

Conceptual and practical barriers to integrating concerns with human health and nature

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Integrating Public and Ecosystem Health Systems to Foster Resilience:
Identifying Research to Bridge the Knowledge-To-Action Gap

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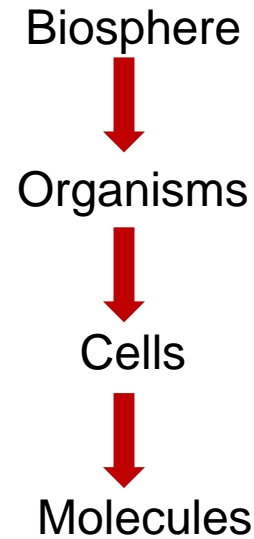
Conceptual barrier

Reductionism:

Complex phenomenon are best understood by breaking them down into simpler isolated parts and analyzing those parts.

Problem: Reductionism is **not** fit for purpose for integrating concerns of nature and humans.

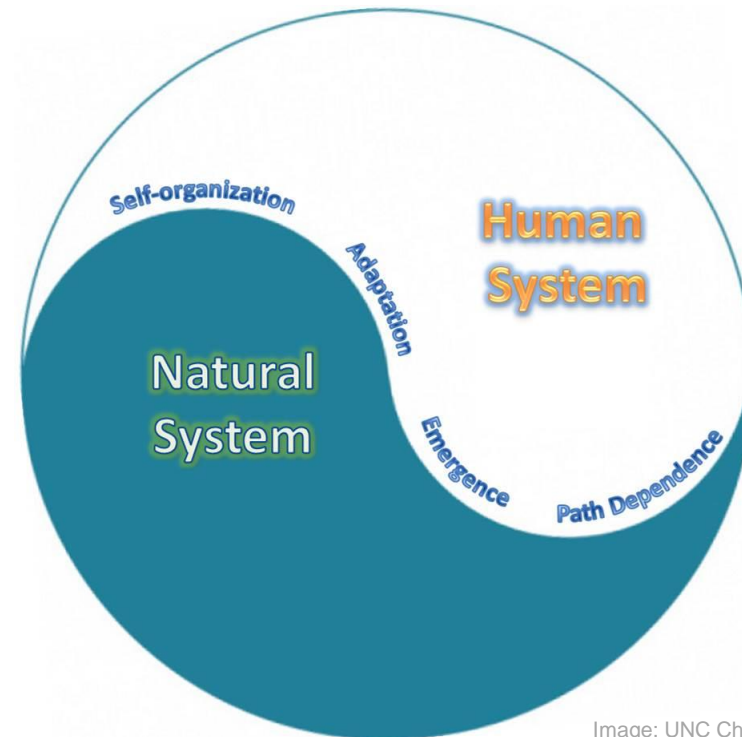
- The wrong tool
- The wrong frame of mind

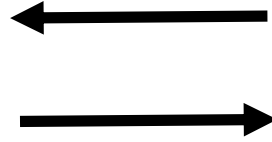


The reductionist scientific program has been wildly successful.

This framing, often unconscious affects how:

- Problems are framed
- Projects are funded
- Life scientists are promoted





- Primary foods are fruits and nectar
- Often fly >10 km from their roost seeking food
- They disperse seeds and pollen over long distance → key species for regenerating cleared tropical forests

Pteropus medius

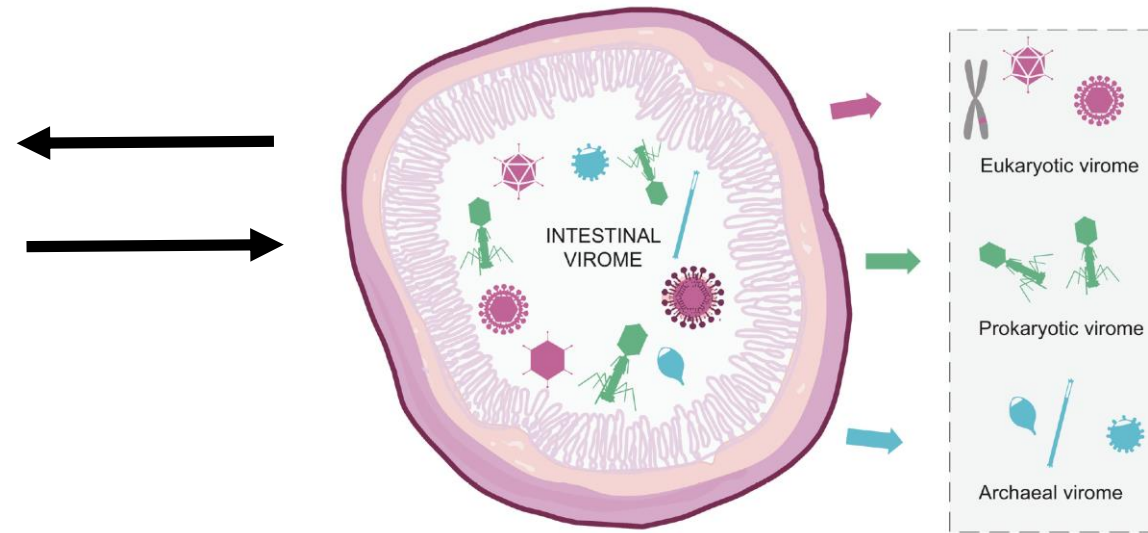
Old world fruit bats (flying foxes)



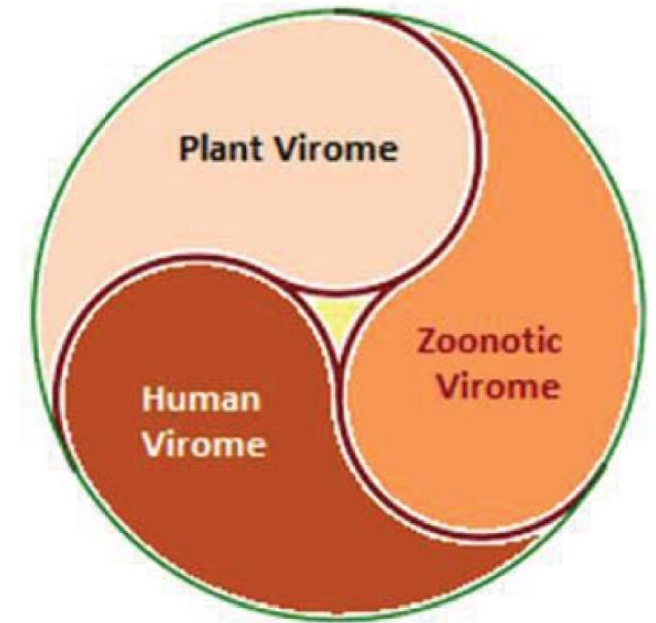
Photo: Fernando Garcia

Pteropus medius

- Social
- They have a microbiome and virome with trillions of organisms that have co-evolved a complex interacting ecology
- One of these commensal viruses is Nipah virus
 - Causes no illness in the bats
 - Enters the bats epithelial cells through the ephrin B2 receptor



Karlsson O, *PLOS One*, 2016



Nikhra V, *Ann Biomed Sci Engineering*, 2020

When *homo sapiens* are infected with Nipah virus



- 75% die
- Some people with Nipah infection pass it on to other people
- Transmission is not very efficient
 - Local high mortality outbreaks
 - But tend to end on their own
- Each human infection provides an environment that selects for improved transmission

one competency away from a global pandemic



Global air routes

Pteropus medias in Bangladesh

	2004	2006	2007
Bats Tested	92	81	218
Nipah IgG+	48	15	107
% positive	52%	19%	49%



How does Nipah virus transmit from wildlife to humans in Bangladesh?

Epidemiological studies identified association with human Nipah infection and drinking fresh date palm sap

Through anthropological investigations we learned:

- Late November through March
 - Sap harvesters cut a tap into the tree
 - In the evening place a clay pot under the tap
 - Remove pot in the morning
 - Most sap is made into molasses
 - Some sold fresh early in the morning
 - A local delicacy
- Some villagers reported bats visited these trees at night



Raw date palm sap —————> Nipah Infection



Evidence:

- Bats shed Nipah virus in urine and saliva
- Bats contaminate sap
- Virus survives in sap
- Animals that drink sap become infected
- Spillovers only identified during date palm sap harvesting season
- People with Nipah were more likely to drink raw date palm sap

Bat to human transmission

Bamboo nets

- Obstructs
 - access to jar
 - shaved part of the tree
- Variation on traditional fishing nets
- Rarely used



Photo: Nazmun Nahar

Effectiveness Trial

Would the skirts keep the bats out of the sap?

- Selected 120 date palm sap producing trees in a village
- Randomly assigned four types of skirts
- 60 trees enrolled as controls
- The controls were matched on
 - height
 - shaving pattern



Photo: Nazmun Nahar



Jute



Doincha



Bamboo



Polyethylene

Bat visits

	Control	Bamboo	Dhoincha	Jute	Poly ethylene
Bat visits on and around tree	4630	176	45	125	112
Number contacting date palm sap	3556	0	0	11	0

Khan SU, *PLoS One*, 2012 7(8):e42689

A subsequent trial demonstrated that with encouragement date palm sap collectors would use the skirts, and people purchased skirt protected sap.

Nahar N. *Ecohealth*. 2017

Pteropus bats, Nipah virus, & humans

Partial success in balancing nature & human health

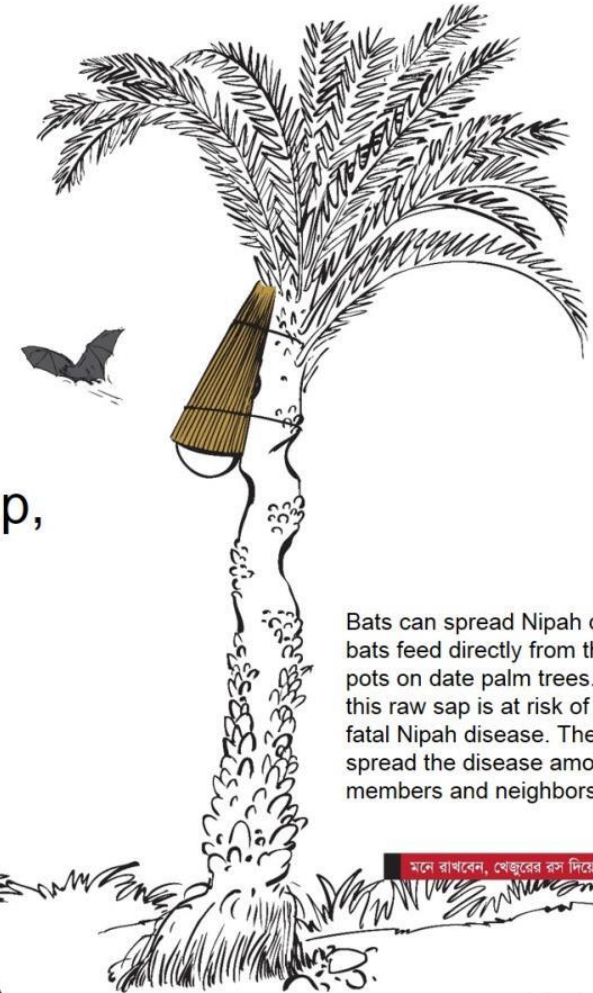
Scientific success

- Figuring out the pathway
- Skirts protected humans
- Bat roosts could still thrive

Knowledge to action incomplete

- Some sap collectors have taken up the practice – cleaner, safer sap
- Ministry of Health has chosen not to encourage the skirts

To protect from Nipah
avoid drinking raw date palm sap,
if you do drink only
bana-protected sap



Bats can spread Nipah disease. At night bats feed directly from the sap collection pots on date palm trees. Anyone drinking this raw sap is at risk of contracting the fatal Nipah disease. They may also spread the disease among their family members and neighbors

মনে রাখবেন, খেজুরের রস দিয়ে তৈরি শুড় খাওয়া নিরাপদ

Practical Barrier: Our economic system pays people to destroy nature

Between 2000 and 2012, an average net loss of 125,000 of square kilometers of forest lost per a year – the equivalent of 48 football fields every minute.

([Hansen M, Science, 2013](#))



Most people understand that clearcutting forests, strip mining coal and spewing pollution undermines the future of the environment and human wellbeing, **but people still do it.**

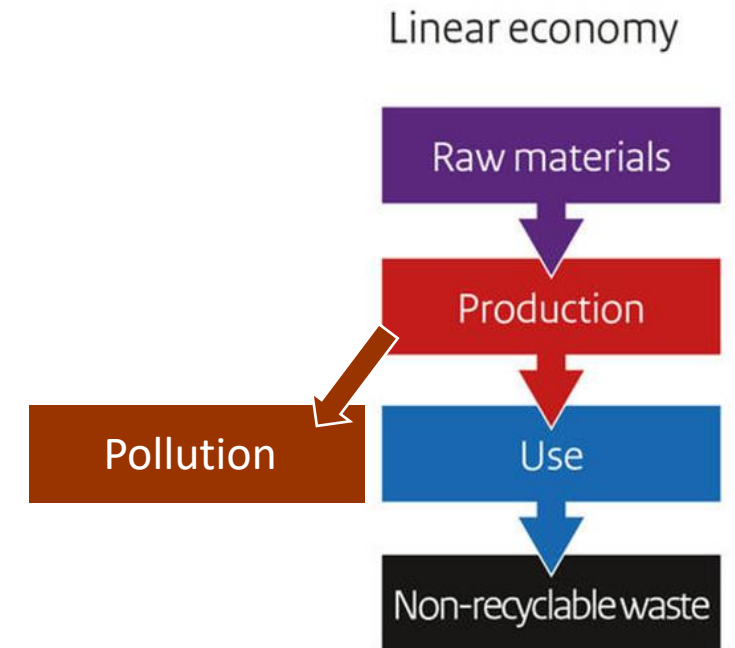
We are stuck in a model of an extractive polluting linear economy that ignores harms (externalities) to

- Nature
- Human health

In the research community we need to

- Consider incentives that drive the system
- Invest in social sciences

“When people will come to know that I use bamboo skirt, they will be more interested to buy molasses which I make.”



A way forward

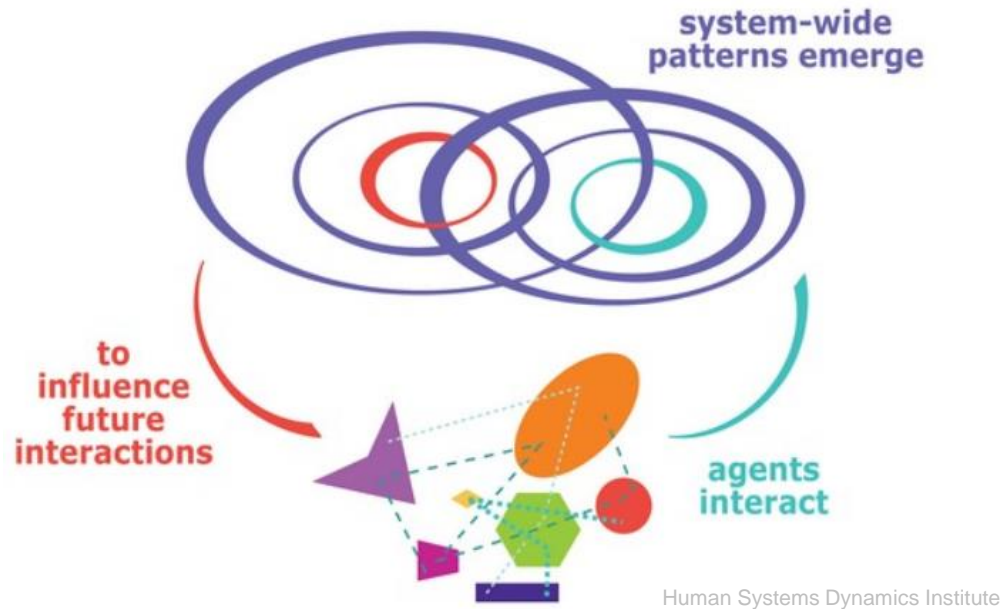
- Step 1: A deeper appreciation that the health of human communities depends on a healthy biosphere.
- Climate change is a huge problem, but it is not our only major environmental problem
 - land use
 - biodiversity loss
 - nitrogen / phosphorus flows
 - Ocean acidification
 - pollution



Tiroir A. Films

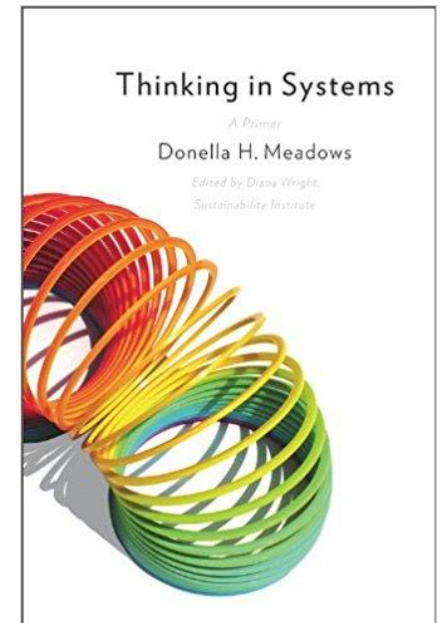
Step 2: Embrace systems thinking

Ecosystem and human community health are products of the interaction of complex adaptive systems



Consider the multi-level complex interactions of

- Biochemistry
- Microbiology
- Human Health
- Ecology
- Earth systems
- Economy
- Politics



Step 3: Encourage long term considerations.

Vincent Callebaut

- Intertemporal choice
 - Decisions with consequences that play out over time
 - Should I go for a run, or relax with a glass of wine at the end of a busy day?
- Difficult for individuals
harder still for society
- Yet, this is a cornerstone to achieving a healthy future
- Envisioning a thriving future encourages making sacrifices today

Zhang S. *British J Psychology*. 2018.

