How can Science and Technology contribute?

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Lecture 8-9

Development and Well-Being

Sustainable Development means doing so by means and to end points that are consistent with maintaining the improved conditions indefinitely.

Sustainable well-being entails pursuing sustainable development to achieve wellbeing where it is absent and to make those others experience a continued state of well-being where the means are not sustainable

5 challenges for ST identified:

1. Meeting the basic needs of the poor
2. Managing the competition of land, water, and terrestrial biota of the planet
3. Maintaining integrity of oceans
4. Mastering the energy-economy-environment dilemma
5. Moving towards a nuclear-free world

Three legged stool: wellbeing

Holdren in his Presidential Address to the AAAS in 2007 stated that human well being rests on 3 pillars:

1. **economic conditions,**
2. **socio-political processes**
3. **and environmental conditions**

>>> all are indispensable, inter-dependent, and enhancing all 3 is core responsibility of society

Shortfalls identified include: Poverty, Preventable disease, impoverishment of the environment, organized violence, oppression of human rights, wastage of human potential, non use of S&T, mal-distribution of consumption and investment, corruption, continued population growth, ignorance, etc.

Millennium Development Goals (MDGs)

- Adopted by 190 countries all over the world
- Encapsulate the development aspirations of the world – not merely development objectives but increasingly projected to be universally accepted human values and rights
- Aim to reduce the gap between developing and the developing world
- These will counter inequalities, violence, and promote human development and sustainable environment
- Achieving set targets is a big challenge given the current situation of global recession and economic slowdown

MDG report 2008

- Climate Change will impact a disproportionate number of poor
- Efforts to reduce poverty will be diminished
- Food crises will increase the number living below the poverty level
- Education and Mortality levels will be effected
- Need unswerving collective effort to achieve MDGs

S&T can help in meeting 8 MDGs (2007)

MDG Goal (1-4)	Target	Progress
Eradicate extreme poverty & hunger	People living on less than a dollar a day to be halved between 1990-2015	Target met in East & Southeast Asia but other developing countries need to gear up
Achieve Universal Primary Education	Full course of primary education for all children by 2015	Southern Asia, northern Africa, and Latin America are on track to achieve it but other developing nations are lagging behind
Promote Gender Equality & Empower women	Eliminate gender disparities in education by 2015	Nearly all developing nations far off from meeting the target
Reduce Child Mortality	Reduce under 5 years child mortality by 2/3 between 1990-2015	East and Southeast Asia, northern Africa, and Latin America are on track to meet target while others lag much far behind

MDG Goal (5-8)	Target	Progress
Improve Maternal Health	Reduce rate by 3/4 between 1990-2105	East and Southeast Asia, northern Africa, and Latin America are on track to meet target while others lag much far behind
Combat Malaria, HIV/AIDS, Malaria and other diseases	Halted progress & begun to reverse spread of HIV/AIDS and malaria by 2015	Number suffering from AIDS in sub-Saharan Africa have been stabilized but their number in rest of world is rising
Ensure Environmental Sustainability	Proportion of people lacking access to safe drinking water and basic sanitation to be halved between 1990-2015	East and Southeast Asia, northern Africa, and Latin America are on track to meet target while others lag much far behind
Develop a Global Partnership for Sustainability	No quantitative target: a range of qualitative goals address mechanisms of assistance	If official development assistance is the index then slight progress; debt and trade measures look better

Immense Global Competition

- Population expansion and affluence is exerting pressure and multiplying demand over resource-use
- Concurrently we recognize the finiteness of natural resources and the decline in earth's biodiversity – clearly recognize that these will set limits to human progress
- Land water and terrestrial biota have become central areas of competitive control for nations – there is likely to be greater conflict over oil, water, etc
- Cumulative impact of industrialization that is being felt everywhere with a toxic spillover. Along with this there is haphazard un-integrated and short-range planning in society's use of land and water

Environmental services

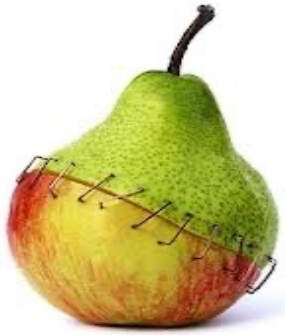
- Advocates the need to factor the cost/charge for environmental degradation and the use of environmental resources – magnitude of human impact is devastating for the environment. Polluter should pay principle is being recognized.

- Ecosystem services (services rendered towards preservation of forests and ecosystems, detoxification, cleaning up of waste, nutrient recycling, carbon sequestration, reduction of pollution, etc) are substantial and there is a need to recognize and quantify these

Funding Growth

Transfer of funds – critical of US – the worlds richest economy is the most stingy in contributing to Organization for Economic Cooperation and Development (OECD) – 0.2% of Gross National Income (while US spends 20 times more on Defense and 3.5% on tobacco consumption)

Challenge


S&T lie at the core of the world greatest problems and simultaneously provide us with the most promising opportunities

Question is not merely of advancement in basic science and social capacity of technology to rise to these challenges but a ***matter of political*** will to turn this knowledge into action.

Technology as propeller of progress

- Apply S&T to meet basic needs of everyone and everywhere
- Regional shortfalls in meeting MDG targets remain strong
- Economic growth has propelled much of this and lifted people out of poverty – global exchange of labor and services
- A country's progress in meeting targets are a combination of social and economic well-being consequent or shaped by the application and the transfer of science and technology (from basic to sophisticated levels) – for instance there is possibility of improved agricultural productivity, availability of medicines and health care, water treatment and technology.

Dilemma of the 3Es

Energy – extraction, consumption and transportation damage the environment and result in many problems

"resolving the energy-economy-environment dilemma is the hardest part of the challenge of sustainable well-being for industrial and developing countries alike" (Holdren 2008: 428).

Energy, Environment, Development

- Why is energy imp? Where [which sectors] are we consuming it?
- Reliable and affordable energy is necessary for basic human need fulfillment and as a propeller of economic growth
- Basic connection between development and economic growth and high energy consumption which has a deleterious impact on the environment

Research

- **Fossil fuels** and Renewable Energy Sources are shaping the global agenda.
- Research and Development on energy issues is a key area
- Climate Change - biggest irreversible environmental change that threatens human well-being and the ecosystem as a whole
- Solution lies in improved technologies and devoting resources towards alternative and sustaining peace and fostering a political climate of cooperation

How can S&T positively improve well-being?

- Modeling, replication and prediction and testing are integral to ST – different stages of technological advancement before its safe-use is permitted
- Advances in science help us is understanding shortfalls, dangers, and aid development of technology
- Advances in technology help meet basic needs, reduce production costs, reduce consumption of resources and environmental impact, and help in development of new or improved product services.
- S&T together provide the basis of integrated assessment of challenges and opportunities, advice to policy makers, and improved literacy about S&T

What can individual scientists and engineers do?

- Thinking out of the box
- Beyond relevant areas of specialization into interdisciplinary areas that can contribute to sustainability and well-being
- Stronger interconnections with other branches and domains especially those connected with providing solutions to practical problems and improving the everyday life of human beings
- Improving communication skills in order to effectively promote STS literacy

What can IITians do to change their institution and society?

(Re)Acting Out: What do we do?

- A stronger recognition and emphasis by scientists and technologists regarding the threats to human well-being
- Interdisciplinary inter-sectoral interregional and intergenerational analysis of threats and remedies
- Education – undergraduate and post-graduate training
- Finding solutions to multiple threats – integrating efforts
- Larger and more coordinated investments in R&D advancements that can provide cost-effective solutions
- Increased public S&T literacy

Challenge before us to are three-fold

Encourage and develop	Encourage and develop indigenous science and technological capacity [but where?]
Curb	Curb excessive consumption and proliferation of unsustainable lifestyles
Develop	Develop infrastructure at local level to provide local solutions that can alter global systems while evolving policies which streamline and address issues going beyond national levels

Democratizing Knowledge is the solution

- Efforts to mobilize S&T for sustainability are more likely to be effective when they manage boundaries between knowledge and action in ways that simultaneously enhance the salience, credibility, and legitimacy of the information they produce.

- Ranging from providing solutions to cooking fuel crises to nuclear reactors….tackling food production to global warming…oil crises to biofuels.

We need to critically think about S&T and its relationship with environment and social development

- Science and technology should be democratized in the interest of the environment and sustainable human development. Science policy should allocate resources according to human right principles [Article 15 of the International Covenant on Economic, Social, and Cultural Rights]
- Technology transfer protocols should be established
- Harmonious global science should be our goal

Balancing equity and scientific progress

We should move towards using the human right lens to look at science. This will/should have **four** components:

1. **Access** by everyone without discrimination
2. **Opportunities** for all to contribute to scientific enterprise and availability of scientific freedom
3. **Participation** of individuals and communities in decision-making about science and related right to information [question of IPR and corporate interests]
4. Developing of an **enabling environment** fostering conservation, development, and diffusion of S&T

The environmental problems we face today can not be resolved by single countries or a few scientists but are complex issues needing multilateral negotiations on a global level involving social scientists, economists, scientists, policy makers and lawyers to frame new rules of living and politicians having the political will and mandate to implement them in their own nations

– Climate Change brings to the fore the challenge of sustainability science.

Intergovernmental Panel on Climate Change

Established in 1988 by the United Nations, the IPCC does not do any original climactic research. Its role is to review current science from around the world, then synthesize and summarize that data within comprehensive reports meant for policymakers.

The first of these four reports states: temperatures are probably going to increase by 1.8 - 4C (3.2 - 7.2F) by the end of the century, while it projected that sea levels were most likely to rise by 28 - 43cm. ***All these are a result of human 'development' in the last 50 years.***

IPCC emphasizes and has reported…

"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level".

Checking 20 years of projections by the foremost global climate science panel against reality finds that the group has consistently underestimated the pace and impacts of climate change – with severe consequences for the public it is tasked to inform [December 2012]

Listen to this podcast as part of your tutorial activity:

https://www.economist.com/podcasts/2022/01/03/will-there-be-significant-action-against-climate-change-in-2022?gclid=EAIaIQobChMI2LiwrZeS_QIVwjUrCh0FHgktEAMYAiAAEgKh0_D_BwE&gclsrc=aw.ds

"We're underestimating the fact that climate change is rearing its head," said Kevin Trenberth, head of the climate analysis section at the National Center for Atmospheric Research and a lead author of key sections of the 2001 and 2007 IPCC reports. "And we're underestimating the role of humans, and this means we're underestimating what it means for the future and what we should be planning for."

The IPCC's overly conservative reading of the science, they say, means governments and the public could be blindsided by the rapid onset of the flooding, extreme storms, drought, and other impacts associated with catastrophic global warming.

You may want to look at or browse through summary of same:
https://www.unep.org/resources/emissions-gap-report-2022

Shifting the *responsibility*

Andrew Dessler [Professor of atmospheric sciences at Texas A&M University] sees no need for the IPCC to do anything differently. "The burden of communication falls on policymakers, not on scientists," he said.

Scientists are responsible for providing the hard data. It is up to policymakers to lead, connect the dots, and explain to the public the necessity of responding to global warming.

[http://wwwp.dailyclimate.org/tdc-newsroom/2012/12/ipcc-climate-predictions]

'Nature of research'

Underestimates will continue to characterize climate projections, cautioned Richard Somerville, IPCC scientist and Professor Emeritus and Research Professor at Scripps Institution, "But that's the nature of research," as it constantly discovers new possibilities. Looking back at the 1950s when scientists first identified the climate problem, Somerville notes that the tone at the time "was not catastrophic at all, but rather curious to see how the climate system would react to a big spike in carbon dioxide emissions." Only over time did the full realization dawn on the scientific community that many of the consequences of climate change could be very serious and even catastrophic.

And that is what hasn't gotten across to the public, Somerville warned: a sense of urgency that, to most scientists, is now very clear. "This is an urgency that has nothing to do with politics or ideology," said Somerville. "**This urgency is dictated by the biogeochemistry and physics of the climate system. *We have a very short time to de-carbonize the world economy and find substitutes for fossil fuels.*"**
[http://wwwp.dailyclimate.org/tdc-newsroom/2012/12/ipcc-climate-predictions]

Note

Holdren discusses MDGs but we are already in era of Sustainable development goals …Prof Yonehara's lectures on Sustainable well-being and evaluation were already done in the lecture class as she was leaving for Japan

Is there anyone who thinks climate crises is a myth?

Gloom and Doom Predicted Ahead: Triple planetary crises of climate change, pollution, and biodiversity loss

The Emissions Gap Report 2022 finds that the world must cut emissions by 45 per cent to avoid global catastrophe.

BAU scenario failed – we need systemic wide-ranging, large-scale, rapid changes

- Targets, National Commitments, Assessment and Monitoring of Co_2
- End of 21 Century we are looking at global warming of $2.8^{o}C$
- Current evidence indicates that nationally determined emission targets are unlikely to be met

Closing window: 2022 Emissions Gap report

- Very limited progress by various nations in reducing emissions – gap between promise and reduction of emissions that is needed
- Nationally Determined Contributions (NDC) emissions targets [G20 countries data set] and mitigation pledges have been made in international meetings. Globally, they are insufficient and implementation has been poor [divided into conditional (defined range between minimal and maximal) and unconditional (single emission level); details refer to https://www.climate-resource.com/tools/ndcs/methods]
- Gap is quite high G20 countries are responsible for 75% of GHG emissions [members include Argentina, Germany, Republic of Korea, USA, Australia, India, Russia, European Union, Brazil, Indonesia, Saudi Arabia, Canada, China, Italy, Japan, South Africa, Turkey]
- Global GHG emissions in 2030 are estimated to be 58 $GtCO_2e$ while emissions gap is 15 $GtCO_2e$ for a 2^oC pathway and 23 $GtCO_2e$ for a 1.5^oC pathway
- Zero GHG emissions and Zero carbon technologies: How to redistribute resources and make energy available to those who are currently not served?

Emissions data

- Top seven emitters accounting for 55% of total GHG emissions are China, EU27, India, Indonesia, Brazil, the Russian Federation and USA plus international transport.

- Per Capita emissions [correlate with population and landmass data- refer - https://www.worldometers.info/world-population/population-by-country/]

	Population [2020]	tCO_2e/capita
USA	331 Million	14
Russian Federation	145.9 Million	13
China	1.4 Billion	9.7
Brazil	212.5 Million	7.5
Indonesia	273.5 Million	7.2
EU27	447.7 Million	7.2
India	1.38 Billion	2.4
World	8 Billion	6.3

What do we do? Who should do what?

Incremental change is no longer an option and broad-based economy-wide transformations are required [electricity supply, transportation, industry, and buildings] while admitting inequalities within a country [between high-emitting households vs bottom]

1. Avoid lock-in in new fossil fuel intensive infrastructure
2. Enabling transition by further advancing zero-carbon technologies, market structures, and plans for just transformation
3. Applying zero emission technologies and promoting behavioural changes

Table ES.3: page XII: Different **actors (**national govt, international organizations and govts, sub-national govt, businesses, financial investors, and citizens have to "act" in different sectors namely electricity supply, industry, transportation, and buildings to reduce emissions, meet zero-carbon targets and in an accelerated manner for durable systemic change [free-rider problem needs to be eliminated]

Food systems

- Healthy diet and food security for all is integral to human development
- Food systems contribute to land-use change and biodiversity loss, depletion of freshwater resources, pollution of aquatic and terrestrial ecosystems and not merely **Climate Change**
- **Food systems contribute one third of total GHG emissions or 18[14-22] $GtCo_2e$/year and will rise to 30 $GtCo_2e$/year by 2050.**
- Incld – agricultural production (including fertilizers), changes in land-use and supply chain activities (retail, transportation, industrial processing, fuel, packaging)

What do we do?

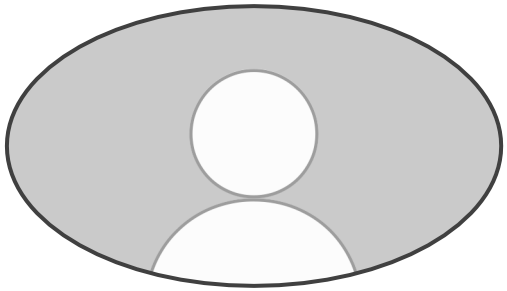
- Required transformation include changing diets, improving food production, decarbonizing the food value chain, and protecting natural ecosystems.

Paris agreement had wanted to limit temp rise to 1.5 degree centigrade

2022: Policies currently in place point to a 2.8 degree centigrade temperature rise by the end of the century.

Zero Carbon technology
Imperative – national economies, actors and companies

- June 2023 Bonn Climate Change event



- Is this discussion an urgent one?
- Who is responsible and who will take the responsibility?

- Intersection of S&T with public policy is paramount
- How does climate change impact me?

Compulsory Reading:

Holdren [2008]

Some sections of Executive Summary of the Emissions Gap Report 2022 will be necessary [circulated]