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

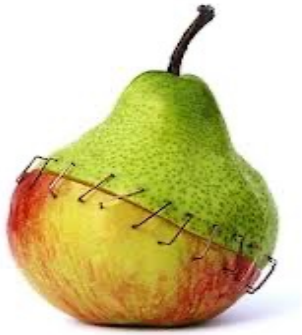
- Advocates the need to factor the cost/charge for environmental degradation and the use of environmental resources – magnitude of human impact is devastating for the environment. Polluter should pay principle is being recognized.

- 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?

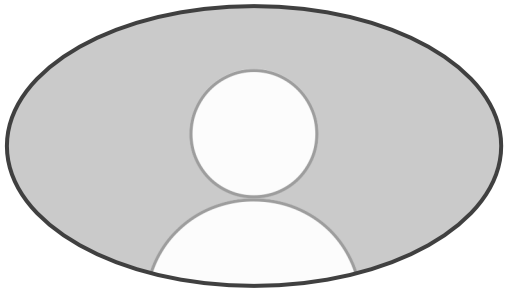
- Required transformation include changing diets, improving food production, decarbonizing the food value chain, and protecting natural ecosystems.

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]

How much should a person consume? Guha

PROF VIBHA ARORA, HSS, IIT DELHI

FEB 2023: LECTURE 10

Self-correction is an ideal

Redistribution has to accompany collective and individual will

Reality: *Today, India is in many ways an ecological disaster zone, marked by high rates of ecological deforestation, species loss, land degradation, and air and water pollution [Guha 2006: 232]*

Any *reduction* of our consumption requires:

- **we need political action [based on scientific and social science data] that has to be guided by technical change, by the exercise of individual restraint and by a wider resolve to redistribute wealth and resources with the less-advantaged countries of the South**

- **Are we doing or merely propagating it to others?**

Which citizen needs to reduce?

"Looted" vs "yield" : In 1938, C. Sauer had spoken about the expanding frontier of technology overcoming limits of nature and warned about difference between the two and that nature could not be exploited indefinitely.

2022: Can technological innovation be sufficient or we need strong behavioural shifts to meet emission targets?

Global emissions Report 2022 emphasizes need for "individual" citizens of the world to reduce their ecological footprint

When we compare?

2.4 tCO_2e/capita Indian citizen VS 14 tCO_2e/capita US citizen

* Picture is evident and self-explanatory! Within each are great inequalities between Indian citizens themselves and averages cloud the picture

All kinds of comparisons about natures stock by an American citizen - (number of cars, consumption of wood, minerals and other materials can be compared)

* Much before we calculated these quantitative comparisons sociologists were already writing about these and tracing this idea to Gandhiji – Eminent sociologist and environmental historical Ram Guha's 2006 article argues this

>>>>>>>my own field research in North-east India

Consumptive individual & nation: Galbraith

- **Worshipping GOD GROWTH as cardinal principle of USA - 1950s**: Plentiful and society of affluent consuming such that consumption of material goods itself became a measure of individual and collective achievement
- What are the consequences of this trajectory, globally? Is this at cost of other nations and other citizens of the world?
- BIG ECOLOGICAL FOOTPRINT: Galbraith published "***The Affluent Society***" in 1958 speaking about American high production and high consumption patterns
- His later essay published in 1958 entitled "***How much should a county consume***?" spoke about disjunction between public squalor and poverty and private affluence [inequity and appetite for consuming more resources than ever] – American citizen has an insatiable desire and hunger for consuming and drawing resources from other countries
- **Pristine nature**: Promote wilderness and conserve nature while shifting resource extraction from other nations [R. Carson and few other romantics argued about value of ecological restoration and cutting environmental degradation and biodiversity loss]
- USA is deeply democratic yet indistinctively imperialist and consuming more than one-third of world natural resources while its population accounts for 330 Million out of 8 Billion persons
- **Ehrlich and Hardin in 1970s: Human Population growth as single most imp factor contributing to ecological crises – developing countries like India were constantly blamed**

German Greens acknowledgeecological vulnerability and need for sustainability

Recognition and admission: Exploitation of developing countries and ecological extraction of resources from Third World countries at cheap prices has permitted the wealth and growth economies of the North

How do we reduce poverty in the developing world without cutting voracious appetite to consume in the industrialized North?

Eco-socialist Bahro: "we are eating up what other nations and future generations need to live on" [1984, From Red to Green: Interviews with New Left Review]

- Debates have proliferated in 1990s, and public have been sensitized on need for reconstructing their industrial society to shift to ecologically and socially equitable distributive processes of production and consumption
- Green Party acknowledged: Present consumptive patterns of industrialized societies and nations was destructive and leading to ecological deterioration and undermining health of the planet. This could not be sustained and had to be curtailed as natural resources were being exhausted and could not be replenished and renewed.
- Netherlands – Dutch also attempted to understand and aim for reducing consumption

Can India ape the West?

Greed and Growth - Civilizational perspective: the distinguishing feature of modern industrial society is insatiable desire to consume and indefinite multiplicity of wants [while traditional society were characterized by collective and individual restraint on wants]

Gandhiji spoke in Dec 1928: “God forbid if India should ever take to industrialization after the manner of the West. The economic imperialism of a singly tiny island kingdom {England} is today keeping the world in chains. If an entire nation of 300 Million took to similar economic exploitation, it would strip the world bare like locusts.”

Whom do we exploit? Where do we extract resources from and how do we tackle growth with redistribution to reduce inequalities?

Greed needs to countered

Mahatma Gandhi considered the earth a living organism.

The distinguishing characteristic of modern civilization is an indefinite multiplicity of wants, whereas ancient civilizations were marked by an imperative restriction upon, and a strict regulating of these wants. Gandhi believed that the ancient civilizations were religious in nature which would surely limit worldly ambitions.

Gandhiji advocated a code of voluntary individual and collective simplicity and sustainable lifestyle [resource recycling, minimization of greed and consumptive desire]

"nature has enough to satisfy every one's needs, but not to satisfy anybody's greed" has over time became the code and ethic of modern environmentalism.

Modern industrial civilization has had a huge impact on human kind as well as on the environment. It made a small part of the population wealthy at the cost of exploiting the world's natural resources. Gandhi believed that it propagates nothing other than the hunger for wealth and the greedy pursuit of worldly pleasures. *Hind Swaraj*, published in 1909, criticized the modern civilization as" 'satanic'. He observed that 'machinery is the chief symbol of modern civilization; it represents a great sin. It is machinery that has impoverished India.'

If interested refer to https://www.mkgandhi.org/articles/green_future.htm#:~:text=His%20idea%20that%20%22nature%20has,and%20the%20Law%20of%20Species.

Romantic vision and contrast

- Gandhi: Set up contrast between idyllic self-sufficient village republics and modern industrial cities
- Guha talks about - India and several India's [ecological diversity and socio-economic inequality]: How India has become like United Kingdom and America?
- Environmentalism of poor and ecological conflicts expressed within India (forests, water, land) highlight the contradictions and inequalities between societies and nation and within India itself – massive asymmetries in power, access and consumption of resources
- India's growth and development story has been based on human exploitation and resource extraction from within the territory of the nation itself, and particularly from rural sections and tribal-dominated geographies that have been alienated from their resources [middle India, North-east India, Andaman and Nicobar Islands].

- Distinguishes between 3 categories:

1. **Omnivores** [industrialists, rich farmers, state officials, middle class living in cities, and others consuming resources and extracting
2. **Ecosystem people** [peasants, urban poor, animal herders and pastoralists, tribals, majority of rural population dependent on primary sector for their livelihood and majority of India's population]
3. **Ecological refugees** who have been displaced by various development projects and migrated to urban areas and live in slums and work in the informal sector

India's development process – Guha identifies 5 aspects

1. concentration of decision-making power with Omnivores
2. use of state machinery to divert resources and give subsidies to Omnivores
3. Indifference towards ecological degradation by Omnivores while ecosystem people pay the cost and suffer
4. Development projects (wood, water, minerals) around dams and hydropower, deforestation, and mining have dispossessed ecosystem people
5. Development has permanently displaced large number of eco-system people from their homes, farms and forests and and transformed them into ecological refugees and created "victims of development" and created ecological faultlines

Contrast & Choices

- Universalization of American style of consumption has been promoted by Globalization [discusses the index of motor car as reflecting lifestyle aspiration]
- Fruits of development within India and China are unevenly distributed although absolute poverty has declined – environmental degradation has been immense

Guha differentiates and discussed

- **Economists romantic fallacy** which supposed there were no limits to growth and resources would be redistributed by the market principle

Solution given by Biology professor – reduce size of human beings genetically alter them!

- **Fallacy of romantic environmentalist** – Gandhi's ideal village [Guha, 2006: page 239-40] read…
- Some spring from emphasizing the agrarian lifestyle while others from a deep ecological perspective

Reality: But the peasant does not want to remain a peasant, or be denied fruits of development!

Ecosystem people do not wish to be stagnating and remain as ecosystem people, but aspire to be omnivores and be denied prosperity and material objects [Gandhiji's lion-cloth vs Ambedkar Blue suit]

Choices of consumption should be available to all

Overlap between ecological entitlements and economic status and this needs to be sorted

The rich not only do they consume more of the resources but also more protected from environmental degradation while the poorer get deprived more and get more exposed and suffer from consequences of ecological destruction

Guha's charter – New Green Development Strategy

1. Foster a genuinely participatory democracy
2. Process of natural resource use should be free, transparent and accountable
3. Removal of subsidies to ensure proper ecological valuation and political decentralization of control over resources
4. Encouraging shift to private market enterprise to curb corruption and factoring environmental externalities in production costs
5. Outline sustainable policies [combining science and social science] for specific resource sectors {transport, energy, health, water, and so on}
6. Work towards a more equitable society by investing in social development (land reform, education, health) and enhancing power of ecological refugees and ecosystem people

Nature-consuming to nature-saving model

- Will the rich retreat from their patterns of consumption and reduce their appetite?
- Discussions and policy suggestions are circulating within Europe but USA is far behind
- Several German towns and cities are putting sustainable policies and proposals into practice

- Bitter arguments are going to occur over distribution of ecologicalresources and as they get scarcer

Not merely an Intellectual Debate – emissions report of 2020:

❖ What element of reducing consumption can be voluntary or can be demanded?

❖ What amount of ecological degradation is avoidable?

Note

Compulsory reading already circulated on Moodle

- Chapter by R. Guha “How much should a person consume?” and inter-connect it with the Exec Summary of the Global Emissions Report 2022

Tutorial discussion: Youtube video produced by the Indian Academy of Sciences

- https://www.youtube.com/watch?v=-tyLEACvSr8, Guha’s lecture on Gandhi, Science and Future of Humanity

INDUSTRIAL ACCIDENTS TO HUMAN-MADE DISASTERS: BHOPAL

DR VIBHA ARORA, HSS, IIT DELHI

HUL275: 2023

FEB 2023

DEALING WITH RISK AND ACCIDENTS

Science and Technology is like any knowledge system

Living in an industrial era of manufacturing - recognition of 'risk', 'occupational injuries', 'industrial accidents', 'work-place stress', 'occupational disease', 'industrial pollution', 'industrial safety'

- Qu is how do we organize our production sites?
- Recognition of 'communities can and are at risk'
- Several industrial cities with factories and working class residences around them - Bhilai, Bokaro, Bombay, Ahmedabad, and so on
- Industrial hubs and SEZ are more recent

LOOKING INTO THE FROZEN EYE

War images….

1995 Award winning photo
of P. Bartholomew on
a Bhopal child's burial
– this death mask is
used extensively in the
campaign for justice

International Campaign for Justice in Bhopal

GASSED TO DEATH@BHOPAL

- Bhopal is the 16th largest city of India [https://en.wikipedia.org/wiki/Bhopal, 26 Feb 2023]
- Capital city located in state of Madhya Pradesh & known as the city of lakes (natural and artificial)
- On midnight of 2/12/1984 and early hours of 3/12/1984, Bhopal became a gas chamber of genocide when approximately 40-42 tons of MIC (Methyl Isocynate) was released from Tank No 610C in an industrial complex owned by Union Carbide (India) Limited – UCIL (a subsidiary of an American Company Union Carbide – Now Dow Chemicals [see: https://www.unioncarbide.com/) that used to manufacture Carbryl and other chemical fertilizers and pesticides.
- Union Carbide plant was set-up in 1968 & Carbaryl manufacture was started in 1979.
- Locality is densely populated, lacks proper roads for emergency evacuation, poor communication and informal settlements and enroachments
- About an area of 20 sq kms was severely affected
- It exposed more than 65% of Bhopal's 900,000 population in December 1984.

CARBARYL

- MIC is used to manufacture Carbaryl (a pesticide), fertilizers, plastics, pharmaceuticals, polyurethane foams etc.
- Carbaryl (1-naphthyl methylcarbamate)
- Carbaryl is often inexpensively produced by direct reaction of Methyl Isocynate with 1-Naphthol

$C_{10}H_7OH + CH_3NCO \rightarrow C_{10}H_7OC(O)NHCH_3$

- Discovered by Union Carbide in 1958 - Carbaryl was the third-most-used insecticide in the United States for home gardens, commercial agriculture, and forestry and rangeland protection
- Carbaryl is a cholinesterase inhibitor and is toxic to humans. It is classified as a likely human carcinogen by the United States Environmental Protection Agency (EPA)

- Marketed under the label Sevine

WHAT HAPPENED THAT NIGHT?

Read extracts from

T.R. Chouhan (ex-MIC plant operator) provides us with a vivid narrative about what actually happened on that fateful night in the plant: MIC storage tank 610.

And

Puri and Bisariya (DIG of Bhopal and Ex-Mayor of Bhopal)

Reading – 3 pages published in 2005

A HUMAN CARNAGE…

- Roused from sleep, blind and breathless, thousands suffered a painful death after inhaling a poisonous gas…many died instantly while thousands others choked to a painful death within a few days of inhaling the poisonous gas, and still thousands of others died a slow painful death while an entire generation now copes with the after-effects…
- Symptoms – irritation in the eye leading to loss of sight, acute burning in the chest, severe headaches, joint pains, skin disorders, reproductive malfunctioning (abortions, stillborn fetuses, early menses)

FROM ACCIDENT TO DISASTER

3 DECEMBER 1984, BHOPAL, INDIA

HOW? WHAT? WHY?

SAFETY…RISK….DISASTER

The plant did not have permission to store MIC over a prolonged period; "The catastrophe happened because the essential safety systems either failed or were inoperable and the safety procedures were not strictly compiled with" [Bisariya and Puri 2005]

- Chouhan: The Bhopal plants safety record prior to 1984 was not good – warning signals had been there. This disaster was not merely an accident!
- There had been other accidents earlier and recorded for Dec 1981, Feb 1982, and Dec 1982 leading into an enquiry about the safety of the plant. The enquiry committee declared the plant to be safe!
- Industrial secrecy and IPR were used to maintain secrecy about information

SAFETY MECHANISMS

- Chouhan: There were four kinds of safety equipment for the MIC storage:

1. vent gas scrubber [not operational on that night];
2. flare tower [under maintenance that night];
3. refrigeration system [system had been shut down in May 1984 to save power costs – very dangerous to keep MIC at ambient temperature of 11°-26°] and alarm system on tank was not working either;
4. water spray [could not reach the height of 30m where gas was released]

- Danger alarm was switched off after the release after 5 minutes as per company policy. None of the plant personnel died due to this.
- Economy measures overrode safety concerns and spares were not available
- Plant engineers and operating personnel left while public got exposed!
- Evacuation plan was in place for the plant personnel and not for the community living adjoining to the industrial factory

CONTESTED EXPLANATIONS

On the website of UCC we have an explanation given about the midnight incident of 2 December 1984, when a gas leak at a plant at Bhopal, India was caused by an act of sabotage, resulted in tragic loss of life (cf. Jasanoff 2007: 345). A US based consultant was cited as responsible for this narrative.

- The GOI nor the citizens of Bhopal ever accepted this sabotage theory.
- Puri and Bisariya's narrative emphasizes the lack of preparedness and complete ignorance to deal with the situation [p. 211]

FROM ACCIDENT TO DISASTER

- No information about storage and handling of hazardous and dangerous material was adequately available nor were any safety drill ever conducted – lack of preparedness
- All warning and safety mechanisms inside the factory & its storage facilities failed
- The company denied any wrongdoing and did not share vital toxicological information about the chemical released.
- Lack of coordination between factory, administrative set-up and health personnel

DENIAL CULMINATES IN A CATASTROPHE

- The medical team [Dr H. Chandra] responding to the patients were misled by the company doctor [Dr L.S. Loya] employed by the UCIL that MIC was not a serious toxin and not dangerous (cf. Muralidharan 2004: 5196)
- L.S. Loya: Give them atropine drops …victims might get irritated eyes and skin…but were not liable to die.
- Doctors did not initially even know what they were treating and were not able to cope with the scale of the industrial accident. Post-mortem studies indicated symptoms of cyanide-like poisoning.

MACABRE MOMENT

- Even 30 years after 3/12, the calculus of the death and injured remains incomplete….
- "the disastrous state of preparedness in both the city and the company running the lethal factory was one hint of the many dimensions that the tragedy would acquire over the years. And to this day there has not been any enforcement of accountability on either the corporation for its crimes of culpability nor the regulatory authorities for their gross neglect of the potential hazards involved in the pesticide factory" [Muralidharan 2004: 5196]

DENIAL OF TOXICITY

- Dr HH Trivedy, "we still do not know what could we have done that day to save lives; we are still not aware of what could we have done in the months and years since" [cf. Muralidharan 2004: 5197]
- The death toll could have been much lesser – however, the recommended antidote of cynaide poisoning namely sodium thiosulphate was not administered by medico's in a timely manner as this would have constituted conclusive proof of industrial poisoning & attributed to criminal culpability of Union Carbide.

ASSESSING THE MAGNITUDE

- Magnitude: ascertaining the extent of damage and fatalities has become a bureaucratic wrangle and controversial.
- Around 3,000 died within a week and 20,000 until 1992 when officials stopped counting (CSE 2006: 308).
- The Greenpeace organization cites a total casualty figure of 20,000 as its own estimate.
- 1989 SC judgment estimated number of fatal cases was 3000 persons and those suffering from serious injuries was estimated to be 30000.
- Review petition filed against this ruling resulted in a later 1991 judgment escalating the fatalities to 4000 persons and tens of thousands as those suffering from serious injures….
- By 2004, about 6000 death claims have been settled while the number of persons claims settled exceeded 550000.
- MP govt report stated the death toll to be 15248 in 2004 while the Amnesty International report (2004) declared 20000 persons as dead.

STATE COMPLICITY AND SUPPRESSION OF EVIDENCE

- Sir Dorabji trust funded the first comprehensive house-to-house survey that was undertaken by faculty and students of TISS between January and February 1985 covering 25259 households in Bhopal.
- MP government did not share these findings….
- Victims were not given the requisite medical care
- ICMR conducted a clinical study on efficacy of Sodium Thiosulphate as an antidote to poisoning and recommending its administration to improve the condition of the affected people. But due to opposition from medical lobby controlled by the company, it did not push for this and government was also wavering.

VICTIMIZATION

- Estimated that about 50,000 people are suffering from respiratory distress, cancers, psychiatric problems, & cardiovascular diseases in Bhopal.
- Bhopal has the highest incidence of pulmonary fibrosis and lung cancer yet the govt turns a blind eye attributing it to other causes – urgent need for a healthcare strategy.
- Official silence is a complete denial of any responsibility towards the silent impoverished sufferers who do not even manage to get decent employment and wages as their productivity is low.
- Major portion of the sufferer's earnings in Bhopal are being spent on expensive medical treatment, which should have been borne and compensated by Union Carbide.

पिछले 25 सालों में
पीड़ितों को इंसाफ नहीं
© EPA
ARREST
THE
WARREN
ANDERSON

NOTABLE EVENTS

Legal deliberations [1) criminal case; l2) civil case for compensation; 3) civil case for medical relief and rehabilitation]

1985: Union Govt of India was declared to be the sole legal representative of all Bhopal Gas Victims by an Act of Parliament in March 1985. The Indian govt files a claim of $3.3 Billion in New York, USA in April.
1986: in May, UOI plea is dismissed and Union Carbide persuades the US court to send the case back to India where compensation liability would be lower for the company
Govt of India files cases in Bhopal's district courts - interim relief demanded.
1989: Review petitions are filed in the Supreme Court. An out-of-court settlement is reached with compensation bought down to merely $470 million. This action of GOI puts an end to all outstanding claims against Union Carbide resulting from the gas leak and also led to closure of official enquiry into the leak.
Was this compensation given and how was it utilized?

Compensation

Supreme Court ordered compensation as follows

Families of the dead – Rs 1-3 Lakhs;

Fully or permanently disabled to receive Rs 50,000-Rs 2 Lakh

Partially injured about Rs 25,000-Rs One Lakh.

- Originally the no. of claims filed was 2 Lakh that has now risen to 1.29 million in 2003.
- Actual amount was very less.
- Indian Lives are cheap (Oil spill affected wildlife such as Otters recd. $40000 each in Alaska in 1989!)
- Many animals died also…

COMPENSATION

- Claims settlement was not based on any scientific understanding of nature of injuries or the number of injured.
- The data was never placed on record in the court…victims were never provided with health booklets to document their deteriorating health.
- Hence, there were nation-wide protests at this arbitrary decision and figures.
- Victims realized the complicity of the government and initiated litigation on their own in 1989 to seek legal remedy.
- ICMR studies showed effects of the exposure to be multi-systemic, irreversible, and progressive on humans. The exposure had impacted the immune system and grave dangers of mutagenic changes were documented in the exposed population. Previously there had been no studies done on impact of MIC.

TURNING POINTS

1994: Indian Govt allows UCIL to sell all of its assets

1999: Bhopal victims file suit in New York citing violation of human rights, environmental law and international criminal law.

2001: Union Carbide and Dow merge to form the largest chemical company.

2002: the Madhya Pradesh govt urges the central govt to press Union Carbide to clean up the contaminated soil and water at the factory site.

EVENTS…CONTD.

2002: Study by People's Science Institute (Dehradun) confirms the presence of toxic mercury in drinking water – people have been drinking since 1984!
CBI and other organizations submit documents incriminating Union Carbide of using unproven technology in their plant. People march peacefully demanding justice and flood Dow with emails and petitions

2003: Some US senators ask Dow to take responsibility and cooperate with the Bhopal victims

2014 – W. Anderson dies in the USA

NEW VICTIMS OF THE BHOPAL GAS TRAGEDY

- Environmental contamination in Bhopal means that the new generation is also suffering.
- Studied have established how indiscriminate dumping of hazardous waste and lack of cleanup within factory has led to a deterioration of groundwater and contamination of drinking water in 14 colonies of Bhopal.
- Toxins presence led to hand pumps being painted red and dangerous by the municipal corporation.
- 2004 SC intervened…

CLEAN DRINKING WATER AS LUXURY

4 May 2004

Supreme Court ordered the provision of clean drinking water to people in Bhopal – yet nothing has been done (red water pumps of contaminated ground water are still being used for drinking by people)

TOXIC BODIES

- NGOs and citizens groups have been very active in the whole process of revealing the nature, extent, and agony of victims. They have forced govt to share data.
- Studies reveal that tankers are unreliable and do not provide adequate water for people's needs.
- The survivors drink poison everyday.
- Toxic chemicals have now entered the food chain as breast-milk was found to contain lead! "In Bhopal, cancer takes the easiest and shortest route to inflict children: breast milk"

ONGOING…UNRESOLVED

- Residents report chronic health problems such as psychological and neurological disabilities, blindness, skin, vision and breathing disorders and the newborn children still suffer from serious birth defects, even after generations.
- The Indian Council of Medical research (ICMR) has classified this cluster of diseases as the 'Bhopal Toxic Gas Disease' in 2004.

- 2005: in response to a Public Interest Litigation the MP High Court directed a cleanup/removal of toxic waste from the factory premises – in three phases by 2007.

COURTS AND SCIENCE

JUSTICE DELAYED AND JUSTICE DENIED

BHOPAL GAS LEAK DISASTER (PROCESSING OF CLAIMS) ACT OF 1985 IS PASSED

- Reserves the right of the Union government and grants it exclusive right to litigate on behalf of victims in its capacity as *parens patriae* (parent of the country).
- Implication - the victims have no right to file private cases/represent themselves in the courts.
- The government of India hence would file a *class* action suit on behalf of the victims who lacked the means to fight the case.
- State also had a responsibility to look after the victims through their protracted and taxing judicial process in India and in the US.

ANDERSON, CEO

- How could GOI allow Warren Anderson to be released on bail and not impress on Govt of US to extradite Anderson back to India?
- As the UCC CEO, Anderson was charged with manslaughter by Indian authorities. He flew to India and was promptly placed in custody by Indian authorities. Anderson posted bail, returned to the US, and refused to return to India. He was declared a fugitive from justice by the Chief Judicial Magistrate of Bhopal on February 1, 1992, for failing to appear at the court hearings in a culpable homicide case in which he was named the chief defendant.
- The chief judicial magistrate of Bhopal, Prakash Mohan Tiwari, issued an arrest warrant for Anderson on July 31, 2009. The United States has declined to extradite him citing a lack of evidence. In August 2009, a UCC spokesperson said Union Carbide had no role in operating the plant at the time as the factory was owned, managed and operated by employees of Union Carbide India Limited.
- Eight former senior employees of the subsidiary were found guilty on June 7, 2010. After these convictions, a UCC spokesperson said, "All the appropriate people from UCIL – officers and those who actually ran the plant on a daily basis – have appeared to face charges."

Warren Anderson dies on September 29, 2014.

Sourced from http://en.wikipedia.org/wiki Warren_Anderson_(American_businessman)

ROLE AND RULE OF LAW

- Law became complex with issues of jurisdiction – UCC was an American Company, UCIL was a partnership with 49% held by Indians [the Indian govt was also an investor] while all the victims were Indian citizens.
- American and Indian legal systems got entangled with their culturally specific laws and conceptions of human rights and justice.
- Compensation and claims settlement were different in both the jurisdictions.
- Bigger question also of idea of monetary compensation of loss – is this sufficient and used as a benchmark for violation and negligence
- Indian legal system had no provision to deal with hazardous industrial chemicals and an industrial accident of this magnitude. Nor did Indian lawyers have the necessary legal competence to deal with this kind of disaster (Jasanoff 2007: 346).
- Shift of case from the US to Indian context was disastrous from the point of view of compensation and rehabilitation of victims.

SHROUDED EVIDENCE

- Administrative inefficiencies and corruption were endemic in identifying victims and sufferers – the extent of damage, the magnitude was unclear and statistics were fuzzy.
- No treatment protocols were established and shared about how to deal with the affected population even until 1994. Only symptomatic treatment was done in an ad hoc manner.
- The GOI had set up a Scientific Commission for Continuing Studies on effects of Bhopal Gas Leakage on Life Systems and it was headed by the Former Director of Indian Institute of Toxicology Research and they submitted a report in 1987 [1000+ pages] but this was not submitted in courts or shared with public.

(IR)RESPONSIBLE SCIENTISTS

- ICMR initiated 24 research projects in 1985 but withheld the research results – all of these projects were terminated in 1994 excepting one on cancer among the gas victims.
- The other epidemiological studies being done by ICMR were abruptly discontinued. The MIC Gas is not present in the air so why conduct studies, explained Sameer Kare, the Director of Dept of Bhopal Gas relief and rehabilitation (cf. CSE 2006:315) – this decision was not based on any researcher's advice but was purely an administrative decision.
- No long term studies were publicly shared and a technical report was released by ICMR in 2004.
- **Don't we need studies with half a million sufferers?**

WHO IS RESPONSIBLE?

Company….yes, nonetheless…others as well

Responsibility lies not merely with Union Carbide but also the state and national government who had not undertaken any necessary steps to rehabilitate (issues of medical, infrastructural, economic nature) the gas affected victims or the people living/residing in the factory area.

Govt covered the damning medical evidence in secrecy…a ban was imposed on doctors on their sharing of relevant information….

Clearly, sections of bureaucracy were colluding with the company!!!!

LACK OF ACCOUNTING & ACCOUNTABILITY

- Law suits demands evidence….
- No one knows how many people died at Bhopal or were affected after the MIC leak – what we find is chaos and mismanagement. On one hand the legal demand for scientific proof, and on the other hand the silenced narratives of the sufferers and victim's families.
- How do we fix responsibility?
- Who are complicit?
- Lack of Official Records & Statistics about the Death toll
- Lack of Documentary Evidence and Conclusive Medical Proof for the suffering victims

REDRESS THROUGH LAW, SCIENCE AS EVIDENCE

- Major portion of the sufferer's earnings in Bhopal are or have been being spent on expensive medical treatment, which should have been borne and compensated by Union Carbide.
- Bhopal's story is not merely about its victims struggle to deal with the aftermath of an industrial disaster but more than anything else a story of how powerful institutions, multinational corporations, medical personnel, and complicit bureaucracy ***screen and mediate knowledge.***
- For Jasanoff, Bhopal's trials illustrate "the incapacity of law and science to restore order when radically different cultures of knowledge and justice come together in an unplanned confrontation" (2007: 344).
- ***Bhopal tragedy represents both the failure of law and of science. The betrayal of promise of progress through corporatization of science …***

LESSONS LEARNT

IMPLICATIONS AND AFTERMATH

IMPACT ON FORMULATION OF LAWS

- 1989 – The Environment (Protection) Act
- 1987 – The Factories Act of 1948 was amended to introduce provisions relating to hazardous industrial processes
- 1989 – The Manufacture, Storage, and Import of Hazardous Chemical (Amendment) Rules passed – it deals with industrial accidents in the chemical industrial complexes.
- 1991 – The Public Liability Insurance Act – provides immediate relief to the affected public
- 1999 - Environment (Siting of Industrial Projects) Rules
- 2003 – Hazardous Wastes (Management and Handling) Amendment rules

LARGER IMPACT – PUBLIC POLICY

- Large Industries and many other development projects need to conduct an Environment Impact Assessment before seeking any clearance form the MOEF.
- Lead to the relocation of many industries (dealing with chemicals or leading to toxic wastes) from thickly inhabited areas such as urban cities etc.

IMPACT OF BHOPAL IN USA

The Tomas Mac Sheoin report of 1989 on the Union Carbide noted: "it is a bitter irony that the major reformist effect of Bhopal were felt in Union Carbide's home country."

In 1986 – US introduced the Toxic Release Inventory System whereby every hazardous substance is accounted by the regulator & the user company.

Stricter monitoring mechanisms were introduced with many compounds reviewed for safety standards – About 70 chemical compounds were relocated by end-1980s.

डूसन को
फाँसी दो
ना उद्योग संगठन
BHOPAL DISASTER 1984 TO?
THE SUFFERING CONTINUES,
SO DOES THE STRUGGLE.
BHOPAL GAS PEEDIT MAHILA
BHOPAL GAS PEEDIT MAHILA

SURVIVING BHOPAL…

- 9/8/2012 saw the culmination of an extended litigation by survivor groups and their support organizations in the Supreme Court seeking medical relief and rehabilitation.
- The writ petition No 50 of 1998 directed Govt of Madhya Pradesh and ICMR to ensure continuation of medical research, prepare standardized protocols for treatment and diagnosis, and recording of patient history of treatment.
- Why did the ICMR abdicate its responsibility and its role as a medical scientific body by discontinuing their studies?

U.S. COURT OF APPEALS UPHOLDS 2012 JUDGMENT OF DISTRICT COURT IN BHOPAL CASE; UNION CARBIDE NOT RESPONSIBLE FOR POLLUTION RELATED, PERSONAL INJURY CLAIMS

On June 27, 2013, the federal Second Circuit Court of Appeals unambiguously concluded that Union Carbide Corporation (UCC) was not liable for any environmental remediation or pollution-related personal injury claims made by residents near the Bhopal plant site in India, which was formerly owned and operated by Union Carbide India Limited.

The lawsuit was filed in 2004 in a U.S. court as a proposed class action by Indian citizens who claimed that their drinking water in India was tainted by pollution from the Bhopal plant site. They sued only UCC, an American company, and its former chairman.
In its written decision, the Court of Appeals agreed, noting: "...many others living near the Bhopal [India] plant may well have suffered terrible and lasting injuries from a wholly preventable disaster for which someone is responsible. After nine years of contentious litigation and discovery, however, all that the evidence in this case demonstrates is that UCC is not that entity."

In its decision, the U.S. Court of Appeals re-affirmed U.S. District Court Judge John F. Keenan's comprehensive decision of June 2012, which rejected all of the class action Indian plaintiffs' arguments seeking to extend liability to UCC and, instead, dismissed all claims against UCC and its former Chairman Warren Anderson.

http://www.bhopal.com/court-of-appeals-upholds-2012-judgment

TOXIC BHOPAL & NEW BHOPAL

- The story of Bhopal is one of seriously botched litigation and a sequence of bureaucratic bungling. It is also one of denial of information by the company and the state to affected people.

- Living in Bhopal today is still an 'unaccepted' risk factor – as the govt and the UCIL have not failed to clean up either the area and check the contamination of the groundwater – the closed factory is a hazardous poisonous dump with chemicals leeching into the ground – posing a severe health and life risk to the people living in the surrounding area.

LEARNING FROM BHOPAL

- India has the 2nd largest Chemical Industry in the world
- An accident like Bhopal exemplifies our inability to recognize and deal with risk. It also exemplifies our inability to manage this risk and the problems that modern industrial development brings in its wake. Bhopal is a reminder of what can happen if we do not account for safety in the modern system. But Bhopal is also a reminder of what will happen if medical system is not capable of managing these risks (CSE 2006: 308).

HOW DO WE UNDERSTAND?

- ✓ Unscientific use
- ✓ Corporate Negligence
- ✓ Industrial Hazard & Disasters
- ✓ Response transformed it into the greatest industrial tragedy of 20 Century
- ✓ Environmental Rehabilitation is near impossible
- ✓ Legal issues

Video – BBC and National Geographic:

- ✓ https://www.youtube.com/watch?v=rJg19W8x_Ls, accessed on 26 Feb 2023
- ✓ https://www.youtube.com/watch?v=HsuUQzhP2Ds, accessed on 26 Feb 2023

Merchandising of biodiversity

Dr Vibha Arora, IIT Delhi

HUL275: March 2023

Ecosystem stewardship

- **Ecosystem Stewardship**: It is an action-oriented framework to foster socio-ecological responsibility for a rapidly changing planet.
- It is a strategy to respond to and shape socio-ecological systems under conditions of uncertainty and change to sustain the supply and opportunities for use of ecosystem services to support human well-being.

Biodiversity

- Some loss are irreversible.
- Loss of biodiversity is widely being recognized everywhere – recall articles done by Raven and Holdren.
- Loss of plant and animal species and possible danger of release of new GMOs.

>>> GR to GMO revolution

Who owns agricultural genetic resources and those which are found in the wilderness?

- Genetic resources (food, seeds, fisheries, forestry) are a positive environmental good in most societies. They are an ecosystem service provided by those engaged in farming full-time or art-time as part of the primary sector.
- International Convention for Biodiversity was established in Rio in 1992, abolished the idea of genetic resources being common heritage of humans. The convention leaves ownership to national legislation.
- This is where ownership of seeds by companies like Monsanto becomes problematic.

Vavilov – germplasm

- N. Vavilov (geneticist from Leningrad) in 1920s identified main centres for agricultural biodiversity in the world where initial agricultural revolutions took place. The center of origin (or center of origin) is a geographical area where a group of organisms, either domesticated or wild, first developed its distinctive properties. Centers of origin are also considered centers of diversity. This allows one to locate wild relatives, related species, and new genes (especially dominant genes, which may provide resistance to diseases).

- Knowledge of the origins of crop plants is important in order to avoid genetic erosion, the loss of germplasm due to the loss of ecotypes and landraces, loss of habitat (such as rainforests), and increased urbanization.

- Germplasm preservation is accomplished through gene banks (largely seed collections but now frozen stem sections) and preservation of natural habitats (especially in centers of origin).

- While developing his theory on the centres of origin of cultivated plants, Vavilov organized a series of botanical-agronomic expeditions, and collected seeds from every corner of the globe. In Leningrad, he created the world's largest collection of plant seeds [cf. http://en.wikipedia.org/wiki/Nikolai_Vavilov]

World centers of origin of Cultivated Plants

1. South Mexican and Central American Centre
2. South American Center
3. Mediterranean Centre
4. Middle east
5. Ethiopia
6. Central Asiatic Centre
7. Indian Centre
8. Chinese Center

Cf. http://en.wikipedia.org/wiki/Center_of_origin, 21Feb 2014.

Corporate bio-prospecting

- Many indigenous groups are quite suspicious of corporate bio-prospecting and patenting activities.
- bio-prospecting becomes bio-piracy [a violation of their human rights and appropriation of their common property resources and heritage]
- Many farmers in India do not subscribe to the idea of IPR in commercial agricultural seeds as seen in GATT negotiations.
- Groups are resisting such commercialization of agriculture (high response varieties/HYVs and genetically modified crops have evinced a strong critical response). Lower straw production in HYV is being recognized as an important economic loss.

Preserving Agro-Biodiversity

- FAO (Food and Agricultural Organization) and International Convention of Biodiversity have proposed creation of a fund for international conservation of plant genetic resources [Shiva's navodyna]. Hence, ethno-botanical stations and labs may be set up to preserve or museumize the rapidly disappearing biodiversity of our Earth.
- If biodiversity disappears, the possibility of coevolution will disappear or will be undermined.
- If we leave decisions to market and prices, then perhaps decisions about production and preserving agricultural biodiversity may be in conflict. As farmers may all decide to follow profitable commercial practices as is evident in green revolution and adoption of Bt cotton.
- Few traditional farms may be preserved as exemplars. Hence, idea of ecological debt to farmers as conservationists or preserving biodiversity by following traditional crops or practices.

Technical progress & profit

- new seed varieties has led to biological impoverishment by replacing diversity with uniformity, security with vulnerability.
- If profitability becomes the yardstick then traditional methods have no future? Farmers do exchange seeds outside the market. Some seeds now have terminator technology – Bt varieties.
- Commercial companies will protect their interests citing they have improved seed quality and IPR issues [citing UPOV system - http://www.upov.int/about/en/upov_system.html]. Many genetic resources are now being controlled by MNCs while there is recognition to store genetic diversity in gene banks maintained by public institutions.
- Should we conserve bio-resources using and following the market principle? Who would pay these costs? Or should communities be assigned the role and considered the natural owners of their resources?

Farmers vs. Scientist

Knowledge is not static, but continuing to evolve through experimentation and improvement for centuries.

- For centuries and over generations, tribals and farmers have been domesticating and improving agricultural practices and seeds, conserving and preserving biodiversity, and innovating in agricultural practices, do we forget their rights? Do we de-recognize or override rights of farmers as they are not covered under any IPR regime? What about medicinal varieties?
- We have recognized superiority of modern medicine and traditional pharma industries. Example of Neem based pesticides. How should peoples access to these resources be controlled or reworked?
- What should be farmers' rights? If knowledge is transferred to an external group without any compensation? How do we assign a value to conservation of knowledge about biodiversity? How do we assess and do we need to commodify these essential ecosystem services? Eg of Kani tribe. Who should get how much from this common fund or be recognized as a heir to knowledge?
- Do scientists have rights to patent because their work is being undertaken in research labs and they file the same? Do corporations enjoy special privileges due to their investment in high-end research?

Farmers role in conservation

- Ecological movements have arisen to support biological diversity and opposed patenting of traditional/indigenous knowledge. Neem and yoga are clear examples. There is loads of knowledge which persists in the oral tradition and now has not been documented.

Argument: Farmers are stewards, who use and preserve genetic diversity and they should be economically rewarded for the same. Their ethno-botanical knowledge is part of their cultural capital. Farmers contribution to ecosystem stewardship needs to be recognized and also rewarded for the same. CBD does not ensure ownership by farmers and tribals or assign them managerial rights to these resources.

- These are connected with critical issue of commercialization of genetic resources.

- Contradictions between national heritage and world heritage

Erosion of genetic diversity

- Many ecological initiatives have been initiated by farmers groups, local NGOs, and some public institutions.
- How do we quantify genetic erosion? How do we quantify loss of biodiversity? What are the indicators?
- These debates have given rise to idea of ecological costs. How do we compare ecological based reasoning vs. market based reasoning? How will the poor and impoverished farmers participate in this exercise/decision-making?

Preserving conservation of wilderness for biodiversity: cultivated and wilderness capital

- **Germplasm** has important immediate commercial value as a genetic resource for chemical and pharma industries and also as a resource which can be opened for prospective commercialization. WWF mandate is to argue for preservation and conservation of natural biodiversity.

- These groups argues about need for ***option value*** (future use) and ***existence value*** (protect an endangered species such as whales – Greenpeace).

- Emerged as a big arena of conflict due to big world-wide movements for need for preserving wilderness and local peoples needs for accessing resources or dependence on forests for their livelihood and basic needs.

- Relationship persists between wild and agricultural biological diversity, with some arguing for agricultural genetic resources being termed *cultivated natural capital*. Can everything in nature be reduced into a commodity/merchandise? How do we quantify the cost of reversing ecological degradation? How do we assess market value of reversing chemical pollution or loss of biodiversity?

- How do we reconcile interests of those who are heavily dependent on forests and wilderness for their survival? In India, we have the Forest Dwellers Act, 2006 [also called the Tribal Land Act 2006]

Forests as Commons, 2006

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 is a result of the protracted struggle by the marginal and tribal communities of our country to assert their rights over the forestland over which they were traditionally dependent.

This Act is crucial to the rights of millions of tribals and other forest dwellers in different parts of our country as it provides for the restitution of deprived forest rights across India, including both individual rights to cultivated land in forestland and community rights over common property resources.

The notification of Rules for the implementation of the Forest Rights Act, 2006 on 1st Jan 2008, has finally paved the way to undo the 'historic injustice' done to the tribals and other forest dwellers [http://www.fra.org.in/new/]

Rights and recognizing them

- Degrees of environmental concern vary across
- Like any law, there are two sides of the coin
- Implementation of this act is a larger debate [we are not covering this here]

PROFITING FROM BIOTECHNOLOGY

HUL275: 2023

Dr Vibha Arora, IIT Delhi

From Bio-politics to Selecting Human Genes

Use of S&T is a political decision

M. Foucault's concept of bio-politics is largely derived from his own notion of ***bio-power***, and the extension of state power over both the physical and political bodies of a population. These examples include "ratio of births to deaths, the rate of reproduction, the fertility of a population, and so on." other examples include the development of vaccines and medicines dealing with public hygiene allowed death to be held (and/or withheld) from certain populations.

Today, nature has become a rewritable text that is ever open to change. This is a political process. On one hand, based on genetics we are able to predict and isolate genes responsible for disabilities and offer possible cures through stem therapy or gene mutation. On the other hand, technology of prenatal sex selection tests have resulted in feticide of girls for sometime.

What kind of Scientific Selection?

Biology can no longer be considered a fundamental given. We have an ***ecology+ revolution*** happening.

Biotechnology involving cellular procedures has been there for some time. In contrast, **genetic engineering** is a powerful technique which draw on advances in molecular biology, biochemistry and genetics.

What is Biotechnology?

The OECD defines biotechnology as "the application of scientific and engineering principles to the processing of materials by biological agents" [http://www.europabio.org/what-biotechnology]

Biotechnology is defined by the American Chemical Society as the application of biological organisms, systems, or processes by various industries to learning about the science of life and the improvement of the value of materials and organisms such as pharmaceuticals, crops, and livestock.

Biotechnology is the research and development in the laboratory using bioinformatics for exploration, extraction, exploitation and production from any living organisms and any source of biomass by means of biochemical engineering where high value-added products could be planned (reproduced by biosynthesis, for example), forecasted, formulated, developed, manufactured and marketed for the purpose of sustainable operations (for the return from bottomless initial investment on R & D) and gaining durable patents rights (for exclusives rights for sales, and prior to this to receive national and international approval from the results on animal experiment and human experiment, especially on the pharmaceutical branch of biotechnology to prevent any undetected side-effects or safety concerns by using the products).

Refer to http://www.public.asu.edu/~langland/biotech-intro.html, accessed on 13 Feb 2014.

Promise and Myth of Biotechnology

• BST [Bovine Soma Totropin] is considered the first-generation output of biotechnology. It is produced artificially by genetically engineered bacteria and injected into cows for higher milk production.

•Documentation on how BST led to deterioration of health of cows & side-effects on human consumption. Hence few countries have now banned.

"Increasing levels of this hormone boosts milk production, causing a number of problems with the milk, among them, raising levels of pus, antibiotics residues and a cancer-accelerating hormone called IGF-1" [see, http://www.ejnet.org/bgh/nogood.html, accessed on 13 Feb 2014].

•How do we distinguish between BST milk and non-BST milk? No tests exist.

Genetic engineering

Genetic engineering, also called genetic modification, **is the direct manipulation of an organism's genome using biotechnology.**

New DNA may be inserted in the host genome by first isolating and copying the genetic material of interest using molecular cloning methods to generate a DNA sequence, or by synthesizing the DNA, and then inserting this construct into the host organism. Genes may be removed, or "knocked out", using a nuclease.

Gene targeting is a different technique that uses homologous recombination to change an endogenous gene, and can be used to delete a gene, remove exons, add a gene, or introduce point mutations.

An organism that is generated through genetic engineering is considered to be a **genetically modified organism** (GMO). The first GMOs were bacteria in 1973; GM mice were generated in 1974. Insulin-producing bacteria were commercialized in 1982 and genetically modified food has been sold since 1994. Glofish, the first GMO designed as a pet, was first sold in the United States December in 2003.

Refer to http://en.wikipedia.org/wiki/Genetic_engineering, accessed on 13 Feb 2014.

Genomic imagination

Genomics is reformulating the relationship between the natural and the social world.

Recombinant DNA technology that allows genes to be moved around between organisms and shape novel forms has become a central focus of debate on biohazards [science fiction films such as Aliens, Resident Evil do document such anxieties].

Remodeling Humanity

New models of human are being experimented with study of gene pools, genetic engineering, isolation of genes responsible for behavior traits/mental disorders/physical disabilities/specific 'genius' abilities and gene sequencing [also Race]

Biological future might shift from chance to conscious design and choice [just like we choose computers with specific configurations we will choose our children to exhibit certain specifications] – we will be redesigning '***healthier, smarter***' humans

Bio-script may possibly be used for human manufacture

Is this desirable and ethical?
Do we need to pause and re-think?
Should there be limits and if yes, then who will set these limits?

GMOs

- Genetically modified crops have become part of our everyday consumption.

- MNCs have become major players in agri-business and are going to control our food supply and price of food. Companies like Monsanto, Ciba Geigy, Hoechst will control the economy.

- Bio-imperialism is happening and being facilitated by agribusiness MNCs such as Monsanto and pharmaceutical companies.

- There is increased demand for bio-labeling. There is demand for more research before biotechnology products are released and considered safe for consumption.
- Biotechnology will diminish genetic diversity and increase genetic vulnerability.

Truth about GMOs – are they safe?

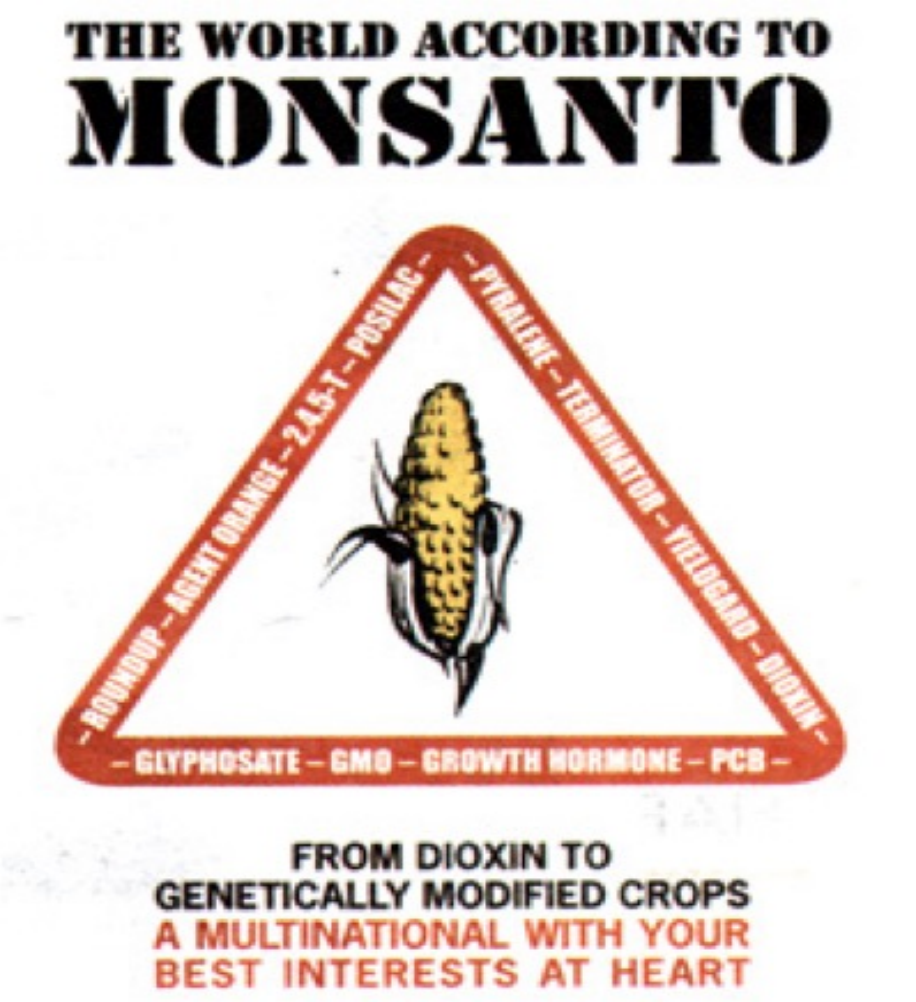
- Genetic engineering of food - Changing nature to make it industrially productive – is this a risk worth taking?
- Need for further research and trials
- Issue of patenting rights

- Seeds of Death – truth about GMOs [tutorial activity]

https://www.youtube.com/watch?v=a6OxbpLwEjQ, accessed on 6 March 2023

Biotechnology has been around for quite some time – does it represents a technological advance and example of human victory over nature – or is it an expression of another human folly?

BIOTECHNOLOGY AND ITS COMMERCIALIZATION



Fortune 500 Company

Headquarters: St. Louis, Missouri, United States

Products:
Agricultural and vegetable seeds
Plant biotechnology traits
Crop protection chemicals

Globally:
21,183 employees
404 facilities in 66 countries

United States:
10,277 employees
146 facilities in 33 states

http://www.monsanto.com/whowe are/Pages/default.aspx, accessed on 13/2/2014

Monsanto: New Vision for Agriculture

•Monsanto is a ***sustainable agriculture company***. We deliver agricultural products that support farmers all around the world.

•We are focused on empowering farmers—large and small—to produce more from their land while conserving more of our world's natural resources such as water and energy. ***We do this with our leading seed brands in crops like corn, cotton, oilseeds and fruits and vegetables***. We also produce leading in-the-seed trait technologies for farmers, which are aimed at protecting their yield, supporting their on-farm efficiency and reducing their on-farm costs.

•We strive to make our products available to farmers throughout the world by broadly licensing our seed and trait technologies to other companies. In addition to our seeds and traits business, we also manufacture Roundup® and other herbicides used by farmers, consumers and lawn-and-garden professionals.

•Monsanto could not exist without farmers. They are our customers--the lifeblood of our company. More important, they are the support system of the world's economy, working day in and day out to feed, clothe and provide energy for our world.

•In sept 2016 acquired by Bayer [German company] and Monsanto name was discontinued.

Refer to http://www.monsanto.com/whoweare/Pages/default.aspx

Corporatization of Science

http://www.monsanto.com/whoweare/Pages/monsanto-history.aspx

We are committed to developing the technologies that enable farmers to produce more crops while conserving more of the natural resources that are essential to their success.

Producing more. Conserving more. Improving lives.

That's sustainable agriculture. And that's what Monsanto is all about.

Enhancing productivity of cash crops

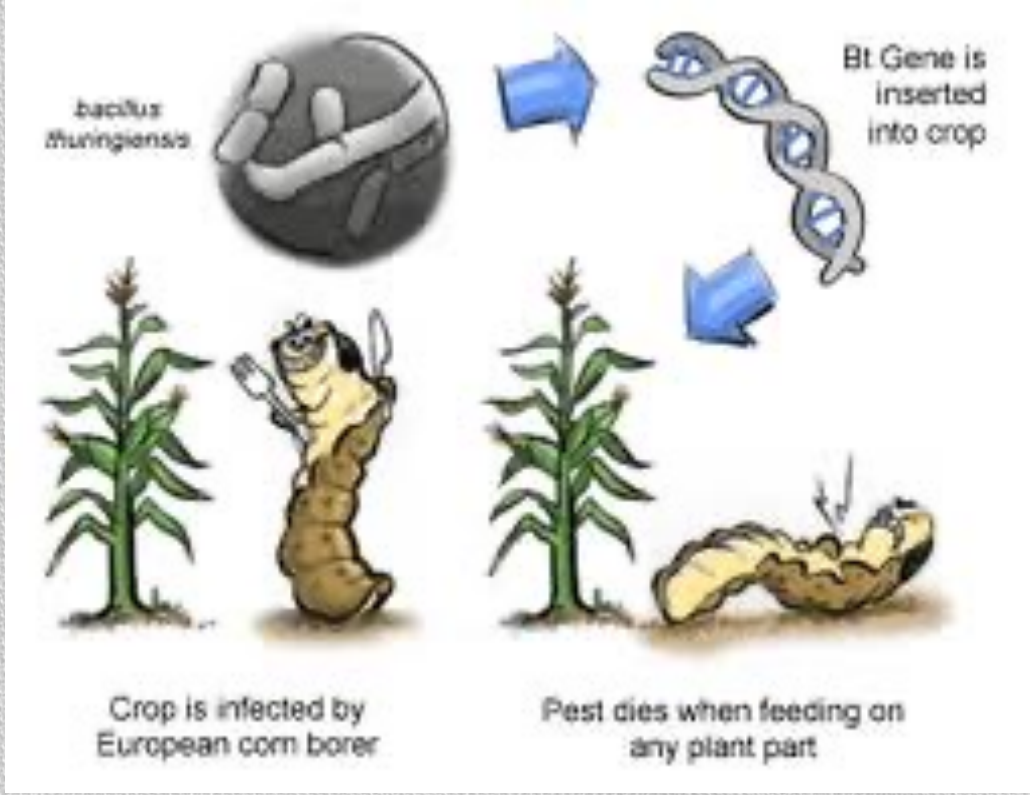
Who is a farmer in India? [P. Sainath]

- Myth: We believe more than 50% of India's population are farmers.
- Rural workers account for nearly 70% of all workers – they do consist of farmer, agricultural laborers, non-farmers, people engaged in fisheries, and artisans.
- 2012 reports reveal declining number of main workers who are farmers.
- Who officially gets counted as a farmer? Census of 2011 tells us that we have 95.8 million cultivators for whom farming is their main occupation – comprising less than 8 per cent of the total population. These people report farming as their main occupation for at least half the year, and operates a piece of land which they may or may not own themselves.
- If we include marginal cultivators (22.8 million), then that is less than 10% of the population.
- If we add agricultural laborers then number would be 263 million or 22 per cent of India's total population.

Cotton

- One of the most important cash crops of India is cotton – remember the British came to India for cotton and Manchester mills depended on India for this raw material
- India is the third largest producer of cotton after China and US
- Nearly 15 million farmers spread over 10 states are dependent on cotton cultivation for their livelihood.
- Cotton yield is low in India due to pest ravages and its production in rain-fed areas which impact productivity.
- Controlling bollworms has been a persistent problem for cotton farmers throughout the country.

Magic of Bt [Bacillus Thuringiensis] gene



2002

- 2002: India officially permitted cultivation of Bt cotton [first genetically modified crop] containing the toxin Bacillus thuringiensis that can resist bollworms.
- 2007: India had the largest world area under Bt cotton – approx 6.2 hectares. By 2008, Bt cotton was being cultivated in more than 10 states with Andhra Pradesh, Gujarat, and Maharashtra leading in total acreage
- From 29415 hectares in 2002, the area under Bt cultivation has expanded to 7,605,000 (7.6 Million) hectares in 2008.
- Critics accuse Bt cotton to be responsible for increasing economic distress among farmers and abetting suicides [P. Sainath]. Many such reports are under circulation and activists have launched various campaigns to educate farmers and policy makers about the impact of GMOs.

False Accusation or Truth?

Farmers suicides - statistics

- We do not have any directly reported statistics showing direct relationship between Bt cotton and farmers suicides in India.
- What are the sources of data available? Two have been cited - Indiastat and National Crime Records Bureau [NRCB].
- Use NRCB to look at suicide data – roughly annual rate is between 95,800 – 118,200 persons during 1997-2007. Of these farmers suicide lies between 13,600 – 18,300 persons annually. Figures indicate a rising trend and farmers rate is not higher than other types [Figure 2]

Linking Bt cotton to Farmers Suicides

Three hypothesis have been postulated and examined by a study:

1. Farmers suicides is a long-term phenomenon and there is no clear or direct relationship between Bt cotton and resurgence of farmers suicide during 2002-2007.
2. Bt cotton is neither a necessary nor a sufficient cause of farmers' suicides. Many other factors [other than agriculture] have played a critical role here.
3. Bt cotton is a technology and can not be blamed. It is the context in which it was introduced or planted such as specific regions and years which might have indirectly contributed to farmer indebtedness [due to crop failure] potentially leading to suicides.

Disaggregated data

- Data on suicides for four cotton producing states - Maharashtra, Madhya Pradesh, Andhra Pradesh, and Karnataka – has often been used to show the correlation between Bt Cotton and farmers suicides. These four states account for nearly 52-65 per cent of total reported farmers suicides and significant number (40 per cent in 2001) of total suicides.
- Maharashtra has a higher share among all four – total and farmers.

Rise of Bt Cotton

- Does the adoption of Bt cotton and its rapid expansion indicate its commercial success? Has Bt cotton increased productivity?
- Productivity reported reached highest levels: 300-400 kgs in 2001 to 500-700 kilograms per hectare in 2007.
- According to the Cotton Advisory Board, Bt cotton has been the major factor behind increased cotton production – rising from 15.8 million bales in 2001-02 to 31.5 million bales in 2007-07.
- Traditionally, cotton was cultivated in rain-fed areas. However, Bt cotton has been grown largely in irrigated areas partly due to high costs of seeds.
- Data on productivity indicates variability across regions and states. One of the reasons for rise of productivity could be absence of technical or climate shocks (such as monsoon failure). Regional data indicates Bt cotton had a greater impact in Maharashtra and Gujarat than other states.

Analysis of regional productivity

Disaggregated picture:

- Highly successful: Gujarat, Tamil Nadu, Madhya Pradesh
- Significant net gains: Maharashtra and Karnataka [higher production costs are offset by higher yields]
- Insignificant gains: Andhra Pradesh [high pesticide costs and not much gain due to insignificant effect on price].

Largest number of reported farmers suicides were in Maharashtra and Andhra Pradesh.

Inadequate Data

How accurate are secondary assessments?

There are no numbers on the actual share of farmers committing suicide who cultivated cotton, let alone Bt cotton, and among them, those who committed suicide because their Bt cotton crop failed.

- Case study of Maharashtra – esp due to the importance of cotton sector here. Figures indicate – growth in farmers suicides started much before Bt cotton and actually slowed down after the introduction of Bt cotton.
- Case study of Andhra Pradesh is ambiguous – linear rise in farmers suicides during the entire period – after the introduction of Bt cotton.
- Case Study of Gujarat gives a different picture – high adoption of Bt cotton while there have been low and stable suicide rates

- *Bt technology is neither a sufficient nor necessary cause of farmers suicides*. What we can not reject is the potential role of Bt cotton varieties in certain states and years such as 2002, 2004, and 2006 in Andhra Pradesh and Maharashtra.

Empirical study of 4 blocks in 2 districts of Maharashtra (A. Narayanamoorthy and S.S. Kalamkar, 2006)

- Sample of 150 Bt growers and 50 non-Bt farmers
- Bt variety is scale neutral
- Due to high costs of seeds, farmers do not want to take the risk of cultivating Bt variety in rain-fed areas where output is not assured.
- Price factor – initial investment
  - Price of seeds of Bt varieties is Rs 1450-1600 per acre
  - Price of seeds of conventional hybrid varieties is Rs 325-450 per acre

cultivating Bt seeds

- Bt is a cost-intensive crop: Higher productivity of Bt is also connected with higher use of manure and fertilizers, higher use of pesticides, costs of irrigation, and labour inputs .
- Average cost of productivity is Rs 26067 for Bt cotton and Rs 19,344 for non-Bt cotton (2006 study): difference of 34%
- Studies indicate Bt is a profitable crop – Bt yields higher profit than non-bt varieties; difference can be as high as 80 per cent.
- Bt is profitable not because of higher price of cotton but due to improved production (A. Narayanamoorthy and S.S. Kalamkar, 2006).

Adopting and Adapting to new seed-technology

Bottlenecks in adoption is lack of education & information dissemination:

- Farmers have lacked information on growing conditions, pesticide use and seed technology impacted their success in adoption of Bt cotton and the performance of BT crop.
- Farmers continued to use similar amounts of high-priced pesticides on Bt cotton further increasing costs of production and reducing their profit margins. Nearly half of what the farmers used to do was required under Bt varieties [studies indicate reduction in pesticide use and sprays by 30-40 per cent]. Farmers did not want to take any risks given the investment in purchase of Bt seeds.
- Indiscriminate spraying has led to development of resistance in bollworm and pest infestation returned lowering productivity in later years. This also created health hazards and caused environmental pollution – contamination of water table.

Spurious seeds

- Bt seeds are expensive so there exists a spurious seed market that grew up and targeted farmers wanting to save seed costs. There was no process of seed certification so many farmers were duped with spurious seeds and had crop failure.
- A large number of Bt varieties added confusion between real and fake seeds.
- If farmers planting spurious Bt seeds had low productivity or there was crop failure, then Bt can not be blamed!

conclusion

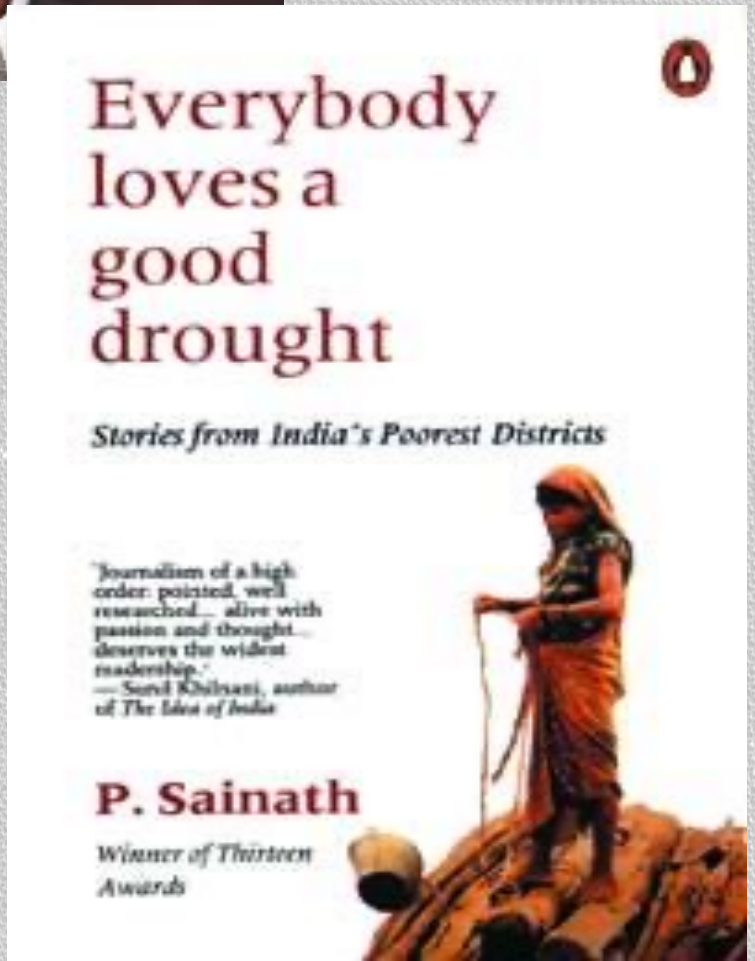
- “there is no direct connection between the suicides and adoption of expensive Bt technology”
- Marketing constraints and other socio-economic factors were directly connected rather than Bt per se.
- Farmers suicides are not new or specific to Bt technology.
- Put the blame on irresponsible journalism and media hype….

Palagummi Sainath [Rural Affairs Editor at the Hindu]

Roughly 200 exclusive field reports and news analysis and hundreds of photographs on the agrarian crises.

Amartya Sen regards him to be one of the world's great experts on famine and hunger.

This book won him the Magsaysay Award in 2007 in the category of Journalism, Literature and Creative Communication Arts



critics

Seeds purchased from companies like Monsanto are also engineered with “terminator technology,” which means plants produce sterile seeds after only one season. Farmers, already in debt because of the high price of “superior” GM seeds, are thereby forced to buy more seeds for the next harvest. http://www.care2.com/causes/monsanto-blamed-for-200-000-farmer-suicides.html#ixzz2ZsCrBE9p

A study from the Union of Concerned Scientists shows that genetically engineered crops do not produce larger harvests. Crop yield increases in recent years have almost entirely been due to improved farming or traditional plant breeding, despite more than 3,000 field trials of GM crops.

http://www.scientificamerican.com/podcast/episode.cfm?id=can-genetically-modified-crops-feed-09-04-16

Bitter Seeds

Bitter Seeds is a 2011 documentary film by American filmmaker and director and political commentator Micha Peled.

Trailer - https://www.youtube.com/watch?v=QZtKB_KuASc

Micha Peled's documentary exposé on BT farming in India reveals the true impact of genetically modified cotton on India's farmers, with a suicide rate of over a quarter million BT cotton farmers each year due to financial stress resulting from massive crop failure and the exorbitantly high price of Monsanto's proprietary BT seed. The film also refutes false claims purported by the biotech industry that BT cotton requires less pesticide and empty promises of higher yields, as farmers discover the bitter truth that in reality BT cotton in fact requires a great deal more pesticide than organic cotton, and often suffer higher levels of infestation by Mealybug resulting in devastating crop losses, and extreme financial and psychological stress on cotton farmers. Due to the biotech seed monopoly in India, where BT cotton seed has become the ubiquitous standard, and organic seed has become absolutely unobtainable, thus cooercing all cotton farmers into signing BT cotton seed purchase agreements which enforce the intellectual property interests of the biotech multinational corporation Monsanto.

The documentary film won the Green Screen Award (2011), the Oxfam Global Justice Award (2011), the Humanitas Award (2012) and the International Green Film Award (2013).

Growing Agrarian Crises

- An agrarian crises is reflected in the rising incidence of farmers suicides in the 1990s. Why?

[see - http://www.youtube.com/watch?v=W9hAMWQU0QA]

- P. Sainath (2011) Farmers Suicides are a consequence of the agrarian crises [http://www.youtube.com/watch?v=RaGZHBIWpU0]
- Excerepts: https://www.youtube.com/watch?v=rQh56k1XtdU

Socio-economic Causes of Farmers Suicides (1)

- Scholars argues that a complex set of socio-economic factors play a role or are responsible for farmers suicides.
- Many areas that earlier focused on rain-fed low cost food crops have shifted to high-cost cash crop cultivation with expansion or greater dependence on irrigation. Digging of wells is another cost that needs to be factored in. charges of electricity and drawing of water has increased costs of cultivation.
- Costs of cultivation have risen considerably requiring larger investments in fertilizers, seeds, pesticides, farm equipment and labour costs. While costs of agricultural produce have not risen as much – loss of competitiveness.
- Successive bad seasons/low yields due to weather and high costs of cultivation followed by low cotton prices increased rural indebtedness significantly.

Socio-economic Causes of Farmers Suicides (2)

- Most important factor is the heavy indebtedness of farmers which is worsened by crop failure or agrarian crises (failure of monsoons, insect infestation, spread of disease and unpredictable weather). Institutional credit availability is low in the rural sector making the farmers dependent on loan sharks. Most farmers who committed suicides in Maharashtra and Andhra Pradesh had unpaid loans taken at high interest from local moneylenders. Nearly 80 per cent of the agricultural loans or credit taken come from non-institutional sources [many political parties have waived loans as part of their electoral promises]
- Breakdown of rural institutions and absence of alternate livelihood opportunities to mitigate losses have also propelled such an extreme step.

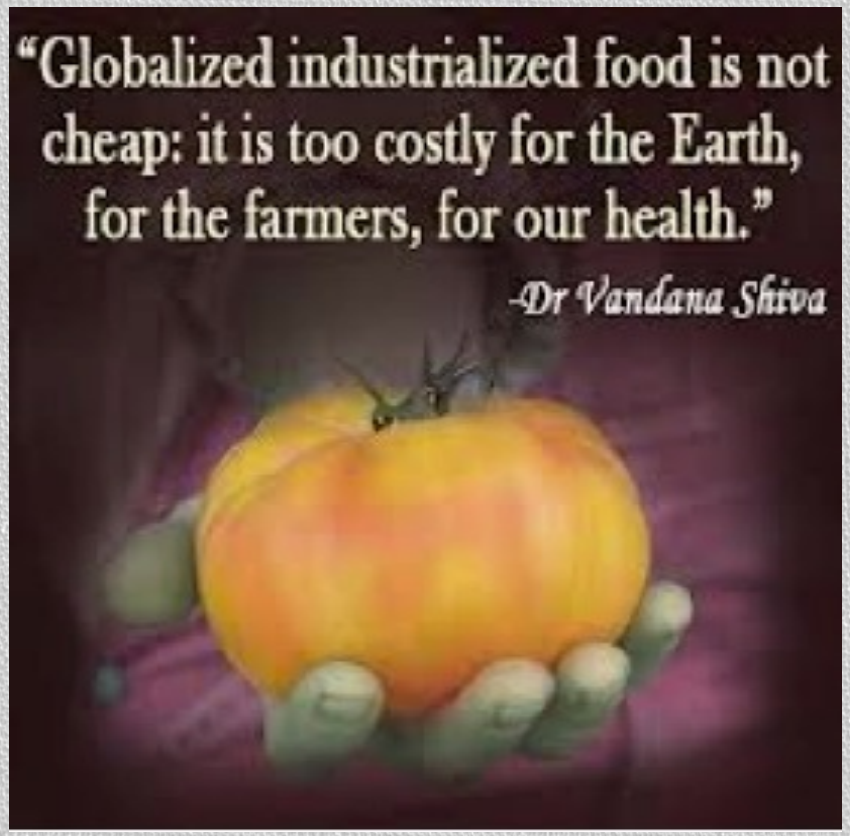
Climatic and Economic Factors played an important role

- Social factors – loss of standing and status and harassment suffered at hands of moneylenders, medical bills, and sometimes failure to meet family expectations added to the distress of farmers.

- Ex-gratia payments to families of victims by state government who committed suicides also encouraged some to take this extreme step. *Peepli Live* [A young debt-burdened farmer named Natha is talked into taking his own life after he learns that his family will be financially compensated through a government program created to alleviate the loss of farmers taking their own lives]

Loan waiver schemes for small and marginal farmers were announced by govt from time to time

Organization of Global Dissent: Vandana Shiva



25 may 2013 – discussion on GMOs

World wide march against Monsanto

[https://www.youtube.com/watch?v=YIbl0SMryVY]

- DTE report, more than a million people spread around in 36 countries and over 250 cities marched against the biotech giant Monsanto on 25 may 2013.
- Marches were held at Delhi and Bengaluru in India.
- Studies have shown that GM crops can lead to formation of tumors, infertility, and birth defects
- Companies like Monsanto via GM seeds are taking control of our food supply and making organic farming and small farmers incur losses making them unviable operations. Monsanto is also controlling the price of food by controlling its supply. Using legislations to get patents on seeds and genetic make-up of seeds.
- Demanding further scientific research on the health effects of GMOs.
- NGOs are urging people to buy organic food and boycott Monsanto and other companies using GMOs.

Campaign against Genetically Modified Crops Biotechnology Regulatory of India Bill: June 2013

- BRAI would become a single window for clearance on GM seeds/crops as it would deny the right to farmers and states to decide if they want field trials or GM crops to be introduced.
- Farmers, NGOs, members of several political parties CPI(M), Aam Aadmi Party etc have been agitating against regulation of GM crops when both farmers and consumers are opposing their introduction and profit seeking companies like Monsanto.
- NGOs have filed a PIL in the Supreme Court seeking safety mechanism and regulatory measures to be put in place and sought a 10 year moratorium period before further field trials are permitted for cultivating GM crops.

World Food Prize given to GMO scientists (July 2013)

- A selection committee comprising M.S. Swaminathan awarded the World Food Prize [250000$) for 2013 to three scientists including M.V. Montagu (the CTO of Monsanto) and R.T. Fraley (Executive Vice President of Monsanto) and Mary Dell Chilton (founder and fellow of Syngenta Biotechnology).
- Citation declared them to be pioneers in new genetics who have opened new opportunities in achieving balance between human numbers and availability of food. Insertion of genes in crops led to development of pest-resistant high yielding GM crops.
- The prize is a mockery.
- Vandana Shiva of Navdanya: it's a prize from Monsanto to Monsanto because they are one of the sponsors of the award. Data on non-chemical ecological farming indicated good productivity and better nutrition.
- Suman Sahai of Gene campaign: biotechnology firms are not the answer to food security.
- Farmers lobby/Bhartiya Kisan Union – this is like mortgaging farming to MNCs.

References

Narayanamoorthy and S.S. Kalamkar, Is Bt cotton cultivation economically viable for Indian farmers?: An empirical analysis, *Economic and Political Weekly*, 2006.

G. Gruere and d. Sengupta, Bt cotton and Farmers Suicides in India: An evidence based assessment, *The Journal of Development Studies*, 2011.

Assessing BT cotton (India)

HUL275: March 2023

Dr Vibha Arora, IIT Delhi

Assessing agro-technology

Simplistic to position is as a technological triumph [country-wise increase of yields and quality of cotton yarn] or an abject failure [increasing number of farmers suicides and rural indebtedness] as this is context-sensitive [vagaries of weather, insect attack].

Kranthi and Stone (2020) argue: Attributions of suicides to *Bt* seed often skirt the fact that suicides were a major problem well before the release of *Bt* seed, and that suicide rates have not risen as *Bt* cotton has been almost universally adopted in India.

Compulsory Article - Long-term impacts of *Bt* cotton in India by Kranthi and Stone, 2020

Abstract

Most scholarship on the closely-watched case of genetically modified *Bacillus thuringiensis* (*Bt*) cotton in India has focused on short-term impacts and has also ignored other major changes in India's cotton agriculture. This Perspective combines several data sources over a 20-year span to provide long-term comparisons of *Bt* adoption with yields and other inputs at both country- wide and state-specific scales. *Bt* cotton adoption is shown to be a poor indicator of yield trends but a strong indicator of initial reductions in pesticide use. Yield increases correspond to changes in fertilizer and other inputs. *Bt* cotton has continued to control one major cotton pest, but with *Bt* resistance in another pest and surging populations of non-target pests, farmers now spend more on pesticides today than before the introduction of *Bt*. Indications are that the situation will continue to deteriorate.

BT technology's farm-level effects – 20 year

- **Cotton yields have been increasing due to complex series of changes [increasing application of fertilizers, pesticides, better seeds, irrigation, and better know-how among farmers**
- Desi-cotton was more pest-resistant. Since 1990s, with adoption of hybrids [(*Gossypium hirsutum*) India cotton production has been impacted by increased costs connected with purchase of seeds, fertilizers, and heavy insecticide use. Main pests impacting production are Lepidopteran caterpillars (2 varieties who eat cotton bolls) and Hemipteran sap-sucking bugs. Farmers found themselves on an insecticide tread-mill spraying more and dealing with new pests over time…
- *Bt* cotton was released in the US in 1995 and China in 1997 ….*Bacillus thuringiensis* (*Bt*) cotton has been one of most studied cases of GMO after its introduction in central and southern India in 2002 by Monsanto and in northern India in 2005.
- Lot depends on how this technology was adopted by farmers (scale) and pests may have developed resistance over time
- Current study has a nearly 20-year time-frame for assessment
- *Argue: Bt* cotton has provided durable resistance to bollworm, although this is partially also linked to use of effective new insecticides that were adopted just before *Bt* seeds were introduced
- Argue: Unfortunately, the increase in fertilizer-intensive *Bt* seeds has worsened the predation by non-Lepidopteran pests. This, coupled with rapidly spreading *Bt* resistance pink bollworm, has led Indian cotton farmers to now spend more on insecticides than before they adopted *Bt* seed.

trends in cotton yields

- Costs of BT cotton production are quite high [seeds] and in many cases farmers have taken special care in application of fertilizers, pesticides and assured irrigation to ensure crop production as stakes are higher than normal hybrid varieties
- Understand short-term bias over long-term perspective about impact of BT technology to loss of yield to insect predation [not as much as increased yields]. The rising use of pesticides nullifies any conclusion about 'sustainability' of pesticide reductions with adoption of BT seeds.

Available statistical data indicates the following trends:

- By 2005, *Bt* adoption was still only 15.7%, but yields were 90% over 2002 levels
- By 2007, *Bt* adoption had risen to 81% and yields were 41% over 2004 levels
- Countrywide yields stagnated after 2007, even as adoption continued to rise. By 2018, yields were lower than in the years of rapid *Bt* adoption.
- Author looks at state-wise data for Gujarat, Karnataka, Andhra Pradesh, Haryana and Punjab to conclude that yield increases did not correspond to *Bt* adoption at either the countrywide or the state-wide level

Explanation

- **Look beyond BT seeds as farmers invest more in cultivating this cash crop**
- Costs of production have been rising: As farmers shifted to expensive BT seeds, they also ensured and were supporting the cultivation with other agro-improvements such as

1. Improvements in irrigation infrastructure and expansion of irrigation facilities (SSP in Gujarat, check-dams, ponds, channels, ground-water)
2. Extensive use of fertilizers
3. Extensive use of new improved effective insecticides for a few years [2 brands used for bollworm control namely Tracer and Avaunt. More and more application of insecticides to reduce pest infestation. After 2008, the sustainable use of insecticides was not possible. Reports increase of Pink bollworms developing resistance to Bt seeds in other geographies (China and USA), and also in India by 2015 with near ubiquitious shift to Bt seeds

- Authors find strong correlation between yields and fertilizer trends [due to a more positive fertilizer response in these relatively well-irrigated areas]

conclusions

- Cotton farming has become extremely cash-intensive in the 21 Century requiring huge capital investments by farmers even though they face higher risk due to agroecological and market conditions. They lack safety-nets and suffer greater distress
- Bt cotton did make a positive contribution in India. Bt seeds sharply reduced predations by bollworms but they were not effective against leaf-worms! So, spraying has not declined.
- Bt seeds were responsible for the sharp falloff in spraying for Lepidopterans beginning in 2005 when adoption first began to surge.
- Long-term analysis indicates, BT technology benefits have been only modest
- There are other necessary conditions that explain high yields and BT seeds are not a sufficient condition - Changes in other inputs, including irrigation, insecticides and especially fertilizer use
- Ironically, countrywide yields have not improved in 13 years, and Indian cotton farmers today are spending more per hectare on insecticide than they did before Bt began to spread.
- Ministry of Agriculture data indicates - In the decade following 2005, when *Bt* seed began its rapid spread across Indian cotton farms, per hectare costs for seed rose by 78%, for insecticide by 158%, for fertilizer by 245% and for labour by 275%, with the overall production cost of seed cotton rising by 143%