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Role of sustainomics and external climate forcing mechanism in biodiversity extinction : An overview

Neerja Upadhyaya*
Department of Chemistry, S.S. Jain Subodh Girls College, Sanganer, Jaipur – 302011 (Rajasthan), India
Ruchi Jain
Department of Chemistry, S.S. Jain Subodh Girls College, Sanganer, Jaipur – 302011 (Rajasthan), India
R. Upadhyaya
SBM-St Xaviers, Bangalore, Karnataka, India

*Corresponding author. E-mail: upadhyayaneerja@gmail.com

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Abstract
Over millions of years, physiology and anatomy of the living organisms has been changed due to internal climate forcing mechanism. This has influenced the world wide distribution of species. External climate forcing mechanism has caused rapid rise in earth's temperature and it is expected to rise by 2-4 °C by the end of the century. It has now been recognised as the most complex problem of present scenario and being concerned in almost every field of science. Climate change is the most sensitive issue which is a challenge not only for the government and society but also for each individual. In the present communication impact of external climate forcing mechanism on biodiversity and its extinction is being analysed and role of sustainomics for the same is overviewed. Studies reveal that the rate of speciation of flora and fauna is not in the accordance with the rate of externally enforced climate change. Thus, the increased rate of climate change has caused catastrophic mass extinction threat for plants, animals and insects in the anthrapocene era. The pattern of extinction and threatened species are not yet known. Various solutions for the problem have been suggested by the multidisciplinary researches, rooted by the sustainomics. These suggestions include to diverge from fossil fuel, to use renewables, to make and apply rules for 3Rs etc. Only cooperative involvement of social, scientific and industrial bodies may resolve the problem.

Keywords: Biodiversity Extinction threat, External climate forcing mechanism, Speciation, Sustainomics

INTRODUCTION

Biodiversity is invariably significant but facing danger enforced by the climate change. Climate change is the most threatening global challenge for the humanity (Jonathan 2016). This issue becomes more prominent for the countries which are encompassed in climatic and geological conditions which make them rich in biodiversity. India also belong to the same class and has wide range of biodiversity including marine, Himalayan, desert, indo-gangatic and panasual ecosystem.

Adverse effects of climate change on ecosystem had lead to numerous investigations and publications in the related disciplines (Munasinghe 2010; Pimm 2008). Such studies support that rate of climate change has increased drastically as a consequence of urbanization and industrial development. In the recent timeframe every man is contributing to this threat which has caused global warming. Combustion of fossil fuel emits near about 40 billion metric tons of carbon dioxide every year. Even agriculture is the third largest source of carbon dioxide, emission after burning of fossil fuel and transportation, which cannot be reduced in order to fulfil the requirement of food. Global contribution of this sector to carbon dioxide emission is increased by about 15% (nearly 5 billion tons per year) in the last two decades (Quéré *et al.* 2018, Figueres *et al.*, 2018, Jackson *et al.,* 2018).

External climate forcing mechanism: Internal climate forcing includes natural changes imposing climate variability. External forcing mechanism is the topic of concern as it has hazardously increased the rate of climate change. Conventional industrial resources and urbanization are prominent external forces. Consumption of fossil fuel emits green house gases. Such practices result in the disturbances in carbon, nitrogen and water cycles. This has been recognized as the dominat-

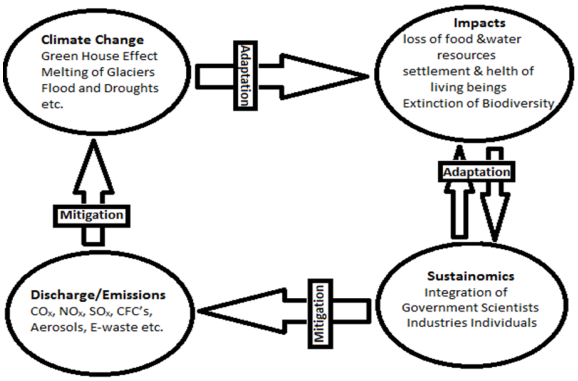

Fig. 1. *Role of Sustainomics and Climate Change in Extinction of Biodiversity (Based on IPCC 2001).*

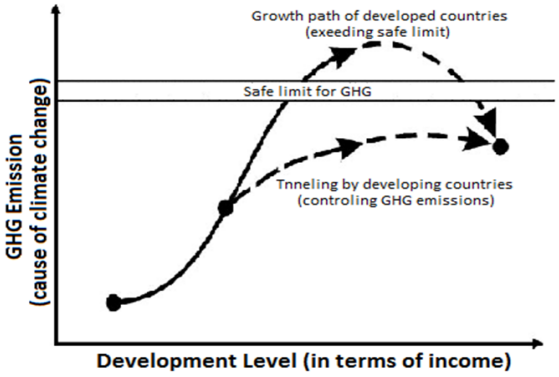

Fig. 2. *Two ways for climate change control : (i) reduced GHG emission in developed countries and (ii) alternate development path with low GHG emission for developing countries. Source : (Munasinghe, 2002).*

ing factor for global warming. Along with green house effect, ozone layer depletion has also witnessed the effect of external forces, including deforestation, use of synthetic harmful chemicals like aerosols, petrochemical based products etc., on climate change. These have imposed unnatural changes in geological, chemical, physical environment which have enforced rapid climate variation, resulting in frequent and unpredicted natural disasters like cyclone, droughts, heat stroke etc. thus, climate change has been recognised as one of the major threats for biodiversity. Studies reveal that about 27000 species are endangered because of changing climatic conditions (Hui, 2013).

Climate change, extinction of biodiversity and role of sustainomics: Biodiversity means worldwide distribution of flora and fauna. Migration of organisms over a period of time and their adaptation and immigration has enriched the biodiversity but externally encouraged rapid climate change has endangered numerous species ranging from insects to vertebrates. Although species get modified and migrate according to climate change but still extinction is being predicted and expected because the increased rate of climate change has increased required rate of immigration. But immigration speed of organisms is about one tenth of the required speed (Dominique B. *et al.* 2010).

Thus, increasing rate of climate change has led to the rate of extinction of biodiversity also and by controlling the rate of climate change rate of extinction can be controlled. Relation between climate change, biodiversity and sustainomics is shown in fig.1.

Overall extinction rate for vertebrates including birds, amphibians and mammals has been approximately tripled in the last century and the number of endangered species has also been doubled to tripled (Anonymous 2010, Birdlife International 2014, Schipper *et al.* 2008, Stuart *et al.* 2004). Climate change is recognised as major cause for the same (Chandrakar *et al.* 2016). The range of estimate for the extinction rate due to climate change is wider ranging from 15% to 37% for various taxa (Thomas *et al.* 2004). More than 400 species (4.6% of 8750 studied species) are expected to commit extinction by the year 2050 (Jetz *et al.,* 2007). Studies on climate induced changes in western hemisphere predicted extinction of land birds ranging from 1.3% to 30% for studied species (3349) for temperature rise from 2.1C to 6.4C (Sekercioglu *et al.,* 2008).

Marine fisheries and invertebrates are also facing danger. Also due to acidification of sea water (Frithjof *et al.,* 2017, Parker *et al.,* 2013). The temperature rise, acidification and increase in water level have threatened coral reef also (Frithjof *et al.,* 2017, Done, 2003). Extinction threats are Poleward range movements would also lead to the extinction of species in tropical region (4%) and sub polar latitudes (7%) (Thomas *et al.,* 2004). Terrestrial species are also endangered due to rapid climate change (IUCN red list 2018) (Pimm 2008). About 7 to 24% of the global vegetation is also predicted to face extinction in the coming era (IUCN red list 2018) (Malcolm *et al.* 2006, Van Vuuren 2006). Studies revealed rate of climate forced extinction of biodiversity varies from species to species and depends upon climatic and ecological conditions also. Expected extinction rate in marine ecosystems is lower than the terrestrial ecosystems because of grater possibilities of migration of organisms in the water (Chandrakar *et al.* 2016).

Eco-evolutionary framework may also help in understanding immigration and adaptation of species and in biodiversity conservation. Sustainomics got its roots in the last decade in the twentieth century and developed continuously. Last two decades have witnessed several national and international responses to control external climate forcing mechanisms. These responses include entrance of UNFCCC (United Nations' Framework Conservation on Climate Change) and Kyoto Protocol to the force, Cancun agreements etc (Soni *et al.* 2017). Initiatives taken by Inter Governmental Science – Policy Platform on Biodiversity and eco-

system services (IPBES) are additive to the knowledge and promoting to the sustainable ways to reverse the problem. IPBES has been adopted as science-policy interface by several biodiversity related conventions like Convention on Biodiversity (CBD) (UN decade on biodiversity press release 2018). Some of the international responses to control and reduce climate change are listed in Table 1.

Availability of ample of data motivates efforts to prevent endangered species. If emission of carbon dioxide is stopped by the immediate effect, even then its level and consequently the temperature elevation is expected to remain constant for the centauries. Expansion of related information is essential for reducing and reverting main made path of climate change for biodiversity extinction. Global level, national level and sactorial and project level integration to minimise the problem include adaptation and mitigation responses, inte-

Table 1. International responses to support and develop sustainomic framework, to reduce rate of climate change and extinction of biodiversity.

2019	Completion of Global Assessment on Biodiversity and Ecosystem Services is due
2019	IPBES-7(seventh meeting of the Platform's Plenary) (due) in Peris, France
2018	Special report of IPCC on Global Warming of 1.5 °C (SR15)
2018	IPBES-6(sixth meeting of the Platform's Plenary) was held in Medellin, Colombia
2017	IPBES-5(fifth meeting of the Platform's Plenary) was held in Bonn, Germany
2016	IPBES-4(fourth meeting of the Platform's Plenary) was held in Kuala Lumpur, Malaysia
2015	UNFCCC's Paris Agreement
2015	UNFCCC adopted the term Action for Climate Empowerment (ACE)
2015	IPBES-3(third meeting of the Platform's Plenary) was held in Bonn, Germany
2013	IPBES-2(the second meeting of the Platform's Plenary) was held in Antalya, Turkey
2013	IPCC's fifth assessment report released
2013	IPBES-1(the first meeting of the Platform's Plenary) was held in Bonn, Germany(Decision on the procedure for receiving and prioritizing requests was adopted
2012	Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) was established
2012	The Doha Amendment to the Kyoto Protocol is adopted by the CMP at CMP 8.
2011	Durban Platform for Enhanced Action was drafted and accepted atCOP17
2011	Special Report of IPCC on Renewable Energy Sources and Climate Change Mitigation (SRREN)
2011	Special Report of IPCC on Managing Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)
2011	United Nations Environment Programme (UNEP) decided to operationalize IPBES at the 26th session of the UNEP Governing Council meeting
2010	Tenth Conference of the parties to the Convention on Biological Diversity (CBD) accepted the Busan outcome in Nagoya
2010	Cancun Agreements were drafted and largely accepted at COP16
2010	Third intergovernmental meeting was held in Busan, Korea on science-policy interface on biodiversity and ecosystem services
2009	Second intergovernmental meeting was held in Kenya on science-policy interface on biodiversity and ecosystem services
2009	Copenhagen Accord drafted at COP15 in Copenhagen
2008	First intergovernmental meeting was held in Malaysia to discuss science-policy interface on biodiversity and ecosystem services
2007	Fourth Assessment Report of IPCC was released
2007	Parties agreed on the Bali Road Map at thirteenth conference. Climate science was emphasized.
2005	Entry into force of the Kyoto Protocol
2002	Special report of IPCC on Emissions Scenarios (SRES)
2001	TAR of IPCC was released
2001	Buenos Aires Plan of Action (1998) based Bonn Agreements were adopted
1997	Kyoto Protocol was adopted at COP3
1996	Action under the Convention was supported by the establishment of UNFCCC Secretariat
1996	IPCC's second assessment report was completed
1995	The first Conference of the Parties (COP 1) was held in Berlin.
1994	UNFCCC enters into force.
1992	Intergovernmental Negotiating Committee (INC) adopted UNF. At the Earth Summit in Rio de Janerio the UNFCCC was adopted
1991	Intergovernmental Negotiating Committee's (INC) first meeting was held
1990	Resease of IPCC's first assessment report
1988	Establishment of IPCC (Intergovernmental Panel on Climate Change)

gration of consumer and producer responses, macro environmental analysis, sustainable energy pricing, Kyoto flexibility mechanisms, action impact matrix, agriculture, water and food security, multi criteria analysis and to promote use of renewable energy resources (Munasinghe, 2009).
Developed countries have crossed the safe limit of green house gases (GHG) emission throughout the development and according to estimation emission of GHG is on the peak which is expected to go down with the further development. For developing countries it's an alarming stage and it is the time to tunnel through the growth path of developed countries (Munasinghe 2002) Fig 2.

Conclusion

Impact of climate change on biodiversity is complex to understand and explain. Although the effect of climate variation seems to be prolonged, but requires immediate and effective reversal because of high climate change inertia. Various development solutions based on sustainomics have been discussed above. Now, necessity is of positive implementation of these suggestions by the government, scientists and society. Both the common people and industrial bodied of developed and developing countries must be abided promisingly with the intergovernmental and science policies to make the development sustainable.Ultimately almost all the sustainomics ways end with the minimisation of energy requirement and consumption, in order to reduce the external climate forcing which in turn will reduce the biodiversity extinction threat.

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