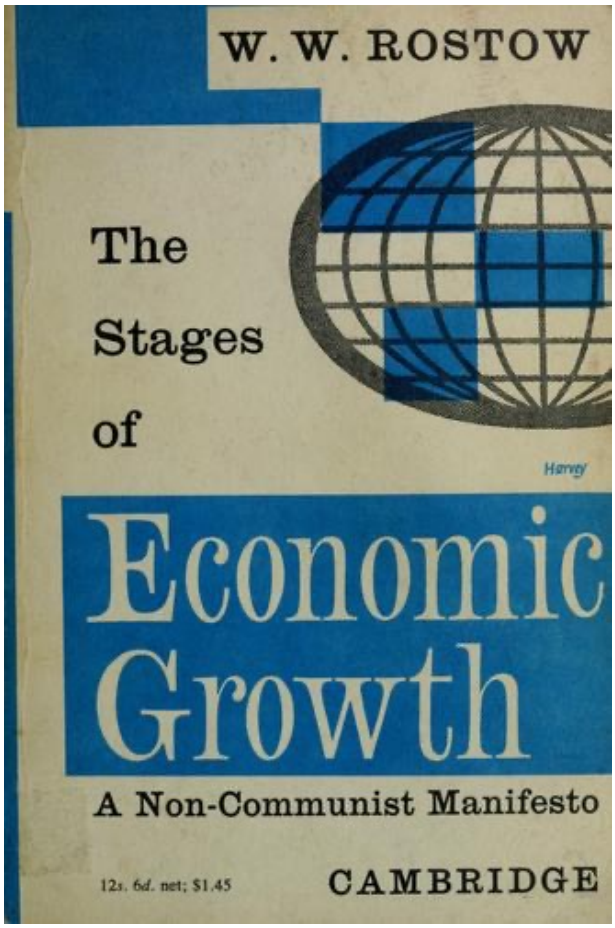
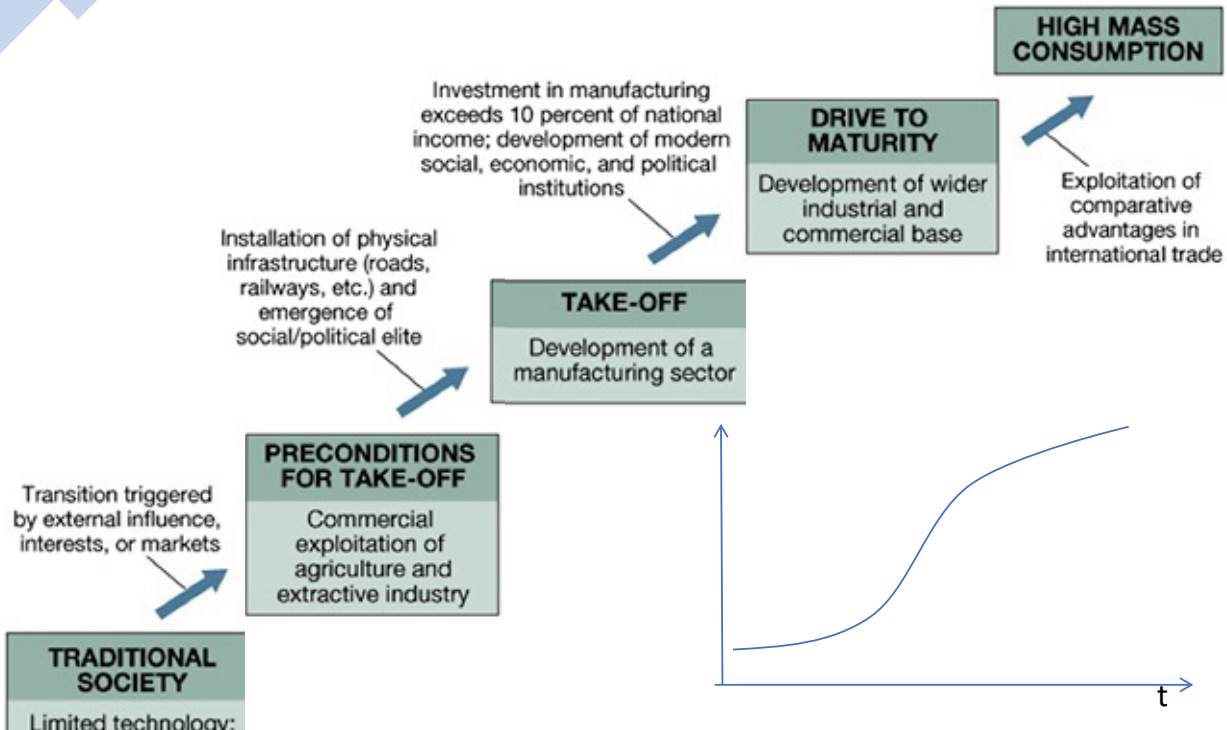




https://www.e-education.psu.edu/geog128/node/719

1960s : Goal of economic development policy → to raise living standards
HOW? providing steadily more goods and services to an expanding population.
The benefits of development will "trickle down" to those who needed them most

Late 1970s Paul Streeten and others: Basic Needs (edu, nutrition, health sanitation, emplyoment) trickle down???
HDI (1990)→ combines life expectancy, adult literacy, and school enrollment ratios with per capita GDP in a weighted average to get an index between 0 and 1

1980s to contrast unbalanced internal and external debts (e.g. Latin America), inefficient bureacreacies
→ liberalization of trade, market-oriented reforms, neoliberism
→ greater inequity
→ higher env damage (Environmental Kuznets Curve)

BUT SEE also ARTICLE BY MENSAH

Modernism, and its more recent manifestation as development, have betrayed progress . . . while a **few** have attained material abundance, resource depletion and environmental degradation now endanger many and threaten the hopes of all to come . . . Modernism betrayed progress by leading us into, preventing us from seeing, and keeping us from addressing interwoven environmental, organizational, and cultural problems (R. NOORGARD 1994)

BUT SEE also ARTICLE BY MENSAH

Sust dev: - Economic, - Social, - Natural

Economic: sustaining welfare via consumption

C= consumption , S= savings, Y= Income

U(C)

C=Y-S

S → to reproduce/maintain means of productions (Capital)

Production function
Y(K, L, N)

N=Nature L=Labour

To which extent can we substitute K and N?

Strong vs weak SUSTAINABILITY

Mainstream: "Hartwick rule":
consumption may remain constant, or increase, with declining non-renewable resources provided that the rents from these resources are reinvested in reproducible capital.

Herman Daly:
keep constant stock of natural capital (SEE Daly's Chapter)
HOW?
For renewables resources: to limit resource consumption to sustainable yield levels; i.e.:

To be harvested no faster than they can be regenerated
while waste must be emitted no faster than they can be assimilated

For nonrenewables: to re-invest the proceeds from non-renewable resource exploitation into investment in renewable natural capital.

Daly's view "man-made and natural capital are fundamentally complements and only marginally substitutes.

Natural capital has a special and unique importance. To remain productive and resilient to support human life.

Safe minimum?
backup

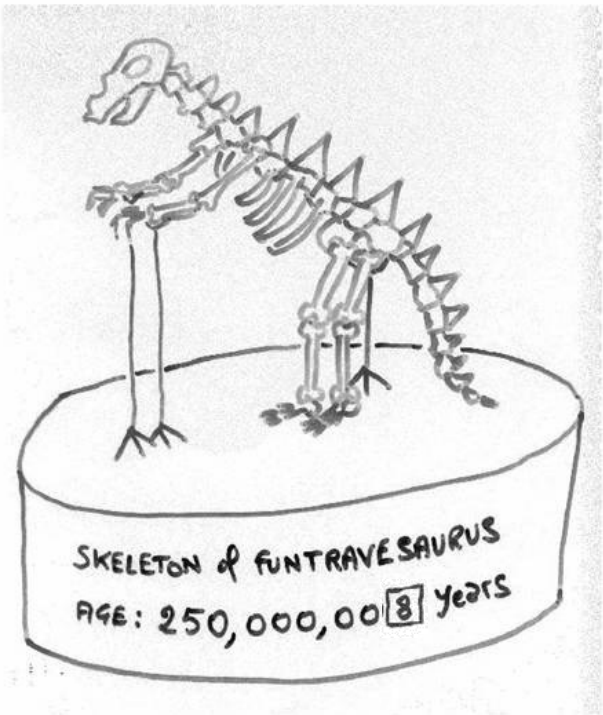
TEMPORAL SCALES?

WHY NATURAL "CAPITAL"?

And what about HUMAN LIFE SUPPORT ?

And what about INTRINSIC value?

Fig. 3.2 The "true" age of the dinosaur



Funtowicz, S. and J. Ravetz (1990). *Uncertainty and Quality in Science for Policy*. Kluwer Academic Publishers.

Weak sustainability in practice

Keep constant the SUM of the capitals, N + K

$$\frac{\Delta K}{\Delta t} + \frac{\Delta N}{\Delta t} = 0$$

US, J, D high investments → sustainable ?

The true age of dinosaur and the “weak sustainability ” indicator!!!

Side effects of economic growth:

growth in GDP has begun to push up

- environmental and
- social costs

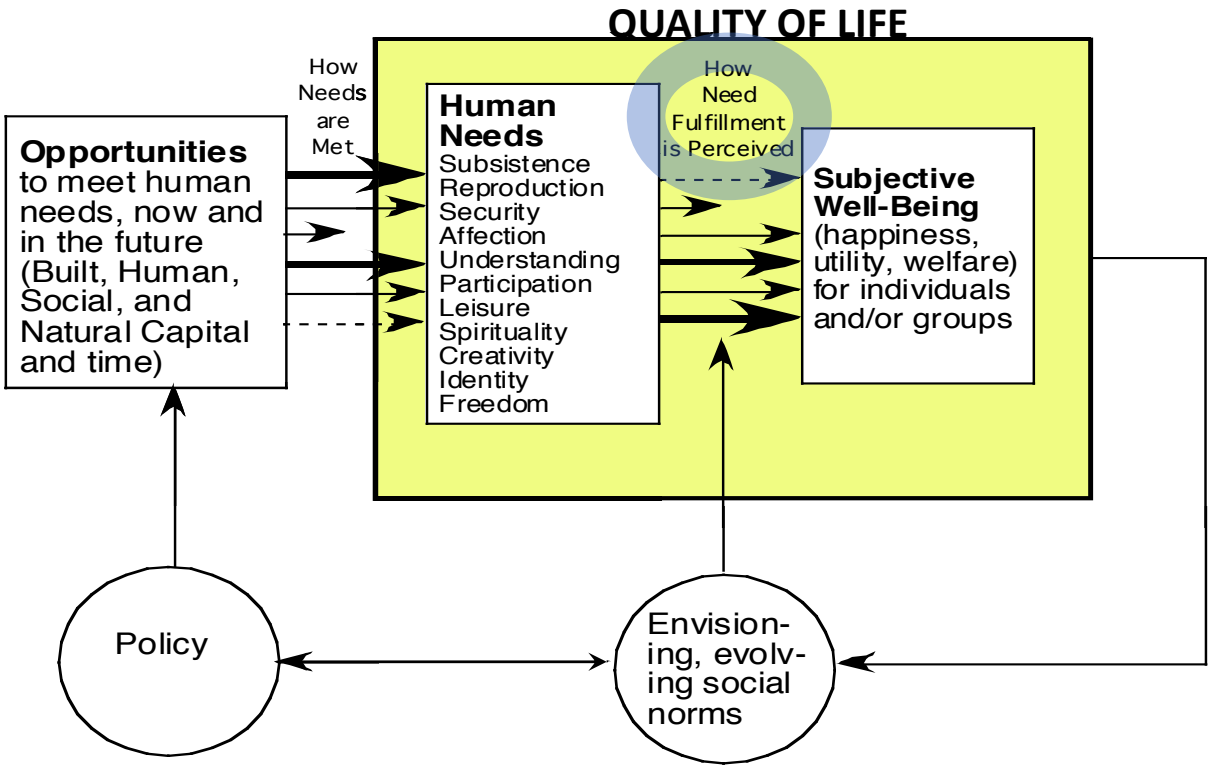
faster than it increases production benefits.

UNECONOMIC growth ?

(defensive expenses?)

Human needs

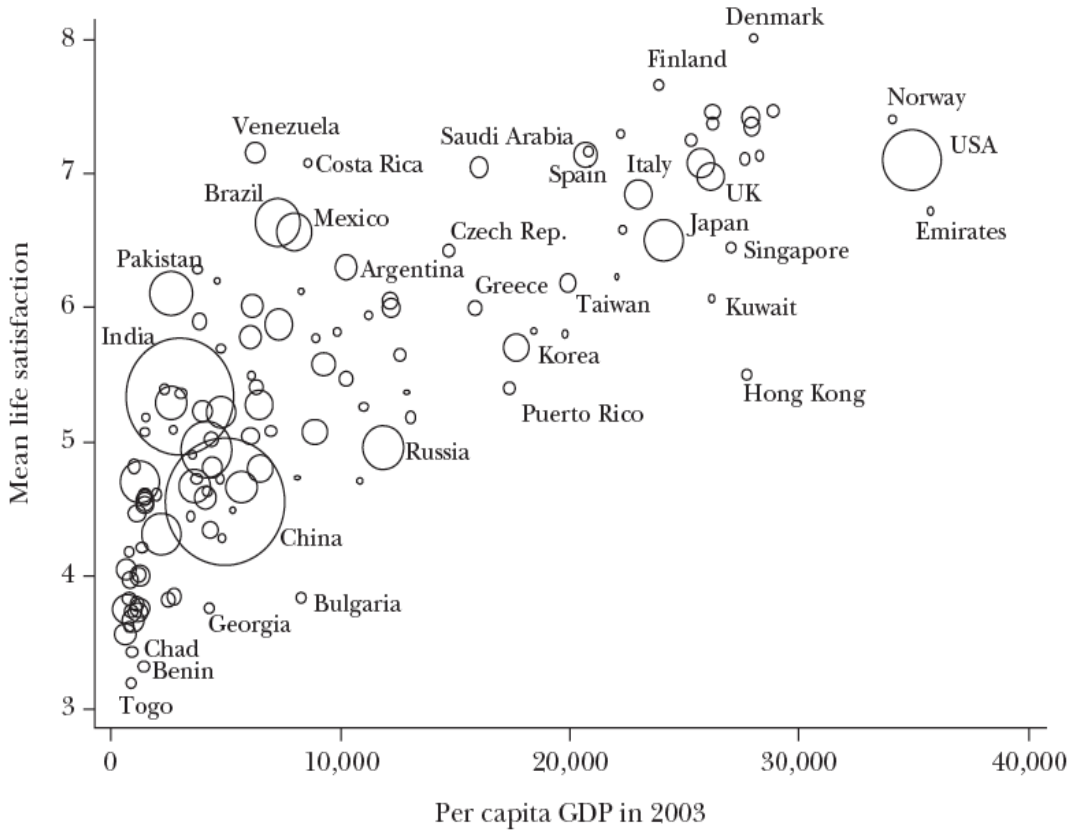
LINK



From: Costanza, R. B. Fisher, S. Ali, C. Beer, L. Bond, R. Boumans, N. L. Danigelis, J. Dickinson, C. Elliott, J. Farley, D. E. Gayer, L. MacDonald Glenn, T. Hudspeth, D. Mahoney, L. McCahill, B. McIntosh, B. Reed, S. A. T. Rizvi, D. M. Rizzo, T. Simpatico, and R. Snapp. 2007. Quality of Life: An Approach Integrating Opportunities, Human Needs, and Subjective Well-Being. *Ecological Economics* 61: 267-276

Life Satisfaction and Per Capita GDP around the World

Source: Deaton, 2008.



PERCEPTIONs

Norton, M. I., & Ariely, D. (2011). Building a better America—One wealth quintile at a time. *Perspectives on psychological science*, *6*(1), 9-12.

https://journals.sagepub.com/doi/pdf/10.1177/1745691610393524

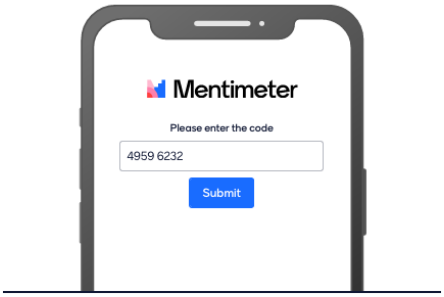
Kiatpongsan, S., & Norton, M. I. (2014). How much (more) should CEOs make? A universal desire for more equal pay. *Perspectives on Psychological Science*, *9*(6), 587-593.

http://pps.sagepub.com/content/9/6/587

CEO-to-unskilled_worker average pay-ratio

Go to

www.menti.com



Enter the code

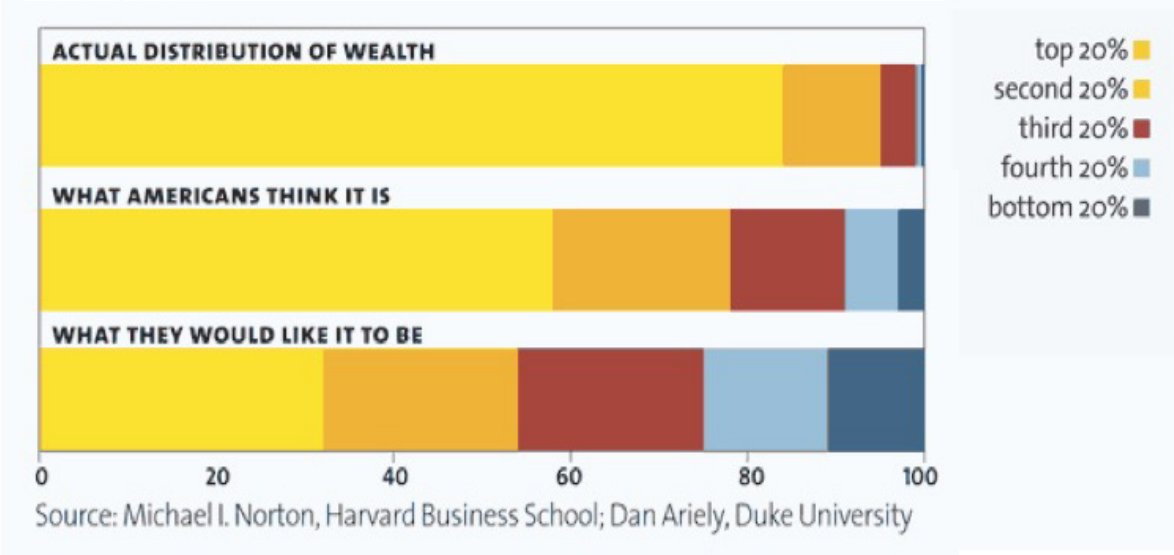
4959 6232

Or use QR code

PERCEPTIONS

OUT OF BALANCE

A Harvard business prof and a behavioral economist recently asked more than 5,000 Americans how they thought wealth is distributed in the United States. Most thought that it's more balanced than it actually is. Asked to choose their ideal distribution of wealth, 92% picked one that was even more equitable.



Norton and Sorapo (2014)
asked about 55,000 people from 40 countries to estimate
how much do **corporate CEOs** and **unskilled workers** earn?
how much CEOs and workers *should* earn.
The median American:
CEO-to-worker pay-ratio was 30-to-1,
and that ideally, it'd be 7-to-1.
The reality? 354-to-1.
Fifty years ago, it was 20-to-1

Again, the patterns were the same for all subgroups, regardless of age, education, political affiliation, or opinion on inequality and pay.
"In sum respondents underestimate actual pay gaps, and their ideal pay gaps are even further from reality than those underestimates."

Economic Inequality: It's Far Worse Than You Think
The great divide between our beliefs, our ideals, and reality
•By Nicholas Fitz on March 31, 2015 Scientific American

How Much (More) Should CEOs Make? A Universal Desire for More Equal Pay

Environment → ECOLOGICAL perspective

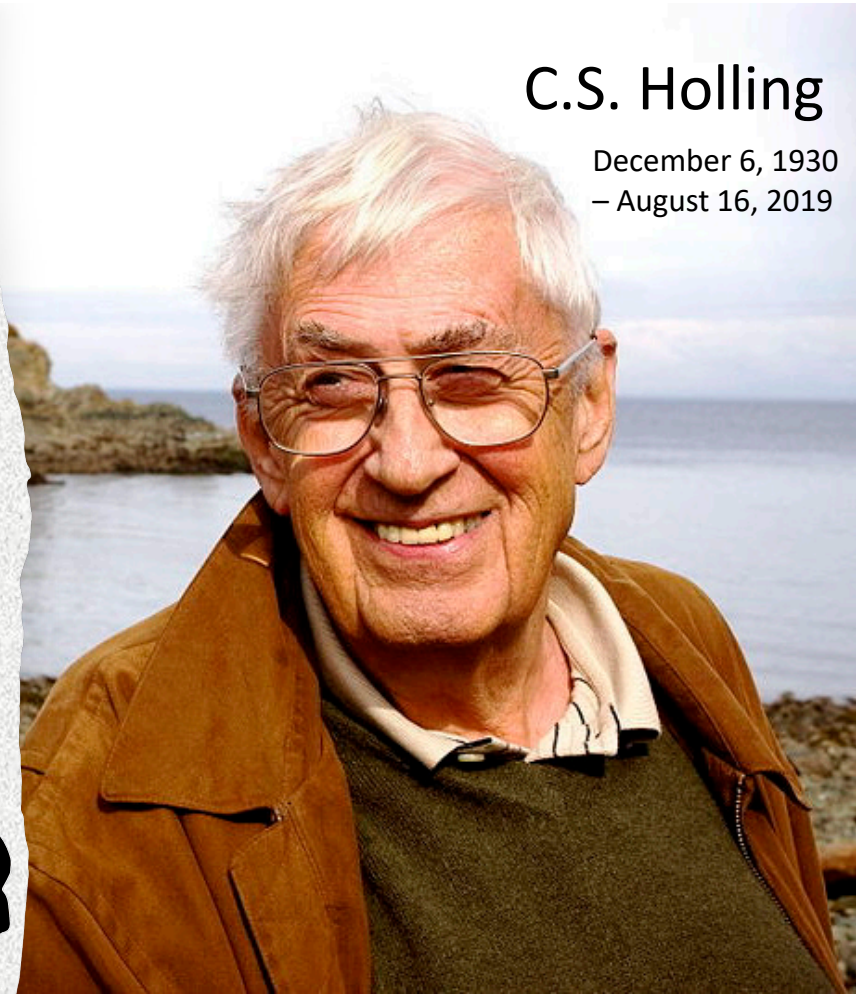
Maintenance of ecosystem resilience!

Fundamental axioms of ecological and evolutionary biology

1) organisms are exuberantly over-productive

2) **limits** set by time, space, and energy are inevitably encountered.

3) Evolution → **variability** → resilience



C.S. Holling

December 6, 1930 – August 16, 2019

Annual Review of Ecology and Systematics
Vol. 4:1-23 (Volume publication date November 1973)
https://doi.org/10.1146/annurev.es.04.110173.000245

RESILIENCE AND STABILITY OF ECOLOGICAL SYSTEMS

❖ 4050

C. S. Holling
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INTRODUCTION

Individuals die, populations disappear, and species become extinct. That is one view of the world. But another view of the world concentrates not so much on presence or absence as upon the numbers of organisms and the degree of constancy of their numbers. These are two very different ways of viewing the behavior of systems and the usefulness of the view depends very much on the properties of the system

RESILIENCE

response to shocks: basin of attraction of a given configuration

system's ability to absorb disturbance
while maintaining
the same basic structure and function

Ecological resilience is the magnitude of disturbance

that can be absorbed (*adaptive capacity*)

before the system passes a *threshold,*

which leads to a substantial **reorganization** of

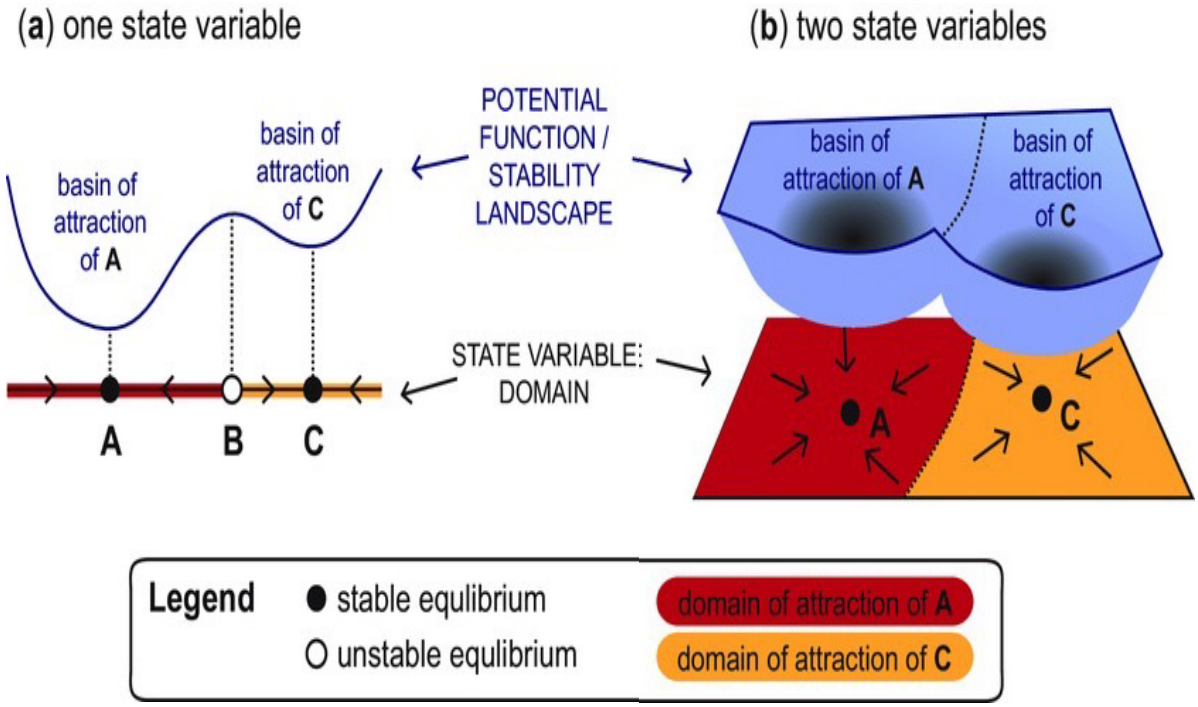
its structure and functions and stabilization **in an**

alternative regime

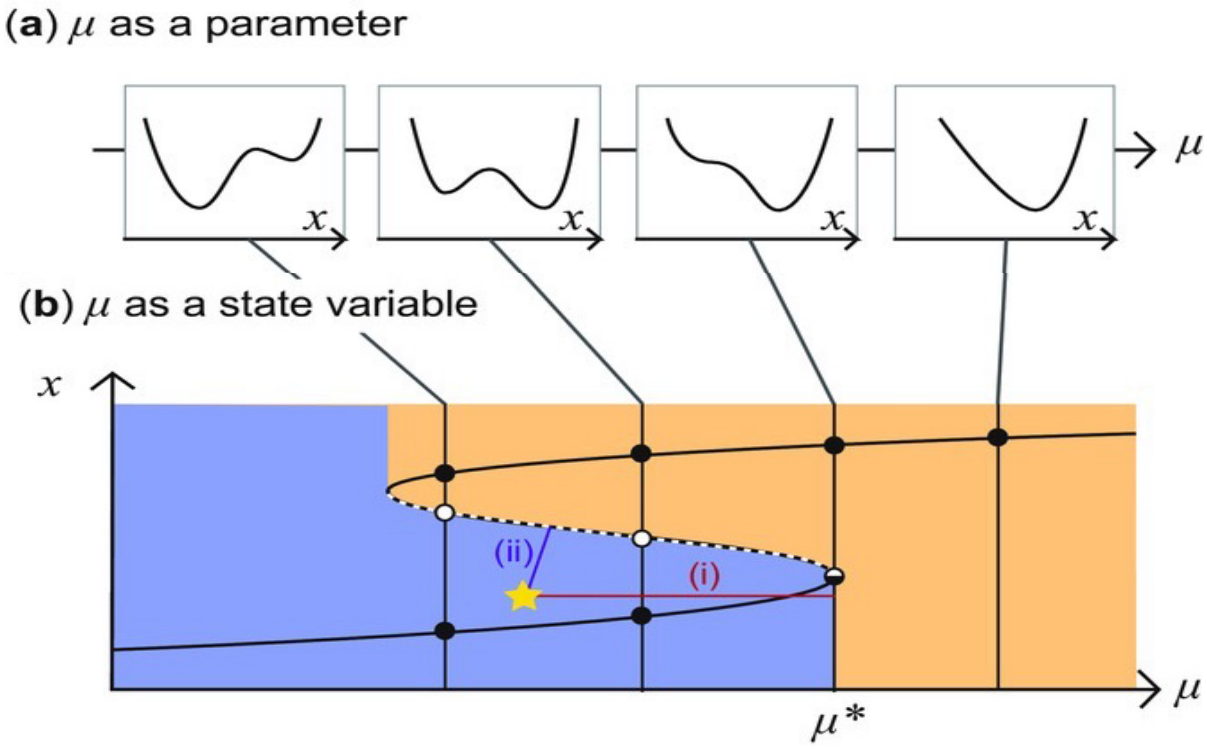
A MATHEMATICAL REVIEW OF RESILIENCE IN ECOLOGY

Natural Resource Modeling, Volume: 29, Issue: 3, Pages: 339-352, First published: 05 July 2016, DOI: (10.1111/nrm.12097)

https://onlinelibrary.wiley.com/doi/10.1111/nrm.12097



CHANGES IN THE LANDSCAPES (in parameters)



TWO contrasting aspects of stability:

maintaining ***efficiency*** of function (engineering resilience)

→ **resistance to disturbance and speed of return** to the equilibrium

are used to measure the property

maintaining ***existence*** of function (ecological resilience)

→ **the magnitude of disturbance that can be absorbed** before the system changes its structure by changing the variables and processes that control behavior

https://www.nap.edu/read/4919/chapter/4

Holling, C. S. (1996). Engineering resilience versus ecological resilience. *Engineering within ecological constraints*, *31*(1996), 32.

https://www.youtube.com/watch?v=tXLMeL5nVQk&t=117s

"The key to resilience is the existence of a **wide variety of species**,
interacting with each other and providing
a reservoir of genetic forms
which provide the potential to adapt to changing conditions"

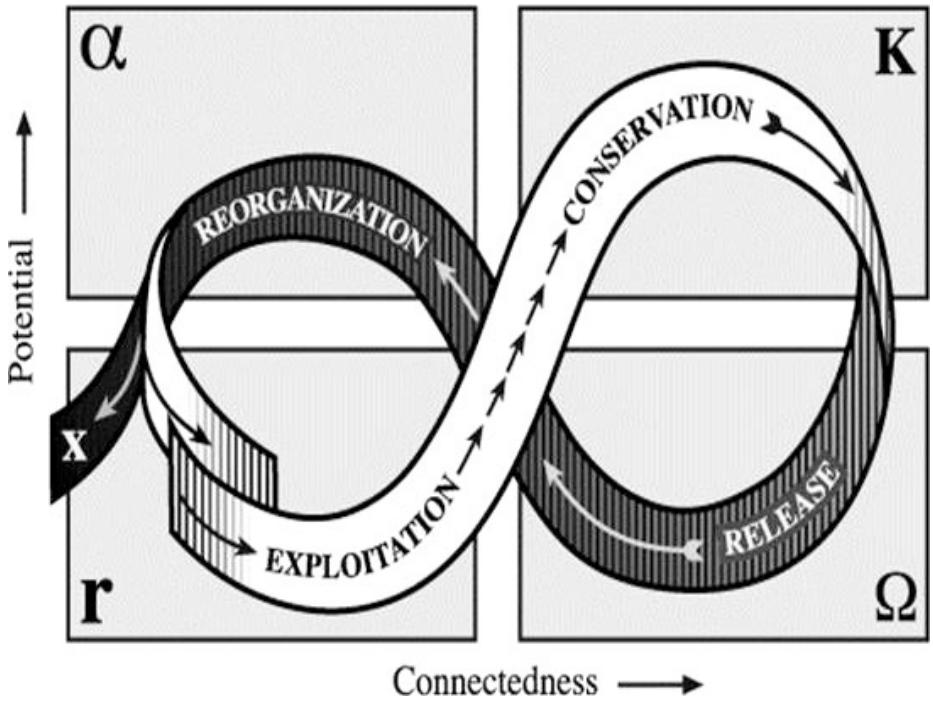
NOT «to maximize **constancy** or productivity of yield,
but …
designing interrelations between people and resources
that are sustainable in the face
of surprises and the unexpected.
If there is such a thing as sustainable development, then that is it.»

That surely is at the heart of sustainable development
—the release of human opportunity.
It requires flexible, diverse, and redundant regulation,
early signals of error built into incentives for corrective action,
and continuous experimental probing of the changes in the external world.

Holling: Engineering Resilience versus Ecological Resilience

Importance of cycles

«birth, growth and maturation, death and renewal»



https://www.resalliance.org/adaptive-cycle

Phase	Description	Potential for change	Connectedness	Resilience
α (reorganization)	- System widely open to reorganization - Experimentation and initial establishment of actors, organizations and institutions, strongly subjected to evolutionary forces (i.e., competition, failure, survival) - Loss of resources (e.g., energy, information) is minimized, so that they become available in r phase (legacies) - Great uncertainty about options for the future and chance for unexpected forms of renewal	Relatively high for future development..	Low. Internal regulation and control over external variability is weak.	High. Wide stability region and weak regulation around equilibria.
r (exploitation and rapid growth)	- Innovators perceive unlimited opportunity - Bases for entrepreneurial and market competition are settled - External variability remains, favorable to entities more adapted to it (r-strategists) - Incremental exploitation of available resources and growth - Actors develop capacity for controlling external variability, hence reinforcing their own expansion - Future starts to be more predictable	Declines as resources start and continue to be exploited.	Still low, but starts to increase, along with stability.	Remains high due to the adaptation to high variability.

https://www.ecologyandsociety.org/vol17/iss1/art26/table2.html

Phase	Description	Potential for change	Connectedness	Resilience
K (consolidation and conservation)	- Growth rate slows down - Reduced opportunity and difficulties for new entrants - The future seems ever more certain and determined - Competitive edge shifts to those that control variability (K-strategists) - Increasing returns from efficiency (e.g., minimizing costs, streamlining operations) - Organizations become bureaucratized, rigid and internally focused (i.e., blind to external changes)	Becomes high again in terms of stored capital	Increases as system becomes highly stable and over-connected in structural and organizational terms, hence more rigid (less flexible).	Rapidly declines, i.e., vulnerability to external disturbance starts to increase.
Ω (release)	- Extreme structural rigidity that may trigger sudden change, collapse and a "creative destruction" phase (Schumpeter 1950) - Chaotic behavior, uncertainty rules govern - All of these create the source for reorganization and the systems begin to acquire a new identity	Suddenly declines as previously accumulated resources are abruptly released and exhausted.	High, but connections and regulatory controls are suddenly broken.	Low, but rapidly increases as the system moves towards the next α phase of reorganization.

"**sustainability** is the capacity to create, test, and maintain **adaptive capability**",
while "**development** is the process of creating, testing, and maintaining **opportunity**".

Holling, C.S. Understanding the complexity of economic, ecological, and social systems. Ecosystems **2001**, 4, 390–405.

Sust.Dev. SUMMARY

- The original idea of development was based on a straight-line progression from traditional to modern mass-consumption society. Within this framework, a tension developed between the promotion of economic growth and the equitable provision of basic needs.
  Development as it has proceeded over the last half-century has remained **inequitable**, and has had **growing negative environmental impacts**.

- Sustainable development → must remedy social inequities and environmental damage, while maintaining a sound economic base.

- The conservation of natural capital is essential for sustainable economic production and intergenerational equity.
  Market mechanisms do not operate effectively to conserve natural capital, but tend to deplete and degrade it.

- From an ecological perspective, both population and total resource **demand** must be limited in scale,
  and the **integrity** of ecosystems and diversity of species must be maintained.

- Social equity, the fulfilment of basic health and educational needs, and **participatory democracy** are crucial elements of development, and are interrelated with environmental sustainability.

Harris, 2000