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Technicalizing non-technical participatory social impact assessment of prospective cellulosic biorefineries: Psychometric quantification and implications

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HIGHLIGHTS

- Quantified participatory social impact assessment (PSIA) of biorefineries.
- Developed highly reliable and valid PSIA instruments; conducted representative PSIA.
- Revealed the operation of familiarity heuristic in social impact assessment.
- Determined impact priorities for different social and geographic entities.
- Enabled legitimate guidance of social investments to mitigate and enhance impacts.

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ABSTRACT

Participatory social impact assessments (PSIAs) are most accurate reflections of social impacts. But, effective integration of PSIAs into Environmental Impact Assessments, decision-making and project implementation present drawbacks. Because of its qualitative content, PSIAs outcomes are termed non-technical—allegedly defying reliable and valid quantification, and consequently impeding determination of impact rankings that inform social investment priorities given limited mitigation and enhancement resources. The participatory fora typically used in PSIAs leads to inadequate representation and outcomes that reflect mostly the perspectives of those who can afford to attend. Social impact assessments are also criticized for lacking reliability. We present a mix methods approach for reliable and representative quantification of PSIAs of cellulosic biorefineries. We conducted 35 structured stakeholder deliberative fora. Four main impact dimensions, each with positive and negative sub-dimensions, emerged from those fora: economic, technical, environmental, and socio-cultural and political impacts. We used these results to develop eight psychometric scales used to quantitatively appraise PSIAs of proposed biorefineries. We compared impacts among social groups differentiated by: un/familiarity with other forms of bioenergy operations and industrial activity, and in/activity in the labor force. No non-response biases were detected. All PSIA instruments were highly reliable; Cronbach α ranged from 0.73 to 0.93. There were significant differences in impacts based on stated differentiating criteria, the most distinguishing of which were positive economic, and negative socio-political and cultural, impacts. We found evidence of the operation of the familiarity heuristic. We show that PSIAs of cellulosic biorfineries can be reliably quantified while ensuring representation, comparisons and determination of priorities to facilitate decision making. Hence, unreliable quantification may no longer deter effective use of PSIAs in cellulosic biorefinery establishment and operation. We discuss the implications of our findings for the sitting of biorefineries, impact mitigation and enhancement, and for PSIAs of other forms of energy.

1. Introduction

Social Impact Assessment (SIA)—the process of identifying how current or future projects such as cellulosic biorefinery establishment and operation may affect individuals and social entities [1]—are useful in several ways. SIAs reveal both the positive and negative effects of project interventions, thereby providing knowledge about the social factors that may compromise or enhance project success. Hence, SIAs

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inform efforts to mitigate and enhance negative and positive impacts, respectively [2]. SIAs are, as a consequence, a required regulatory component of effective Environmental Impact Assessments (EIAs), and essential for effective decision-making and project implementation [3].

SIAs are valuable for securing the Social License to Operate (SLO)—level of ongoing acceptance of a biorefinery by local communities and other stakeholders—that affects refinery profitability [4,5]. Perceived negative social impacts leading to the denial of SLO by local communities has been shown to undermine renewable energy expansion and attainment of renewable energy targets [6]. It is widely agreed that project proponents must acquire and maintain SLO from local communities and other stakeholders, to prevent costly disruptions that may also undermine the reputation of project proponents [7].

The centrality of SIAs to project success and the quest for SLO has led project proponents to extend SIAs beyond technocratic minimum regulatory requirements to include thorough engagements with local communities and other stakeholders [8]. This engagement process, referred to as community-based or participatory SIAs (PSIAs), enables potentially impacted people to participate in impact identification and assessment. Hence, unlike technocratic SIAs that are often different from actual social impacts, PSIA does not rely on often inaccurate predetermined lists of possible and easily quantifiable impacts. By considering the perspectives of affected communities, PSIAs are more effective and accurate reflections of how projects might affect community wellbeing and living environments [2,9]. PSIAs occur in variously structured small group interactive community fora where participants project and deliberate about impacts [10].

Despite being a more accurate reflection of how projects may affect pertinent communities, PSIAs are less readily integrated in EIAs and consequently less used in decision-making. And, for several reasons, PSIAs can also mislead decision-making. First, PSIAs are referred to as non-technical SIA because its contents are essentially qualitative, appearing to defy reliable and valid quantification. Nonetheless, we recognize that quantification would enhance integration of PSIAs in EIAs and efforts to respectively mitigate and enhance negative and positive impacts. But, there exist no protocol for systematically quantifying PSIAs while ensuring reliability, a key attribute of valid assessments.

Second, the conduct of PSIAs can lead to misleading outcomes through default stakeholder exclusion. The characteristic requirement that stakeholders participate in PSIAs, challenges adequate stakeholder representation and comprehensive coverage of impacts—not all stakeholders can make the schedules and venues for participatory fora. Therefore, PSIAs may lead to situations where rather than effectively representing community impacts, the outcomes are dominated by the interests of those who afford time and other resources to participate [11]. Such dominance undermines the accuracy of impact assessments. Inaccurate assessments are likely to misinform efforts to enhance and mitigate positive and negative impacts, respectively. Hence, despite being more accurate, PSIA fora present similar drawbacks to technocratic SIAs—misestimating the realities of affected people, which undermines social acceptability and thence costly to the project.

Third, given its qualitative content, even inclusive PSIAs does not enable determination of relative impact salience—impact priorities—among communities and constituent groups. Impacts are not felt uniformly across communities [2]. Different social groups may prioritize different impacts; yet there exist no clear method for determining such differences [3]. Some influential stakeholder groups may obstruct the establishment and operation of a biorefinery, on the basis of what is perceived to be more impactful to them [12]. For impact mitigation and enhancement efforts to be effective, they must be tailored to the specific concerns of each social group within pertinent communities. Hence, the need for quantification that enables commensurate comparisons of impacts within and among particular interest groups.

Fourth, effective decision-making under typical resource constraints often involve prioritization of issues worthy of intervention; impact prioritization, and hence quantification, is essential in these circumstances. Without quantification, determinations and comparisons of impact priorities among different social groups are impossible or at best messy. Thus, despite best attempts, the outcomes of PSIAs are likely to undermine social acceptability and consequent project success, when impact priorities of communities and constituent social groups are not readily discernable.

Fifth, there are growing critiques of the methodological soundness of SIAs, including detailed protocols that enable transparency, and determination of reliability and validity of SIAs [13,14]. Hence, for this study, we aim to: (i) quantify (technicalize) PSIAs while addressing concerns about methodological soundness, reliability and validity, (ii) enable broader stakeholder representation in quantifying PSIAs, and (iii) illustrate impact comparisons and determination of impact priorities for pertinent communities and social groups. We discuss the implications of the quantification protocol and findings on the sitting and operation of cellulosic biorefineries, including negative impact mitigation and positive impact enhancements. Our approach compliments efforts at understanding the social impacts of other forms of renewable energy such as windfarms [15] and solar photovoltaic soiling [16], as well as the social impacts of renewable energy policies [17].

2. Methods

2.1. Background, study area and hypotheses

The United States National Institute of Food and Agriculture mandated an initiative to examine the prospects for a sustainable cellulosic—hybrid poplar-based—biofuels system for the Pacific Northwest, USA. The region encompasses Northern California, Northern Idaho, Western Montana, and the entire states of Washington and Oregon. Cellulosic biofuel refineries are a potentially impactful component of that regional biofuels system. As part of the research initiative, we developed a protocol for PSIA, to identify and reliably quantify social issues that may arise from cellulosic biorefineries.

We used a two-phased approach to enable comprehensive impact identification, reliable and valid quantification, and broader coverage of social impacts. First, we scoped for impacts by convening and moderating several interactive participatory fora, within the region. Then, we used results of qualitative analysis of the content of interactive fora to design quantitative psychometric scales that we used to conduct PSIAs. We also used the results of the participatory fora to guide study site selection, and to generate and test hypotheses.

Twenty-two sites, in several counties within the region, were identified as suitable for biorefineries. But, the exact locations of the refineries were not determined. So, study site selection was informed by the results of participatory fora; analyses of fora data indicated potential deferential expressions of impacts based on whether stakeholders were familiar or not with other forms of bioenergy operations. The data also indicated potential differential expressions of impacts based on whether the stakeholder was from an industrial or rural area. These observations indicated the potential operation of the familiarity heuristics—the bias of rendering more favorable positive than negative judgments to familiar situations [18,19]. In this case, the possibility that familiarity with other forms of bioenergy operations and/or industrial activities are associated with higher perceived positive impacts than perceived negative impacts [20]. Equally, perceived negative impacts will be higher than perceived positive impacts for those without both forms of unfamiliarity. To test these variants of the familiarity bias hypotheses [18,19], we selected four counties in WA State (Fig. 1), differentiated by: (i) the presence or absence of other forms of bioenergy plants, and (ii) whether the county was predominantly rural or industrial—familiarity or not with other forms of industrial activities. The rural-urban divide site selection criteria was further motivated by evidence of differential preferences for renewable energy developments between rural and urban areas [21].

Of the four counties selected, Grays Harbor and Stevens counties