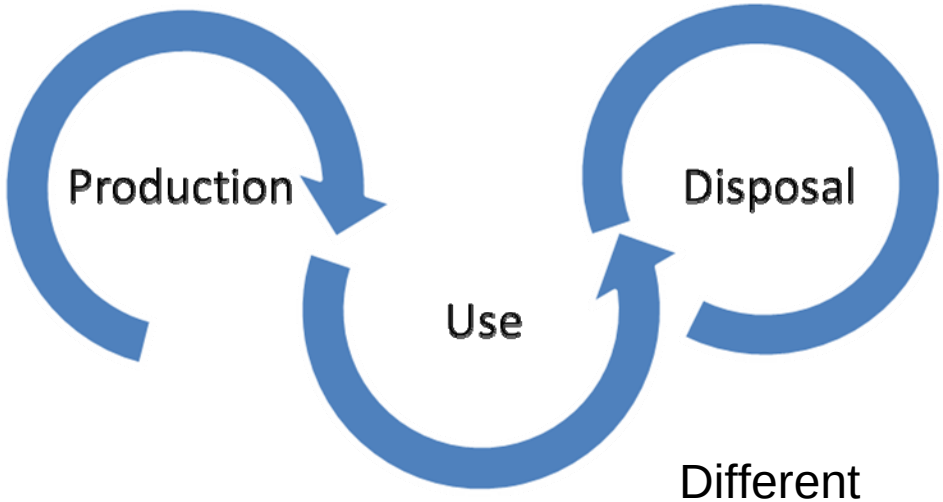
Life Cycle Assessment (LCA) of raw silk

Life cycle analysis of cumulative energy demand on sericulture in Karnataka, India.

Fritz Vollrath, Robin Carter, G. N. Rajesh, Gunnar Thalwitz, Miguel F. Astudillo

What is LCA?

- A standardised method to assess the environmental impact associated with the different stages of the life cycle of a product.

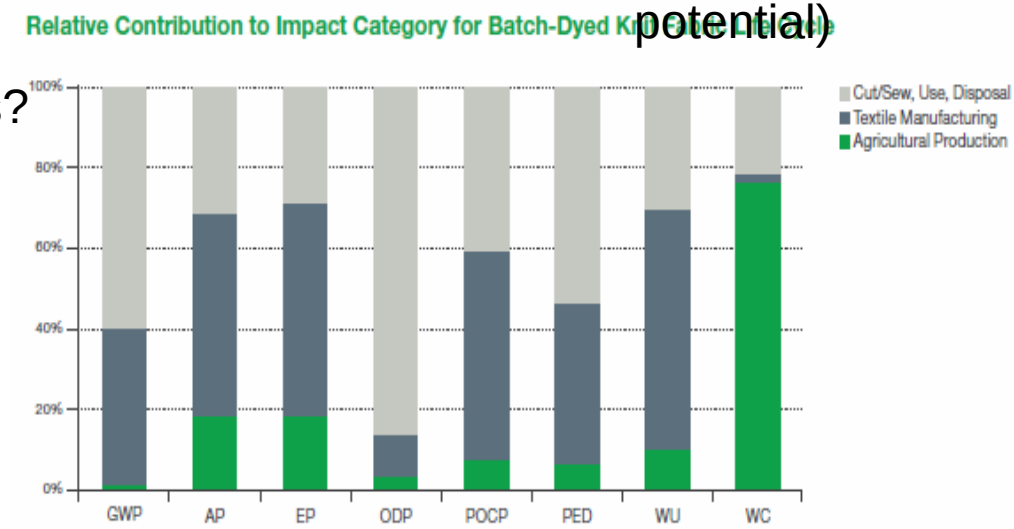


Different indicators: i.e. Carbon footprint (Global Warming potential)

What is it used for?

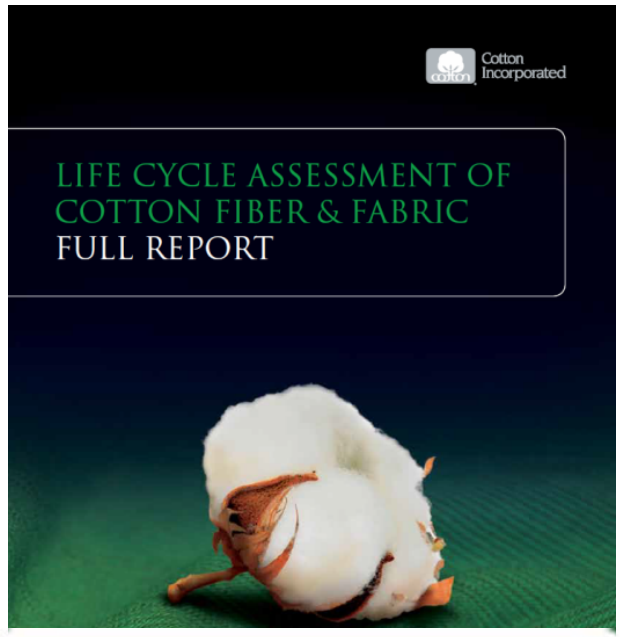
- **In policy**: Consumer Information and policy development
- **In industry**: Identify environmental hotspots & best practices.

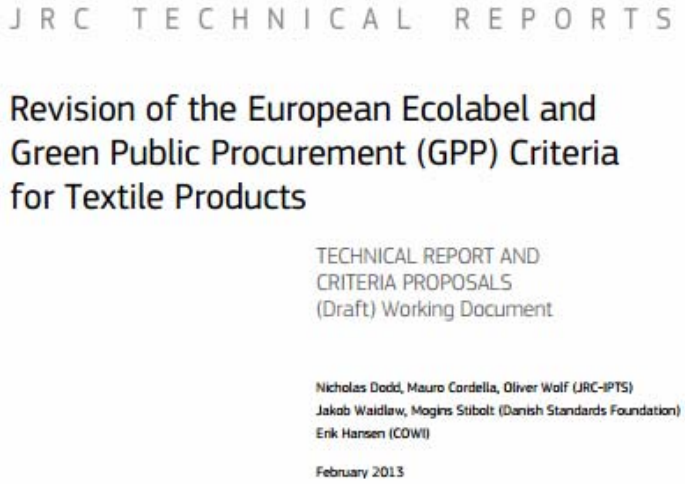
Biofuels? Organic food?



Why is it relevant for Silk?

- Policy makers & consumers are increasingly interested in environmental performance & life cycle thinking
- EU updating ecolabel criteria for textiles
- No baseline available for silk
- Identify ways to improve production performance (already done for other textiles).





First survey of raw silk production

Who?
20 reelers & 20 rearers

Where?
Karnataka, India. India is the second biggest silk producer. Karnataka is the most important sericulture region in India

When?
2011

What it was included?
Cocoon production (fertiliser use, pesticides…)
Reeling process (wood requirements, renditta…)

Environmental indicator used:
Cumulative energy demand (total amount of energy required to produce 1 kg of silk)

it?

ISO 14040:2006 & ISO 14044:2006

Inventory of all the relevant **mass and energy flows** through the system.

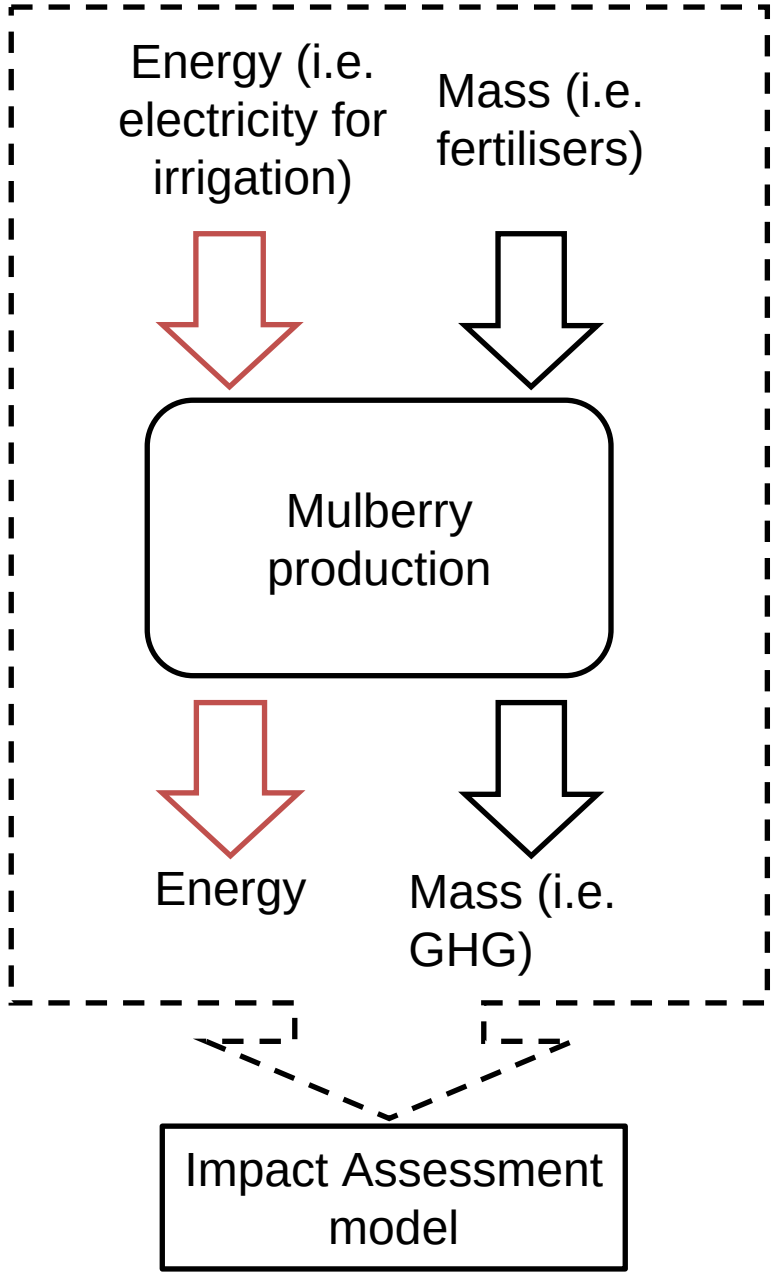
Use of **impact assessment models** determine Environmental impact.

-Global Warming Potential

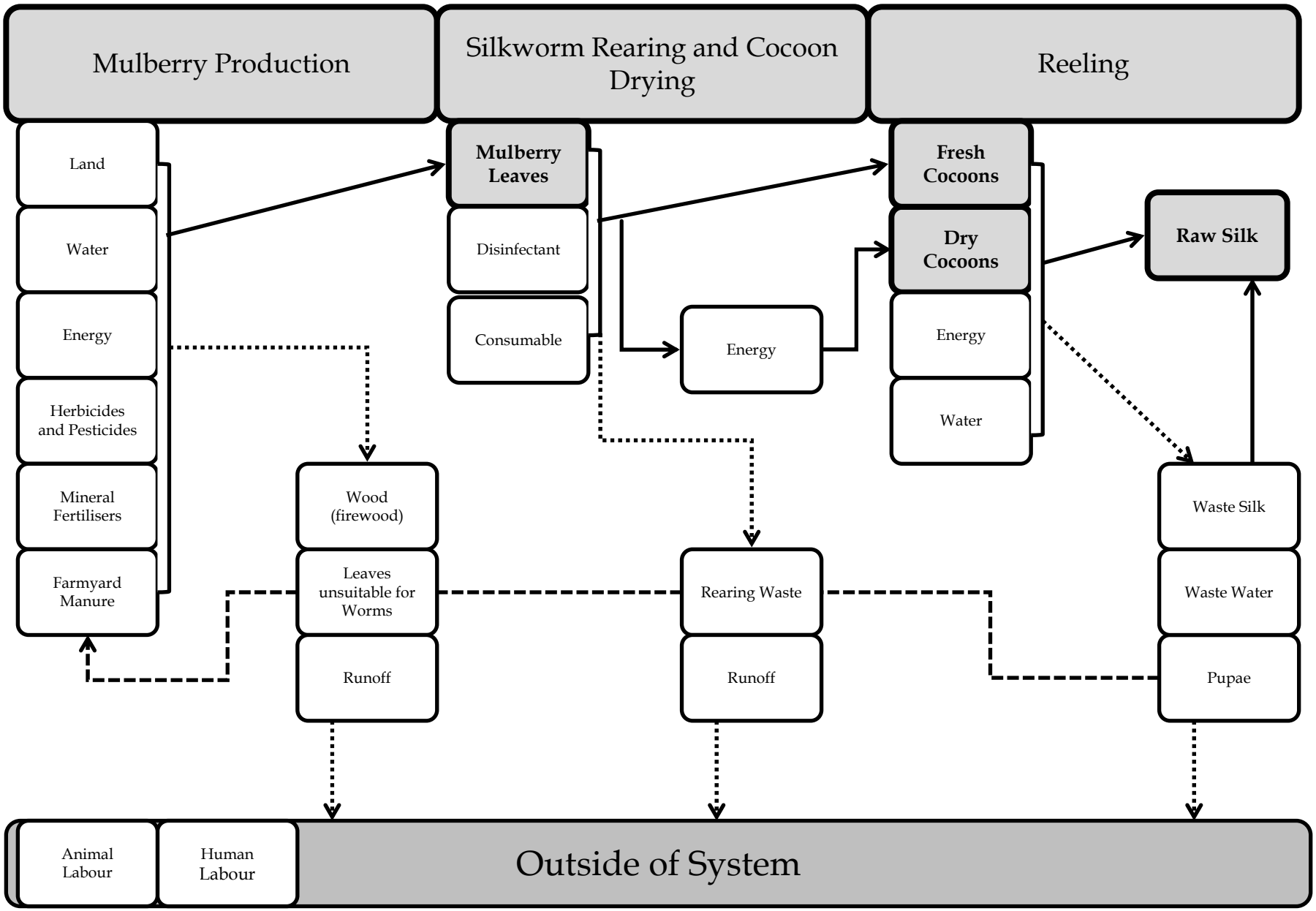
-Energy use

-Ecotoxicity

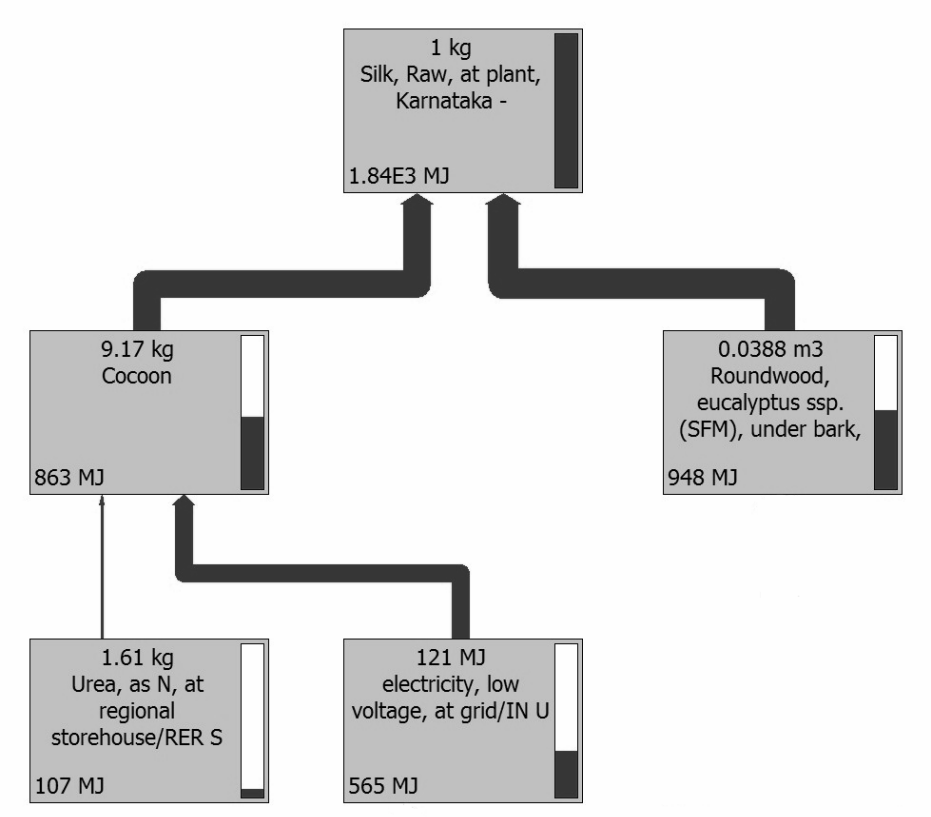
-etc



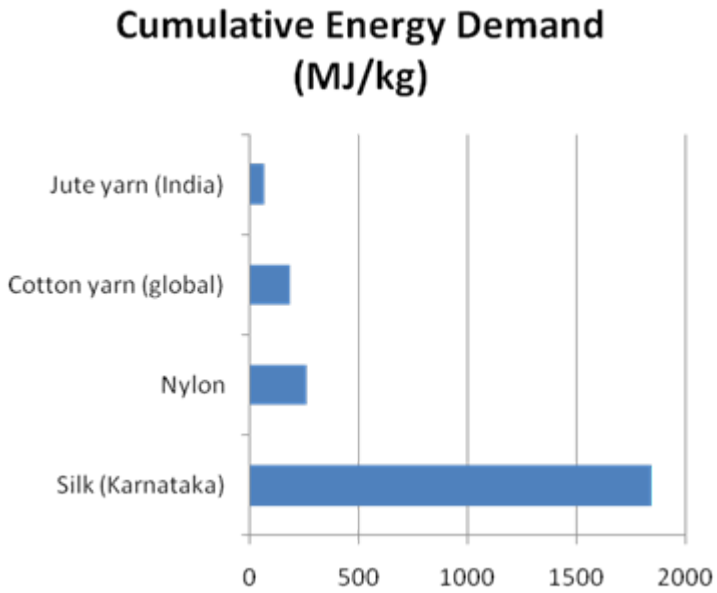
system:


Mulberry Production
Silkworm Rearing and Cocoon Drying
Reeling
Land
Water
Energy
Herbicides and Pesticides
Mineral Fertilisers
Farmyard Manure
Mulberry Leaves
Disinfectant
Consumable
Energy
Fresh Cocoons
Dry Cocoons
Energy
Water
Raw Silk
Wood (firewood)
Leaves unsuitable for Worms
Runoff
Rearing Waste
Runoff
Waste Silk
Waste Water
Pupae
Animal Labour
Human Labour
Outside of System

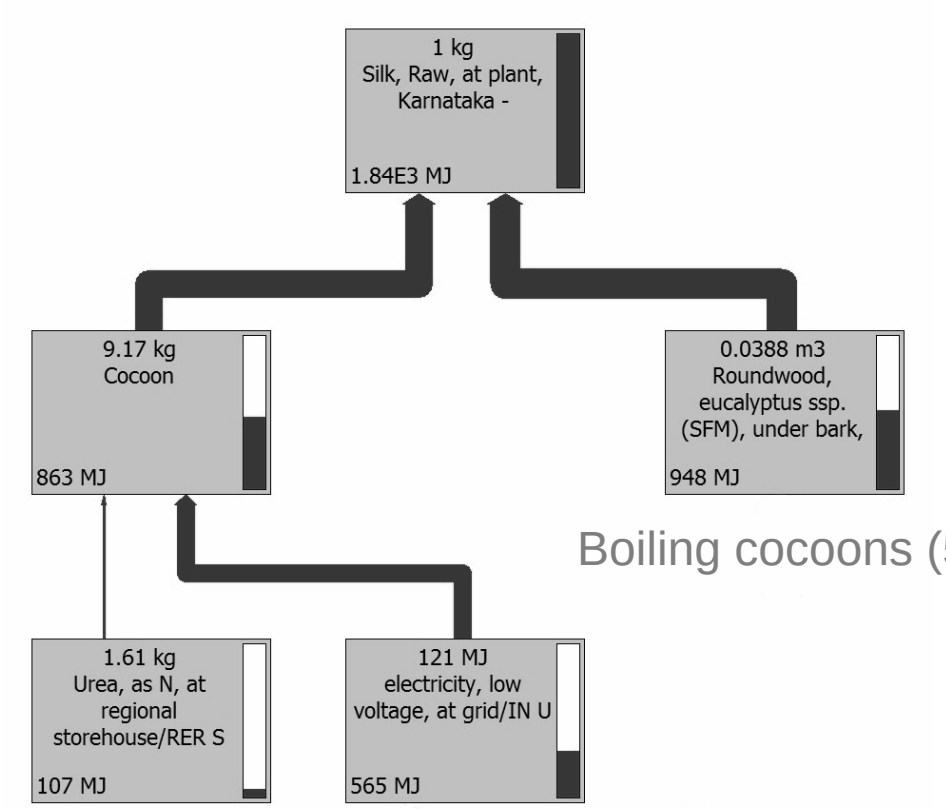
Results: Hotspots: Where to focus



On a mass basis silk production is highly energy intensive compared with other fabrics :



Results: Hotspots: Where to focus



Boiling cocoons (51%

Fertiliser use (14%)

Electricity for irrigation (32%)

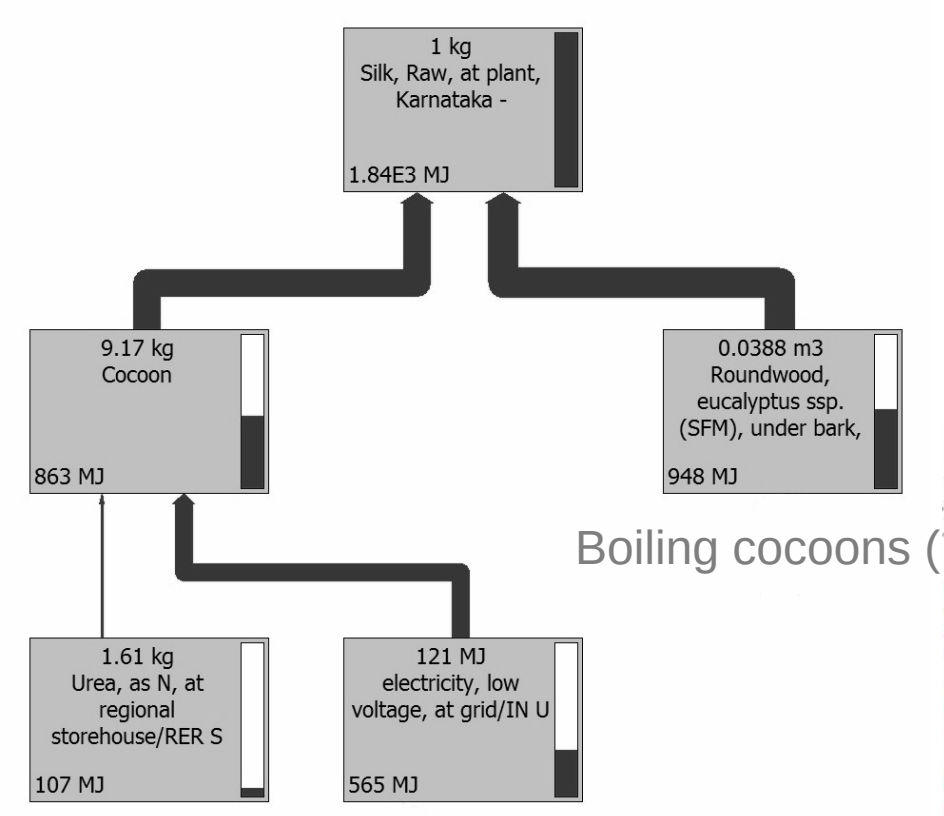
Hotspots: Where to focus

Overfertilization & nutrient inbalance

-**N fertiliser:** 520 kg N/ha/y

-50% more than the recommended dose

Results: Hotspots: Where to focus



Boiling cocoons (

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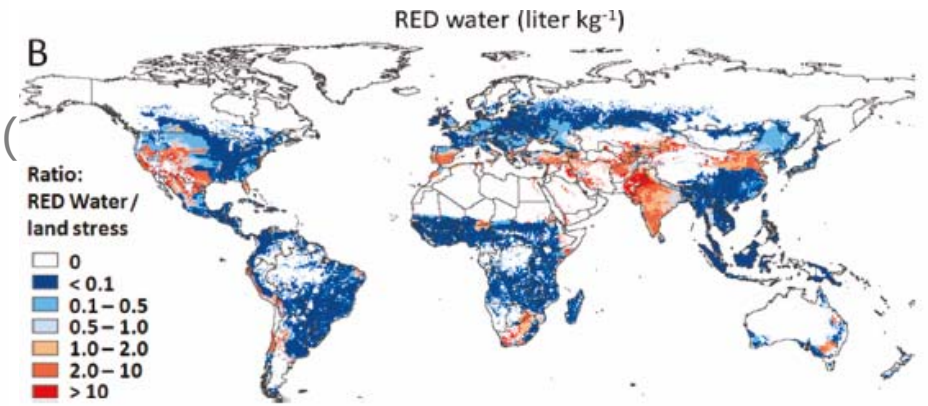
Electricity for irrigation (32%)

Energy Use in Irrigation

- Furrow irrigation
- Not one farmer in sample has paid a bill

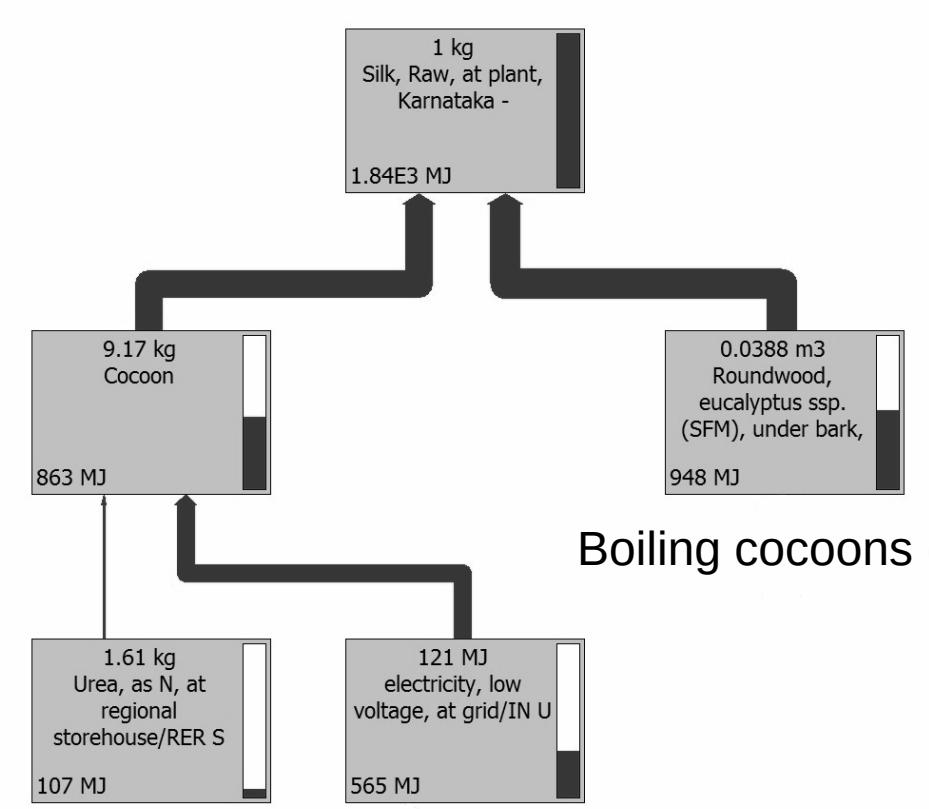
⇒Distorted incentives



Relevant Environmental Deficiency of wat

Pfister et al. 2011

Results: Hotspots: Where to focus



Boiling cocoons (51%)

Fertiliser use (14%)

Electricity for irrigation (32%)

Hotspots: Where to focus

Inefficient use of wood

-Low efficiency boilers

-Higher wood use than reported in previous studies

Conclusions

- Indian silk production needs to improve its environmental performance to be sustainable

- There are possibilities for improvement :
  - Reeling sector: improved stoves
  - Cocoon production: fertiliser planning, irrigation optimization
  - Better use of co-products (pupae, sericin, waste silk)

- Subsidies of irrigation and agriculture can lead to distorted use of agricultural inputs

New Questions

Have we missed something important?
- infrastructure, field works, grainage …

How does it perform concerning other environmental indicators?
- greenhouse gases
- water use
- toxicity

How other countries perform?
China, Brazil, SE Asia

How other technologies /phases perform?
Multi-end reeling vs cottage basin

How sure we are about what we know?

Preliminary answers:

inclusion of capital goods and field works have small influence in energy requirements.

+ 10% of total energy requirements
(aprox)

By rajkumar1220

By CameliaTWU

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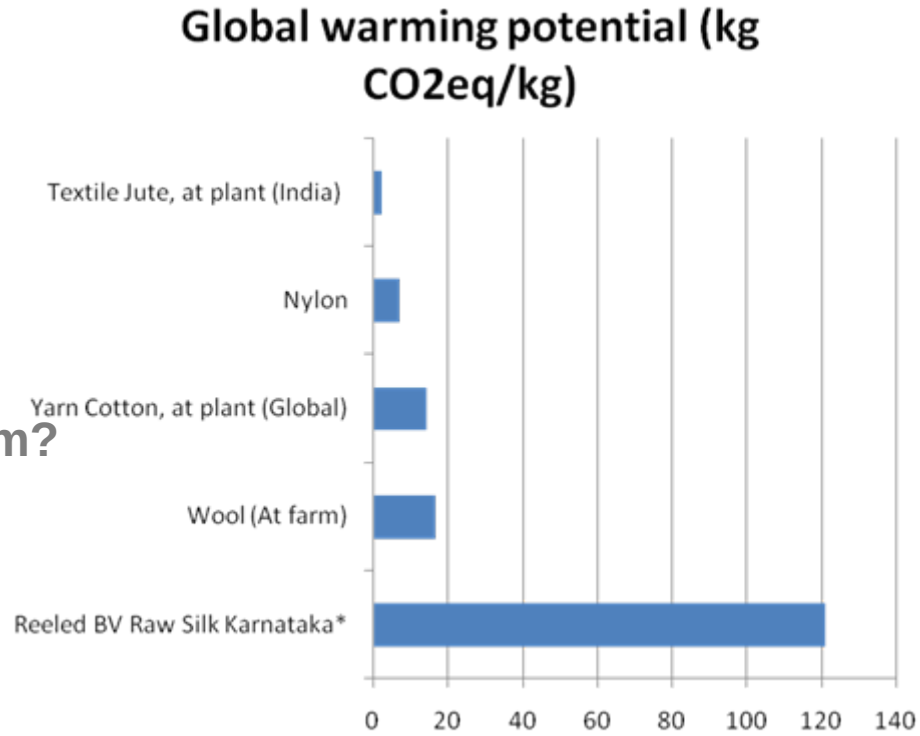
Preliminary answers:

Carbon footprint is also high compared with other textiles



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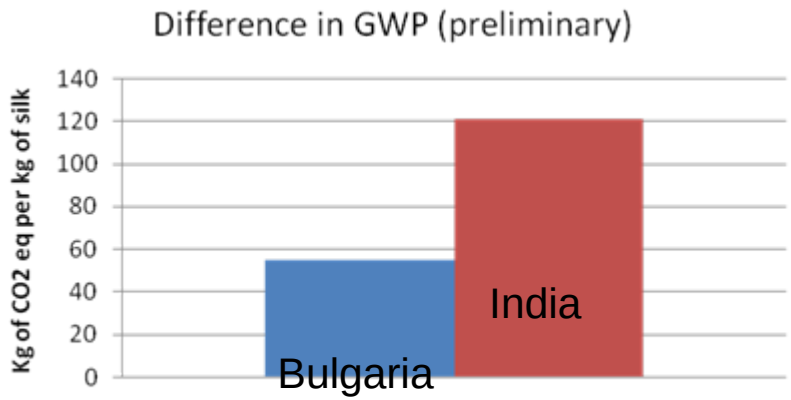
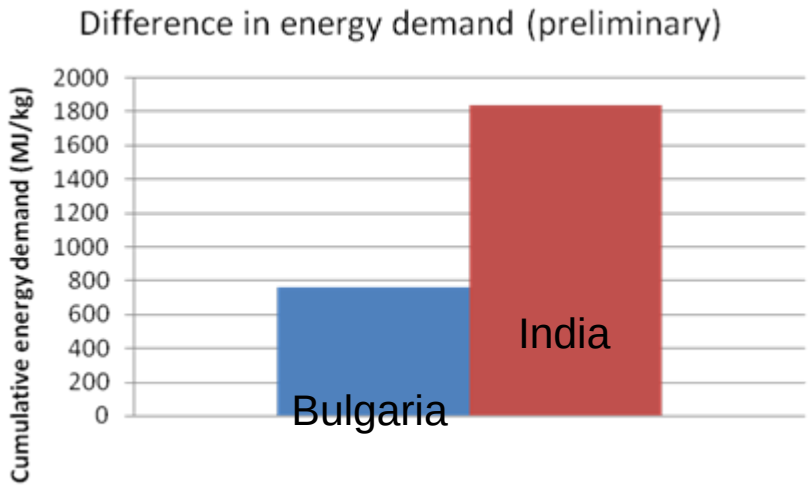
Preliminary answers:

Other production systems may have significantly different impact

Scope for Improvement





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How sure we are about what we know?

Weaving?
Multi-end reeling?
Enzymatic or chemical degumming?

Industry needs?

New Questions

Have we missed something important?
- infrastructure, field works, grainage…

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- toxicity

How other countries perform?
China, Brazil, SE Asia

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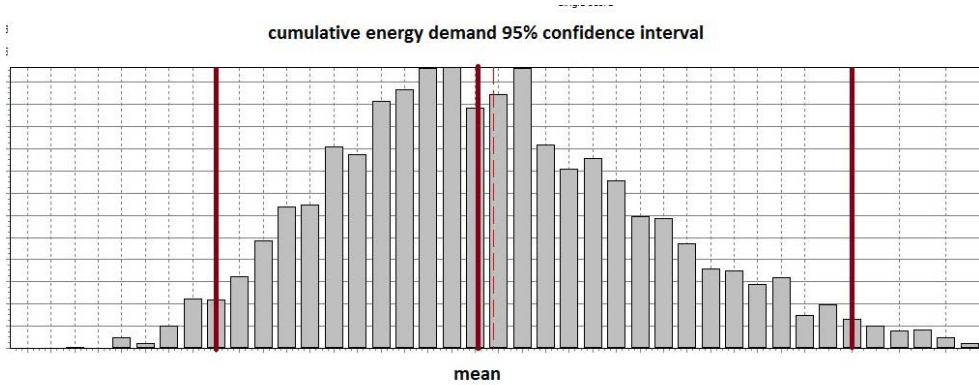
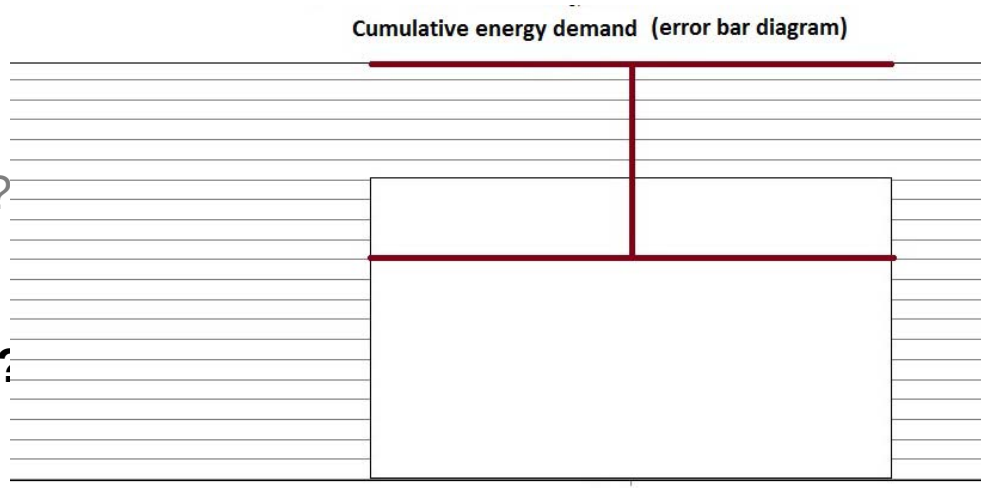
How sure we are about what we know?

Preliminary answers:

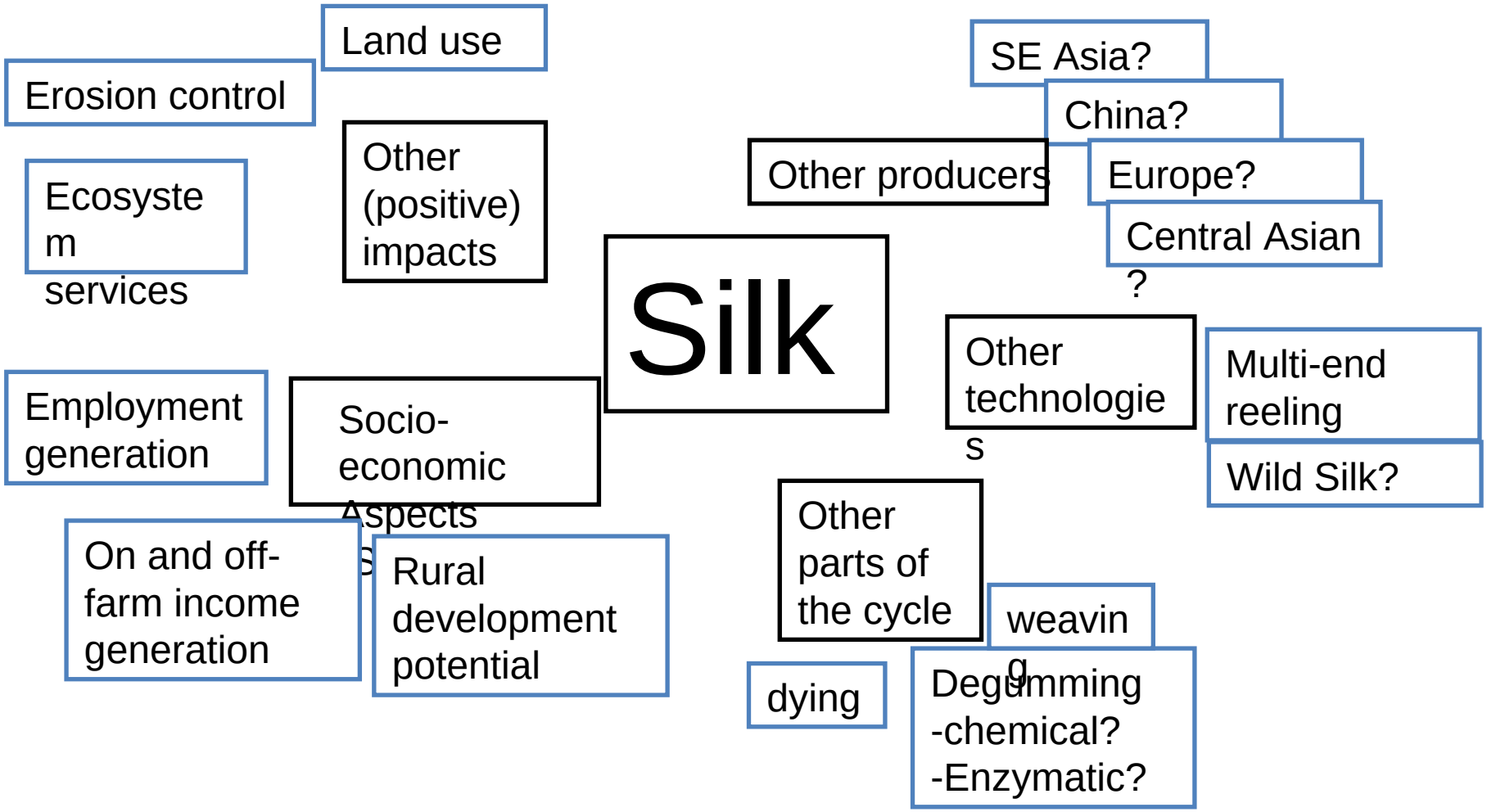
perform a sensitivity and uncertainty analysis (Monte Carlo simulation)

+ data => less uncertainty





Expanding the analysis



Thank You!

- Questions?

Funded by: