The Impacts of change in land use on ecosystem services for adaptation in forested landscapes in Semi-Arid India

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Introduction

Forests in the semi-arid tropics play a key role in providing provisioning services to tribal communities. These services are strategically used by communities to buffer risks. The multiplicity of uses and diversity of these services provide elasticity to tribal livelihoods that is crucial to community resilience. Increasing pressure on these services from various natural and anthropogenic sources including changing land use patterns, spread of invasive species, drought and climate change is increasing the precarity of these services.

Through our study in the forested Moyar basin in Tamil Nadu, in Southern India, we explore two main questions: How are ecosystem services crucial for adaptation and coping responses of tribal communities in the region? and to what extent are these ecosystem services vulnerable to the impacts of stressors?

We attempt to answer these questions using an interdisciplinary approach focusing on key ecosystem services identified in the region 1) Non-timber Forest Products (NTFPs) 2) Agricultural services 3) Pasturing. We conducted a 400 Household survey of tribal hamlets in the region to understand community perceptions on the importance of these services focusing on stress periods (droughts, reduced rainfall), to understand the role of ecosystem services in the adaptive capacity of indigenous vulnerable communities. Further, we use remote sensing methods validated by ground truthing to understand changing agricultural patterns and forest vegetation patterns in the region.

Fig 1: Stressors to Ecosystem Services and impacts on communities

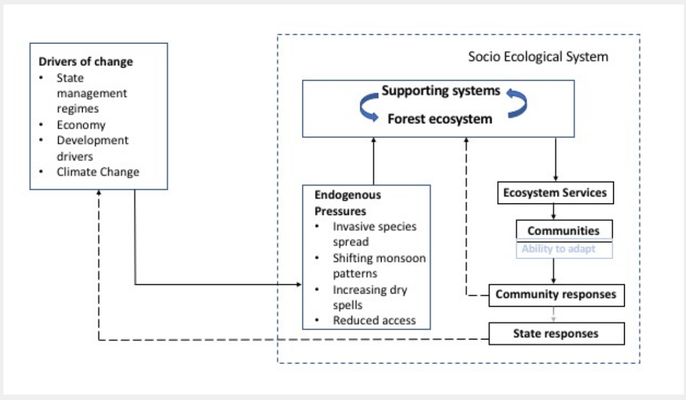


Table 1: Community dependence on Ecosystem services

Ecosystem Services usage	Livelihood	Domestic	Cultural/Religious
Timber	2.41	96.39	95.66
Fodder	6.02	59.76	0.00
Firewood	2.17	96.14	2.41
NTFPs	94.70	89.16	34.46

NTFP collection is an important livelihood of Tribal communities living in the region particularly during periods of drought

Ecosystem service: Non Timber Forest Produce

Communities identified the following Threats to Non Timber Forest Products:

- Increasing spread of Alien Invasive Species
- Restrictions imposed due to new forest management regimes
- Increasing commercialization leading to over extraction

Table 1: Community dependence on Non Timber Forest Produce

NTFP collected		Usage %		
Vernacular name	**Scientific name**	**Domestic**	**Commercial**	**Annual economic value (Rs)**
Broom grass	*Aristida setacea Retz*	83	100	9,000
Mango	*Mangifera indica*		100	2,442
Sundaikkai (Turkey berry)	*Solanum torvum*		100	5,892
Kadukkai	*Terminalia chebula*	41	48	12,625
Gooseberry	*Phyllanthus emblica*	15	47	2,509
Mara pasam (Tree moss)	*Barbula convoluta*		100	2,657
Tamarind	*Tamarindus indica*		100	10,433
Poosakai	*Sapindus emarignatus*		100	2,965
Sambrani	Benzoin tree		100	2,321
Tubers	*Decalepis hamiltonii*	20	80	2,000
Kal pasam (Stone moss)	*Politricum densifolium*		100	5,154
Then (Honey and wax)		10	100	2,200

Fig 1: Spread of *Prosopis juliflora* in the landscape (2015)

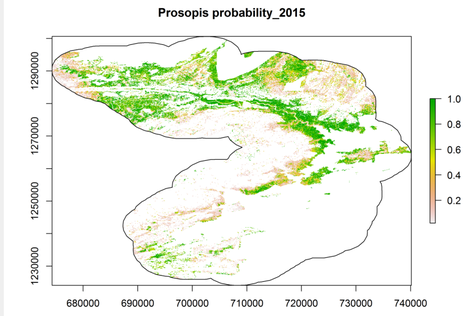
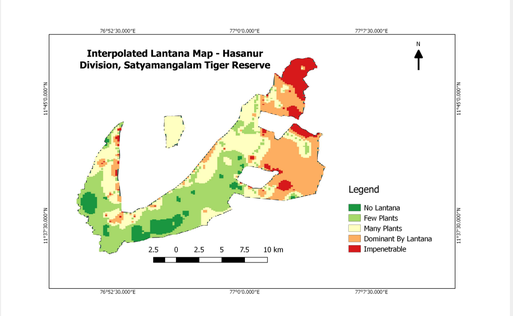
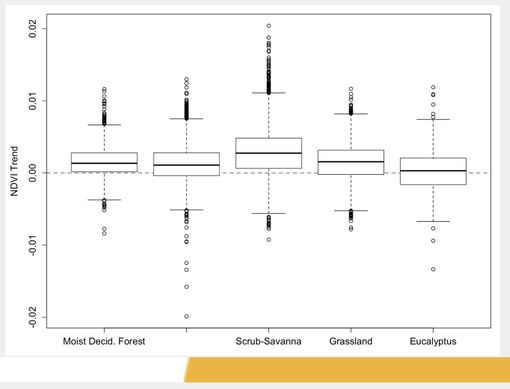


Fig 2: Spread of *Lantana camara* in the landscape (2009)



Data courtesy: WWF India

Fig 3: NDVI trends in the forested landscape

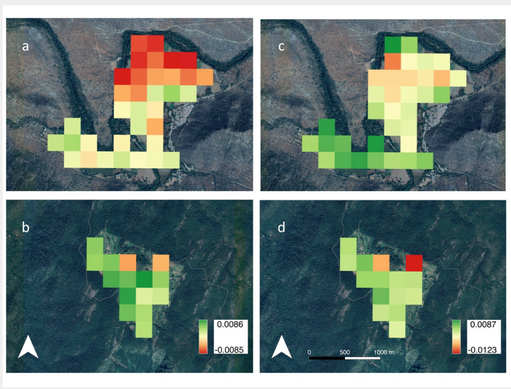


Our study shows an increasing spread of *Prosopis juliflora* in the areas closer to water bodies, particularly along the banks of rivers. There is an increase of *Lantana camara* in the higher regions.

Ecosystem service: Agriculture

Agriculture in the region is predominantly rainfed and highly susceptible to climate vagaries. 84% of respondents felt that there has been a weakening of the North east monsoon over the last 15 years

Fig 4: NDVI trends of greening and browning in cultivated lands in settlements



Trends in maximum seasonal vegetation greenness using the Theil-Sen slope (NDVI units/year) for Jun-Sep (a, b) and and for Oct-Dec (c, d) from 2001 to 2015 for Thengumarhada (top panels) and for Ittarai (bottom panels) in the Moyar watershed

Threats to agricultural productivity:

- Weakening North East monsoon
- Increased crop raiding particularly from wild pig and peacocks
- Increase in the spread of Alien Invasive Species

Ecosystem service: Pasturing

Communities identified the following threats to pasturing lands:

- Change in forest type, increase in plantations
- Increase in spread of Alien Invasive Species
- Increased wild animal predation on livestock

Conclusion

Tribal Communities in the Moyar use ecosystem services to buffer climatic and non-climatic risks. These ecosystem services are under multiple threats from the spread of Alien Invasive Species linked to forest management practices, changing climate regimes and over-extraction.

Alien Invasive Species present a major risk to forest ecosystems. A rethinking of the normative framings of Alien Invasive Species using a novel ecosystems approach considering the potential of these new ecosystems is required to sustainably and equitably manage forest ecosystems in the region.

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This work was carried out under the Adaptation at Scale in Semi-Arid Regions project (ASSAR). ASSAR is one of five research programmes funded under the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), with financial support from the UK Government's Department for International Development (DfID) and the International Development Research Centre (IDRC), Canada. The views expressed in this work are those of the creators and do not necessarily represent those of DfID and IDRC or its Board of Governors.

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Part of the CARIAA programme: