

NSF PIRE Collaboration: Sustainability Evaluation of Jatropha Oil Production in Yucatan, Mexico



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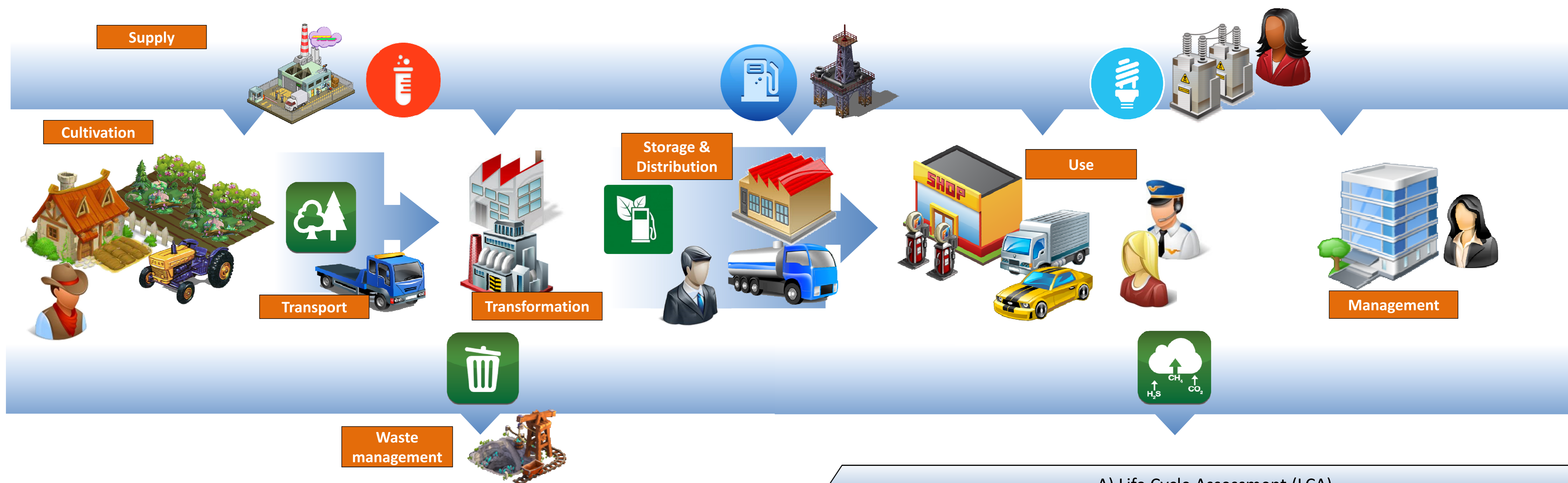
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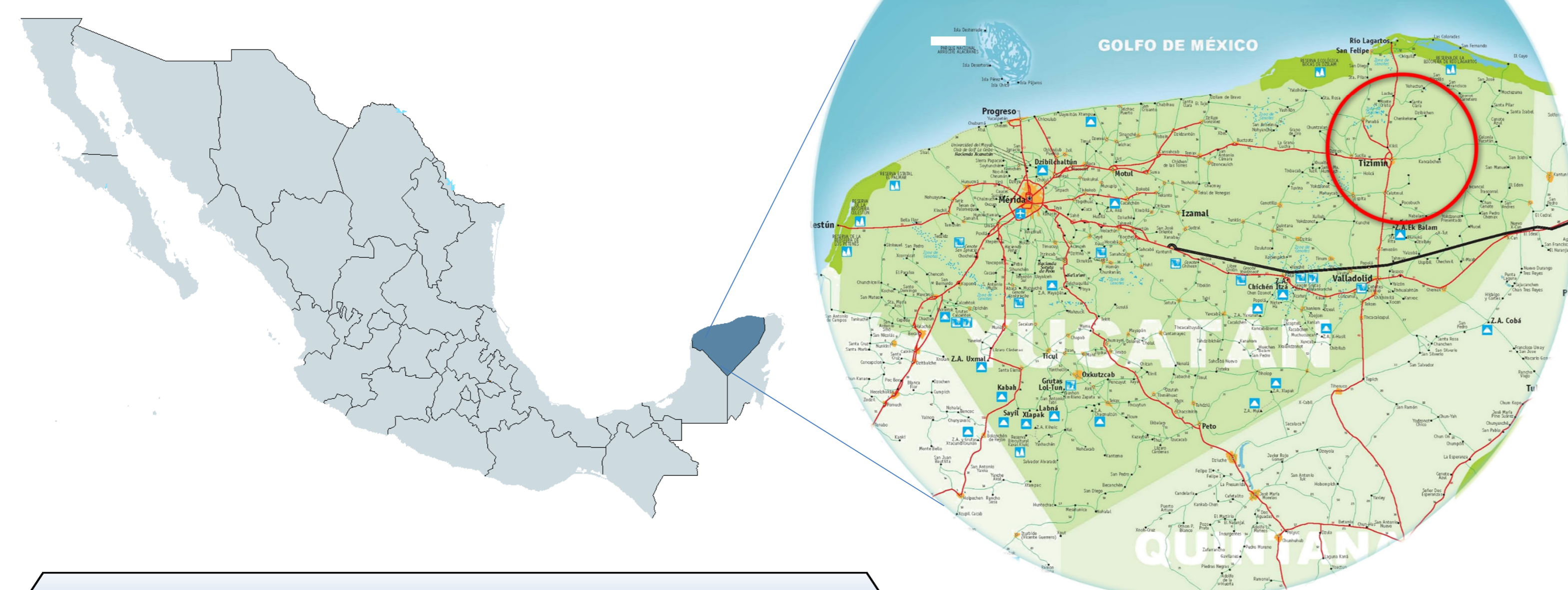


This project enhances the scope of the awarded OISE-PIRE proposal "Sustainability, Ecosystem Services, and Bioenergy Development across the Americas", focusing mainly on two research questions: "How is bioenergy development affecting social systems?" and "How could the biorefinery concept improve the sustainability of biofuel and bioenergy systems?" This project seeks answers to these two questions, under the overarching OISE-PIRE themes of "Life-Cycle Assessment" and "Community-impacts". It analyzes the jatropha-oil industry, currently at R&D status in the Yucatan state, Mexico. In 2008 several companies established medium to large-size jatropha plantations in so-called non-agricultural land, hiring local peasants farmers to carry out the agricultural work. After 5 years the plantations were considerably downsized or even abandoned due to poor yields and lack of key knowledge of proper cultivation practices worldwide. Based on sustainability indicators¹, this case study focuses on assessing the effect that the biofuel-related activities had on the surrounding communities from a multidisciplinary perspective.²

1 Life cycle of jatropha-oil biofuels: Stages, flows, and stakeholders



2 Case study in Sucopo, Yucatan



B) Propensity Score Matching

By using the "nearest neighbor matching" algorithm, we could quantify the economic impact of establishing jatropha plantations in local communities. The **main findings** were that, in comparison with peasant farmers who did not work on the plantations, those that did had:

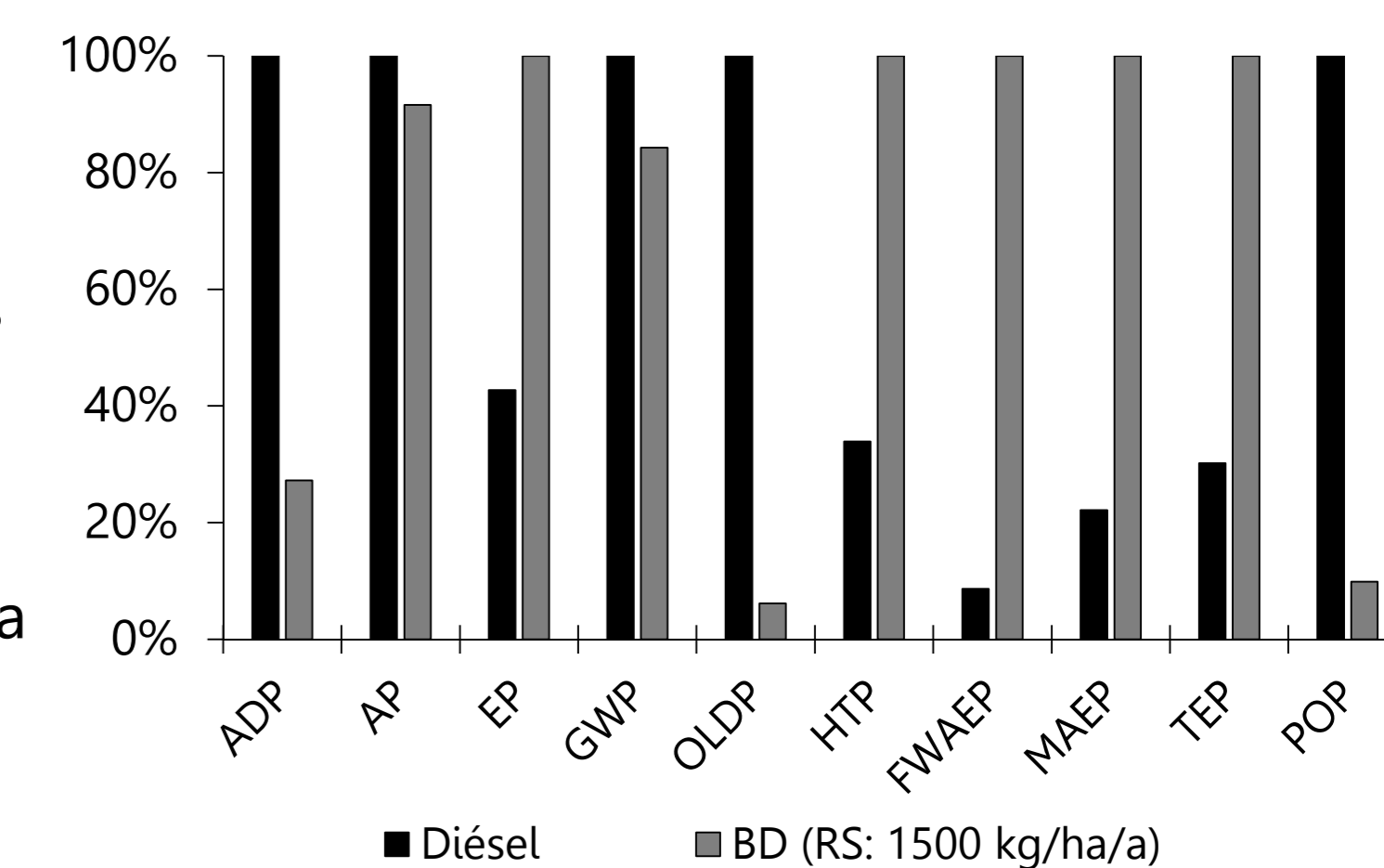
- Larger annual incomes (a difference of around \$1,000 USD).
- Considerable economic flow in salaries
- More available time for maintaining their own farm production (*Solar*, *Milpa*, and *Parcela*).
- No evidence of Capital (productive) Investment.
- Investments in unproductive assets (Motorcycles and TVs)



A) Life Cycle Assessment (LCA)

A system producing **biodiesel from jatropha seed-oil** (at 1.5 ton/ha/yr) has the potential to be **energetically self-sufficient** and produce 40% extra energy. If agroindustrial waste is burned to produce electricity, the available energy for exports increases to 90%. These values increase as seed productivity increases on the field.

Some potential environmental impacts are better (ADP, AP, GWP, OLDP, POP), and some are worse (EP, HTP, FWEP, MEP, TEP) than the fossil diesel alternative. The *hot spots* are the use of fertilizers during the agricultural stage, and the land-use change emissions. The Global Warming Potential (GWP) of the biodiesel is less than that of the fossil diesel, but a seed productivity of at least 2.5 ton/ha/yr is required to achieve the reductions demanded by international standards.



C) Qualitative Interviews

Some 160 household interviews were carried out in the treatment and control villages near the jatropha plantations to enquire about perceptions of the local communities, their environmental services and how sustainability was understood. In the treatment village of Sucopo people were also asked about the impact of Global Clean Energy's jatropha plantations.

It was found that nature and environmental services were fundamental to people's sense of identity, that sustainability was understood as being able to continue living in the same manner and that unemployment was the greatest problem everyone faced. Hence Global Clean Energy's jatropha plantations were perceived by Sucopo as a benefit when they were established and as a loss when they were abandoned by the company and 500 local people lost their jobs.³

Although the plantations caused a reduction of natural capital through some deforestation, diminishing honey production and traditional agricultural yields, this was seen as a small price to pay for steady employment.

3 Conclusions

- ✓ While the local peasants farmers had clear **income and perks benefits** during the time they worked on the jatropha plantations, they lost their job after 4 years due to the companies' failure to obtain acceptable seed yields. Interestingly, one of the companies had just attained a **RSB sustainability certificate** one month before it began to downsize its operations.
- ✓ Sucopo inhabitants considered that the **employment opportunities** brought by Global Clean Energy's jatropha plantations more than compensated for the deforestation and the perceived negative ecosystem impacts that they caused.
- ✓ Currently, companies are focusing on **genetic selection**, and gaining knowledge about best cultivation practices, which **should have preceded** planting on a large scale.
- ✓ Using LCA results and a biorefinery concept³ for designing **large capacity plants** could significantly improve the environmental and economic performance of the biofuel production. In any case, seed productivity is a key parameter for achieving the levels of environmental benefits demanded by international standards.

References

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Acknowledgements



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