign"** that the water is polluted.

Algae grows when the water is nutrient-rich. Household chemicals (e.g. phosphorus in detergents), fertilizers used in farming, and other nutrients are washed into our drains and rivers and eventually end up in the sea. In the coastal waters these chemicals encourage the growth of algae. As it spreads and becomes abundant, this algae **depletes oxygen in the water**, and creates an environment where plants thrive, and fish and other aquatic animals suffer or die. This is known as the eutrophication of coastal waters. Eutrophication is the process whereby a body of water becomes rich in dissolved nutrients through natural or man-made processes.

CLIMATE CHANGE
What could this mean for coastal communities in the Caribbean?

Our Coastal Areas

What's going on at the beach near you?

And, what happens when there are conflicts between users of our beaches?

PICTURE THIS:

Pigeon Point, Tobago.

Pigeon Point in Trinidad and Tobago, is part of the Courtland Watershed and Buccoo Reef / Bon Accord Lagoon. This is a mangrove area; an inter-dependent, ecological complex of mangroves, sea grass beds and coral reefs. The area is used by various stakeholders, and sometimes conflicts occur between the users. The users include fisher people, and recreational users (i.e. swimmers, glass bottom boat operators who give tours of the reef, etc). A few years ago, tension between users culminated in the shooting of a fisherman by a security guard who was employed by the private owners of the beach facility. The conflict here only ended when the local government, the Tobago House of Assembly, acquired the facility. One of the aims of the local government is to manage this facility for the benefit of all Tobagonians.

Swimming area, Pigeon Point Resort, Trinidad and Tobago

Coastal Ecosystem Condition Assessment

Small islands have limited resources. Economic activities rely heavily on the resources in the coastal and marine areas, especially tourism and fishing industries. We've seen the consequences of our land-based activities on the marine environment, in the form of pollution and the resulting ecosystem destruction.

The main sources of marine pollution include:

- Runoff from agricultural lands and urban areas, which introduces high levels of sediment, agrochemicals and other pollutants into coastal waters;
- Improperly disposed solid waste, which can flow with runoff into rivers or streams and into coastal areas;
- Raw or partially treated sewage (human and animal) disposed of in waterways or directly into coastal waters
- Wastewater from residential or commercial developments also disposed of in waterways or directly into coastal waters.

NEXT STEPS: MAPPING

Observe the Beach and make a Map

Now that we've identified some of the causes of coastal degradation, both natural and human-made, and their main sources, we can get ready to begin to assess the situation. It's time for MAPPING.

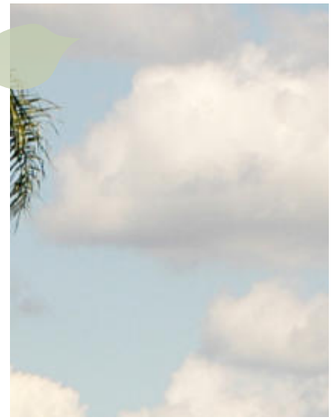
On your sketch map of the coastal environment, you could include the following elements:

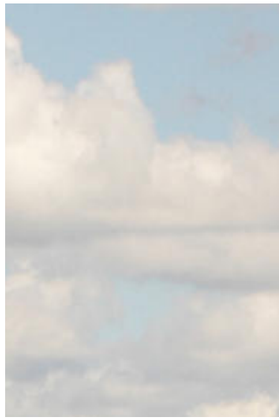
- Beach material (sand, stone, rocks)
- Animals (crabs, birds, domestic animals, etc.)
- Plants & trees (seaweed, sea grass, mangroves, trees behind the beach, etc.)
- Debris, litter, pollution
- Human activities
- Buildings behind the beach, bars, hotels, signs, litter bins, lavatories,
- Sea conditions
- Objects in the sea (mooring buoys, swimming areas)

sample sketch map

Which Coastal Systems are Affected by Human Activities on Land?

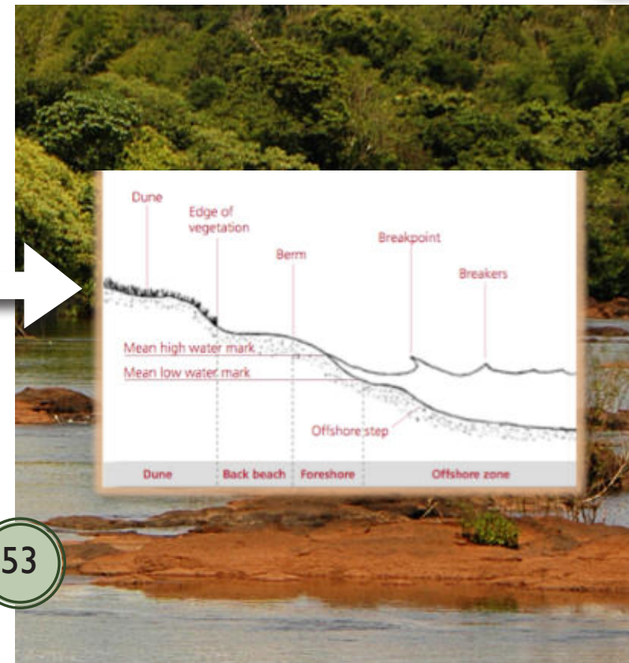
Mangroves / Beaches / Coral Reefs / Sea grass Beds





COASTAL ZONE ASSESSMENT WORKSHEET

Click here for the Survey Form to conduct of a simple status assessment. This assessment focuses on mangroves, coastal water quality and beaches. (Annex 2, pg.77)



Take a Picture Archaeological site threatened by coastal degradation

St. Lucia's cultural heritage

Coastal Degradation

Why Should I Care?

Williams Bay, Trinidad and Tobago (above photo)

Coastal Degradation and Water Resource Management: What's the BIG DEAL?

We have seen how silt ends up in coastal waters, smothering coral reefs and sea grass. Silt and other water pollutants such as faecal coliform bacteria and pesticides kill corals and negatively affect marine flora and fauna, disrupting the food chain and affecting all life in the sea.

What does this mean for the local economy?

- **Fisheries:**
  fisher people catch less fish and smaller fish and their livelihoods are negatively affected

- **Tourism:**
  dirty water causes illness, keeping visitors away

WHY SHOULD I CARE?

Take the Quiz: **TRUE or FALSE?**

1. Over 80% of all marine pollution originates from land-based sources which are primarily industrial, agricultural and urban (http://www.marbef.org/wiki/Coastal_pollution_and_impacts) **TRUE**

2. Diseases caused by drinking contaminated water (with pathogenic bacteria, viruses, or parasites) include:
- cholera
- typhoid, schistosomiasis, dysentery and other diarrheal diseases
  (http://www.grinningplanet.com/2005/07-26/water-- -pollution-facts-article.htm) **TRUE**

3. Each year, plastic waste in water and coastal areas kills up to:
- 100,000 marine mammals,
- 1 million sea birds, and
- countless fish.
  (http://www.grinningplanet.com/2005/07-26/water-pollution-facts-article.htm) **TRUE**

4. In one week, a typical cruise ship generates:
- 210,000 gallons of sewage;
- 1,000,000 gallons of "grey water" from showers, sinks, dishwashers and clothes washers;
- 37,000 gallons of oily bilge water;
- more than eight tons of solid waste and toxic wastes from onboard operations like dry cleaners and photo processing laboratories.
  (http://www.grinningplanet.com/2005/07-26/water-pollution-facts-article.htm) **TRUE**

5. By the time a typical tuna fish is 6 years old, it has 25 lbs of mercury throughout its body. **TRUE**

6. 70% of all household septic tanks in the Caribbean leak overtime and most of this waste ends up along our beaches and coastal areas **TRUE**

An important archaeological site in St. Lucia is threatened by erosion and coastal degradation.
Cas-en-Bas beach, St. Lucia
(also see side panel, pg. 54)

Tourism & Coastal Degradation:
Is Sustainable Tourism really working?
Where are the best examples?

Step #1: Measure

What are the "Indicators" for coastal degradation and what do they mean?

Click here for "Indicators" and "How To Measure"
(Annex 1 pg. 70)

Take a Picture

Step #2 Monitor

The GEF-IWCAM Demonstration Project in Trinidad & Tobago

There are many different ways to monitor the coastal and near-shore environment. The GEF-IWCAM Demonstration Project in Trinidad and Tobago uses a scientific diving programme to help monitor the health of the near-shore marine environment impacted by activities in the Courland Watershed of Tobago. Three permanent stations (transects) on the reef were established for monitoring, each a distance of twenty metres long, using nylon and fishing cork. The impact of these stations on the reef is extremely minor and they enable the scientific diver to return to the exact same spot each time and observe how things have changed and how they have stayed the same. The diver can film and observe the amount and type of live and dead hard coral, live and dead soft coral, sponges, sand and algae. This information has helped to assess the health of the reef and implement measures to better protect it.

Diver filming the reef with underwater camera,
Buccoo Reef, Tobago

Step #3 Take Action

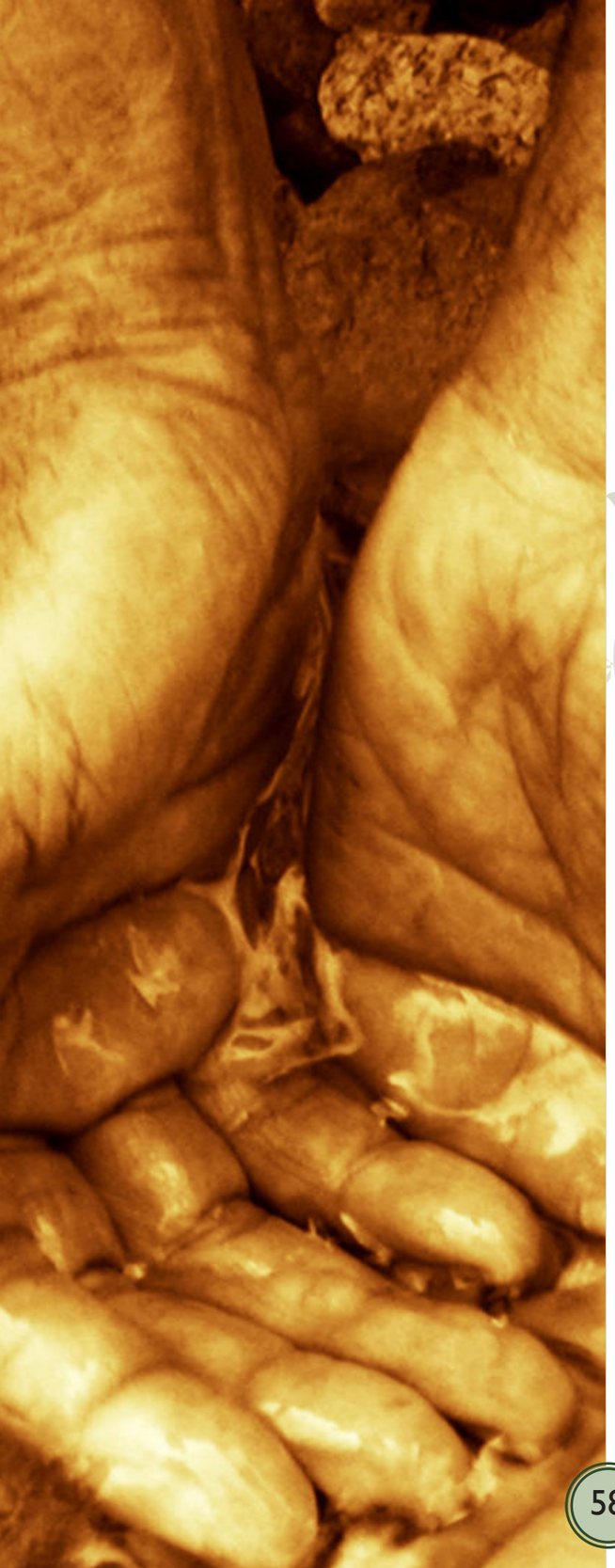
Snorkel training workshop for teachers & students
Soufriere, St. Lucia

Tour boats,
Buccoo Reef, Tobago

Coastal Zone Assessment Worksheet
(Annex 2, pg 77)

Mobilizing online:
Use Social Media for Taking Action:

Facebook Twitter



Some Useful Resources

There are many resources available to you on the Internet, to help you to monitor the natural resources in your community. To get you started, we have listed some of the key reference sources that were used as a foundation for this toolkit. We encourage you to learn more about the materials developed by these groups and others working in this area.

The Sandwatch Project
www.sandwatch.ca

The Sandwatch Project seeks to modify the life-style and habits of children, youth and adults on a community-wide basis and to develop awareness of the fragile nature of the marine and coastal environment and the need to use it wisely. It is an educational process through which school students and community members learn and work together to critically evaluate the problems and conflicts facing their beach environments and to develop sustainable approaches to address these issues. With a strong field monitoring component, Sandwatch tries to make science 'live' yet remains inter-disciplinary with applications ranging from biology to woodwork and from poetry to mathematics.

The RiverCare Programme
www.rivercarefiji.org

RiverCare is an educational programme involving teachers, students and communities in caring for water resources and the environment. Developed by Live & Learn Environmental Education and funded by Vodafone ATH Foundation, RiverCare is a positive response to growing environmental problems in Fiji and the Pacific.

World Water Day
www.worldwaterday.org

The international observance of World Water Day is an initiative that grew out of the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. It has been celebrated annually since then. The web-site has valuable information on monitoring and activities that you can do on World Water Day, and on the other 364 days of the year.

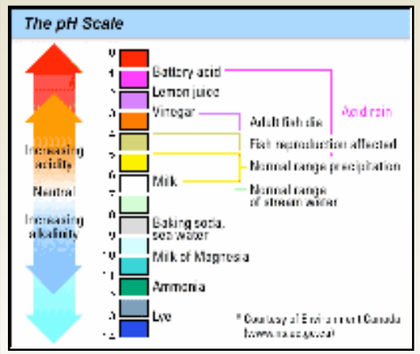
Global Environment Facility Funded Integrating Watershed and Coastal Areas in Small Island Developing States of the Caribbean (GEF-IWCAM) Project
www.iwcam.org

The GEF-IWCAM Project developed the Community Based Resource Assessment Toolkit. The Project seeks to strengthen the commitment and capacity of the participating countries to implement an integrated approach to the management of watersheds and coastal areas. The long-term goal is to enhance the capacity of the countries to plan and manage their aquatic resources and ecosystems on a sustainable basis. In particular, project activities focus on improvements in integrated freshwater basin-coastal areas management on each island of the regional groupings of Caribbean SIDS.

Rivers & Lakes

A. Water Quality Indicators: What do they mean?

Indicator	Description
Faecal Coliform Bacteria	Human and animal waste can contain harmful viruses and bacteria. Faecal coliform bacteria, which, while not harmful in small amounts, if found in higher concentrations can be worrisome, serves as an indicator for water contamination. Their presence in water shows that poop is in the water. The higher the numbers of faecal coliform bacteria, the greater the contamination of the water . Example of Worst Case Scenario: In 2004, 7 people died and 2,500 people became ill in Walkerton, a small town in Ontario as a result of cow manure entering and contaminating their drinking water with E. coli bacteria. Cow manure from farms ran off into an adjacent well and into the town's public water supply.
Dissolved Oxygen	Biochemical Oxygen Demand is the amount of oxygen that has dissolved (mixed) in the water. Fish, plants, and small aquatic animals need this oxygen to breathe and survive in the water. When the level of dissolved oxygen falls too low, then these animals and plants die. Oxygen levels can be lowered by a number of factors: • Too much algae growth • Rising water temperatures • Non-moving water (stagnant water) **Biochemical Oxygen Demand:** The amount of oxygen required by bacteria to decompose organic matter, such as sewage and dead algae, in the water. It is used as a measure of the degree of water pollution.
Nitrate	This is a chemical compound (a group of chemicals) that is used in fertilizers. Because it helps to make plants grow in agricultural production, it has the same affect on plants in the water. When the level of nitrates in the water is high, algae and other plants may grow out of control and use up all the available oxygen, which can suffocate and kill off any other plants or animals living in the water.
Phosphate	This is another chemical compound, used in detergents and laundry soaps. Phosphates have a similar effect in water as nitrates.

Indicator	Description
Temperature	The temperature of the water affects EVERYTHING! It affects: • the amount of oxygen that can be dissolved in water • the ability of plants and animals to take energy from their food, and to thrive (metabolic rates) • the ability of parasites, bacteria and disease causing organisms to live in the water is directly associated with temperature. In the natural environment, there are an unlimited number of factors that affect temperature. Often, they are caused by human activity, such as the dumping of industrial waste or industrial cooling water into the water. Climate change is a more global threat that is also impacting on water temperature, among other things. (For information on Climate Change see page: 50)
pH (or Acid Level)	Most fresh water has a certain level of acidity or alkalinity within which fish and plants have adapted to live comfortably. The pH scale ranges from 0 to 14 with pH 7 being neutral, acidity increasing from 7 to 0 and alkalinity increasing from 7 to 14. Healthy, fresh water that fish can live in is 6.5 to 8.2 on the pH scale.  **What causes changes in pH?** - waste & pollution running into the water - activity of bacteria in water - rate at which aquatic plants turn sun light into food energy (rate of photosynthesis); example: algal blooms can cause changes in pH levels Changes in the pH mean the water chemistry has changed, and this is usually harmful to the plants and animals living in the water.
Transparency	It is a measure of the clarity of the water and can be applicable to streams, rivers, lakes, reservoirs and seawater. Levels of clarity or transparency change depending upon the colour of the water, turbidity (murkiness), and light intensity.
Turbidity	This is the level of cloudiness or murkiness of the water. Cloudiness in water can be the result of organic debris, like plankton (tiny microscopic animals), clay, soil and/or dust particles. Turbidity can also be the result of particles that have entered the water through human activity. High levels of turbidity can result in less oxygen in the water and less plant and animal growth.

Rivers & Lakes

B. How to measure

Indicator	Step by Step
Faecal Coliform Bacteria Click for video	(method from: "Green Low Cost Monitoring Kit") 1. Pour the water sample into the large test tube containing a tablet (3599) until it is filled to the 10mL line. Don't worry if you overfill or under fill slightly. 2. Replace the cap on the test tube. 3. Stand the tube upright, with the tablet flat on the bottom of the tube. 4. Incubate by storing the tube upright, at room temperature, out of direct sunlight, for 48 hours. Store the tubes where the temperature will be fairly constant and between 70 to 80 degrees F (21 to 27 degrees C) Do not disturb, handle, or shake tubes during the incubatation. 5. Compare the appearance of the tube to the picture on the Coliform colour chart. 6. Record the result as negative or positive.
Dissolved Oxygen Click for video	(method from: "Green Low Cost Monitoring Kit") 1. Record the temperature of the water sample (see page 59) 2. Submerge the small tube (0125) into the water sample. Carefully remove the tube from the water sample, keeping the tube full to the top. 3. Drop two Dissolved Oxygen TesTabs (3976) into the tube. Water will overflow when tablets are added. 4. Screw the cap on the tube. More water will overflow as the cap is tightened. Make sure no air bubbles are present in the sample. 5. Mix by inverting the tube over and over until the tablets have disintegrated. This will take about 4 minutes. 6. Wait 5 more minutes for the colour to develop. 7. Compare the colour of the sample to the Dissolved Oxygen colour chart. Record the result as ppm Dissolved Oxygen.
Nitrate Click for video	(method from: "Green Low Cost Monitoring Kit") 1. Fill the test tube to the 5 mL line with the water sample 2. Add one Nitrate Wide Range CTA TesTab 3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample. 4. Wait 5 minutes for the red colour to develop. (Note: If the sample does not develop a red colour [sample is colourless or yellow], record the result as 0 ppm - parts-per-million). 5. Compare the colour of the sample to the Nitrate colour chart. Record the result as ppm Nitrate.

Indicator	Step by Step
Phosphate Click for video	(method from:"Green Low Cost Monitoring Kit") 1. Fill the test tube to the 10 mL line with the water sample 2. Add one Phosphorus TesTab 3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample. 4. Wait 5 minutes for the blue colour to develop. (Note: If the sample does not develop a blue colour [sample is colourless], record the result as 0 ppm) 5. Compare the colour of the sample to the Phosphate colour chart. Record the result as ppm Phosphate
Temperature	1. Place the bottom end of the thermometer in the water. 2. Swirl the thermometer for a few seconds 3. Hold the thermometer in place for 2 minutes 4. Record the temperature on the data sheet 5. For best results, take temperature readings at different sections of the river and average the readings Air Temperature: - The same glass thermometer can be used to measure the air temperature - Before measuring the water temperature, allow the thermometer to (equilibrate with) adjust to the surrounding air for 3 to 5 minutes. Keep out of direct sunlight
pH (or Acid Level) Click for video	1. Clean a small beaker by rinsing twice with the stream water. 2. Collect a sample of the stream water in the clean beaker 3. Place a strip of pH paper in the water 4. Leave the beaker for 5 minutes in a shady place. 5. Compare the colour of the pH paper with the pH paper colour index 6. Record the pH on the data sheet OR 1. Wash the comparator cell 3 times with the "test water" and fill the cell with this sample 2. Drop one "Phenol Red" tablet into the pH cell 3. Replace the lid of the comparator & push to seal it firmly. Turn comparator upside down several times until the tablet dissolves completely. Use the plastic paddle to crush & mix the tablets, if not dissolving quickly (do not shake the comparator, as this will let in air & ruin sample) 4. Immediately read the pH by holding the comparator up to daylight & matching the colour in the cells with the standard scale. (If the colour falls below 2 standard colours, then it will be necessary to estimate the concentration)

B. How to measure

Indicator	Step by Step
Transparency Click for video	A Secchi disc – is the tool used to measure transparency 1. In an area where the surface water is under shade, lower the Secchi disc down (a glare on the surface of the water could distort the reading). 2. As the disc is lowered, note the depth at which it just disappears from view. 3. Lower the disc a little further, then raise it and note the depth at which it reappears. 4. The average of the two depth readings is reported as the Secchi disc transparency. The report should also state the diameter of the disc and the pattern, if any on the upper surface of the disc.
Turbidity Click for video	1. Remove the 2 halves of the "turbidity tube" from their clips in the lid of the case. 2. Push the upper tube (open at both ends) squarely into the lower tube and align the graduation marks up the side. 3. Look through the open end of the tube at the black circle printed on the white base of the tube; this is the marker. (Ensure there is good light so you can see clearly.) 4. Hold the tube vertically & slowly pour the water sample into the tube until the marker just disappears when viewed from the top of the tube (don't make bubbles – they may cause false readings) 5. (This step can also be done in reverse – filling the tube with sample and then slowly pouring out the water) 6. Hold the tube vertically and read the turbidity using the graduations on the side of the tube – the RESULT is the numbered line nearest to the water level. Or: you can judge the distance of the water level
General Appearance	How things LOOK at a monitoring site can give valuable information, and can make interpreting (understanding) of other data easier and more meaningful To make a visual assessment you simply OBSERVE the conditions in the environment at the site, and record what is interesting or remarkable. COLOUR: Is clean water really clear? The clarity of rivers and streams will vary depending on the size of the river or stream, and will also depend on whether it is transporting sediments due to recent rainfall. In the same regard, coastal waters do not always have a perfect blue hue. River or coastal waters derive their colour from the colour of the dissolved and suspended materials in the water. Plankton, plant pigments and metallic ions, all naturally-occurring substances will also give water its various colours. ODOUR: Does it smell? The smell of water can help tell you if it is polluted or not. However, in most cases of polluted water, there will not be a distinct smell or odour. Detecting a smell will also depend upon wind conditions and the type of pollutants in the water.

Indicator	Step by Step
Stream Velocity Click for video	(method from http://www.wesleyan.edu/ctgeology/LISproject/stream_examination.htm) This is the rate or speed at which the water flows in the river. As we've seen flow is an important physical factor in streams & rivers, since the rate of flow determines the amount of oxygen and food that is available in the water for the plants and animals that inhabit the river environment. Since velocity is a function of both distance and time, you will need to measure both of those properties. To do this, you are going to measure the time it takes the water to flow a distance of 4 meters. Measuring Equipment • 2 Flags on sticks • Tennis ball (or piece of round fruit) • Stopwatch • Calculator • Metric measuring tape Method 1. Measure a four-meter distance along the stream. Ideally this would be a straight stretch. 2. Place flags on sticks (or other markers) at the beginning and end of the four-meter distance. 3. Place an object that floats, such as a ping-pong or tennis ball, in the water at the higher end of the four-meter stretch. 4. Drop the ball above the starting flag and start timing when it reaches the first flag; stop when it reaches the second flag. Record the time in seconds. 5. Repeat at least two more times, and then average your results. 6. Calculate the velocity of the stream in meters per second by dividing the average time in seconds into the distance of four meters.

Land

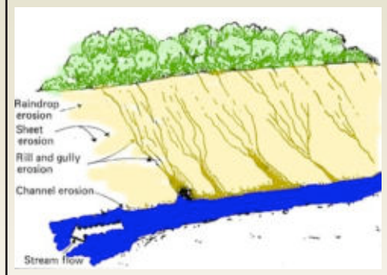
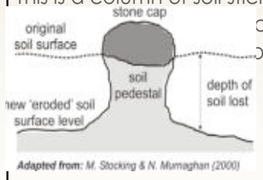
A. Processes that degrade our land: What do they mean?

Process / Indicator	Description
Water Erosion	In general, the land (and soil), if not disturbed by our activities, will absorb most of the rain-water that falls, and when it becomes too saturated to absorb any more, the water will flow over the land surface as runoff. However if the soil is disturbed by land clearing (removal of vegetation and loss of rooting to hold the soil) and remains exposed, erosion will occur, a process when the soil gets washed away by the water flowing over the surface. Over time, this can lead to a loss of large amounts of soil, which dramatically degrades the landscape. The accumulated soil is deposited in the rivers and eventually flows downstream to our coastal waters and reef areas, which can be very harmful to these ecosystems.
Soil Fertility	Topsoil contains important chemical nutrients (plant food!) for healthy plant growth. Fertility is used to describe how well the soil is supplied with nutrients to support plant growth. The loss of top soil through erosion (as described above) means that the nutrients are also lost, and the soil becomes less fertile – that is, less able to support the healthy growth of plants and crops.
Waterlogging	Ever walked through a swampy playing field, where water came up to your ankles? The field may be described as being waterlogged. While some areas are naturally wet (swamps, mangroves), waterlogging may be caused by human activity such as compacting the soil (and loss of natural openings in the soil surface), and not creating adequate drainage to allow water to drain away quickly. This soil then remains very wet for prolonged periods and plant roots are not able to breathe properly. Plant roots do in fact need oxygen to maintain life much like we do and the plant will die off if its roots remain in waterlogged conditions for too long.

Process/ Indicator	Description
Salinization	Salt is a naturally-occurring substance in almost all soils. However, irrigation practices can introduce excessive salt accumulation within the soil if the irrigation water evaporates too quickly. The salt in the irrigation water eventually becomes concentrated and crystallizes in the soil rendering the soil unable to support plant growth. This process is also known as "sali-nization".
Water Table Level	When groundwater from wells and underground streams is drawn out (usually for drinking water or irrigation water supply) faster than it can be replenished naturally, the water table around the location from where the water is drawn can be dramatically lowered. The water table is the level or depth at which the underlying soil and rocks are naturally saturated with water. The lowering of the water table can be excessive to the point where the wells that supply water to communities may run dry.
Wind Erosion	In very dry and windy environments, the constant scouring action of the wind on the land can loosen and blow away soil. Wind erosion is not common in the Caribbean, except in very specific areas exposed to continual on-shore winds particularly in the 'windward' coastal areas.

Land

B. How to measure

Feature / Indicator	What and How to Observe
Sheet Erosion	The soil surface will typically be exposed to direct raindrop impact (which serves to dislodge the soil particles) and left without supporting vegetation to trap soil particles. Tiny channels carved into the soil surface by water as it washes over the land will usually be visible, and the soil particles themselves will be loose. This process is described as the top soil being washed away in "thin sheets"; hence the term sheet erosion.
Rills & Gullies	Rills result when the water flowing downslope carves a distinct channel in the soil due to concentrated water flow through the channel. It is common to see several rills across a land area that has been stripped of vegetation. Rilling is usually the first visual sign of serious erosion by water. Gullies develop over time if the erosion by water flowing in the rill continues unchecked. A gully is therefore a deeper version of a rill. 
Pedestal	This is a column of soil sticking up from an eroded land surface. The soil that forms the pedcted from erosion by a solid object on top, usually a rock or plant obvious as erosive rainfall washes away the surrounding surface soil 
Root Exposure	Root exposure is a good indication that the surrounding soil is being eroded away.

Feature/ Indicator	What and How to Observe
Exposure of Below-Ground Portions of Structures	Fence posts, walls, bridge footings and other objects built into the ground will often show discoloration marks that indicate where the soil or ground level once was. This is a good tell-tale sign of the occurrence of erosion at that location
Tree Mound	When you notice soil appearing to be heaped in a mound directly under a tree, with the surrounding soil surface at a much lower level, it suggests that erosion on the landscape is occurring. The mound of soil remains because the tree's canopy acts like an "umbrella", preventing direct rain drop impact erosion.
Sediment Build-up in Drains	Soil accumulation in street, irrigation and other types of drains is a good sign that erosion is occurring upstream or upslope of that location.
For All Features:	Using this assessment method, we check to see if these features are present at the site. If they are, we then work to determine how severe or dramatic they are. We can then categorize the severity of the damage to the land (degradation).

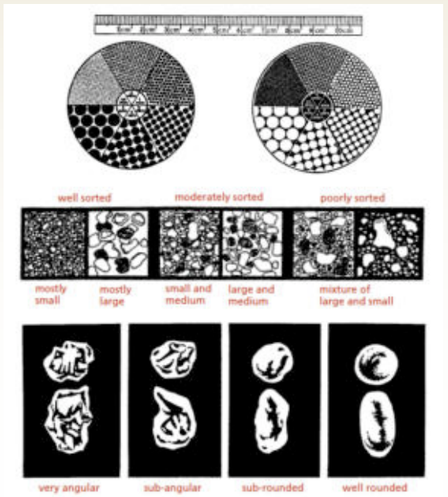
Coasts

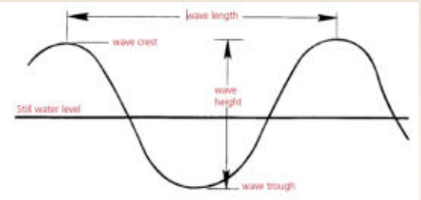
A. Processes that damage our coastal areas: What do they mean?

Process / Indicator	Description
Erosion / Accretion	Erosion happens when sand or sediment is washed away or taken from the beach, and the beach becomes narrower. The opposite process is called "accretion", when sand or other material is added to the beach, resulting in the beach getting larger or wider.
Beach Profiles	The "profile" or cross-section of the beach is an accurate measurement of the slope and width of the beach. When these measurements are repeated over time, they show HOW the beach is eroding or accreting. Today there is a new threat to beaches: sea level rise, caused by global warming. Sea level rise means that many of our beaches may erode or disappear and this will threaten communities located on the coasts.
Beach Sand	Sand is made up of very tiny fragments of stone or shell, of which there are many different types. The colour and texture of sand depend on where the material originated. For example the paler-coloured sands usually comes from coral reefs or coral reef limestone rocks. Darker-coloured and black sands on the other hand, often found on volcanic islands, comes from volcanic rock.
Human Activities	Human Activities include anything people do on the beach, from picnicking to jet-skiing, from mining to fishing, from farming to building resort hotels. All human activity has an impact on the coastal environment, and usually the impact is negative.
Tourism & Tourism Development	Tourism is one of the most important economic activities in the Caribbean, and tourism-related activities impact the coastal areas more than any other part of the watershed. It is only quite recently that some parts of industry have started to integrate sustainable tourism practices into their businesses.
Views of Beach Users	What do you want to know about your beach? Finding out what people think about their beach or a particular coastal-related problem can help give you a better understanding of the condition of your beach.

Process / Indicator	Description
Water Quality	For Water Quality Indicators, see the "Rivers & Streams" section (pg. 60)
Waves	Waves are generated by the wind blowing over water. "Swells" result in groups of waves moving away from the wind at similar speeds, and forming a pattern. Waves are the main cause of beaches changing their size, shape and sediment type. Waves have large amounts of energy that are capable of moving materials over long distances within the coastal zone over time.
Currents	When waves approach the beach at an angle, they generate a longshore current, which moves parallel to the beach. Although not as strong as the wave, it can move materials that have already been stirred up by the waves. These currents are responsible for moving material from one part of the beach to another.
Plants & Animals	Our coastal and beach areas are unstable environments, because the surface layers of the beach are in constant motion as a result of the waves and wind. This means that animals and plants that permanently live there must be highly adapted to survive. Certain bird, fish and turtle species are visitors, using specific parts of the coastal area at different times. It is important to understand how plants and animals depend upon the beach environment, so that we can understand what the impact on them will be when the beach and coastal areas undergo changes or suffer damage. Vegetation on the beach and behind the beach plays an important role in helping to stabilize the beach and prevent erosion.

B. How to measure

Feature / Indicator	What and How to Observe
Erosion / Accretion	Measure the distance from a fixed object behind the beach (e.g. a tree, building) to the high water mark – that is the highest point to which waves reached on that day. Finding the High Water Mark: Look for: a line of debris, seaweed, etc. or where the line between the dry beach & where it was recently wetted by the water) Repeat the measurements over time (e.g. Every two to three months at the same site)
Beach Profiles	The monitoring consists of surveying the beach profile from a fixed point set up behind the beach. The fixed point is called the reference mark and is the starting point for the measurement. The reference mark is usually a painted square on a wall or tree. It is essential to always start the beach profile measurement at the reference mark. The profiles run at right angles across the beach and in most cases specific orientations for the beach profiles are determined. Photographs should be taken of the reference points. The beach profile at each location should be measured every three months. This will give four data sets a year and will adequately cover seasonal changes. However, this is only a guide, and depending on the time available, the frequency of monitoring can be increased or decreased. In addition, the beach profiles should be re-measured as soon as possible after a major event such as a tropical storm or hurricane. Repeat the measurements every 3 months.
Beach Sand Profiling	Collect sand samples from different parts of the beach. Place the samples in clean, plastic bags and label each bag and note where the sample was collected. Use the Chart to sort the samples by shape, size and colour. These characteristics are likely to vary from one part of the beach to another. Variations in size, sorting and shape will tell you about the different zones on the beach and the processes that shaped these zones. 

Feature/ Indicator	What and How to Observe
Human Activity	Observe and record the different activities taking place at the beach and the time of day, and draw up a timeline of activities. Then list the number of people involved in those activities and try to determine a usage pattern for the beach.
Tourism & Tourism Development	What are the specific tourism-related activities occurring on the beach? Are there efforts being made to ensure that these activities are ecologically responsible or sustainable? Make a list of these activities and assess their impact. **SAMPLE TIMELINE OF BEACH ACTIVITIES** **6-7 am** Fishermen take their boats out to sea. Early morning bathers visit the beach to bathe and swim. **7-10 am** Walkers, people with dogs. **10 am - 3 pm** Sunbathers, picnickers use the beach, people bathing in the sea, playing, people walking. Fishing boats return around 3 pm, the catch is unloaded into trucks and take into town. **3-6 pm** Other groups of picnickers arrive, one group has a barbecue. Hotel guests playing volleyball on the beach.
Views of Beach Users	Conduct a simple questionnaire survey. Design your questionnaire and decide how many people you plan to survey. For tourism industry-related questions, you could survey the members of your local Tourism Association, to see what efforts are being made to use the coastal resources sustainably.
Water Quality	For Measurement of Water Quality Indicators, see the "Rivers & Streams" section on pg. 62
Waves	The three main characteristics of waves that can be measured are the height, wavelength, and the direction from which the approach. 
Currents	Measurements of longshore currents are best combined with wave measurements. So, if longshore currents are being monitored, then waves should also be measured. Together, these provide a picture of the processes moving sand around on the beach.
Plants & Animals	For observing and recording plants and animals on the beach, you can collect different objects from the beach and also record different plants and animals that you see. You can measure vegetation on the beach and behind the beach to see changes over time, which may indicate signs of possible erosion. You can monitor your beach for nesting turtles, as many tropical beaches are used by sea turtles for nesting. There are more than 6 common species of sea turtles. It takes between 55 and 72 days for their hatchlings to emerge and make the journey down the beach to the sea.

Name of Observer:_____

Date of Observation (yy-mm-dd):_____

Geographic Coordinates: Latitude_____ Longitude_____

Site Location	Sheet Erosion[1]				Rills & Guillies[2]				Pedestals		
	none	slight	mod	sev	none	slight	mod	sev	none	few	many
General Land Use Description (agriculture, housing etc.)											
Other Observations (irrigation use, solid & liquid waste, land clearing activities, etc.)											

[1]Sheet Erosion

Severity	Description
No Sheet Erosion	No visual indicators of sheet erosion
Slight	Some visual evidence of the movement of topsoil particles downslope through surface wash; no evidence of pedestal development only a few superficial roots exposed.
Moderate	Clear signs of transportation and deportation of topsoil particles downslope through surface wash; some pedestalling but individual pedestals no more than 5cm high; some tree and crop roots exposed within the topsoil; evidence of topsoil removal but no subsoil horizons exposed.
Severe	Clear evidence of the wholesale transportation and deposition of topsoil particles downslope through surface wash; individuals pedestals over 5cm high; extensive exposure of tree and crop roots; subsoil horizons exposed at or close to the soil surface.

Signature: _____

Name of Observer:_____

Date of Observation (yy-mm-dd):_____

Geographic Coordinates: Latitude_____ Longitude_____

Site Location	Plant Root Exposure			Tree Mounds			Sediment Build Up in Drains		Grazing		
	none	few	many	none	few	many	light	heavy	light	mod	sev
General Land Use Description (agriculture, housing etc.)											
Other Observations (irrigation use, solid & liquid waste, land clearing activities, etc.)											

[2]Rill & Guilles

Severity	Description
None	No rills present within the field.
Slight	A few shallow (<100mm depth) rills affecting no more than 5% of the surface area.
Moderate	Presence of shallow to moderately deep rills (<200mm depth) and/or rills affecting up to 25% of the surface area.
Severe	Presence of deep rills (up to 300mm depth) and/or rills affecting more than 25% of the surface area.

Signature: _____

Land Degradation Assessment Worksheet

Name of Sampler:_____

Date of Sampling (yy-mm-dd):_____ Time:_____

Sampling Site:_____ Sampling Station: _____

Site Conditions: Check one item under each category

Wind:	Calm	Slight Breeze	Windy	
Weather on the Day Before:	No Rain	Little Rain	Rainy	Heavy Rain
Weather on the Day:	Clear	Cloudy	Overcas	Rainy
Water Surface:	Calm	Ripples	Choppy	Swells
Solid Waste:	Low	Moderate	High	

Water Quality Measurements:

Water Temperature	°C	Dissolved Oxygen	% saturation	
Turbidity	JTU	Biochemical Oxygen Demand	ppm	
Stream Velocity	**meters per second**	Nitrate	ppm	
Coliform Bacteria	counts per 100 mL water	Phosphate	ppm	
		pH	pH units	

General Observations and Comments: (e.g., animals grazing, households nearby, difficulties in measurement)

_____

_____

_____

_____

Signature: _____

Name of Observer: _____

Date of Monitoring (yy-mm-dd): _____ Weather Conditions: _____

Tidal Conditions: _____

General Description_____

Location (geographical coordinates, if possible): Latitude _____ Longitude _____

Country: _____

Name of site: _____

Coastal Systems Present (Tick as appropriate)	Mangroves	Beaches	Seagrass	Coral reefs
	Lagoon	Mud flat	Sandy seabed	Marshes

Infrastructure Present	Residences	Hotels	Jetty, etc.	Other

Mangrove Wetland				
Type of mangrove wetland	Basin	Riverine	Fringing coast	
Species present	Red	White	Black	Buttonwood
Most abundant species present:	Red	White	Black	Buttonwood
Least abundant species present	Red	White	Black	Buttonwood
Mangrove oysters	Absent	Present (if present, approximate number observed _____)		
Number of bird species observed	None	1-3	4-6	>6
Number of crab species observed	None	1	2	3 >3
Signs of mangrove vegetation clearing	None	Low	Medium	High
Signs of drying out	None	Low	Medium	High
Solid waste	None	Low	Medium	High
Mangrove canopy	Lush	Brown	Sparse	
Liquid waste entering wetland	Absent	Present		

Coastal Water Quality	Verticle visibility:_____(m)			
Water quality	Vertical visibility: _____(m)			
Nutrient indicating algae	Absent	Low	Medium	High
White sea urchins	Absent	Present (if present, approximate number observed ____)		
Long spine black sea urchins	Absent	Present (if present, approximate number observed ___)		
Juvenile fish	Absent	Present (if present, approximate number observed ___)		

Signature: _____

Name of Observer: _____

Date of Monitoring (yy-mm-dd): _____ Weather Conditions: _____

Tidal Conditions: _____

General Description_____

Location (geographical coordinates, if possible): Latitude _____ Longitude _____

Country: _____

Name of site: _____

Beaches					
Beach substrate	Sand	Silt	Rubble		Rock
Vegetation	None	Trees	Shrub	Mangrove	Grass
Beach slope	Steep	Moderate Slope	Gentle slope		
Solid waste	Absent	Low	Moderate		High
Natural debris	Absent	Low	Moderate		High
Vegetation clearing	Absent	Low	Moderate		High
Turtle activity	Describe				
Sand crabs	Absent	Present. If present, describe			
Wild Animals (eg. pigs, goats)	Absent	Present. If present, describe			
Sand mining activities	Absent	Present. If present, describe			
Domesticated animals (dogs, cows etc)	Absent	Present. If present, describe			
Drain(s) running in the sea	Absent	Present. If present, describe			
Area used for recreation					
Area used for fishing activity					
Area used for yachting/boating					
Other Comments					

Signature: _____

Name of Sampler:_____

Date of Sampling (yy-mm-dd):_____ Time:_____

Sampling Site:_____ Sampling Station: _____

Site Conditions: Check one item under each category

Wind:	Calm	Slight Breeze	Windy	
Weather on the Day Before:	No Rain	Little Rain	Rainy	Heavy Rain
Weather on the Day:	Clear	Cloudy	Overcas	Rainy
Water Surface:	Calm	Ripples	Choppy	Swells
Solid Waste:	Low	Moderate	High	

Water Quality Measurements:

Water Temperature	°C		Dissolved Oxygen	% saturation
Turbidity	JTU		Biochemical Oxygen Demand	ppm
Stream Velocity	**meters per second**		Nitrate	ppm
Coliform Bacteria	counts per 100 mL water		Phosphate	ppm
			pH	pH units

General Observations and Comments: (e.g., animals grazing, households nearby, difficulties in measurement)

Signature: _____

Field Data Sheets: Guide / Key

Weather conditions – describe the weather during the survey. E.g. state whether it was sunny, windy, rainy, stormy, etc.

Tidal conditions – state whether it was high tide or low tide.

Identification – identify type of mangrove wetland, mangrove species and stress in mangroves.

Vegetation clearing means vegetation deliberately cut by humans.
Low = Some visual evidence of vegetation clearing
Moderate = Clear evidence of vegetation clearing
High = Evidence of extensive clearing of vegetation

Mangrove weltland
Low = Some visual evidence of mangrove wetland drying out, such as areas of trees drying out, along with mud substrate being dry.
Moderate = Clear signs of mangrove wetland drying out (Clear signs of dried out trees and mud substrate).
High = Extensive areas of wetland drying out (extensive areas of dried out trees and mud substrate).

Solid waste comprises of discarded human-made material (garbage/litter)
Low = <10 pieces of solid waste material observed
Moderate = >10, but easily counted
High = Too numerous to count

Nutrient indicating algae
Low = Few patches of nutrient indicating algae on rocks (in intertidal zone)
Moderate = Clear presence of nutrient indicating algae on rocks (in intertidal zone and within nearshore)
High = Large amounts of nutrient indicating algae on rocks (in intertidal zone, within the nearshore and washed up on shore)

Slope
Steep = > 45 degrees
Moderate slope = 10-45 degrees
Gentle slope = <10 degrees

Natural debris comprises driftwood, dried coconuts, branches, etc. located on the beach area.
Low = <10 pieces of natural debris observed
Moderate = >10, but easily counted
High = Too numerous to count

Turtle activity includes observation of hatchlings, exposed eggs, tracks, nesting activities, etc.

Other comments – include any relevant observations not previously recorded, including traditional knowledge of issues pertaining to this coastal area.