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Research paper

Use of a participatory approach to develop a regional assessment tool for bioenergy production

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ABSTRACT

Recent years have witnessed an upsurge in certification schemes and sustainability assessment tools for bioenergy, however these mechanisms are often too generic, numerous and too broad for regional or local level implementation. Furthermore, these assessments are often weighted toward economic and environmental sustainability with less focus on social, cultural and institutional factors. This study was intended to overcome these limitations. We developed a community-driven regional assessment tool for forest-based bioenergy production in the Upper Peninsula of Michigan (USA). Stakeholders representing local landowners, farmers, township supervisors, timberland management companies, venture capitalists, government organizations and local interest groups generated a preliminary list of criteria and indicators (C&I) in a series of focus groups and interviews, and narrowed the list using multiple criteria analysis (MCA) in a workshop. Participants ranked environmental protection as the most important and relevant sustainability criteria, although policy and governance, and institutional capacity were also weighted highly. The final set of C&I consisted of 17 criteria and 31 indicators (in parentheses): Economic (6), Environmental (7), Social (8), Policy and regulations (4) and Institutional capacity (6). This set reflected the general balance across sustainability principles valued by the stakeholders. While expert-developed sustainability assessments are routinely biased toward easily quantifiable indicators, the indicators that were considered important and relevant by our participants included both quantitative as well as qualitative indicators, in almost equal proportions. This participatory MCA method identified criteria and indicators that reflect the regional context and the concerns of local stakeholders, and data for many of these indicators are readily available.

1. Introduction

Growing interest of countries in the production and use of renewable energy, particularly since the early 2000s (e.g. US Energy Independence and Security Act of 2007; EU Renewable Energy Directive 2009) has generated a rapid expansion of biomass-based bioenergy production. In response, there has been a sharp increase in the number of initiatives to monitor and standardize the production of bioenergy products and their sustainability-related impacts [1]. These initiatives are generally motivated by the need for international trade obligations and other considerations [2], with little regard to local contexts [3].

Sustainability is an integrative function of environmental protection, economic viability and social equity [4–8]. Sustainable bioenergy development entails context-driven policy, regulations and institutional capacity [9,10]. Nevertheless, most sustainability assessment frameworks for bioenergy neglect issues such as governance, social impacts, and the linkages among global, national and local contexts [3,10,11]. Van Dam et al. (2010) suggested that bioenergy assessments of developing countries are generally motivated by socio-economic concerns while assessments in developed countries focus more on economic and environmental principles of bioenergy production [11]. Similarly, assessment tools used for micro and meso-scale assessments (e.g., Life Cycle Assessments, Cost-Benefit Analysis, and Environmental Impact Assessment) mostly focus on techno-economic and environmental aspects of bioenergy development, largely failing to reflect socio-economic and other community concerns and contexts [12]. A few global-scale sustainability assessments address these shortcomings and incorporate all sustainability principles (such as Roundtable on Sustainable Biomaterials (RSB), Roundtable on Sustainable Palm Oil (RSPO), Global Bioenergy Partnership (GBEP), and International

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Organization for Standardization (ISO) etc.). However, the variety of feedstocks, geographical regions, cultural contexts, logistic requirements, and production processes make existing generic frameworks too broad and ambiguous for practitioners to use at the grassroots level [3,13–16]. This suggests the need for a comprehensive framework for building sustainability assessments to address sustainability goals at a variety of scales [3,11,13,15].

Bioenergy production is a complex system with multiple interconnected components. An indicators-based sustainability assessment for bioenergy should be holistic and systemic, incorporating the participation of experts and actors from all components of the system [16,17]. This is possible only through an inductive, collaborative and reflexive approach that involves all key stakeholders in the development of the framework [13,18]. Participation in decision-making processes by key stakeholders and local experts can also enhance credibility, ownership, and context-specificity of the interventions, which are all imperative in the pursuit of sustainable bioenergy development [13].

This paper discusses the participatory development of a regional bioenergy sustainability assessment, involving stakeholders from all key components of a potential bioenergy production system. In the earlier phase of this study, we identified the interests and values of key stakeholders in relation to regional bioenergy development. These concerns and values were then translated into an extensive list of sustainability criteria and indicators (C&I) using an expert-assisted approach[1] for a bioenergy production system [10]. The main objective of this paper is to report the results from a stakeholder workshop and Multiple Criteria Analysis (MCA) methods to narrow down the long list of C&I from the earlier phase into a comprehensive yet manageable set of sustainability C&I. In Section 2, we briefly discuss the different phases of the research, and techniques used to collect and analyze data over the course of this study. In Section 3, we discuss our research outcomes and present the final sustainability assessment framework. In Section 4, we discuss the conclusions and limitations of our study.

2. Methods

Our study was conducted in the Western Upper Peninsula (WUP) of Michigan. The immense exploitation of the forestlands in the late 1800s and the early 1900s by the logging and mining industries had once left this region almost completely deforested [20]. Following the rapid downsizing of these industries by the 1960s, the subsequent outmigration had a tremendous impact on the regional economy. In the intervening decades the forests have regenerated, and currently more than 80% of the WUP land is forested [21]. The forest industry remains as an important part of the local economy and culture in the WUP. However, the youth population has continued to decline and the WUP remains an aging population [22].

We divided the study into three distinct phases: I) stakeholder selection; II) qualitative development of C&I; and III) preference elicitation using MCA techniques. We accomplished stakeholder selection through stakeholder analysis [23]. We collected data using a combination of three different participatory techniques for the latter two phases: focus groups and interviews for phase II [10] and one workshop to accomplish phase III. Here we will limit our discussion to phases I and III of this study. The main purpose of the workshop was to solicit feedback using MCA techniques on the importance and relevance of C&I generated from phase II, to generate a manageable, representative set of C&I to be used as a sustainability assessment tool as the bioenergy industry develops in the WUP.

2.1. Stakeholder selection

We identified stakeholders using a number of sources, including professional networks, snowballing and Internet searches. We invited potential participants through physical mail and/or email, which conveyed a brief description about the project, their role in the study, time commitments required of them, and incentives for their participation in the project.

A total of 31 stakeholders participated in the study, representing four major stakeholder groups as illustrated in Fig 1.

2.2. Qualitative development of C&Is

This phase identified the concerns of the stakeholders and their information needs. In addition to data collected through focus group meetings and interviews, a literature review on sustainability assessments also contributed to the development of the preliminary list of C&I. The literature review allowed us to partially validate our results from the focus groups and interviews, and highlighted the influence of the regional context on the sustainability goals of the community. Subsequently, we developed an extensive list of sustainability principles and criteria (and subcriteria and indicators for some criteria) based on the framework described in Ref. [24] (see Appendix A).

2.3. Preference elicitation: stakeholder workshop

Criteria that are widely used in the evaluation of sustainability indicators are: importance, relevance, practicality, reliability and their sensitivity to the changes caused by the system of concern [17,25–27]. In our study, participants evaluated the preliminary set of sustainability criteria for their importance (to the participants) and relevance (to the wood-based bioenergy production in the WUP) at the stakeholder workshop. The evaluation of C&I based on their sensitivity and practicality was beyond the scope of this study.

Prior to the preference elicitation, we gave a PowerPoint presentation to participants about the research activities conducted up to that point, expected outcomes of the workshop, and the MCA techniques that participants would use to evaluate the criteria and indicators. The presentation also included a brief introduction about the project, objectives of the workshop agenda, purpose of the workshop, and the project as a whole. The stakeholder workshop was held to accomplish this task. The workshop followed three steps:

2.3.1. Preparation

2.3.1.1. Criteria and indicators. Not all criteria and indicators in the preliminary list were bioenergy-specific, and many of them reflected the general concerns of the participants as a community. On the other hand, some of the bioenergy-specific criteria and indicators were relevant to one group of stakeholders with little relevance to another group. For instance, 'land management opportunities for landowners' and 'professional consulting services for landowners and farmers' are clearly relevant to feedstock producers, while they are of little relevance to the bioenergy producers or potential consumers of the bioenergy products. Therefore, in order to make the assessments comprehensive and easy to work with for all participants, we rearranged the criteria and indicators in the preliminary list into two broad categories: general (for criteria that reflected the concerns of the stakeholders as a community) and bioenergy-specific (for criteria that were reflective of participants' concerns as stakeholders of the bioenergy system).

[1] An expert-assisted approach is a participatory approach, which involves the elicitation of local knowledge to understand the local socio-ecological context. In this approach, experts only facilitate the process and avoid using pre-defined criteria and indicators to generate a sustainability framework [19].