Climate Change and Sustainable Development: Adaptive Strategies

K G Saxena

The goal of sustainable development is so vast and a problem like climate change is so complex that we need to adopt the best available solution(s) without delay, monitor the outcomes and further improve the tried solution with new knowledge and experiences: a flexible and adaptive problem solving strategy

Development is a perpetual process enabling humans to expand and/or realize their potentialities to achieve a greater, better fuller state of living. Utilization of natural resources forms the very basis of sustenance of human life, while nature has only limited regeneration capacity. Expansion of human population, increase in per capita demand of natural resources and release of chemicals altogether new to natural ecosystems (e.g., chemical pesticides and plastics) innovated by humans over the last two centuries has resulted in global environmental changes with adverse consequences for human well being. The thesis of sustainable development emerged in the 1980s when it was realised that betterments in some spheres of life (e.g., comforts from air-conditioning technologies, dramatic increase in food production by green revolution technologies and rapid economic growth) were achieved at the expense of creation of new problems (e.g., climate change, loss of biodiversity, depletion and degradation of soil and water resources) or aggravation of pre-existing problems (e.g., inequitable development, natural constraints to production of resources needed by humans and earthquakes). While advancements in environmental/ ecological sciences established that natural ecosystems had only a limited capacity to withstand/recover from human disturbances, those in social sciences drew attention to the importance of equitable economic development. Advancements in knowledge led to interdisciplinary approaches to development looking at environmental, economic and social problems and prospects across spatial (local to global) and temporal (short term to long term) scale simultaneously, the foundation of sustainable development. Defined in different ways, elaboration of sustainable development as "a process that meets the needs of the present generation without compromising over the ability of future generations to meet their own needs" by the World Commission on Environment and Development/ Brundtland Commission was widely accepted and appreciated in the United Nations Conference on Environment and Development held in Rio (commonly known as the Earth Summit) in 1992. With formalization of United Nations Framework Convention on Climate Change (UNFCCC) and Convention on Biological Diversity (CBD), a global strategy of saving mankind from the threats of unsustainability arising from the changing climate and loss of biodiversity was laid out and new global environment-development funding mechanisms like Global Environmental Facility (GEF) established. As climate change is confounded with other changes

The author is Faculty of Jawaharlal Nehru University, New Delhi, India and a Fellow of National Academy of Agricultural Sciences (NAAS), Leadership in Environment and Development (LEAD) and National Institute of Ecology (NIE) with research interests in ecology and sustainable development.

in biophysical environment (e.g., changes in atmospheric composition and land use, desertification and biological invasion) and in economic-social-political environment (e.g., globalization, free trade, acculturation, new intellectual property regimes and bilateral/multilateral cooperation/ alignment), sustainable development approach assumes importance for its scope of addressing multiple problems simultaneously. Global acceptance of sustainable development philosophy was further firmed up with United Nations Conference on Sustainable Development in 2002 in Johannesburg and a quantum jump in financial and human resources for environmental sound, economically viable and socially acceptable development, the core of sustainable development.

As increase in carbon dioxide concentration in the atmosphere is the prime cause of climate change, reduction in emission of this gas and its sequestration from atmosphere are the prime requirements for reducing climate change driven threats. Persistence of current climate change trend will threaten biodiversity conservation in future. Nevertheless, biodiversity, particularly, forests and tree-based organic agriculture, could mitigate climate change and enhance human capacity to meet this challenge. International Platform on Biodiversity and Ecosystem Services (IPBES) and the Reducing Emissions from Deforestation and Forest Degradation in Developing countries programme of the United Nations (UN-REDD) are the two major international initiatives of the decade targeting biodiversity management as a means of meeting the challenges posed by global climate change and a poor state of human well-being in developing countries.

While unprecedented rate of global warming in recent times is conclusively established, there is a huge variation in the estimates made on the rates of climate change. Projections on global warming rates during the 21st century vary in the range of 1.0 to 5.8^{0}C on a global scale and 0.4 to 2.0^{0}C in India. There is equally high uncertainty about the precipitation regimes, particularly the extreme events like drought and flood, in future climate. A high degree of uncertainty associated with projected global climate change scenarios is a combined outcome of variation in spatial/temporal scale of change analysis, gaps in scientific knowledge of factors and feedbacks determining climate and multiple tools/ techniques of inferring past/future climate. Nevertheless, all scientific studies point to inevitability of climate change and the necessity of adapting to this change together with reducing its magnitude. Climate change mitigation and adaptation actions therefore, are to be taken in the face of scientific uncertainty of projected climate change scenarios. Indeed, uncertainty is an element associated with virtually all scientific predictions, but this is quite high in case of climate change, more so of local level/finer scale climate change which is the prime concern of the public at large.

The earth system is such that sensitivity to and impacts of climate change vary in space as also the potential of mitigating and adapting to this change. While highlands and islands are the regions most sensitive to climate change, the areas rich in forests or having potential for development of forests and organic agroforestry systems have a high potential of mitigating climate change. Areas rich in biodiversity become significant for offering a genetic base for developing new crop varieties and livestock breeds resilient to climate change and thus for food security in the changing climate. A region like Himalayan mountain system attracts more global attention than other mountain regions as (i) it is exposed to higher magnitude of climate change and regulates the regional climate, (ii) it is one of the 34 global biodiversity hotspots and is part of one of the eight centers of crop diversity and thus harbours biological resources with potential benefits to the global community, (iii) it stores the highest ice mass next to polar regions, feeding the mighty rivers like Indus, Ganges, Brahmputra, Salween and Mekong, supporting livelihoods of millions of poor people, (iv) it is covered by partly/fully eight developing countries (viz., Afghanistan, Bangladesh,'India, Nepal, China, Bhutan, Bhutan and Myanmar) where climate change mitigation/adaption and biodiversity conservation need to be coupled with socio-economic development of local people for ensuring sustainable flow global benefits from it, i.e., harmonization of the priorities for socio-economic development stressed by the local people and environmental conservation by the developed world. Climate change and biodiversity concern foster cooperation among the eight developing Himalayan countries as well as between the developed and developing countries. Responding to the global importance of the Himalayas, India has drawn a National Mission "Sustaining the Himalayan Ecosystem" as part of the National Action Plan on Climate Change (www.envfor.nic.in; www.dst.gov.in).

With time, it was realised that "achieving sustainable development" was an ideal approach and needed articulations in terms of concrete time bound goals. This realisation led to framing of the eight Millennium Development Goals (MDGs), with each goal, except for the 8th one (Promote Global Partnership) further broken down into specific targets, by the United Nations. Environmental Sustainability is the goal which covers climate change alongwith other environmental issues like biodiversity, water resources and human habitats. While there is a significant progress in socio-economic spheres of development like reduction in hunger, poverty and mortality and promotion of equitable development over 2000-2015 period, there has been very limited success in the sphere of environmental development. Outcomes of efforts towards climate change mitigation and biodiversity conservation met very limited success (Table 1). Biodiversity is the foundation of all ecosystem services (viz., provisioning services, regulating services, supporting services and cultural services, the benefits ecosystems provide, directly or indirectly, to humans) and the two

Table 1. Millennium Development Goals, Targets and Achievements

Goal	Targets	Achievement
1. Reduce extreme hunger and poverty	Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day	The proportion of people living in extreme poverty declined by half at the global level.
	Achieve full and productive employment and decent work for all	In developing regions, the proportion of people living on less than $1.25 a day fell from 47 per cent in 1990 to 22 per cent in 2010
	Halve, between 1990 and 2015, the proportion of people who suffer from hunger	Proportion of undernourished people globally decreased from 23.2 per cent in 1990-1992 to 14.9 per cent in 2010-2012, this still leaves 870 million people (13 per cent) suffering from hunger .
2. Achieve universal primary education	Ensure that, by 2015, all children will be able to complete a full course of primary schooling	Literacy rates among adults and youths are on the rise, gender gaps are narrowing, the number of out-of-school children dropped from 102 million in 2000 to 57 million in 2011 and primary education enrolment in developing countries reached 90 per cent in 2010.
3. Promote gender equality and empower women	Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education, no later than 2015	Globally, the share of women employed outside of agriculture rose to 40 per cent and represented in Parliament to 20 per cent in 2012.
4. Reduce child mortality	Reduce by two-thirds, between 1990 and 2015, the mortality rate of children under five	Since 1990, the under-five mortality rate has dropped by 47 per cent, this still leaves around 17,000 children are dying each day and, in sub-Saharan Africa, one in ten children dies before age five, more than 15 times the average for developed regions.
5.Improve maternal health	1. Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio	Globally, maternal mortality declined by 47 per cent per cent over the last two decades.
	2. Achieve, by 2015, universal access to reproductive health	Only half of pregnant women in developing regions receive the recommended minimum of four antenatal care visits. Most maternal deaths in developing countries are preventable through adequate nutrition, proper health care, including access to family planning, the presence of a skilled birth attendant during delivery and emergency obstetric care.
6.Combat HIV/AIDS, malaria and other diseases	1. Halt and begin to reverse, by 2015, the spread of HIV/AIDS	Worldwide, the number of people newly infected with HIV continues to fall, dropping 33 per cent from 2001 to 2011. In 2012, 290,000 fewer children under age 15 were infected with HIV than in 2001.
	2. Achieve universal access to treatment for HIV/AIDS for all those who need it	A record 9.7 million people were receiving antiretroviral therapy for HIV in 2012.
	3. Halt and begin to reverse, by 2015, the incidence of malaria and other major diseases	In the decade since 2000, 1.1 million deaths from malaria were averted and treatment for tuberculosis has saved some 20 million lives.
7. Ensure environmental sustainability	1. Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	Global carbon dioxide emissions have increased by more than 46 per cent since 1990.
	2 Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	Nearly one-third of marine fish stocks have been overexploited and the world's fisheries can no longer produce maximum sustainable yields. More species are at risk of extinction despite an increase in protected areas. Forests, particularly in South America and Africa, are disappearing at an alarming rate.
	3. Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation	More than 2.1 billion people have gained access to improved drinking water sources since 1990, exceeding the MDG target. While almost 2 billion more people now have access to proper sanitation than in 1990, 2.5 billion still do not have access to toilets or latrines.
	4. Achieve, by 2020, a significant improvement in the lives of at least 100 million slum dwellers	An estimated 863 million people reside in slums in developing countries.
8. Global partnership	No specific targets	

together constitute the backbone of our resilience to climate change as well as any other ecological or economic shocks.

Monitoring of the achievements of MDGs followed led to renaming as well as reorganization of the eight MDGs as 17 Sustainable Development Goals (SDGs) of United Nations to be achieved over 2015-30 period (Table 2). The MDG of achieving environmental sustainability has been rephrased

Table 2. The Eight Millennium Development Goals set for the period 2000-2015 and the corresponding seventeen Sustainable Development Goals set for 2015-30

Millennium Development Goals (2000-2015)	Sustainable Development Goals (2015-2030)
1. Reduce extreme hunger and poverty	1. End poverty 2. End hunger
2. Achieve universal primary education	4. Ensure inclusive and equitable quality education
3. Promote gender equality and empower women	5. Achieve gender equality
	10. Reduce inequality within and among countries
4. Reduce child mortality 5. Improve maternal health 6. Combat HIV/AIDS, malaria and other diseases	3. Ensure healthy lives and promote well being
7. Ensure environmental sustainability	6. Ensure availability and sustainable management of water and sanitation for all 7. Ensure access to affordable, reliable, sustainable and modern energy for all 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all 9. Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation 11. Make cities and human settlements inclusive, safe, resilient and sustainable 12. Ensure sustainable consumption and production patterns 13. Take urgent action to combat climate change and its impacts (taking note of agreements made by the UNFCCC forum) 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss
8. Promote global partnership	16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels 17. Strengthen the means of implementation and revitalise the global partnership for sustainable development

in terms of more focussed 9 SDGs highlighting the growing importance of environmental sustainability and the interconnections between environmental, economic and social problems. Solution to climate change is now being addressed through multiple approaches – reducing emissions, improving capacity of the poor to face climate change and increasing sequestration of atmospheric carbon dioxide. Equitable development within and among countries is another component of sustainable development philosophy that has received more recognition in SDG framework in the form of an explicit goal.

Climate change is one of the several dimensions of sustainable development. While averting climate change and achieving sustainable development are desired by all, there are conflicts of opinions about the solutions to achieve the goals as well as limitations of knowledge in designing perfect and universally acceptable solutions and resources to implement them. Global partnerships aim for capitalizing on the opportunities of cooperation for ground actions to the benefit of all. UN-REDD programme is one such programme providing a new opportunity of income to people in developing countries by conserving their forests and switching over to land uses with high carbon stocks; developed countries paying for carbon conserved and sequestered by people in developing countries. As climate change will affect both developed and developing countries, it has become the crucial agenda of international relations and a point of action driving convergence of social, economic and environmental development goals and synergy or the best trade off between short term and long term and local and global development goals. The goal of sustainable development is so vast and a problem like climate change is so complex that we need to adopt the best available solution(s) without delay, monitor the outcomes and further improve the tried solution with new knowledge and experiences: a flexible and adaptive problem solving strategy. ❑

(E-mail: kgsaxena@mail.jnu.ac.in; kgsaxena@gmail.com)