Comparative LCA for natural *vs.* glass fibre as reinforcement for composites

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Context

- Nilmini is in month nine of her PhD
- she is from Sri Lanka
- the waiting list for visas to enter Spain was longer than the gap between acceptance of this paper and today!

Overview

- Introduction
- Fibre Production: Natural & Glass
- LCA
- Environmental impact classification factors
- Results
- Discussion
- Conclusion
- Questions?

Introduction

- natural fibres perceived to be more environmentally friendly than synthetic fibres
- long-term aim is to gather quantitative data to confirm or refute that perception
- flax is (a) temperate zone plant and (b) more resource intensive than hemp, so this is the system we propose to study.

Natural Fibres - agriculture

- ploughing
- drilling
- fertiliser
- weed & pest control
- dessication
- harvest

Flax Field, Providence by Hazel Barker

From http://www.art.com/asp/sp-asp/_/pd--10125356/Flax_Field_Providence.htm

Natural Fibres - processing

- rippling
- retting
- decortication
- hackling
- carding
- spinning
- weaving

Glass Fibre Production

- raw material processing
- melting
- spinning
- forming
- curing & cooling
- weaving

Life Cycle Assessment

- The goal & scope definition
- Life Cycle Inventory analysis (LCI)
- Life Cycle Impact Assessment (LCIA)
- Life Cycle Interpretation

Environmental Impact Classification Factors:

ISO/TR 14047:2003(E)	Azapagic et al
Acidification	Acidification Potential (AP)
Ecotoxicity	Aquatic Toxicity Potential (ATP)
Eutrophication / Nitrification	Eutrophication Potential (EP)
Climate Change	Global Warming Potential (GWP)
Human Toxicity	Human Toxicity Potential (HTP)
Depletion of abiotic /biotic resources	Non-Renewable / Abiotic Resource Depletion (NRADP)
Stratospheric ozone depletion	Ozone Depletion Potential (ODP)
Photo-oxidant formation	Photochemical Oxidants Creation Potential (POCP)

Acidification of surface water and soil :

- nitrogen leaching from fertiliser

Eco/Human toxicity

- **plant** fibre
  - fertiliser (N, P, K), herbicides, insecticides, fungicides
- **glass** fibre
  - aluminosilicate dust

Eutrophication/Nitrification

- phosphorus/nitrogen leaching from fertiliser
- retting flax and hemp
  e.g.: Dallund Sø (lake in Denmark)

Climate Change/Global Warming

- energy used for **glass** fibre
  - melting and spinning
- energy used for **natural** fibre production
  - power for agricultural equipment
  - production/application of fertiliser/pesticides
  - release of CO_2 from decomposition and oxidation of soil organic carbon (SOC)

Depletion of resources

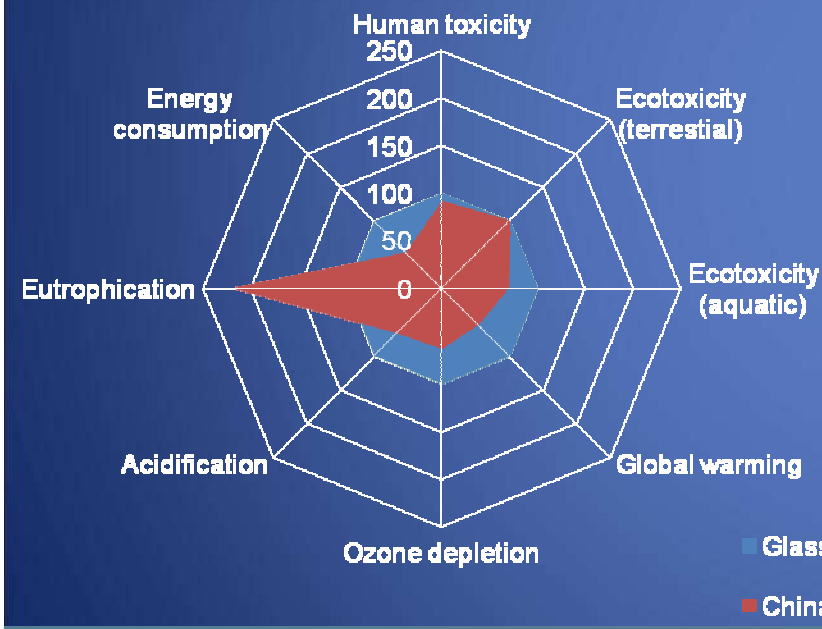
- quartz and feldspar used in glass manufacturing process
- feldspar used in fertiliser production
- loss of soil fertility and reduction in soil pH through long term conventional tillage

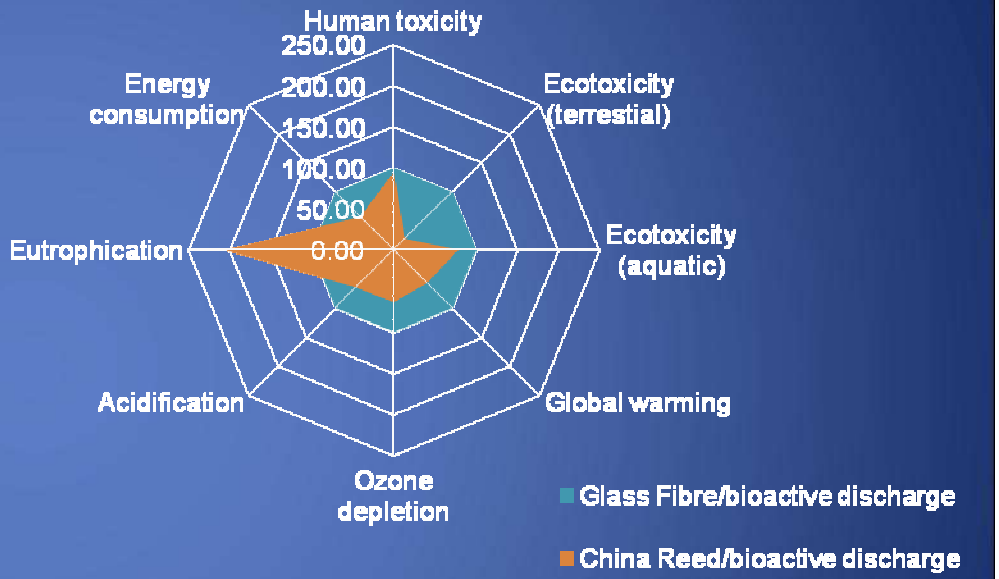
Ozone Depletion / Photo-oxidant formation

No significant issues identified at this stage of the study.

Previous study/model output

- Corbière-Nicollier on China Reed vs Glass





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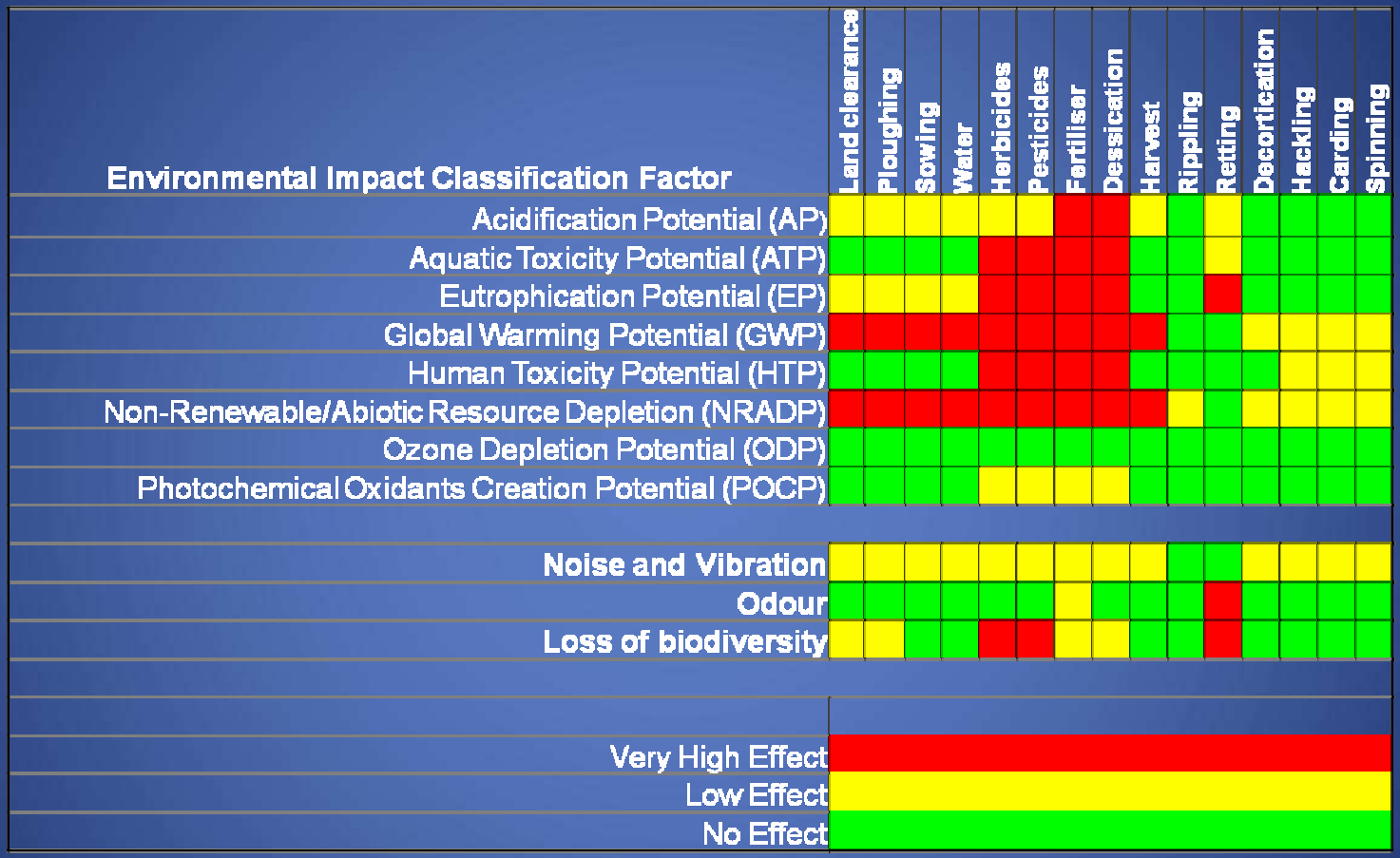
Results

Environmental Impact for Flax fibre:



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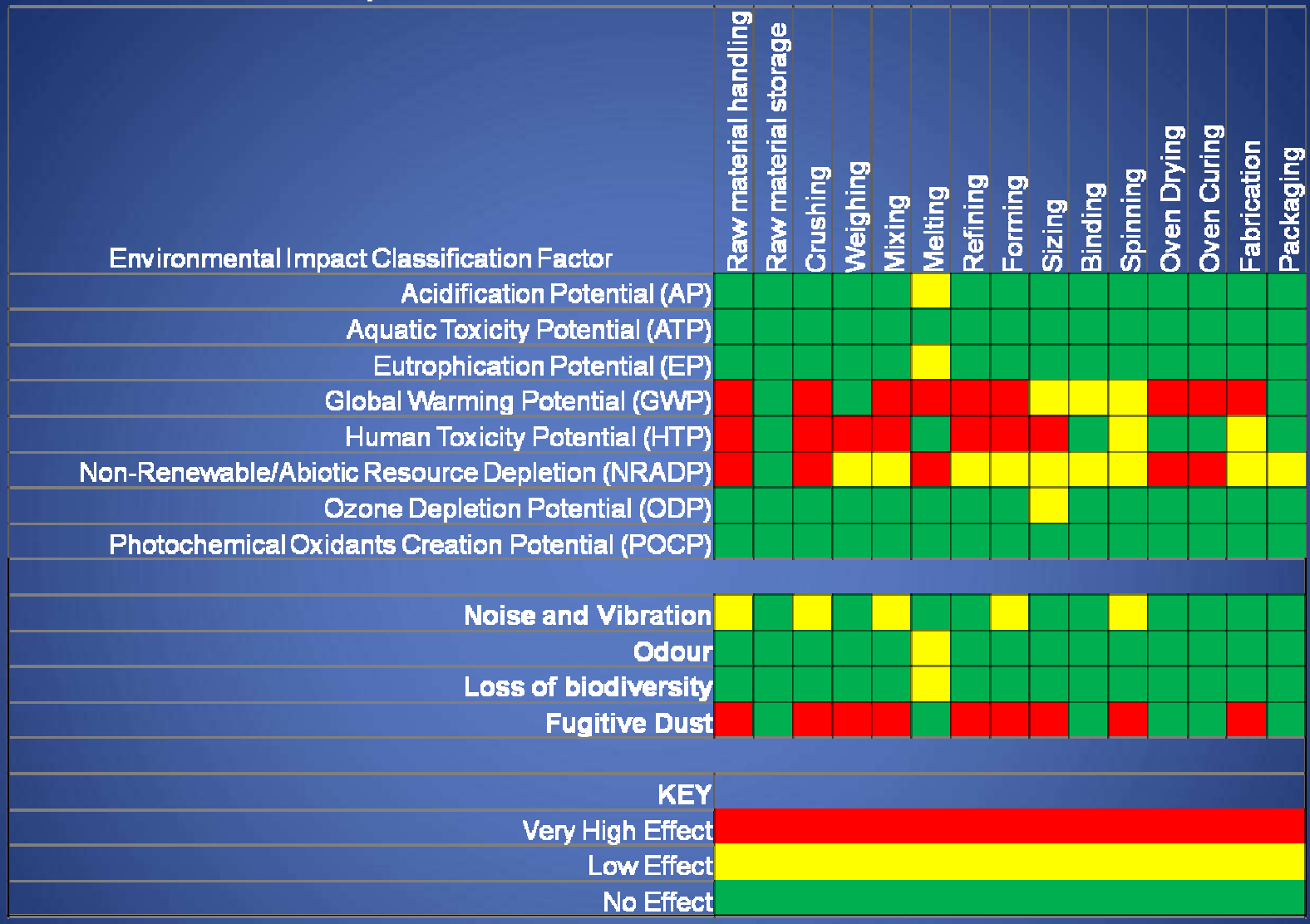
Environmental Impact for Glass fibre:



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Discussion

- Key issues (red in preceding Figures)
  - flax fibre production:

    eutrophication, eco/human toxicity, global warming, abiotic resource depletion

  - glass fibre production:

    global warming, human toxicity

Conclusion

- main environmental issues are identified
- need to determine variation between worst and best practice in each case
- need to acquire more comprehensive data – clues welcome !

Any questions ....