



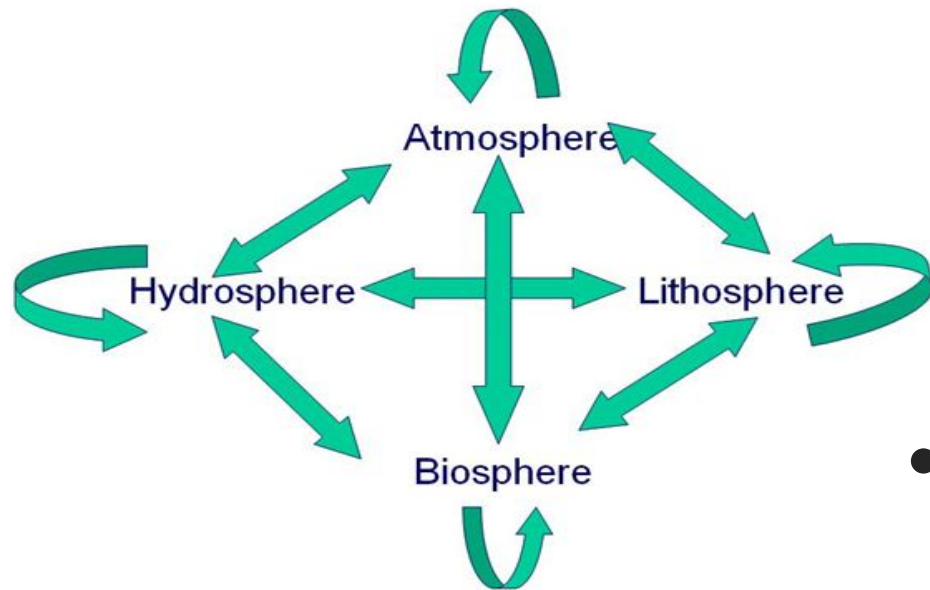
Introduction

ENV300 Environmental Science and Sustainability

Outline

- The Nurturing Biosphere
- Well-Being and Resource Consumption
- Present Unsustainability
- Course Description
- State of the Environment
 - Forests
 - Biodiversity
 - Water
 - Ozone layer
 - Urbanization
 - Resource depletion, waste and pollution
 - Consumerism
 - Climate Change
- Perceptions of the Crisis
- Causes of the Crisis
- Environmental Movement
- Sustainable Development

The Nurturing Biosphere



- The biosphere is the global **ecological** system integrating all living beings and their relationships, including their interaction with the elements of the **lithosphere**, **geosphere**, **hydrosphere**, and **atmosphere**.
- Biosphere can also specifically refer to all the living beings on the planet.

Watch Video: Video: [She's Alive...](#) (5)



Gaia Theory

- By James Lovelock. Gaia: Greek Earth Goddess
- Earth with all intricate and interacting systems is like a Super-Organism
- Self regulation: chemistry of oceans, atmosphere, temperature, living beings
- It appears as if Earth had a purpose...to nurture life and maintain life-friendly conditions.
- This perspective brings a new awareness that can enable further evolution of humanity's understanding of Nature and interactions with it:
 - When all systems in nature work in order to nurture us, it is in our best interest to design our activities so as to be in harmony with it.
 - This idea can be the foundation of all future development.

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Consumption, Sustainability and Wellbeing

- Humans are the beneficiaries of this dynamic, evolving, nurturing biosphere, which is our HOME.
- It sustains us: providing resources for our consumption.
- In this beautiful HOME, we would like to survive and achieve well-being into the indefinite future--SUSTAINABILITY.
- But our consumption is often continued far beyond survival--OVERCONSUMPTION.
- Overconsumption leads to very little improvement in well-being.
- But it damages the environment and reduces well-being for others and future generations...UNSUSTAINABILITY

Consumption, Sustainability and Wellbeing

- Human well-being is influenced by factors other than consumption
 - External: family, friends, education, position in society
 - Internal: identification and fulfillment of one's purpose in life, realization of spiritual/philosophical truths.
- After consuming adequately, further improvement in well-being should be sought through other means.

Consumption, Sustainability and Wellbeing

Many thinkers of our time have realized this and are developing ways to measure well-being in relation to factors other than mere resource consumption.

- Quality of life [\[ref\]](#)
 - ecology, economics, politics, culture
- Human Development Index [\[ref\]](#):
 - life expectancy, education, and income indices.
- Happy Planet Index [\[ref\]](#):
 - Attained well-being (not necessarily material goods) per unit of extraction or imposition upon nature.
- Satisfaction with Life Index [\[ref\]](#):
 - Strong correlation with health, wealth, basic education
 - Based on asking people how happy they are and social and economic development.

What are the rest of us upto?

Development, economic progress, technological progress...all for improving one's personal standard of living.

But all this happens at the cost of the environment

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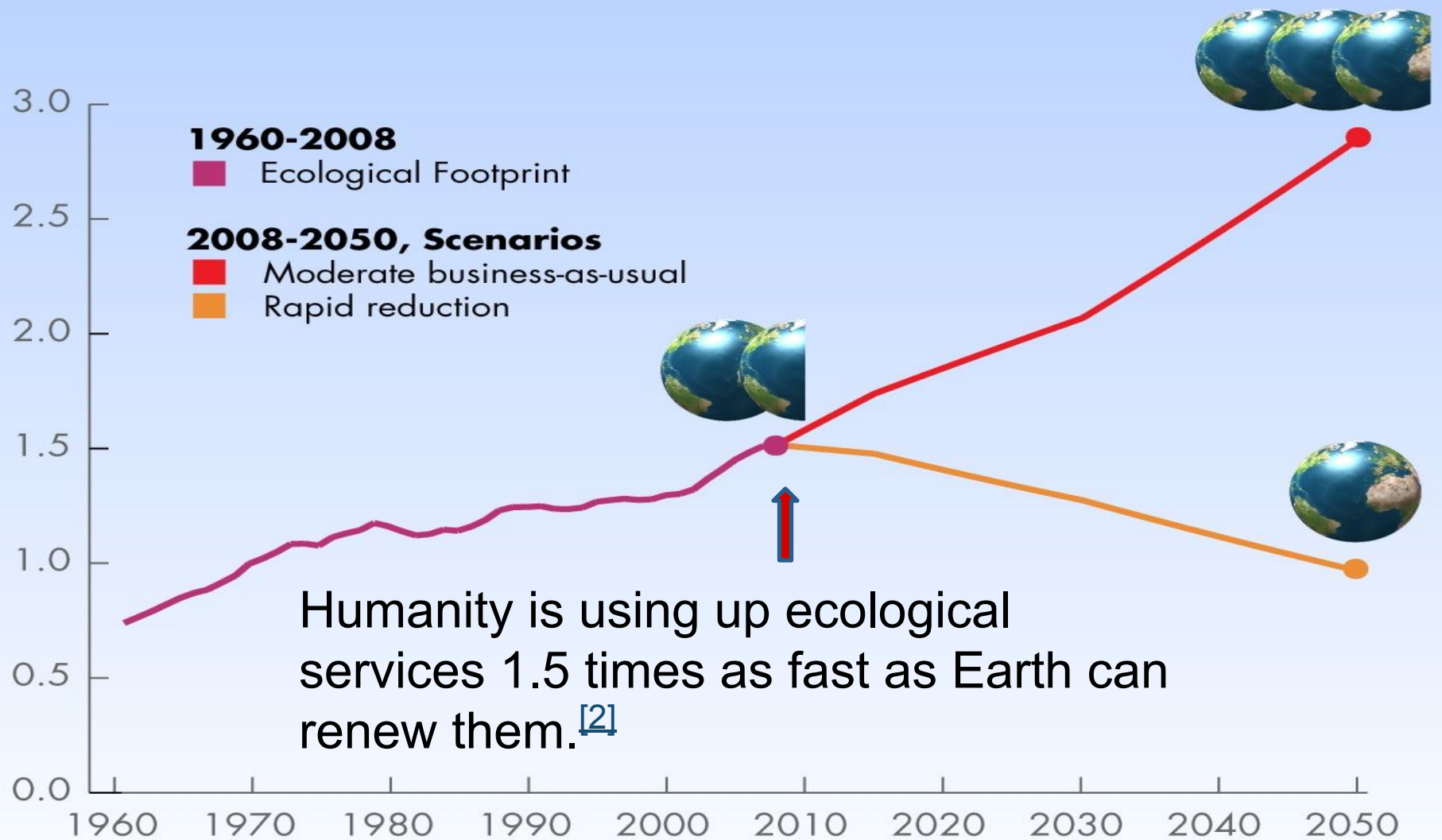
Problem of Unsustainability

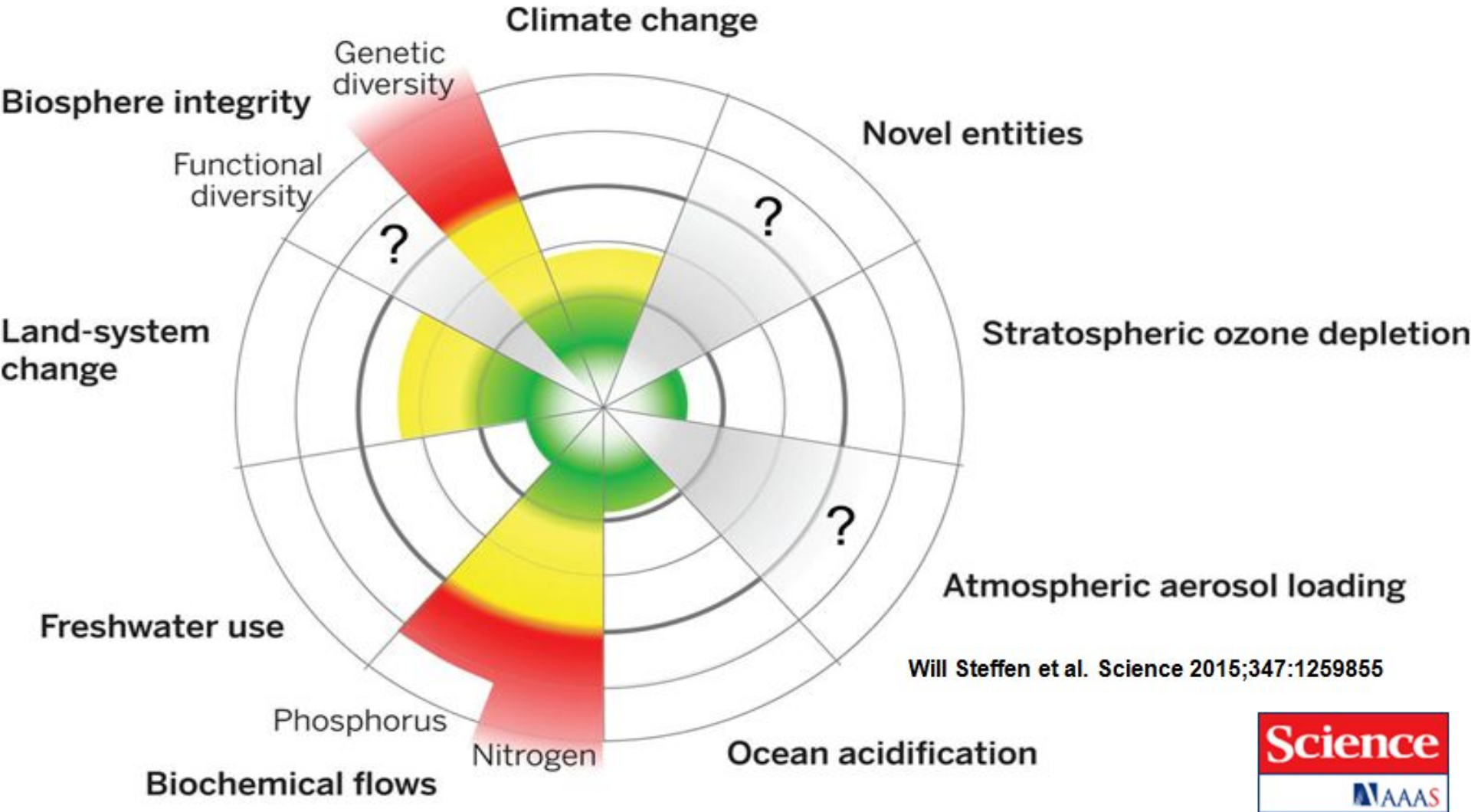
- The marvellous progress in technology and many fields, has come at a staggering cost.
- The scene of modern development is that of simultaneous crises on many fronts.
- Environmental crisis:
 - Earth-threatening environmental problems like Global Warming, Ozone depletion, Deforestation, Desertification, Loss of biodiversity, natural habitats and species, Pollution of food, water, air, land, radioactive pollution
- How do we measure our impacts on the environment?

Ecological Footprint

- Resources and ecosystem services are provided by Earth through the biogeochemical cycles and the biodiverse ecosystems.
- Human activities use up or degrade Earth's resources, but Earth regenerates/recovers (biocapacity).
- **Ecological Footprint is the amount of biologically productive land and sea area needed to supply the resources a human population consumes, and to assimilate associated waste.**
- It is reported in area units.
- It attempts to quantify the human demand on the Earth's ecosystems.
- *Can be calculated for an individual, a family, an organization, a country or the entire human population on the earth.*

Humanity's Ecological Footprint





- | | |
|--|---|
| ■ Beyond zone of uncertainty (high risk) | ■ Below boundary (safe) |
| ■ In zone of uncertainty (increasing risk) | ■ Boundary not yet quantified |

Current status of the control variables for seven of the nine planetary boundaries. The green zone is the safe operating space, the yellow represents the zone of uncertainty (increasing risk), and the red is a high-risk zone. Published by AAAS.

Problem of Unsustainability

- Apart from the environmental crisis, we simultaneously have:
 - Social crisis:
 - War, oppression, terrorism, corruption: motivated by control over resources
 - Growing slums, degrading morality, broken families,
 - Basic needs: food, clothing and shelter—the very motivation for development—have not been satisfied.
 - Poverty and hunger.
 - Individual crisis
 - Serious health problems: Cancers, heart disease, AIDS, infectious diseases, birth defects, anxiety, stress...

Alas, development, which aims at the survival, and prosperity of humanity, ironically threatens our very existence today.

Quote for the Topic

*We stand at a critical moment in Earth's history,
A time when humanity must choose its future.*

*As the world becomes increasingly interdependent and fragile,
the future at once holds great peril and great promise.*

*To move forward we must recognize that in the midst of
A magnificent diversity of cultures and life forms*

*We are one human family and
one Earth community with a common destiny.*

Preamble to the Earth Charter (2000)

*We must join together to bring forth
a sustainable global society
founded on respect for nature,
universal human rights, economic justice,
and a culture of peace.*

*Towards this end, it is imperative that
we, the peoples of Earth,
declare our responsibility to one another,
to the greater community of life,
and to future generations.*

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Why Study This Course?

- Earth-threatening anthropogenic environmental issues
 - In developed countries, pollution and environmental damage may be less obvious
 - Shocking state of the environment in India...all around us.
- Simultaneous social problems that are deeply intertwined with environmental problems.
- You can never even begin to solve a problem unless you first understand the problem and its solution.
- The more complex the problem, the deeper your understanding should be.
- Education for Sustainability is therefore essential

Textbooks and Notes

- Course Website: <https://sites.google.com/site/amritaevs>
- Course Material is provided on the website.
- Reference Books:
 - R. Rajagopalan “Environmental Studies-From Crisis to Cure”, Oxford University Press.
 - G.T. Miller Jr., “Environmental Science”, 11th Edition, Cenage Learning India Pvt. Ltd., 2008.
 - Benny Joseph “Environmental Studies”, Tata McGraw-Hill Publishing Company Limited, 2006.

Teaching Approach

- Interactive, Open Discussions, Active Feedback
- Class participation is critical
- Medium level of difficulty
- Attendance is mandatory
- Will be required to come up and talk/present frequently.

How To Study for This Course?

- Be attentive in class.
- Participate in discussions and activities, answer questions when asked by teacher and pose questions to the teacher.
- Write notes during the lecture:
 - Lecture slides are already available to you through the course website, so the content of the slides need not be copied in notebook in class.
 - Simply write the **slide number or slide heading in the margin**.
 - Write details explained or mentioned by the instructor *that are not indicated on the slide*.
 - Add any additional points that you notice.

How To Study for This Course?

- **Must revise everyday; study the slides and your notes together.**
 - **Write a 1-2 pg summary of each topic.**
 - **Do additional independent reading on each topic.**
 - **Independently reflect on the topic, and write down your reflections.**
- Bring difficulties to the notice of the instructor before it is too late.
- Be prepared for the next lecture (questions and surprise tests).

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What is the state of the environment?

State of the environment: Who tells us?

- Regular reports
- State of the World Report (Worldwatch Institute)
- Global Environment Outlook (UNEP)
- State of India's Environment (CSE)
- Living Planet Report (WWF)

- Other sources of reports
- World Conservation Union (IUCN)
- Earth Policy Institute

State of the environment: What are the messages?

- Thematic reports (Examples):
 - World Water Development Report (UN)
 - World Commission on Dams
 - Intergovernmental Panel for Climate Change
- Special reports
 - UN Millennium Ecosystem Assessment

Upon reading all the various reports, a common story emerges...

The story of what Man has been doing to Nature.

It is a story of many chapters...

Let's see some of them one by one.

Man first said:
Let us cut all the trees
and
remove the forests!

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Once upon a time,
about 2500 years ago, on a small island, in the
Pacific, people actually cut down all the trees.

They also made...





Easter Island

- Colonised 2500 years ago by Polynesians
- 1400 AD: Population of 20,000
- Large stone sculptures
- Palm trees used up, none left
- No more boats, fish
- Water runoff, drought, famine
- Conflicts over resources, collapse
- 1722 AD: Dutch explorers found just 2000 famished people on barren island !

Can Easter Island happen again?

No,
Easter Island is an old story,
we are wiser today !
Are we ?





Madagascar

- 40 million years in isolation
- Astonishing biodiversity
- 85 % species endemic
- Humans arrived 1500 years ago
- 80 % of forests destroyed, soil erosion
- Most species endangered
- 50 % may go extinct by 2025

Easter Island and Madagascar
are far away,
surely it cannot happen in India!



The Himalayas

- Responsible for India's monsoon
- Source of many rivers
- Had 40 % forest cover
- Immense biodiversity
- Metal deposits
- 50 million people in the region

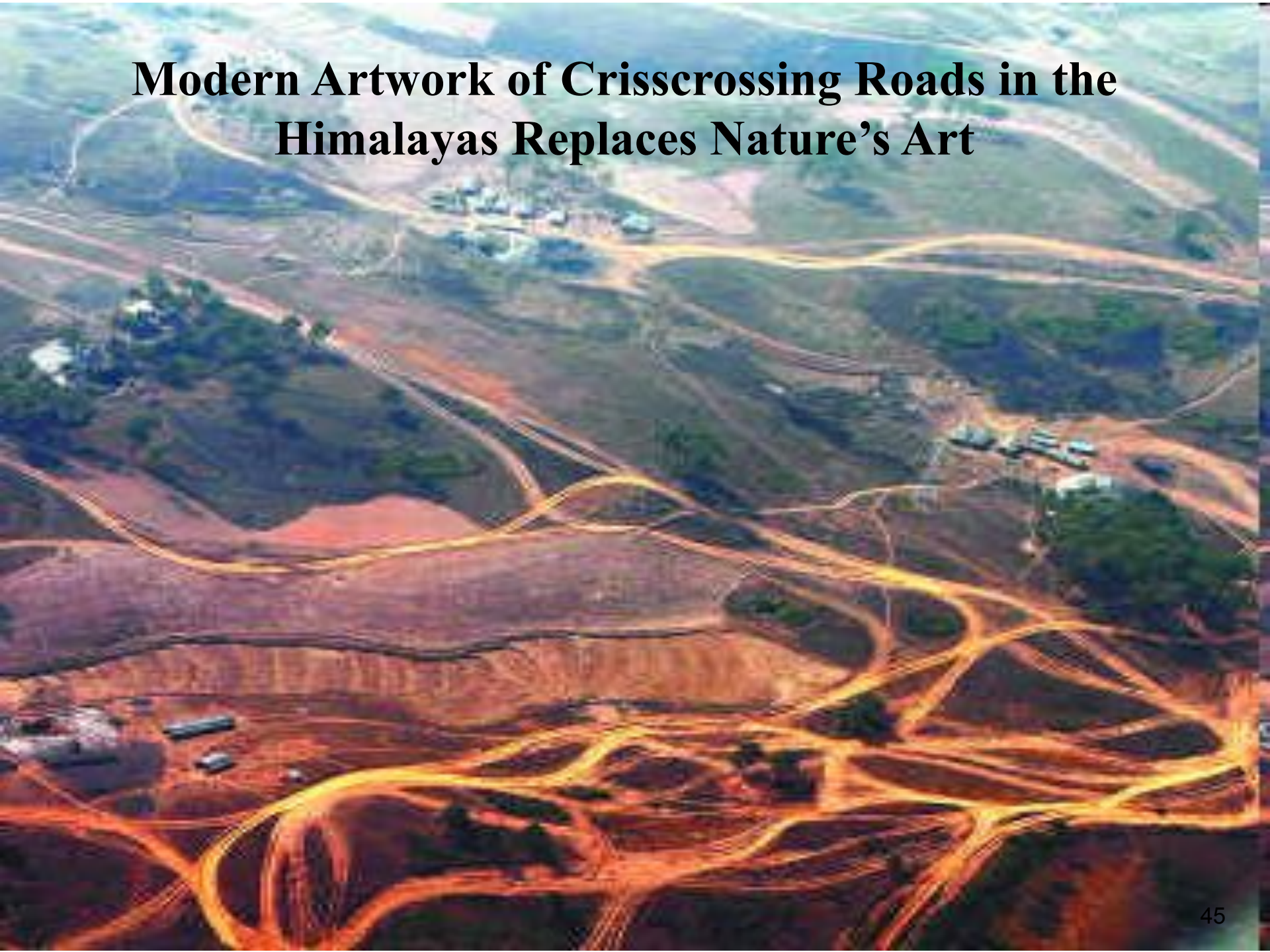
Himalayas laid bare: severe deforestation and denudation



The Himalayas in peril

- Deforestation:
 - Landslides, soil erosion, floods
- Projects and road building:
 - More exploitation, ecosystems affected
- Mountaineering:
 - Garbage, heavy movement, resource depletion
- GLOBAL WARMING: GLACIERS ARE MELTING

Modern Artwork of Crisscrossing Roads in the Himalayas Replaces Nature's Art



Result: The Uttarakhand Disaster



Nature avenges its exploitation

There is little doubt that the present Himalayan disaster has been triggered by natural events, but the catastrophe is man-made. --**The Hindu**

Forests

- More than 50 countries have lost between 90 and 100 per cent of their forests
- Tropical forests are being cleared at the rate of one hectare every second.

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Man felt so powerful. He thought:
Let us kill birds, tigers, elephants,
all other life forms,
and cause
the Sixth Mass Extinction of species !

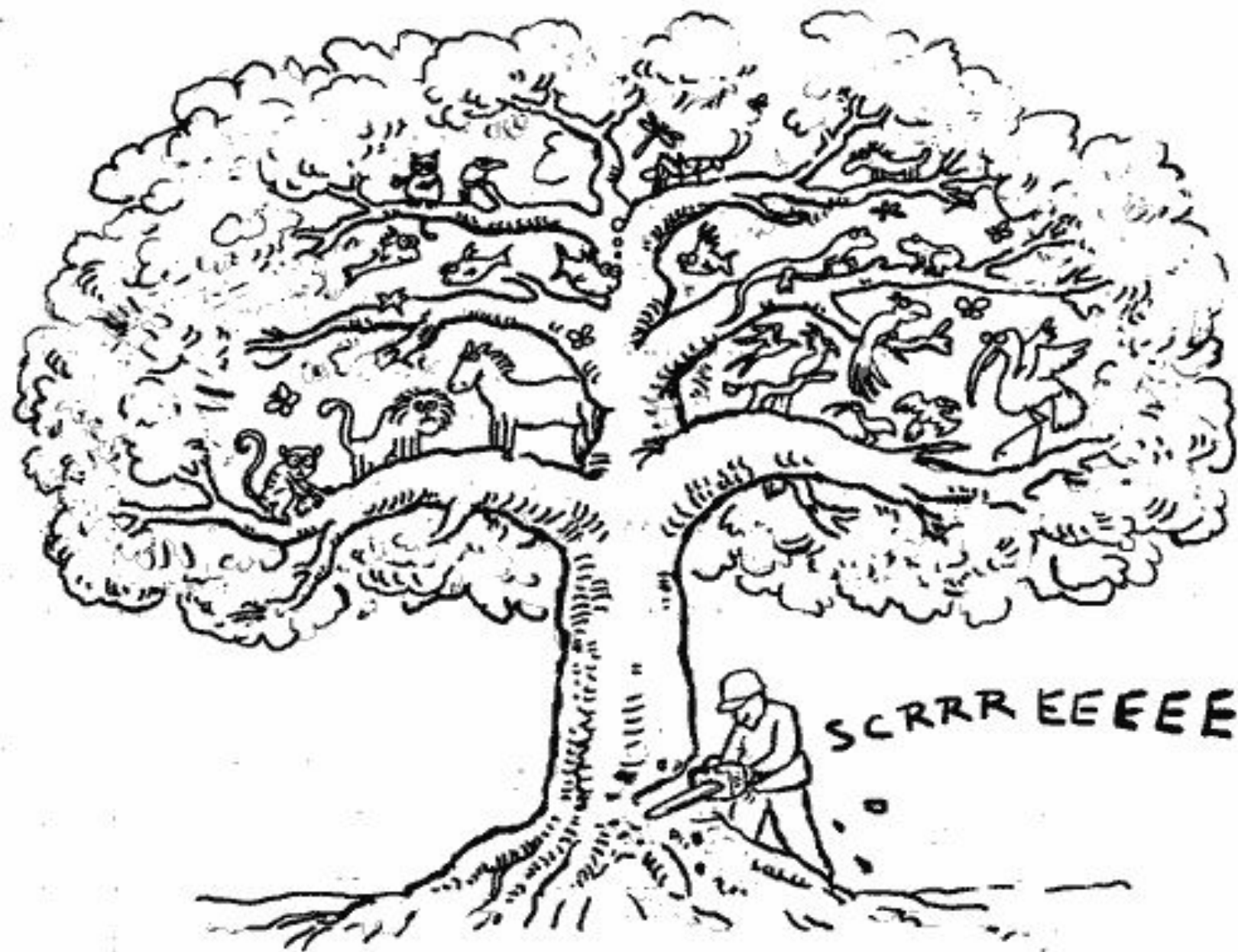
Biodiversity

World:

- 24% mammals, 12% birds, 25% reptiles, 30% fish threatened or endangered
 - 100-1000 times faster than natural process of extinction

India:

- > 10% flora and fauna are threatened, many on verge of extinction



THE TREE OF LIFE



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Man continued:
Let us extract all the groundwater,
pollute all the waterways,
exploit the oceans and coastal space!

Water

- The per capita availability of freshwater is declining globally.
- Contaminated water remains the greatest single environmental cause of human sickness and death.
- The decline of quantity and quality of surface and groundwater is impacting aquatic ecosystems and their services.
- By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the people in the world could be subject to water stress.

Water

World:

- 80 countries of the world suffer from serious water shortages:
 - 1.5 billion people, one fourth of the population, have no access to safe drinking water.
 - Half the population lacks sanitation facilities.

India:

- No drinking water in > 60,000 villages
- Diarrhoea kills one million children per year
- 45 million affected by bad water per year



STATE OF THE WORLD'S ENVIRONMENT 2025 AD



Oceans, Rivers, and Fisheries

- Aquatic ecosystems continue to be heavily exploited, putting at risk sustainability of food supplies and biodiversity.
- Global marine and freshwater fish catches show large-scale declines, caused mostly by persistent overfishing.
- No fish to catch, by 2050 ?

State of the Coast

- The average population density in coastal areas is now twice as high as the global average.
- More than 100 million people live in areas no more than one metre above mean sea-level.
- 21 of the world's 33 mega-cities are located in coastal areas, with most of them in developing countries.

State of the Coast

- Poor planning,
- the loss of key ecosystems such as wetlands, mangroves and coral reefs, and
- sea level rise due to climate change,
- are increasing the risk of flooding and reducing coastal protection from storms, tsunamis and erosion.

Coastal/Marine Degradation

World:

- Marine pollution has increased enormously.
- World fisheries have collapsed due to overexploitation and pollution.

India:

- 50% of mangroves and corals lost
- Heavy sea erosion, sea water intrusion

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Man said:
Let us be cool, use CFCs,
and
blow a big hole in the ozone layer !

Ozone Hole

- The “hole” in the stratospheric ozone layer over the Antarctic is now the largest ever.
- Due to decreased emissions of ozone depleting substances and assuming full Montreal Protocol compliance, the ozone layer is expected to recover, but not until 2060 (or even later).



"There goes another one
through the hole in the Ozone."

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Man also had a great idea:
Let us create big cities
and
we can live happily !

Our Urban Future

- An Urbanizing World
- Increase in urban population:
- From 732 million in 1950 to 3.2 billion in 2006.
- Half the world population is in cities (from 2008)
- Asia and Africa to double their urban populations to roughly 3.4 billion by 2030.

Urban Woes

- Roughly half the people in African and Asian cities lack adequate water and sanitation.
- 6 of the 10 are vulnerable to storm surges.
- Eight of the world's 10 most populous cities sit on earthquake faults
- Urban air pollution kills an estimated 800,000 people each year, roughly half of them in China
- Each year, traffic accidents kill about 1.2 million people and injure up to 50 million more.





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Then Man said:
Let us use up all the natural resources, convert
them to waste,
and dump it or
pollute the air and water !

The original inhabitants of this land had a saying -
'Every time you take something from the Earth,
you must give something back.'



Air Pollution

- At least one billion people in the world breathe unhealthy air.
- More than 2 million people globally die prematurely every year due to outdoor and indoor air pollution.
- Although air pollution has decreased in some cities in the North, emissions are increasing in many cities of the South.
- Indoor air pollution due to the improper burning of solid biomass fuels imposes an enormous health burden.
- Indian cities among the most polluted in the world.

Can you interpret this cartoon?



**Can you
interpret this
cartoon?**

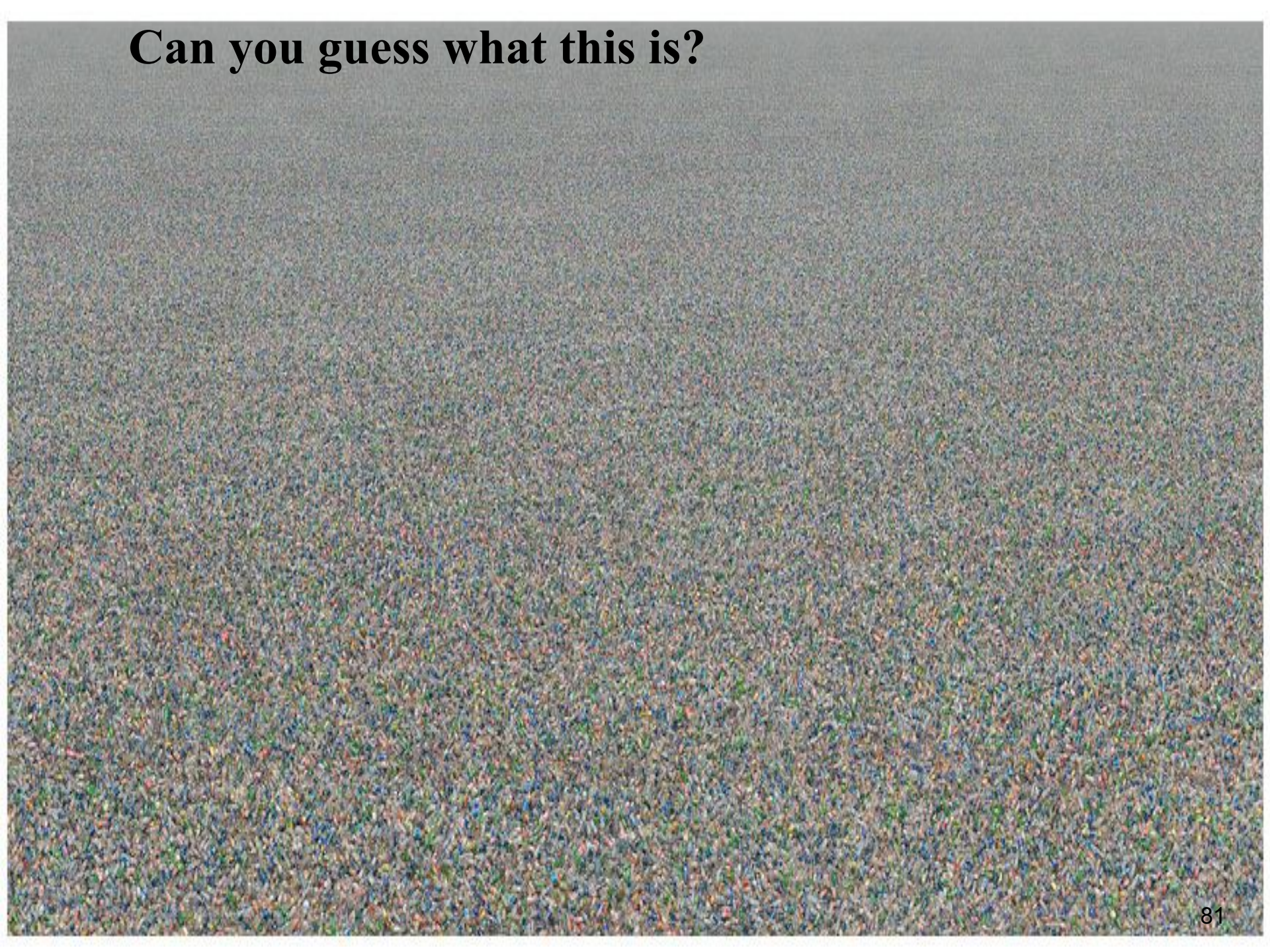


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Man in essence said:
Let us consume more and more
and
we will all be happy !

Can you guess what this is?



How about now?



Certainly now, it is obvious!!



Art by Chris Jordan

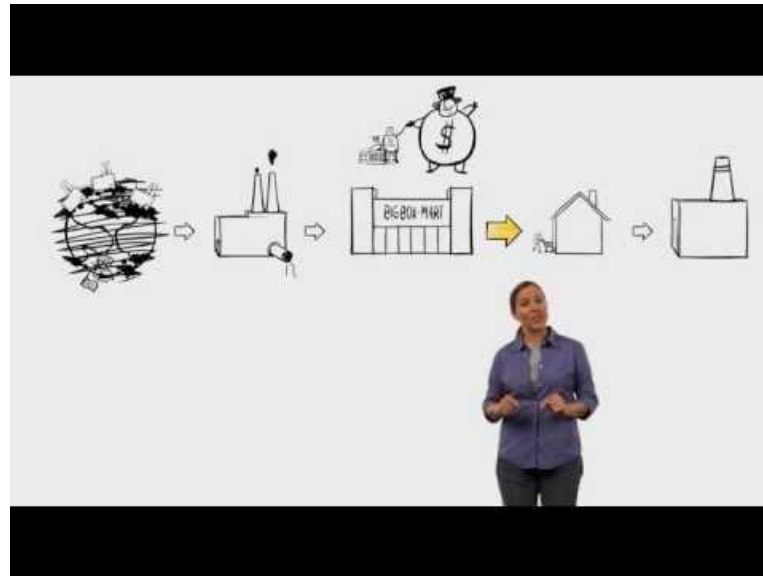
Plastic Bottles, 2007

60" x 120"

Depicts two million
plastic beverage bottles,
the number used in the US
every five minutes.

Consumerism

Consumerism has become a way of life for us. Let's learn more about what happens to the stuff we buy, consume and throw.



Let's watch the video: [The Story of Stuff](#) (21) or [read the transcript](#)

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Things are warming up !

Global warming is happening:

- The Arctic is melting.
- Antarctic ice shelves are breaking off.
- The weather is becoming unpredictable.
- The frequency of natural disasters and the number of people affected are increasing.
- Sea level rise is threatening the existence of small islands.

India: The Himalayan glaciers are receding !

Climate Change Worsens Natural Disasters



Avalanches,
Snowstorms,
Landslides



Wildfires



Floods, Droughts,
Famines



Storms



Lightning



Tornadoes

Note: The above disasters can get worse due to climate change

Increased Damage from Natural Disasters

Due to:

- Uncontrolled urbanization
- High population density
- Poor planning and preparedness



Tsunamis



Volcanoes



Earthquakes

Note: The above disasters are not related to climate change

We are past the tipping point
in many aspects of the environment !

It may all come together as a catastrophe
by 2030-35.

Of course, as we saw before, it is not environment alone

Interconnected things:

- Increasing population, food prices
- Increasing disparities:
 - Marginalisation of the poor
 - Farmers in distress
- Increasing militarisation, terrorism
- Large scale corruption, frauds
- Financial crisis, economic ups and downs.

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Is Unsustainability Really a Crisis?

Different Perceptions

- Environmental problems are not as bad as they are made out to be.
- There are problems, but S&T will find solutions.
- There is a real crisis, the wolf is at the door, there is no way out !
- Hunger and poverty are more important issues, we need economic growth.
- It is all part of a Grand Design. God made this world, and He will take care of it.
- The Earth is a self-evolving and self-regulating living system and it will survive (Gaia Theory).

*Human beings and
the natural world
are on a collision course.*

- World Scientists' Warning to Humanity

So, it is much worse than I imagined !

Changes are coming !

Within your lifetime, you will see major environmental and social changes.

They will not be pleasant for you, your children, and humanity.

You can, however, mitigate the impact by taking action NOW.

There is **no time to lose !**



Wait a minute,
Were we not living happily
for thousands of years?
Why is there a crisis now?

Earth, Nature, Man: The Long View

We have survived for so long:

- Earth: 5 billion years
- Man: 3 to 5 million years
- Civilization: 10,000 years

We know:

- Nature absorbs disturbances !
- Man is the master !
- S&T can solve all problems !
- Economic development is the key.



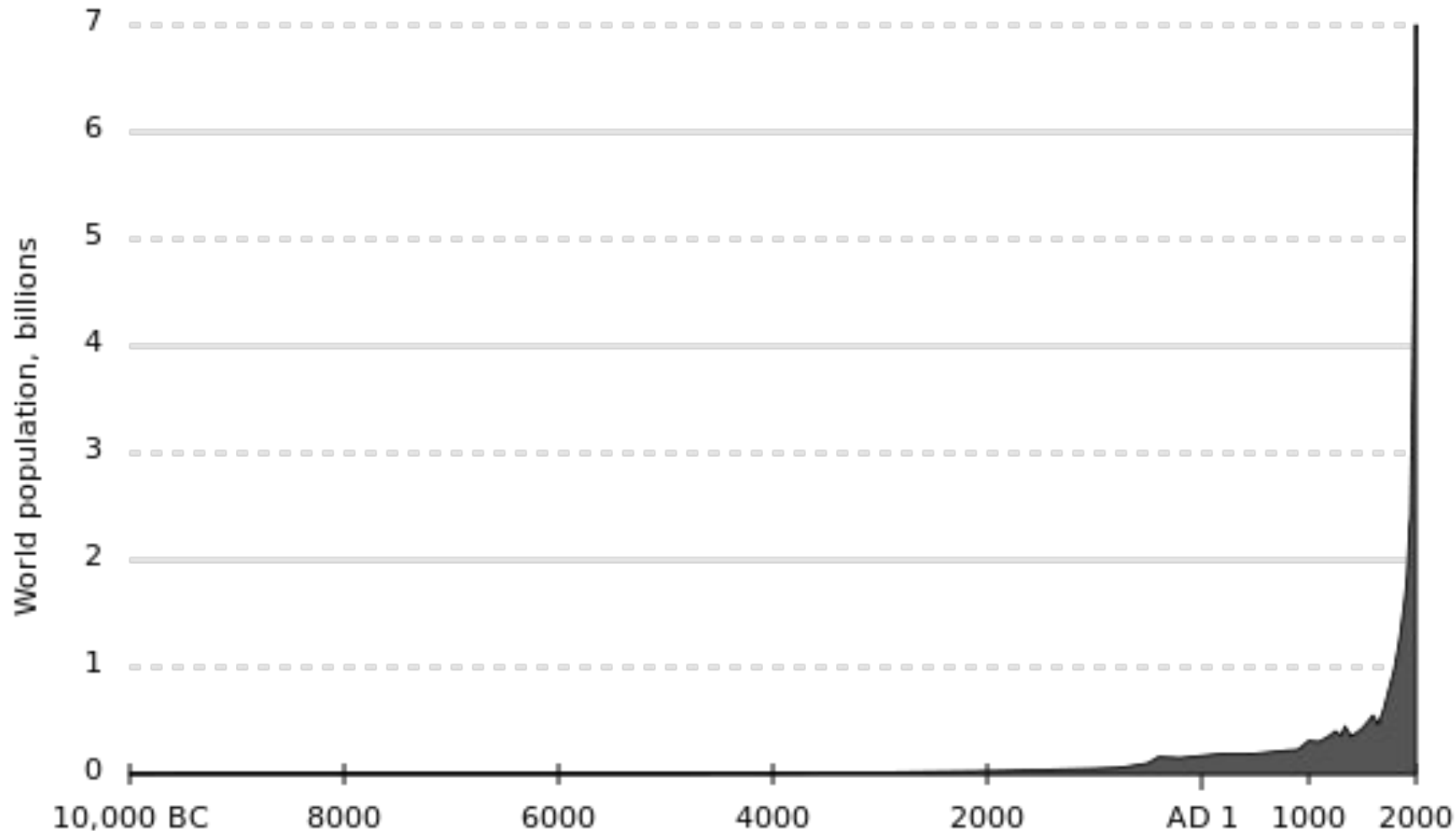
Why can't we continue the same way?
Or, is something different happening now?

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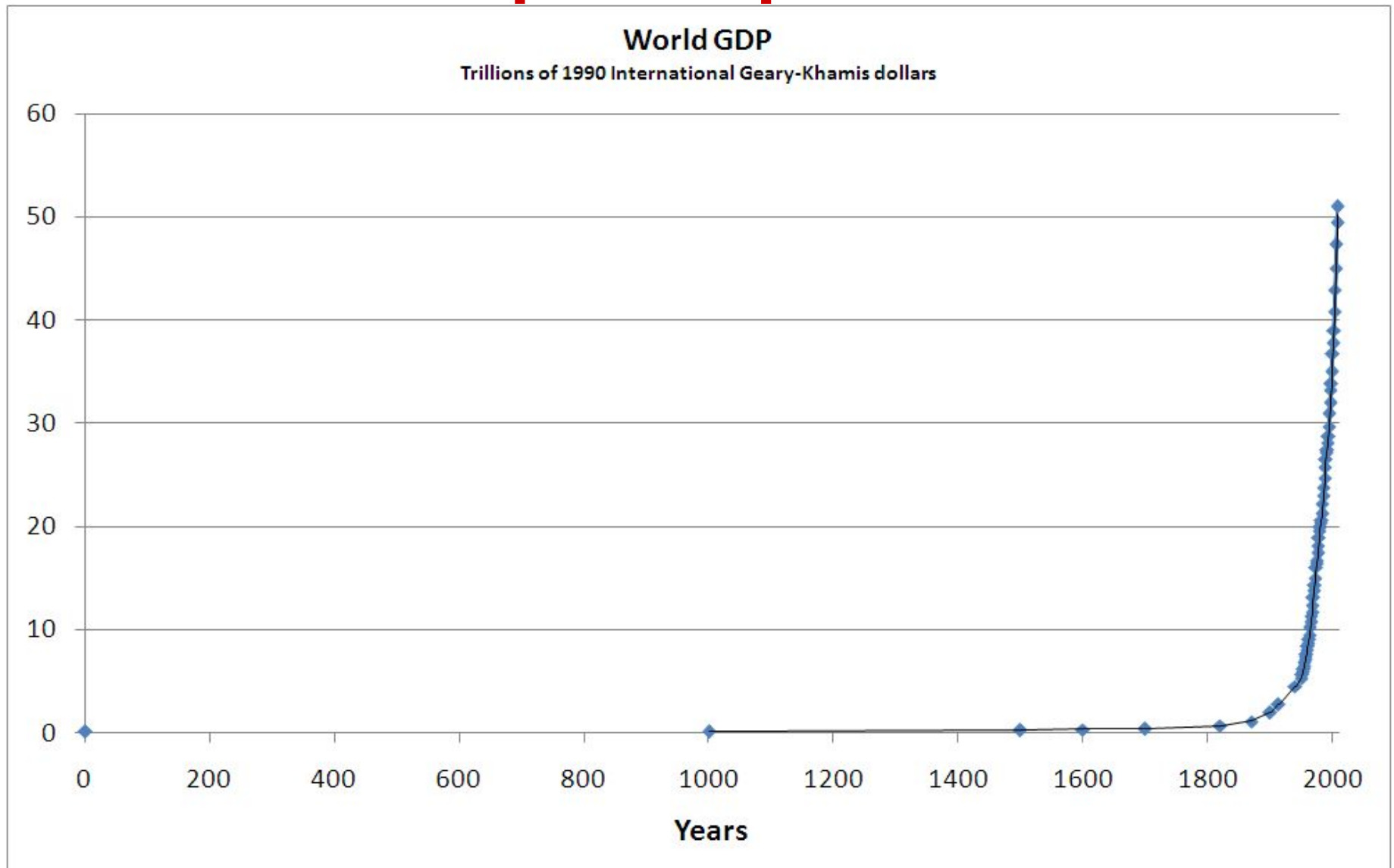
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Examine the graphs on the next four slides...

The Population Spike

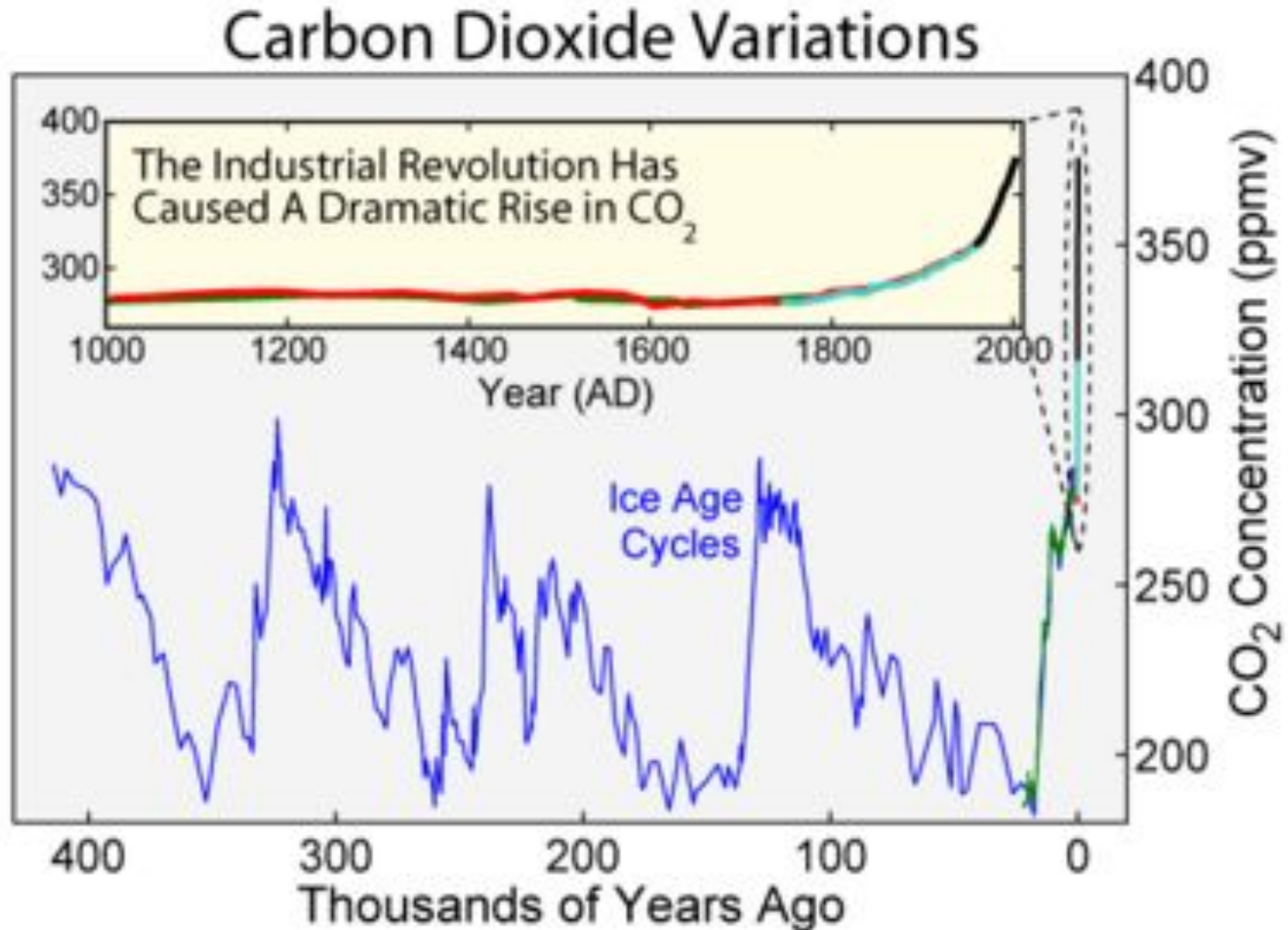


The Consumption Spike

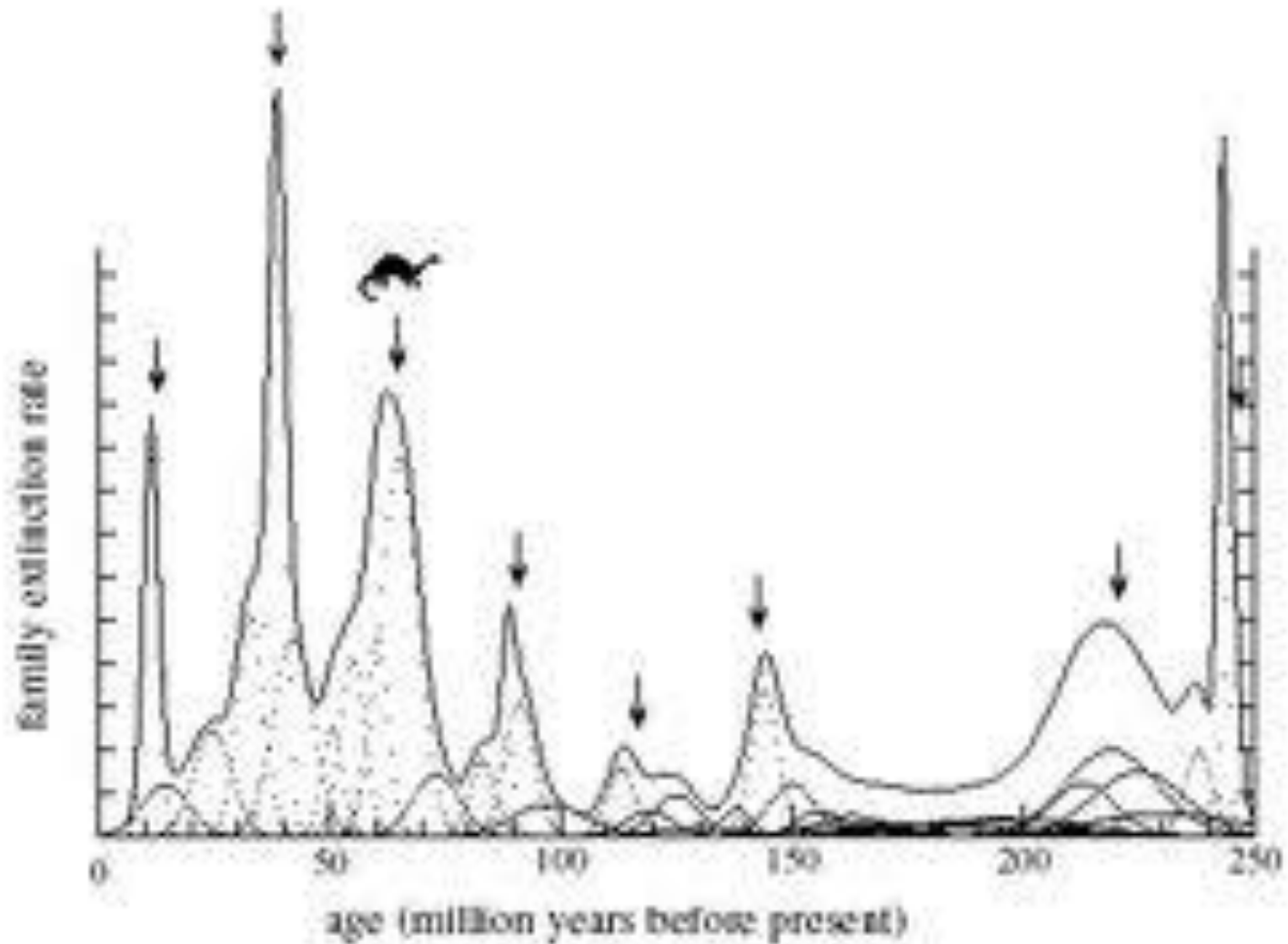


Plotted from the Data of "Historical Statistics of the World Economy: 1-2008 AD" Angus Maddison

The CO₂ Spike



The Extinction Spike



Anyone who believes that exponential growth
can go on forever in a finite world is
either a madman or an economist.

- Kenneth Boulding

*But don't we all want growth?
That is what our politicians, industrialists and
economists are striving for.*

*Why do we have to question
'economic growth' and 'development'?*

We certainly don't have to give up development.
But we do have to think of development
differently...very differently.



Why do the spikes occur?

GROWTH AND DEVELOPMENT

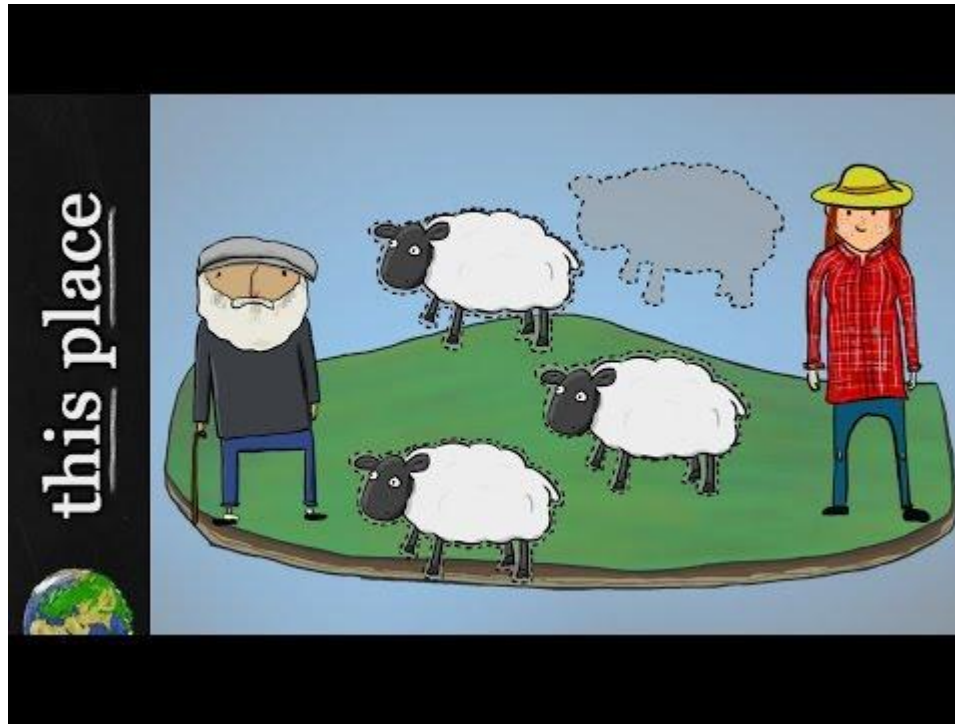
- The Idea of Progress
 - 16th/17th Century Europe
 - Industrial Revolution
- New attitude towards nature
 - Man is most important
 - Nature is for exploitation
- Exponential growth in many areas
 - Supported by Science & Technology

Let's understand present sustainability through a model...

Unsustainability is a Tragedy of the Commons (Open Access Resources)

- The degradation of a common shared resource (commons) is inevitable in the long term when:
 - The sharing individuals are rational and self-interested (profit-minded).
 - Its use is unregulated.
- The benefits of increased consumption are immediate and privately enjoyed, while the degradation of the resource is delayed and is distributed among all.
- So, consumption goes on increasing until the resource degrades...

The socio-environmental crisis is a greatly magnified Tragedy of the Commons.



Watch Video: [Tragedy of the Commons | The Problem with Open Access](#) (3.26 min)

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What has the world done about it?

- Rachel Carson: *Silent Spring* (1962)
- Environmental movement
- Stockholm Conference (1972)
- UNEP, UN Conventions & Agreements
- Earth Summit, Agenda 21 (1992)
- World Summit on Sust. Development (2002)
- Intergovernmental Panel on Climate Change, Kyoto Protocol

What has India done about it?

- Initial legislation: Water Act, etc.
- Post-Bhopal: Many laws
- Environment Protection Act, 1986
- MoEF, Pollution Control Boards
- Environmental Impact Assessment
- Rise of civil society

*Yet, environmental degradation
continues unabated !*

Is there no hope, then?

If things are so bad and disaster is imminent,
should I just give up?

No, I must find out
the real enemy of the environment !

Who is responsible?

- My neighbour who throws the garbage on the street?
- Rich countries like the US that consume and pollute a lot?
- Companies that use natural resources and throw away the waste?
- Corrupt officials who let the companies pollute?
- Municipalities that do not clear the garbage?
- Overpopulation? But it only amplifies what is basically wrong.
- Politics or the 'system'? But, in a democracy, don't we make the system?

Who is responsible?

- Don't say that you have nothing to do with it; you are party to it and also the sufferer.
- Don't say you are helpless and insignificant; small steps make big impacts.

I am responsible for the damage and for bringing change.

Our Attitudes and Actions are the Cause

- My consumption
- The waste that I create and throw away
- NIMBY (Not In My Back Yard) syndrome
- The corruption that I support, directly or indirectly
- The unsustainable or polluting nature of my work, my organization

So, I am now part of the problem !

Can I become a part of the solution ?

Yes!

*We are the ones
we have been waiting for!*

- June Jordan

*I am the real cause of the problem
so I have to begin with myself !*

Fine. I'm ready to do what it takes.

But what am I supposed to do?

What are WE supposed to do?

We all need to work towards:

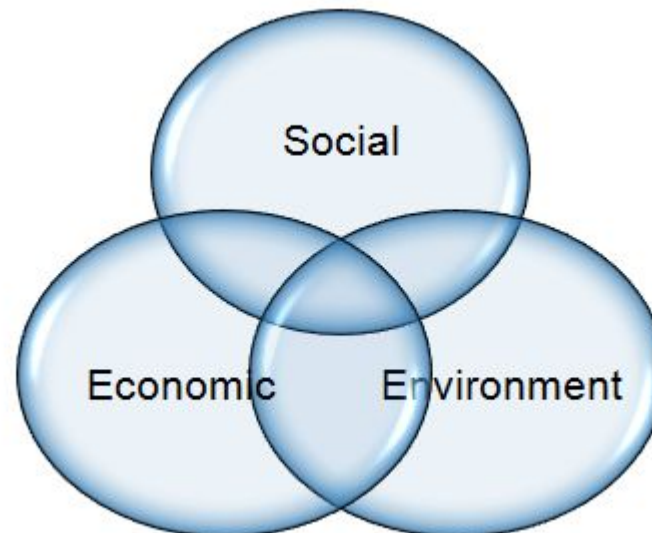
SUSTAINABLE DEVELOPMENT

Outline

- The Nurturing Biosphere
- Well-Being and Resource Consumption
- Present Unsustainability
- Course Description
- State of the Environment
 - Forests
 - Biodiversity
 - Water
 - Ozone layer
 - Urbanization
 - Resource depletion, waste and pollution
 - Consumerism
 - Climate Change
- Perceptions of the Crisis
- Causes of the Crisis
- Environmental Movement
- Sustainable Development

Sustainable Development (SD)

- SD is the **economic development** to meet **human needs** while preserving the **environment**.
- Meet needs into the indefinite future.
- **Present economic growth is unsustainable since it leads to social inequities and environmental damage.**
- Economy, Society, Environment: 3 interdependent and mutually reinforcing pillars of SD.



In order to work towards Sustainable Development, we need to learn a lot of things....

We need to study this course for starters!

So, let's get on with it!

A lush, green Japanese garden scene. In the foreground, a dark, still pond reflects the surrounding greenery. A large, gnarled tree with long, weeping branches dominates the right side of the frame. The ground is covered in vibrant green moss and ferns. In the background, more trees and a hint of a stone fence are visible. The overall atmosphere is peaceful and natural.

Thank You

Look forward to learning more about
our wonderful environment with
you...

*May peace be inside your
walls, and wealth in your noble
houses.*

Psalms 122:7