Introduction

- The resource nexus can be defined as a set of critical interlinkages among natural resources used as inputs for essential services to human life, such as water, energy, and food, and their value chains (Bleichschmidt et al. 2018).
- However, being a novel framework, the nexus is not yet embedded in resource use and management literature, which tends to analyse each resource separately.
- The nexus framework is intrinsically context-specific, as each respective region will have their particularities in terms of critical interlinkages. Hence, nexus research should ideally be conducted downscaled to a country or region focus.
- Being a large emerging economy, which economic activities are based to a great extent in agriculture and renewable resources, Brazil has proven to be a textbook-case for such effort (Mercure et al. 2019).

Objective

The aim of this paper is to propose a research agenda for the resource nexus framework in Brazil, raising the most important interlinkages between two or more resources and their underlying research gaps.

Method: Systematic Review

Definition of Resource Use and Management Practices

- The concept of resource use and management practices used refers to practices regarding: (i) Clean water provision for households, agricultural water uses, water treatment, solid waste and effluents disposal, sewage collection and treatment; (ii) energy generation technologies; (iii) agriculture and livestock activities and techniques which produce food goods for the population.
- Krueger et. al. (1986) and the European Commission (2002) define natural resource management as a means to cope with resource scarcity and ensuring their sustainability across time.

Systematic Review

Key words: “water” or “waste” or “food” or “energy” and “Brazil”

Scope and Web of Science searches in English and Portuguese

Titles and abstracts reviewed

Exclusion criteria: (i) case studies in Brazil (ii) Describing specific practices for one or more resources.

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Number of Papers per Interlinkage Identified

- (i) Group papers per practice they describe; (ii) identify how many resources the described practices involve; (iii) Analyse how each of the resources is impacted; (iv) Select critical interlinkages according to: incidence in the literature, number of resources impacted scale of use in the national context.

Number of Practices per Resource Analysed in Each Paper

<table>
<thead>
<tr>
<th>Resource</th>
<th>Type of Practice</th>
<th>No. of Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Agricultural use</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Household use</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Water treatment</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Solid Waste disposal</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Effluents/sewage</td>
<td>15</td>
</tr>
<tr>
<td>Waste</td>
<td>Agricultural use</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Thermal energy</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Agriculture</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>135</td>
</tr>
</tbody>
</table>

Main findings

- Although the reviewed literature is focused in one resource at a time, 35% of practices analysed involve two or more resources.
- Biogas technologies are seen by the literature as a potentially relevant synergy mostly between waste, energy and food for the medium to long term (31 papers).
- The water-food interlinkage is highly relevant due to the expansion of agriculture to areas where irrigation is necessary (29 papers).
- The most relevant nexus research agenda for Brazil lies in the resource interlinkages around bioenergy and hydropower.
- The most significant trade-offs in terms of scale are the water-energy-food interlinkage of bioenergy and the water-energy interlinkage of hydropower.
- Solar and wind sources are the most prominent alternatives to tackle such trade-offs.

Paper under review: Renewable and Sustainable Energy Reviews Journal

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