Climate Change Mitigation and Sustainable Development: Cooperation between Japan and India

R. K. Pachauri

Director-General, The Energy and Resources Institute

Chairman, Intergovernmental Panel on Climate Change

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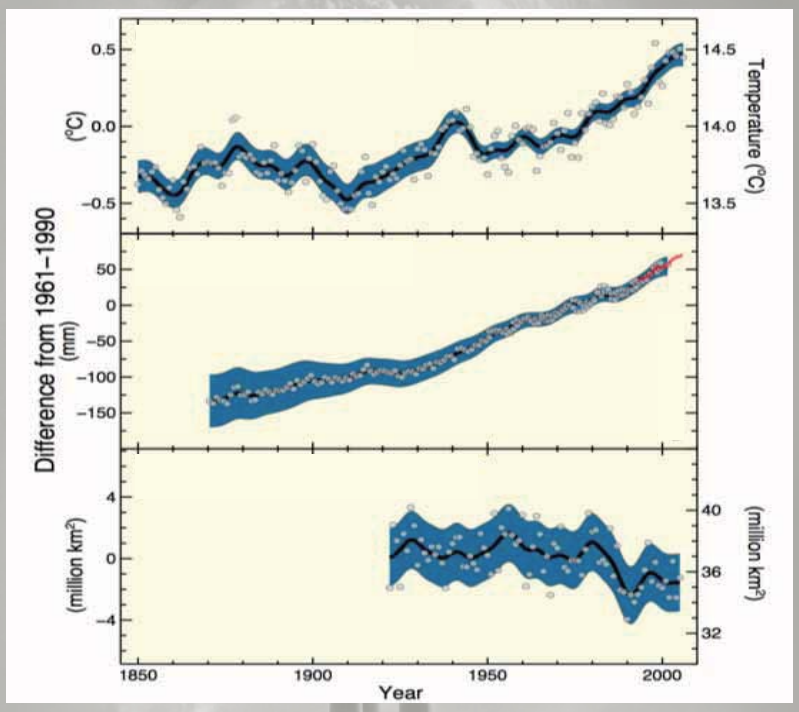
Observed Changes

Global average temperature

Global average sea level

Northern hemisphere snow cover



Global average sea level has risen since 1961 at an average rate of 1.8mm/yr and since 1993 at 3.1mm/yr

Source : IPCC

Some observed changes in Japan and India

Morbidity

- Hot days and multiple-day heat waves have become more frequent in the past century. India has seen an increase in deaths due to heat stress in recent years.

Droughts

- Consecutive droughts between 2000 and 2002 caused crop failures, mass starvation and affected ~11 million people in Orissa, India.

Flooding

- Parts of South Asia has experienced serious and recurrent floods and parts South-East Asia has experienced increased occurrences of extreme rains, which have caused flash floods.
- Japan experienced serious flooding in 2004 due to heavy rains brought by 10 typhoons

Source : IPCC

Possible abrupt or irreversible impacts

- Partial loss of ice sheets on polar land could imply metres of **sea level rise**, major changes in coastlines and inundation of low-lying areas

- 20-30% of **species** are likely to be at risk of extinction if increases in warming exceed 1.5-2.5°C

- Large scale and persistent changes in **Meridional Overturning Circulation** would have impacts on marine ecosystem productivity, fisheries, ocean CO2 uptake and terrestrial vegetation

Source : IPCC

Projected impacts

Water

- The gross per capita water availability in India is projected to decline from ~1820 m^3/yr in 2001 to as low as ~1140 m^3/yr in 2050.

Agriculture

- In certain scenarios, rice yield could decrease up to 40% even in irrigated lowland areas of central and southern Japan.
- Studies suggest a 2 to 5% decrease in yield potential of wheat and maize for a temperature rise of 0.5 to 1.5°C in India

Food security

- Net cereal production in South Asia could decline between 4 to 10% by 2100. Changes in cereal crop production potential indicate increasing stress on resources in many of Asia's developing countries.

Source : IPCC

Projected impacts (cont.)

Ocean acidification

- The progressive acidification of oceans is expected to have negative impacts on marine shell-forming organisms (e.g. corals) and their dependent species.

Forests

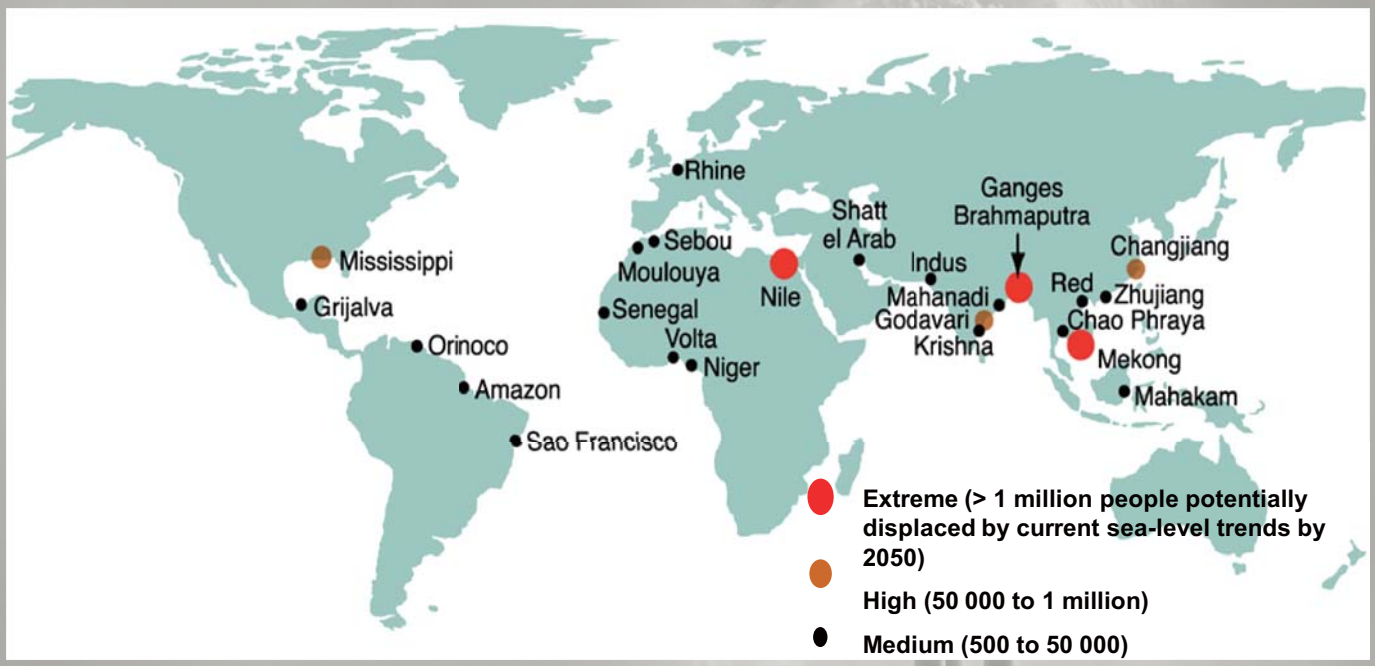
- About 90% of the suitable habitat for a dominant forest species, beech tree (*Fagus crenata*), in Japan could disappear by the end of this century

Flooding

- Potential impacts of one metre sea-level rise include inundation of 5,763 km^2 in India and 2,339 km^2 in some big cities of Japan.

Source : IPCC

Vulnerability of coastal zones



Asian megadeltas especially are key societal hotspots of coastal vulnerability

Impacts of climate change on development

Without appropriate measures:

- Will likely **exacerbate poverty** and slow down economic growth in developing countries
- Will act as a 'threat multiplier', especially in developing countries

Climate change adds to the list of stressors that challenge our ability to achieve the ecologic, economic and social objectives that define sustainable development

Source : IPCC

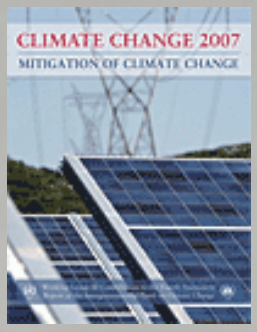
Role and limits of adaptation

- Societies have a **long record** of adapting to the impacts of weather and climate
- Adaptation is **necessary** to address impacts resulting from the warming which is already unavoidable due to past emissions
- Adaptation to the impacts of climate change & promotion of sustainable development share **common goals**

But adaptation alone is not expected to cope with all the projected effects of climate change

Source : IPCC

Adaptation and Mitigation



"Neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change"

- IPCC Fourth Assessment Report

Source : IPCC

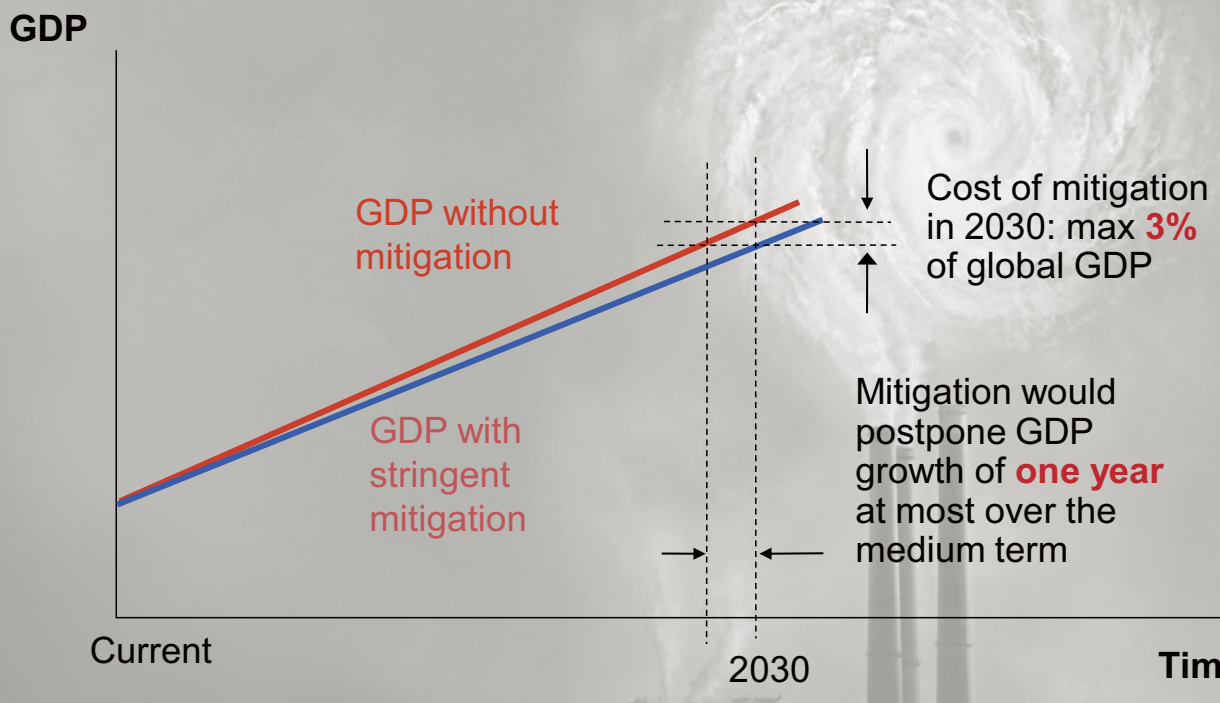
Characteristics of Stabilization Scenarios

Post-TAR stabilization scenarios

Stabilization level (ppm CO2-eq)	Global mean temp. increase (ºC)	**Year CO2 needs to peak**	Global sea level rise above pre- industrial from thermal expansion (m)
445 – 490	2.0 – 2.4	2000-2015	0.4 – 1.4
490 – 535	2.4 – 2.8	2000-2020	0.5 – 1.7
535 – 590	2.8 – 3.2	2010-2030	0.6 – 1.9
590 – 710	3.2 – 4.0	2020-2060	0.6 – 2.4

Source : IPCC

Impacts of mitigation on GDP growth



Source : IPCC

Co-benefits of mitigation

- **Common drivers** lie behind mitigation policies and policies addressing economic development, poverty, health, employment, energy security, and local environmental protection
- **Linking policies** may provide the opportunity for no-regrets policies, reducing greenhouse gases mitigation costs

CO2 mitigation potential for 2010 without a net cost in India: between 13 and 23% of business as usual scenario

Source : IPCC

Mitigation capacity

- All stabilization levels assessed can be achieved by deployment of a portfolio of **technologies that are currently available or expected to be commercialized** in coming decades.

- This assumes that i**nvestment flows, technology transfer and incentives** are in place for technology development.

Source : IPCC

Mitigation in the energy supply sector

Examples of currently commercially available options

- Improved supply and distribution efficiency
- Fuel switching from coal to gas
- Renewable heat and power (e.g. hydropower, solar, wind, geothermal, bioenergy)
- Combined heat and power
- Early applications of carbon dioxide capture and storage (CCS)

60-80% of GHG reductions would come from energy supply & use and industrial processes

Source : IPCC

Renewable energy and mitigation

- RE has a **large potentia**l to mitigate GHG emissions
- There is no obvious dominant RE technology at the global level
- Individual studies indicate that **if RE deployment is limited, mitigation costs increase** and low GHG concentration stabilizations may not be achieved

Source : IPCC SRREN

Renewable Energy and Sustainable Development

- RE can accelerate access to energy, particularly for the **1.4 billion people without access to electricity** and the additional 1.3 billion people using traditional biomass.
- RE deployment might **reduce vulnerability** to supply disruptions and market volatility.
- **Lowered risk** of severe accidents
- RE can provide environmental and health **benefits**

Average global cumulative RE investment needs in the power sector are below 1% of the world GDP

Source : IPCC SRREN

Current Japan-India Collaboration: Low-Carbon Energy Solutions for MSME

TERI-IGES-JICA "Science and Technology Research Partnership for Sustainable Development" (2010 – 2014)

- Micro, Small and Medium Enterprises (MSME) account for 45% of India's manufacturing output
- The focus of this project is the promotion of low carbon technologies in India's Small and Medium Enterprises
- Identified low carbon technologies include Small Gas and Electric Heat Pumps for heating and cooling applications

Source : TERI

TERI projects in Mitigation, Renewable Energy and Sustainable Development

Biomass Gasifier

- TERI's biomass gasifer technology converts biomass into clean gaseous fuel that can be used for small scale, rural power generation.

TEAM Process

- TERI's Enhanced Acidification and Methanation Process creates biogass (methane and CO_2) from many kinds of organic waste including agricultural residues, aquatic plants and kitchen waste.
- TEAM is suitable for small and decentralized applications and has low maintenance costs.

Cold Storage/Power

- TERI's Solar-Biomass Hybrid Cold Storage/Power Generation System uses solar energy and biomass to provide small scale cold storage and electricity generation to villages.

Source : TERI

Potential Areas of Collaboration

Gasification

- Development of a gasifier for loose biomass (rice husk, bagasse and stalks) with fuel flexibility
- Development of steam gasification system for hydrogen-rich syngas production

Biofuels & Biochemicals

- Biomass liquification using super critical fluid technology for fuels and chemicals
- Production of bio-oils and bio-chemicals from biomass and industrial wastes
- Production of liquid fuels from syngas

Source : TERI

Towards sustainable development

Committing to alternative development paths would require **changes** both in developed and developing countries, in a variety of areas:

- Institutional arrangements
- Geographical distribution of activities
- Lifestyles and consumption patterns

The dominant path to industrialisation has been characterised by high concurrent GHG emissions and natural resource consumption

Source : IPCC

"A technological society has two choices.

First it can wait until catastrophic failures expose systemic deficiencies, distortion and self deceptions…

Secondly, a culture can provide social checks and balances to correct for systemic distortion prior to catastrophic failures"

- Mahatma Gandhi