Biodiversity implications of international trade: comparison of threatened species from alternative electricity production with natural gas or concentrated solar power

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INTRODUCTION

International trade frequently implies that parts of the value chain of products and services consumed in developed nations take place in developing countries with weaker environmental protection laws, leading to uncontrolled air and water pollution. However, the implications that such international trade has on biodiversity have received lesser attention for various reasons. The lack of detailed and comprehensive data, the complexity in assessing the interlinked causes of species threats, and being considered low priorities in policy-makers´ agendas could be some of the main reasons. To shed some light to this issue, based on a Multiregional Input Output (MRIO) framework, this work analyzes the biodiversity implications in terms of affection to threatened species along the supply chain of two electricity generation systems in Mexico: Concentrated solar Power (CSP) vs. Natural Gas Combined Cycle (NGCC). Besides the installation and operation and maintenance (O&M) of the systems are assumed to be located in Mexico, the assessment also accounts for the required international trade of products and services, both directly (e.g. imports of plant components) and indirectly (e.g. inputs needed for manufacturing such plant components).

Figure 1. CSP and NGCC supply chains: international trade of products and services and associated biodiversity damages

MATERIALS & METHODS

Based on the Framework for Integrated Sustainability Assessment (FISA) [1], the global economic stimulation of the supply chains is estimated through a MRIO analysis. Next, the associated effects on biodiversity are estimated considering the damage of human production activities to ecosystems and species. This is conducted using the threatened species database EORA [2], which relates the IUCN red list of species threats [3] to the responsible economic sectors. By adapting EORA to the MRIO database used in this work [4], results show the number of threatened species that would be affected by each electricity generation system and the involved global trade throughout their supply chains. It also allows to identify the responsible economic sectors and effects characterization (direct/indirect, national/international or investment/operational phases) affecting biodiversity.

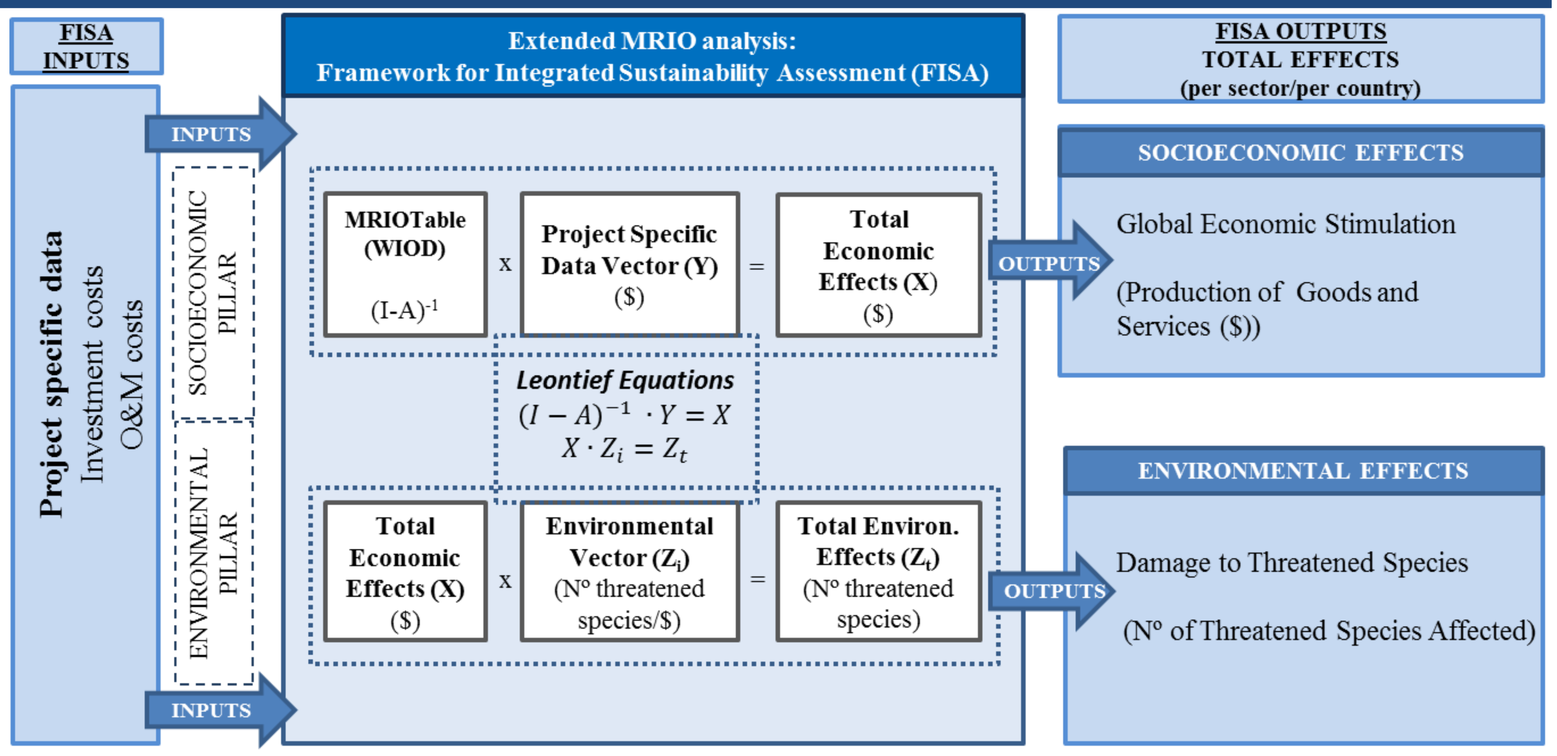

Figure 2. Extended MRIO analysis: Framework for Integrated Sustainability Assessment

RESULTS & DISCUSSION

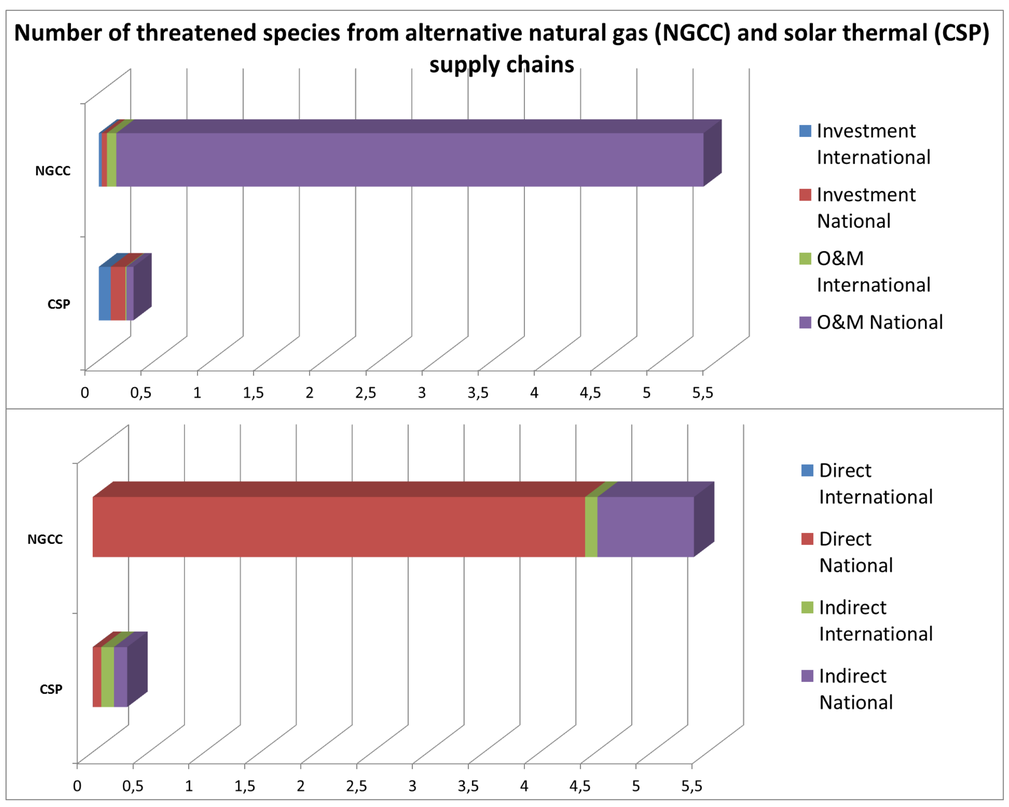

Figure 3. Contribution of project phases (up), and direct and indirect effects (down) to the number of threatened species affected, in Mexico and in an international scope

Figure 3 shows the number of threatened species affected by CSP and NGCC supply chains. While CSP supply chain activities would be affecting less than one threatened species, NGCC supply chain activities would be affecting more than five threatened species. As shown in Figure 3 (up), this difference is mainly caused by NGCC activities in the O&M phase, taking place in Mexico. Additionally, Figure 3 (down) shows that main responsible threats are caused by direct effects also taking place in Mexico, and indirect effects to a lesser extent.

The larger effects of NGCC are related to the demand of natural gas needed to produce electricity, stimulating the "Electricity, gas and water supply" sector in Mexico, and therefore responsible of main biodiversity damages (Figure 4). Threats of this sector could be related to climate change effects from fossil fuels production and consumption, which according to the IUCN threat classification, include habitat shifting and alteration, droughts, extreme temperatures, storms and flooding [3].

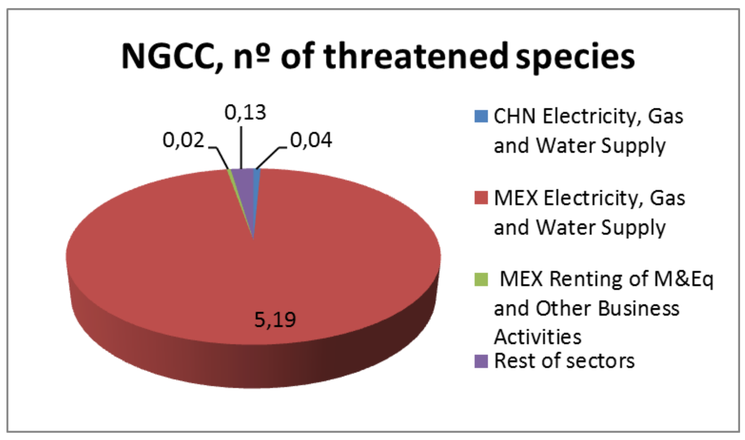

Figure 4. Contribution of economic sectors and counties affecting threatened species from NGCC supply chain activities

CONCLUSIONS AND FUTURE RESEARCH

Results of this analysis could help identify and raise awareness about the harmful effects on biodiversity of the embedded international trade of two alternative generation technologies. Results show that the CSP technology and its supply chain is the alternative less harmful to biodiversity, and they also help identify riskiest activities damaging threatened species. This could aware manufacturers, consumers and decision makers about the biodiversity implications of products and services´ international trade. However, more research is needed to minimize riskier activities and boost societal changes. Future research will be focussed on a deep study of the riskiest supply chain activities and threats, and trying to identify main affected threatened species.

REFERENCES

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