Jennifer Baka, Rob Bailis, Grishma Jain and Megha Shenoy

Marginal lands and biofuels: a comparative MEFA of India's wastelands

Conference Item (Poster)

Marginal Lands & Biofuels: A Comparative MEFA of India's Wastelands

Jenn Baka, Yale FES, jennifer.baka@yale.edu, Rob Bailis, Yale FES, robert.bailis@yale.edu, Grishma Jain, ROI, grishma@roi-online.org, Megha Shenoy, ROI, megha@roi-online.org

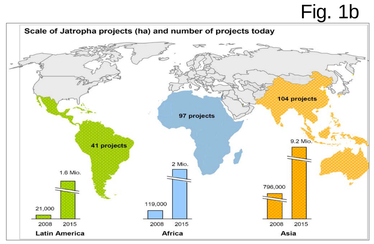
Abstract: India's current biodiesel policy mandates the use of non-edible oilseed feedstocks such as *Jatropha curcas* grown exclusively on *wastelands*, a government classification of marginal lands. However, existing biomass stocks from wastelands, principally *Prosopis juliflora*, currently support robust rural and industrial energy economies. Using a material and energy flow accounting (MEFA) framework, we find that India's current *Prosopis* economy has a 10-90 times greater energy return on investment (EROI) than a *Jatropha* economy. Approximately 56% of industries using Prosopis would close down or move elsewhere if faced with a *Prosopis* shortage. Lastly, the *Prosopis* economy provides nine months of annual employment for rural laborers while *Jatropha* provides about 15 days per year. Thus, as currently designed, India's biofuel program may perversely impact energy security and rural welfare if *Jatropha* replaces *Prosopis*.

Background: *Jatropha*, Wastelands & *Prosopis*

Jatropha is a drought-tolerant shrub commonly found across the Global South. Its oil-rich, inedible seeds can be used as a feedstock for biodiesel. As result, *Jatropha* promoters tout its ability to improve energy security and environmental quality while minimizing threats to food security. According to a 2008 global market survey, ~900,000 ha of *Jatropha* is cultivated worldwide with over 400,000 ha in India (GEXSI 2008).

Fig. 1a

Fig. 1b



India's National Biofuel Policy (2009) mandates the use of non-edible oilseeds grown on *wastelands*. The *National Wasteland Atlas*, consisting of 23 classifications, estimates ~15% (47.22 M ha) of India's total geographic area (TGA) is wasteland. According to key stakeholders, scrublands are the most likely category for biofuel cultivation (18.5 M ha; 5.84% of TGA; 39% of total wasteland area; largest single category).

Fig. 2a

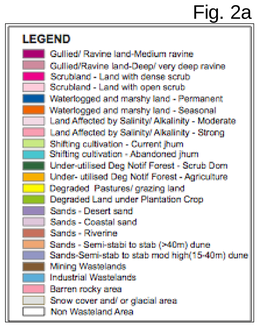
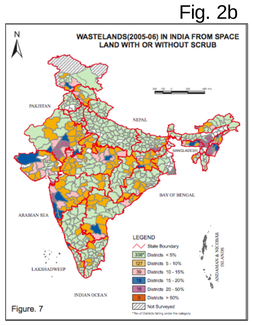


Fig. 2b



Scrublands are often covered with *Prosopis juliflora*. *Prosopis* biomass is currently used as a household fuelwood, as a feedstock for electricity generation and charcoal production and as an energy source for industries such as bricks, paper and match making.

Fig. 3a

Sources:
Fig. 1a: Baka photos, Fig. 1b: GEXI, 2008; Figs. 2a&b: NRSA, 2010; Fig. 3a: Baka photos.

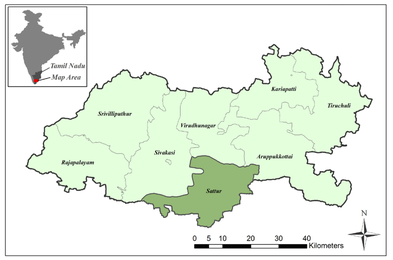
Methods & Fieldsite

Methods:
Comparative Material and Energy Flow Analysis (MEFA)
Three components:

- MFA
- EFA
- EROI (land use change metric)

Fieldsite: Sattur taluk, Tamil Nadu, India

Fig. 4a



Sattur Demographics

Fig. 5a

Metric	Value	Source
Population (#)	156,968	Census of India, 2001
Households (#)	41,087	Census of India, 2001
Villages (#)	60	Census of India, 2001
Average Rainfall (mm/yr)	830	Virudhunagar Statistical Handbook, 2009
Main crops	Maize, cotton, grams, pulses	Virudhunagar Statistical Handbook, 2009
Total Geographic Area (TGA) (ha)	45,749	Virudhunagar Statistical Handbook, 2009
Prosopis area (ha)	16,537	Estimated
Prosopis area (%)	36.2%	Calculated

Current *Prosopis* Usage: 162.1 ktonnes (kt)/yr

Power Plant — Fig 6a
89.3 kt/yr
55.1% of total annual use
N=1

Paper — Fig 6b
33.8 kt/yr
20.8% of total annual use
N=5

Bricks — Fig 6c
15.4 kt/yr
9.5% of total annual use
N=125

Charcoal — Fig 6d
11.5 kt/yr
7.1% of total annual use
N=121

Fuelwood — Fig 6e
7.8 kt/yr
4.8% of total annual use
N=23,141

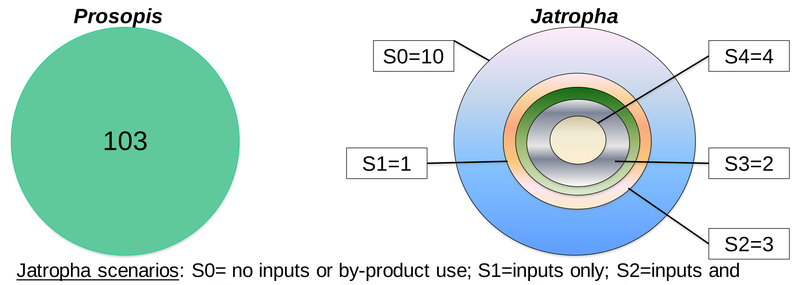
Other* — Fig 6f
4.3 kt/yr
2.7% of total annual use
N=228

*Other includes match factories (pictured), eateries, and oil mills.

Findings

EROI=(useful energy output +by-products)/inputs

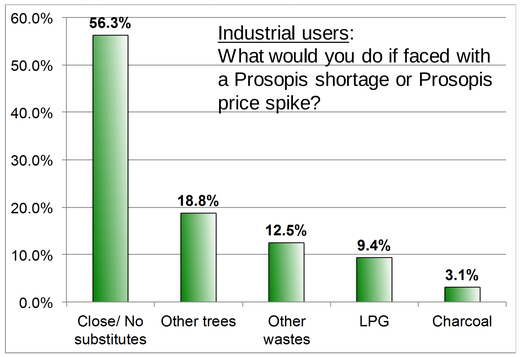
Fig. 7a



Jatropha scenarios: S0= no inputs or by-product use; S1=inputs only; S2=inputs and Jatropha by-products; S3=inputs and Prosopis uprootings; S4=inputs, Jatropha by-products and Prosopis uprootings.

Energy Security Comparison

Fig. 8a



- Rural households will likely accelerate usage of LPG.
- India currently imports 76% of its fossil fuel needs.
- 53% of Indian population still lives in rural areas.

Social Ecology Dimension: Labor Impacts

Fig. 9a

	Prosopis	*Jatropha*
Laborers (per ha)	14 • Male: 11 • Female: 3	2 Male: 0 Female: 2
Labor duration (days per year)	216	15
Wages (Rs/day)	Male: Rs. 200 Female: Rs. 150	Male: NA Female: Rs. 100

Fig. 9b: *Prosopis* coppicing crew

Fig. 7c: *Jatropha* harvester

Conclusions

India's wastelands are not empty, unproductive spaces.
•*Prosopis* system less material intensive and more locally concentrated than *Jatropha*.
•*Prosopis* system EROI is 10-90 times greater than *Jatropha* system.
•Replacing *Jatropha* with *Prosopis* may perversely impact energy security by increasing imports of LPG.
•Replacing *Prosopis* with *Jatropha* may perversely impact rural welfare by reducing employment opportunities for the landless poor and by causing industries to close or move.

Study Limitations/Future Research Areas

- MEFA framework excludes:
  - Health impacts of fuelwood usage.
  - Water impacts of *Prosopis* and *Jatropha* usage.
  - Invasiveness potential of *Prosopis* and *Jatropha* and the resultant impacts on biodiversity.