



**ANIL AGARWAL**  
**DIALOGUE 2026**



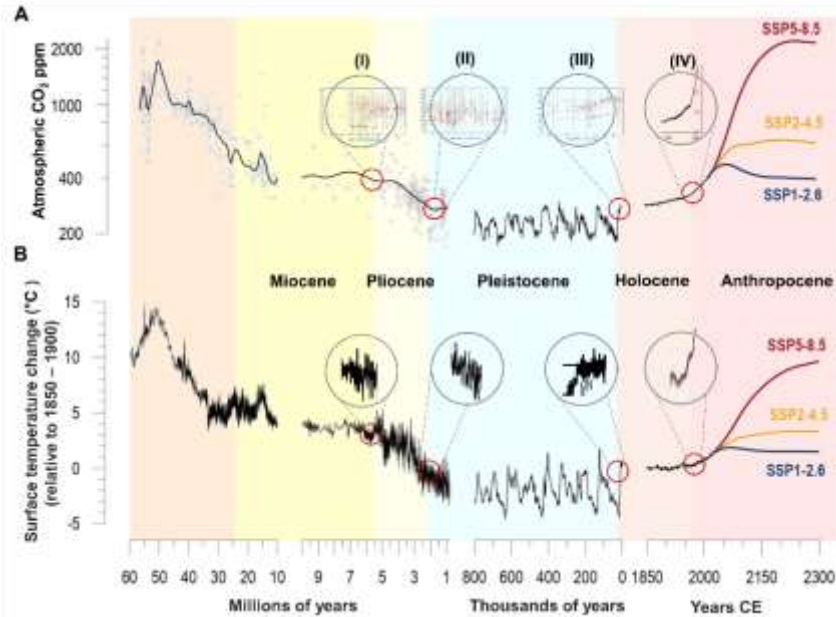
# Biological invasions in India

**Ninad Avinash Mungi**  
Assistant Professor



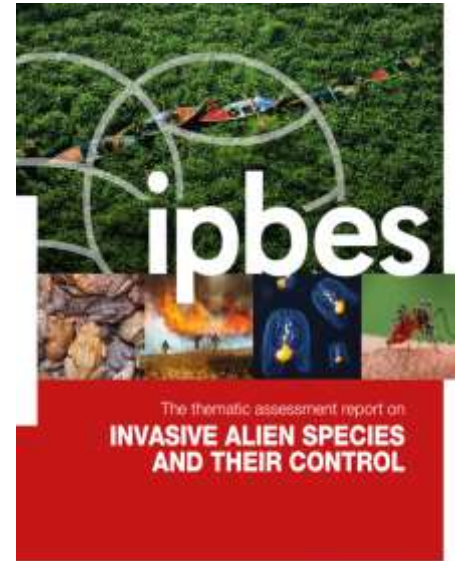
**ECONOVO**  
CENTER FOR ECOLOGICAL DYNAMICS  
IN A NOVEL BIOSPHERE

## Aspects of global changes



### Climatic changes

Svenning, Mungi, et al. (2024, *One Earth*)



### Biological invasions

IPBES (2023)

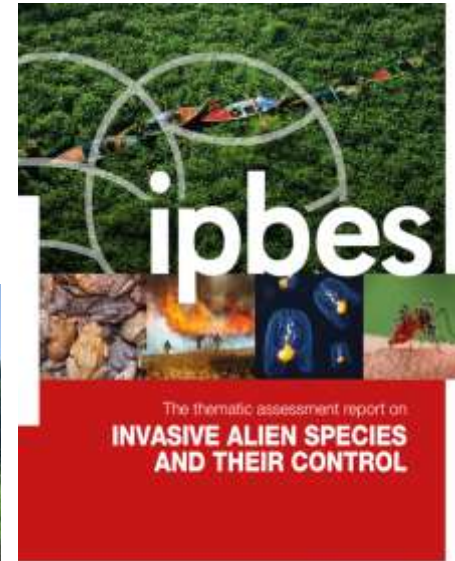
Species introduced via people to **areas beyond their ecological range**, where they exert **negative impacts on local** biodiversity or society are called invasive species



*Prosopis juliflora*

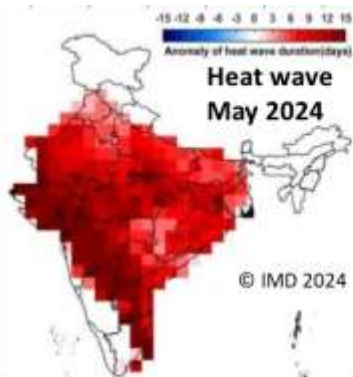


*Mikania micrantha*

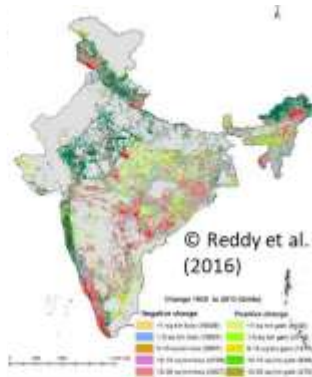


**Biological invasions**

IPBES (2023)



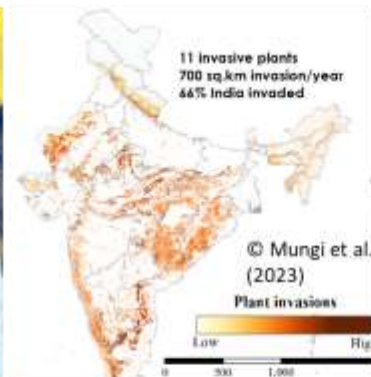
**Climate change**



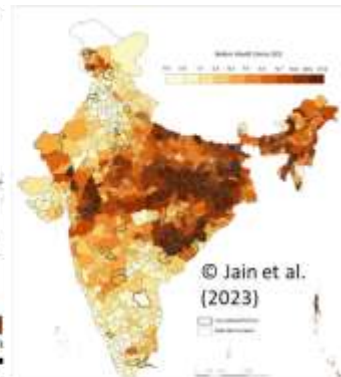
**Tree change**



**Faunal change**



**Plant invasions**



**Poverty inequity**



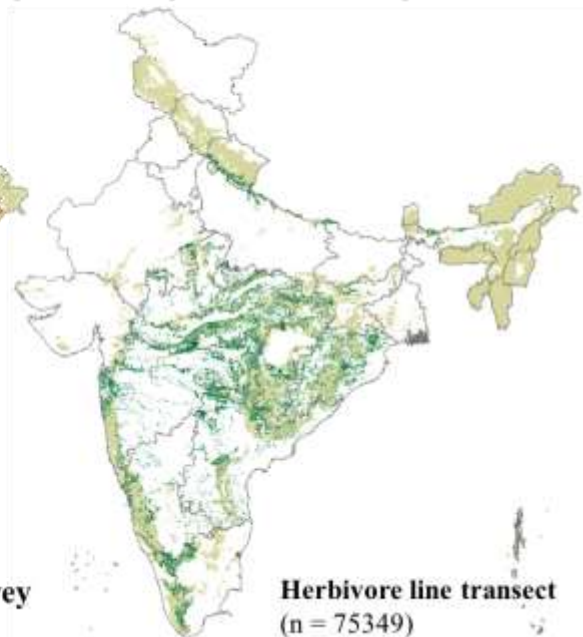
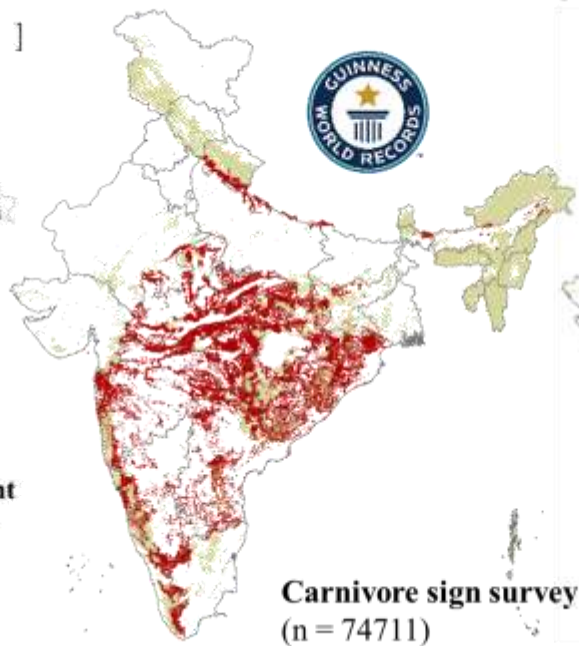
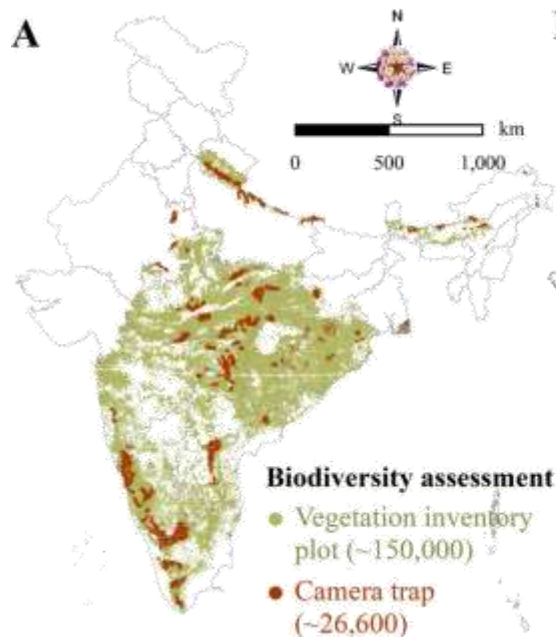


1. What is the **scale** of plant invasions in India?
2. What **drives** invasive plants dominance?
3. What are the **risks** associated with invasive plants?
4. How to navigate invasive species **management**?



## Large-scale long-term monitoring (2006-2022)

A





In the name  
of the tiger

ANALYSIS / FOREST



## SILENT INVADERS

The 11 high-concern invasive species have already attacked 66 per cent of India's natural systems. They are most prolific in fragmented and deciduous ecosystems and are least prevalent in areas with extreme climate and less anthropic pressure.

Invasive hotspot  
 % share of natural areas invaded

**NILGIRI BIOSPHERE RESERVE** is one of the largest **INVASION HOTSPOTS** for trees, predominantly invaded by **LANTANA CAMARA**, **MIMOSA DIPLOTRICHA** and **CHROMOLAENA ODOBATA**.

**SOUTHERN EASTERN BIHAR** among the **MOST DESERTY INVADIED LANDSCAPES**, predominantly by **Prosopis juliflora** and **Lantana camara**.

**LEAST SUITABLE NATIVE SYSTEMS** for invaders were distributed in extreme climatic condition like the **DESERT SAVANNAS** IN WESTERN INDIA, **EVERGREEN RAINFOREST** OF THE **NORTHEASTERN INDIA** and **WESTERN SHALE**, along with **LEAST HUMAN-MODIFIED AREAS** in Central India.



Source: Chaudhary, et al. (2022) *Journal of Applied Ecology*, 9(1): 1-10. doi:10.1002/jae.1002

**ANKANIA MICRANTHA** (*altissima*)  
 One of the most invaded plant in the Pacific and Asian countries, it was introduced in India around World War-II.



**MIMOSA DIPLOTRICHA** (*plant sensitive plant*)  
 Native to Central and South America, it can form dense thickets quickly.



**XANTHIUM STRUMARIUM** (*tanaman doodlebug*)  
 Native of North America and Argentina, the plant is drought-resistant.



**HECOSPHERUM SUAVEOLENS** (*agruif*)  
 A herbaceous plant native to the South America and West Indies, its introduction into India is unknown.



**CHROMOLAENA ODOBATA** (*stam weed*)  
 Belonging to the sunflower family, this South American shrub was introduced in India in the 17th C.



**LANTANA CAMARA** (*lantana*)  
 Native of South America, it was introduced in India as a decorative shrub in 1809.



**SENNA TORA** (*sishe sirni*)  
 An invasive weed native of South America, its introduction into India is unknown.



**PROSOPIS JULIFLORA** (*mesquite*)  
 Native to Mexico and South America, it was introduced in India in 1887.



**AGERATINA ADEPHORA** (*tickweed*)  
 A weed indigenous to Central America, it was introduced in the subcontinent in 1950s.

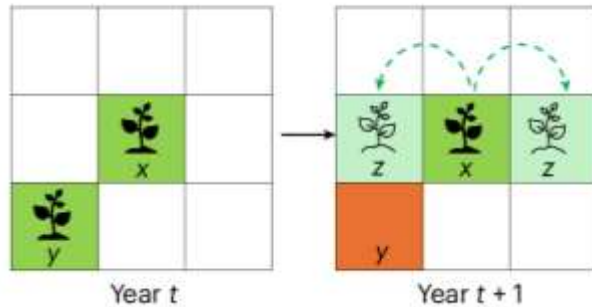


**AGERATUM CONYZOIDES** (*good weed*)  
 A flower bearing plant native to tropical America and known to exist in India before 1882.

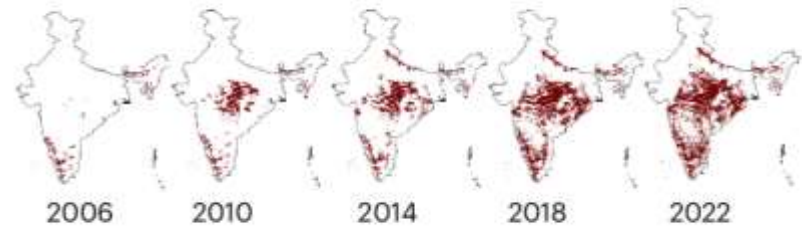


**PARTHENIUM HYSTEROPHORUS** (*dogross grass*)  
 A poisonous weed introduced in India in 1954 as contaminant in imported wheat.

**a** Meta-community dynamics

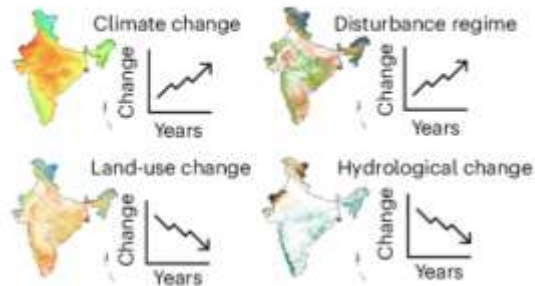


**b** Four-year assessment for 16 years

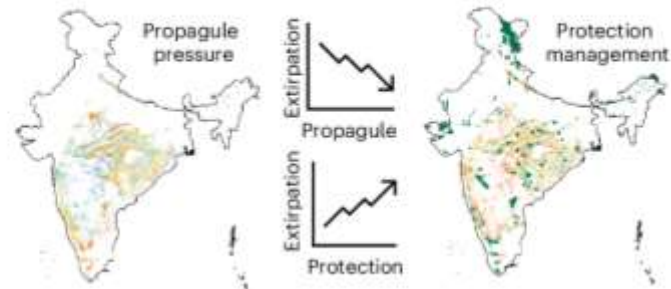


Expansion of an example invasive species over the years

**c** Colonization probability (z)



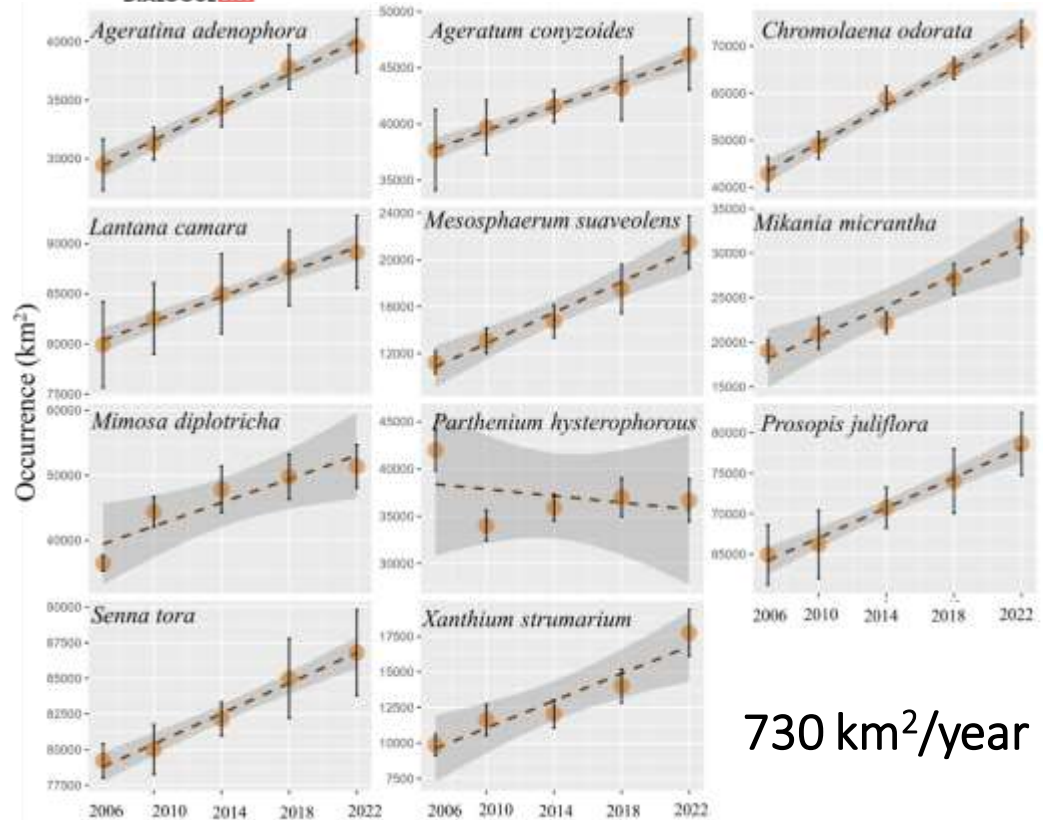
**d** Local extirpation probability (y)





- India recorded the fastest spread of any invasive species: *Chromolaena odorata* spreading 1988 km<sup>2</sup> every year
- Around 15,000 km<sup>2</sup> natural areas face new invasive plants every year
- Significant driver = Nearness to invaded patches
- What drives invasions?

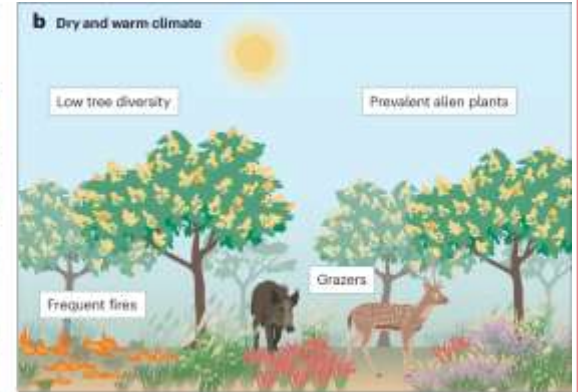
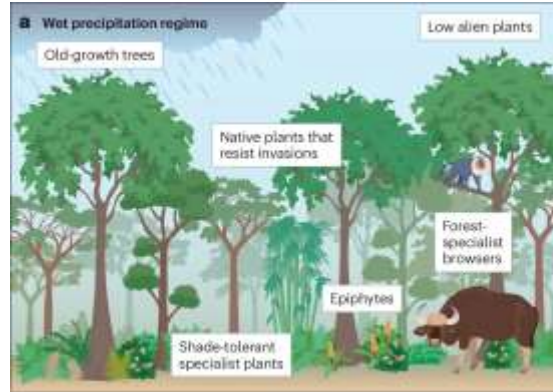
Land-use change + hydrological change + climate change + fire/herbivory change



730 km<sup>2</sup>/year

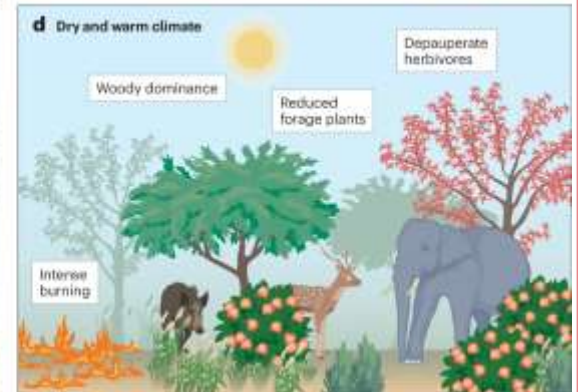
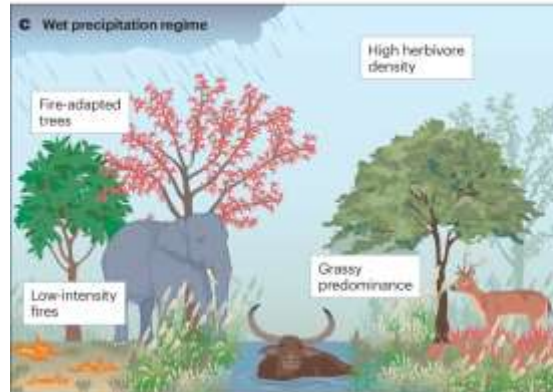
### Tropical forest degradation:

Deforestation +  
Rising sub-canopy heat +  
Wildfires +  
Propagation of C4 grasses =  
Rising CO<sub>2</sub> levels,  
Increasing invasions



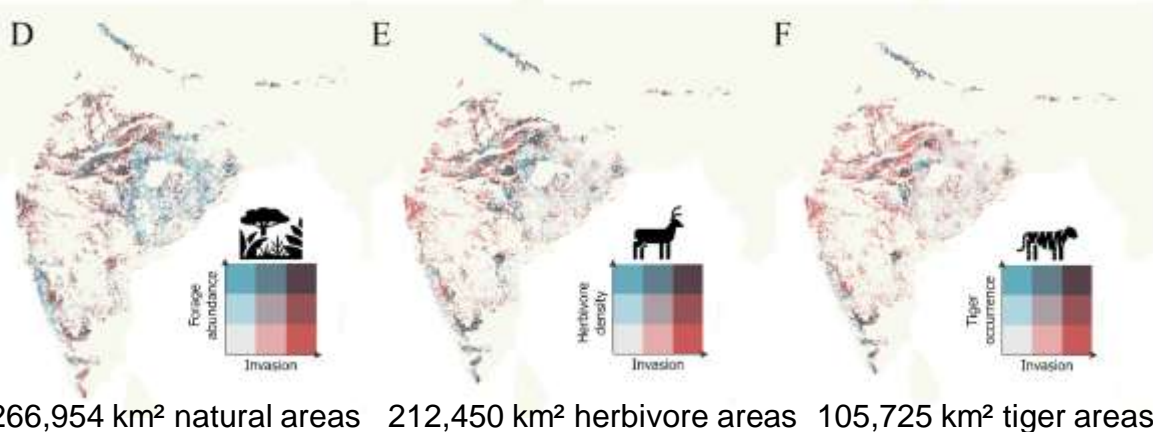
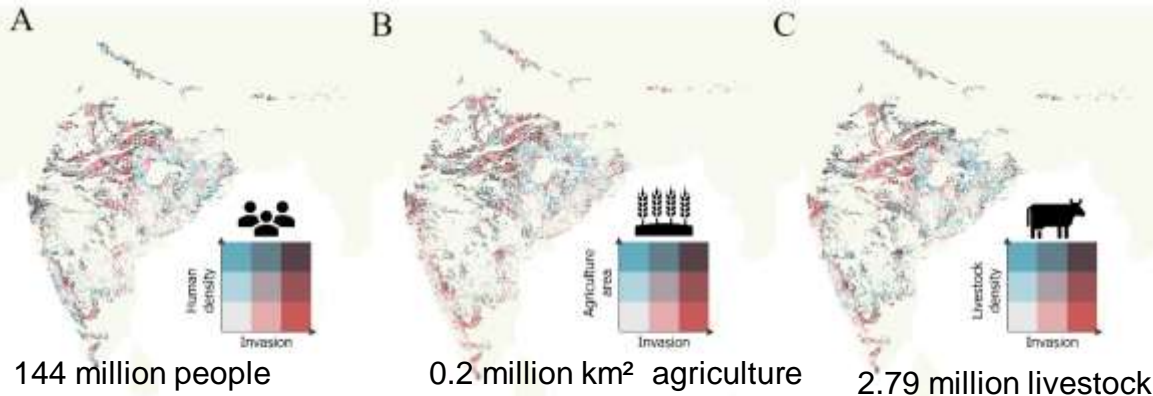
### Tropical savanna degradation:

Rising CO<sub>2</sub> levels +  
Altered fire-herbivory regime +  
Altered soil moisture +  
Propagation of woody plants =  
aboveground biomass thickening,  
Increasing invasions



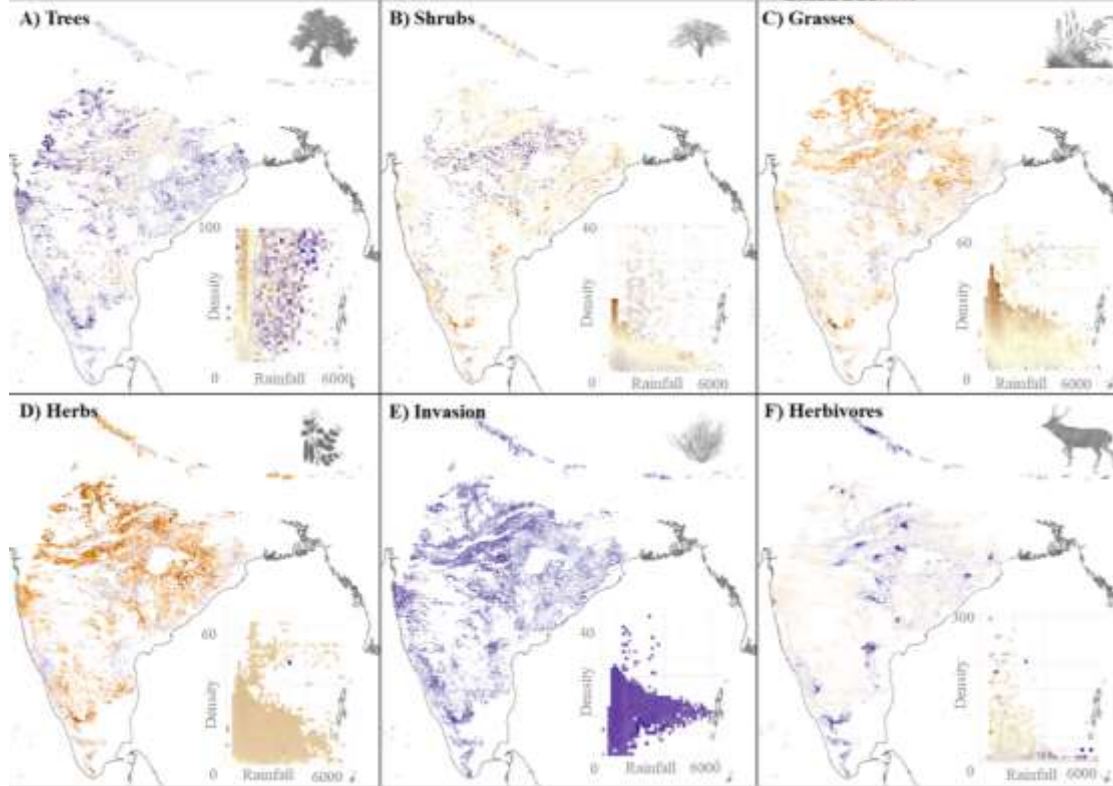


ANIL AGARWAL

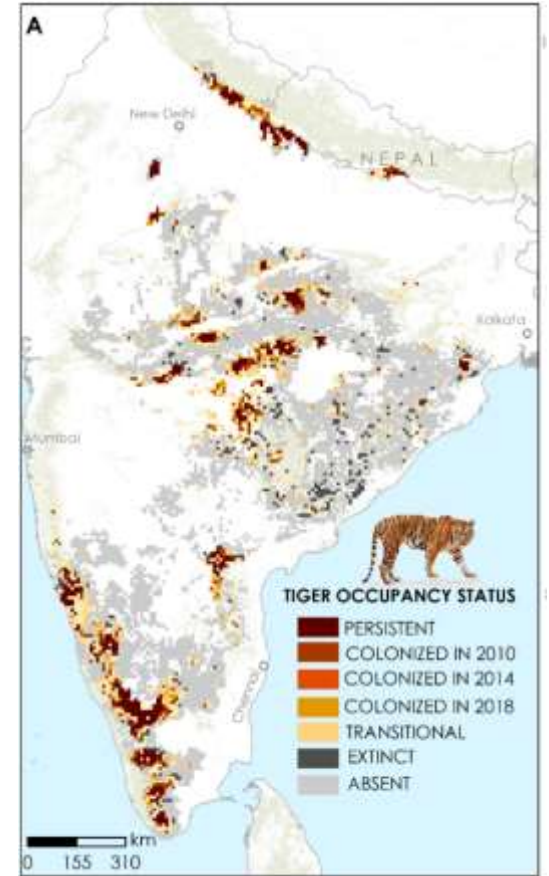


Daya and Anand Patki, Raigad, Maharashtra



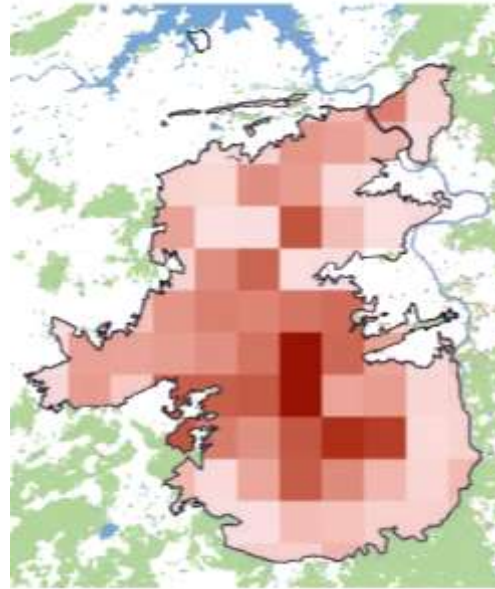


Blue represent increase, brown represent decline in the variables

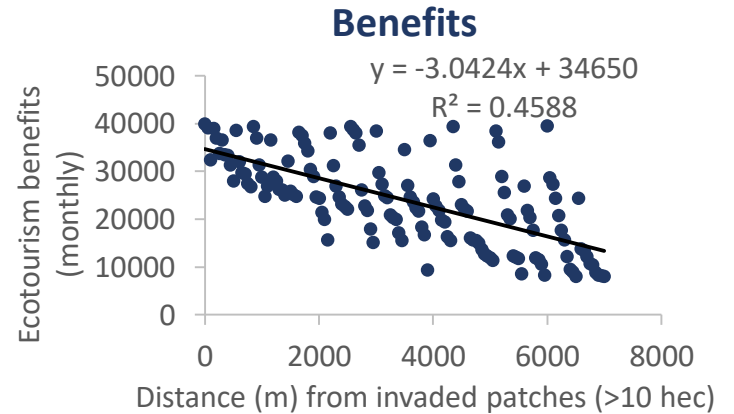
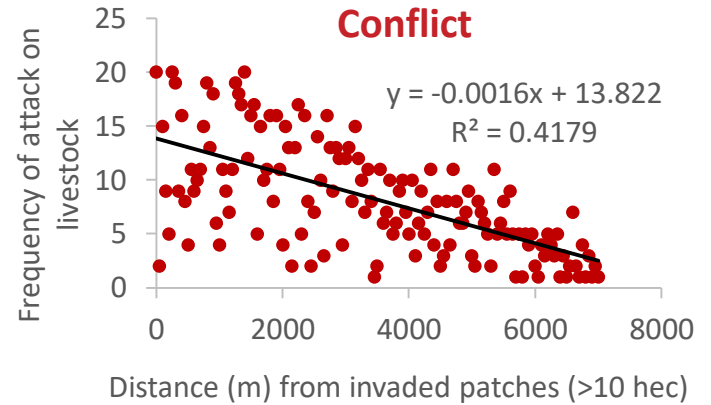




# Lantana tigers



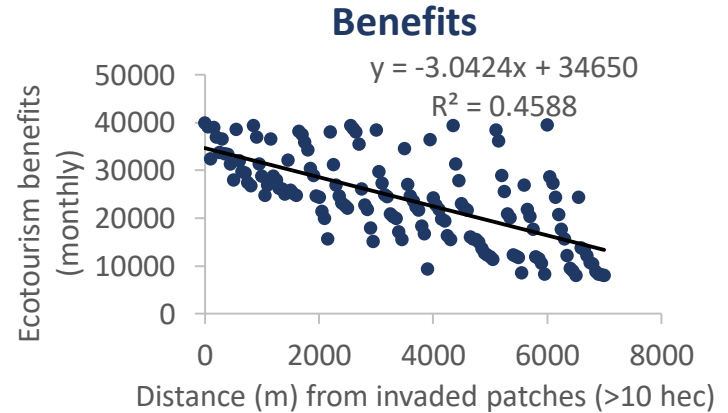
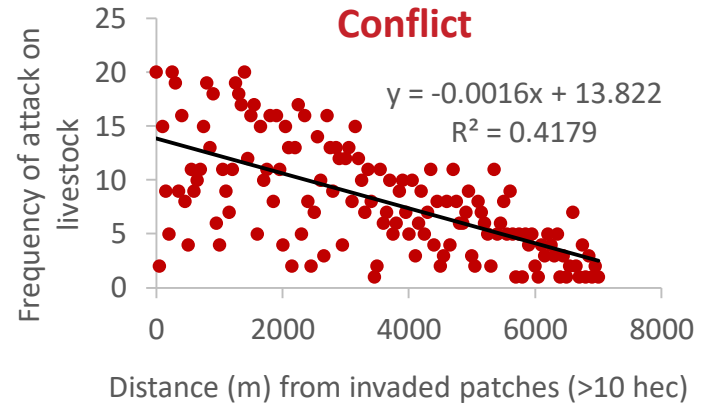
Tiger density  
(population around 200)





# Lantana tigers

- Around 8 km<sup>2</sup> areas burnt and community-led management of 14 km<sup>2</sup> areas during 2018-19.
- Tiger/leopard habitat use (sign encounter based) reduced in controlled areas. No change in habitat use by herbivores (persistently less).
- Free-ranging livestock population tripled by 2022.
- Livestock grazing depleted native plants and promoted regeneration of invasive plants over 3-4 years.
- Claims for livestock compensation increased by 2.5 fold every year (15-30 thousand/animal).
- Persistent invasions linked with higher ecotourism benefits and compensation frequency.



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- Persistent invasions linked with higher ecotourism benefits and compensation frequency.
- Novel socioecological system? something stranger and potentially more stable.

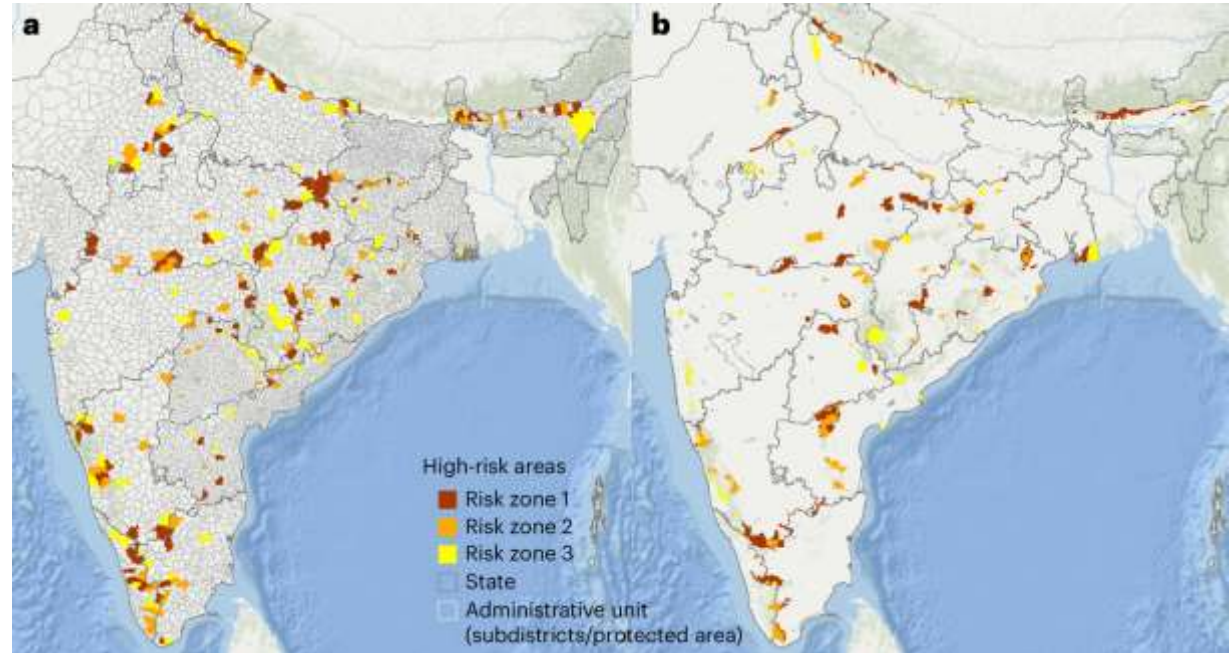




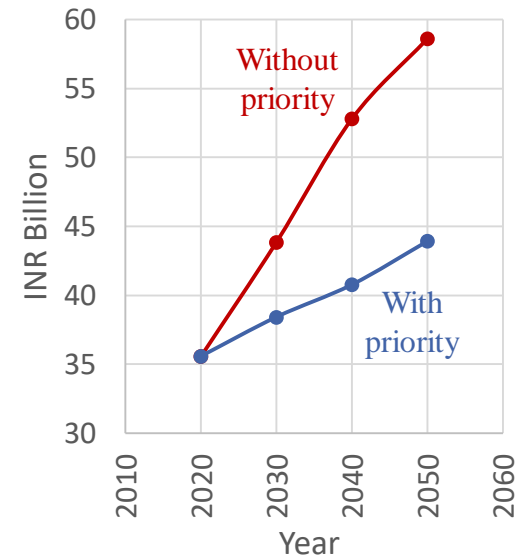
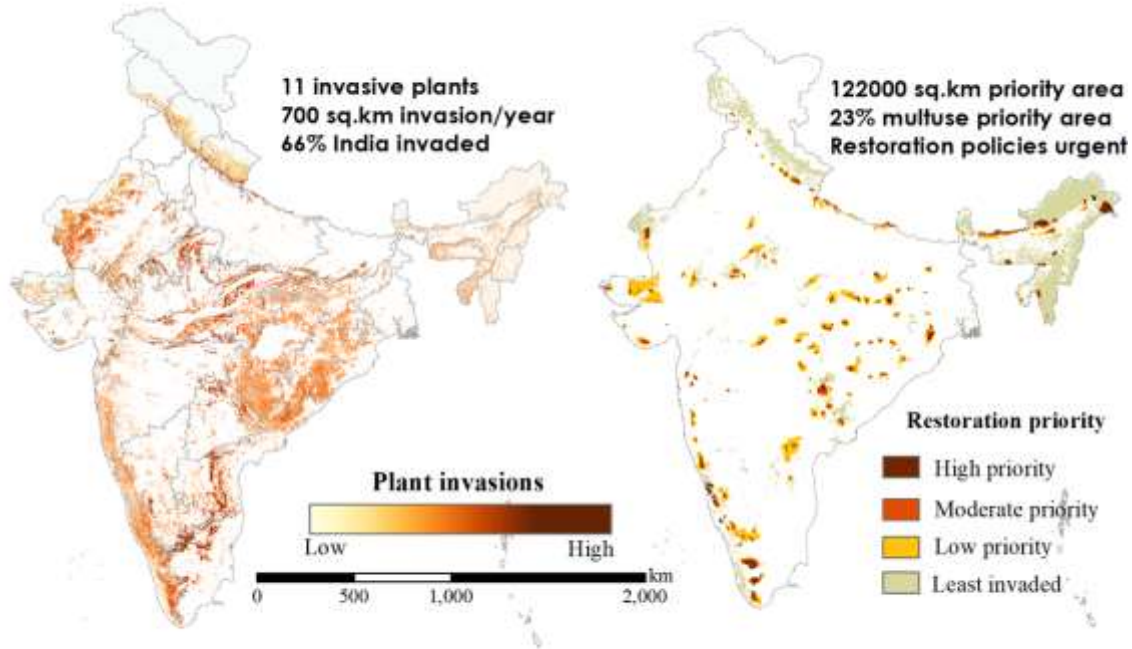
- The lantana tiger is not an anomaly. It may be a preview of conservation in the Anthropocene.
- Uncomfortable question: If tigers are surviving and even thriving in invasive, human-modified landscapes, what exactly are we conserving? Are lantana thickets “habitat”? Are cattle a legitimate prey base? Is compensation-mediated coexistence sustainable?
- Ecological reality is moving faster than ideology, and ignoring uncomfortable patterns does not make them disappear.
- These Patterns do not weaken conservation. They sharpen it.

# Socioecological vulnerability

- **High-risk tehsils of India**  
Invasions + nature-dependent livelihoods + multidimensional poverty
- **High-risk PAs of India**  
Invasions + Tiger population + relative area for native forage



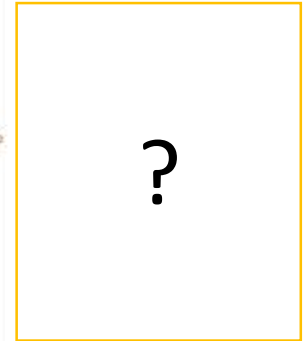
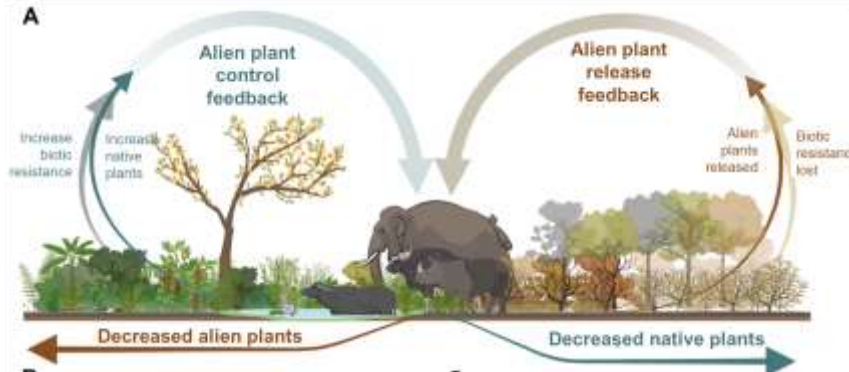
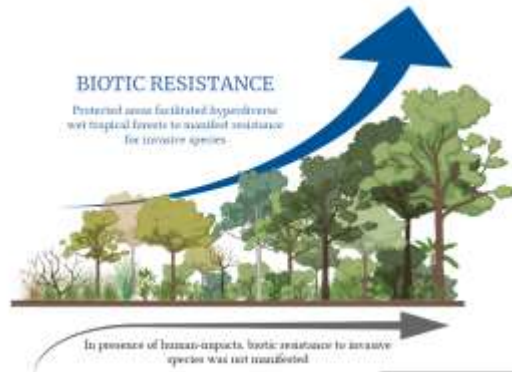
## Realistic and objective management



Source: Mungi NA, Rastogi R, Qureshi Q, Jhala YV (2023) Plant invasions and restoration priorities in India. In Status of Tigers Copredators & Prey in India: 2023. National Tiger Conservation Authority, New Delhi and Wildlife Institute of India, Dehradun.

# Nature-based Solutions for Biological Invasions

“ Measures developed to strengthen ecological processes that control biological invasions and their undesirable impacts, enhancing long-term ecological autonomy, resilience, and human well-being, with potential to scale through ecological and social feedbacks. Mungi et al. (2025) *People and Nature* ”



High

**PRODUCTIVITY**

Low

# People and alien plants

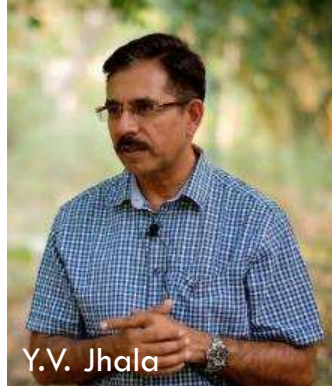
- 1. Community adaptations:**  
Incentivizing utilization of invasive plants to replace dependencies from native plants
- 2. Commercial links:**  
Generating market links and end-to-end solutions for invasive plant products
- 3. Science-based restoration:**  
Long-term in-situ experiments on restoration of invaded areas for creating success stories





# Real challenges to invasive species management in India

- 1. Policy fragmentation:** No national policy instruments to assist management or direct investments.
- 2. Diffused actions:** Every actor/sector reacts at a different scale, intensity, and frequency. Short-lived intentions beget unsustainable actions.
- 3. Scientific amnesia:** Lack of systematic scalable research on experimental management. No institutional address for research or scientific management.
- 4. Biofinance:** The scale gap necessitates systematic and sustained investments over a long-period to mitigate the impacts and invasion levels. The drivers of invasions (mining, infrastructure, irrigation, etc.) obscure the true cost evading penalization.
- 5. Economic model:** Sustained solutions necessitate economic models that would incentivize resource generation via invasive species management. This must outcompete the resources provided by invaded systems.



Y.V. Jhala



Q. Qureshi



Melodie



Jens-Christian



Elizabeth



Tiffany



V.B. Mathur



Rajat



Priya



P. Raina



Monica



V. Kolipakam



R. Gopal



Tiger cell



ECONOVO