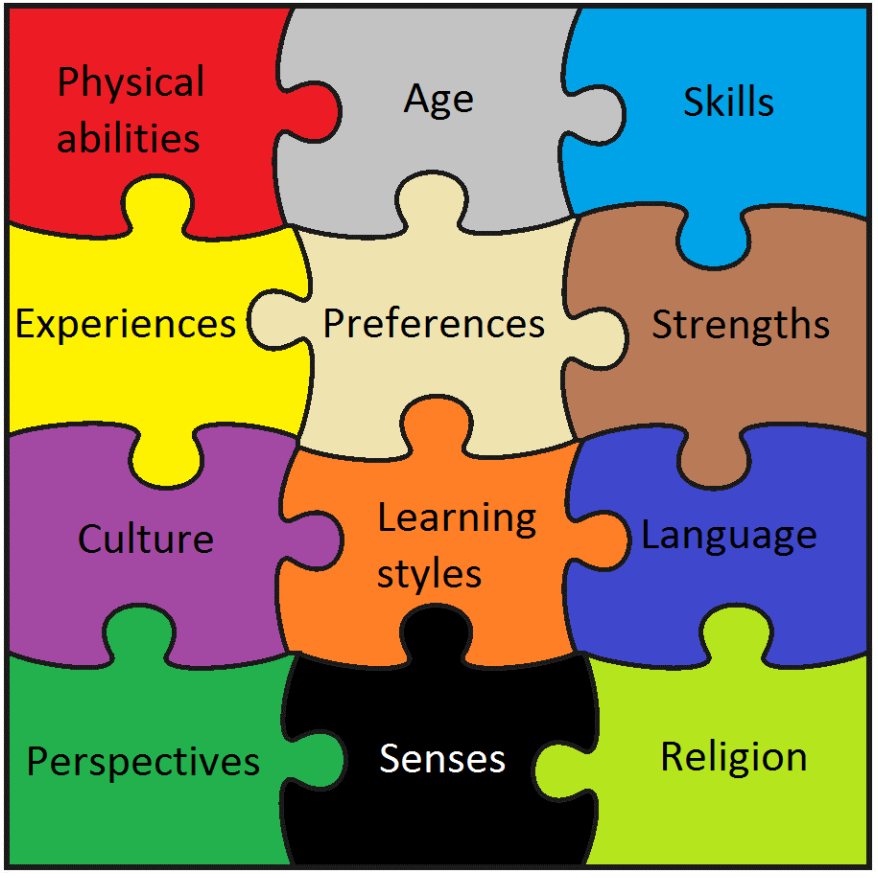
Diversity in a classroom

Diverse = Different



Biodiversity

Bio = Life
Diverse = Different

Biodiversity refers to the variety in life from and habitat they exist in.

Biodiversity

As per the **Convention on Biological Diversity** (CBD) 1992, held in Rio De Jenerio, Brazil by 154 countries:

"Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.

Value of a Tree

A tree that lives for **50 years** generates:

Rs. 5.3 lakhs worth of **oxygen**

Facilitates Rs. 6.4 lakhs worth of **soil erosion control**

Creates Rs. 10.5 lakhs worth of **air pollution control**

Provides Rs. 5.3 lakhs worth of **shelter for birds and animals**

Recycles Rs. 6.4 lakhs worth of **fertility**

Besides provide **flower, fruits and timber**

Biodiversity: Importance

Intricate dependence of species on each other makes biodiversity a key factor for the sustenance of life on earth.

Microscopic biodiversity in our soils creates the chemical conditions necessary for healthy, abundant, and sustainable crops.

The hardwood trees in the rainforests that are our most effective above-ground carbon sinks.

Without bees, many of our crops would vanish.

Economically, the services provided by biodiversity are estimated to be double the world's annual GDP.

Biodiversity: Importance/Types

Biodiversity makes an ecosystem more productive.

A biodiverse ecosystem is generally more stable and sustainable.

A biodiverse ecosystem has higher chance of survival, during the environmental stress.

Biodiversity can be categorized into three levels:

1. Genetic diversity

2. Species diversity

3. Ecosystem diversity

Genetic diversity

This refers to the genetic variability among or within the species.

Genetic constitution of species is vastly different from each other. This is the source of unique features of an species.

Genetic diversity

Genetic diversity primarily originates due to combination of inherited genetic materials.

Other factors can also be responsible for genetic diversity e.g., mutation, or environmental conditions etc.

Species diversity

Species: A group of organisms, capable of interbreeding.

Species diversity is then number of different species and their abundance in a ecosystem.

There are about 1.8 million different species on earth and one million are **insects**.

But there might be 5 -30 million species on the earth.

Each year 13,000 more species added.

Species diversity

Species richness: Number of different species present in an ecosystem.

Species evenness: Relative abundance of individuals of each of those species.

Tropical Rainforests: It is a ecosystem with most species diversity. According to the estimates, half of world species lives in tropical rainforests. It is home to 40 % of flower plant and 30 % of bird species.

Species diversity is dependent on both place and season.

Ecosystem diversity

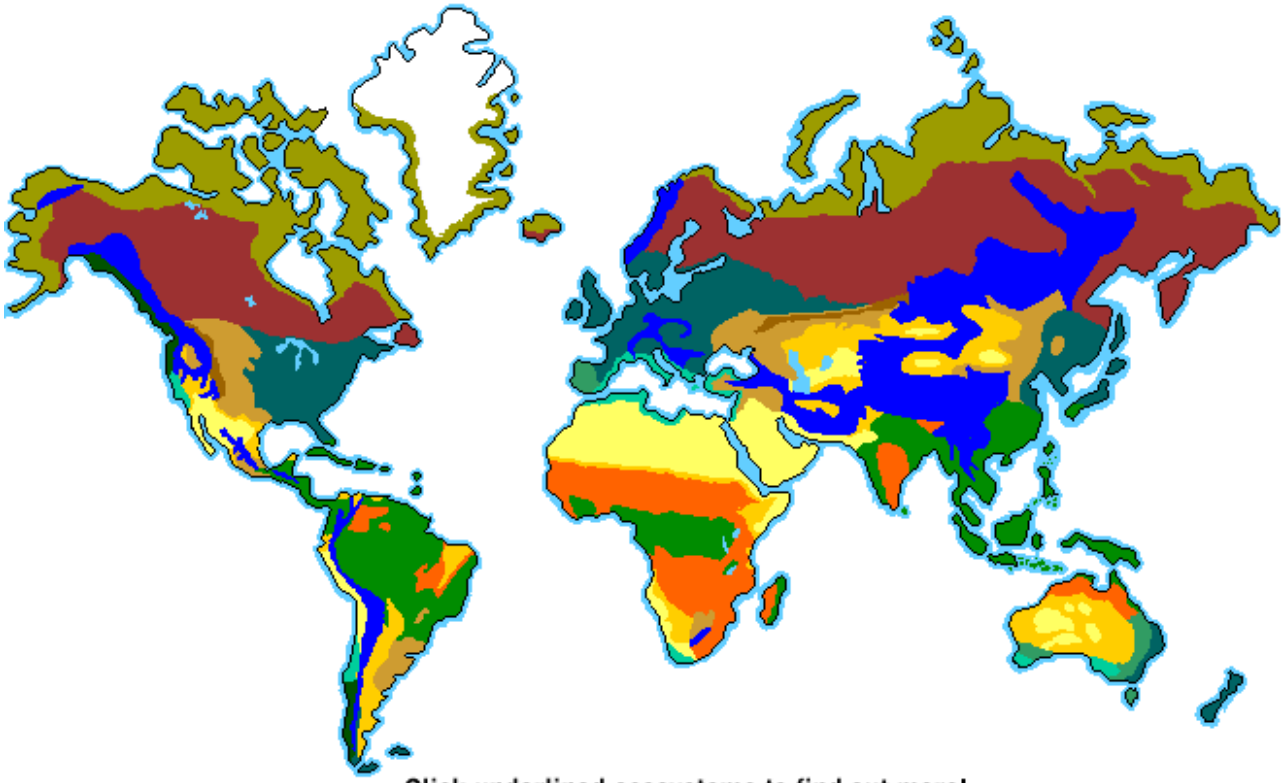
Different Ecosystem (aquatic & terrestrial) are formed due to different geological and environmental conditions prevailing on earth.

These ecosystems are habitat to different types of plants & animals.

Diversity of ecosystem refers to different kind of ecosystems present in a particular geographical area.

Ecosystem diversity includes both: **community diversity** and **habitat diversity**.

Ecosystem diversity



Hot spots

Biodiversity hotspot is a biogeographic region with significant levels of biodiversity that is **threatened with destruction**.

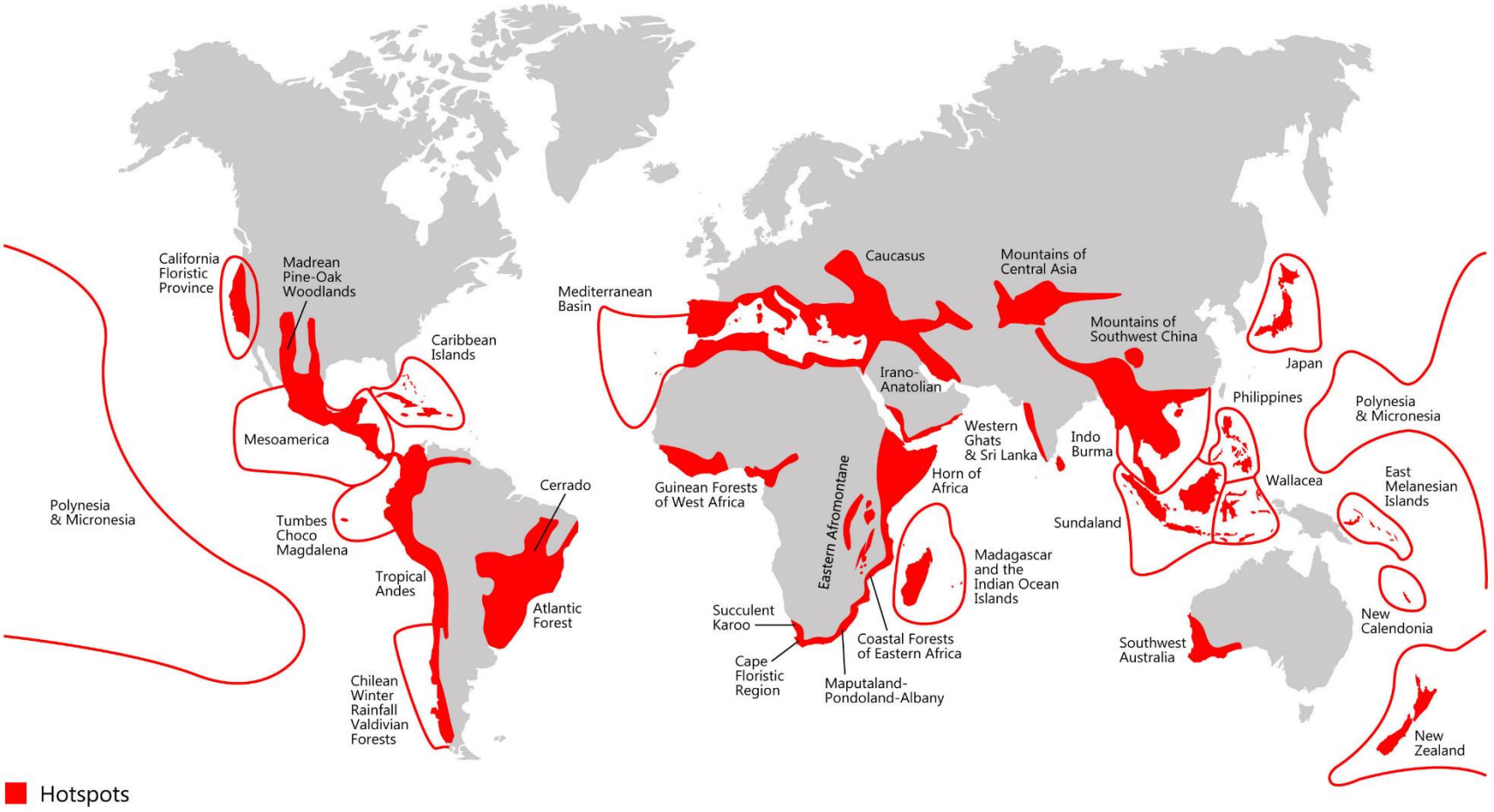
To qualify as a biodiversity hotspot, a region must meet two strict criteria:

It must have at least 0.5% or 1,500 vascular plants as endemics — which is to say, it must have a high percentage of plant life found nowhere else on the planet.

Have lost at least 75% of its primary native vegetation.

Around the world 36 areas qualify under this definition.

Hot spots


California Floristic Province
Madrean Pine-Oak Woodlands
Caribbean Islands
Mesoamerica
Polynesia & Micronesia
Tumbes Choco Magdalena
Cerrado
Tropical Andes
Atlantic Forest
Chilean Winter Rainfall Valdivian Forests
Mediterranean Basin
Caucasus
Mountains of Central Asia
Irano-Anatolian
Mountains of Southwest China
Western Ghats & Sri Lanka
Indo Burma
Guinean Forests of West Africa
Eastern Afromontane
Horn of Africa
Madagascar and the Indian Ocean Islands
Succulent Karoo
Cape Floristic Region
Coastal Forests of Eastern Africa
Maputaland-Pondoland-Albany
Japan
Philippines
Polynesia & Micronesia
Wallacea
East Melanesian Islands
Sundaland
New Calendonia
Southwest Australia
New Zealand
Hotspots

Mega-biodiversity

Mega-biodiversity refers to exhibition of great biodiversity.

List of mega diverse countries:

Australia	Brazil	China	Colombia
D. R. Congo	Ecuador	Indonesia	Madagascar
Malaysia	Mexico	Papua New Guinea	Peru
Philippines	South Africa	United States	Venezuela

India

Mega-biodiverse countries, acoount for 60% of planet’s terrestial biodiversity.

India bio-geography

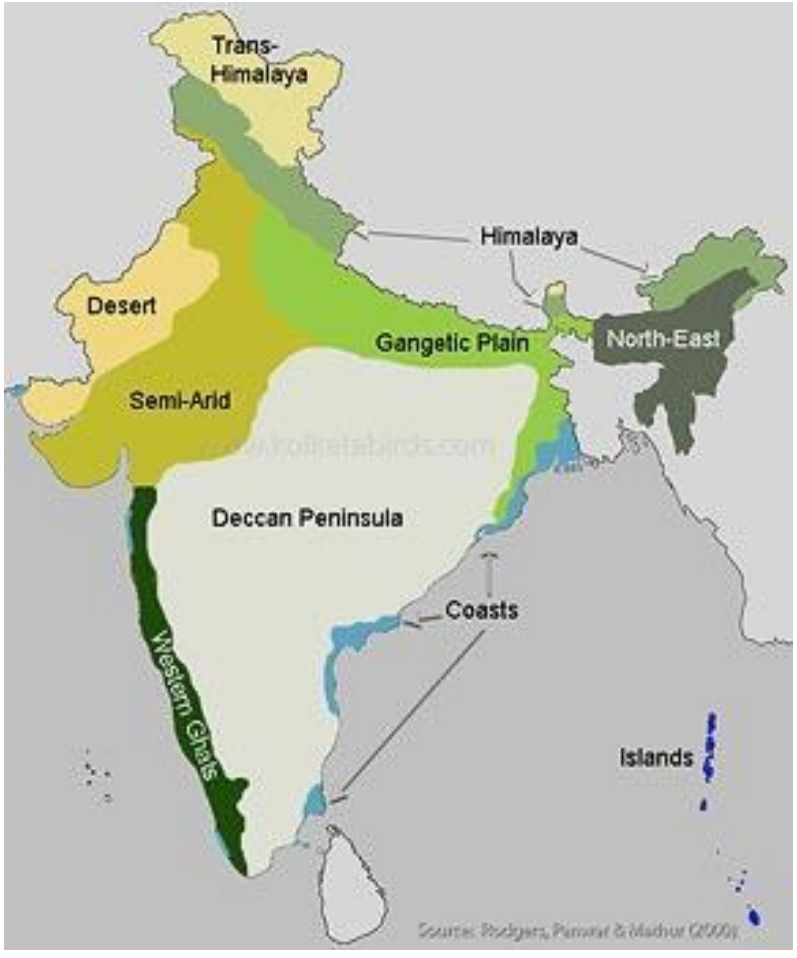
Biodiversity in India can be attributed to its vastly varying geographic and climatic conditions.

India has 2.4 % of world's total area .

1% of the world's forest area.

7.31% of Earth's biodiversity.

India has 16.1% of world human population and 15.1% of cattle population



India Mega-biodiversity

The ministry of environment and forests, Govt. of India records ~45000 species of plants and ~90000 species of animals i.e., 7% and 6.5% of the global flora and fauna.

About 62% of amphibians and 50% lizards are endemic to India.

Western Ghats are the site of maximum endemism.

About 18 percent of the country's recorded plants and animals are endemic to the country.

India has 26 recognized endemic centers that are home to nearly one third of all the identified flowering plants.

India Mega-biodiversity

Taxonomic Group	World	India	%
Chordata	48,451	4,952	10.22
Protochordata	2,106	119	11.80
Pisces	21,723	2546	12.00
Amphibia	5,150	219	17.80
Reptilia	5,817	456	8.46
Aves	9,026	1,166	8.53
Mammalia	4,629	397	7.00
Total (Animalia)	11,96,903	86,874	7.25
Protista	31,250	2,577	9.24
Total	12,28,153	89,457	7.29

Animal species

India Mega-biodiversity

Taxonomic Group	India	World	%
Algae	6,500	40,000	16.25
Fungi	14,500	72,000	11.80
Lichens	2,021	17,000	12.00
Bryophyta	2,850	16,000	17.80
Pteridophyta	1,135	13,000	8.46
Gymnosperms	64	750	8.53
Angiosperms	17,500	2,50,000	7.00

Plant species

Threats to biodiversity

Extinction, the elimination of species is a normal process in nature. Species die out and are replaced by other as part of **evolutionary process**.

Human activities has significantly increased the rate of elimination of species. **As per E. O. Wilson, 10,000 species per year or 27 per day becomes extinct.**

For an undisturbed ecosystem rate of rate of extinction should be ~10.

It is rare that humans intend to make a species go extinct or to threaten biodiversity in some other way. Usually, those impacts are the unfortunate by-products of people trying to provide a decent living for themselves.

Loss of biodiversity

“HIPPO”

- **H**abitat Loss
- **I**nvasive Species
- **P**oaching
- **P**ollution
- **O**ver population

Habitat loss

The term **habitat** refers to an area with the resources and conditions present to produce occupancy by a given organism.

Habitat loss refers to the loss of these resources and environmental conditions.

Habitat destruction is the single largest cause of biodiversity loss.

Loss of habitat can be classified into three major types:

1. Habitat destruction

2. Habitat degradation

3. Habitat fragmentation

Habitat destruction

Habitat destruction is a process by which natural habitat is damaged to such an extent that it becomes incapable of supporting ecological community existing there.

Habitat are being destroyed by the human activities such as mining, agriculture, hydroelectric dams, and urbanization etc.

Habitat loss can also occur due to natural events such as volcanic activity, earthquakes, and floods etc.

Habitat degreadation

It is a process that leads to the reduction in the quality of habitat.

Habitat degradation is primarily a byproduct of human activities e.g., air pollution, water pollution or noise pollution etc.

Habitat fregmentation

Habitat fragmentation refers to the splitting of a habitat into smaller patches.

It reduces animal ranges and restricts movement, placing animals in these areas at higher risk of extinction.

This can also lead to reduction of genetic diversity, due to separation of species.

Invasive species

An invasive species is a non native species, that has become a threat to the native species.

If an aggressive species is introduced to an ecosystem, it may not have a predator or controller. Thus, it spreads rapidly and becomes dominant.

Lantana camara

Poaching

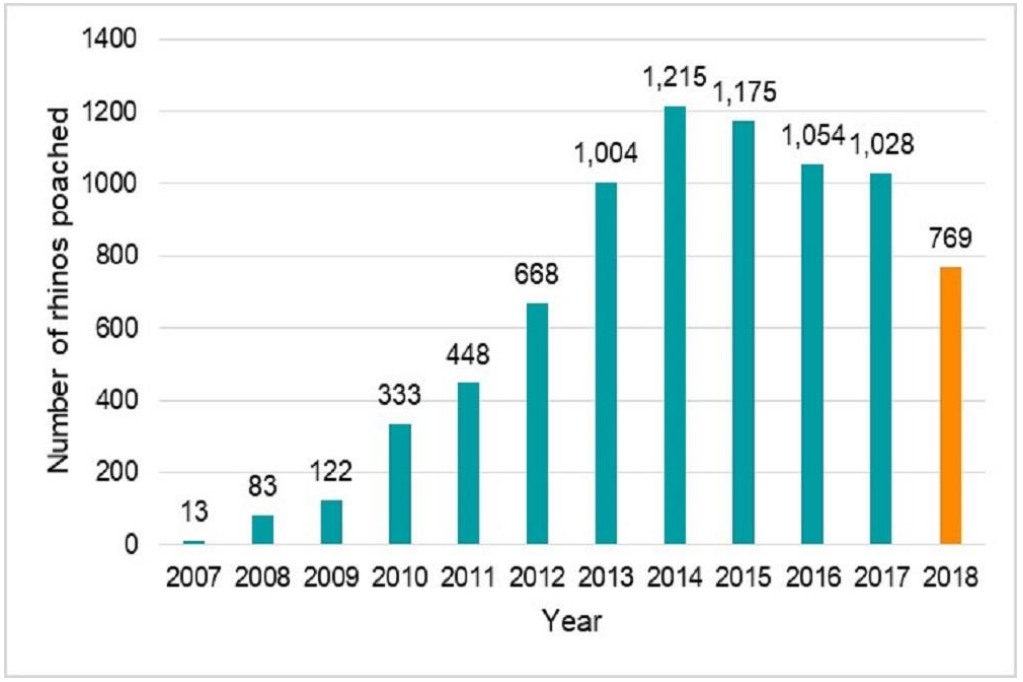
Poaching is the practice of illegal hunting or removing of species from its habitat.

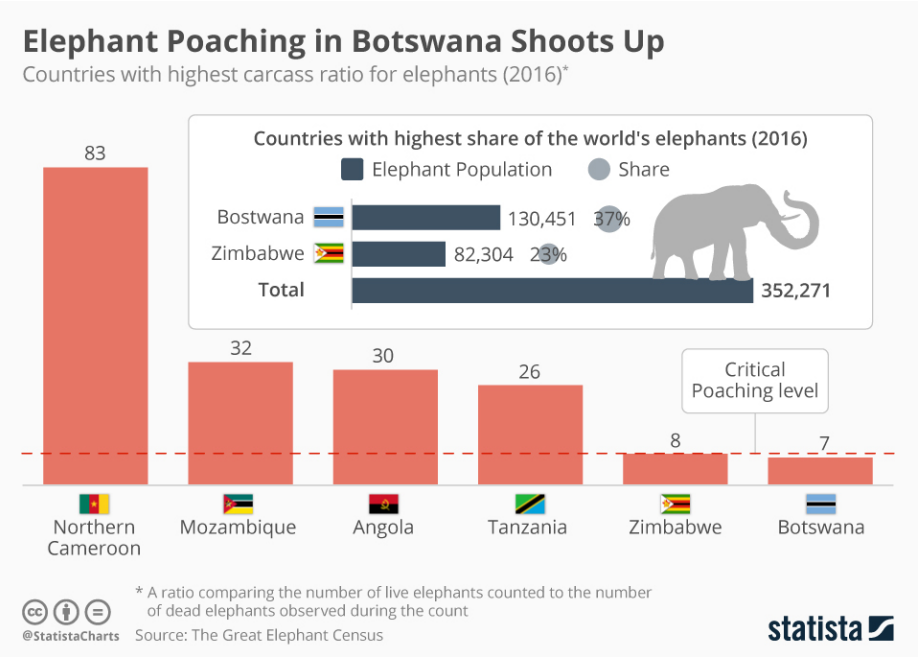
Poachers generally kill or smuggle the species for the monetary benefits. Asia is one of the largest market for wildlife trading.

Poachers target animals to prevent them from destroying crops or attacking livestock.

In some cases hunting is treated as sport.

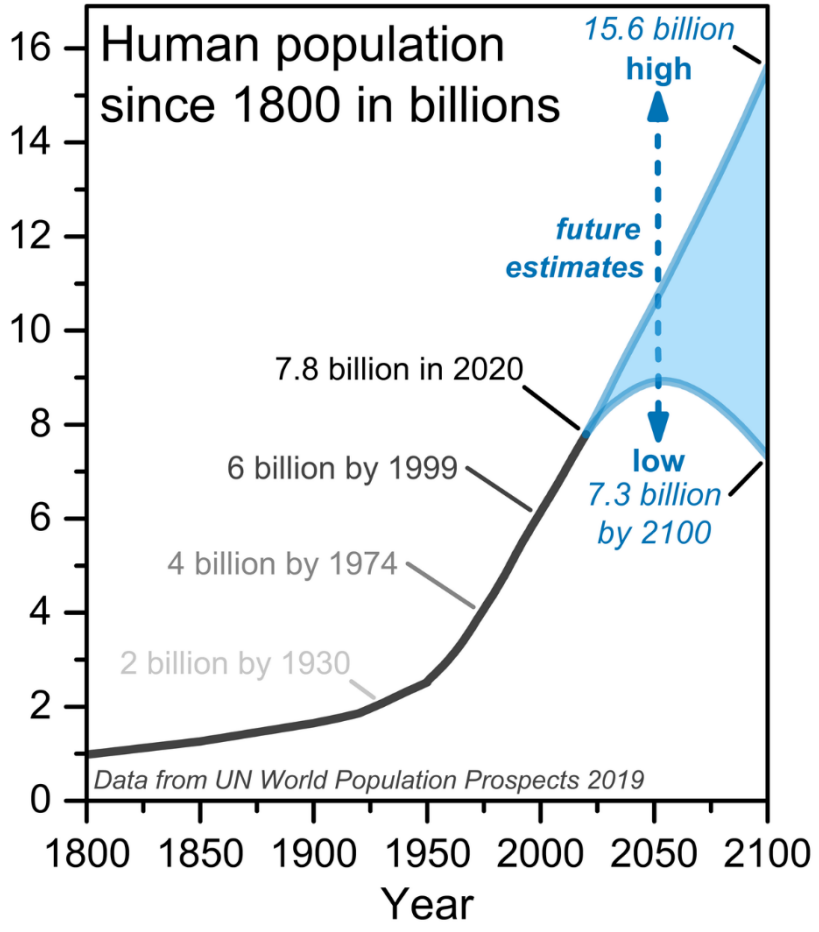
Poaching

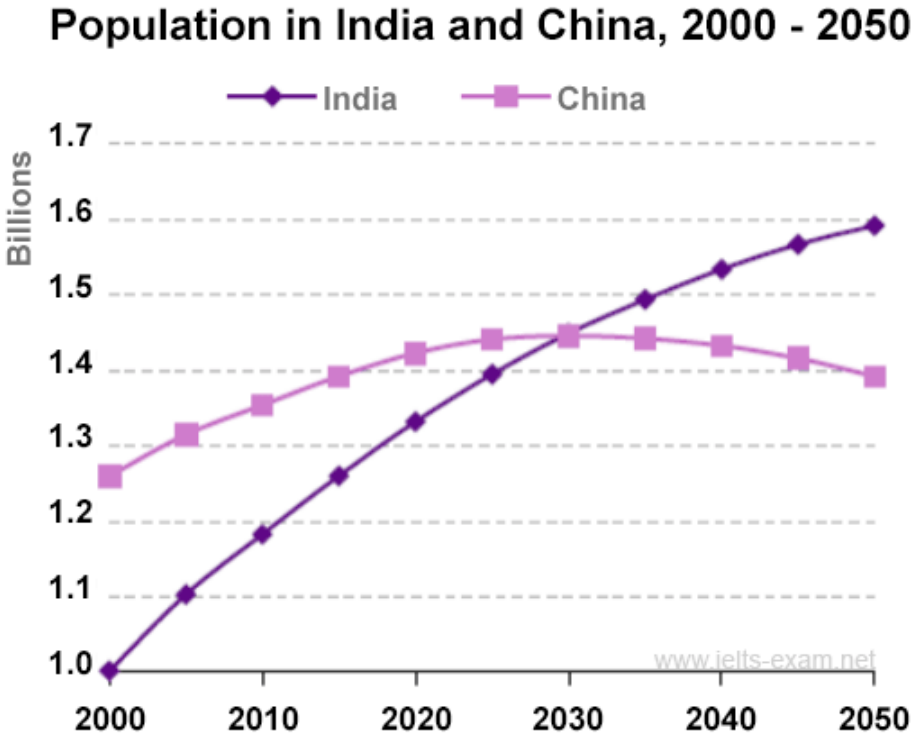

Number of rhinos poached
1400
1200
1000
800
600
400
200
0
13
83
122
333
448
668
1,004
1,215
1,175
1,054
1,028
769
2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Year


Elephant Poaching in Botswana Shoots Up
Countries with highest carcass ratio for elephants (2016)*
Countries with highest share of the world's elephants (2016)
Elephant Population
Share
Bostwana 130,451 37%
Zimbabwe 82,304 23%
Total 352,271
83
32
30
26
8
7
Critical Poaching level
Northern Cameroon
Mozambique
Angola
Tanzania
Zimbabwe
Botswana
* A ratio comparing the number of live elephants counted to the number of dead elephants observed during the count
@StatistaCharts
Source: The Great Elephant Census
statista

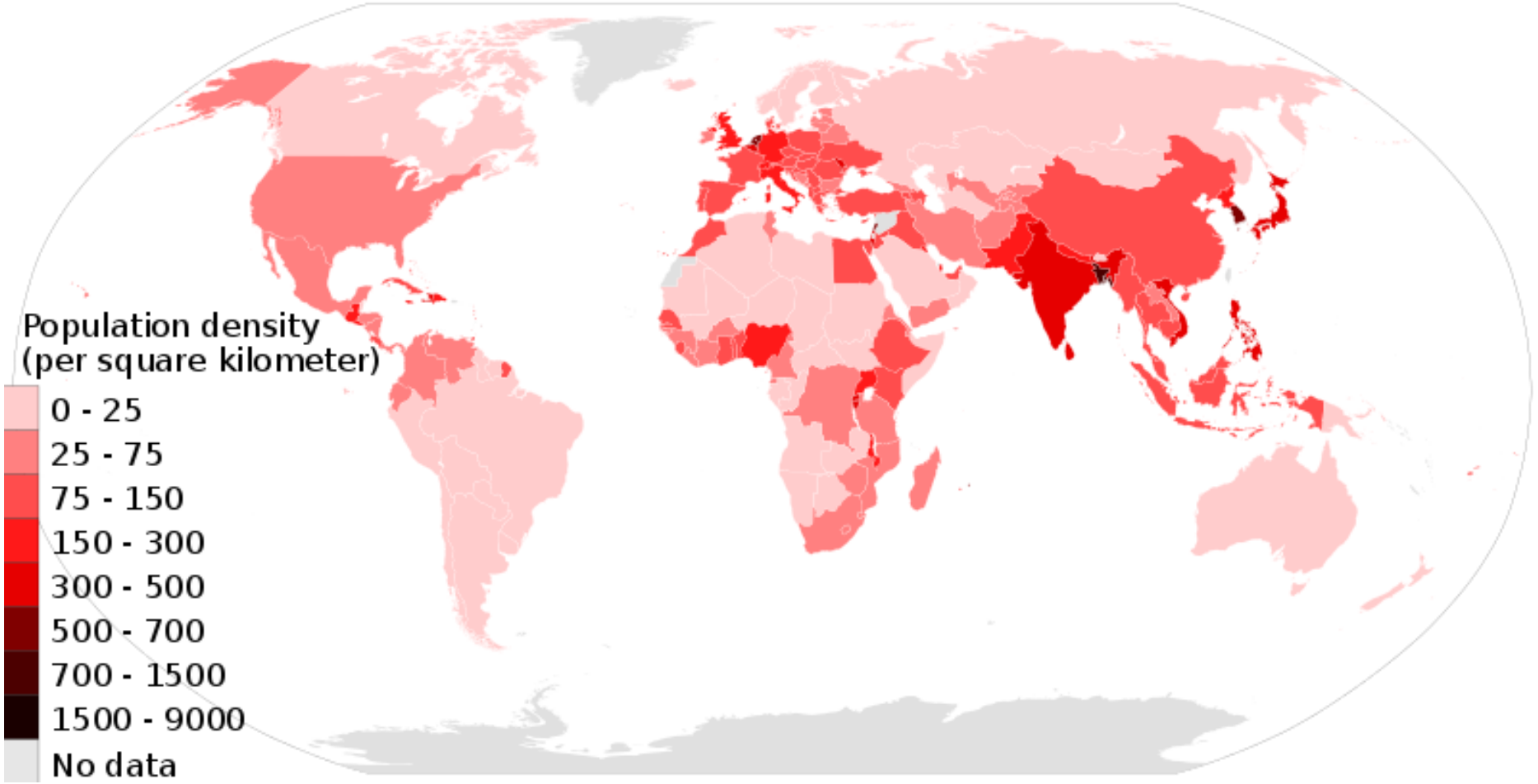
Pollution

Overpopulation





Overpopulation



Threatened species

Loss of bio-diversity poses a serious threat to the survival of many species.

International Union for Conservation of Nature (IUCN) defines threatened species in following categories:

1. Critically Endangered (CR), 2.Endangered (EN), and 3. Vulnerable (VU)

Extinct species

A species is said to be extinct when it is not seen in the wild for 50 years at a stretch.

List of species extinct in India

Indian aurochs

Pink-headed duck

Sunderban dwarf rhinoceros

Northern Sumatran rhinoceros

Asiatic cheetah

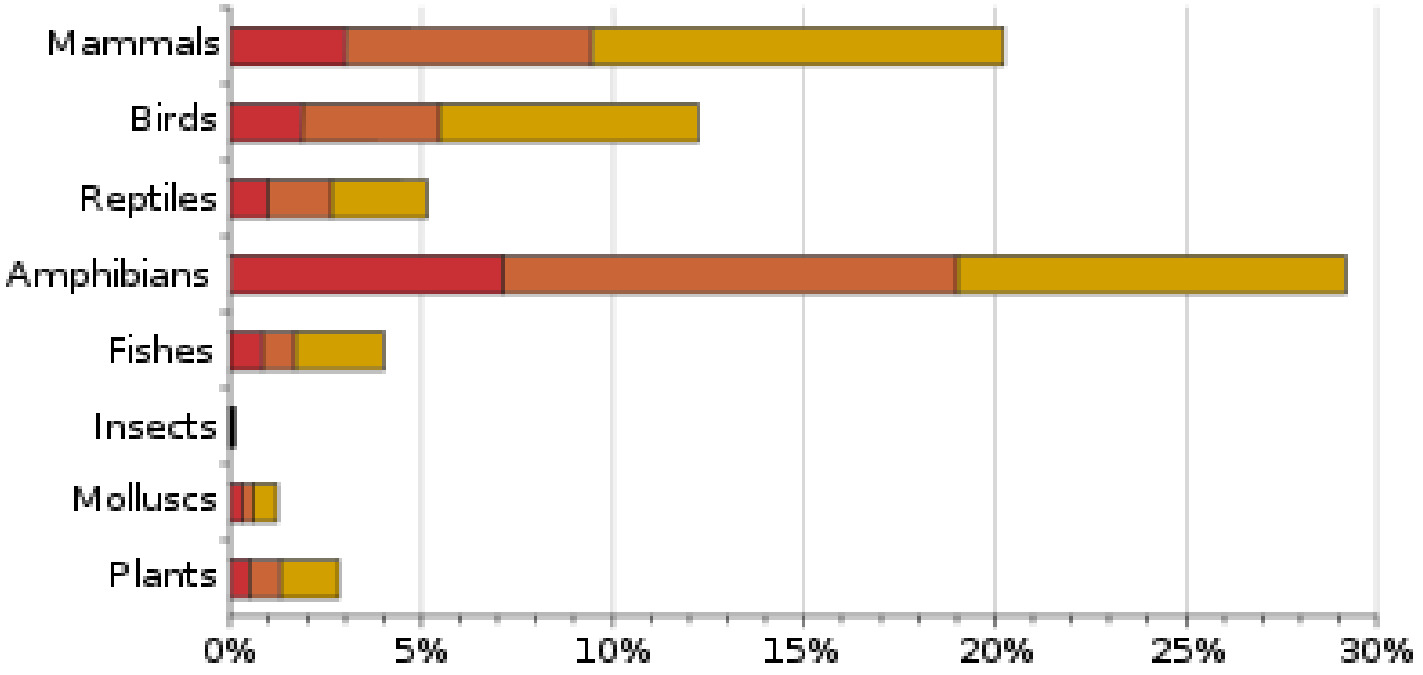
Threatened species

A species is said to be "threatened" or "endangered" when its number has been reduced to a critical level or whose habitats, have been drastically reduced.

If such a species is not protected and conserved, it is in immediate danger of extinction.

Species become endangered for two main reasons: (a) loss of habitat and (b) loss of genetic variation.

Threatened species



Endemic or precinctive species

Endemic species are plants and animals that exist only in one geographical region. Species can be endemic to a particular continent, some part of continent or to an island.

Endemic specie are more vulnerable to extinct because they depend on a certain type of habitat or food source, can not adjust to alteration whether natural or human caused.

Rare species

A group of organisms (plants / animals) that are uncommon.

Rare species are the species with small population and are generally considered as threatened species because small population size is more likely to face ecological disaster.

Rare species are different from endangered species or threatened species. Designation of rare species are made by official bodies like government, state or province.

Species interaction

In an ecological community, individual organism interact in many difrrent manner. This interaction may benefit both individuals, or the interaction may benefit one.

Predation

Competition

Symbiosis
– Mutualism
– Commensalism
– Parasitism

Predation

Predation is any interaction between two organisms in which one organism (the predator) consumes all or part of another organism (the prey).

Both, one animal eating other or a herbivore grazing on a plant are examples of predation.

Different animals or plants adopt different strategies to deal with predation such as camouflage, warning signals, or defensive weapons etc.

Similarly, different predators adopt different strategies to maximize there chances of success such as ambush, stalking, or group hunting etc.

Competition

Competition in an interaction between two organisms that are using the same limited resource.

Competition can be within the same species (intraspecific) or between different species (interspecific).

Most interspecific competition involves one species becoming more efficient than others in obtaining the resources it needs.

Symbiosis

“A long-term relationship between two different species”.

“A convenient living arrangements in which dissimilar partners live together with some mutual benefit, explicit or implicit”.

Symbiosis is an intimate relationship between different species in which at least one species depends upon the relationship to survive.

Most of the interactions between species involve food:

- Competing for the same food supply
- Eating (predation)
- Avoiding being eaten (avoiding predation)

Mutualism

Mutualism is commonly defined as interactions between individuals of different species that benefit both of them.

Obligate mutualism: Mutualism is vital for the growth, survival or reproduction of an organism.

Facultative: Organism is not so dependent on the mutualism that it cannot survive without it.

Commensalism

Commensalism is a relationship between two organisms in which one organism benefits, and one is unaffected.

Benefits to be gained in a commensal relationship can be transportation, nutrition, and protection etc.

Parasitism

Parasitism is a symbiotic relationship, where one member, the parasite, gains benefits that come at the expense of the other, host.

Obligate parasitism: Parasites are completely dependent on the host in order to complete their life cycle.

Facultative parasitism: Parasite can survive without the host, and only sometimes perform parasitic activities.

Parasitism

Ectoparasitism: Parasite lives outside the body host, e.g., ticks or lice.
Endoparasitism: Parasite lives inside the body of host, e.g., tapeworm.
Mesoparasitism: Parasite enters through an opening, e.g., flea.

Macroparasitism: Can be seen with the naked eye, e.g., mosquito.
Microparasitism: Need a microscope to view them, e.g., protozoa.

Necrotrophic: Necrotrophic parasites eat part of the host organism's tissue until it dies from the loss of tissue or from nutrient loss, e.g., botrytis cinerea.
Biotrophic: Biotrophic parasites need to keep the host alive as they can't survive in a dead one, ustilago maydis.

Parasitism

Monogenic: Monogenic parasites complete their life cycle in only one individual host.
Digenetic: Digenetic parasites need more than one host to complete their life cycle, e.g., Plasmodium vivax.

Epiparasitism: A parasite that parasitizes another organism that is also a parasite. These are also called hyper-parasites or secondary parasites.
Brood Parasitism: Adult of one species will raise the abandoned young of other species, e.g., cowbirds and cuckoos.
Social Parasitism: Social parasites take advantage of social insects like ants, bees, and termites.

Conservation

“Conservation of biodiversity is protection, upliftment and scientific management of biodiversity so as to maintain it at its threshold level and derive sustainable benefits for the present and future generation.”

Objectives of conservation of biodiversity are:

Maintain essential ecological processes
Preserve the diversity of species
Ensure sustainable utilization of species and ecosystem

Convention on biological diversity

On 22 May 1992, in Nairobi, the nations of the world adopted a global Convention on Biological Diversity.

Later, on 5 June 1992, at the UN Conference on Environment and Development in Rio de Janeiro, a record number of over 150 States signed it.

Approximately 18 months later, on 29 December 1993, the Convention entered into force.

Convention on biological diversity

The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity. The sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

Convention on biological diversity

Preamble

The Contracting Parties,

Conscious of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components.

Conscious also of the importance of biological diversity for evolution and for maintaining life sustaining systems of the biosphere, Affirming that the conservation of biological diversity is a common concern of humankind.

Reaffirming that States have sovereign rights over their own biological resources.

Convention on biological diversity

Reaffirming also that States are responsible for conserving their biological diversity and for using their biological resources in a sustainable manner.

Concerned that biological diversity is being significantly reduced by certain human activities.

Aware of the general lack of information and knowledge regarding biological diversity and of the urgent need to develop scientific, technical and institutional capacities to provide the basic understanding upon which to plan and implement appropriate measures.

Noting that it is vital to anticipate, prevent and attack the causes of significant reduction or loss of biological diversity at source.

Convention on biological diversity

Noting also that where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.

Noting further that the fundamental requirement for the conservation of biological diversity is the in-situ conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings.

Noting further that ex-situ measures, preferably in the country of origin, also have an important role to play.

Convention on biological diversity

Recognizing the close and traditional dependence of many indigenous and local communities embodying traditional lifestyles on biological resources, and the desirability of sharing equitably benefits arising from the use of traditional knowledge, innovations and practices relevant to the conservation of biological diversity and the sustainable use of its components.

Recognizing also so the vital role that women play in the conservation and sustainable use of biological diversity and affirming the need for the full participation of women at all levels of policy-making and implementation for biological diversity conservation.

Convention on biological diversity

Stressing the importance of, and the need to promote, international, regional and global cooperation among States and intergovernmental organizations and the non-governmental sector for the conservation of biological diversity and the sustainable use of its components.

Acknowledging that the provision of new and additional financial resources and appropriate access to relevant technologies can be expected to make a substantial difference in the world's ability to address the loss of biological diversity.

Acknowledging further that special provision is required to meet the needs of developing countries, including the provision of new and additional financial resources and appropriate access to relevant technologies.

Convention on biological diversity

Noting in this regard the special conditions of the least developed countries and small island States.

Acknowledging that substantial investments are required to conserve biological diversity and that there is the expectation of a broad range of environmental, economic and social benefits from those investments.

Recognizing that economic and social development and poverty eradication are the first and overriding priorities of developing countries.

Aware that conservation and sustainable use of biological diversity is of critical importance for meeting the food, health and other needs of the growing world population, for which purpose access to and sharing of both genetic resources and technologies are essential.

Convention on biological diversity

Noting that, ultimately, the conservation and sustainable use of biological diversity will strengthen friendly relations among States and contribute to peace for humankind.

Desiring to enhance and complement existing international arrangements for the conservation of biological diversity and sustainable use of its components.

Determined to conserve and sustainably use biological diversity for the benefit of present and future generations.

Action plan

1. Protected areas
2. Species protection and recovery measures
3. Ex situ and in situ conservation of genetic diversity
4. Restoration
5. Consider biodiversity in agriculture, forestry, and fisheries
6. Capture of benefits by local communities
7. Increased coordination
8. Public awareness and education
9. Increased integration of sectorial responses
10. Sustainable intensification of agriculture
11. Addressing unsustainable consumption patterns
12. Slowing global growth of nutrient loading
13. Correction of market failures
14. Integration of biodiversity conservation and development
15. Increased accountability of performance in decisions
16. Scientific data need to be made available to all sectors of society

Laws Governing Biodiversity Conservation in India

1. The Madras Wild Elephant Preservation Act, 1873.

2. Bengal Rhinoceros Act, 1932.

3. Haily National Park Act.. 1936.

4. Bombay Wild, Animals and Wild Birds Protection Act, 1951.

5. Assam Rhinoceros Protection Act, 1954.

Laws Governing Biodiversity Conservation in India

Fisheries Act 1897.

Indian Forests Act 1927.

Mining and Mineral Development Regulation Act 1957.

Prevention of cruelty to animals 1960.

Wildlife protection act 1972.

Water (prevention and control of pollution) act 1974.

Forest Conservation Act 1980.

Laws Governing Biodiversity Conservation in India

Air (prevention and control of pollution) act 1981.

Environment Protection Act 1986.

Biological Diversity Act 2002.

Scheduled Tribes and other traditional forest dwellers (recognition of rights) act 2006.

Policies related to Environment and Bio-Diversity

National Forest Policy.

National Conservation Strategy and Policy statement on Environment and Development.

National Policy and macro-level action strategy on Biodiversity.

National Biodiversity Action Plan (2009).

National Agriculture Policy.

National Water Policy.

National Environment Policy (2006).

Conservation of biodiversity

Wildlife life conservation in protected habitat can be done by following approaches:

1) In-situ conservation
2) Ex-situ conservation

In-situ conservation

Conservation of species in natural ecosystem or in man- made ecosystem (artificial ecosystem).

Conserving a species in its own environment by creating national parks or wildlife sanctuaries.

In-situ or on-site conservation is the conservation of wild flora and fauna and not to domesticated animal and plants because conservation is possible by protection of population in nature.

Protection of population in nature is done by declaring the area as protected area.

In-situ conservation

Three types of protected areas-

(i) Wildlife Sanctuaries;
(ii) National Park;
(iii) Biosphere Reserves

There are 543 Wildlife Sanctuaries, 105 National Park, 18 Biosphere Reserved in India covering about 4% of total geographical area.

Project tiger

Tiger conservation program was launched by the Government of Indian April 1973, with support of WWF-International.

It was aimed at protecting the “Indian tiger” and its habitat.

In 2006, tiger population in India was estimated to be 1411.

As per the census of 2018, tiger population of India has climbed up to 2,967.

Project crocodile

Gharial or Indian crocodile is a fish eating crocodile.

Once found from Pakistan to Myanmar, the reptile's range has shrunk to two countries: India, along the Chambal, Girwa, and Son Rivers; and Nepal, along the Narayani River.

To save these, they were extensively bred in the 30 captive breeding centers.

Till now, more than 6,000 captive-bred gharials into the wild.

Other projects

Gir Lion Project: The Asiatic lion In 1972 the State government prepared a scheme for the management of the Gir Lion Sanctuary with proper guidelines for conservation.

Himalayan Musk Deer Project: due to its musk been used in the preparation of perfumes and medicine. Secondly the habitat destruction brought about a sharp decline in their population. A conservation project was therefore launched at the Kedarnath sanctuary in Uttrakahand.

Project Elephant: Elephant habitat restoration work was done in Rajaji National Park.

Ex-situ conservation

Ex-situ or off-site conservation means conservation of species particularly endangered species away from their natural habitat under human supervision.

Many rare species or species having small remaining population are protected by this strategy, e.g., Zoo, Aquarium, Botanical garden, Seed Bank, Gene Bank.

Ex-situ conservation includes a variety of activities, from managing captive populations, education and raising awareness, supporting research initiatives and collaborating with in-situ efforts.

Beej bachao aandolan

“Beej Bachao aandolan” or “Save Seeds Movement” began in late 1980s in Tehri District of Uttrakhand.

Green revolution caused a great loss to many indigenous species of grains, e.g., of 3000 varieties of rice in Garhwal, only 320 are remaining now. Also excessive use of chemicals and poor crop rotation led to decline in soil fertility.

To overcome this they promoted traditional practices like baranaja (12 grains) focusing on indigenous species.

The success of movement can simply be measured by the collection of about 350 varieties of paddy, eight varieties of wheat, four of barley, 220 varieties of kidney beans (rajma), eight of cowpea and 12 varieties of navrangi dhal.

Vijay Jardhari

Planting a forest

Jadav went on to plant saplings and seeds along a dry sandbar by the Brahmaputra in Assam, creating a forest that stands at 550 hectares today on the island of Majuli near Jorhat. He is known as the ‘Forest Man of India’, a moniker that was conferred on him in April 2012 by Jawaharlal Nehru University.

Jadav Payeng

People travel from across the globe to see his forest that is visited by 120 species of birds, including migratory ones; and elephants, rhinos, and tigers that visit from Kaziranga National Park.

Green revolution

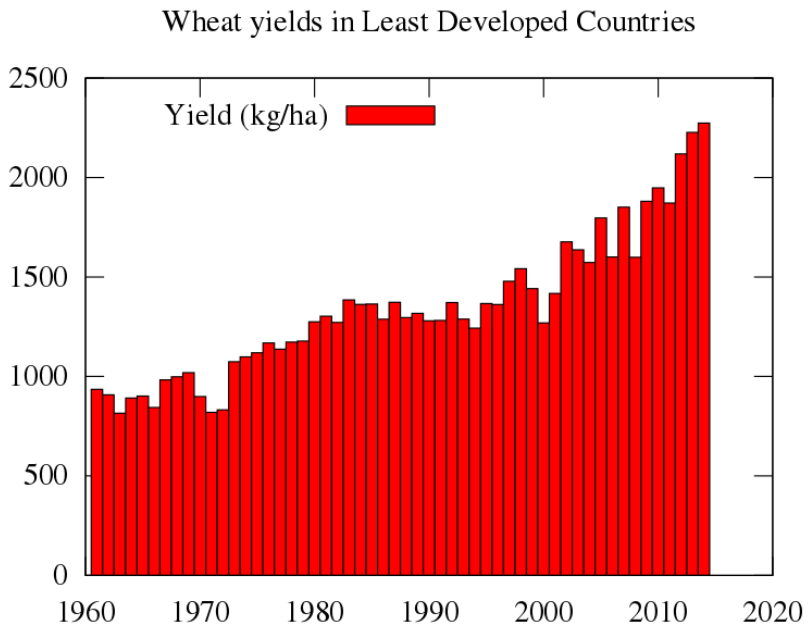
Green revolution or third agricultural revolution primarily refers to the technology transfer to increase the agricultural production. It was initiated in 1960 by Norman Borlaug.

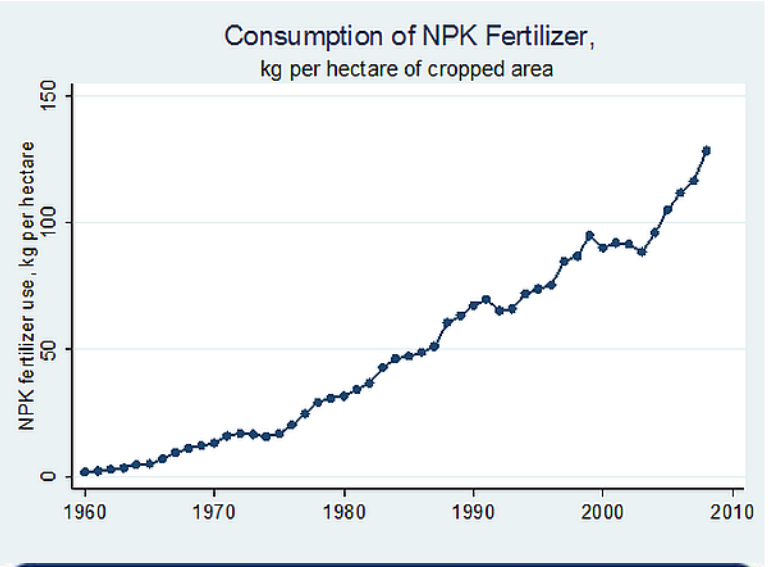
It led to development of new “High Yielding Verities (HYVs)” of the crop and adoption of modern technologies, such as tractors, chemical fertilizers, and pesticides etc.

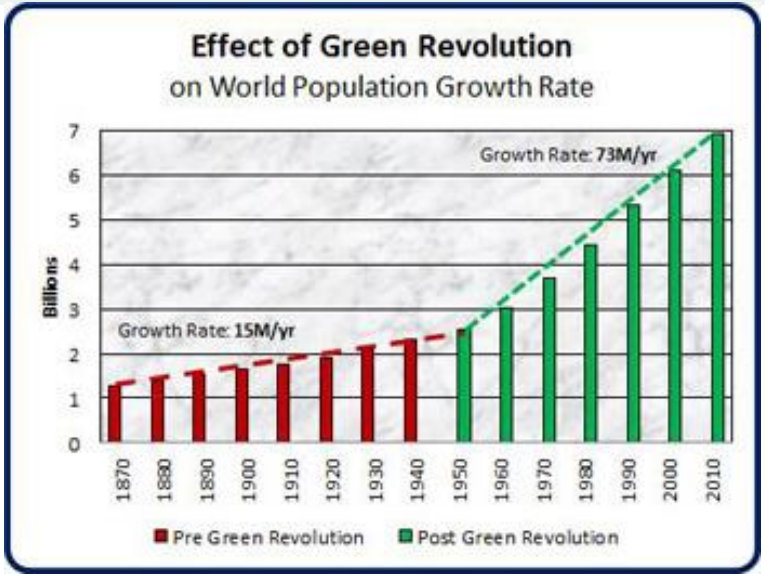
In India, this revolution was led by M S Swaminathan.

As a result of green revolution, India became a leading agricultural country.

Green revolution



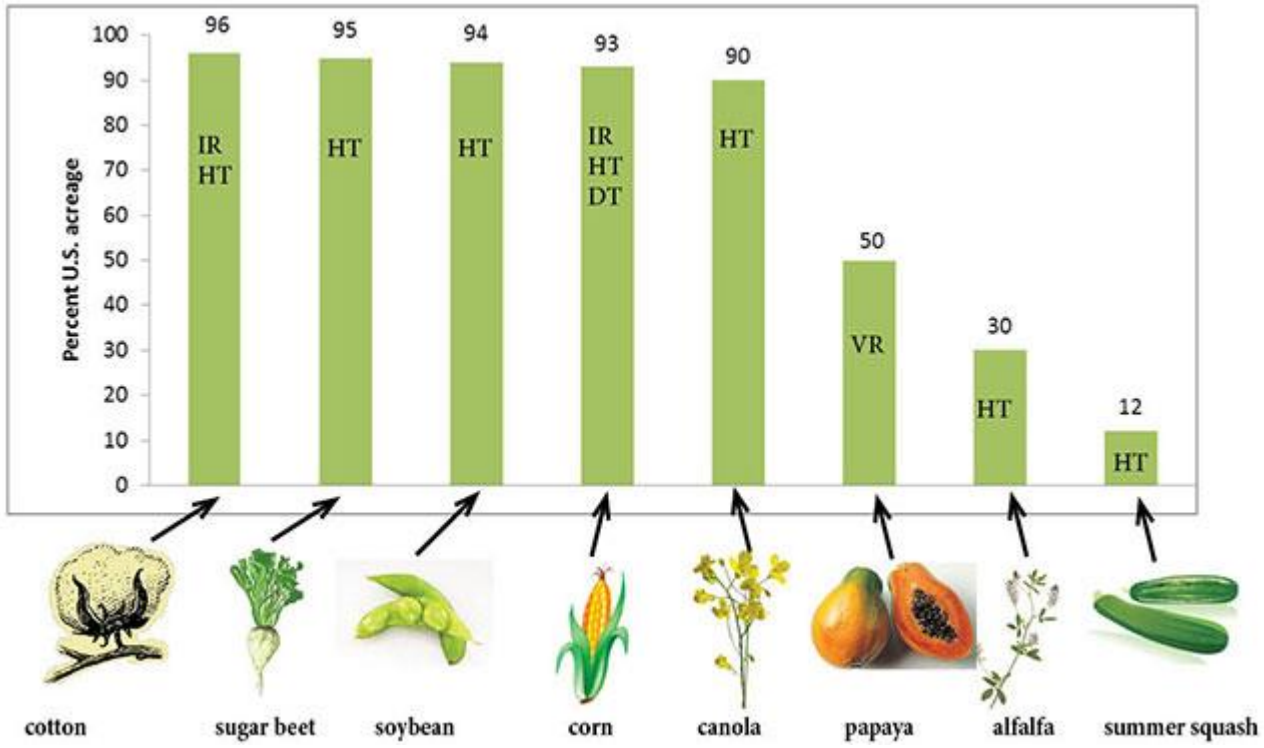




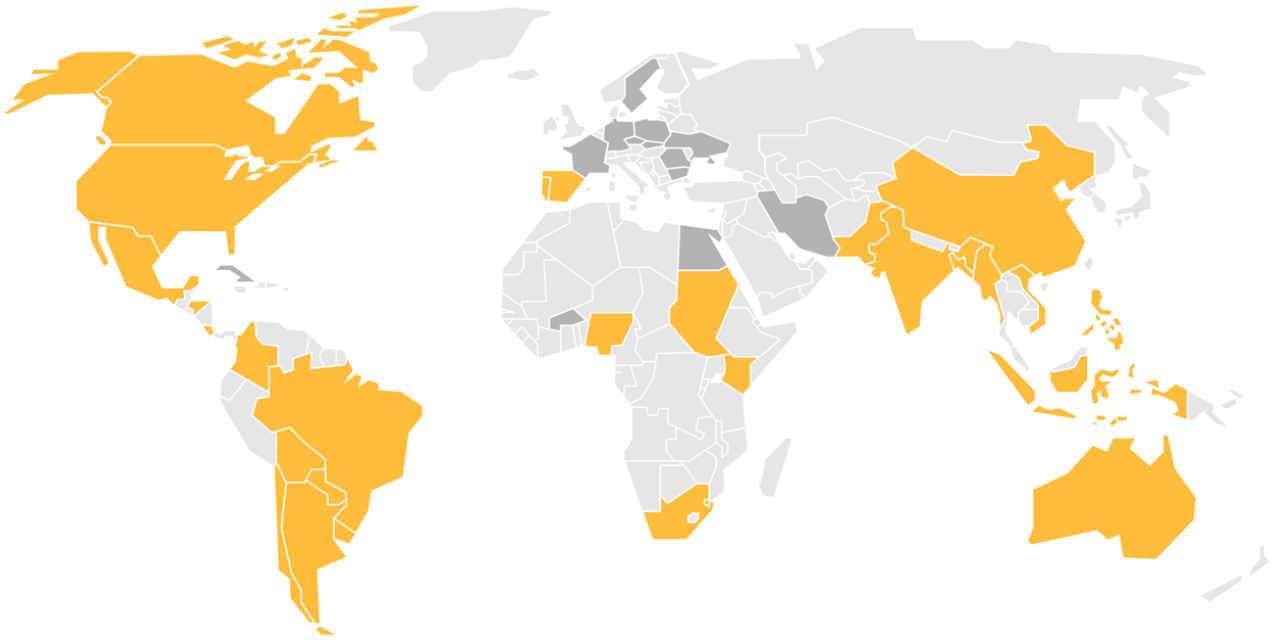
GM crops

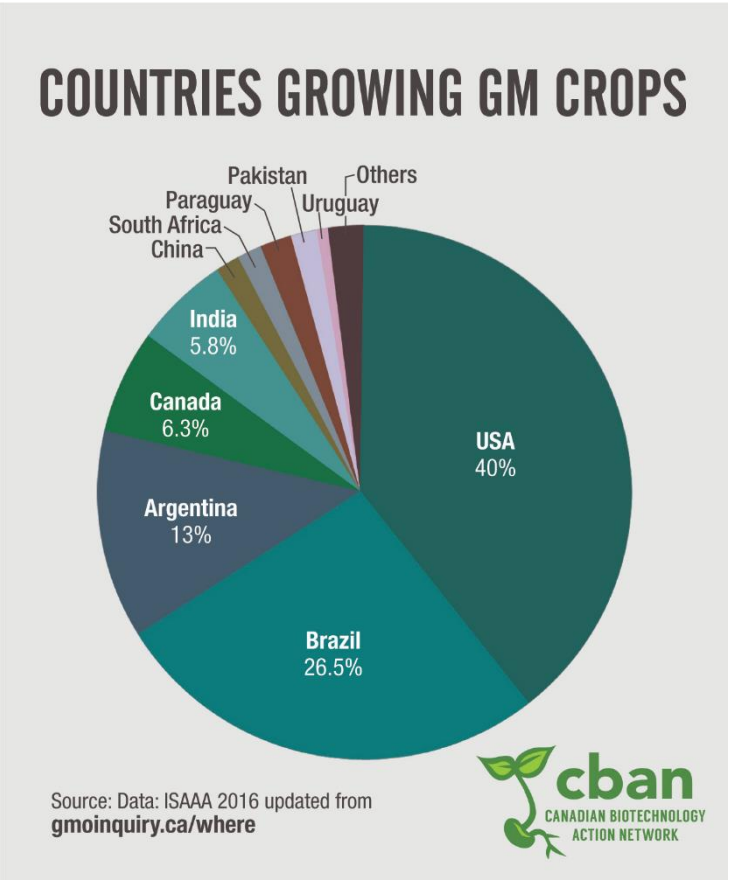
Genetic modification (GM) is the process of altering the traits of an organism by chaining its genetic information.

GM crops generally have following advantages:
(1) High nutrient content, (2) Higher resistance to disease and pest, (3) Higher productivity, (4) Faster growth

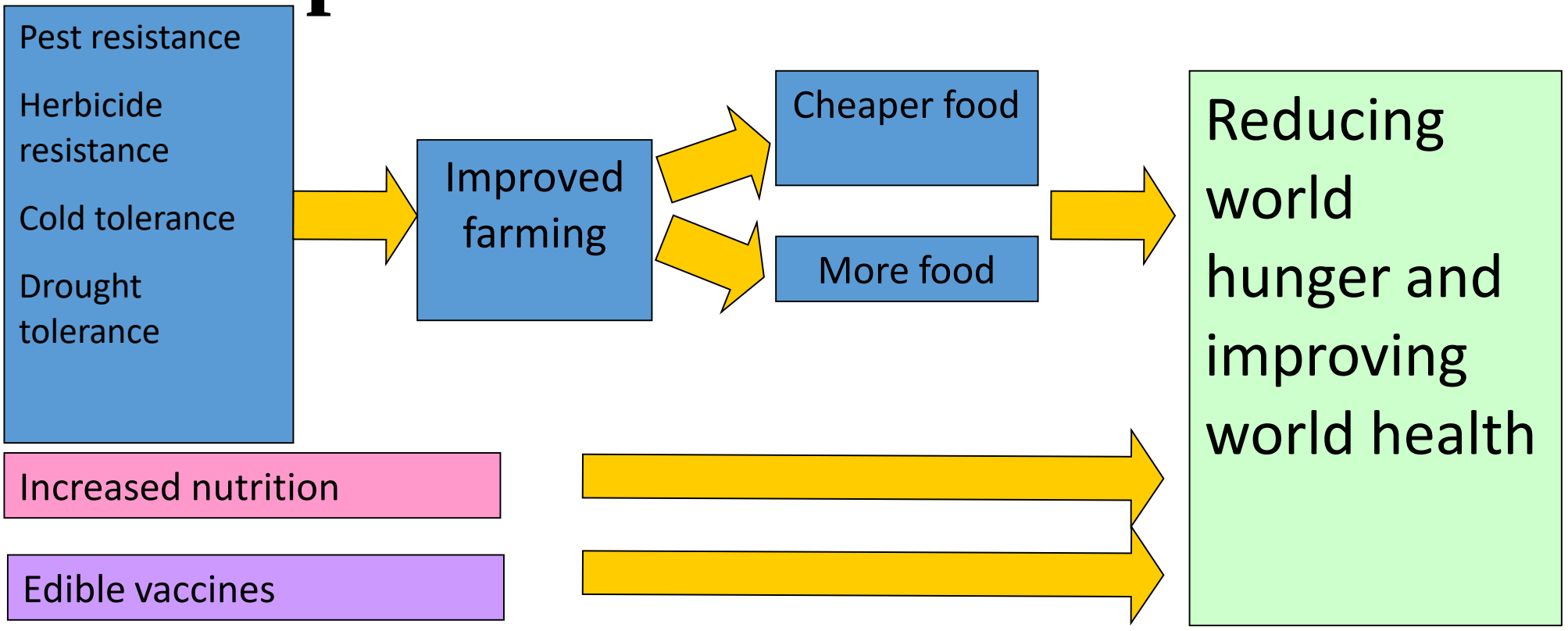


GM crops




COUNTRIES GROWING GM CROPS
Pakistan
Others
Paraguay
Uruguay
South Africa
China
India
5.8%
Canada
6.3%
USA
40%
Argentina
13%
Brazil
26.5%
Source: Data: ISAAA 2016 updated from
gmoinquiry.ca/where
cban
CANADIAN BIOTECHNOLOGY
ACTION NETWORK

GM crops


Pest resistance
Herbicide resistance
Cold tolerance
Drought tolerance
Improved farming
Cheaper food
More food
Reducing world hunger and improving world health
Increased nutrition
Edible vaccines

GM crops : Negative impact

Superweeds and superpests: GM seeds have created weeds or bugs that, over time, become resistant to GM seeds and crops and to other herbicides and pesticides.

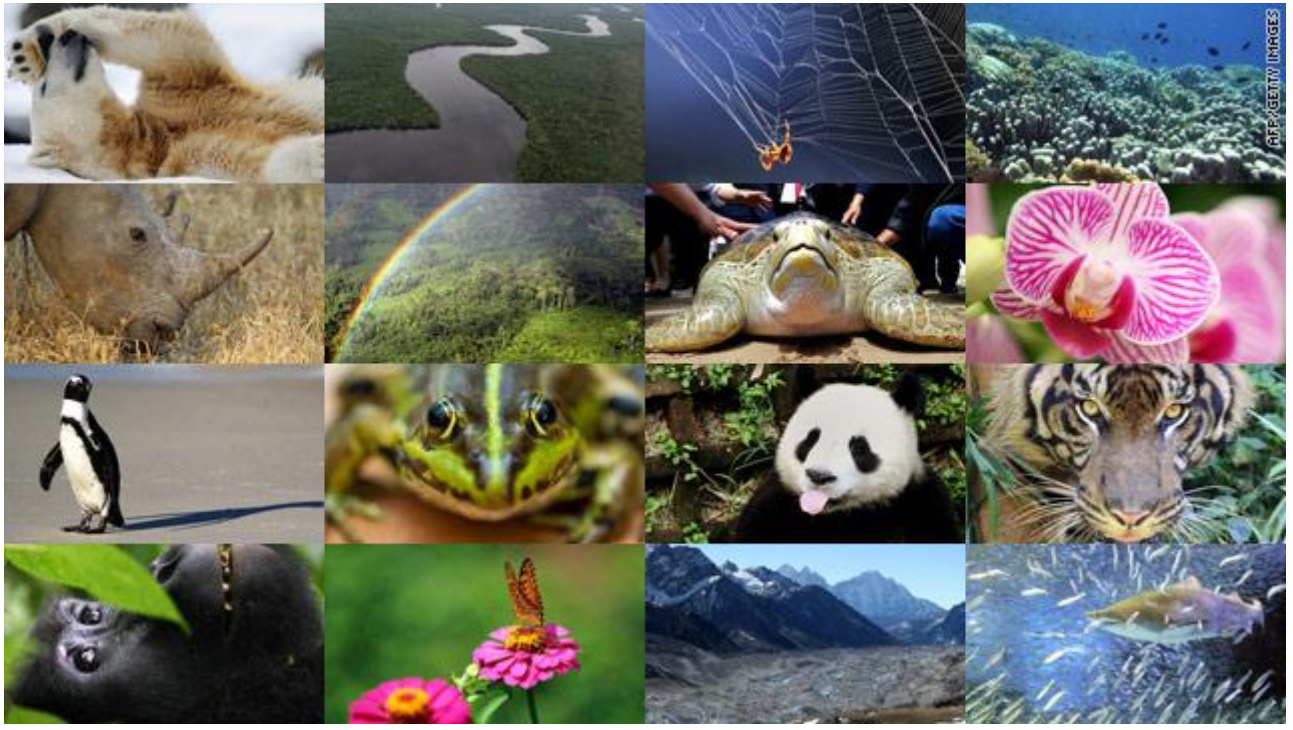
Non-target organisms: Use of GM crops can possibly harm the other beneficial species.

Uncertainties concerning human health risks: Presence of unknown allergens in the GM food supply poses a serious heath.

Tutuorials

GM crops are we ahead of the nature?

Biodiversity convservation



Ecological issue in India