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Environmental Challenges and General Framework of Sustainability

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Human activities

- Extracting and processing of raw materials, e.g., fossil fuels, metals, rocks
- Energy production
- Industrial activities
- Agriculture
- Forestry (Deforestation)
- Transportation

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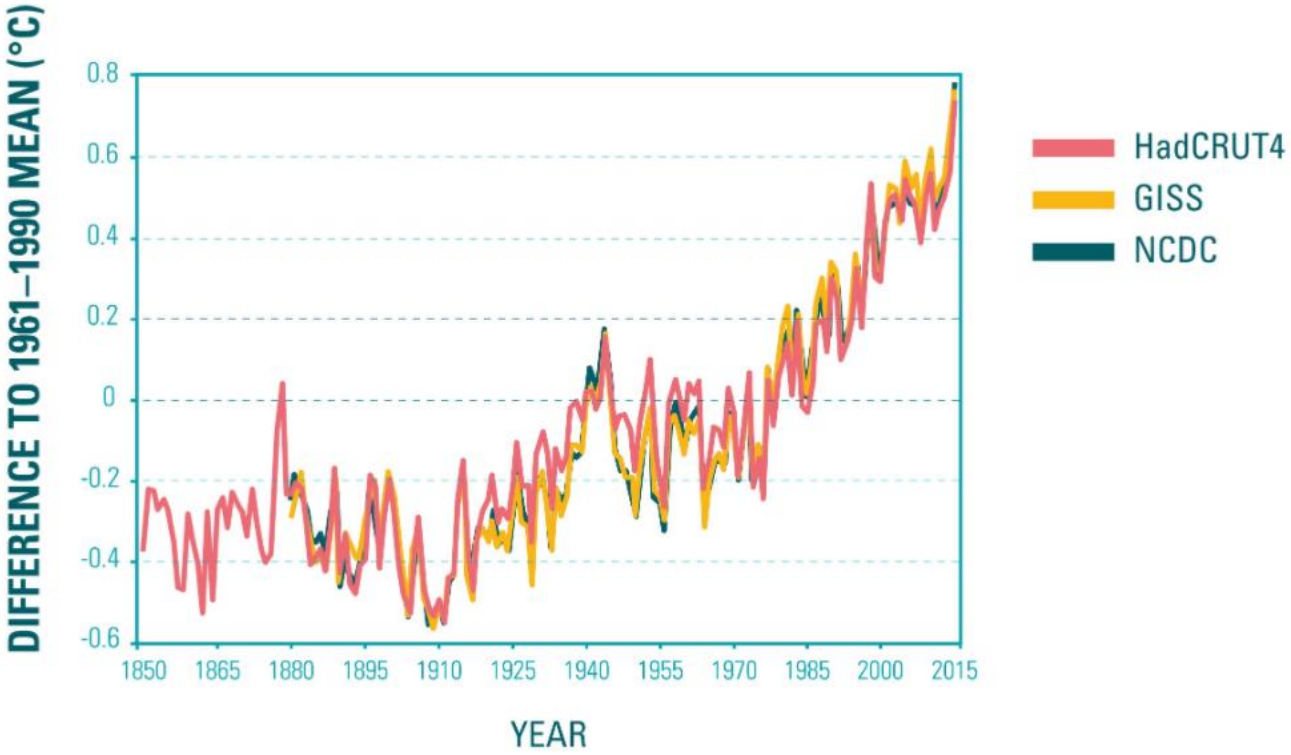
Earth's surface temperature

- **The global annual average of the Earth's surface temperature according to different estimates**



Source: https://mooc.helsinki.fi/mod/book/view.php?id=3633&chapterid=227

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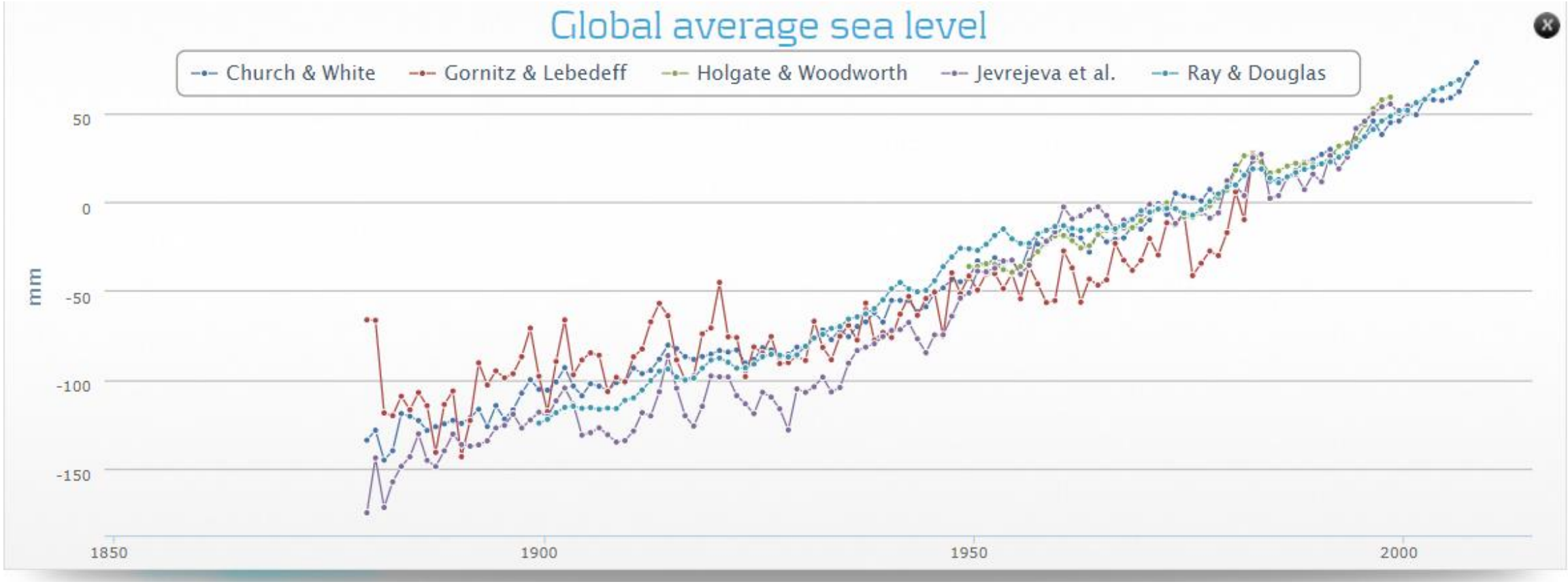
Global average sea level



Source: https://ilmasto-opas.fi/en/ilmastonmuutos/videot-ja-visualisoinnit/-/artikkeli/b4df9633-7e1f-4389-9dd0-a0539588f211/visualisoinnit.html#muutoksen-merkit

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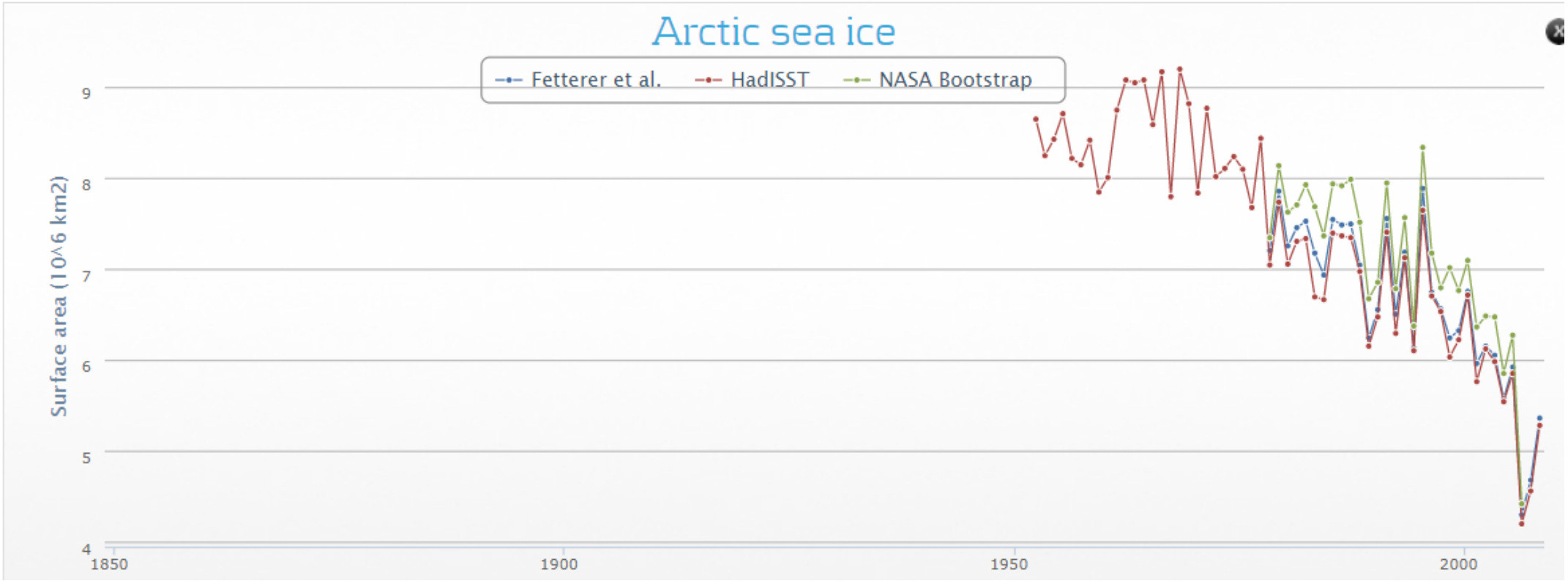
Arctic sea ice



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Global warming/Climate change

- "It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century." (Intergovernmental Panel on Climate Change, 2013)
- Largest human influence - CO_2, N_2O, CH_4
- During 21st century → rise of global surface temperature:
  - The lowest emissions scenario - 0.3 to 1.7 deg C
  - The highest emissions scenario - 2.6 to **4.8** deg C

  S. Hawking in 2017: «Humans must leave planet Earth in 600 years in order to survive»

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Global warming impacts

- Increasing global temperatures
- Rising sea levels and increased coastal flooding
- Heavier precipitation (rain, snow, hail)
- Expansion of deserts in subtropics
- More severe droughts in some areas
- An increase in extreme weather events
- Longer and more damaging wildfire seasons
- More destructive hurricanes
- More frequent and intense heat waves

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- An increase in extreme weather events
- Longer and more damaging wildfire seasons
- More destructive hurricanes
- More frequent and intense heat waves
- Costly and growing health impacts
- Ocean acidification (CO_2+H_2O)
- Species extinctions due to shifting temperature regimes
- Threat to food security from decreasing crop yields and the abandonment of populated areas (due to rising sea levels)
- Others

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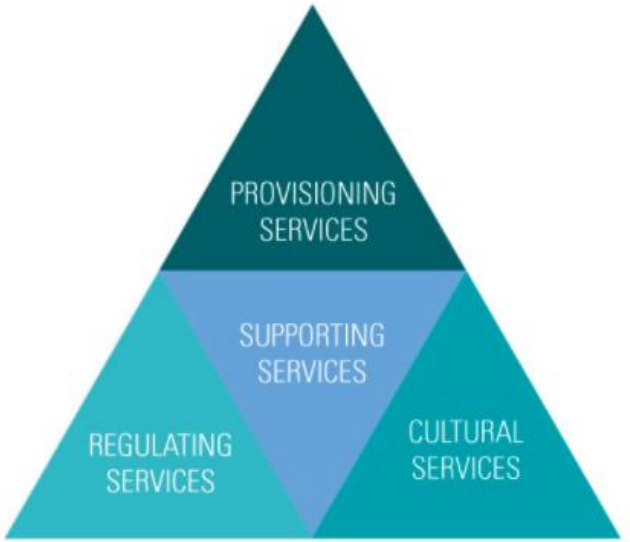
Ecosystem Services

- The concept of ecosystem services combines the needs of humans and nature. The impacts that climate change has on the functioning of ecosystems become manifest in changes in the ecosystem services we use in our daily lives.



The four categories of ecosystem services.

- *provisioning services*: drinking water
- *cultural services*: water-related tourism
- *regulating services*: regulation of water flows, storage of water; peatlands, wetlands, flood control
- *supporting services*: maintaining the habitats of aquatic organisms; on the other hand, the global water cycle supports other services

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Sustainability and Sustainable Development

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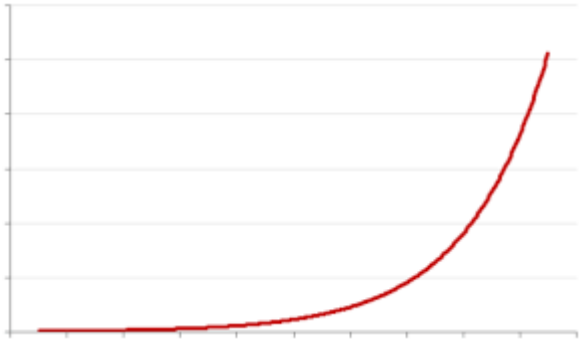
Development in 20th century

- Exponential growth of
  - population
  - production
  - consumption
- Globalization of processes
- Economic growth can solve some of the problems (creating jobs, providing social protection and technical advances), but unfortunately it also creates new ones.
- The Earth is limited.



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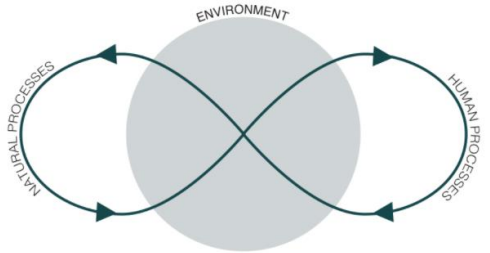
Anthroposcene

- The **Anthropocene** (anthropo- meaning ‘human’ and -cene meaning ‘new’) has been proposed as the new geological era where humankind is the main driving force. **Capitalocene**, a concept similar to the concept of anthropocene, looks at the human impact on the environment. According to world-ecology reasoning, it is not just a human impact that defines this epoch, but a certain kind of human activity—capitalism. Capitalocene suggests that capitalism, since its initiation in 1492, has had the most substantial effect on nature.



The environment, both natural and human-made, seamlessly tie human and natural processes into one reciprocal system. What happens to one, sparks a reaction in the other. Sustainability aims to stop the negative-cycle of action-reaction by turning it into a positive cycle, and perhaps even a restorative one.

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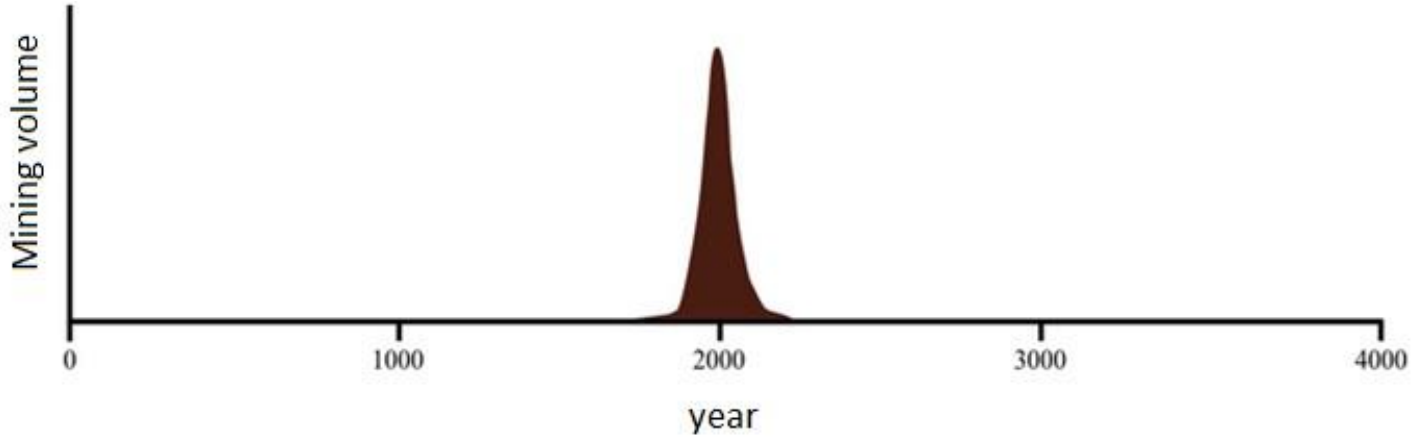
Era of black gold

- Pre-industrial community used only renewable resources - for example, in a mill, the grain was edged with wind or water, but the house was heated with firewood.
- Oil availability led to drastic changes. Various industries evolved, and a machine powered by an oil fraction was more efficient than a horse. Oil was used to produce fuel, solvents, plastic products, fertilizers.



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«Oil era»

- We are currently living in the oil era, but as oil runs out, it will end. We will need to be clear about how to survive with renewable energy, how to live with less energy and how to use the energy more efficiently.
- **How can these goals be achieved while avoiding disaster?**

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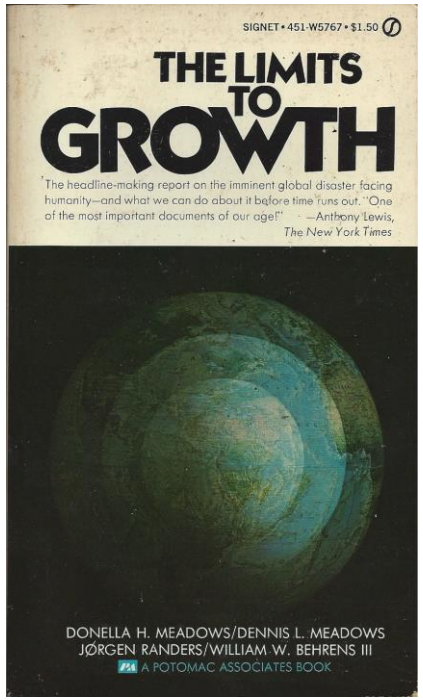
Limits to Growth

- 1972 - "The Limits to Growth" by Donella Meadows et al.
- Study of what will happen to our world if growth continues, in what is known as "business as usual" development model



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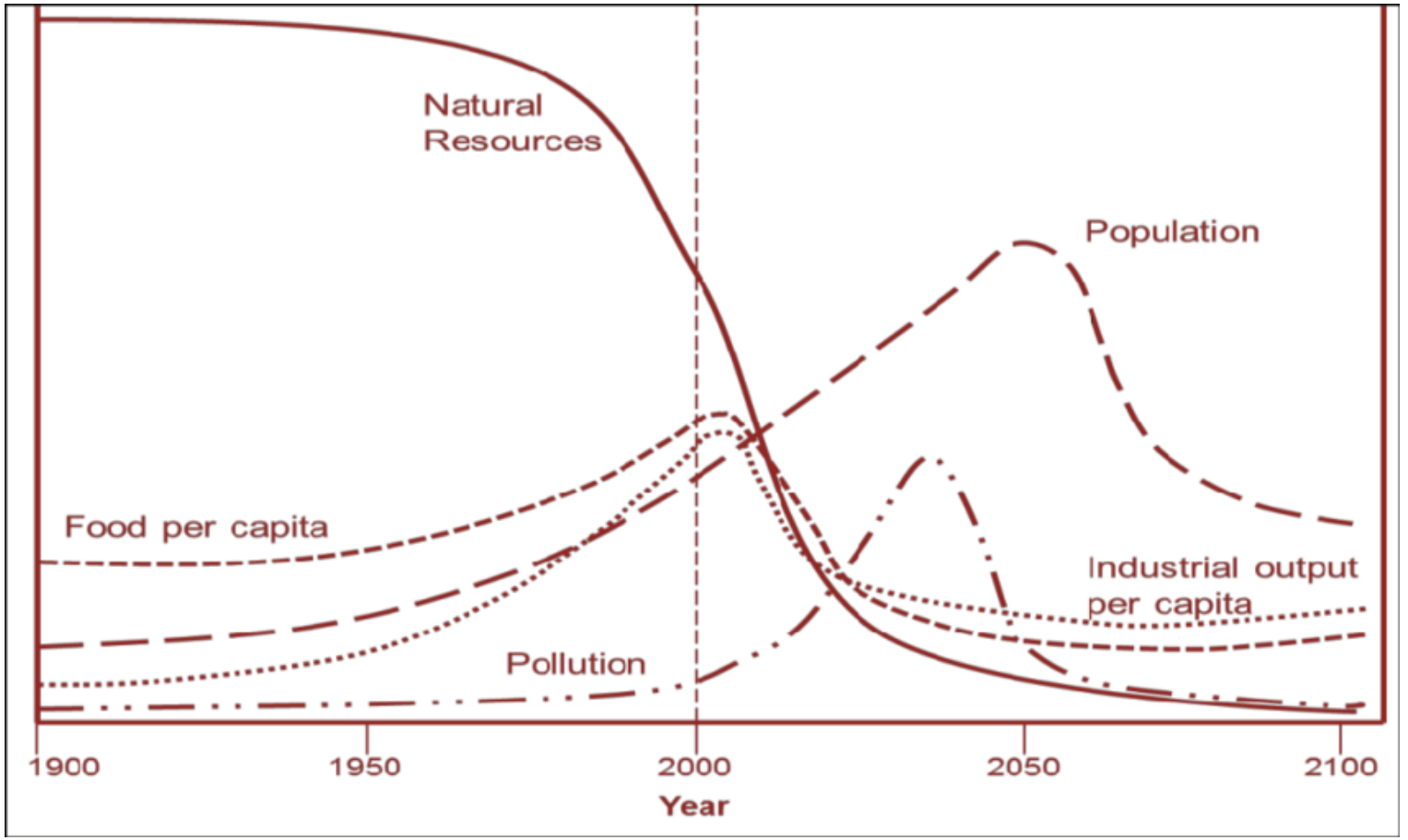
Limits to Growth



Source: https://www.researchgate.net/figure/The-original-projections-of-the-limits-to-growth-model-examined-the-relation-of-a-growing_fig2_263599396

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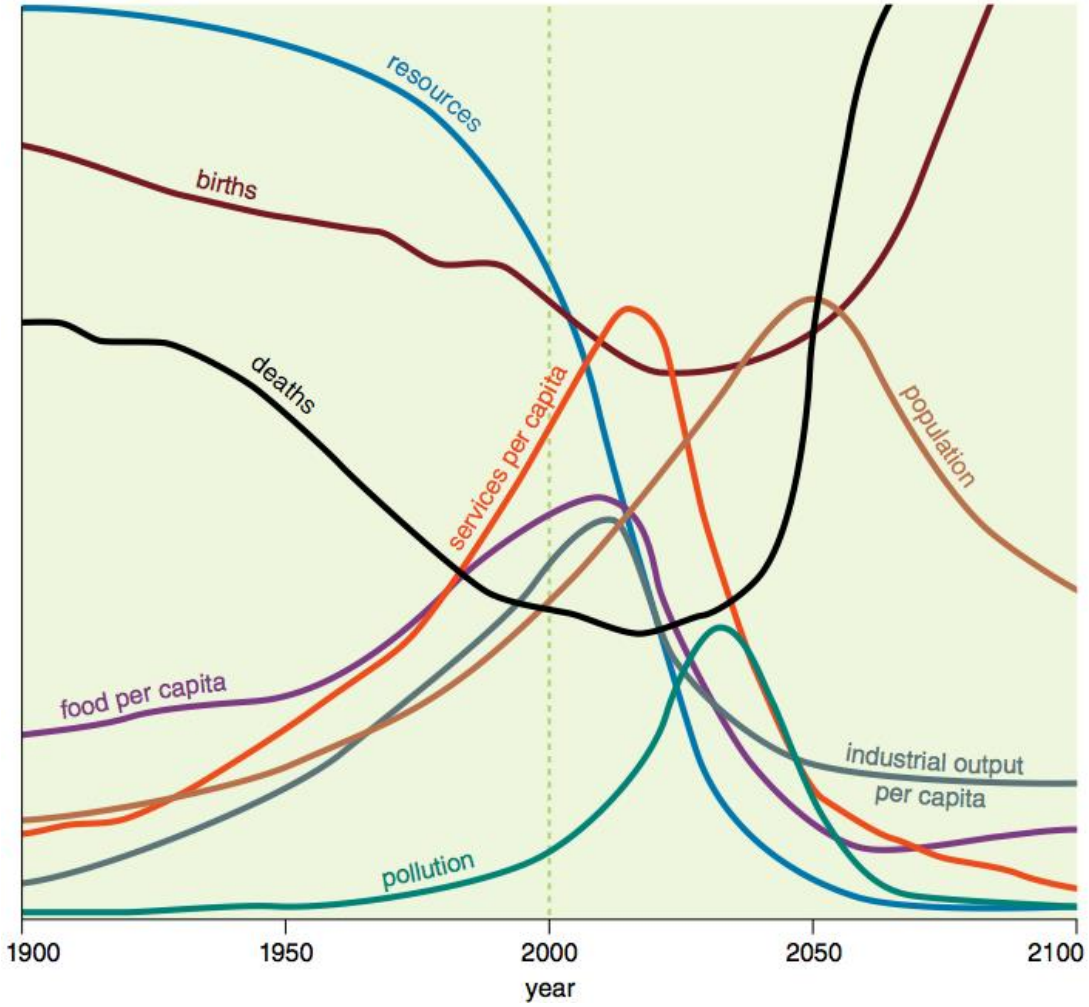
Limits to Growth



Source: https://forum.aerocene.org/t/limits-to-growth-the-club-of-rome/267

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Limits of humanity

- Already in 1953, 1600 scientists of 58 of the world's most prestigious academies of science signed a "Warning to Humanity" stating: "... there is no doubt that the unrestricted growth of humanity as a population and the increase in resource consumption pose a serious threat to the Earth's ecosystem. Greenhouse gas emissions are rising, the ozone layer is being depleted, acid rain is falling, forests are being cut, intensive soil management is depleting the fertile surface of the land, drinking water supplies are reducing because of pollution and fossil raw materials are being depleted. All of this indicates that **humanity is approaching a margin beyond which its continued existence will be impossible.**"

Source: http://www.lzj.lv/lv/ilgtspejiga-attistiba

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Sustainability

- Sustainability as a concept was first mentioned 300 years ago. It emerged as part of mining industry planning. The aim was to harvest **timber** at a rate which produced enough to be used by the mining industry and enough to be traded. The capital gained from the timber trade assured the well-being of the human community that were economically reliant on that system. In other words, timber needed to be managed in a way that would allow it to continue being produced.

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Sustainable Development

- The concept of sustainable development is defined in the report of the UN World Commission on Environment and Development entitled "Our Common Future" (also known as the Bruntland Commission Report, 1987).
- It has been used internationally since United Nations Conference 'Environment and Development' in 1992 at Rio De Janeiro.
- **"Development that meets today's needs without compromising the needs of future generations"**
- The concept of sustainable development is not only a view on how society and humanity as a whole needs to develop, but a set of views on **how to ensure the existence of society**.
- A set of concepts, methods, processes, interactions and objectives that aim at ensuring the long-term existence of society.

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The essence of ‘Sustainable Development’ concept

- Human consumption must not exceed the capacity of the Earth’s ecosystem
  - Ecosystem – totality of living organisms in a particular environment
  - Capacity – the maximum number of individuals of a given population or biomass that can be sustained by a particular environment
- Implementation of activities and processes that deliver long-term benefits and effects

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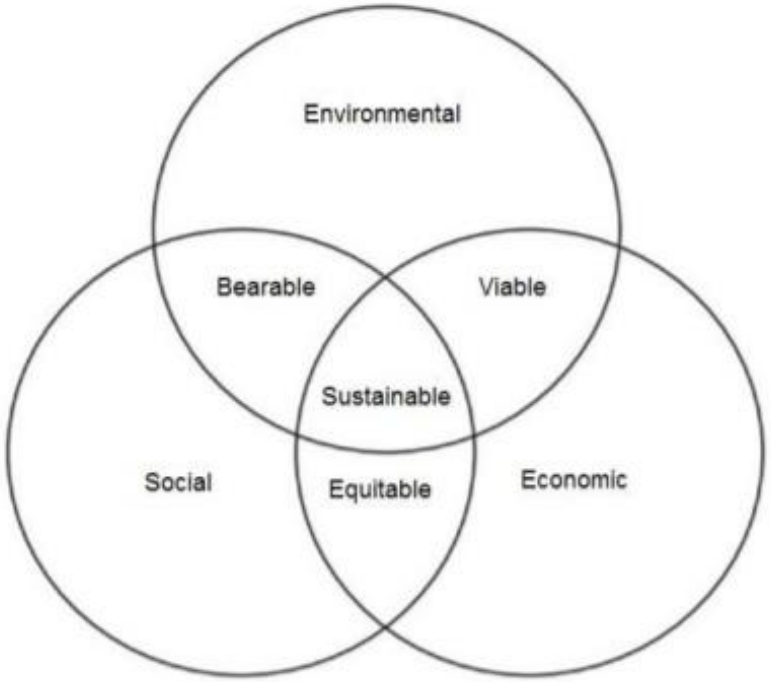
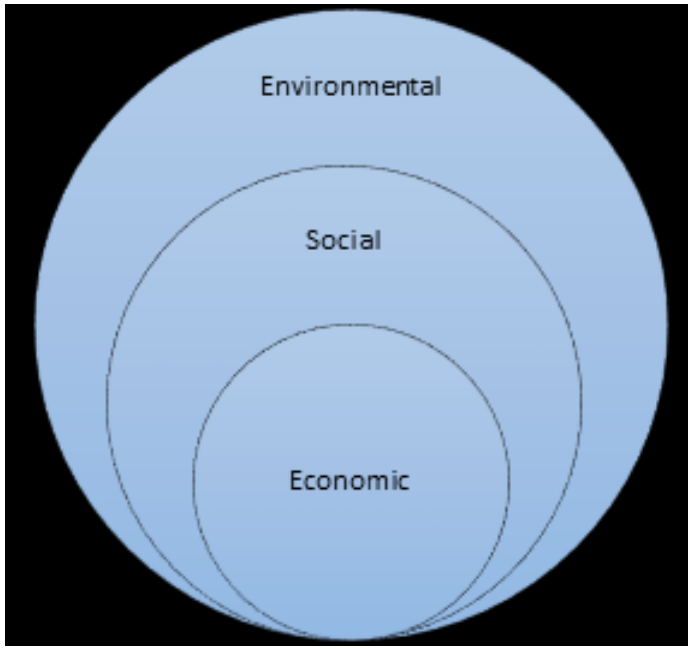
Dimensions of Sustainable Development

- Classic Sustainable Development Paradigm



Triple Bottom Sustainability

- New Paradigm of Sustainable Development - General economic and social development, with full regard to the environmental aspects



Source: http://www.jcreview.com/fulltext/197-1602678378.pdf?1630666176

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Environmental Dimension

- **Environment** is the **basis** of Sustainable Development
  - Conservation of biodiversity
  - Conservation of natural resources
  - Not exceeding natural regenerative capacity

Consumption of renewable resources	Environmental condition	Sustainability
Greater than natural regeneration	Environmental degradation	Unsustainable development
Equal to natural regeneration	Environmental balance	Stable sustainability
Less than natural regeneration	Environmental renewal	Sustainable Development

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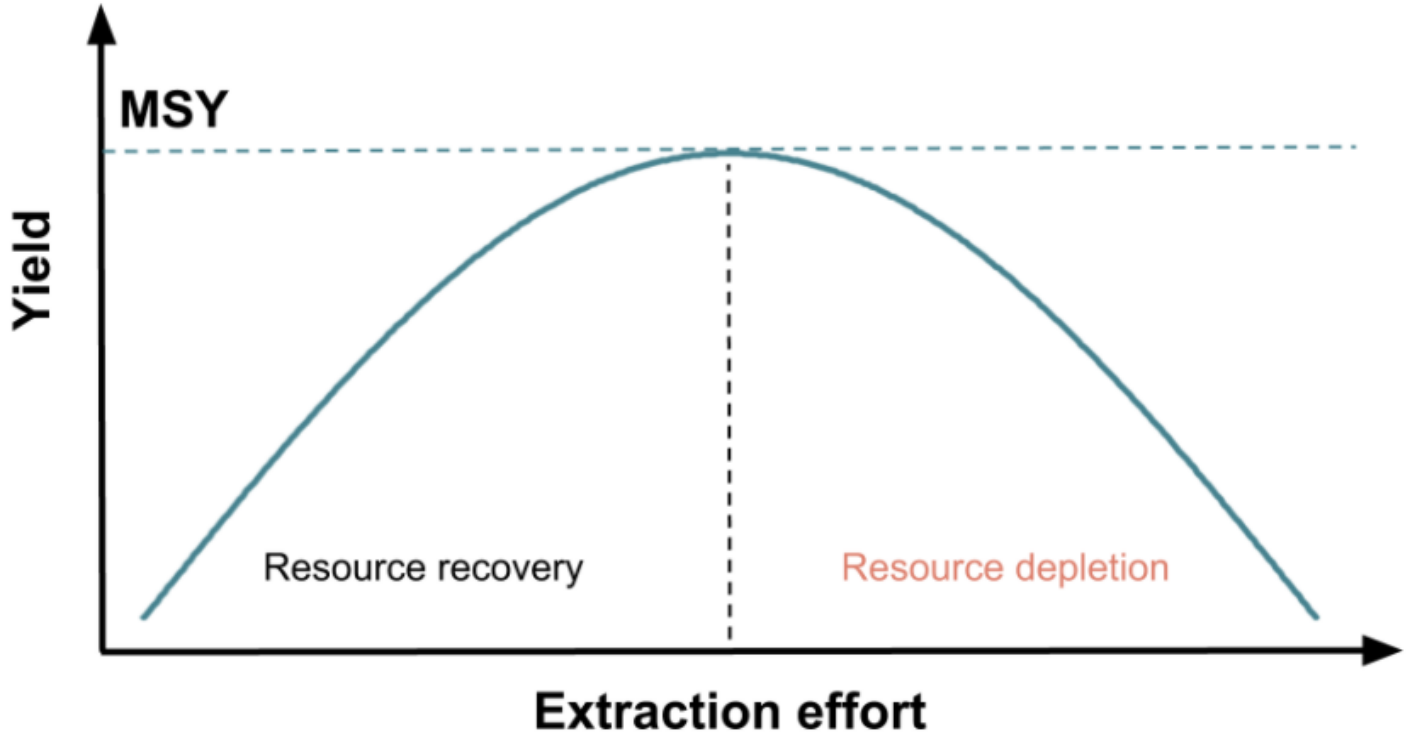
The maximum sustainable yield



The maximum sustainable yield is the largest possible yield of a natural resource that does not impair its ability to recover.

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Economical Dimension

- Economy should not prosper at the expense of the environment or at the expense of socio-cultural aspects
- Economic sustainability is not at all just operating in the economic sphere, but through its environmental, social, and cultural ties.
- Economic development:
  - contributes to fighting poverty
  - ensures the well-being of society
  - is promoted taking in account environmental aspects

Source: https://bsa.edu.lv/en/courses/regional-economy-and-economic-policy/

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Social Dimension

- Social sustainability focuses on such issues as social inequality, like poverty, security, justice and peace.
- We cannot achieve a social sustainability, if we cannot manage our societal norms, practices, and the whole human-made environment to be sustainable. In that case there will be no economic or environmental sustainability.
- Social sustainability entails sustainability in social institutions, such as governance, democracy, policy and politics.

Source: https://www.3blmedia.com/News/Driving-Social-Sustainability-Through-Volunteerism

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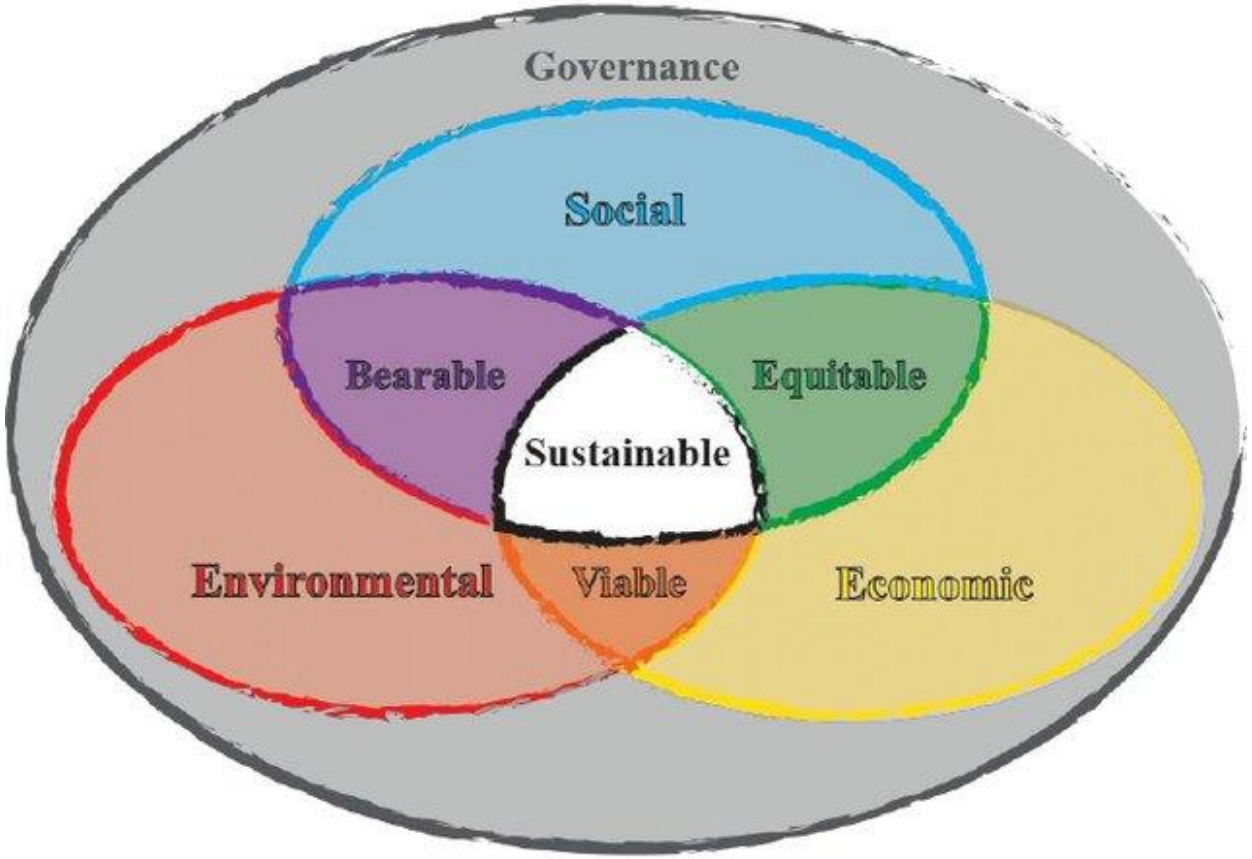
Governance dimension



(Patsa et al., 2015)

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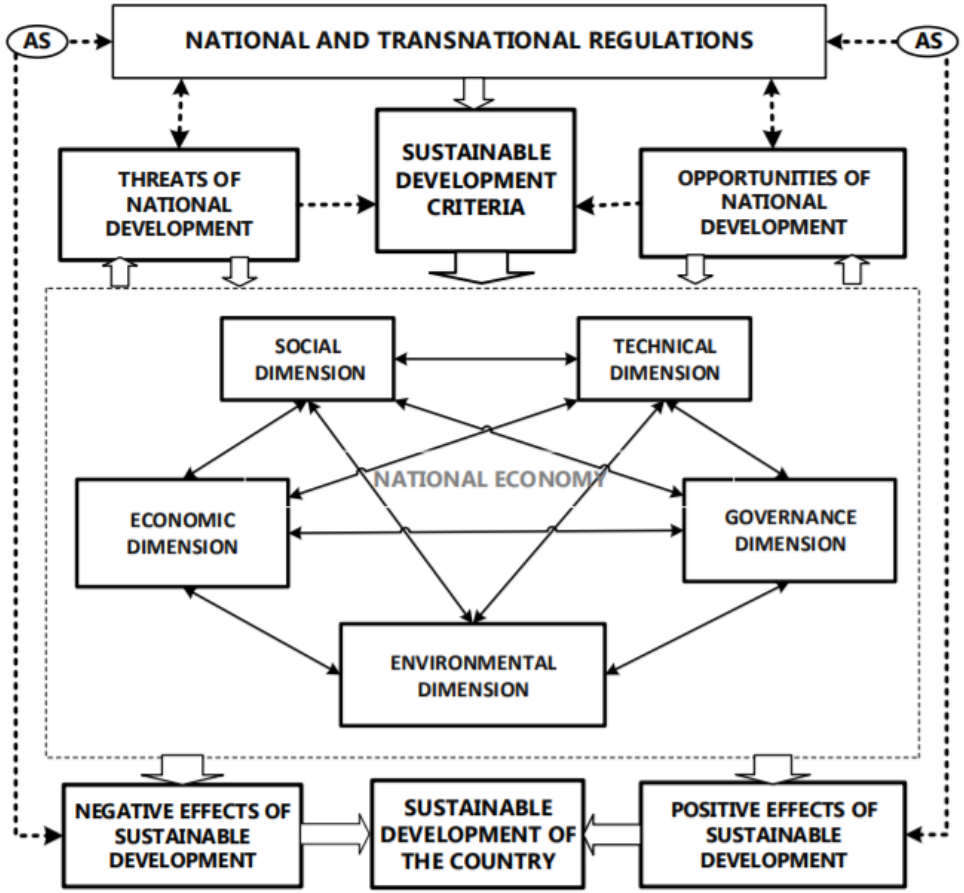
The Model of Sustainable Development System



(Zvirgzdins & Vanags, 2020)

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Regularities of World Bank economist Herman Daly

- **for renewable resources** - soil, water, forests, fish - **the rate of sustainable use should not be higher than the rate of regeneration**. For example, fish can be harvested in a way if they are caught at a rate balanced by reproduction of the rest of the population;
- **for non-renewable resources** - fossil fuels, high-concentration mineral ores, natural groundwater **- the rate of sustainable use should not be higher than the rate at which renewable resources are used to replace non-renewable resources**. For example, oil fields would be used in a balanced way if part of the revenue were systematically invested in solar panels or tree planting, because once the oil runs out, the flow of renewable energy is still possible;
- **the rate of balanced discharge of pollution must not exceed the rate at which the pollution can be recovered, absorbed or rendered harmless to the environment**. For example, wastewater can be discharged in a balanced way into a river or lake only if the injection rate fits to the self-purification capacity of natural ecosystems.

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Global Issues

- Climate Change/Global Warming
- Loss of biodiversity
- Overpopulation
- Ozone depletion
- Resource Insufficiency
- Air, water and soil pollution
- Urbanization
- Land depletion
- Poverty
- Hunger
- Deforestation
- Desertification
- Accumulation of waste
- Social inequality
- Others

Source: https://en.calameo.com/books/0040809936df95133cbe6

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UN Sustainable Development Goals

Source: https://www.un.org/development/desa/en/news/sustainable/sustainable-development-goals.html

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Thank you for attention!