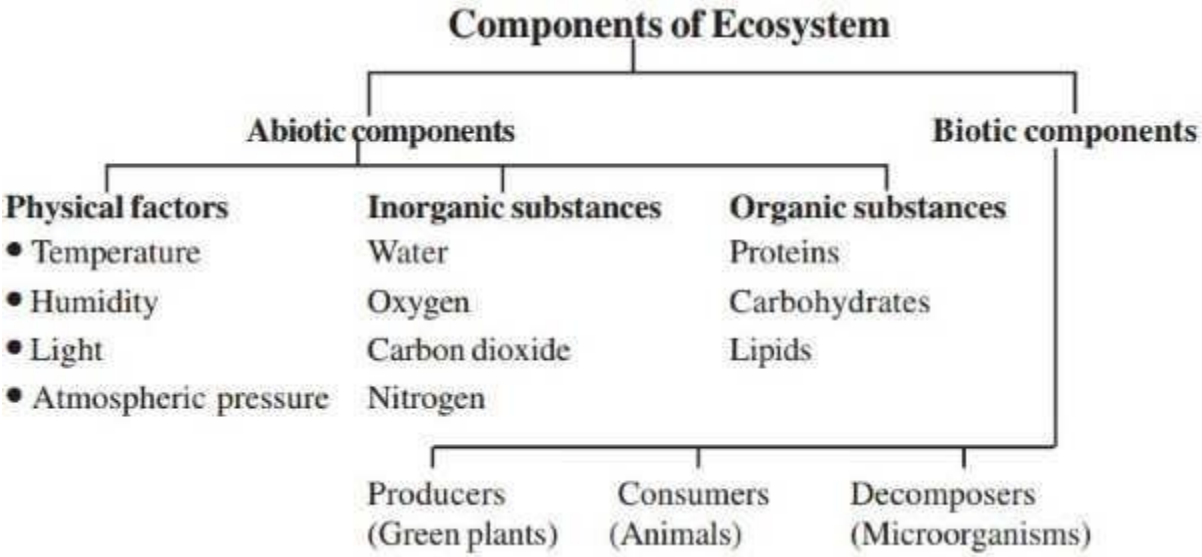
Classify ecosystem services of mangrove forests

Ecosystem:

An ecosystem is all the plants and animals that live in a particular area together with the complex relationship that exists between them and their environment. a system made up of a community of animals, plants, and bacteria interrelated together with its physical and chemical environment.

Component of an Ecosystem:

The components of the ecosystem are categorized into abiotic or non-living and biotic or living components. Both the components of ecosystem and environment are **same**.



Ecosystem service:

Ecosystem services are the many and varied benefits that humans freely gain from the natural environment and from properly-functioning ecosystems. Such ecosystems include, for example, agroecosystems, forest ecosystems, grassland ecosystems and aquatic ecosystems. Collectively, these benefits are becoming known as 'ecosystem services', and are often integral to the provisioning of clean drinking water, the decomposition of wastes, and the natural pollination of crops and other plants.

While scientists and environmentalists have discussed ecosystem services implicitly for decades, the Millennium Ecosystem Assessment (MA) in the early 2000s popularized the concept (Croma and Hussain 2008). There, ecosystem services are grouped into four

broad categories: provisioning, such as the production of food and water; regulating, such as the control of climate and disease; supporting, such as nutrient cycles and crop pollination; and cultural, such as spiritual and recreational benefits. To help inform decision-makers, many ecosystem services are being assigned economic value (Haque et al 1994).

Importance of Ecosystem services:

Ecosystem Services are the benefits nature provides to human well-being (Biswas and Choudhury 2007). Although the term is quite new, our connection to nature is not. We depend on nature for our survival – without healthy ecosystems, our drinking water isn't clean nor is the air we breathe. We also *enjoy* nature··· studies show that people who spend time in nature tend to be happier than those that don't. It can even act as a natural anti-depressant. With industry and urban sprawl expanding at unprecedented rates, Ecosystem Services attempt to translate the benefits we receive from nature into economic terms so we can better understand the trade-offs we are making between nature and industrial development (Giri et al 2000).

This brings us to the reasons why we feel Ecosystem Services are important to each and every person:

Boundless Benefits

Understanding nature in economic terms, while not perfect, allows us to put everything into the same comparison unit. Despite nature being such an integral part of the human existence, it is sometimes an afterthought in today's economy. Nature and money are often on competing terms, so to make a more level playing field, environmental economists have tried to bridge this gap by placing a monetary value on the benefits nature provides (Ojea 2010).

A recent study estimated the combined benefits of nature to people at well over $100 USD trillion per year. To put this in perspective, the top 50 most profitable companies globally combine to make just under $10 USD trillion per year (Daniel et al 2012).

Valuing nature in a way that can speak to decision makers, may help promote conservation efforts in the future. It brings nature back into the cost-benefit discussion in a way that can be easily understood (Kirchhoff 2010).

The Foundation For Sustainable Development

Ecosystem Services help measure the true cost of industrial development. Often, the impact industrial development has on the economy and job creation overshadows the cost it will have on surrounding lakes, forests, keystone species, and so on. Assigning a dollar value to these lakes and forests, and the Ecosystem Services they provide, helps adjust the cost benefit analysis by evaluating the negative effects development will have on the natural environment.

Companies have also started to use Ecosystem Services in conservation offset planning, where they can buy and sell credits to offset a development or set aside land to meet a specific offset. Sustainable development supports the maintenance of a healthy economy while also protecting the ecological process for future generations.

Essential For Our Survival

Whether you live in rural Newfoundland or downtown Los Angeles, your dependence on Ecosystem Services is the same. As a society, we depend on healthy ecosystems to do many things; to purify the air so we can breathe properly, sequester carbon for climate regulation, cycle nutrients so we have access to clean drinking water without costly infrastructure, and pollinate our crops so we don't go hungry. As the world's population continues to grow, so too does our dependence on healthy ecosystems to provide the necessities essential to our survival.

The benefits provided by forest ecosystems include:

- goods such as timber, food, fuel and bioproducts
- ecological functions such as carbon storage, nutrient cycling, water and air purification, and maintenance of wildlife habitat
- social and cultural benefits such as recreation, traditional resource uses and spirituality

Ecosystem services in Sundarban:

The islands in Sundarbans are of great economic importance as a storm barrier, shore stabilizer, nutrient and sediment trap, a source of timber and natural resources, and support a wide variety of aquatic, benthic and terrestrial organisms. It support livelihoods of the localities.(

Provisioning service:

Fishing and timber are among the major provisioning services in the Sundarbans. Wax and honey (by *Apis dorsata* bees), raw material for paper industry are also collected from the forest. Annual harvest of honey and wax are 185,000 kg and 44,400kg, respectively. The Sundarbans is an important source of fuel wood for the locals as well as the distant market. *Ceriops decandra, Cynometra ramiflora, Amoora cuculatta,* and *Hibiscus tiliaceus* which thrive under story of of the forest, are used as fuelwood. Fuelwood are also collected from the branches and twigs of taller trees as *Heritiera fomes, Avicennia officinalis, Sonneratia apetala* and barks of *Excoecaria agallocha. C. decandra,* are more abundant in the western part, are high in calorific value; its barks are reach in tannin which is locally extracted to dye fishnets.

Leaves of *Nypha fruticans* are extensively used in thatching roofs of local households. Timber from *Phoenix paludosa* is used to build house posts, jetties and rafts.Unlike many of the mangroves of the world, The Sundarbans is rich in floral and faunal biodiversity. The forest has about 70 plant species, 55% of which are true mangroves.

- food (including seafood and game), crops, wild foods, and spices
- raw materials (including lumber, skins, fuel wood, organic matter, fodder, and fertilizer)
- genetic resources (including crop improvement genes, and health care)
- water
- Biogenic minerals
- medicinal resources (including pharmaceuticals, chemical models, and test and assay organisms)
- energy (hydropower, biomass fuels)

ornamental resources (including fashion, handicraft, jewelry, pets, worship, decoration and souvenirs l Provisioning Services are ecosystem services that describe the material or energy outputs from ecosystems. They include food, water and other resources.

Food: Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems but marine and freshwater systems or forests also provide food for human consumption. Wild foods from forests are often underestimated.

Raw materials: Ecosystems provide a great diversity of materials for construction and fuel including wood, biofuels and plant oils that are directly derived from wild and cultivated plant species.

Fresh water: Ecosystems play a vital role in the global hydrological cycle, as they regulate the flow and purification of water. Vegetation and forests influence the quantity of water available locally.

Medicinal resources: Ecosystems and biodiversity provide many plants used as traditional medicines as well as providing the raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources.

ike furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.).

Regulating service

Coastal protection and habitat function are the major ecosystem services emphasizing on the need for its sustainable management. A natural belt, Sundarbans is often the first to face and minimize the rigorous winds and waves during cyclones saving both life, properties and its biodiversity. Nutrient, pollutant and sediment regulation of the mangroves is worth studying which offer benefit of millions of dollars if not billions.

- carbon sequestration and climate regulation
- waste decomposition and detoxification

- purification of water and air
- pest and disease control

Regulating Services are the services that ecosystems provide by acting as regulators eg. regulating the quality of air and soil or by providing flood and disease control.

Local climate and air quality: Trees provide shade whilst forests influence rainfall and water availability both locally and regionally. Trees or other plants also play an important role in regulating air quality by removing pollutants from the atmosphere.

Carbon sequestration and storage: Ecosystems regulate the global climate by storing and sequestering greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues. In this way forest ecosystems are carbon stores. Biodiversity also plays an important role by improving the capacity of ecosystems to adapt to the effects of climate change.

Moderation of extreme events: Extreme weather events or natural hazards include floods, storms, tsunamis, avalanches and landslides. Ecosystems and living organisms create buffers against natural disasters, thereby preventing possible damage. For example, wetlands can soak up flood water whilst trees can stabilize slopes. Coral reefs and mangroves help protect coastlines from storm damage.

Waste-water treatment: Ecosystems such as wetlands filter both human and animal waste and act as a natural buffer to the surrounding environment. Through the biological activity of microorganisms in the soil, most waste is broken down. Thereby pathogens

(disease causing microbes) are eliminated, and the level of nutrients and pollution is reduced.

Erosion prevention and maintenance of soil fertility: Soil erosion is a key factor in the process of land degradation and desertification. Vegetation cover provides a vital regulating service by preventing soil erosion. Soil fertility is essential for plant growth and agriculture and well functioning ecosystems supply the soil with nutrients required to support plant growth.

Pollination: Insects and wind pollinate plants and trees which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats. Some 87 out of the 115 leading global food crops depend upon animal pollination including important cash crops such as cocoa and coffee (Klein et al. 2007).

Biological control: Ecosystems are important for regulating pests and vector borne diseases that attack plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls**Habitats for species:** Habitats provide everything that an individual plant or animal needs to survive: food; water; and shelter. Each ecosystem provides different habitats that can be essential for a species' lifecycle. Migratory species including birds, fish, mammals and insects all depend upon different ecosystems during their movements.

Maintenance of genetic diversity: Genetic diversity is the variety of genes between and within species populations. Genetic diversity distinguishes different breeds or races from

each other thus providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock. Some habitats have an exceptionally high number of species which makes them more genetically diverse than others and are known as 'biodiversity hotspots'.

Cultural service

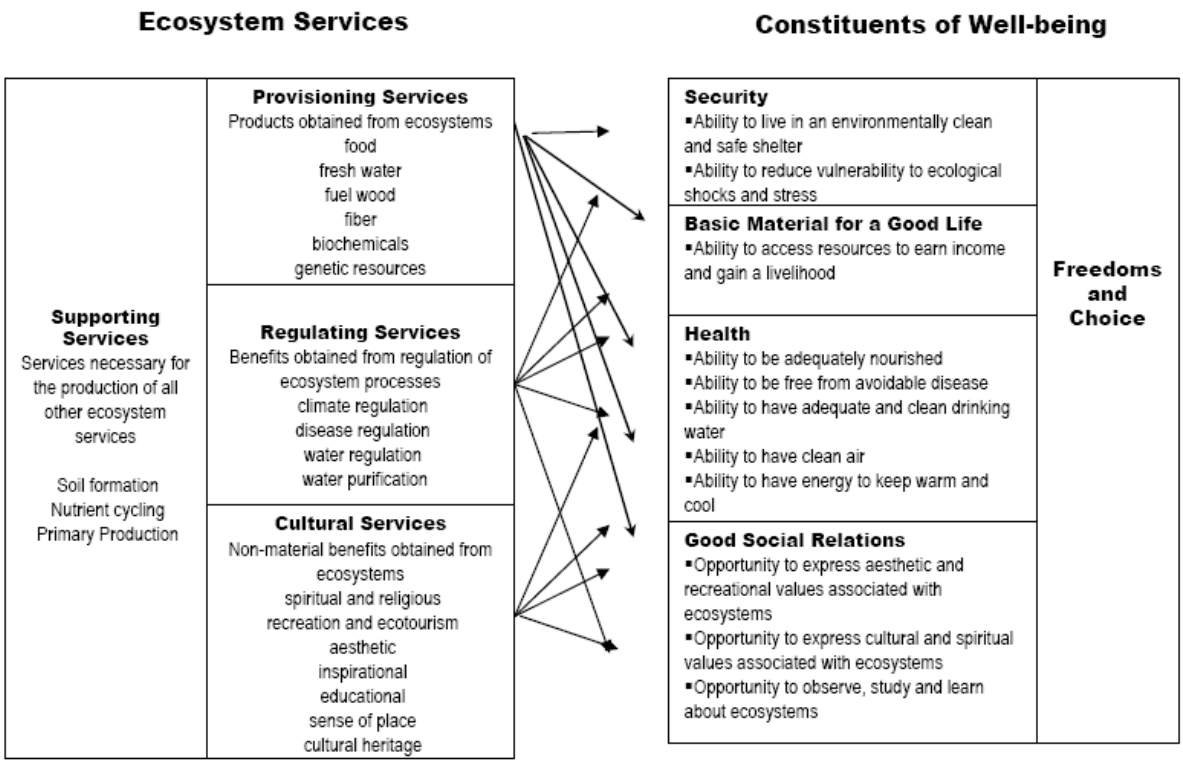
- Tourism is one of the rising economic activities in the area in recent years which is a major threat as well. Considering declining and threatened mangroves around the world, Sundarbans holds huge potential for scientific community and hence the global community. cultural (including use of nature as motif in books, film, painting, folklore, national symbols, architect, advertising, etc.)
- spiritual and historical (including use of nature for religious or heritage value or natural)
- recreational experiences (including ecotourism, outdoor sports, and recreation)
- science and education (including use of natural systems for school excursions, and scientific discovery)
- Therapeutic (including Ecotherapy, social forestry and animal assisted therapy)

Recreation and mental and physical health: Walking and playing sports in green space is not only a good form of physical exercise but also lets people relax. The role that green space plays in maintaining mental and physical health is increasingly being recognized, despite difficulties of measurement.

Tourism: Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and is a vital source of income for many countries. In 2008 global earnings from tourism summed up to US$ 944 billion. Cultural and eco-tourism can also educate people about the importance of biological diversity.

Aesthetic appreciation and inspiration for culture, art and design: Language, knowledge and the natural environment have been intimately related throughout human history. Biodiversity, ecosystems and natural landscapes have been the source of inspiration for much of our art, culture and increasingly for science.

Spiritual experience and sense of place: In many parts of the world natural features such as specific forests, caves or mountains are considered sacred or have a religious meaning. Nature is a common element of all major religions and traditional knowledge, and associated customs are important for creating a sense of belonging.



Source: Zakri, 2003

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