North Asian International Research Journal of Social Science & Humanities
IRJIF: 3.015
ISSN: 2454-9827 Vol. 4, Issue-2 February-2018
Index Copernicus Value: 57.07 UGC Journal No: 48727

BIO-DIVERSITY AND ITS IMPACT ON AGRICULTURE AND HUMAN LIFE

***DR. RAMAMOHANA REDDY APPANNAGARI**

**Environmental Ecologist, CHEMTEX Environmental& Industrial Hygiene Services, Laboratory, Port Arthur, Texas -77642 USA.*

ABSTRACT

The biodiversity found on Earth today is the result of approximately 3.5 billion years of evolution. Until the emergence of humans, the earth supported more biodiversity than any other period in geological history. However, since the dominance of humans, biodiversity has begun a rapid decline, with one species after another suffering extinction. Biodiversity loss threatens human security and well-being. Food chains on which we depend would be disrupted, water sources might disappear, and medicines and other resources obtained from lost organisms—or the organisms that depend on them—would be lost to us. Climate change seems to be a major driver of the loss of biodiversity and it is predicted to have an even greater impact in the decades to come. Melting Arctic sea ice, ocean acidification, warming temperatures, extreme weather events, and rising sea levels will have a devastating effect on some species if predictions are true.

INTRODUCTION

'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 a part; this includes diversity within species, between species and of ecosystems.

History

In the context of conservation science the term ‘biodiversity’, a contraction of 'biological diversity', is relatively young. ‘Biological diversity’ in its current sense began to be used in the early 1980s, with interest in the concept elevated by publications such as ‘Limits to Growth’ , which discussed the implications of unrestricted population and economic growth on the environment . Use of the term has ranged from a focus on species richness (number of different species in a location/sample) to greater emphasis on ecological and genetic diversity. The specific origin of the word ‘biodiversity’ is often attributed to W.G.Rosen in 1985 during planning for the ‘National Forum on Biodiversity’ which took place in America later that year. The proceedings of the forum were published by E. O.Wilson in 1988 in a book entitled ‘Biodiversity’, which is likely to have initiated the widespread use of the word.

Initially the term biodiversity was used more in political forums than scientific ones, progressing over time to become a term used to symbolize the concept of the "richness of life on earth”. Importantly, biodiversity does not exclusively refer to species richness. It also encompasses diversity at a wider scale meaning that differences in the genetic makeup of populations are important. Endemism has a key role to play in this context because endemic species are restricted to small areas and provide pockets of particularly high genetic diversity.

The concept of biodiversity continues to evolve and more recently it has been included in the idea of ecosystem services in that it is a form of ‘natural capital’ and thus underpins the functioning of ecosystems. Biodiversity itself is not generally considered an ecosystem service but rather supports environmental functions.

Importance

The increasing use of the term biodiversity is being driven by the fact that, in an ecological context, global biodiversity itself is being lost at an alarming rate. Although it has been shown that the significant global biodiversity loss that has occurred over the timeframe of human existence has not stopped global human population increase, there is clear evidence that biodiversity loss can affect the wellbeing of society and have negative economic impacts.

Biodiversity underpins ecosystem function and the provision of ecosystem services. Biodiversity loss therefore threatens the provision of goods and services provided by ecosystems. Reduction in biodiversity can affect decomposition rates, vegetation biomass production and, in the marine environment, affect fish stocks . It is predicted that a reduction in marine productivity means that fisheries will not be able to meet the demands of a growing global population. In addition to the gradual decline in environmental function linked to reductions in biodiversity, it has been suggested that there is a risk that at some point a threshold will be crossed and a catastrophe may occur. Research has highlighted that biodiversity loss could rival the problems of carbon dioxide increases as one of the major drivers of ecosystem change in the 21st century. Whether from environmental collapse or gradual decline in function, our ability to adapt to a changing world may be considerably reduced if the environment on which we rely does not contain sufficient biodiversity to evolve and continue to support our needs.

In response to the current rate of biodiversity loss, and on the grounds that biodiversity is a common concern for humankind, the Convention on Biological Diversity (CBD)was opened for signature in 1992. As of June 2013 it has been ratified by 193 parties (governments). The CBD provides a global legal framework for action on biodiversity and is considered a key instrument for sustainable development. Its three main goals are:

- The conservation of biological diversity;
- The sustainable use of the components of biological diversity;
- The fair and equitable sharing of the benefits arising from the use of genetic resources.

The CBD’s governing body is the Conference of the Parties (COP). It holds periodic meetings to review progress on the Convention targets, and advance its implementation. To support implementation of the CBD, the United Nations General Assembly declared 2011-2020 the United Nations Decade on Biodiversity and adopted the Strategic Plan for Biodiversity 2011-2020. The Strategy is a ten-year framework for action adopted by signatory countries in 2010 in Nagoya, Japan. It builds on the vision that “by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people”. The Strategy calls for all countries and stakeholders to effectively implement the three objectives of the CBD by establishing national and regional targets, feeding into the five strategic goals and 20 global targets (collectively known as the Aichi Biodiversity Targets) outlined by the Strategy. The primary framework for action set forth by the CBD is the ecosystem approach, an integrated strategy for the management of biodiversity resources.

Biodiversity is also at the centre of a number of other Conventions e.g. the Convention on Migratory Species (CMS), the International Treaty on Plant Genetic Resources for Food and Agriculture (Plant Treaty), The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It is also the subject of a number of associated Protocols such as the Specially Protected Areas Protocol and the Cartagena Protocol.

A new platform, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), was established by the international community in 2012 and is open to all United Nations member countries. It is an independent intergovernmental body committed to providing scientifically-sound assessments on the state of the planet's biodiversity in order to support informed decision-making on biodiversity and ecosystem services conservation and use around the world.

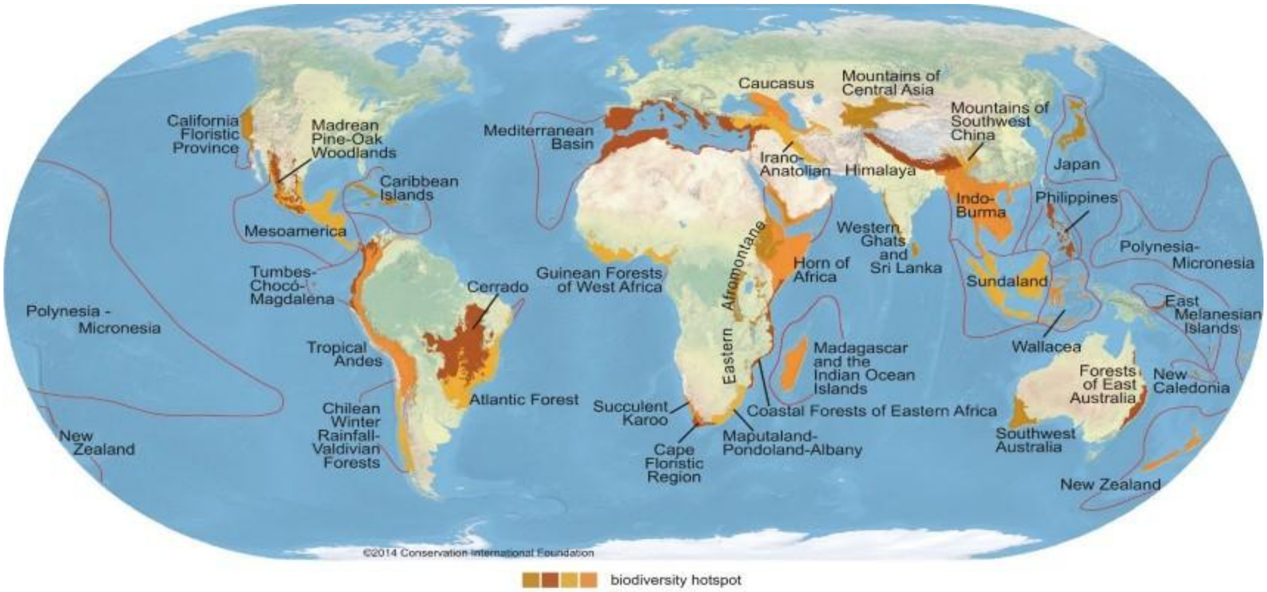
BIODIVERSITY HOTSPOTS ACROSS THE WORLD

Biodiversity hotspots are a method to identify those regions of the world where attention is needed to address biodiversity loss and to guide investments in conservation. The idea was first developed by Norman Myers in 1988 to identify tropical forest 'hotspots' characterized both by exceptional levels of plant endemism and serious habitat loss, which he then expanded to a more global scope. Conservation International adopted Myers' hotspots as its institutional blueprint in 1989, and in 1999, the organization undertook an extensive global review which introduced quantitative thresholds for the designation of biodiversity hotspots. [3] A reworking of the hotspots analysis in 2004 resulted in the system in place today. [4] Currently, 35 biodiversity hotspots have been identified, most of which occur in tropical forests. They represent just 2.3% of Earth's land surface, but between them they contain around 50% of the world's endemic plant species and 42% of all terrestrial vertebrates. [5] Overall, Hotspots have lost around 86% of their original habitat and additionally are considered to be significantly threatened by extinctions induced by climate change.

The eight hottest hot spots in terms of the above five factors are:

1. Madagascar
2. Philippines
3. Sundaland [South East Asia]
4. Brazil's Atlantic Forest
5. Caribbean
6. Indo-Burma
7. Western Ghats and Sri Lanka
8. Eastern Arc and Coastal Forests of Tanzania/Kenya

These eight 'hottest hot spots', appear at least three times in the top ten listings for each factor.



Conservation International (conservation.org) defines 35 biodiversity hotspots — extraordinary places that harbor vast numbers of plant and animal species found nowhere else. All are heavily threatened by habitat loss and degradation, making their conservation crucial to protecting nature for the benefit of all life on Earth.

AGRICULTURAL BIODIVERSITY

The components of agricultural biodiversity variously occur in protected areas, seed banks, laboratories, and the stores of industrial seed producers, but their primary habitat is land supporting agricultural production. Although most crop production is rainfed and based in the cool to warm humid regions of the world, production is extended into drylands by irrigation. Domestic livestock can thrive under a variety of climatic conditions. The ability of sheep, goats and camels to exist on sparse vegetation with little water allows humans to occupy marginal drylands, and the semi-domestic reindeer ranges into arctic regions.

At the close of the Pleistocene, some 11,500 years before present, domestication of plants and animals had just begun and the area of agricultural land would have been imperceptibly small. The history of agriculture is a history of experimentation with plant and animal genetic resources by human communities, and the dispersion of these resources by trade and the migration of peoples. Map 15 shows possible centres of origin of major crop plants. Map 16 presents the high dependence that most countries have on food crops that originated in distant centres of origin.

Agricultural land now forms a significant proportion, some 38 per cent, of the world's total land area. Table 1shows global level estimates of the recent area of land use types relating to agriculture, based on aggregated national data collated by the FAO. In this classification, permanent pastures, which include wild and cultivated forage crops, grassland and rangelands, make up the largest area of agricultural land. Land regularly cultivated for mainly annual crops, ranging from kitchen gardens to the cereal plains of industrial farming, i.e. arable lands in the usual sense, form 11% of the total.

Clearly, at global level, the habitat of agricultural biodiversity has increased enormously during the past ten millennia. Although some care is needed in interpreting these data, a graph of estimates of agricultural land area shows the rate of increase from the 1960s to the present (apart from an anomalous datum for 1970). An increase in area attributed to one classification unit must entail a decrease in some other land cover type; in this case, the increase in agricultural land is accompanied by a decrease in forest and woodland area, and a decrease in the category `all other land'.

Table 1
Agricultural land in relation to total world land area

Particulars	**Area in 1998** (million km^2)	**% world land area**
World land, excluding inland waters	130.5	100
Agricultural land:	49.4	38
Arable land (mainly annual crops)	13.8	11
Permanent crops (e.g. fruit and nut trees)	1.3	1
Permanent pasture (incl. rangeland)	34.3	26

Source: estimates rounded from FAO land-cover data for 1998, available at http://apps.fao.org

SURFACE PROPERTIES AND CLIMATE PROCESSES AFFECTED BY ECOSYSTEMS

Ecosystems affect climate through the alteration of energy and water fluxes in the lowest atmosphere, or planetary boundary layer (about 1–2.5 kilometers above Earth's surface) (Pitman et al. 2004). Within this layer, vertical profiles of temperature and humidity depend strongly on the partitioning of energy between sensible heat and latent heat. Over land, this partitioning is largely controlled by ecosystems. Over bare, dry land, the energy is transported via sensible heat, resulting in relatively high surface air temperatures. Vegetation canopies transpire water extracted from the root zone, increase the upward latent heat flux, and cool the surface air. Modification of the fluxes of water and energy by ecosystems has significant regional effects on precipitation, temperature, and wind. Globally averaged impacts are small, complex, and hard to detect against the background of natural climate variability and anthropogenic climate change. Key physical properties and processes affected by ecosystems are summarized here: Surface albedo is the fraction of solar radiation reflected back into the atmosphere from Earth's surface. Higher albedo means that more energy leaves the planetary boundary layer (net cooling of the atmosphere). Vegetation traps radiation, generally reducing albedo compared with, for instance, snow cover or bare ground in dry lands. In agricultural regions, tillage usually decreases albedo since bare soil in moist climates is generally darker (less reflective) than plant canopies. Forests are very effective at trapping radiation by multiple reflections within the canopy; this effect is particularly strong in snow covered regions where trees extend above the snow, while short vegetation such as crops and pastures are covered by snow. Phytoplankton modify ocean surface albedo, with different types either reducing or increasing it. Transpiration is the flux of water from the ground to the atmosphere through plants, controlled by the opening and closing of tiny pores in the leaf's surface called stomata. The volume of water transpired is determined by vegetation rooting depth, leaf area, soil moisture, temperature, wind, and stomatal conductance (which is biologically regulated). Transpiration drives the hydrological cycle—recycling rain water back to the atmosphere to be rained out elsewhere. Thus terrestrial ecosystems mediate the service of water recycling. Through transpiration and precipitation, water evaporated over the ocean is transported into the interior of continents. A part of the rainfall escapes immediate recycling and forms river runoff; thus the presence of vegetation reduces the fraction of rainfall going into runoff. As runoff is part of the freshwater flux into the surface ocean, changes in terrestrial ecosystems can in principle affect ocean dynamics. Transpiration cools the surface during the daytime and increases air humidity in the near-surface atmospheric layer. Increased concentration of water vapor (a greenhouse gas) leads to reduced fluctuations in the diurnal temperature cycle by increasing the night temperatures. Photosynthesis is tightly coupled to transpiration, but while increased atmospheric CO2 concentration in the future is likely to enhance photosynthesis, it may tend to reduce transpiration due to reduced stomatal conductance (medium certainty). Cloud formation has strong but complex effects on global and regional climate. Evapotranspiration determines the availability of water vapor for the formation of clouds. Clouds alter the radiation balance (low clouds are cooling while high cirrus clouds are warming), air circulation, and precipitation. Vegetation also affects cloud formation via changes in surface albedo and roughness. Some of the atmospheric constituents with ecosystem sources act as cloud condensation nuclei: in particular DMS emitted by marine plankton, VOCs emitted by some types of vegetation, and some aerosols emitted during biomass burning. Increased concentrations of CCNs produce more and smaller cloud droplets, making clouds more reflective and persistent; this has a cooling effect on Earth. In addition, such clouds tend to rise in the atmosphere, delaying the onset of rain; increasing ice formation, rainfall intensity, and lightning; creating more violent convective storms; and altering energy balances and air circulation. The net effect on the total rainfall within a given area is unknown. Both marine and terrestrial biota naturally regulates CCN concentrations to remain at fairly low levels. Increased DMS and VOC emissions increase CCNs, which reduces radiation and cools the planet; this in turn reduces photosynthesis and emissions of DMS and VOCs and increases thermal stability, thus reducing the probability of cloud formation in a negative feedback loop. The natural regulation mechanism is becoming overwhelmed by anthropogenic emissions of aerosols and deforestation. Some aerosols, such as soot particles, absorb sunlight, which cools the surface and heats the atmosphere, reducing cloud formation.

PATTERNS AND TRENDS IN THE DISTRIBUTION OF HUMAN WELL-BEING

In the aggregate, human well-being has improved dramatically since the advent of agriculture first made possible the accumulation of wealth. Incomes have risen, life expectancy has gone up, food supplies have risen, culture has become enriched, and political institutions have become more participatory. Two exceptions to this generalization have been the trends in warfare and hunger. Battle deaths (both combatant and civilian) peaked in the middle of the twentieth century, as a consequence of the intensity of the two world wars. Since 1945 they have declined. The second exception is the number of hungry people, which is now increasing. Although the size of world population is not a direct measure of well-being, it constitutes a fundamental background measure and is therefore included in this summary. Of these trends, population growth shows clear signs of leveling off. Per capita incomes, life expectancy, and democratization do not yet show signs of leveling off, although they have increased historically at different rates. The absolute number of hungry people began to rise in 1995/97 (FAO 2003), as described in Chapter 8. Warfare patterns are not stable enough to identify clear trends, although the past 50 years have been comparatively peaceful in historical terms. Cultural trends are not susceptible to simple generalizations. Some observers have argued that the global reach of a relatively homogenous mass media threatens local cultural institutions, while others have argued that knowledge of cultural traditions has been able to spread globally; placing values on recent changes such as these is difficult. Many dimensions of human well-being that can be measured on a large scale, then, have increased considerably over the past 10 centuries and in the aggregate shows signs of continued expansion.

The data shows estimates of human life expectancy and per capita income over the past 2,000 years, demonstrating the enormous improvements in basic material aspects of well-being over this long time frame. Various studies show trends in the level of democracy and warfare since 1800 in 25-year increments; signs of progress are also visible in these more social dimensions of wellbeing. As Modelski and Perry (2002) demonstrate, the percentage of the world's population living under democratic institutions has increased steadily for several centuries and crossed the 50% mark in the 1990s. War deaths are lower today than they were in the first half of the twentieth century, but not low in longer historical comparison.

CONCLUSION

Species are the building blocks of Earth's life-support systems. We all depend on them. But our planet's "biodiversity," the vast array of life on Earth, faces a crisis of historic proportions. Development, urbanization, pollution, disease — they're all wreaking havoc on the tree of life. Today, species are going extinct at the fastest rate since the mass extinction of the dinosaurs. To stem this crisis, we must protect the places where biodiversity lives. But species aren't evenly distributed around the planet. Certain areas have large numbers of endemic species- those found nowhere else. Many of these are heavily threatened by habitat loss and other human activities. These areas are the biodiversity hotspots, 35 regions where success in conserving species can have an enormous impact in securing our global biodiversity. The forests and other remnant habitats in hotspots represent just 2.3% of Earth's land surface. But you'd be hard-pressed to find another 2.3% of the planet that's more important.

REFERENCES

1. Altieri, M. A. 1995: Agroecology: The Science of Sustainable Agriculture. Westview Press, Boulder, Colorado, 448 pp.
2. Archer, E.R.M., 2003: Identifying underserved end-user groups in the provision of climate information. Bulletin of the American Meteorological Society 84(11), 1525–1532.
3. Eriksen, S., 2000: Responding to Global Change: Vulnerability and Management of Agro-ecosystems in Kenya and Tanzania. Ph.D. Thesis, Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich, UK.
4. Erwin, T.L., 1982: Tropical forests: their richness in Coleoptera and other Arthropod species. The Coleopterist's Bulletin, 36, 74–75.
5. Estes, J.A., M.T. Tinker, T.M. Williams, and D.F. Doak, 1998: Killer Whale Predatoin on Sea Otters Linking Oceanic and Nearshore Ecosystems. Science, 282, 473–476.
6. http://www.millenniumassessment.org/en/Condition.html
7. Myers, N. The biodiversity challenge: expanded hot-spots analysis. Environmentalist 10, 243–256 (1990).
8. Myers, N. Threatened biotas: "hot spots" in tropical forests. Environmentalist 8, 187–208 (1988).
9. Price, C. and D. Rind, 1994: The impact of a 2xCO2 climate on lightningcaused fires. Journal of Climate, 7(10), 1484–1494.
10. UN., Environment WCMC, Bio Diversity A- Z.

11. USDA (U.S. Department of Agriculture), 1998: Global desertification vulnerability. See: www.nrcs.usda.gov/technical/worldsoils/mapindex/desert.html
12. Vogel, C. and J. Smith, 2002: The politics of scarcity: Conceptualizing the current food security crisis in southern Africa. South African Journal of Science 98(7/8), 315–317.