SUSTAINABLE DEVELOPMENT TERMS AND CONCEPTS

A Reference for Teachers and Students

Compiled by The Cropper Foundation

Table of Contents

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Preface

The Cropper Foundation (TCF) is a not-for-profit philanthropic non-governmental organization contributing to policy and practice, public awareness and education in support of sustainable development. TCF is pleased to have collaborated with the The Ministry of Education of Trinidad and Tobago, the Caribbean Examination Council (CXC), the University of the West Indies, the Environmental Management Authority (EMA) and Caribbean Advanced Proficiency Exam (CAPE) science teachers in the production of this Handbook.

This initiative was in direct response to a need expressed by teachers of environmental sciences, geography and biology for assistance in delivering on various aspects of the CAPE and Caribbean Secondary Education Certificate (CSEC) science syllabi. More specifically, as gleaned from workshops with the teachers, a credible reference source(s) explaining key terms and concepts relating to sustainable development was an urgent requirement.

The term "sustainable development" has dominated discussion on development (global, regional, national and local) ever since the seminal definition by the Bruntland Commission in 1987: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Yet for much of the world's population, sustainable development is a vague concept which to be relevant must be defined within context, personalized, and action-oriented. It is in this regard that the handbook has relevance and utility as a ready reference in the tool kit of teachers.

TCF was able to help teachers overcome this difficulty through its education and awareness programme. It is envisaged that this handbook will not only provide information, but will generate interest and spur action on issues related to sustainable development.

Winston Rudder
President of The Cropper Foundation

Introduction

Background

Consider your needs. How do you define them? How do you prioritize them? How can you gauge when they've been met? It is difficult. Now, multiply that by the six billion or so other people who make up the world's population. Now, situate these humans in a place shared with innumerable plant and animal species, oceans, mountains, deserts, ice fields and forests.

This is the hard part: you're not the only one with needs. The idea of sustainable development is to take into account all of these needs now while keeping an eye on what the planet will need in the future.

Sustainable development is defined in the Brundtland Report as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

To address the issues related to meeting needs, we begin to think through concepts like carrying capacity and green gross domestic product. We formulate conventions to facilitate sustainable development such as the United Nations Framework Convention on Climate Change. We create the organizations that govern these conventions, like the United Nations Environment Programme. As a concept and practice still unfamiliar or misunderstood by many, the language of sustainable development presents no small challenge.

This Handbook of sustainable development terms and concepts is a framework document for anyone interested in sustainable development. The principle objective here is to provide context and clarification. Many of these terms have specific meanings within the discourse of sustainable development. The terms and concepts also share relationships among
themselves - relationships which are not readily evident.

Some of the main areas covered in the text are:
terms
organizations, conferences, conventions
concepts
bibliography

Terms
Many of the terms found in the glossary were sourced from the environmental studies, geography and biology syllabi for CAPE. Terms were also sourced from the Millennium Ecosystem Assessment and Global Environment Outlook reports. The terms provide a foundation for the next section of the document.

Organizations, Conferences, Conventions
It is necessary to understand the importance and role of the institutions, agreements and treaties for creating frameworks that support sustainable development. This section also highlights the links and processes that allow the organizations, conferences and conventions to fulfil their aims.

Concepts
Understanding the mechanisms by which frameworks that support sustainable development work, is a critical step to application of these frameworks. This section focuses on understanding frameworks and also on tweezing apart complexed issues like defining an ecosystem for study.

Bibliography
The bibliography contains an extensive list of all the source materials used in the creation of the glossary and is provided to ensure that users have access to credible sources of information. Referencing within the handbook uses numerical citations. Citations are numbered, enclosed in square brackets [ ], and refer directly to the numbered references provided in the bibliography.

In attempting to show what underpins sustainable development, accuracy, relevance and a sense of the scale and scope of the components have guided the content of this text. Still, it has not been possible to capture all of the associated terms and concepts. Readers are encouraged to review more material related to sustainable development.

Sustainable Development

In 1987, the World Commission on Environment and Development produced a report entitled ***Our Common Future***, also known as ***The Brundtland Report***. The report defined sustainable development as:

> …development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains two key concepts: the concept of the 'needs' of the poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.[186]

This definition has been internationally accepted and subsequent policies and action plans concerned with sustainable development encompass these core ideas. It is important to note that sustainable development is a process and not an endpoint.

The concept of sustainable development has been around for thousands of years in the form of cultural and religious practices preserving resources, or by tribes such as the Mro tribe of Bandarban, Bangladesh who practice forest conservation. These practices were often targeted to specific components of ecosystems and were not enshrined in a legal framework. In 1972, the United Nations Conference on the Human Environment held in Stockholm, Sweden called for global action to be taken on issues of the environment and development. The conference was the birthplace for international environmental cooperation and diplomacy. Ten years after Stockholm, it was realized that development still had not fully addressed the problem of increasing poverty, famine, and terrestrial and marine pollution. This led to the establishment of the World Commission on Environment and Development in 1983.

Sustainable development is emerging as a key issue for many nations, and is being incorporated into the development strategies of many nations. Trinidad and Tobago responds to the call for sustainable development through its "Vision 2020" plan. The MDGs also respond to the call to sustainable development on an international scale. Common to both Vision 2020 and the MDGs is the concept of achievable targets. Targets, when achieved, become indicators of sustainability. Targets that reflect sustainability should be set within the context of the needs of the affected population or the affected environment. For example, environmental management of a rural area may require targets to be set for solid waste as the only form of pollution, whereas in urban areas targets may be set for air quality, solid waste, and water quality as forms of pollution control. It is important to understand that attainment of these targets does not automatically reflect sustainability. Human needs are constantly changing, and our subsequent environmental impacts and use of resources will change. Therefore, goals and targets must be continuously revised and created to ensure sustainable use of resources and low or reversible impacts on the environment.

Sustainable development requires the integrated participation of many actors. These include government, international and regional governing bodies, NGOs, CBOs and other stakeholders.

Actors	Role
Multilateral and Regional Organizations	Multilateral organizations include the UN, WWF and IUCN. Regional organizations include CARICOM, AOSIS and ACS. They provide frameworks within which countries can work toward SD. Frameworks include treaties, conventions and agreements, for example, the CBD and the MDGs. While organizations lobby and pressure governments to implement various frameworks, they themselves have no power to implement the frameworks; it is the responsibility of each country's government to do so. Multilateral and regional organizations also act as support mechanisms for many initiatives, activities and projects. For example, UNEP often partners with governments and civic society in various undertakings. One of the best examples of an initiative is the MA. UNEP brought together many other multilateral and regional organizations, as well as civic society organizations, to carry out this initiative.
Government	Governments use guidelines set by treaties, conventions and agreements to create legislation and laws and set standards. They also create incentives and disincentives targeted toward the business community to encourage activity that supports SD. For example, the Kyoto Protocol falls under the auspices of UNFCCC and suggests that countries use emissions trading to reduce their carbon output. Government's role here is to facilitate the sale of carbon credits which acts as incentive to corporations and industries to reduce their carbon emissions. Government also supports projects with a sustainable development focus. Many of these activities are undertaken by community groups. For example TDC (Tourism Development Company Ltd.) has a Tourism Action Committee that facilitates community-based initiatives through provision of startup resources.
Business Community	The business community includes (but is not limited to) industries, the corporate sector, small-scale businesses and agricultural activity. Because of their financial power and their influence over the use of resources, this group can steer a country toward or away from SD.
Civic Society	Civic society includes (but is not limited to) NGOs, CBOs, religious organizations, community groups and clubs. They initiate, manage and support projects that work toward sustainable development; assist the government in keeping on track with the guidelines of the international treaties and agreements; translate policies, conventions, treaties and agreements into the language of the general public and, in turn, make these more applicable and user-friendly; building networks between different communities and government.
General Public	The collective effect of individual action is powerful. Individuals personalize SD through changing behaviour and attitudes. For example, lobbying the government to pass legislation that supports sustainable extraction of resources, or reducing one's carbon footprint by using public transport instead of personal cars. The general public also need to support activities and initiatives that work toward SD.

There are number of key areas that must be addressed in developing strategies for sustainable development.

Knowledge
Building a knowledge-base involves gathering information from sources. Both documented and undocumented information is used as well as the findings of science and research.

Research
"How much is too much?" is a question best answered through science and research.
An environment may suffer without any outward sign of injury until a threshold is reached and the environment simply collapses. Scientific evidence can be used to inform legislation that seeks to avoid breaching the thresholds.

Outreach
An important follow-up from science and research is the dissemination of information. The information must be physically accessible to the public through documents, mass media or other communication means. The information must also be applicable to people's lives and scientific and technical documents should also be translated into language that the general public can understand.

For example, a technical document that discusses the effects of nutrients on water quality may place high emphasis on BOD levels. For a rural community that uses this water a BOD level of 500mg/L may mean absolutely nothing. However, if the information reads "overuse of fertilizers results in BOD levels of 500 mg/L and can cause gastro if water is consumed," then the information becomes understandable and relevant.

Nations are unique in their history, resource base, demographics and culture, and thus their development pattern. Therefore, sustainable development needs to be a prominent topic of discourse at all levels in order to generate ideas that work towards its success.

Attitude
Working towards sustainable development involves changing the attitudes of people. First, they must understand what it means and then how individual actions positively or negatively affect it. It is important for governments and civic society organizations to ensure that this is one of their programme areas.

To enable people to make informed decisions it is important that substantial answers be available to their questions. These answers, drawn from the knowledge base created to support sustainable development will help to change old attitudes and habits.

Money is often used as an incentive to change behaviour. However, the shift in attitude should not be based solely on financial reward but be the result of considered, logical thought.

Action

Action comes out of a change in attitude – largely, through changes made by individuals in society. Actions like riding the bus to work instead of driving or reusing the same container for drinking water instead of buying a bottle of water every day work towards sustainability. Deciding to tailor actions that work toward sustainability can be difficult to make unless the actions can be justified, and these can only be justified if the individual knows why it is being done.

The tastes of future generations are uncertain, and, as a result, their needs are uncertain. This challenge, however, must not be used as an excuse for avoiding measures that promote sustainability. Developing sustainably is a collective action, and thus there are individual actions that can work toward sustainable development.

These include,

i. **Consumer choices** – Consumers can choose to purchase products that they know have been certified as "sustainably produced" ***(ACTION)***. As a consumer, it is your duty to inquire about the labour conditions under which the goods were produced. For example, goods that are made in "sweat-shops" should be avoided ***(KNOWLEDGE)***.

ii. **Energy conservation** – a simple, cost-effective means of doing this is to change the bulbs in your house to energy-saving bulbs ***(ACTION)***. Turning off appliances when not in use contributes significantly to energy conservation ***(ATTITUDE & ACTION)***.

iii. **Resource conservation** – a simple action to promote resource conservation is maximizing the use of paper. This can be achieved by recycling unused paper; printing on both sides of the page; and only printing documents when necessary ***(ACTION).***

Acronyms & Abbreviations

ACS	Association of Caribbean States
AIDS	acquired immunodeficiency syndrome
AMEP	Assessment and Management of Environmental Pollution
AOSIS	Alliance of Small Island States
BMI	body mass index
BOD	biological oxygen demand
BPoA	Barbados Plan of Action
CARICOM	Caribbean Community
CAR/ RCU	Caribbean Regional Coordinating Unit
CARSEA	Caribbean Sea Assessment
CBD	Convention on Biological Diversity
CBO	community-based organisation
CEHI	Caribbean Environmental Health Institute
CEPAL	Comisión Económica para América Latina
CETA	Communication, Education, Training & Awareness
CFC	chlorofluorocarbon
CH_4	methane
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CLME	Caribbean Large Marine Ecosystem
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CO	carbon monoxide
CO_2	carbon dioxide
COD	chemical oxygen demand
DDT	dichlorodiphenyltrichloroethane
DTM	Demographic Transition Model
DO	dissolved oxygen
EMA	Environmental Management Authority
GBM	greenbelt movement
GCRMN	Global Coral Reef Monitoring Network
GDI	Gender Development Index
GDP	gross domestic product
GEO	Global Environment Outlook
GHG	greenhouse gas
GIS	geographic information systems
GNP	gross national product
FAO	Food and Agricultural Organisation of the United Nations
GATT	General Agreement on Tariffs and Trade
HDI	human development index
HDR	Human Development Report
HFC	hydrofluorocarbon
HIV	human immunodeficiency virus
ICRAN	International Coral Reef Action Network
ICRI	International Coral Reef Initiative
IISD	International Institute for Sustainable Development
ILO	International Labour Organisation
IMF	International Monetary Fund
IMO	International Maritime Organisation
IMR	infant mortality rate
IPCC	Intergovernmental Panel on Climate Change
IPM	integrated pest management
IUCN	World Conservation Union
LBS	land-based sources
MA	Millennium Ecosystem Assessment
MARPOL	Marine Pollution
MDG	Millennium Development Goal
MOU	memorandum of understanding
NGO	non-governmental organisation
NRA	Northern Range Assessment
N_2O	nitrous oxide
OECS	Organisation of Eastern Caribbean States

PAHO	**Pan American Health Organisation**
PFC	**perfluorocarbon**
SD	**sustainable development**
SF_6	**sulphur hexafluoride**
SIDS	**small island developing states**
SPAW	**Specially Protected Areas and Wildlife**
TSS	**total suspended solids**
UK	**United Kingdom**
UN	**United Nations**
UNCCD	**United Nation Convention to Combat Desertification**
UNCED	**United Nations Conference on Environment and Devlopment**
UNDP	**United Nations Development Programme**
UN ECLAC	**United Nations Economic Commission for Latin America and the Caribbean**
UN ECOSOC	**United Nations Economic and Social Council**
UNESCO	**United Nations Educational, Scientific and Cultural Organisation**
UNEP	**United Nations Environment Programme**
UNEP- CEP	**United Nations Environment Programme- Caribbean Environment Programme**
UNFCCC	**United Nations Framework Convention on Climate Change**
UNGA	**United Nations General Assembly**
UNICEF	**United Nations Children's Fund**
USA	**United States of America**
US EPA	**United States Environmental Protection Agency**
WCR	**wider Caribbean region**
WCS	**World Conservation Strategy**
WFP	**World Food Programme**
WHO	**World Health Organisation**
WMO	**World Meteorological Organisation**
WSSD	**World Summit on Sustainable Development**
WTO	**World Trade Organisation**
WWF	**World Wildlife Fund for Nature**

Environmental and Sustainable Development Terms

Abiotic – Without life. The abiotic elements of an ecosystem constitute its climatic, geological and pedologic (soil) components. [75]

Acid deposition - Any form of deposition on water, land or other surfaces that increases acidity by contamination with acidic pollutants, for example, sulphur dioxide and nitrates. Deposition can be either dry (in the form of particulate matter) or wet (in the form of acid precipitation).

Acid precipitation - Any form of precipitation in which acidity has been increased through the uptake of acid pollutants from the air, such as sulphur and nitrous oxides (the primary source of these pollutants is the burning of oil and coal, as well as other industrial processes). Acid precipitation usually has negative impacts on forest ecosystems through vegetation damage.

Acidification - An increase in hydrogen ions, and/or a decrease in pH of an environmental medium such as soil or water. Acidification can lead to lower soil productivity.

Activated carbon - A highly absorbent form of carbon used to remove odours and toxic substances from gaseous and liquid emissions.

Activated sludge - A sludge containing a high degree of active bacterial mass mixed into primary effluent or raw waste water to eliminate organic material.

Active solar system - A system which collects, transfers or converts solar energy through the use of mechanical equipment which is powered by energy not derived by solar radiation. Solar heaters are an active solar energy system since electrical pumps are utilized to harness the solar energy.

Adverse effect - Change in morphology, physiology, growth, development or lifespan of an organism that results in impairment of functional capacity. Included in this definition is the impairment of capacity to compensate for additional stress, as well as change that results in an increase in susceptibility to the harmful effects of other environmental influences. [8]

Advocacy - Working to influence public policy in social, economic, political and cultural spheres in order to bring about justice and positive change in human rights and environmental issues.

Aeration - The addition of air to water usually achieved by bubbling air through tubes resulting in increased dissolved oxygen (DO) content. Aeration is used in wastewater treatment to promote biological oxidation and to keep activated sludge in suspension.

Aesthetics - The sense of what people consider beautiful or culturally appropriate, varying from individual to individual. [82]

Aerobic - Living or occurring only in the presence of oxygen.

Agriculture - Any form of human activity that comprises utilization of soil for the purpose of growing and harvesting crops meant for human consumption, fibres, energy, livestock production or any other enterprise from which economic benefit is derived.

Agricultural run-off - Water leaving areas of agricultural land use is usually enriched with sediments, nutrients and agricultural chemicals. Agricultural run-off has been identified as a major source of freshwater and groundwater pollution.

Agrochemicals - All synthetic inputs directly or indirectly used in the production of agricultural products or in the maintenance of processing equipment. Included here are pesticides, fertilizers, cleansing substances, detergents and mineral oil products.

Agro-forestry - The intentional combination of agriculture and forestry to create integrated and sustainable land use systems. Agro-forestry includes the intentional use of trees and shrubs on the same land management unit as agricultural products or livestock in some form to create more integrated, sustainable, diverse, productive, profitable and healthy land use systems. Examples include alley cropping, forest farming, silvopasture and wind breaks. [89], [185]

Air filter - A device which is used to remove solid (particulate) and/or gaseous pollutants from the air.

Air pollution index - A quantitative measure that describes ambient air quality, obtained by combining the figures of various air pollutants into a single measurement.

Air pollution – (*See* Pollution, air.)

Air quality standards - Levels of air pollutants prescribed by regulators which may not be exceeded within a specified time in a defined area.

Algae - Primitive non-flowering photosynthetic plant of a large assemblage that includes mainly aquatic forms like seaweed and many plankton.

Algal bloom - The rapid and significant increase in the concentrations of one or a few species of planktonic algae, stimulated by the input of nutrients into a water body.

Ambient concentration - A measure of environmental quality indicating the amount of a certain pollutant (substance) found per unit volume in an environmental medium.

Ambient - The surroundings or surrounding environment. For example, ambient temperature refers to the temperature around a given point. The issue of scale should be taken into consideration when describing something as ambient.

Anthropogenic - Caused by humans.

Aquaculture - The science, and business of cultivating marine or freshwater fish or shellfish. Oysters, lobster, tilapia and salmon have all been reared under the controlled conditions of aquaculture. Usually conducted on “fish farms”.

Aquatic - Consisting of, or relating to water. Organisms living or growing in, on, or near to water are considered aquatic.

Archipelago - A chain or cluster of islands.

Asbestos - A mineral fibre that can pollute air or water and cause cancer. Asbestos is a common form of magnesium silicate used in various construction products due to its stability and resistance to fire. Its extremely fine fibres are easily inhaled, and prolonged exposure to them has been linked to cancers of the lung or lung-cavity lining, and to asbestosis - a severe lung impairment. [65] However, asbestos materials in good condition are safe unless the asbestos fibres become airborne, which happens when materials are damaged.

Atmosphere - The layer of gases surrounding the earth and retained by the earth's gravity. It contains roughly (by relative volume) 78% nitrogen, 20.95% oxygen, 0.93% argon, 0.038% carbon dioxide, trace amounts of other gases, and a variable amount (average around 1%) of water vapour. It is divided into four parts (in order of increasing distance from the surface): troposphere, stratosphere, mesosphere and exosphere.

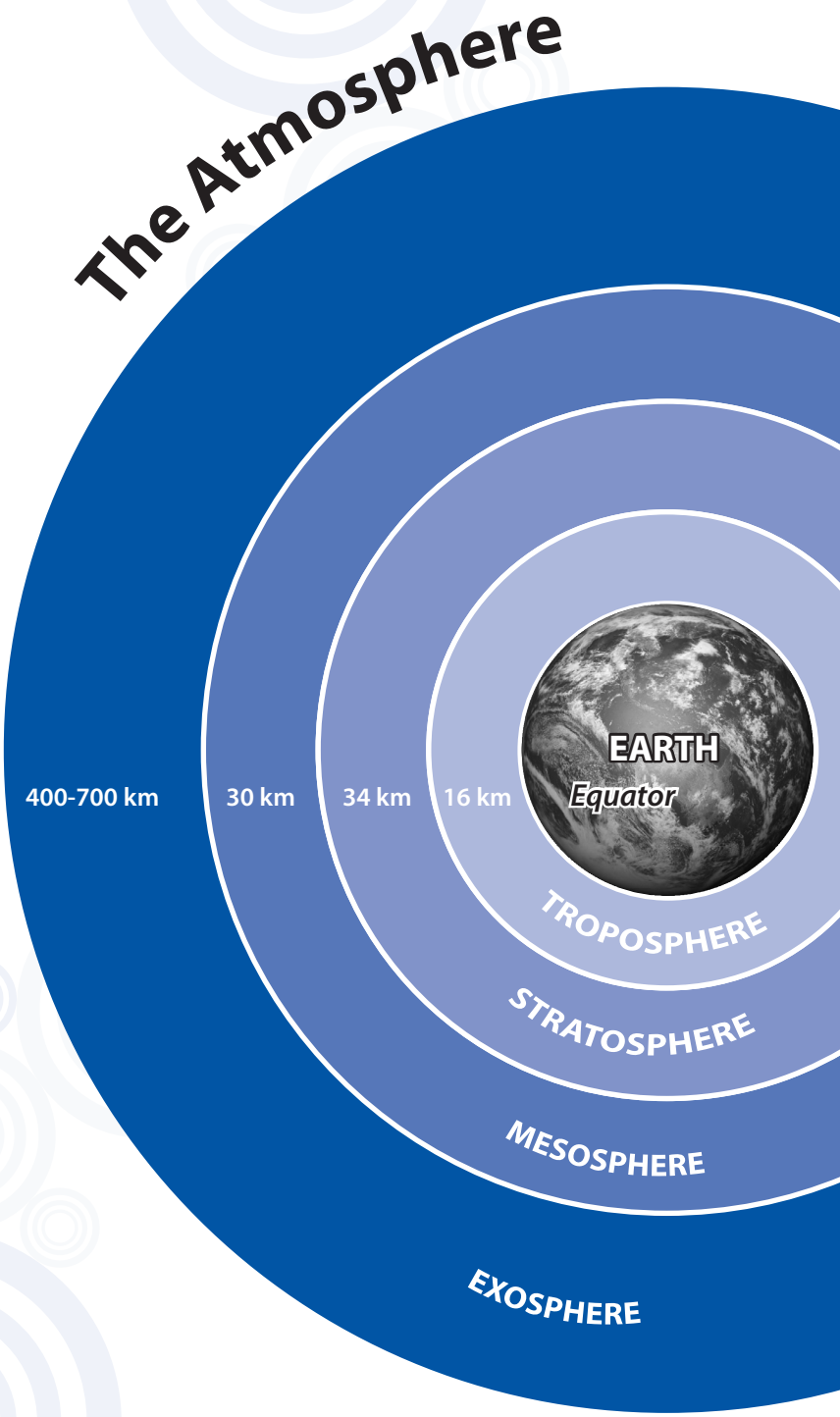


Figure 1

The figure above shows the height of each layer that comprises the earth's atmosphere.

Autotrophs - Organisms that are able to obtain their own energy either from sunlight or from chemicals. [7]

Bacterial denitrification - The reduction of nitrates and nitrites from the soil by denitrifying bacteria that survive under anaerobic conditions in soils.

Bauxite - Claylike mineral containing various proportions of alumina. It is the chief source of alumina. The major Caribbean extractors are Jamaica and Guyana.

Biograss fuel – *See* biomass fuel.

Biomagnification - The bioaccumulation or build-up of substances (such as toxic DDT) up the food chain by the transfer of residues of the substances from smaller organisms to larger organisms which prey on them.

Bio-remediation - The use of biological agents such as bacteria or plants, to remove and neutralize contaminants in polluted soil or water.

Bioaccumulation - The accumulation of a substance, such as a toxic metal, in various tissues of a living organism. For example the accumulation of mercury in marine fish.

Biocontrol – *See* biological pest control.

Biodegradable - The abality of a substance to be broken down by bacteria, microorganisms, or sunlight into basic components. For example, many chemicals, food scraps, organic materials and paper are biodegradable; while plastics and polyester are not. [33], [55], [169]

Biodiversity index - A measure of species diversity expressed as ratios between the number of species and "importance values" (for example numbers, biomass and productivity) of individuals. Common biodiversity indices include total species richness and the Shannon diversity index.

Biodiversity - The variability among living organisms from all sources: terrestrial, marine and other aquatic ecosystems, as well as the ecological complexes of which they are part. Biodiversity includes diversity within and among species (genetic and species diversity) and diversity within and among ecosystems (ecosystem diversity). Biodiversity is considered at three main levels: genetic, species and ecosystem. Diversity is calculated using the formula:

$$D = \frac{N\,(N\text{-}1)}{\sum n_i\,(n_i - 1)}$$

D, Diversity; N, number of individuals; ni, number of individuals in the ith species.

Biofuel – See biomass fuel.

Biogas - A mixture of methane and carbon dioxide in the ratio 7:3 that is produced by the treatment of animal dung, industrial waste and crop residue. Biogas is an alternative renewable source of energy.

Biochemical cycles - The transport and transformation of matter through the earth's atmosphere, hydrosphere, biosphere and lithosphere, via a series of biological, geological and chemical processes

Biological oxygen demand (BOD) - Also biochemical oxygen demand. The amount of dissolved oxygen expressed in milligrams per litre, necessary for the decomposition of organic matter by microorganisms, such as bacteria. Measurement of BOD is used to determine the level of organic pollution of a stream or lake. The greater the BOD, the greater the degree of water pollution.

Biological pest control - The disruption of a pest's ecological status and the reduction of pest populations through the use of organisms which are natural predators, parasites or pathogens (typically involving an active human role).

Biomass fuel (biofuel) - Fuel, for example, methane, produced by renewable biological resources such as plant biomass and treated municipal and industrial waste.

Biome - Biome is the largest unit of ecological classification characterized by distinctive life forms, plant and animal species. Terrestrial biomes are typically based on dominant vegetation structure (for example, forest and grassland). Ecosystems within a biome function in a broadly similar way, although they may have very different species composition. For example, all forests share certain properties regarding nutrient cycling, disturbance and biomass that are different from the properties of grasslands. Marine biomes are typically based on biogeochemical properties. The biome classification of WWF was used in the MA.

Bioprospecting - The exploration of biodiversity for genetic and biochemical resources of social or commercial value. [24]

Bioremediation - This is a treatment that uses naturally occurring micro-organisms (yeast, fungi or bacteria) to break down or degrade hazardous substances into less toxic or non-toxic substances. This type of treatment can be used for clean-up of contaminated soil or water.

Biosphere - The part of the earth including the air, sea surface, rocks and water within which biotic processes and interactions occur

Biotic (of an ecosystem) - Of or belonging to living organisms. The biotic elements of an ecosystem consist of its flora and fauna. [75]

Biotic potential - An estimate of the potential growth a population of living organisms can expect if it were living in optimal environmental conditions. It is often expressed as a percentage increase per year.

Birth rate - The number of live births per 1,000 of a population per year. In 2007, the birth rate for Trinidad and Tobago was 13.7 live births per 1000 persons.

Blue-green algae - These are referred to as cyanobacteria. Like bacteria they are prokaryotic, and the cyano indicates their blue-green nature. Prokaryotes are cells without a well-defined nucleus. [7]

Bottom trawling - A fishing method involving one or more boats dragging a long cone shaped net, called a trawl net, along the sea floor. It is a non-selective method of fishing, and can cause severe damage to seabeds and coral reefs.

Brackish water - Water containing salt concentration significantly lower than that of saltwater but higher than that of freshwater.

Brain drain - The loss of skilled and technical labour from a country or region through the movement of such labour to more favorable geographic, economic or professional environments. In the Caribbean the loss of trained professionals moving to Canada, the US and the UK is a major cause of brain drain.

Carbon dioxide (CO_2) - A colourless, odourless, non-poisonous gas that comes from fossil fuel combustion and is normally a part of ambient air. It is

also a byproduct of respiration of living organisms and is considered to be the main greenhouse gas contributing to climate change.

Carbon Footprint - A representation of the effect human activities have on the climate in terms of the total amount of greenhouse gases produced (measured in units of carbon dioxide).[181] Individual carbon footprints can be calculated based on household conservation of energy, modes of transport, etc. You can measure your personal carbon footprint at http://www.carbonfootprint.com

Carbon Monoxide (CO) - A colourless, odourless, poisonous gas produced by incomplete oxidation of carbon in combustion. CO is a by-product of fossil fuel combustion.

Carbon sink - A reservoir that absorbs or takes up released carbon from another part of the carbon cycle. Forests are often carbon sinks since they absorb more carbon dioxide through photosynthesis than they release through respiration. Oceans are also major carbon sinks.

Carcinogen - A cancer-causing substance or agent. Asbestos, mercury and tobacco smoke are common carcinogens.

Carrying capacity - In ecological terms, the carrying capacity of an ecosystem is the size of the population or community that can be supported indefinitely using the available resources and services of that ecosystem. For example, an ecosystem may have the available food and space to support 100 individuals adequately without the food and space becoming scarce. The carrying capacity of that ecosystem is therefore 100. If the population exceeds 100, food and space will then become scarce, and the population would have exceeded the carrying capacity of the area.

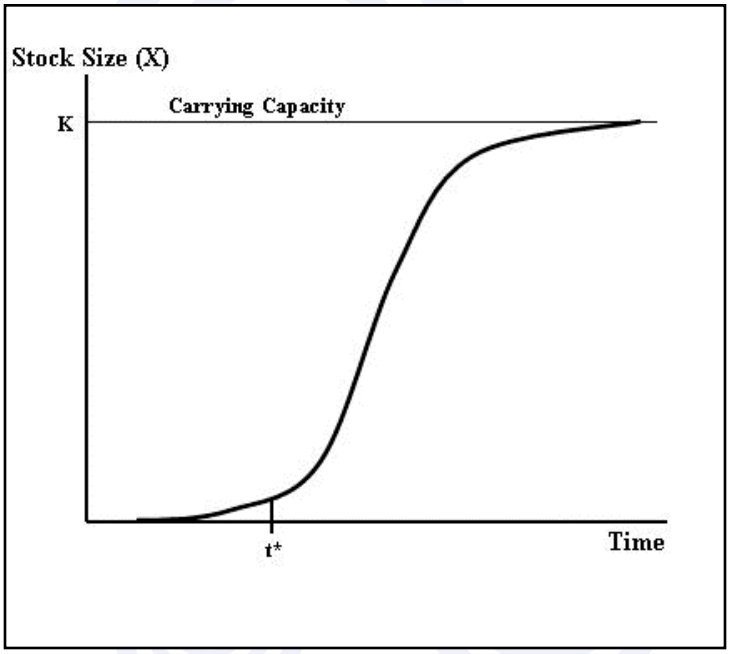


Figure 2

Carrying Capacity

Source: LSU

The stock size X rises with time until the carrying capacity is reached. Upon reaching carrying capacity the stock size can fall below the carrying capacity or rise above the carrying capacity. Technological advancements have allowed the carrying capacity to be increased through greater access to and more efficient use of resources.

Catalytic converter - A device fitted to the exhaust pipe of motor vehicles in order to remove pollutants.

Catchment area - *See* Drainage basin.

Caustic scrubbing - A chemical process for removing sulphur dioxide from flue gases by treating them with sodium hydroxide and lime.

Cesspit - A well or pit where refuse or sewage is stored, usually constructed to be air-tight and non-porous.

Chemical mutagens - *See* Mutagen.

Chemical Oxygen Demand (COD) - The amount of oxygen consumed to completely chemically oxidize organic constituents in water, into inorganic end-products. COD is an important measurable variable for the approximate determination of the organic matter content of water samples.

Cloud forest - Forest in mountainous regions where cloudiness and condensation occur regularly.

Cloud seeding - A technique which promotes rainfall by the introduction of sea salt, dry ice and zinc or silver iodine into clouds.

Coast - Interface between ocean and land, extending seawards to about the middle of the continental shelf and inland to include all areas strongly influenced by the proximity to the ocean. [24]

Combined cycle - An activity in which a power plant or engine uses more than one thermodynamic cycle to reduce energy wastage and improve overall efficiency. For example, electricity plants that use gas turbine generators to produce electricity and then utilize the waste heat to make steam to generate additional electricity.

Commensalism (compare with parasitism and mutualism) - A relationship in which one species profits by an association that the other species finds neither advantageous nor inconvenient. Examples include epiphytic plants like orchids, and insects that live in rodent burrows or bird nests. [80]

Commercial – An activity undertaken for financial profit.

Community (ecological) - An assemblage of species occurring in the same space and/or time, and is often linked by biotic interactions such as competition or predation. More broadly, a community refers to the biotic component of an ecosystem as opposed to an ecosystem's abiotic (chemical or physical) properties or processes. [24]

Community (human, local) - A collection of human beings who have something in common. A local community is a fairly small group of people who share a common place of residence and a set of institutions based on this fact. The word "community" is also used to refer to larger collections of people who have something else in common (for example, national community, donor community). [24]

Competition (ecological) - This involves the struggle of two or more species over the use of the same resource, whether space or food. Competition often exists between organisms at the same trophic level. [80]

Composting - The process of reducing vegetable and animal refuse by controlled decomposition using microorganisms, worms and beetles.

Conservation (ecological) - The action of minimizing human impact on species, communities and ecosystems using practical approaches to prevent the extinction of species and reintegrating species into properly functioning ecosystems. [108]

Conservation (energy) - *See* Energy conservation.

Conservation (habitat) - *See* Habitat conservation.

Conservation (water) - *See* Water conservation.

Conservation biology - The science of analyzing and protecting the earth's biological diversity. Also refers to the application of this science to the conservation of genes, species, populations and ecosystems. [70], [73]

Conservation dependent - Taxa in this category are the focus of a conservation programme, the termination of which will lead to the species becoming vulnerable, endangered, or critically endangered within a period of five years. Also, a conservation status and a category of the IUCN Red list [32], [71]

Conservation status - Refers to the state of a species in terms of raw numbers. Conservation status is an indicator of the likelihood of the survival of a species in the present or into the future.

Conservation - The planned management of a natural resource or ecosystem to prevent exploitation, pollution, destruction or neglect and to ensure the future usability of the resource.

Conservation tillage (no-till farming) - A technique in which soil is only disturbed along the slit or hole into which seeds are planted. [71]

Consumption pattern - "Consumption pattern" is a term often used to describe how much of a resource is utilized and the rate at which it is utilized.

Consumptive use - The use of a resource in a manner that reduces the supply, for example, removing water from a source such as a river or lake without returning an equal amount. [111]

Contact pesticide - A pesticide which kills pests upon contact with the body rather than by ingestion.

Convention – A term used for multilateral agreements with a large number of parties. Conventions are normally open for participation by the international community as a whole, or by a large number of states. [135]

Coolant - A liquid or gas used to reduce the heat generated by various industrial and mechanic processes such as those used for automobile engines and nuclear power generation.

Coral bleaching - The loss of colour from coral due to the stress induced expulsion of symbiotic unicellular active algae caused by various anthropogenic and natural variants in water temperature, chemistry and ecology. Global warming of the atmosphere and sea is associated with increasing levels of coral bleaching. [13]

Coral reef – A large, ridge-like underwater formation created from the exoskeleton of coral polyps. The ridge-like formation is composed of calcium carbonate and takes four principal forms: fringing reefs, barrier reefs, atolls and patch reefs. They form an important marine ecosystem rich in biodiversity, and are also a natural resource. [10]
The Buccoo Reef in Tobago is a fringing reef.

Core-periphery model - An economic and political relationship existing between a more highly developed country or region (the "center") and a lesser developed country or region in contact with it (the periphery). For example, Port of Spain would be a 'core' as compared to the "periphery" areas of Laventille, Belmont, and Woodbrook.

Cost-benefit analysis - An assessment of the direct social and economic costs and benefits of a project or programme to determine its feasibility. It calculates the ratio of projected benefits and costs. .
A project with a high benefit-cost (low cost-benefit) ratio (that is, a project with the most benefits per dollar of cost) is favoured over those with lower ratios.

Coastal lagoons – Shallow water bodies separated from the ocean by a barrier, but connected at least intermittently to the ocean by narrow inlets. Seawater bodies situated at the coast but separated from the sea by land splits or similar land features. Coastal lagoons are open to the sea in restricted spaces.

Coastal zone - Lands and waters adjacent to the coast that exert an influence on the uses of the sea and its ecology, or inversely, whose uses and ecology are affected by the sea.

Counter urbanization - The migration of people from major urban areas to suburban areas resulting in the creation of new urban centres.

Critically endangered – The point at which a species is facing extremely high risk of extinction in the wild. A species is considered critically endangered when the best available evidence indicates a decline in population of at least 80% over the last 10 years or 3 generations (which ever is longer). Also a conservation status and a category of the IUCN Red list. [71]

Crop rotation - The successive planting of different crops on the same land to improve soil quality, reduce soil degradation, and help control insects and diseases.

DDT - Dichloro-diphenyl-trichloroethane is a synthetic pesticide known for its toxic properties, and its detrimental effect on the environment through the processes of biomagnification and bioaccumulation in organisms.

Death rate - The number of deaths per 1,000 of a country's population per year. Trinidad and Tobago's death rate was 8.0 per 1,000 persons in 2005. [163]

Decomposer organism - A bacterium, fungus or insect that breaks down parts of dead plants or animals into simpler substances.

Decomposition – The breakdown of organic matter by decomposer organisms into simpler chemical and physical forms.

Degradation - *See* Environmental degradation.

Delta - A deposit of sediment formed at the mouth of a river or a tidal inlet, generally triangular in shape, for example, the Orinoco Delta located in eastern Venezuela.

Demography - The study of populations that records and analyzes their size, age-sex composition, distribution, density, growth, natality, mortality, nuptiality, immigration, and any other characteristics which may affect these factors.

Demographic transition model (DTM) - A model that describes population change over time.
The DTM was created based on the experiences that industrialized countries of Europe encountered over the course of the past 200 years.The model has been found to be applicable to the development patterns of other countries as well.

Figure 3

Demographic Transition Model

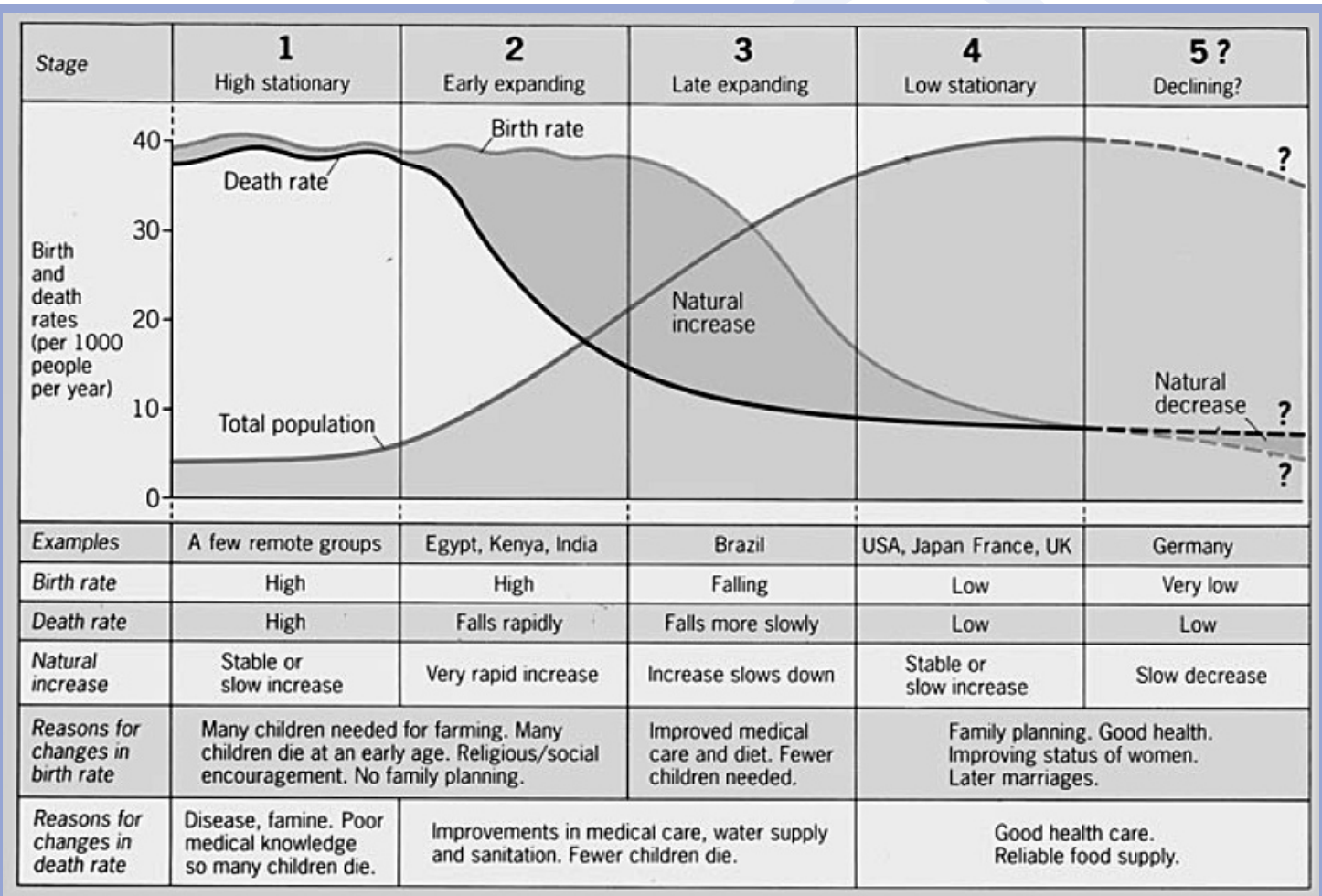
Source: Geographyalltheway.com

Deoxygenation - The removal of dissolved oxygen from a liquid, such as water. (*See* Eutrophication and Dissolved oxygen.)

Dependency ratio - The ratio of persons who are economically dependent on others to the people who provide for them. Population between 0 and 14 years and over 65 years (dependent): Population between the ages of 15 and 64 years (independent).

Depletion - The use or consumption of a resource, especially a natural resource, faster than it is replenished, resulting in a reduction in stock.

Deposit refund systems - A system where a surcharge is placed on the price of potentially polluting products. Deposit refund systems reduce pollution by granting a surcharge for the return of some



The figure above shows how rates of birth, death, and increase of a population vary as a country moves form a pre-industrial to industrialized economy.

products. A simple example is the return of beer bottles for a refund.

Developed nation - A country with a comparatively high standard of living, achieved primarily through social, economic and technological infrastructure. Many European nations, the United States, Canada, Japan, Australia, and New Zealand are referred to as developed, or industrialized nations. [115]

Developing nation - A country with a low standard of living, generally indicated by severe poverty, low income and education levels, high birth rate, and poorly developed social, economic, and technological infrastructure. Many countries in Africa, Asia (except Japan), Latin America, the Caribbean and Oceania (except Australia and New Zealand) are referred to as developing nations. [115]

Direct foreign investment - An investment made to acquire lasting interest in enterprises operating outside of the economy of the investor.

Direct solar power - The single conversion of solar radiation to another form of usable energy. For example, a solar cell converts solar energy directly to electrical energy.

Dissolved oxygen (DO) - The amount of oxygen present in fresh water such as rivers or lakes. The permissible level for dissolved oxygen set by the EMA is 4 mg/ L; DO levels below 4 mg/L indicate a significant level of pollution. i

i **The maximum permissible levels are set within Water Pollution Rules 2001. These standards have been adopted from international standards set by the United States Environmental Protection Agency (US EPA).**

Doctor-patient ratio - The number of patients per doctor in an area. This ratio is sometimes used as a proxy for healthcare in an area, with a high doctor patient ratio indicating good health care.

Domestic - Of or concerning the internal affairs of a nation.

Domesticated - The process by which plants, animals and microbes selected from the wild adapt to a special habitat created for them by humans.

Drainage basin - An area drained by a river and its tributaries. The drainage basin acts like a funnel, channeling all of the precipitation and water in that area towards waterways.

Drainage density - The total length of streams per unit area. The measure of the length of stream channel per unit area of a drainage basin. 100 It is expressed mathematically as: Drainage density (Dd) = Stream length/ basin area. [106]

Ecological integrity (ecological health) - The capacity of an environment to maintain a balanced and well-adapted community of organisms with a species composition, diversity and functional organization comparable to those of natural local habitats.

Ecological niche - *See* Niche.

Ecological systems - *See* Ecosystem.

Economic equalization - A process that attempts to narrow the economic gap between the global rich and poor through intervention in trade markets and the provision of sustainable aid from developed to developing countries.

Economic instruments (conservation context) - Fiscal and other economic incentives and disincentives designed to incorporate environmental costs and benefits into the budgets of households and enterprises. These are used to encourage environmentally sound and efficient production and consumption. Economic instruments include effluent taxes, deposit-refund systems and tradable pollution permits.

Ecosystem - Dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. [24]

Ecosystem assessment – A social process through which the findings of science concerning the causes of ecosystem change, their consequences for human well-being, and management and policy options are brought to bear on the needs of decision-makers. [24] Local examples include the Northern Range Assessment (NRA) and Caribbean Sea Assessment (CARSEA). Both of these were undertaken as part of the larger Millennium Ecosystem Assessment (MA).

Ecosystem boundary – The spatial delineation of an ecosystem, typically based on discontinuities in the distribution of organisms, the biophysical environment (soil types, drainage basins, depth in a water body such as a lake), and spatial interactions (home ranges, migration patterns, fluxes of matter). [24]

Ecosystem processes - An intrinsic ecosystem characteristic related to the set of conditions and processes whereby an ecosystem maintains its integrity (such as primary productivity, food chain, and biogeochemical cycles). Ecosystem functions include such processes as decomposition, production, nutrient cycling, and fluxes of nutrients and energy. [24]

Ecosystem restoration – The process of assisting the recovery of an ecosystem that has been

degraded damaged or destroyed. Reforestation is an example of ecosystem restoration. [76]

Ecosystem services - The benefits people obtain from ecosystems (*See*: MA Conceptual Framework).

Ecosystem stability - The capability of a natural system to apply self-regulating mechanisms to return to a steady state after an outside disturbance.

Ecotone - The transitional area between two adjacent ecosystems or ecological communities.

Ecotourism - Travel to areas of natural or ecological interest, typically under the guidance of a naturalist, for the purpose of observing wildlife and learning more about the environment. The Nariva Swamp and Buccoo Reef are both ecotourist attractions.

Effluent (pollution) - The discharge of processed liquid (usually waste) from a man-made structure, into a larger body of water. The discharge of raw sewage into the ocean from sewage pipes is an example of effluent pollution.

Effluent taxes - Taxes levied on individuals and firms penalizing their effluent discharges into the environment, based on either quantity or quality of discharged material.

Emigration - The movement of people out of an area or country. Emigration usually refers to a permanent outward movement; however, it can also be applied to daily or seasonal movements. [179]

Emission taxes - Taxes levied on individuals and firms penalizing their emission discharges into the environment, based on either quantity or quality of discharged material.

Emission - The act of discharging pollutants into the environment especially the atmosphere, for example the discharge of carbon dioxide from cars and trucks.

Endangered (species) - A species that is not critically endangered but facing a very high risk of extinction in the wild in the near future. A species is considered endangered when best available evidence indicates at least a 50% decline in population over the last 10 years or 3 generations (which ever is longer). "Endangered" is a conservation status and a category of the IUCN Red list. [71]

Endemic species - A species limited to a specific region or locality, for example the West Indian manatee native to Cuba, Haiti, Dominican Republic, Puerto Rico and Jamaica. Local endemic species include the golden tree frog and the West Indian parrot.

Energy conservation - The reduction in quantity of energy utilized by individuals and organizations while maintaining or improving quality of life previously provided by that energy. The use of energy saving bulbs in the home is an example of an energy conservation strategy.

Energy efficiency - Using less energy to achieve the same output or goal. Common household appliances, like refrigerators, are manufactured with different levels of energy efficiencies. [146]

Environmental accounting (national accounts) - The physical and monetary accounts of environmental assets and the costs of their depletion and degradation.

Environmental advocacy - *See* Advocacy.

Environmental costs - Costs associated with the actual or potential deterioration of natural assets

due to economic activities, such as the depletion of natural forest for timber extraction.

Environmental debt - The accumulation of past environmental impacts of natural resource depletion and environmental degradation. The concept that current environmental damages, such as atmospheric or water source pollution will have to be dealt with or reversed by future generations.

Environmental degradation - The deterioration of the environment's quality from ambient concentrations of pollutants and other activities and processes like improper land use, species extinction and natural disasters.

Environmental externality - An economic concept of uncompensated environmental effects of production and consumption that affect consumer well-being and social utility.

Environmental impact assessment - An analytical process that systematically examines the possible environmental consequences of the implementation of projects, programmes and policies.

Environmental management – The control and guidance of human interactions and impacts on the environment, as well as the development of strategies to manage and conserve natural resources. *See:* Conservation.

Environmental Management Authority (EMA) - A statutory body established in 1995 by the government of Trinidad and Tobago, to address and deal with the nation's environmental concerns. The EMA serves as both a regulatory and advisory body to the government of Trinidad and Tobago.

Environmental resistance - The limiting influences of environmental factors on a species that prevents the species from reproducing at its maximum rate.

Erosion - The removal of soil by wind, water, glaciers, waves and by the mass movement of soil down slopes. [176]

Estuary - The area of the river mouth which is affected by sea tides.

Eutrophication – The degradation of water quality due to enrichment by nutrients, primarily nitrogen and phosphorous, which results in excessive plant (principally algae) growth and decay. Eutrophication may be accelerated by human activities such as agricultural runoff. [7]

Evaluation - The process of determining the nature, extent, quality and other characteristics of a thing, a process, a system or a programme.

Evapotranspiration - The combined loss of water by evaporation from soil or surface water and the transpiration from plants and animals.

Evolution - A gradual, directional change in the characteristics of an organism. The process by which one species might arise from another. [7]

Ex-situ conservation - Literally translates as "off site" conservation; the process of protecting an endangered species by removing part of the population and transplanting them to a new location, which may be in the wild or under human care.

Exosphere - The layer of the upper atmosphere that lies between about 480 and 725 km above the earth's surface. The predominant gases are atomic oxygen, helium, and hydrogen, about 1% of which are ionised. [4]

Exotic species - A species occurring in an area outside its historically known natural range as a result of accidental dispersal by humans. Also referred to as introduced or alien species. [7]

Externality - A situation in which an individual or firm takes the action but does not bare all the costs (a negative externality) or receive all the benefits (a positive externality). For example, a firm produc-

es atmospheric pollution but does not bare the cost of health-care and other problems caused by their pollution; the cost of health care and other problems of pollution becomes an externality to those persons who must bear these costs.

Extinct - A species is extinct when there is no reasonable doubt that the last individual of that species has died. "Extinct" is a conservation status and a category of the IUCN Red list. [71]

Extinct in the wild – When a species is only known to survive in cultivation, in captivity or as a naturalized population well outside its past range. "Extinct in the wild" is a conservation status and a category of the IUCN Red list. [71]

Fauna – All the animal life occurring in an area or time period, including mammals, reptiles, arthropods, nematodes, bacteria and some microorganisms.

Fen - A low-lying area of soft waterlogged ground and standing water; a type of bog or marsh.

Fertility rate - *See* Total fertility rate.

Field capacity - The amount of water held in a soil after excess water (removed by gravity) water has drained away.

Firm - A commercial partnership of two or more persons.

Fish kill - The mass death of freshwater or marine organisms – particularly fish - in a localized region.
Flaring - The burning of waste gases through a flare stack or other device before releasing them into the air. The practice is usually carried out on industrial estates.

Flora - All the plant life occurring in an area or time period, especially naturally-occurring or indigenous plant life.

Flue gases - The vented air coming out of a chimney after combustion in a furnace, burner boiler or steam generator. It can include nitrous oxides, carbon oxides, water vapor, sulphur oxides, particulate matter and other chemical pollutants.

Fluorocarbon - A liquid or gaseous halocarbon compound used as an aerosol propellant, as well as in the manufacture of refrigerants, solvents and lubricants. Fluorocarbons are a major contributor to the destruction of the ozone layer in the stratosphere.

Food chain - A sequence of organisms, each of which uses the next lower member of the sequence as a food source.

Food web - A series of interlinked food chains.

Forest - Generally an area with a high density of trees that can be natural or artificial. A few examples of naturally occurring forests in the Caribbean are: upper and lower Montane, evergreen broadleaf rainforest, semi-evergreen moist broadleaf rainforest, mangrove, deciduous broadleaf, and sclerophyllous dry forest.

Freshwater - Defined as water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids. Generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses. [172]

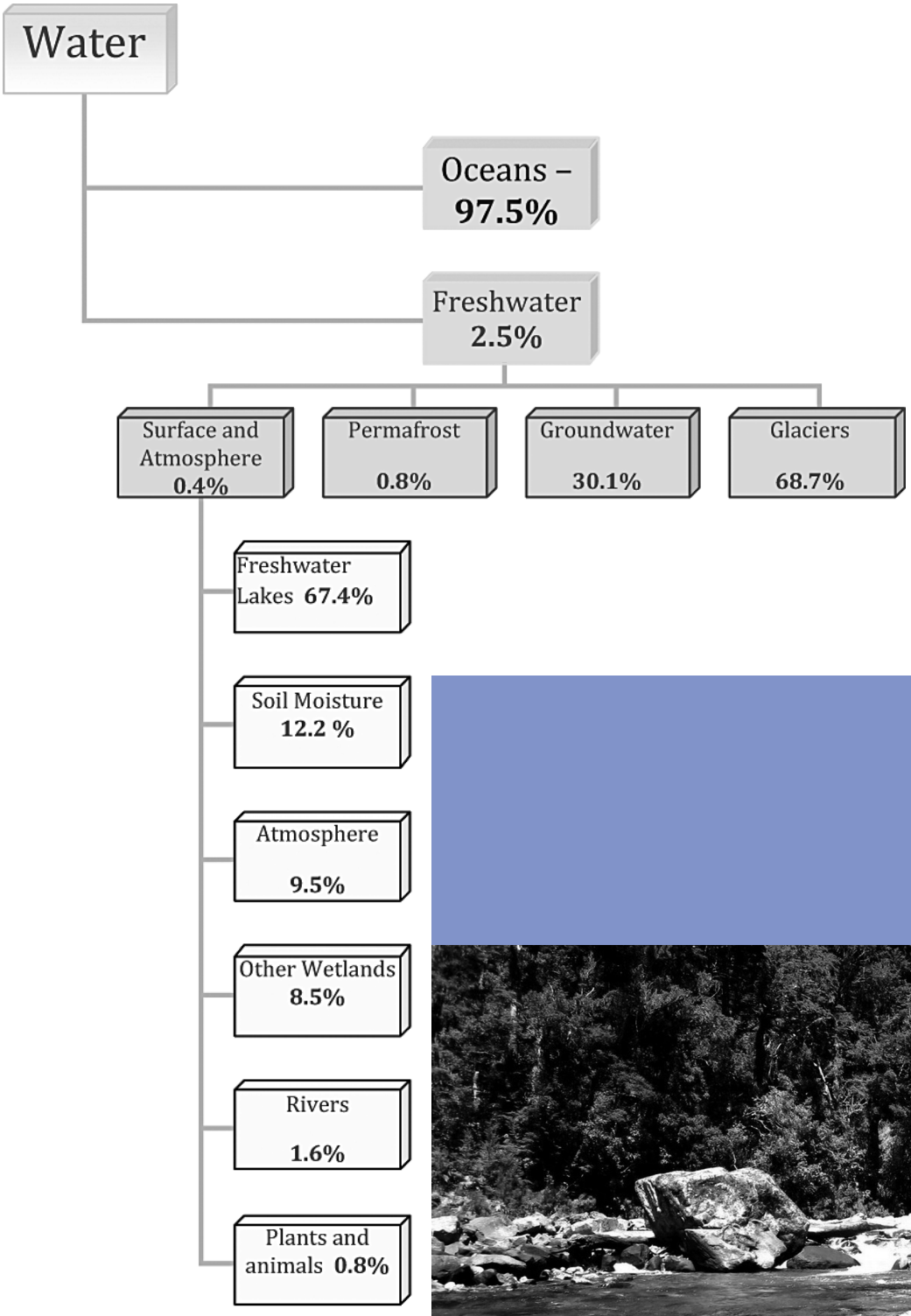


Figure 4

Source: GEO4

The figure shows the distribution of water on a global scale. Note that only a very small amount of the total water available on the earth is freshwater.

Fundamental niche - The niche breadth or area that a species would occupy in the absence of competitors or predators. [7]

Gender Development Index (GDI) - The GDI was developed by the UN to be used as an indicator of the standard of living in a country. The index measures the inequalities between men and women in the following areas; life expectancy, standard of living, adult literacy and enrolment at the primary, secondary and tertiary levels.

Genetic engineering - Scientific alteration of the structure of genetic material in a living organism. The alteration is physical as opposed to the reproductive alteration of the genetic material of living organisms. This type of engineering is used to improve the yields and robustness of certain agricultural crops.

Geographic information system (GIS) - A system that integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows one to view and interpret data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports and charts. GIS data outputs are used by a number of specialists including land-use planners, conservationists and ecologists.

Geological hazard - Extreme natural events in the crust of the earth that pose a threat to wildlife and property. Examples include earthquakes, tsunamis, volcanic eruptions and landslides.

Geothermal energy - Thermal energy contained in the earth that can be used directly to supply heat or can be converted to mechanical or electrical energy.

Germicide - An agent that kills germs, especially pathogenic organisms.

Global commons - Natural assets that exist outside of national jurisdiction, such as the oceans, the Antarctic and outer space.

Global warming - A phenomenon believed to occur due to the build up of carbon dioxide and other greenhouse gases cased by human activities. Currently global warming is potentially the largest global environmental threat. This phenomenon is studied by the IPCC.

Globalization - The greater movement of people, goods, capital and ideas within and between countries due to increased economic integration, improved technologies and a reduction in trade barriers. Globalization provides many opportunities and challenges for which countries must make policies and decisions to maximize the benefits and minimize the challenges. [51]

Governance - The manner in which society exercises control over resources. It is exercised, for example, through systems of law, property rights and various forms of social organization. [146]

Green GDP - An adjustment of traditional GDP made by deducting resource and environmental costs associated with economic activity. For example, if Trinidad and Tobago's GDP in 1999 was five billion dollars and environmental costs due to forest loss was valued at one billion dollars, the country's green GDP in 1999 was four billion dollars. This type of GDP had the potential to improve environmental protection and rational resource utilization.

Green revolution - A period of significant increase in agricultural productivity resulting from the introduction of high yield varieties of grains, the use of pesticides, and improved management techniques. The green revolution occurred between 1940s and 1960s largely in response to an eminent global food shortage.

Greenhouse effect - Trapping of solar heat in a planet's lower atmosphere due to the greater transparency of the atmosphere to visible radiation from the sun than to infrared radiation from the planet's surface. Atmospheric radiation is emitted to all sides, including downward to the earth's surface. Greenhouse gases trap heat within the surface-troposphere system. This is the natural greenhouse

effect. Without the greenhouse effect, life on this planet would probably not exist as the average temperature would be about -18°C, rather than the present 15°C. [68]; [105]

Greenhouse gases – Gases like carbon dioxide, methane, nitrous oxide, ozone, chloroforocarbons and other gases occurring naturally and resulting from human production which gases contribute to the greenhouse effect. Recent trends have indicated that some of these gases (carbon dioxide, methane) have increased beyond their ambient levels in the atmosphere, and these increases have been cited as possible causes of global warming.

Gross Domestic Product (GDP) - The market value of all final goods and services produced within a given country in a given period of time. Final goods are those that are consumed rather than used to make another product. For example a car is a final good. GDP is measured as total consumer investment and government spending, plus the value of exports, minus the value of imports.

Gross National Product (GNP) - The total value of all final goods and services produced by a country's factors of production and sold on the market at any given time period. It is measured as the gross domestic product (GDP) plus income earned by domestic residents from foreign investments minus income earned by foreign investors in the country's domestic markets. GNP is essentially the wealth of the country and is important as an indicator of the strength of an economy.

Groundwater - All water found beneath the surface of the ground which is not chemically combined with any minerals present. Underground streams are not considered groundwater. [46]

Groundwater depletion - Long-term drop in the level of a water table caused by sustained groundwater pumping. Groundwater depletion usually follows a situation in which groundwater removal occurs faster than its replenishment. [46]

Guano - A substance composed chiefly of the dung of sea birds or bats, accumulated along certain costal areas or in caves and used as fertilizer.

Habitat – The natural physical environment in which an organism or ecological community normally lives or occurs.

Habitat conservation - The protection of various habitats to prevent the extinction, displacement and reduction in a range of various species.

Habitat destruction - A change in land-use from one that supported a habitat to one that does not. In the process, animals and plants that previously used the site or habitat are destroyed or displaced. Habitat destruction has been identified as a major cause of species extinction. Habitat fragmentation is one type of habitat destruction.

Habitat diversity - The variety or range of habitats in a region. (*See* Biodiversity.)

Habitat fragmentation - The process in which a large, continuous area of habitat is both reduced in area and divided into two or more fragments. The fragments are often isolated from one another by a highly modified or degraded landscape. Dispersal of animals and plants is severely affected by fragmentation. [108]

Hard water - Water that contains certain salts that form insoluble deposits in boilers and forms precipitates with soap, preventing it from lathering. Much of Barbados' water is hard because of its limestone landscape.

Hazardous substance - Any substance that poses a threat to human health or the environment. A hazardous substance can be corrosive, toxic, ignitable, explosive or chemically reactive.

Haze - A phenomenon by which atmospheric visibility is reduced due to the presence of particulate matter, usually pollution, in suspension.

Health - A state of complete physical, mental and social wellbeing and not merely the absence of disease or sickness.

Heat island - An area - usually metropolitan - that consistently has higher temperatures than surrounding areas due to a greater retention of heat by materials like concrete, asphalt and metal.

Heat sink - An environment capable of absorbing heat from a source with which it is in thermal contact. For example, a large body of water in contact with warmer air is a heat sink.

Heavy metal - Potentially toxic metals used in industrial processes, for example, arsenic, copper, lead and mercury. They may damage plant and animal life at low concentrations and tend to accumulate in the food chain.

Human capital - Productive wealth embodied in labour, skills, experience, education, and knowledge of a population. It is a measure of the economic value of a population.

Human Development Index (HDI) – A summary measure of human development that is published by the United Nations Development Programme.

Human development – Creation of an environment in which people can realize their full potential and lead productive, creative lives in accord with needs and interest. An important aspect of human development is expanding the choices that people have. These choices include access to resources, education, health and security. [122], [138]

Hydropower - The generation of electricity utilizing the power embodied in falling water. This is a major renewable source of energy.

Hydroelectric – The type of electricity generated through the conversion of the energy of running water to electrical energy.

Hydroponics - The cultivation of plants in soil-less mineral solutions. The roots of the plants are immersed in the mineral solution. [83]

Hydrosphere - The collective mass of water found on, under and over the surface of the earth. It includes water in oceans, rivers, lakes, groundwater, ice caps, glaciers, ice sheets, clouds and water vapour.[165] The total volume of water in the hydrosphere never changes, but transfers between the different water bodies cause individual volume changes. For example, during an ice age, there is less water in the ocean than during an interglacial period (that is, the span between ice ages). In the interglacial period, less water frozen into glaciers means more in the ocean.

Immigration - The movement of people into an area or country. Immigration usually refers to a permanent inward movement, however, it can also be applied to daily or seasonal movements. [179]

In situ conservation - This phrase literally translates as "on site" conservation. It is the process of protecting an endangered species in its natural habitat by protecting or cleaning up the habitat, or by directly protecting the species from predators.

Incentive - A tangible or intangible reward that motivates effort, behaviour, and action. (*See* Economic instruments.)

Indirect solar power - The transformation of solar energy to another form of usable energy involving multiple transformations of energy. Biomass is a form of indirect solar power since solar energy is transformed into the chemical energy of plants and then combusted to produce heat energy.

Indigenous - Native; originating in or characterizing a particular country or region.

Industrial effluent - *See* Effluent.

Industrialization - The process by which manufacturing industries develop within a typically agrarian or underdeveloped economy.

Infant mortality rate (IMR) - The ratio of the number of deaths among children younger than one year old during a given year, to the number of live births during the same year. The IMR of Trinidad and Tobago is 18 deaths per 1,000 live births. [163], [182]

Inflation - The rate at which the prices of goods and services may rise or fall, and the changes in purchasing power consequent to this movement. For example, if the inflation rate is 10% from 2006 to 2007 a pencil costing $1.00 in 2006 will cost $1.10 in 2007.

Informal economy (sectors) - Employment which is not formally recognized; workers generally do not have contracts, fixed hours or employment benefits. Examples include street vendors and small-scale agriculture food vendors.

Inorganic pesticides – These are pesticides that are not formed from living things or the remains of living things. Inorganic pesticides used for agricultural pest control include compounds like sulphates, arsenates, chlorides of lead and copper.

Institution - Regularized patterns of interaction by which society organizes itself: the rules, practices and conventions that structure human interaction. Formal institutions include law, international agreements, bylaws and memoranda of understanding. Informal institutions include unwritten rules, codes of conduct and value systems. [146] An institution is also defined as a society or organization founded for a particular purpose, for example charitable, religious, educational or social purposes. [43]

Integrated pest management (IPM) - A technique for agricultural disease and pest control that combines information on the life cycle of pests and their interaction with the environment, with pest control methods. IPM manages pest damage by the most economical means, and with least possible hazard to people, property and the environment. [11], [171]

Intensive agriculture - Agricultural practices that produce a high output (yields) per unit area, usually by intensive use of labour and capital. Capital includes manure, agrochemicals and mechanization. Intensive agriculture is usually a feature of small-scale subsistence farming.

Invasive species - A non-indigenous species whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. [96]

Isobar - A line joining areas of equal barometric pressure on a map.

Isotherm - A line joining points of equal temperature on a map.

IUCN Red list - This list evaluates the varying levels of extinction risk of most documented species and sub-species by classifying them using their conservation status. [73]

Land capability - The potential of land for agriculture and/or forestry depending on its physical and environmental qualities. [47]

Landfill - The final placement of waste in or on land in a controlled or uncontrolled manner according to different sanitary, environmental protection and other safety requirements.

Land use classification - Identification and analysis of land according to its use. Categories include agricultural, industrial, residential and recreational.

Least concern - Taxa which do not qualify for the Conservation Dependent or Near Threatened category. Also a conservation status and a category of the IUCN Red list. [71]

Legislation - A proposed or enacted law or group of laws.

Life expectancy - Statistically, the average number of years a newborn is expected to live, often calculated by geographic region and gender. According to WHO, Trinidad and Tobago's life expectancy in 2007 was 67/74 (M/F).

Limestone scrubbing - A process which removes sulphur dioxide from flue gases by passing them through a limestone and water solution.

Liming - Addition of lime (type of alkaline substance) to water or soil to reduce the effects of acid deposits.

Limiting factor - Any factor that tends to inhibit

growth or activity of an individual or a population, either by being less than or exceeding the level necessary for normal growth and activity. [116]

Lithosphere - The lithosphere is the solid outer part of the earth, including the crust and uppermost mantle. The lithosphere is about 100 km thick. However, its thickness is age dependent (older lithosphere is thicker). [176]

Livelihood - Means of living or supporting oneself.

Mangal - The plant community and habitat where mangroves thrive.

Mangrove - Evergreen trees and shrubs that grow in dense thickets or forests along tidal estuaries, in salt marshes, and on muddy coasts in the tropics and subtropics. The name also refers to the vegetal communities formed by these plants. The mangrove is important as (but not limited to) a buffer against erosion and storm surges, a natural resource, a habitat, a source of biodiversity, and as a fishery. [177] Mangroves occur locally in the Caroni and Nariva Swamps and Bon Accord lagoon.

Mariculture - Harvesting of marine organisms through ocean fishing.

Marine - Of or related to the sea. Native to, inhabiting or formed by the sea. [117]

Marsh - A type of wetland often described as a costal wetland, featuring marine grasses, rushes and reeds. Marshes may be fresh water or saltwater and tidal or non-tidal.

Maximum sustainable yield - The highest output a renewable resource can sustain without impairing its renewability through growth or replenishment. It is an essential concept to sustainable use of renewable natural resources.

Mechanization (agricultural) - The use of machinery in agricultural production.

Mercury - A highly toxic and carcinogenic heavy metal that can accumulate in the environment. (*See* Bioaccumulation.)

Mesosphere - The layer of atmosphere that lies above the stratosphere. Its lower boundary is about 50 km above the surface of the earth and it extends to a height of 80 km. [3] This layer is capped by the mesopause.

Microclimate - The climatic structure of a small, local area. The term is used on a variety of scales, for example the Arena Forest in Trinidad creates a microclimate, while each tree that comprises the forest creates its individual microclimate.

Mineral - A naturally occurring substance formed by geological processes with unique chemical composition and characteristics. Valuable minerals found in the Caribbean include gold (Guyana), platinum, bauxite (Jamaica), and granite (Suriname).

Mining of minerals and beach sand - Mining involves a process of extraction, concentration and smelting of economic minerals from a mineral deposit. The process includes exploration for mineral deposits, construction of the mine, extraction of minerals and processing of mineral ores [93] In the Caribbean, mining is done in Jamaica (bauxite), Trinidad (gravel and sand) and Guyana (gold).

Mixed cropping - A system of cultivating multiple crops, usually two or three on the same land. Crops that have a mutualistic relationship are often planted together.

Mixed farm - A farm on which both agricultural production and livestock-rearing are practised simultaneously.

Monitoring - Continuous or frequent standardized measurement and observation of the environment (air, water, land/soil, biota) often used for warning and control.

Monoculture - The repeated cultivation of a specific crop on a given piece of land. Advantages include increased efficiency of farming and higher output quality. Disadvantages include increased disease susceptibility, increased soil degradation, gradual loss in biodiversity and increased susceptibility to

price fluctuations.

Moral suasion - A persuasion tactic used by an authority to influence and pressure -- but not force -- firms and individuals into adhering to policy. The tactic focuses on someone's beliefs and ideas of what is right and wrong, and uses these to influence that individual's decisions. For example, one of the ways to promote sustainable development is to ask people to consider their moral obligation to ensuring that future generations have available resources to meet their needs.

Mortality rate - *See* Death rate.

Mulch - A layer of material consisting of organic matter like straw, leaves, peat or wood chips placed over the soil to trap moisture, prevent weed growth and protect soil.

Municipal - Properties, goods, and services owned or operated by a city or county government. Landfills and sewage treatment plants are common examples of municipal services. [169]

Mutagen - An element, substance, or agent such as a chemical, ultraviolet light or radioactive element which can induce or increase frequency of mutation in an organism and its offspring. For example, nitrous acid and radiation. See Carcinogen.

Mutualism (compare with parasitism and commensalism) - A reciprocally beneficial association between two species that otherwise lead independent lives. One of the partners plays a role that provides a service to its associate, and because it receives compensation in return, it finds an advantage in the association. Insects and flowers often display a mutualistic relationship. [80]

National debt - The amount of money a nation's government owes to anyone including its own citizens.

Nationalization - The act of transferring various sectors of the economy from the private sector to the public sector. Also known as de-privatization.

Natural Assets - The assets of the natural environment; consists of biological assets (produced in the wild), land and water areas with their ecosystems, subsoil assets, and air.

Natural disaster - A natural event that results in widespread destruction of property or causes injury or death to humans, animals or plants.

Natural hazard - An unexpected or uncontrollable natural event of unusual magnitude that threatens the activities of people, property and the people themselves.

Natural increase - The growth of a population brought about as births exceed deaths.

Natural increase rate - A rate of population growth calculated by subtracting the crude death rate from the birth rate expressed as a percentage. A measure of population growth that excludes migration.

Natural resource - Actual and potential forms of wealth supplied by nature, such as minerals, fossil fuels, soil, freshwater, forests, wind energy, solar energy, beaches and arable land.

Natural selection - The reproductive success of different individuals in the face of the constraints placed upon them by their environment. Less fit individuals fail to reproduce and their genes are lost from the gene pool. The persistence of some insects over thousands of years is a result of natural selection. [7] Charles Darwin's theory of evolution was based on the principle of natural selection.

Near Threatened - Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme, the cessation of which would result in the taxon qualifying for one of the IUCN threatened categories within a period of five years. Also a conservation status and a category of the IUCN Red list. [71]

Net above-ground productivity - Accumulation of biomass in the above ground parts of plants (trunk, branches, flowers, leaves and fruits) over a specified period.

Niche - The status and environmental role of an organism within its environment and community.

Nominal GDP - A gross domestic product (GDP) figure that has not been adjusted for inflation. (*See* Gross Domestic Product.)

Non-consumptive use - The use of a resource that does not reduce its supply. For example, the use of sunlight for solar energy is non-consumptive.

Non-point source of pollution - Pollution sources that are diffused and without a single point of origin. They are difficult to identify spatially.

Non-renewable resources - Exhaustible natural resources- such as mineral resources and fossil fuels - that cannot be regenerated after exploitation. Petroleum is an example of a non-renewable resource.

Nutritional status - The levels of nutrients in the body and the ability of those levels to maintain normal metabolic activity. For adults, nutritional status is measured using body mass and height commonly expressed as Body Mass Index (BMI). For children, comparisons of weight-height-bone development and head circumference are compared to standard data of adequately nourished children.

Optimum population - A theoretically perfect situation in which the population of an area can develop its resources to the greatest extent and achieve maximum output while enjoying the highest possible standard of living.

Ore - A mineral from which a valuable constituent, especially a metal, can be profitably extracted. In the Caribbean, bauxite is an ore mined for aluminum.

Over-population - A situation in which a certain limit of population density is exceeded and environmental resources fail to meet the requirements of individual organisms. This can give rise to high rates of mortality and morbidity.

Over-exploitation - The unsustainable use of resources through over-harvesting, over-fishing, and over-extraction of raw materials without considering the long-term ecological impacts of such use. [155] Overexploitation of resources contributes to a reduction in the diversity of animal and plant species, as well as a reduction in overall numbers of species.

Ozone - The triatomic form of oxygen existing as a gaseous atmospheric constituent. In the troposphere it is created both naturally and by photochemical reactions involving gases resulting from human activities. In high concentrations, tropospheric ozone can be harmful to a wide range of living organisms. Stratospheric ozone is of particular importance because depletion of this results in increased ground-level flux of ultraviolet-B radiation, which is harmful to humans. [170]

Particulate matter - Material suspended in the air in the form of minute solid particles or liquid droplets. The term is often used to describe atmospheric pollutants.

Parasite - An organism that is metabolically dependent on another at the expense of the host. [7]

Parasitism (compare with commensalism and mutualism) - A type of relationship in which an organism (the parasite) profits from its host. Parasites divert a portion of the resources normally intended for the growth, survival and reproduction of the hosts and use them for their own benefit. [80]

Passive solar energy - Solar energy collected and transferred predominantly by natural means, such as natural radiation, convection and conduction without the assistance of mechanical equipment powered by other energy sources.

Pathogen - An agent that causes diseases. Microorganisms like bacteria or fungi are examples of pathogens.

Penalties - The money or cost firms and individuals pay for infringing on legislation related to environmental damage.

Per capita - For each person. For example, a government may allocate $500 per capita for health care; this means that each individual in the society will have $500 to spend on health care.

Per capita income - The total national income divided by the number of persons in a nation. Often used as a measure of wealth in a nation - particularly in comparison to other nations - usually to reflect the level of development. A factor considered in the HDI.

Percentage literacy - The percentage of a country which is literate. It is used as a measure of a country's or region's overall development and quality of human capital.

Persistence (chemical influence) - Persistence is the ability of a chemical substance to remain in an environment in an unchanged form. The longer a chemical persists, the higher the potential for human or environmental exposure to it. The environmental media for which a chemical's persistence is usually measured or estimated are air, water, soil, and sediment. [167]

Pest - Species, virus, bacteria, as well as other microorganisms considered harmful to the health of human beings, crops and other living organisms.

Photochemical smog - A type of fog that forms when chemical reactions involving nitrous oxides and hydrocarbons take place in the presence of sunlight. Ozone and other oxidants are produced by the chemical reactions and form the main component of the smog. [89]

Photovoltaic cells - *See* Solar cell.

Phytoremediation - The use of plants and trees to remove and neutralize contaminants, as in polluted soil or water.

Point source - A source, especially of pollution and radiation, located at an identifiable point in space and occupying a small area.

Pollutant - Any substance that causes harm to the environment when it mixes with soil, water or air. [146]

Pollution - The introduction of pollutants into the environment usually through the contamination of soil, water or the atmosphere. Pollution results in various detrimental effects such as endangering human beings, damaging ecosystems, living resources, and natural resources.

Pollution abatement - Technologies applied or measures taken to reduce pollution and/or its impact on the environment.

Pollution, Groundwater - A form of water pollution on groundwater caused mainly by the infiltrations and percolation of surface contaminants into the soil.

Pollution, Air - The presence of a contaminant, particulate matter, chemical or biological agent that modifies the natural characteristics of the atmosphere. Air pollution interferes with human health and welfare and produces other harmful environmental effects.

Pollution, Marine - Direct or indirect introduction by humans of substances or energy into the marine environment (including estuaries) resulting in harm to living resources, hazards to human health, hindrances to marine activities (including fishing), impairment to the quality of sea water and reduction of amenities.

Pollution, Microbiological Water - A form of natural water pollution caused by microorganisms that have an adverse effect on human health as well as marine and terrestrial organisms. [178]

Pollution, Thermal - A change in temperature of natural water bodies due to anthropogenic influences which can affect the health of aquatic ecosystems. This type of pollution is generated mainly by the discharge of heated effluents from industrial processes, such as aluminum smelters, electric power generation and atomic power stations. [132]

Pollution, Water - The impairment of water quality by agricultural, domestic or industrial waste to a degree that the natural water quality is changed. When sufficient amounts of waste accumulate, they can create or pose a potential threat to human health or the environment. [169] Examples include sedimen-

tation from runoff, discharge of industrial effluents into the Gulf of Paria, and discharge of untreated sewage into the Caroni Swamp.

Population (biological) - A group of individuals of the same species occupying a defined area at a particular time. Populations can be spatially isolated and adapted to local environments.

Population (human) - A collection of people living in an area.

Population control – The management of population growth rates. It is usually practiced as a way to reduce population growth. Population control can be achieved through various initiatives - governmental and non-governmental - and mainly involves attempts to reduce birth rates.

Population density - The total number of inhabitants per square unit of surface area.

Population growth rate - The change in population over a specific time period expressed as a percentage of the number of individuals in the population at the beginning of that period. Growth rate = [(births + immigration) - (deaths + emigration)]/total population.

Population growth - The change in population over time, measured as the change in the raw total number of individuals per unit time.

Poverty - The pronounced deprivation of well-being. [146] The aspect of poverty most often considered is the lack of money necessary for meeting basic needs. However, poverty also includes lack of freedom and choices, opportunities, security.

Primary economic activity (industry) - Economic activity such as fishing, forestry, mining and quarrying concerned with the direct extraction of natural resources.

Primary producer (ecosystems) - These represent the first stage in fixing the sun's energy through photosynthesis. Most plants are primary producers. [7]

Process chemicals - Products that are primarily sold to the process industry, such as nitric acid and ammonia. [76]

Productivity (ecology) - The rate at which radiant energy is used by producers to form organic substances as food for consumers.

Productivity (economics) - The rate at which goods and services are produced, especially output per unit of labour.

Protected area - An area of land or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means. [70]

Protected area systems - A series of six protected area management categories or systems based on the primary management objectives for the area as defined by IUCN. For example, one of the protected area systems is the "Wilderness Area"; the primary management objective of this area is protection of wilderness. [104]

Purchasing power - The power of a currency expressed in terms of the amount of goods and services that one unit of money can buy.

Quaternary economic activity - Economic activity concerned with information, its acquisition, manipulation and transmission. Examples include law, finance, education, research and the media.

Range of tolerance - The optimal range of an abiotic factor in which a population thrives, beyond this range the population begins to decline.

Rates of degradation - *See* Environmental degradation.

Ratification - At the international level indicates to the international community a state's commitment to undertake the obligations under a treaty. [135] When a state ratifies a treaty it is bound to the obligations of that treaty.

Realized niche - The niche breadth or area that a species is restricted to in the presence of competing species. [7]

Reforestation - The practice of planting or restocking existing forests and woodlands which have been damaged or depleted with the native vegetation species.

Rehabilitative conservation - The attempt to restore land which has been altered by some process (industry, hurricane, mining) to its former environmental state.

Renewable natural resource - A natural resource that, after exploitation, can return to previous stock levels by a natural process of growth or replenishment, for example, fisheries.

Replacement rate - The number of children that need to be born to balance the number of people who die. Globally, the replacement rate is 2.1 children per woman. [179]

Residence time - The average time a substance spends within a system in equilibrium or in a specified region of space.

Residual - A pollutant or substance that is not further utilized and remains in the environment after a natural or technological process has taken place.

Resilience - The capacity of a natural system to recover from a disturbance.

Rostow's model - A model of economic development proposed by US economist, Walt Rostow in 1960. Rostow suggests that countries pass through five stages of development, namely: traditional society, transitional stage, take-off, drive to maturity and high mass consumption. [114]

Salinization (of soil) - Deposition of hard crusts of salts on the soil surface by upward capillary action. Salinization is a problem in many irrigated areas particularly where evaporation rates are high. It usually occurs in dry climates and is a characteristic of desert soils. [179]

Sanitary landfills - Lands that have been rehabilitated after being used as a site for burying garbage and trash.

Scrubber - An air pollution control device or system used to remove particulate matter or gases from industrial exhaust and emissions. Usually located in chimneys, some scrubbers utilize a spray of water or chemical reagent to remove or reduce the concentrations of unwanted chemicals being emitted.

Sea grass - A generic name for flowering plants from four plant families that colonize soft-bottomed areas of the ocean mainly in the tropics but up to temperate zones. Sea grass is important as nurseries and habitats for fishes and invertebrates, food sources, sediment traps, sources of biodiversity and natural resources. [24], [84]

Sea grass beds - An ecosystem comprising mainly of underwater thickets of various sea grass species and associated organisms.

Sea level - The height of the ocean's surface midway between high and low tide.

Secondary air pollution - Pollution not directly emitted into the atmosphere, but caused by reactions in the air already polluted by primary emissions, for example, petrochemical smog.

Secondary economic activity (industry) - The creation of finished products from raw materials. Manufacturing and refining are types of secondary economic activities.

Secondary producers - These are consumers that derive their energy from eating primary producers. Herbivores are secondary producers. [7]

Sedimentation - The deposition or settling of matter to the bottom of a liquid or body of water.

Signature (of treaty) – This can be of two types: definitive signature and simple signature. Definitive signature occurs where a state expresses its consent to be bound by a treaty by signing the treaty without the need for ratification. [135] Simple signature

means that when a state signs the treaty, the signature is subject to ratification. The state has not expressed its consent to be bound by the treaty until it ratifies it. In that case, a state that signs a treaty is obliged to refrain, in good faith, from acts that would defeat the object and purpose of the treaty. [135]

Siltation - The in-filling of lakes and stream channels with soil particles, usually as a result of erosion on adjacent land. Also called "sedimentation".

Slash and burn agriculture - An agricultural technique frequently used in the Caribbean. It involves the clearing of patches of forest and other natural vegetation by cutting and burning the undergrowth; the area is then used as an agricultural plot. The plots are usually abandoned once yields decline.

Small Island Developing States (SIDS) - SIDS include low-lying coastal countries that share similar sustainable development challenges, including small population, limited resources, remoteness, susceptibility to natural disasters, vulnerability to external shocks, and excessive dependence on international trade. Their growth and development is often further stymied by high transportation and communication costs, disproportionately expensive public administration and infrastructure due to their small size, and little to no opportunity to create economies of scale. [141]

Smelting - An industrial process which involves the removal of a metal from its ore usually by heating beyond melting point in the presence of oxidizing agents.

Soil - The loose and unconsolidated material on the outer layer of the earth's crust made up of rock, mineral particles and organic matter.

Soil compaction - The compression of soil by heavy machinery, livestock, humans or other factors, resulting in loss of pore spaces.

Soil conservation - The protection of soil from erosion and other types of deterioration to maintain soil fertility and productivity.

Soil degradation – The deterioration of soil caused by human activities. Acidification, nutrient depletion, compaction and landsides are all forms of soil degradation. [185]

Soil erosion - *See* Erosion.

Soil fertility - The ability of a soil to supply plant nutrients.

Solar cell - A semiconductor device that converts the energy of sunlight into electrical energy, also known as a photovoltaic cell.

Southern Caribbean - A group of islands situated in the south of the Caribbean region including St. Lucia, Barbados, St. Vincent and the Grenadines, Grenada, Trinidad and Tobago, and Aruba.

Species - An interbreeding group of organisms that is reproductively isolated from all other organisms, although there are many partial exceptions to this rule in particular taxa. Operationally, the term "species" is a generally agreed fundamental taxonomic unit, based on morphological or genetic similarity, which once described and accepted is associated with a unique scientific name. [24]

Species depletion - This is a decrease in the number of species in an area due to causes such as habitat loss and degradation, introduction of exotic species and over-exploitation of the species themselves.

Species extinction - *See* Extinction.

Stratosphere - The layer of the atmosphere that lies above the tropopause and extends to an altitude of about 50km. The ozone layer is located in stratosphere. [176]
This layer is capped by the stratopause.

Surcharge - An additional sum added to the usual cost.

Surface water - All water naturally open to the atmosphere, including rivers, lakes, streams, and estuaries.

Surface water pollution - *See* Water pollution, Surface water.

Sustainable Development - *See* Introduction.

Sustainability - A characteristic or state whereby the needs of the present and local population can be met without compromising the ability of future generations or populations in other locations to meet their needs. [146]

Sustainable energy - Energy which is replenishable within a human lifetime and causes no long-term damage to the environment. Wind energy generated from windmills is an example of sustainable energy. [74]

Symbiosis (and types of symbiosis with reference to parasitism, commensalisms and mutualism) - An association between two species that appears necessary and inseparable. All of the major types of ecosystems existing today have their own set of symbiotic relationships. For example, zooxanthellae live in symbiosis with polyps in coral reefs.

Synergism - The cooperative action of two or more organisms producing a greater total result than the sum of their independent effects.

Taxon (plural taxa) - Any definite unit in the classification of plants or animals. Examples include species, genus, family and class.

Technological hazard - An unexpected and uncontrollable event related to the use and transfer of modern man made technologies that threatens the activities of people and property. For example, chemical spills and nuclear meltdowns.

Teratogen - A substance that causes birth defects by damaging the foetus. [22]

Terrestrial – Of or related to the land; living or growing on land, not aquatic. [117]

Tertiary economic activity (industry) - Economic activity concerned with the sale and use of economic goods and services, also known as the service industry. Activities include retailing, wholesaling and delivery.

Tetratogenic - Of or relating to, or causing malformations of an embryo or fetus.

Tillage - Preparation of land for cultivation by manual plowing or mechanical cultivation.

Tolerance (ecological) - The ability of an organism to endure unfavorable environmental conditions.

Total fertility rate - The average number of babies born to women during their reproductive years, statistically 15 to 49. This is a synthetic rate, not actually counted but calculated. And is a key factor in the demographic transition model and population predictions. The total fertility rate for Trinidad in 2005 was 1.6 according to UNICEF data. (Related: Replacement rate.)

Toxicity - Any abnormal, undesirable or harmful effect to an organism, indicated by some result such as mortality, altered food consumption, altered body and organ weights, altered enzyme levels, or visible pathological change caused by a chemical's effect on a living organism.

Tradable pollution permits - Permits which allow pollution up to a certain limit. The permits give firms the right to sell and buy actual or potential pollution in artificially created markets. [45] These permits are examples of economic instruments.

Tradeoff - Management choices that intentionally or otherwise change the type, magnitude, and relative mix of services provided by ecosystems. [146]

Total suspended solids (TSS) - Very small particles remaining dispersed in a liquid due to turbulent mixing that can create turbid or cloudy conditions. Total suspended solids can cause interference with light penetration, buildup of sediment and potential reduction in aquatic habitat.

Transnational corporation - A firm which owns or controls production facilities in more than one country through direct foreign investment.

Treaty - "An international agreement concluded between States in written form and governed by

international law, whether embodied in a single instrument or in two or more related instruments and whatever its particular designation" (article 2(1)(a) Vienna Convention ,1969). Accordingly, conventions, agreements, protocols and exchange of letters or notes may all constitute treaties. A treaty must be governed by international law and is normally in written form. [135]

Trophic level - Position along the food chain, from primary producer to a sequence of consumers. In a simplified scheme, primary producers constitute the first trophic level, secondary producers or herbivores constitute the second trophic level, and secondary consumers or carnivores constitute the third trophic level. [7], [146]

Troposphere - The lowest layer of the atmosphere. The average height varies from 16 km over the equator to 11 km over the mid-latitudes and 8 km over the poles. The height varies according to convective air movements. This layer is capped by the tropopause.

Under population - A situation in which there are too few people to fully develop the economic potential of an area or nation. It assumes that a larger population could be supported on the same resource base.

Urbanization - The increase in the population of urban areas in proportion to the regions' rural population.

Value added - Of or related to the estimated value that is added to a product or material at each stage of its manufacture or distribution.

Vulnerable (species) - A species that is not critically endangered or endangered but facing a high risk of extinction in the wild in the medium-term future. A species is classified as vulnerable when best available evidence indicates at least a 20% decline in population over the last 10 years or 3 generations (which ever is longer). [71]

Waste management - Administration of activities that provide for the collection, source separation, storage, transportation, transfer, processing, treatment and disposal of waste. [169]

Waste utilization - The use of agricultural waste, such as manure and wastewater or other organic residues on land in an environmentally acceptable manner while maintaining or improving soil, air, water and plant resources.

Water conservation - The reduction in water usage through technological or social methods. Water conservation is one of the most pressing issues globally as many countries are facing water shortages. Common practices for water conservation include taking showers instead of baths, repairing dripping faucets and watering lawns once per week.

Water quality - The physical, biological and chemical organoleptic (taste related) properties of water.

Water resources - The entire range of natural waters in any of the three states that occur on the earth and that are of potential use to humans.

Waterlogged - Soaked or saturated with water.

Waterlogging - Natural flooding or over-irrigation that brings water from underground levels to the surface, displacing air in pore spaces in soil and changing soil processes.

Watershed - An area of land that catches precipitation and drains or seeps into a marsh, river, stream, lake or groundwater. [26]

Watershed destruction - The deforestation or destruction of natural vegetation within a watershed, thereby impeding its ability to regulate water flow.

Wave energy - Energy generated by the force of ocean waves. The use of this energy is still in an experimental stage, but successful models have been built.

Well-being - The extent to which the basic material for a good life, freedom of choice, health, good social relations, security, peace of mind, and spiri-

tual experience are satisfied. [24] How well-being is expressed and experienced is context and situation dependant, reflecting local, social and personal factors such as geography, ecology, age, gender, culture and values. [85]

Western Caribbean - A group of islands situated in the western area of the Caribbean region including Cuba, Jamaica, Cayman Islands, Haiti, Dominican Republic and the Bahamas.

Wetlands - An area inundated or saturated by surface or groundwater, at a frequency and duration to support a prevalence of vegetation adapted to life in saturated soil conditions including, but not limited to, swamps, bogs and marshes.

Wildlife rehabilitation - The process of removing from the wild and caring for injured, orphaned or sick wild animals, with the intention of returning them to the wild after treatment.

Wind energy - Power generated by harvesting wind energy.

World Meteorological Organization (WMO) - "A specialized agency of the UN. It is the UN system's authoritative voice on the state and behavior of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources." [183]
(Related: Global warming, UN, UNEP.)

Yield per unit - The amount produced or yielded of some item as compared to one unit of another variable in production, such as, area cultivated, time or labour. For example a parcel of land located at point A may have a yield per unit of 5 kg of cassava per $1m^2$ of land, whereas at point B the yield per unit is 10 kg of cassava per $1m^2$ of land.

Some

Regional Organizations

involved in Sustainable Development

Alliance of Small Island States (AOSIS)

Established:
1990 in preparation for the second UN conference on climate change.

Background

The small islands and low-lying coastal countries that make up the alliance share similar development challenges, particularly related to climate change. The alliance works through their diplomatic missions to the UN and functions on the basis of consultation and consensus. AOSIS was pivotal in drafting the 1994 BPoA.

Currently there are 43 member states from Africa, the Caribbean, Indian Ocean, Mediterranean, Pacific and South China Sea.
http://www.sidsnet.org/aosis/

Association of Caribbean States (ACS)

Established:
24 July 1994 in Cartagena de Indias, Colombia to promote consultation, cooperation and concentrated action among all the countries in the Caribbean.

Objectives

• Creation of enhanced economic space in the region • Preservation of the environmental integrity of the Caribbean Sea • Promotion of sustainable development of the greater Caribbean

Mandate

ACS has a strong commitment to the international recognition of the Caribbean Sea as a Special Area in the context of sustainable development. The association recognizes the economic, social, cultural, and symbolic importance of the Caribbean Sea, and thus the impetus to have it declared a Special Area in the context of sustainable development.
http://www.acs-aec.org/

Caribbean Community (CARICOM)

Established:
1972 at the 7th conference of the heads of government of Commonwealth Caribbean states.

Background

CARICOM grew out of a transformation of the Caribbean Free Trade Association (CARIFTA) to Common Market. The Common Market treaty was signed on 4 July 1973 at Chaguaramas, Trinidad.

Operationalization

CARICOM has a strong commitment to sustained economic development which is fulfilled through increasing productivity, ensuring full employment of labour, and increasing international trade and economic relations. CARICOM also formulates regional policies regarding health, education, labour, science, technology, tourism, foreign policy and the environment.

In association with international agencies like the World Bank, CARICOM has been involved in projects in renewable energy, climate change, HIV/AIDS, information, communication and technology.

Governance

Two important governance structures fall under the purview of CARICOM:

CARICOM Single Market Economy (CSME)

Implementation began in 2006 and was scheduled to be fully on-stream in 2008. The main objective of CSME is to benefit regional people by providing better opportunities to buy and sell goods as well as attracting investment.

Caribbean Court of Justice (CCJ)

CCJ was created in 2003 under the 2001 Revised Treaty of Chaguaramas. CCJ serves as a court to handle trade disputes among CARICOM member states, and will also serve as the final court of appeal, replacing the Judicial Committee of the Privy Council in London. The CCJ is located in Port of Spain, Trinidad.
http://www.caricom.org/

Caribbean Environmental Health Institute (CEHI)

Established:
CEHI became a legal entity under CARICOM in 1988 and is governed by the CARICOM Council on Human and Social Development (COHSOD). CEHI was born out of a Caribbean Environment Health Strategy in 1979.

Objectives

- To provide technical and advisory services to member states in all areas of environmental management.
- To act as a regional centre for collection and dissemination of information.
- To promote and coordinate applied research relevant to environmental problems.

Projects and Programmes

Caribbean Agrochemicals Management Project (CAMP)

CAMP is an uptake promotion project to increase awareness of the need for improved agrochemical use and management. This is necessary to achieve implementation of best-practice, pro-poor, integrated natural resource and pollution prevention management in coastal zones in the Wider Caribbean.

Waste management

This is a priority area for CEHI, and includes solid waste management as well as biomedical waste management.

Climate change and health

One of the main objectives under this programme area is to develop analytical tools, methodologies and procedures to facilitate a more methodical and systematic identification of climate change impacts on human health. In doing so appropriate intervention options can be identified and implemented by authorities in the region. Activities are being implemented to meet this objective.

Preventing land degradation

Undertaken in Small Island Developing State ecosystems in the Caribbean through sustainable land management projects.

Today, CEHI has a membership that includes 16 Caribbean states with headquarters in St. Lucia. http://www.cehi.org.lc/

UNEP Caribbean Environment Programme (UNEP-CEP)

Background

UNEP-CEP is one of the UNEP Regional Sea Programmes and is managed by and for the countries of the Wider Caribbean Region (WCR) through the Caribbean Action Plan. UNEP-CEP provides the programmatic framework for the Cartagena Convention. The Caribbean Regional Coordinating Unit (CAR/RCU) was created in 1986 and serves as the secretariat to UNEP-CEP. CAR/RCU is situated in Kingston, Jamaica.

Objectives

The aim of UNEP-CEP is to promote regional cooperation for the protection and development of the marine environment of the WCR.

Projects and Programmes

Assessment and Management of Environmental Pollution (AMEP)

AMEP provides regional coordination for the implementation of the Protocol concerning Pollution from Land-based Sources and Activities (LBS Protocol) and the Protocol concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region (Oil Spills Protocol). [145] AMEP supports the activities required for the establishment of necessary measures to prevent, reduce and control marine pollution and to assist in the development of integrated environmental planning and management of coastal and marine areas.[145]

Specially Protected Areas and Wildlife (SPAW) – The SPAW Protocol was adopted in Kingston, Jamaica by the member governments of UNEP-CEP on 18 January 1990, and was entered into force on 18 June 2000. The objective of the Protocol is to protect rare and fragile ecosystems and habitats, thereby protecting endangered and threatened species residing therein.[146] The SPAW programme supports activities for the protection and management of sensitive and highly valuable natural marine resources. This sub-programme is responsible for the regionalization of global conventions and initiatives such as CBD, the International Coral Reef Initiative (ICRI), the Global Coral Reef Monitoring Network (GCRMN), as well as for the implementation of the Caribbean component of the International Coral Reef Action Network (ICRAN).[146]

Communication, Education, Training and Awareness (CETA) – CETA is a merger of the previous CEPNET (Information Systems for the Management of Marine and Coastal Resources) and ETA (Education, Training and Awareness) sub-programmes. The merger occurred during the 12th intergovernmental meeting of the Action Plan for UNEP-CEP and the 9th meeting of the Contracting Parties to the Convention for the Protection and Development of the Marine Environment of the WCR, Montego Bay, Jamaica from 29 November to 2 December 2006. CETA's objectives are to transform and improve educational systems to promote positive attitudes

and behavioral changes toward environment and natural resources; to develop and implement programmes that focus on "training the trainers"; and to support the public awareness efforts of media and civic society.
http://www.cep.unep.org

Organisation of Eastern Caribbean States (OECS)

Established:
18 June 1981 at the signing of the Treaty of Basseterre in St. Kitts & Nevis.

Objectives

The OECS works towards sustainable development of its member states by promoting cooperation, economic integration, unity and solidarity among its member states and harmonization of foreign policy.

OECS members share a common currency – the Eastern Caribbean dollar – and a common supreme court – the Eastern Caribbean Supreme Court.
See Region.

http://www.oecs.org/about.html

Selected

Conferences, Conventions and Agreements

involved in Sustainable Development

United Nations Conference on the Human Environment

- 5 to 16 June 1972
- Stockholm, Sweden
- Secretariat: United Nations Economic and Social Council
- Secretary General: Mr. Maurice F. Strong

Focus

"The need for a common outlook and for common principles to inspire and guide the people of the world in the preservation and enhancement of the human environment."

Discussed

1. Population – Increasing rates of population growth were identified as hindrances to developmental plans.
2. Conservation – It was agreed that conservation of natural resources needed to be an integral part of environment and development programmes.
3. Marine pollution.

Action

1. Earthwatch – Established this global enviromental assessment programme used as the action plan for the human environment.
2. Declaration of the United Nations Conference on the Human Environment - The declaration included recommendations for educational, informational, social and cultural aspects of environmental issues. The conference recognized that environmental considerations were necessary in national action plans to avoid the mistakes that were made by developed countries in their development, to enhance the quality of life of their peoples, and to utilize human and natural resources more efficiently.

Proceedings

Some resolutions adopted by the conference include:

1. The convening of a second United Nations Conference on the Human Environment.
2. Establishment of World Environment Day.
3. To condemn nuclear weapons tests and to call upon states to abandon plans to carry out such tests.

http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=97

World Food Conference

- Rome, Italy
- 5 to 16 November 1974

Focus

The conference was organized to address the problems of extreme food shortages in Africa and parts of South-East Asia; lack of progress in the global fight against hunger and malnutrition; and slow progress in the creation of a coordinated cereal reserve system.

The conference found that the solution to the food problem required coordinated efforts to increase food production; to improve consumption and distribution of food; and to build a system of food security.

Action

1. Establishment of the first ever International Fund for Agricultural development.
2. Declaration for eradication of hunger and malnutrition through enforcing human rights to adequate food and nutrition; government intervention and action for attaining, ensuring and maintaining food security; more state involvement in food production; and sustainable use of marine and inland water resources to meet food needs
3. Recommendation that donors make a concerted effort to provide at least 10 million tons of grain as food every year.

Proceedings

Twenty resolutions were taken during the conference on important issues relating to food security, increasing agricultural yields, women in agriculture and increasing food aid.

Two major food summits followed the World Food Conference. The first World Food Summit was held in Rome in 1996 to renew the commitment of world leaders to combat world hunger and malnutrition. The second was also held in Rome in 2002 to track the progress of the previous summit. Food shortages continue to the present date.

http://www.fao.org

Convention on International Trade in Endangered Species of Flora and Fauna (CITES)

- Drafted in 1963
- Final agreement of document made on 3 March 1973
- Implemented on 1 July 1975

Focus

CITES is an international agreement between governments that aims to ensure that the survival of wild animals and plants is not threatened by world trade. Over 30,000 species come under the protection of CITES.

How is it operationalized?

CITES works by subjecting the trade of selected plant and animal species to certain controls. All import, export, re-export and introduction of species covered by the convention have to be authorized through a licensing system. CITES classifies species into three categories:

1. species threatened with extinction;
2. species not necessarily threatened with extinction but can become vulnerable due to overextraction;
3. species that are protected in at least one country.

Each party to the convention must designate one or more management authorities to oversee administration of the licensing system, and one or more scientific bodies to advise them on the status of species and the effects of trade on them. Trinidad and Tobago became a member party to CITES in April 1984. The Wildlife Section of the Forestry Division is the management authority in Trinidad and Tobago for CITES.
The member parties of CITES meet every two to three years to review the implementation of the convention, to make recommendations for improvement of CITES, and to discuss problems and successes of the programme.

http://www.cites.org/

Ramsar Convention

Convention on Wetlands of International Importance especially as a Waterfowl Habitat

- Signed in Ramsar, Iran on 2 February 1971.
- Came into force in 1975

Focus

The original emphasis of the convention was protection of wetlands primarily as bird habitats. This emphasis changed as the importance of wetlands as ecosystems and its link to human well-being was realized.
The convention currently considers all aspects of wetland conservation and wise use.

How is it operationalized?

The treaty provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
Under the treaty, parties agree to:

1. Designate suitable wetlands and ensure their effective management.
2. Cooperate internationally concerning transboundary wetlands, shared wetland systems, shared species, and development projects.
3. Promote wise use of all their wetlands. Parties meet every two to three years to promote policies and guidelines to further the application of the convention.

As of January 2008, 158 nations had signed on to the treaty and 1718 wetland sites designated.
There are currently three Ramsar sites in Trinidad and Tobago:

1. Buccoo Reef – since 8 July 2005
2. Caroni Swamp – since 8 July 2005
3. Nariva Swamp – since 21 December 1992

http://www.ramsar.org/

Bonn Convention

Convention on the Conservation of Migratory Species of Wild Animals (CMS)

- Signed in Bonn, Germany on 22 June 1980
- Membership includes 109 parties from Africa, Central and South America, Asia, Europe and Oceania
- Cuba and Aruba are the only Caribbean countries to ratify CMS

Focus

CMS is concerned with the conservation of wildlife habitats on a global scale. Parties of CMS strive towards strict protection of animals threatened to extinction, conserving or restoring places where they live, mitigating obstacles to migration, and controlling other factors that might endanger them.

How is it operationalized?

Administrative support for CMS is provided by a secretariat under the auspices of UNEP. The secretariat also facilitates the Conference of the Parties (COP) which meets at intervals of not more than three years.
A standing committee, comprising some member parties, provides policy and administrative guidance between regular COP meetings. A scientific council, comprising an expert from each party, gives advice on technical and scientific matters for the parties.

Proceedings

CMS facilitates global or regional agreements between parties that have signed onto the convention. Agreements include legally binding treaties and also less formal instruments such as memoranda of understanding.

Some agreements under the auspices of CMS aim to conserve populations of European Bats and African-Eurasian migratory water birds. Some memoranda of understanding under the auspices of CMS aim to conserve West African populations of the African Elephant and marine turtles of the Atlantic Coast of Africa.

http://www.cms.int/

World Conservation Strategy (WCS)

- Published in 1980 by a collaborative effort of IUCN, UNEP and WWF

Focus

The main aim of the WCS is to help advance sustainable development through conservation of living resources by maintaining essential ecological processes of life support systems, preserving genetic diversity, and ensuring the sustainable utilization of species and ecosystems. It provides policy guidance for a more focused approach to living resource conservation, tackling three main users: conservationists, development practitioners (aid agencies, industry, commerce, trade unions) and government policy-makers and their advisers.

WCS was an important milestone because it reflected the combined efforts of many conservationists whose conservation priorities differed, and recognized that addressing environmental problems required long term

effort and the integration of environmental and development objectives.

http://www.unep.org/

World Commission on Environment and Development (The Brundtland Report)

- Oslo, Norway 1983
- Chaired by Mrs. Gro Harlem Brundtland

Focus

The commission was convened to address the growing concern of the acceleration of the deterioration of natural resources and the human environment and the resultant socioeconomic implications.

Proceedings

The major outcome of the commission is the Brundtland report (also known as Our Common Future).
The report formed the cornerstone for further environmental work like Agenda 21, and the Montreal and Kyoto Protocols. The Brundtland report recognizes that environmental and development issues are common global challenges which must be addressed through global action. Sustainable development is a major theme of the report and calls were made for the international community to address the needs of the poor and to consider the impacts of actions on future generations.

http://www.ourcommonfuture.org/

Cartagena Convention

Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region

- Cartagena, Colombia
- Adopted 24 March 1983
- Enforced from 11 October 1986
- Ratified by 21 UN members
- Its area of applicability comprises the marine Gulf of Mexico, the Caribbean Sea and adjacent areas of the Atlantic Ocean

Focus

The prevention of pollution from ships; pollution caused by dumping; pollution from seabed activities; pollution from land-based sources and activities; and airborne pollution.
Members are required to protect and preserve rare and fragile ecosystems, as well as the habitats of depleted, threatened or endangered species. They must also develop technical and other guidelines for planning and environmental impact assessments of important development projects.

Proceedings

The Convention established the action plan for the Caribbean Environment Programme (CEP), a framework for sustainable development.

CEP gave rise to:

- A protocol concerning cooperation in combating oil spills in the Wider Caribbean Region.
- The Specially Protected Areas and Wildlife (SPAW) protocol for the Wider Caribbean Region.
- A protocol on marine pollution from land-based sources and activities.

The Cartagena Convention supports and complements other international agreements like the Ramsar Convention (the two conventions signed a memorandum of cooperation), the Convention of Biological Diversity, MARPOL 73/78 [ii], and the Basel Convention [iii]. While the Cartagena Convention has been recognized as one of the most successful programmes under UNEP, much work still needs to be done, particularly in the management of established marine protected areas in the Caribbean Region.

www.cep.unep.org/pubs/legislation/cartxt.html
www.cep.unep.org/law/cartnut.html

Earth Summit

United Nations Conference on Environment and Development (UNCED)

- Rio de Janeiro, Brazil
- 5 June 1992
- Secretariat: United Nations Environment Programme
- Secretary General: Mr. Maurice F. Strong

Focus

The main message of the summit was that "nothing less than a transformation of our attitudes and behaviour would bring about the necessary changes".

Proceedings

Four very important outcomes of the conference were Agenda 21, the Rio Declaration on Environment and Development, the United Nations Framework Convention on Climate Change, and the United Nations Convention on Biological Diversity.

[ii] MARPOL 73/78 is the International Convention for the Prevention of Pollution from ships, 1973 as modified by the protocol of 1978. MARPOL – Marine Pollution.

[iii] The Basel Convention is the Convention for the Control of Transboundary Movements of Hazardous Wastes and their Disposal. The Convention was signed under the auspices of UNEP in Basel, Switzerland, and came into force in 1992.

Rio Declaration on Environment and Development

A series of principles defining the rights and responsibilities of states. The main objectives of the declaration are conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of benefits arising out of utilization of genetic resources.

Agenda 21

An action plan that was aimed at addressing the current pressing problems and preparing the world for the challenges of the 21st century. The strength of Agenda 21 was that it reflected a global consensus and political commitment at the highest level on development and environmental cooperation. Agenda 21 outlines strategies and sets objectives in key areas:

Social and economic - Focuses on combating poverty, changing consumption patterns, demographic dynamics, human settlement development and integrating environment and development into decision-making.

Conservation and management of resources for development - Focuses on maintaining biodiversity, managing ecosystems, management of all types of wastes, sustainable agriculture and deforestation.

Strengthening the role of major groups - Major groups include women, children and youth, indigenous people, local authorities, farmers and scientific and technical communities.

United Nations Framework Convention on Climate Change (UNFCCC)

An international treaty that sets an overall framework for intergovernmental efforts to tackle the challenges posed by climate change. The treaty recognizes that the climate system is a shared resource and so cooperation is required by the 192 governments that have signed on to the treaty. Under the convention, governments share information and adopt national strategies to reduce anthropogenic climate change.

Convention on Biological Diversity (CBD)

The Convention was first opened for at UNCED in 1992 but came into force on 29 December 1993. CBD is the first global agreement on the conservation and sustainable use of biological diversity.

The convention has three main goals:

1. The conservation of biodiversity.
2. Sustainable use of the components of biodiversity.
3. Sharing the benefits arising from the commercial and other utilization of genetic resources in a fair and equitable way.

CBD is one the most powerful agreements to come out of the UN body. The agreement recognizes conservation of biological diversity as an integral part of the development process. The convention sets principles for the fair and equitable sharing of the benefits arising from the use of genetic resources, notably those destined for commercial activity. The strength of the convention lies in its legally binding nature: when a country signs on to the convention it is obliged to implement its provisions.

Some of the issues dealt with under CBD include education and awareness; regulated access to genetic resources; and technical and scientific cooperation.

Since the Rio conference, more than 187 countries have ratified the agreement, including Trinidad and Tobago and many other Caribbean countries.

Other major outcomes of the summit include:

- The Inter-agency Committee on Sustainable Development - 1992
- UN Commission on Sustainable Development - June 1993
- High Level Advisory Board on Sustainable Development – 1993
- Global Conference on the Sustainable Development of Small Island Developing States - May 1994
- UN Agreement on High Seas Fishing - December 1995
- International Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification - December 1996

http://www.un.org/geninfo/bp/enviro.html

Global Conference on the Sustainable Development of Small Island Developing States

- Bridgetown, Barbados
- 25 April to 6 May 1994
- Presided over by the then prime minister of Barbados, Mr. L. Erskine Sandiford

Focus

The conference was held to start putting action into Agenda 21 with respect to small island developing states (SIDS) in light of the challenges that are faced because of the uniqueness and vulnerability of these states.

Proceedings

The major outcome of the conference was the Barbados Plan of Action (BPoA). The BPoA outlines the measures, strategies, actions and policies that SIDS should adopt that would move them along the path of sustainable development.

The strategies, actions and policies outlined emerged after addressing the special challenges and constraints that SIDS face and were made in accordance with the principles endorsed by the governments at the Earth Summit.

http://islands.unep.ch/dsidscnf.htm

United Nations Convention to Combat Desertification (UNCCD)

- Adopted in Paris, France on 17 June 1994
- Opened for signature 14 to 15th October 1994
- Entered into force 26 December 1996
- Secretariat located in Bonn, Germany
- 179 countries, including nine Caribbean countries, are signed on as parties to the convention

Focus

Desertification has been an issue from as early as 1977 when the United Nations Conference on Desertification was held and a Plan of Action to Combat Desertification (PACD) was adopted. In 1991, UNEP concluded that the problem of land degradation in arid, semi-arid and dry sub-humid areas had intensified. Desertification was raised as a major issue at the Earth Summit, and the UN general assembly was called on to establish

an Intergovernmental Negotiating Committee to prepare by, June 1994, a convention to combat desertification, particularly in Africa. The convention emphasizes the full participation of communities, especially of women, to promote sustainable development.

How is it operationalized?

UNCCD activities are coordinated with the secretariats of other international organizations and conventions like UNFCCC and CBD. National Action Programmes are key instruments used in the implementation of the convention. These are developed in the framework of a participative approach involving the local communities and they outline practical steps to be taken to combat desertification in specific ecosystems.

http://www.unccd.int/

International Conference on Population and Development (ICPD)

- Cairo, Egypt
- 5 to13 September 1994
- Presided over by the then president of the Arab Republic of Egypt, Muhammad Hosni Mubarak
- Secretary General: Dr. Nafis Sadik

Focus

This conference followed from two other conferences: the World Population Conference in Bucharest, Romania in 1974, and the International Conference on Population in Mexico City in 1984. The two earlier conferences focused on the broad issues of - and interrelationships between - people, sustainable economic growth and sustainable development, and advances in the education, economic status and empowerment of women.
The ICPD sought solutions for:

1. slowing population growth
2. reducing poverty
3. achieving economic progress
4. improving environmental protection
5. reducing unsustainable consumption and production

Other themes included poverty alleviation, women's empowerment and environmental protection. The conference highlighted the need for greater investment in people and for measures to be put in place to ensure the full participation of women at all levels in the social, economic and political spheres of their communities.

Proceedings

The conference yielded a programme of action with such objectives as: sustained economic growth in the context of sustainable development education especially for girls; gender equality and equity; infant, child and maternity mortality reduction; and the provision of universal access to reproductive health services.

http://www.iisd.ca/Cairo.html

World Summit for Social Development

- Copenhagen, Denmark
- 6 to 12 March 1995
- Presided over by the then prime minister of the United Kingdom of Denmark, Poul Nyrup Rasmussen

Focus

The summit placed education at the centre of anti-poverty strategies and called for commitment in education and health to attain the goals of access to quality education, a high standard of physical and mental health, access to primary health care, and equality despite race, nation, culture, gender, age or disability.

Proceedings

The major outcomes of the summit were the Copenhagen Declaration and the subsequent Programme of Action of the World Summit for Social Development. Ten commitments were made in lieu of the declaration, focusing on issues including poverty eradication; equality and equity between men and women; development of least developed countries particularly those in Africa; and universal and equitable access to education and primary health care.

http://www.un.org/esa/socdev/wssd/

Fourth World Conference on Women

- Beijing, China
- 4 to 15 September 1995
- Secretary General: Mrs. Gertrude Mongella

Focus

The main themes were the advancement and empowerment of women in relation to women's human rights; women and poverty; women and decision-making; the girl-child; and violence against women.
Critical areas of concern in the conference included:

- the persistent and increasing burden of poverty on women
- inadequacies in education for girls and women
- sharing of power between men and women and decision-making at all levels
- gender inequalities in the management of natural resources and in the safeguarding of the environment
- persistent discrimination against and violation of the rights of the child

Other issues highlighted at the conference included: women's right to inherit land and property; laws on illegal abortion; role of the family; culture and religion; and rape as a war crime.

Proceedings

The main outcome of the conference was the
Beijing Declaration and Platform for Action. The Platform aims to enhance the social, economic and political empowerment of women, improve their health and their access to relevant education and promote their reproductive rights. The conference highlighted the integrated issues of equality, development and peace, and analysed them from a gender perspective.

http://www.un.org/womenwatch/daw/beijing/

World Summit on Sustainable Development

- Johannesburg, South Africa
- 26 August to 4 September 2002
- Presided over by the then president of South Africa, Thabo Mbeki

Focus

The main themes of the summit were poverty eradication; changing unsustainable patterns of consumption and production; water and sanitation; energy; health; agriculture; biodiversity; and protecting and managing the natural resource base of economic and social development. The summit focused on directing the world towards meeting difficult challenges - including improving people's lives and conserving the world's natural resources – in the face of increasing demands for food, water, shelter, sanitation, energy, health services and economic security.

Summit attendees included business and industry, children and youth, farmers, indigenous people, local authorities, non-governmental organizations (NGOs), scientific and technological communities, women, and workers and trade unions.

Proceedings

One major outcome of the summit was the Johannesburg Declaration on Sustainable Development. The declaration resolves to make a determined effort to respond positively to the need to produce a practical and visible plan to bring about poverty eradication and human development.

http://www.un.org/jsummit/

Selected Projects and Reports involved in Sustainable Development

Global Environment Outlook (GEO)

Background

GEO is a global assessment process that is cross-sectoral, participatory and consultative. It was initiated in response to the reporting requirements on the state of the environment by Agenda 21.

GEO is presented as a series of state of the environment reports and provides guidance for decision-making processes such as the formulation of environmental policies, action-planning and resource allocation. Environmental trends are analysed under the considerations of social, political, economic and cultural drivers and root causes.
Incorporated into the GEO are regional views and priority issues identified at regional and global levels. It also investigates the relationship between people and the environment.

Four GEO reports have been produced since 1997.

http://www.unep.org/geo/

Millennium Development Goals (MDGs)

Background

In 2000, country representatives at the UN Millennium Summit in New York agreed to a set of time-bound measurable goals and targets for combating poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women. The conference was chaired by the then UNDP administrator, Malloch Brown. With a target deadline set for 2015, a framework of eight goals was developed to:

1. Eradicate extreme poverty and hunger.
2. Achieve universal primary education.
3. Promote gender equality and empower women.
4. Reduce child mortality.
5. Improve maternal health
6. Combat HIV/ AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

The MDGs were adopted by 189 nations. Trinidad and Tobago's strategy for achieving the MDGs is bound in the framework of the goals set out by its Vision 2020 plan for development.

http://www.millenniumassessment.org

Human Development Reports (HDRs)

Background

The HDR was commissioned by the UNDP in 1990 and published under the leadership of Pakistani economist and finance minister, Mahbub ul Haq, and Indian Nobel Laureate for economics, Amartya Sen. The principal motivation for the HDRs was the realization that expansion of economy measured by per capita GDP does not necessarily reflect the well-being of the people.

Operationalization

There are three types of HDR reports published annually:

1. Global reports call for international attention to issues and policy options that put people at the centre of strategies to meet the challenges of development taking into account economic, social, political and cultural factors.

2. Regional reports promote regional partnerships for influencing change and address region-specific human development approaches to human rights, poverty, education, economic reform, HIV/AIDS and globalization.

3. National reports influence national policy development and encourage policy that reflects people's priorities; strengthens national capacities; engages national partners; identifies inequities; and measures progress.

Human development is measured by four indices which include Human Development Index (HDI), Gender-related-development Index, the Gender Empowerment Measure and the Human Poverty Index. The HDI measures average achievements in a country based on three basic dimensions of human health: long healthy life; knowledge; decent standard of living. In 2004, Trinidad and Tobago ranked 57th out of 177 countries for the HDI.

http://hdr.undp.org/en/statistics/

Green Belt Movement (GBM)

Background

The GBM was established in 1977 by Professor Wangari Maathai[iv] under the auspices of the National Council of Women in Kenya. The aim of the movement is to create a society where people work towards a greener and cleaner environment. GBM began as a grassroots, non-governmental programme to address the challenges of deforestation, soil erosion and lack of water. Tree planting was their major activity. Today, GBM is one of the most prominent women's civil society organizations, based in Kenya The movement has grown and is now a vehicle for empowering women to become champions for sustainable management of scarce resources such as water, equitable economic development, good political governance, and ultimately….. peace.
The act of planting a tree is helping women throughout Africa become stewards of the natural environment.

Operationalization

GBM has activities and interests in indigenous tree-planting, civic education, advocacy, food security, greenbelt eco-safaris, and women and change. Kenya used tree-planting for its GBM scheme and was largely successful with the replanting of more than 30 million trees. In Kenya, GBM has been largely successful in promoting environmental consciousness, volunteerism, self-empowerment, conservation of local biodiversity and community development and accountability.

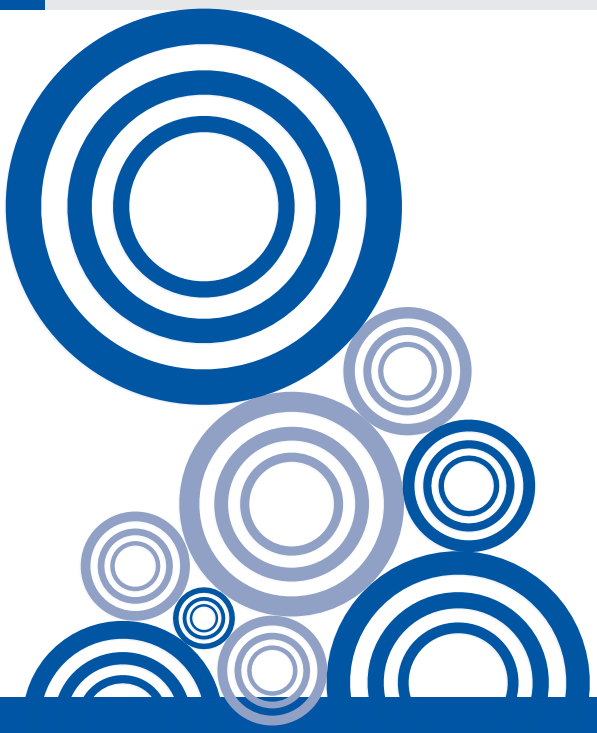
Specific objectives of GBM include:

- Mobilizing community consciousness for self determination
- Equity
- Improved livelihoods and security
- Environmental conservation

Today, more than 40 million trees have been planted across Africa resulting in reduced soil erosion in critical watersheds, restoration and protection of thousands of acres of biodiversity-rich indigenous forest, and hundreds of thousands of women and their families are standing up for their rights and those of their communities and so are living healthier, more productive lives. However, much remains to be done to slow rates of forest loss, improve democracy, and reduce poverty levels. GBM's goal in the next decade is to plant one billion trees worldwide and to continue promoting an equitable and peaceful society, protecting the environment through individual efforts.

http://greenbeltmovement.org

[iv] Wangari Maathai was the first woman in East and Central Africa to earn a doctoral degree. In 2004 she was awarded the prestigious Nobel Peace Prize for her contribution to sustainable development, democracy and peace.



Selected Declarations involved in Sustainable Development

Mauritius Declaration

International Meeting to Review the Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States

- Port Louis, Mauritius
- 10 to 14 January 2005
- Presided over by then prime minister of Mauritius, Paul Raymond Bérenger
- Secretary General: Anwarul K. Chowdury

Focus

The Mauritius 2005 meeting was a follow-up to the Global Conference on the Sustainable Development of Small Island Developing States (SIDS). The meeting reassessed the original BPoA and built upon existing and emerging issues that were considered important dimensions of sustainable development in SIDS. Attention was given to marginalized areas like culture, youth and very small islands like those that make up the Grenadines.

Proceedings

The major outcome of the meeting was the Mauritius Strategy. The strategy acknowledges international trade as important for building resilience and for the sustainable development of SIDS. However, because of their small areas, SIDS often face difficulty in entering and competing in the global economy. Emphasis was also given to the vulnerability of SIDS to natural and environmental disasters because of their location and fragile ecosystems.

www.un.org

The Montreal Protocol on Substances that Deplete the Ozone Layer

- Treaty opened for signature on 16 September 1987
- Adjusted and amended 27 to 29 June 1990; 23 to 25 November 1992; 5 to 7 December 1995; 15 to 17 September 1997; 29 November to 3 December 1999

Focus

The Montreal Protocol is an international agreement designed to protect the stratospheric ozone layer. The aim of the agreement is to phase out the production and consumption of compounds that deplete the ozone in the stratosphere. The compounds include chlorofluorocarbons (CFCs), halons, carbon tetrachlorides, and methyl chloroform.

The Montreal Protocol has been largely successful in reducing or levelling-off important CFCs and chlorinated hydrocarbon concentrations. Halon continues to increase; however, the rate of increase has slowed.

http://ozone.unep.org/

The Kyoto Protocol

- Agreement adopted in Kyoto, Japan on 11 December 1997 and entered into force on 16 February 2005
- As of 2008, 183 countries have ratified the protocol
- Trinidad and Tobago signed the protocol on 7 January 1999 and ratified it on 28 January 1999

Focus

The Kyoto Protocol is an international agreement linked to the existing UNFCCC treaty. The protocol sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions. Their mandate is to achieve a reduction of approximately five percent over the five-year period 2008 to 2012. The major distinction between the Kyoto Protocol and the UNFCCC is that while the convention encourages industrialized countries to stabilize GHG emissions, the protocol commits them to do so.

Operationalization

GHG cuts included carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).

Mechanisms by which countries can cut their emissions:

- Emissions trading – Countries can buy and sell emission credits amongst themselves.
- Emission reduction units – Financing certain projects in other developing countries can earn countries emission reduction units.
- Clean development mechanism – Credit earned for financing emission reduction projects in developing countries.

http://unfccc.int

The Caribbean Sea

The following sections will focus on options for defining ecosystems for study, looking broadly at different regional considerations, and specifically at what options exist for defining the Caribbean Sea ecosystem.

What is a REGION?

A region can be defined as an area with one or more characteristics that distinguish it from other areas. Based on this definition, a region can represent a vast range of areas. A region can be used on several spatial scales from as small as areas within ecosystems, to groupings of countries.

A nested hierarchy of six levels helps to narrow down this loose definition:

regions → sub-regions → basins → sub-basins → watersheds → sub-watersheds.

Type of Region	Definition and Examples
Ecoregion	This is a large area of land or water that contains a geographically distinct assemblage of natural communities that share the majority of their species and ecological dynamics; present similar environmental conditions; and interact ecologically. [111] Ecoregions are part of a nested hierarchy of ecological regions of different scales. WWF has identified three types of ecoregions: Terrestrial ecoregions – there are 825 terrestrial ecoregions across the globe, which include Trinidad and Tobago's moist forests. Marine ecoregions – there are 232 identified marine ecoregions. Trinidad and Tobago is part of the Southern Caribbean ecoregion. Freshwater ecoregions – WWF has not yet compiled information on these.
Hydrological	This is a region that is delineated by the location or movement of water. Drainage basins form the most common type of hydrological region, and because drainage basins vary in size and shape, hydrological regions also vary in terms of size and shape. Streams, wetlands, watersheds and other types of surface water can also form regions. In the US, hydrological pyramids form the topmost level of a six-level nested hierarchy. The Caroni River Basin in Trinidad forms its own hydrological region.
Physiographic	These are broad-scale subdivisions based on terrain texture, rock type, and geological structure and history.[163] In areas where this categorization is used, for example in North America, physiographic regions are then subdivided to divisions, provinces and sections. Trinidad is divided into five physiographic regions: Northern Range, Southern Range, Central Range, Northern Basin and Southern Basin. Tobago has one physiographic region – Main Ridge.
Paleogeographic	These are areas that no longer exist, but existed during the earth's long history. Examples of paleogeographic regions include Pangaea (a supercontinent dated at about 225 million years ago), Gondwana (a large continent between 545 and 248 million years ago) and Tethys Ocean (an ocean from about 300 million years ago).
Historical	These regions relate human history with a physical place and have particular historical significance as a result. For example, Arima, Trinidad is described as a historic region because of its long settlement history beginning with the Amerindians.

Type of Region	Definition and Examples
Tourism	Tourist destinations are classified because of the amenities they can offer. For example, the Caribbean is classed as a tourist region because it has a sunny climate, and beautiful beaches that attract a regular throng of tourists.
Natural Resource	Different natural resources, such as oil and natural gas, often occur in similar areas because of natural formation. These are natural resource regions.
Political	Areas may be grouped because of the similarity of political units, or they may belong to a multi-national grouping that has political foundations, for example, CARICOM member states comprise a political region. In political regions, countries may benefit from having common trade policies and even a common currency – for example OECS states.

A precise delineation of the Caribbean Sea is an elusive task . Many of the definitions available come from political or ecological perspectives.

1. ***The Wider Caribbean Sea*** was defined by UNEP as comprising insular and coastal states and territories with coasts on the Caribbean Sea and Gulf of Mexico, as well as waters of the Atlantic Ocean adjacent to these states and territories. Under the umbrella of the Wider Caribbean Sea, governments have identified priority issues in the region that include land-based sources of pollution; over-exploitation of resources; increasing urbanization and coastal development; and unsustainable economic growth and agricultural forestry practices. The countries and territories which comprise the Wider Caribbean Sea are found in Table 1.

2. ***Greater Caribbean Region*** shares an area similar to the Wider Caribbean Sea. The oceanography of the southern Caribbean is strongly influenced by the outflow of two of the world's largest river systems, the Orinoco and Amazon river systems, and, in turn, the Caribbean has a great influence downstream on the Gulf of Mexico. In this definition, the Gulf and the Guianan region are included.[111] The countries and territories which comprise the Greater Caribbean Region are found in Table 1.

3. ***Caribbean Large Marine Ecosystem (CLME)*** - Using an ecological definition, the CLME is a semi-enclosed tropical sea bounded by Florida, North America, Central and South America and the Lesser Antilles.[16] The CLME forms a large ecosystem that is utilized by a number of organisms including sea birds, shell fish, fish and marine and coastal fauna. Marine resources of the CLME are shared by many nations so that sustainable use and recovery of depleting resources (such as fisheries) must be managed at the international level. The countries and territories which comprise CLME are found in Table 1.

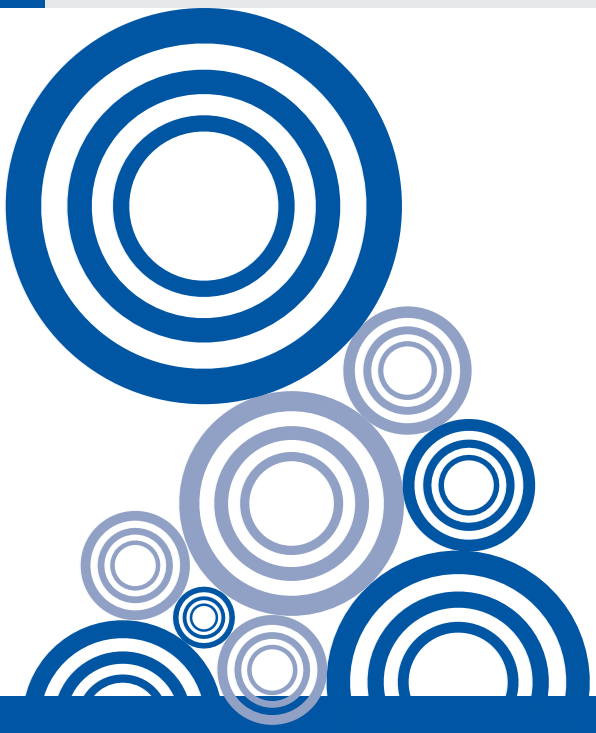
Although the Caribbean Sea can be viewed as one entity, nations exercise jurisdiction over the marine area that surrounds them and the Caribbean Sea is nationally and politically subdivided. The management of such divided ecosystems is difficult. Especially with regard to migratory species, borders, infringements and property rights are sources of on-going debate. Besides the migration of organisms which provide food, migration of marine pollution is also a problem because the action of ocean currents can take pollution from as far as Trinidad and Tobago to Jamaica. ***CARSEA*** recognized that any sustainable management plan must be characterized by coordinated efforts with a holistic management plan. However, this is not yet occurring, and the current situation is that management efforts tend to be largely individual or by political blocs. The major political blocs operating in the Caribbean Sea are ***CARICOM, OECS, ACS,*** and ***AOSIS***. Table 1 lists the countries that belong to these political blocs. Although there are examples of collaborations between these bodies[v], governance frameworks may not necessarily coalesce and may result in conflict.

[v] **CARICOM and OECS collaborated on the Free Trade Area of the Americas (FTAA) Initiative in 1994.**

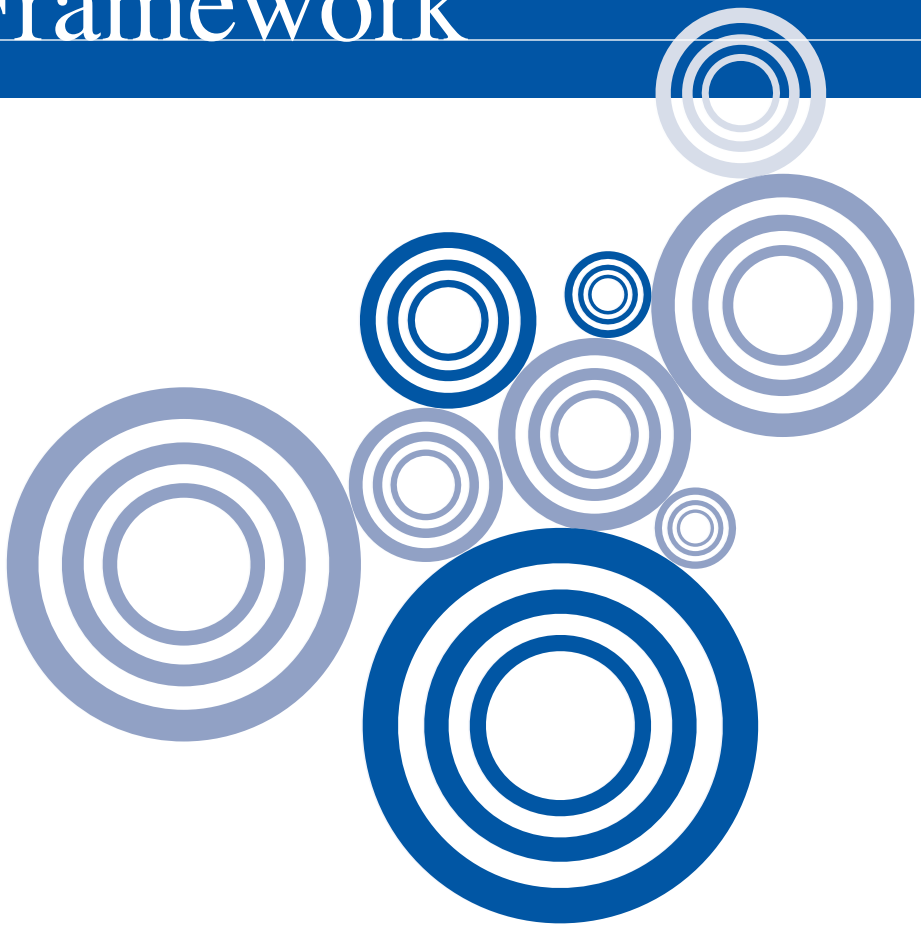
Table 1: Countries that fall within a definition of the Caribbean Sea or Political Bloc.

	Definitions of Caribbean Sea			Political Blocs			
Countries	Wider Caribbean	CLME	Greater Caribbean	OECS	CARICOM	ACS	AOSIS
Anguilla							
Antigua & Barbuda							
Aruba							
Bahamas							
Barbados							
Belize							
Brazil							
British Virgin Islands							
Cayman Islands							
Colombia							
Costa Rica							
Cuba							
Dominica							
Dominican Republic							
El Salvador							
French Guiana							
Grenada							
Guadeloupe							
Guatemala							
Guyana							
Haiti							
Honduras							
Jamaica							
Mexico							
Montserrat							
Martinique							
Netherland Antilles							
Nicaragua							
Panama							
Puerto Rico							
St. Kitts/ Nevis							
St. Lucia							
S t. Vincent and the Grenadines							
Suriname							
Trinidad and Tobago							
Turks and Caicos							
USA							
US. Virgin Islands							
Venezuela							

The listed countries in the table are highlighted according to political blocs as well as the definition of the Caribbean Sea under which they fall. Note that a country may fall under all three definitions of the Caribbean Sea.



Millennium Ecosystem Assessment Conceptual Framework



From 2001 - 2005, the United Nations - specifically UNEP - carried out an assessment called the Millennium Ecosystem Assessment (MA). The purpose was to assess the consequences of ecosystem change on human well-being and to establish scientific basis for actions needed to reduce the harmful effects that humans have on ecosystems. The interaction between human actions and well-being; and ecosystems is at the core of the MA's conceptual framework.[vi]

Ecosystem Services

The MA has categorized ecosystem services into four groups:

1. ***Provisioning*** – these are the products provided by ecosystems for people. For example, water, food (fish, animals, fruits and vegetables), textiles, rubber, wood and fibre, and fuel.
2. ***Regulating*** – a number of processes allow ecosystems to keep in check the impact of environmental (both natural and man-made) phenomena.
   a. Climate regulation – Forests are integral to the global water cycle and their removal results in disturbance to the cycle. Removal of forest also affects the global surface albedo.[vii]
   b. Pollution regulation – Vegetation, soil and large bodies of water can absorb and thus filter GHG out of the atmosphere. These are called sinks.
   c. Flood regulation – Vegetation promotes infiltration and percolation of rainwater, and slows overland flow of water. Erosion control by vegetation prevents sedimentation in river channels and lakes; indirectly promoting flood regulation.
   d. Water purification – Soil filters percolating water of heavy metals, fertilizers, pesticides. Some organisms, like shrimp and bivalves, ingest waste and hydrocarbons respectively.
   e. Disease regulation – Predators of disease-causing pathogens and microbes exist naturally in some ecosystems.
3. ***Cultural*** – these are non-material benefits that people gain from ecosystems through recreation, aesthetic appreciation, intellectual inspiration, spiritual enrichment and reflection.
4. ***Supporting*** – these are the services that are necessary for the functioning of other ecosystem services. Examples include:
   a. Primary production – forms the basis of food chains and can have a significant impact on provisioning services such as food.
   b. Nutrient cycling – provides vegetation with a constant source of nutrients. Vegetation significantly affects regulation services as well as provisional and cultural services.
   c. Production of oxygen – This service is necessary for survival of aerobic organisms and affects provisioning services particularly food.

[vi] A conceptual framework is an outline of the process or possible courses of action to be taken for a study, project or research.

[vii] Global surface albedo is the total reflectivity of the earth's surface, and plays a major role in the earth's energy balance.

Human Well-being

Five components of human well-being have been identified by the MA.

1. ***Security*** is multidimensional in this regard and includes assured access to resources (food, water, raw materials, and finances), personal safety, protection from natural disasters, and fair political process.
2. ***Basic material for good life*** is synonymous with "basic needs" and these include access to adequate food, shelter, clothing. Additionally, adequate livelihoods that ensure fair labour, income generation and job-safety.
3. ***Health*** includes good physical and mental health and the conditions that work to promote these. Mental health includes a sense of balance (no one excessive emotional state).
4. ***Good social relations*** include respect for the opposite gender, other cultures, and ethnic groups. The ethos is manifest in the ability to work and live with others (social cohesion).
5. ***Freedom of choice and action*** hinges on the success of the other components. Freedom of choice and action offers individuals the chance to engage in their preferred and valued pursuits. However, these must be considered within the confines of the law.

Figure 6 shows the potential for mediation of the linkages between the identified constituents and ecosystem services by socioeconomic factors. Potential for mediation is essentially a measure of the extent to which socio-economic factors can influence the strength of such linkages. For example, if a substitute can be purchased for a degraded ecosystem service then the potential for mediation would be high. This can be observed in the linkage between regulating services and basic material for good life; seawater can be desalinated to provide freshwater. In this case the socioeconomic factor would be money. Technological advancements that promote change in energy sources can act as a mediator of the linkage between provisional ecosystem services and basic material for good life. For example, the change from wood to natural gas as a source of fuel will reduce the strength of the linkage between wood and basic material for good life, and strengthen the linkage between natural gas and basic material for good life. Wood and natural gas are likely to come from two different ecosystems. The link between disease regulation and health can be affected by medical advancements and finances, because regulation can then be achieved using medicine.

It is noteworthy that the linkages between cultural ecosystem services and the constituents of well being are generally weak and the potential for mediation is low. This may be because culturally derived services cannot be substituted as they are not material or tangible. The strength of linkages and potential for mediation will vary between different ecosystems. However, one can expect the general pattern shown to be common to most ecosystems.

Drivers of change

Drivers are any factors that change an aspect of the ecosystem. Ecosystems can be affected directly through physical change or indirectly through changes in policy which may then serve to affect the ecosystem. Drivers are categorized as direct or indirect. At any one time, a combination of direct and indirect drivers may be acting on an ecosystem.

Direct drivers are those for which the link between an activity and the ecosystem response is unambiguous. These drivers are identifiable and measurable to varying degrees of accuracy. Direct drivers are primarily physical, biological and chemical. Examples include deforestation, illegal mining, over-extraction of natural resources, climate change, effluent discharge into water bodies, introduction of invasive species, and use of fertilizers. Drivers are not necessarily anthropogenic and can be natural, for example volcanoes and earthquakes are natural direct drivers.

Indirect drivers are those for which the link between an activity and the ecosystem response is ambiguous, and several chain links may exist between the activity and ecosystem response. Indirect drivers are primarily demographic (such as population size, age and gender structure); economic (national and per capita income, international trade, macroeconomic policies[viii], and capital flows); sociopolitical (democratization, the roles of women, of civil society and of the private sector); scientific and technical (rates of investment in new technologies, in research and development and the rates of adoption of new technologies including biotechnologies and information technologies); and cultural and religious (choices individuals make about what and how much to consume and what they value). [144]

The diagrammatic representation of the conceptual framework of the MA shows the various linkages among human well-being, indirect and direct drivers of change and ecosystem services. Changes in indirect drivers, such as population expansion, can influence direct drivers such deforestation to create more homes. Deforestation can then affect provisioning services (lack of access to food, wood); regulating services (water regulation cycle can be disrupted); cultural services (recreational activities such as bird-watching and nature-trails become defunct); and supporting services (primary production is lost and the food chain is disrupted). The changes in the ecosystem services will then affect human well-being. Although, a negative effect on human well-being was highlighted here, positive effects do occur, and can be found in programmes like reforestation which will have an almost opposite effect to deforestation. Indirect and direct drivers can affect human well being without first affecting ecosystem services. For example, development in medical science and technology can affect human well-being by providing medicine to treat physical or mental illness – thus promoting wellness. Climate change in the form of global warming can also impact health by increasing the incidence of heat strokes.

Drivers may have impacts on several levels ranging from a localized ecosystem to global scale impact. Drivers also have an element of time associated with them as the effects of actions may be long term or short term. For example, large-scale deforestation of the Amazon Rainforest can have the short-term impact of erosion and disruption of the local water cycle. Consequently, the Amazon forest is a large carbon dioxide sink and removal may result in increasing levels of CO_2 in the atmosphere over time, which can lead to global warming in the long term, over the entire earth.

Strategies and interventions exist to respond to changes in ecosystem services and to mitigate the effects of drivers on ecosystem services and on human well-being. Many of these strategies and interventions work to protect ecosystem services from disruption and to restore damaged ecosystems to ensure that services can be provided. Education, creation of property rights and incorporating value of ecosystem services in decisions are options that decision-makers can take to protect ecosystems. These can be achieved by collaboration between various stakeholders, public and private action, laws, regulations, and enforcement schemes. For example, regulations

can be created that limit fertilizer use on farms to decrease the incidence of water pollution that disrupt the provisional ecosystem service of freshwater.

Maintaining ecosystem integrity is an important aspect of human well-being because of human dependence on ecosystems. The conceptual framework, in addition to defining the linkages among ecosystem services, human well-being and drivers, does provide decision makers with various start-points from which they can begin intervention to enhance the quality of or restore ecosystem services.

viii **Macroeconomic policies are those that affect the entire economy of a country or even a region.**

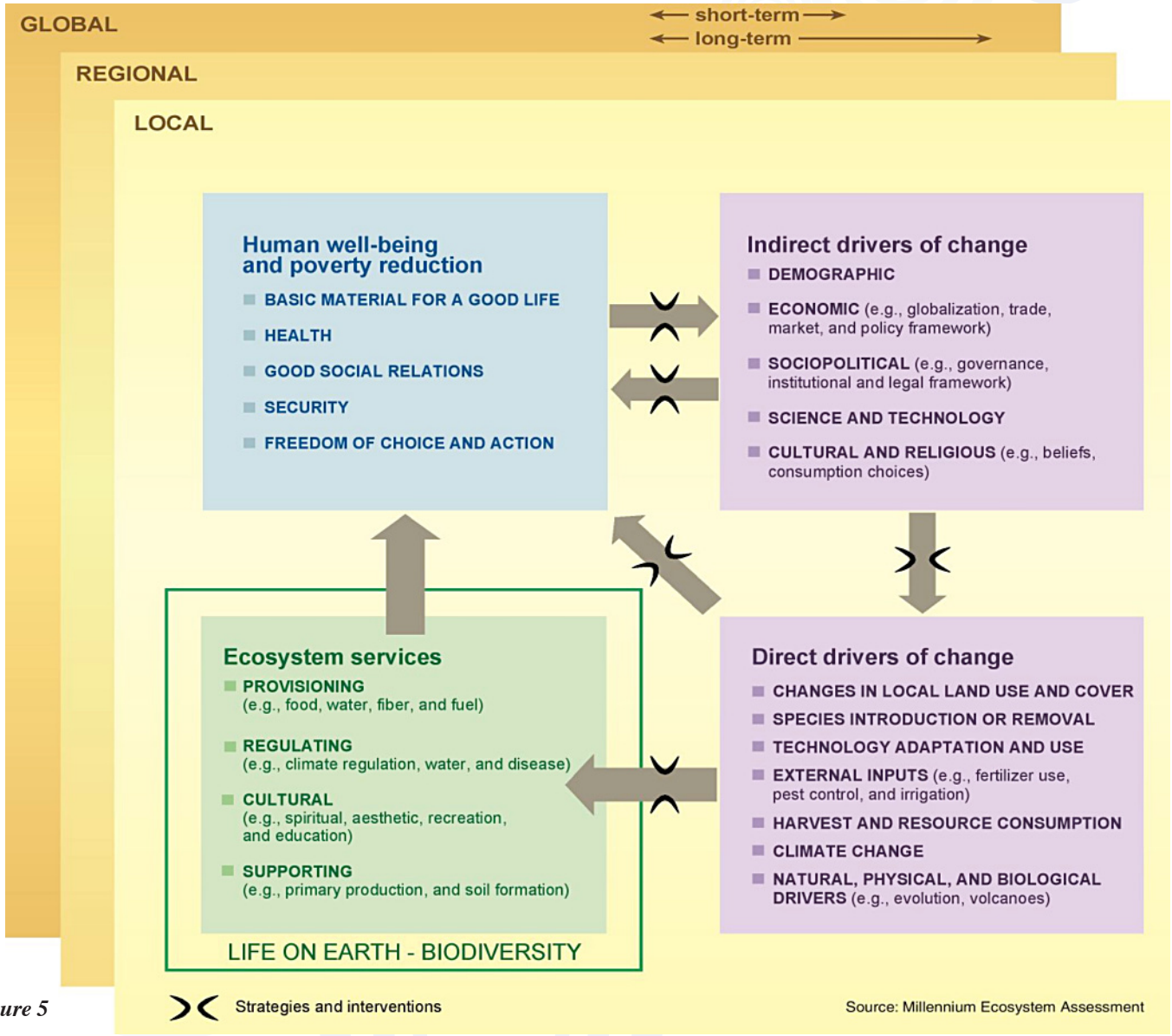


Figure 5

Millennium Ecosystem Assessment Conceptual Framework *Source: MA*

The figure shows the linkages between the components of the MA Conceptual Framework: human well being, ecosystem services, direct drivers of change, and indirect drivers of change.

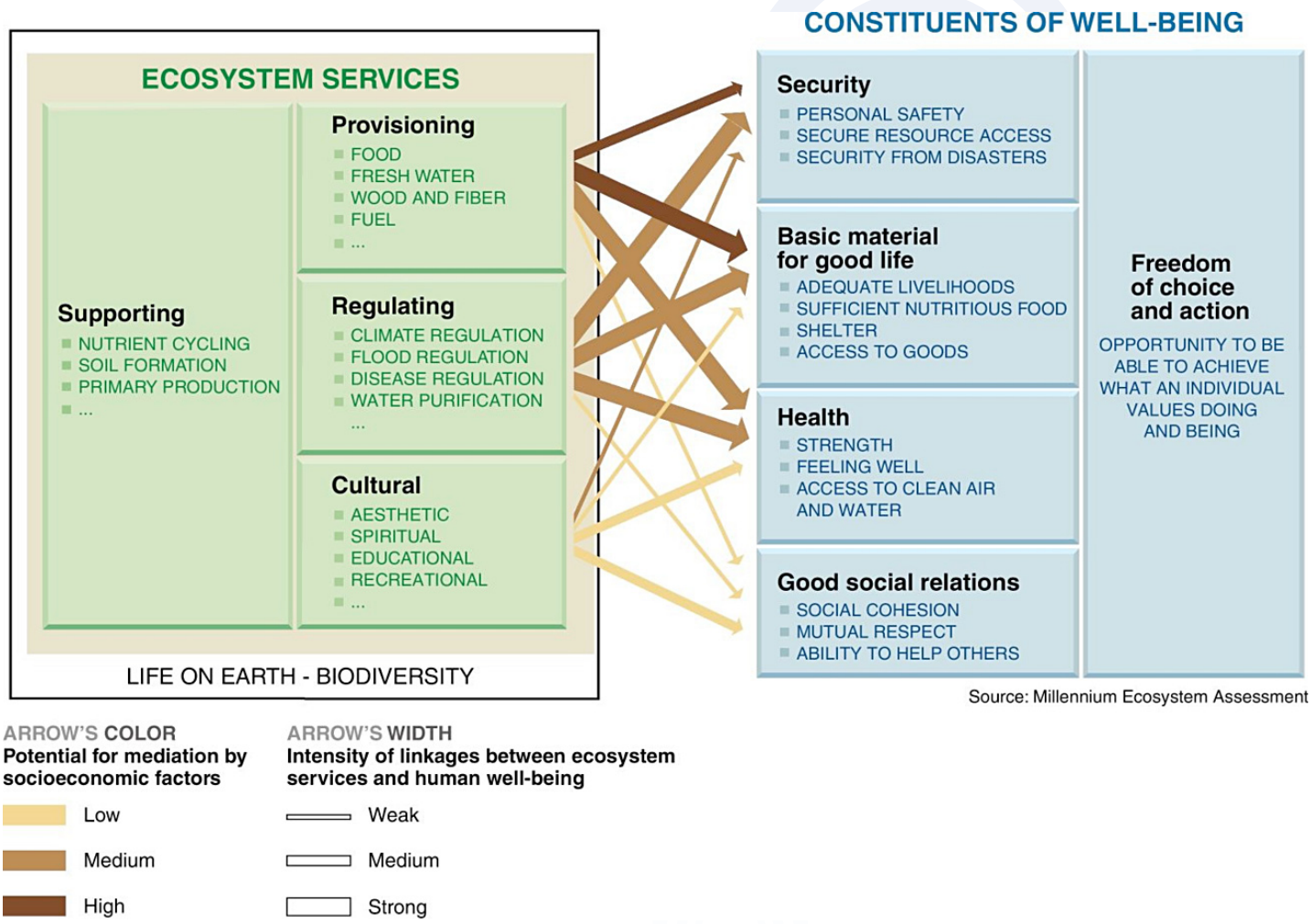


Figure 6

Linkages between Ecosystem Services and Human Well-being *Source: MA*

The figure shows the linkages between the constituents of human well-being and the four categories of ecosystem services defined by the MA. These linkages are described in terms of intensity and potential for mediation by socioeconomic factors.

Biogeochemical Cycles

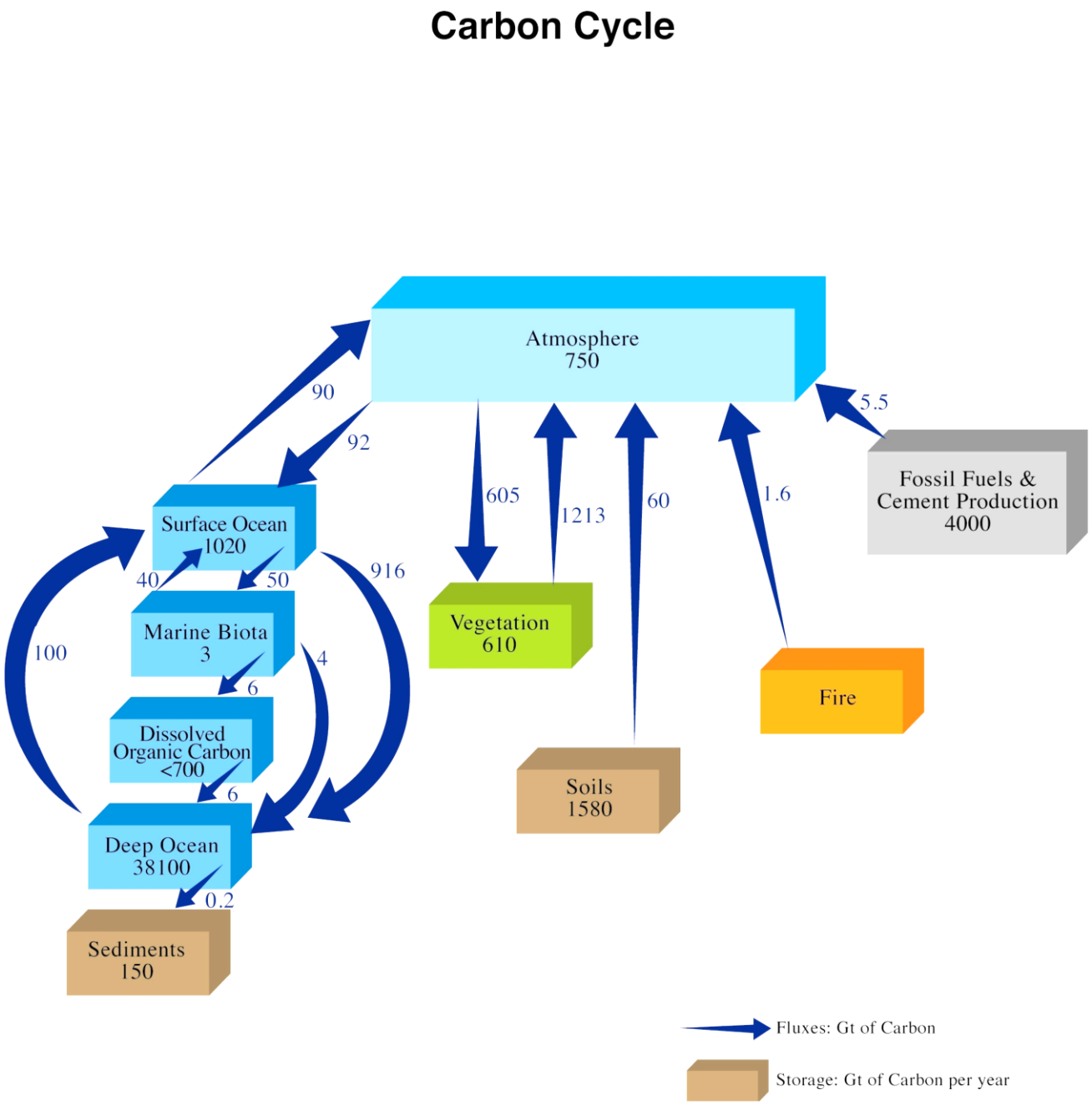


Figure 7

The diagram shows the different stores and fluxes of carbon on a global scale. Note that the fluxes change as the stores change. For example, if the amount of vegetation is reduced, the flux of carbon toward and away from the vegetation changes.

Source: Ritter, 2006

Nitrogen Cycle

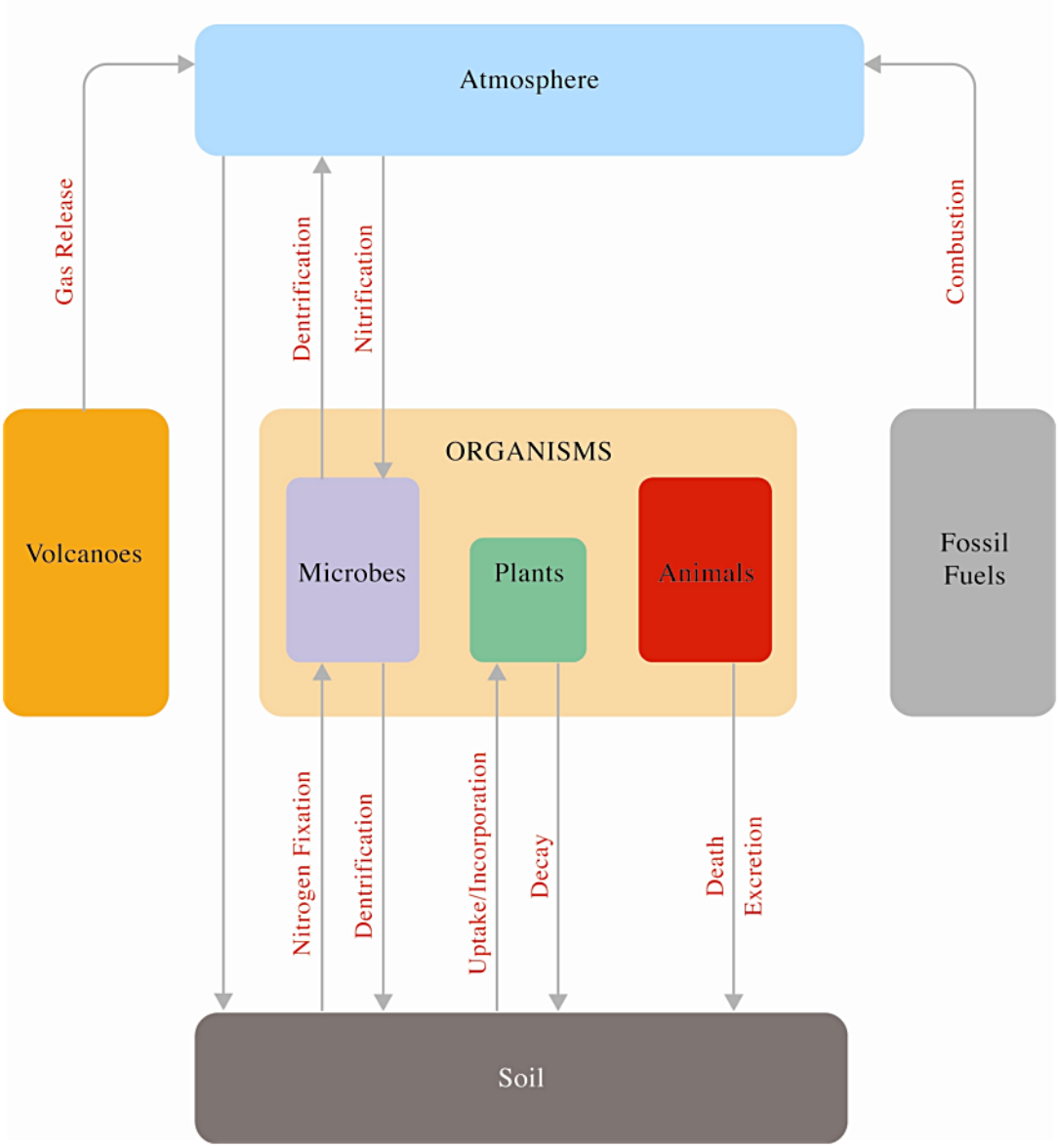


Figure 8

The diagram shows the different stores of nitrogen on the earth, and the pathways for movement of nitrogen between stores.

Source: Beeby and Brennan, 1997

Nitrogen Fixation – The process by which nitrogen gas is converted to ammonia.

Denitrification - A process of nitrate reduction that may ultimately produce molecular nitrogen (N_2) through a series of intermediate gaseous nitrogen oxide products.

Nitrification - The biological oxidation of ammonia with oxygen into nitrite followed by the oxidation of these nitrites into nitrates.

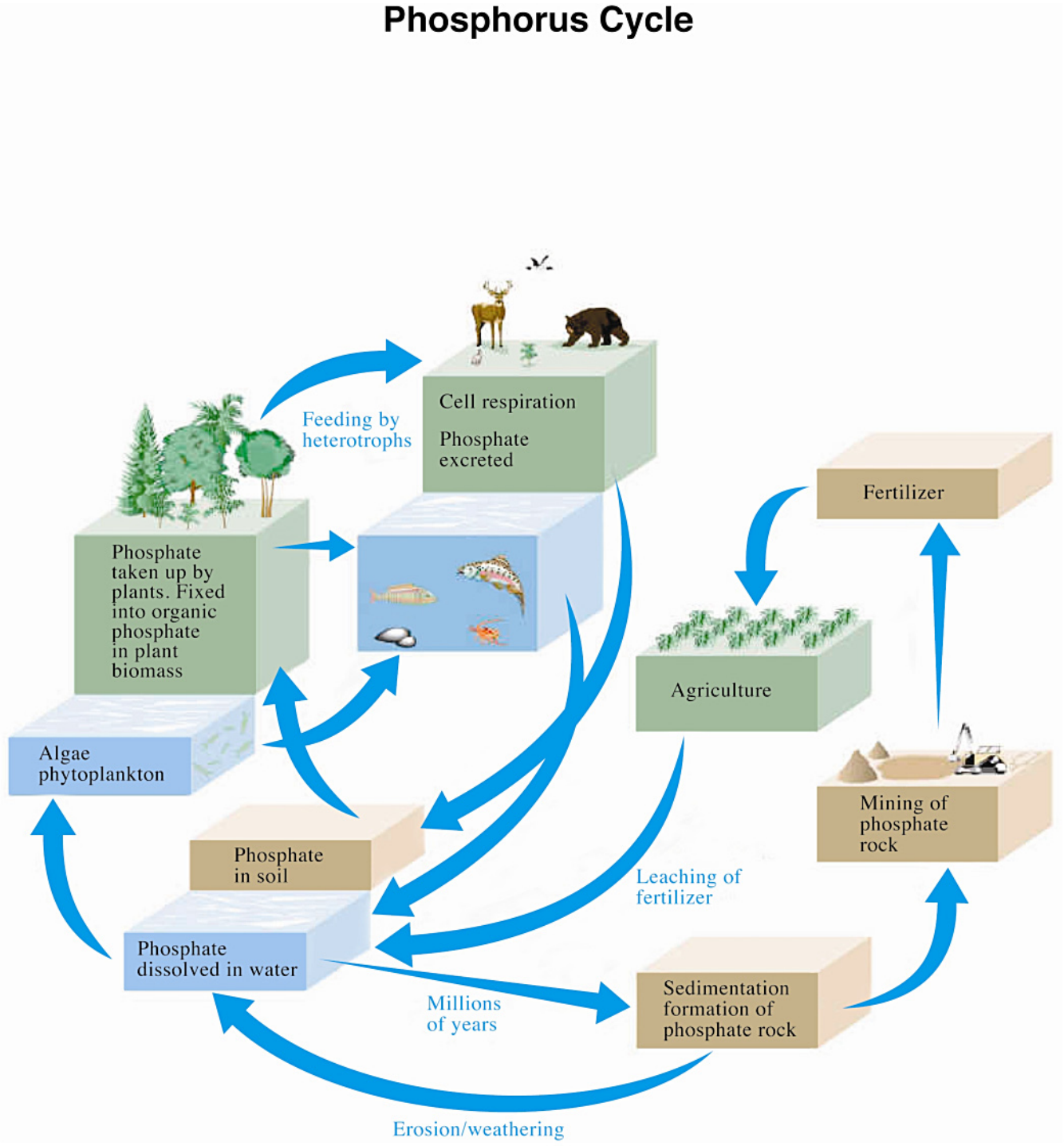


Figure 9

The diagram shows the different stores of phosphorous on the earth, and the pathways for movement of phosphorous between stores.

Source: Wolfe, Steven A.

Water Cycle

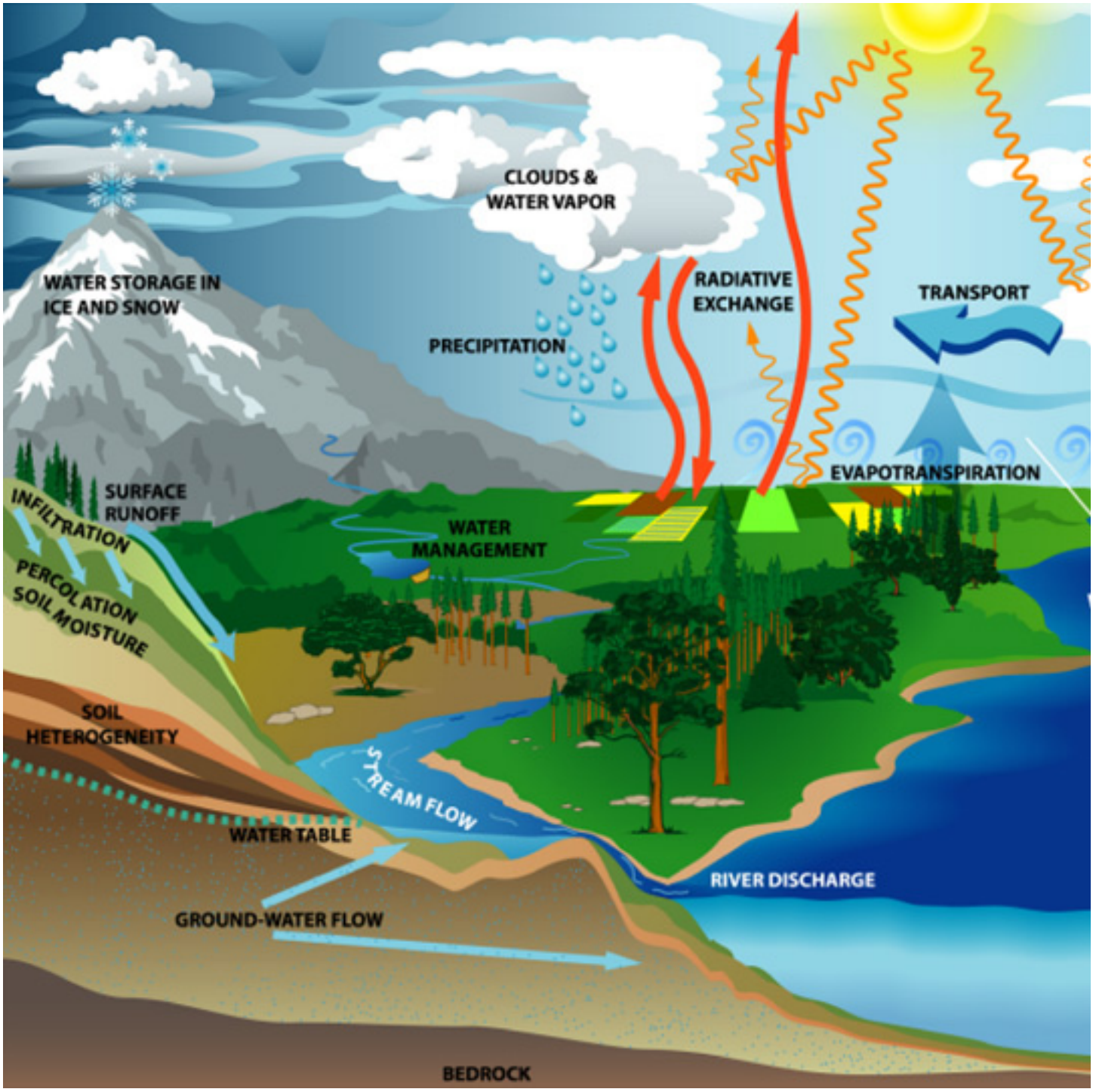


Figure 10

The diagram shows the movement of water through different storages of the earth and atmosphere. Energy fluxes are also indicated in the diagram.

Source: Fen Ditton Community Primary School, 2009

Trophic Levels

1. Primary Producers/ Autotrophs – These represent the first stage in fixing the sun's energy. Include green plants, certain types of bacteria and algae.

2. Secondary Producers/ Heterotrophs/ Primary Consumers – These depend on the productivity of plants. They incorporate energy gained from photosynthesis into their own tissues. Include herbivores and omnivores.

3. Secondary Consumers/ Primary Carnivores – These live on energy fixed in the tissues of herbivores, omnivores or other primary consumers. Include parasites and omnivores.

4. Tertiary Consumers/ Top Carnivores – Include omnivores and detritivores.

5. Detritivores – consume dead plant and animal tissues and wastes and break down complex tissues and organic molecules.

Common Examples of Local Ecosystems and their Trophic Levels.

Trophic Level	Ecosystem Type		
	Coral Reefs	Wetlands	Tropical Forest
1	Zooxanthellae *(a type of algae)*	Red Mangrove *(Rhizophera mangle)*	Trees
2	Coral Polyps	Red crab *(Gecarcoidea natalis)*	Bettle
3	Butterfly fish	Scarlet Ibis	Small monkey *(brown capuchin monkey)*
4	Eels		Ocelot

Basic Food Web

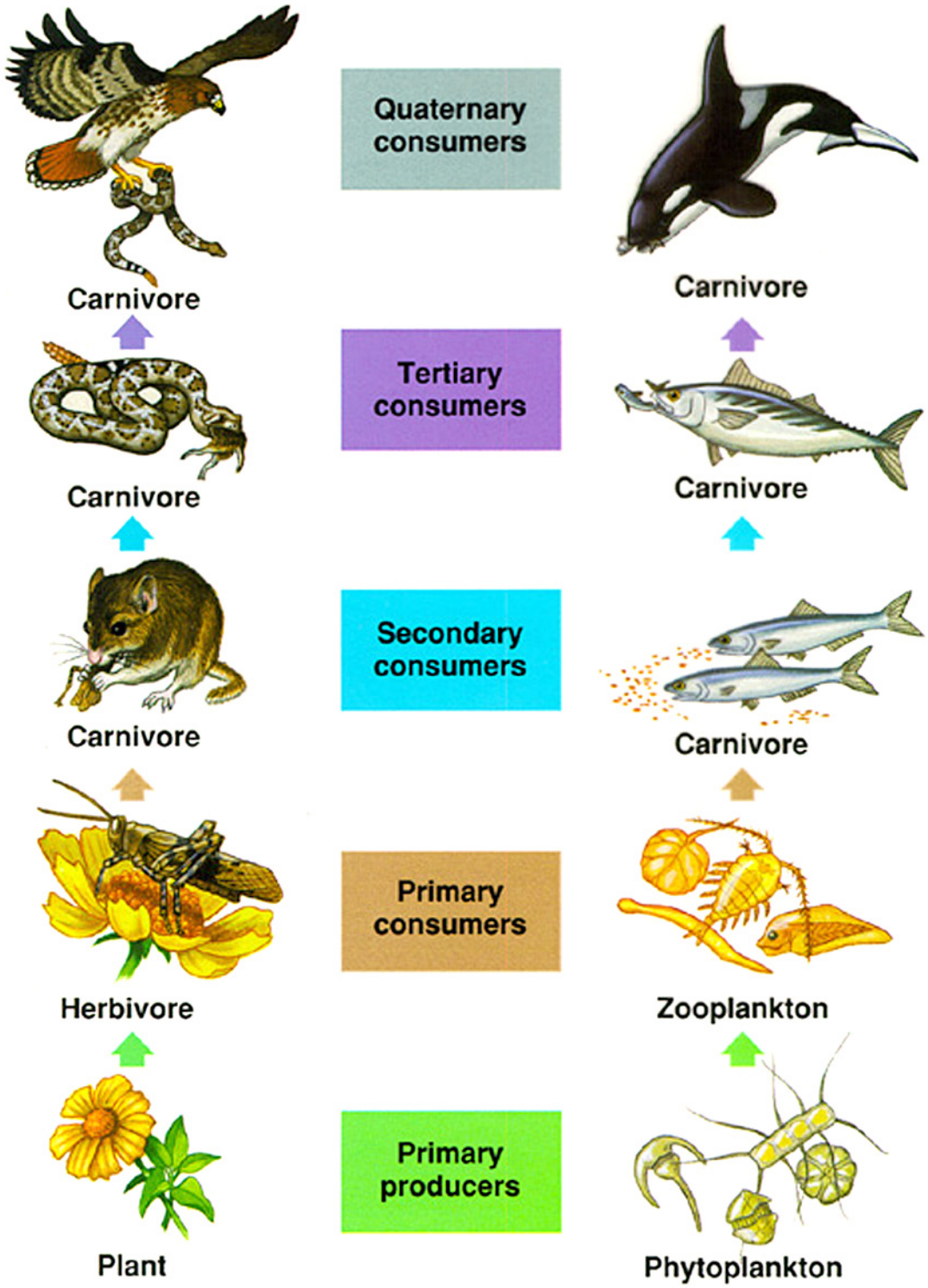


Figure 11

The diagram shows the first three trophic levels found in any basic food web. The food web maps the flow of energy through an ecosystem. In a complete food web, when the animals at the highest trophic level die, the minerals and nutrients from their decomposition are returned to lower trophic levels.

Source: Desert Vista High School, Phoenix, AZ.

Energy Pyramid

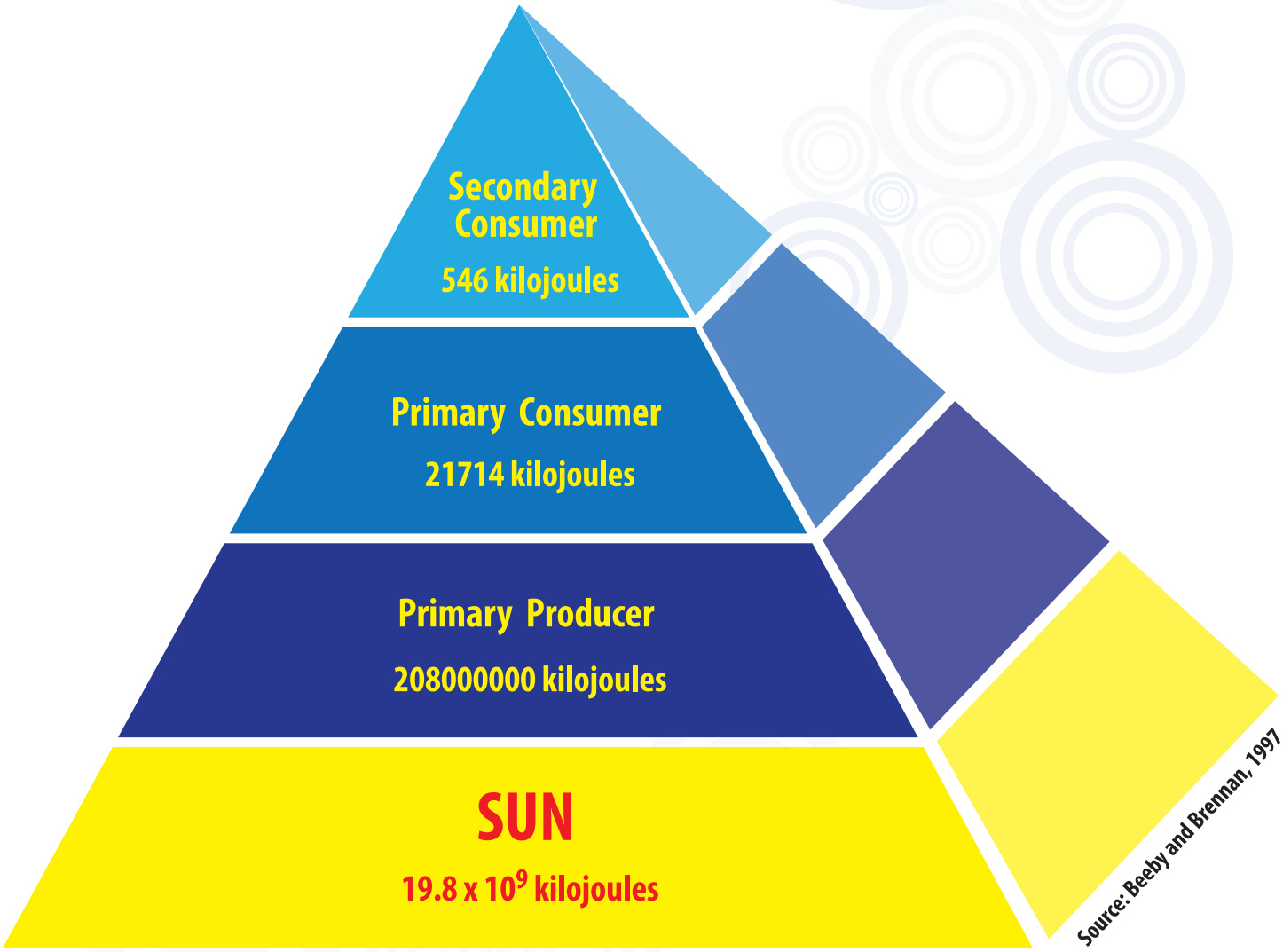


Figure 12

The inefficiency of energy transfer - and the inevitable losses with each transformation - means that little energy is available to higher trophic levels. Losses occur due to respiration, waste, and unconsumed food sources, for example the trunks of trees. Energy pyramids are a clear indication of why the number of organisms decreases up a food chain.

Numbers Pyramid

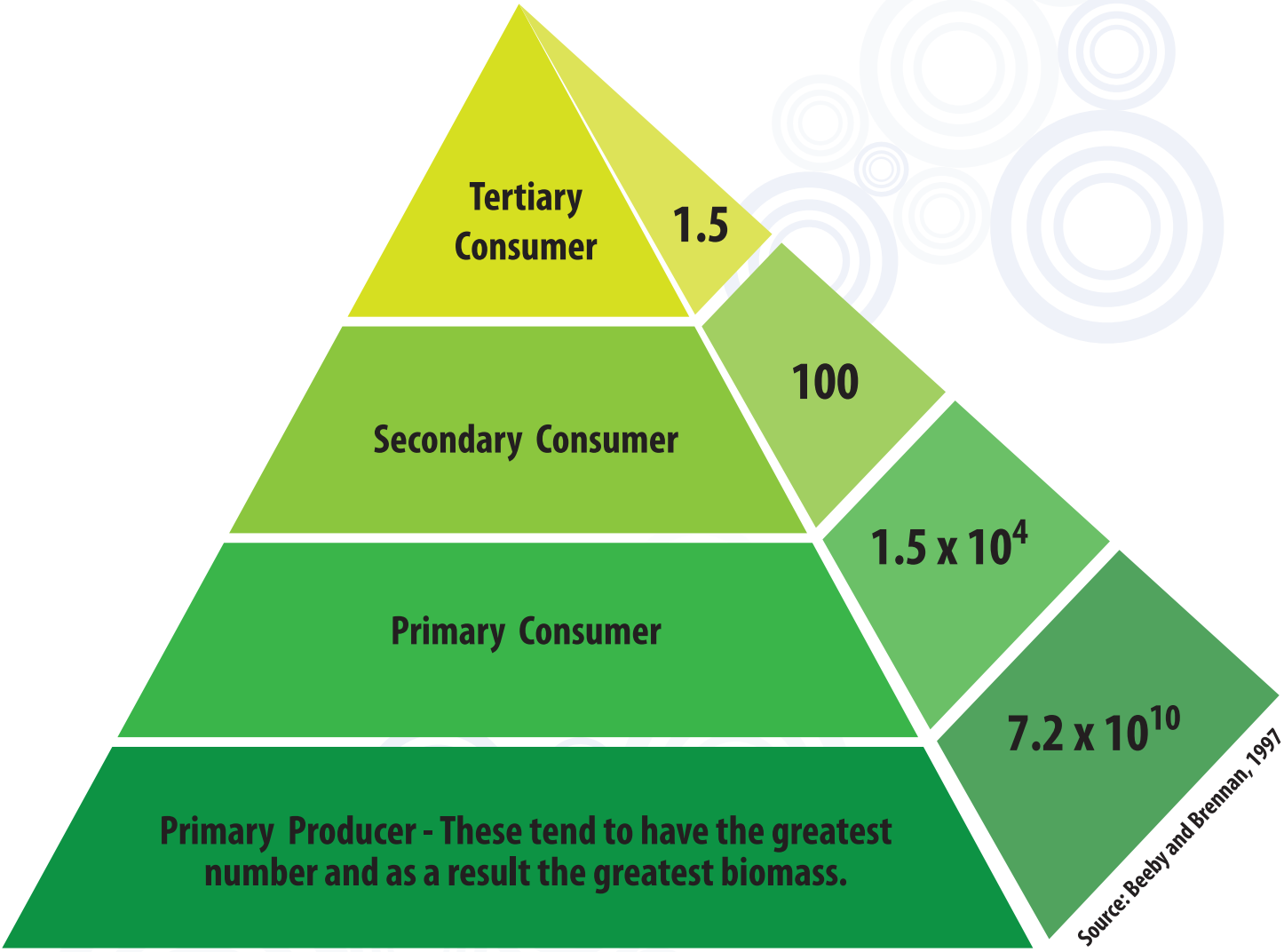


Figure 13

As trophic levels increase the energy decreases, and thus a large number of organisms cannot be supported. The difference between the two numbers pyramids arises out of the type of primary producer that exists in an ecosystem. For example a field of corn that has 1000 individual corn plants may feed a flock of 500 birds. Similarly a large fruit tree may also feed a flock of 500 birds.

Biomass Pyramid

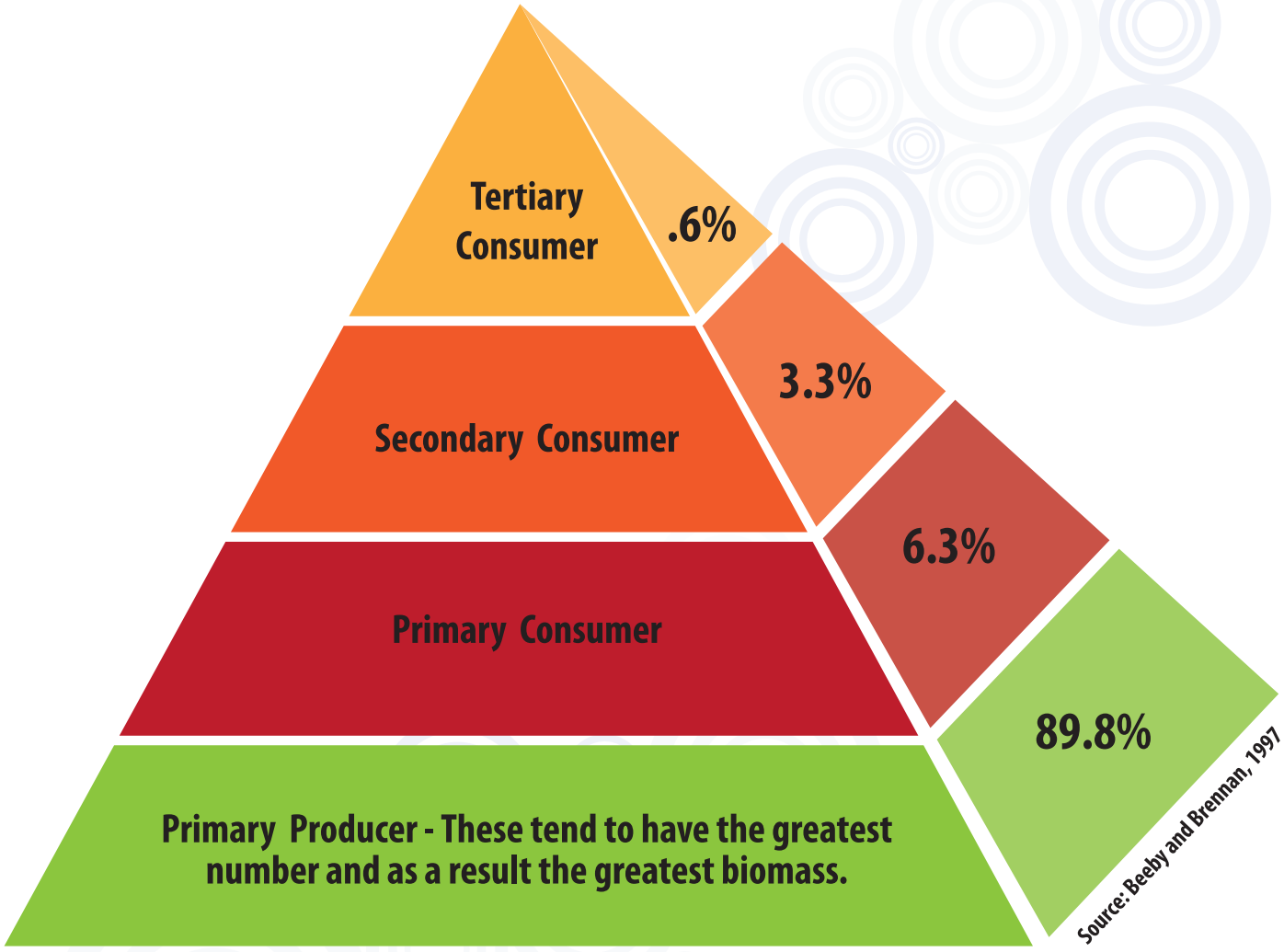


Figure 14

Primary producers usually account for the highest biomass because they are greatest in number. As trophic levels increase the biomass gets smaller; this is related to energy transfer up pyramids. As the trophic levels increase energy transfer decreases, and as a result cannot support large numbers of organisms.

Numbers Pyramid 2

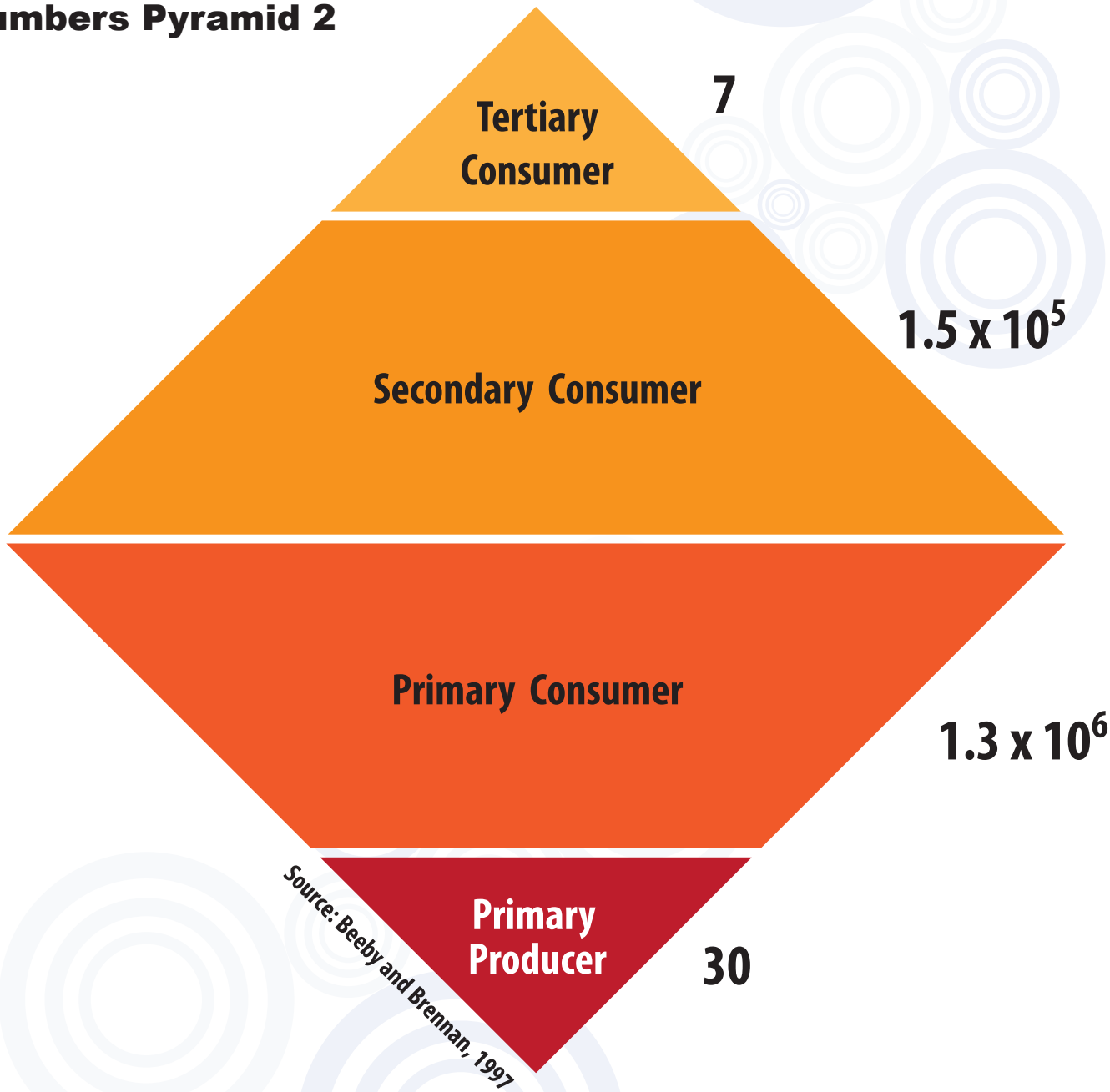


Figure 15

The difference between the two numbers arises out of the type of primary producer that exists in an ecosystem. For example a field of corn that has 1000 individual corn plants may feed a flock of birds, and similarly one large fruit tree may feed the same flock of birds.

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