DEVELOPING A SUSTAINABILITY FRAMEWORK FOR ASSESSING BIOENERGY PROJECTS

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ABSTRACT: Focusing on the situation relating to Bioenergy in India, this paper provides an analysis of the currently available methodologies for assessing the varied impacts, both positive and negative, of bioenergy production. This contextual information is then framed within a perspective of planning for sustainability; and the reasoning behind development of the RE-Impact framework, drawing particularly from field experience in India, is presented.

Keywords: bioenergy; decentralised generation; environmental impact; rural development; socio-economic impact; sustainability.

1 INTRODUCTION

Whether the cultivation and use of biofuels have positive or negative impacts is a widely disputed and fiercely contentious current issue globally. Cultivation of crops as feedstock for energy production has been occurring for centuries but has experienced renewed political and public interest over the last decades. The alarming rate of population expansion, simultaneous per capita consumption hikes and the increased cost of importing fossil fuels mean that secure energy supplies are a major global concern; so supplying sustainable energy production systems has become an urgent and unavoidable necessity. On top of supply concerns, renewable energy options such as biomass are being pursued in the expectation that they will provide cleaner and more environmentally friendly energy sources for future generations; as well as having positive rural development outcomes. More recently, opposition to the increasing cultivation of bioenergy crops has emerged strongly because projects where large scale deforestation has occurred to make way for monoculture plantations, and those where local people are negatively impacted, have been widely publicised. There are also situations, using starchy crops such as wheat, where carbon balances have been shown to be negative and effects on global food prices have been proven [1]. These issues have all contributed towards a change in the public perception of whether or not bioenergy programmes can contribute positively towards global development.

The concept of sustainability has become synonymous with development discussions, such as those described above, in the 21st Century. Therefore the challenge for bioenergy is to contribute towards meeting the needs of the expanding, developing global population while protecting natural resources and the environment; all essential characteristics of sustainable development. There have been numerous global efforts to provide frameworks for sustainability assessment of bioenergy programmes including international certification schemes and national policies or guidelines [2; 3]. The RE-Impact "Rural Energy Production from Bioenergy Projects: Providing regulatory and impact assessment frameworks, furthering sustainable biomass production policies and reducing associated risks" (www.ceg.ncl.ac.uk/reimpact) project has drawn on case studies in India, China, South Africa and Uganda to develop a sustainability framework for setting goals and criteria against which to assess sustainability of bioenergy programmes in a given context; and provides methodologies for furthering stakeholder understanding of specific aspects of sustainability.

Focusing on one of the four RE-Impact case study countries, namely India, this paper provides an analysis of the currently available methodologies for assessing the varied impacts, both positive and negative, of bioenergy production. This contextual information is then framed within a perspective of planning for sustainability; and the reasoning behind development of the RE-Impact framework, drawing particularly from field experience, is presented.

2 CURRENTLY AVAILABLE METHODOLOGIES

Environmental Impact Assessment (EIA), which is a procedure for measuring the effects that a planned development will be likely to have on the physical environment in which it is placed, is currently the most commonly and widely used methodology for impact assessment globally. The technique and process of EIA have an established history of application spanning the past 40 years, having first been legislated in the USA in the National Environmental Policy Act of 1969 [4]. Later versions do include variables for assessment of economic and social issues but still focus primarily on identifying and evaluating these issues separately and in isolation from ecological ones, which are seen as central. It is only thereafter that attempts are made to integrate the implications of these effects, so that a more comprehensive picture of the holistic impact of the proposed development can be obtained. The practice of EIA is widely used by law for the formulation of new projects or programmes (particularly large ones) and included in policies; however it is generally not seen as a participatory exercise, and takes place after the conception of a particular project or programme. In addition, EIA traditionally does not address potential effects that may manifest over time, and is most often used to evaluate a proposal at a “snapshot” in time. The result is that the nature, extent and dimensions of that project must be constant for the analysis to take place, and so changes in the project over time constitute a “new project”, which must then be subjected to a new EIA.

Social Impact Assessment (SIA) is an increasingly recognised methodology for quantifying what the likely impacts of a planned intervention may be on the host population and community structures in advance [5]. This approach has evolved as a separate entity to EIA because the scant coverage of social issues in the former is often deemed insufficient for social science practitioners. The process differs from EIA in that it generally has a strong emphasis on participation as it involves a certain amount of consultation with stakeholders to see what their current situations and views are. Some iterations will go further and encourage multi stakeholder consultation (MSC) to formulate in depth knowledge of the social context and perceptions prior to commencement of an intervention, even continuing the participation throughout the decision making processes.

Strategic Environmental Assessment (SEA) is a now well established framework for consideration of the probable impact that a planned development will have on the social, environmental and economic aspects of a host area in advance. Building on the foundation of EIA, but including the full sustainability triple bottom line theory and proceeding in an entirely participatory manner; this has represented a real step forward in the incorporation of sustainability into planning frameworks. As the name of the tool implies, SEA is intended to facilitate the consideration of environmental effects from a strategic perspective, so that broader considerations than only those seemingly applicable to individual projects, are taken into account during planning. SEA has been widely used over the past 20 years to improve the incorporation of environmental issues into development policy, plans and programmes [6]. More recently, developments of SEA, namely Objectives-led SEA and Objectives-led Integrated Assessment, have been constructed. The latter seeks to integrate economic, social and environmental concerns in the assessment process and both are based on a common shared vision of the stakeholders set out in the planning process.

3 A PLANNING FOR SUSTAINABILITY PERSPECTIVE

Achieving sustainability is a core challenge for most development programs, partly as it is not a measurable target or an accurate science. Sustainability can only be achieved if, at the planning and implementation stages, there is as clear an understanding as possible of the expected and potential impacts of the intervention – both positive and negative. The term sustainability itself is subjective; depending as it does on the desired outcomes of the end user, which means a relatively strict framework for use is vital. The objective of planning for sustainability at the onset is to foster and preserve the social ecological system in which the project or programme is to occur so that it remains dynamic, adaptive, resilient and therefore durable over time [4].

This new area of impact assessment methodology builds on all previously used procedures, particularly the Objectives-led SEA; looking to optimise the process for a more sustainability oriented outcome. This method, entitled Sustainability Assessment (SA) aims to identify the entry point or goal for a particular area and bring sustainability into the planning procedure from the very outset to accomplish that goal. Separate targets are set, which are deemed markers for sustainability and, importantly, outlined by those stakeholders affected. So ideally this framework comes in to the planning process before a particular project or development is conceived, and is used to establish as many options for meeting the goal as possible. In addition, and in practice this may prove to be a common use of the tool, planning for sustainability can also be used to see whether a particular project, which has already been conceived, represents the most sustainable way of achieving the identified goal and what potential alternatives are available.

It is in this way, outlined above, that SA differs from the conventional approach to EIA; which is used to provide information for decision making, based on the level of potential environmental impacts that are considered acceptable, or which can be managed through mitigation. Although the more traditional assessment tools such as EIA or Life Cycle Analysis (LCA) have their place in the SA framework, the planning process throughout is expressly sustainability led, rather than having as its goal the identification and mitigation of potential negative environmental effects.

Building on the successes of the SIA and SEA approaches, the participatory element of SA has been incorporated as intrinsic to the process. Going even further than the previous methodologies, this approach seeks to identify and consult with stakeholders at the point of setting goals and targets, ideally before individual projects are even conceived, so that the participation is evident at all stages of the developmental planning procedure.

As well as in terms of the process objectives, SA differs primarily from the first two generation tools in that it focuses on the sustainability of the intervention under investigation, rather than having only an environmental focus. Further, in the case of the EIA approach; the lack of consideration of cumulative effects has been seen to be a major downfall [5; 6]. The SEA approach has attempted to address the limitations of EIA, in part at least, by considering environmental concerns from a strategic perspective and thus incorporating them in the planning process [6]. Though the SEA process has contributed towards incorporating environmental concerns in development planning, it does not necessarily contribute towards planning for sustainability, as it is driven by the strategies formulated for individual projects at its core rather than sustainability. The developments of Objectives-led SEA and Integrated Assessment, however, have proved to be important steps towards SA and the notion of planning for sustainability.

Sustainability is the *desired outcome* of the SA approach rather than merely the mitigation or minimisation of potential adverse environmental impacts. The approach is inherently integrative, participatory, positive and future-oriented. The first and most important step in this direction is for all stakeholders to jointly define a sustainability goal (or vision), namely the *desired outcomes* of the intervention upon which the planning for it should be focused [7]. Next, in order to assess whether the proposed intervention achieves the goals, sustainability principles and criteria would need to be defined. These criteria would be context specific, taking into account local economic, social and

environmental conditions, as well as the relationships between these components for the given set of stakeholders [4]. Understanding the interrelationships between economic, social and environmental components is critical and should influence the setting of the sustainability goals and criteria. It has been strongly advocated by proponents of the SA approach that it must be focused on these interrelationships and their character, resilience to change and adaptability, and the sustainability goals should embody such an orientation [8]. Therefore, the SA process has to be iterative and cyclic in nature so that the learning generated at each of the steps can be fed back into the process, thus allowing for goals and criteria to be revised as necessary. The SA approach is clearly a challenging one both practically and intellectually, but in order to incorporate sustainability as the key driving element in the development planning process, it is a crucial step that that authors believe must be taken for achieving sustainable development.

4 REQUIREMENT FOR THE RE-IMPACT FRAMEWORK – DRAWING ON FIELD EXPERIENCE IN INDIA

There is currently no requirement for prior assessment of biofuels policies in India. This is due to the fact that biofuel production is seen as an agricultural undertaking and therefore categorised as a low risk activity. There has been an Indian Biofuels Program in existence for over 60 years, but significant momentum in this direction has only occurred in the past five years. A draft version of a National Biofuels Policy has been under consideration for over two years, so for the most part the country is still early on in the implementation phase of the procedure as the final policy is still not released following the initial draft phase. Based on the draft, the main drivers for the Indian National Biofuels Policy are expected to be:

- Generation of rural employment opportunities
- Saving of foreign exchange
- Promotion of energy security in the country
- Promotion of environmental security
- Achievement of climate change commitments
- Promotion of renewable energy sources

The initial focus of biofuels policy in India, until early 2000, has been on ethanol for gasoline blending, but more recently the Planning Commission, under the umbrella of the National Biodiesel Mission, identified *Jatropha curcas* (jatropha) as the most suitable tree-borne oilseed for the production of biodiesel in 2003. The Biofuels Program was then expected to expand to substitute fossil diesel up to 20% by 2011-12, this move being supported additionally as an option to rehabilitate degraded lands by improving their water retention capacity [9].

The use of vast amounts of waste and degraded lands for India's Biofuels Program has been devised as part of the Government's focus to promote rural development, in this case through bioenergy plantations. Until recently plantation activities, which have been occurring in some States where political will is strong, were often funded by Government schemes such as the National Rural Employment Guarantee Scheme. The responsibility for storage, distribution and marketing of biofuels once feedstock is being produced in any quantity presently rests with oil marketing companies in the country.

Most States have considered implementation strategies and a number of proactive State Governments have actually set up Biofuel Boards and State Authorities. Some, such as Chhattisgarh, have already undertaken to plant up large areas under bioenergy feedstock crops such as *Jatropha curcas* meaning that there are initial results emerging, but there is certainly still time remaining for learning to be passed on to other States and, even more broadly, to other countries. For testing and development of this SA methodology for bioenergy projects in a real case there is a good balance of implementation occurring and policy development in the early stages in India, so the chance to learn from experiences certainly exists, but there is also an opportunity to influence policy, particularly at the State level.

4.1. Issues and concerns regarding India's biofuels plans

A number of civil society organisations have raised issues and concerns regarding the implementation of the Biofuels Program [10]. These include question marks over the existence of such large areas of wasteland, and the possible negative impacts that monoculture bioenergy plantations could have on biodiversity and local ecosystems (correspondingly the livelihoods of the poor). In fact there is some suggestion that the identification of wasteland areas and plans to crop them will prove to be a strong mechanism for preventing community members from expanding their tenure into marginal areas.

In a practical sense it seems that initial yield predictions for crops such as jatropha have not come to fruition in the time since the Biofuels Program has been implemented, leading to concerns regarding the lag time in seed production and unreliability of existing planting material. In addition it is feared that, as an indirect effect of the above, high external inputs such as fertilisers and irrigation to ensure economical production of biofuel feedstocks could lead to the diversion of good agricultural land away from food production. However, in some cases where seed has been produced, the inadequacy of market support has led to the incurring of major losses by those who had invested in the planting material.

It is clear that, for the introduction of bioenergy feedstock cultivation to be a successful practice in India and to avoid the undesired consequences mentioned above, there needs to be an acceptable degree of harmony between the drivers for the Biofuels Program and the local level impacts. The number of cross cutting sectors involved in this Program is virtually unrivalled; consider for example: energy, natural resources, rural development, agricultural production, trade, and foreign exchange saving. Ensuring that one sector does not develop at the cost of another, and understanding the complex relationships between them, has to be central to the planning of bioenergy expansion in the country if the issues and concerns raised thus far are to be ameliorated fully.

4.2. Current impact assessment procedures in India

EIA is currently the most widely used assessment

procedure in India, but even this is limited to large development programs such as river valley projects, highways, thermal power plants and mining. EIA is not administered in the case of other land use change interventions such as large scale plantation activities, e.g. jatropha plantations, even though they have economic, social and environmental impacts. Furthermore, a common critique of EIAs undertaken in the country is that they are largely focused on technical aspects (and therefore most often beyond the comprehension of the lay person) with minimal regard to social components, and are undertaken in a non participatory manner. In addition to those limitations already mentioned, EIAs provide only a snapshot capturing a static moment in time and not the whole (effects over time) which have a bearing on the sustainability of the proposed intervention, as described in section 2. If the intention of development planning in the 21st Century is to ensure sustainability, particularly that of poor, rural populations engaged in marginal farming, and thereby make sustainable development a tangible option, a new tool is required. The authors recommend that the best such tool available currently is SA, and have designed the RE-Impact SA framework accordingly.

In the context of bioenergy in general, and India more specifically, it would be a great injustice not to consider the numerous linkages in the bioenergy system. The interrelationship between the so-called pillars of sustainability (ecology, economics and society) have already been discussed, but there are also vital linkages between all forms of governance looking at both strategic and project levels; between geographic areas (both within and outside the country) and between forms of knowledge whether indigenous, traditional or otherwise [8]. The RE-Impact SA approach must therefore consider these relationships as part of the process itself, and this certainly represents a step forwards from previous forms of impact assessment.

4.3. Assessment of bioenergy projects

A brief survey of assessment methodologies described in the literature, and currently in use for the assessment of bioenergy projects, has been undertaken for RE-Impact [4]. This survey revealed that there are essentially two levels at which these assessments are conducted. The first level comprises a technology assessment approach where multi-criteria decision making (MCDM) is most commonly used the purpose of assessment [11; 12]. Included in the discussion of MCDM methods in this work, is reference to Decision Support Systems, which in these contexts are computer based tools to assist decision makers in systematically conducting “optimised” energy planning [12], where tradeoffs are made between several objectives.

At the second level are a range of approaches that attempt to incorporate sustainable development considerations into energy planning, and provide an integrated assessment perspective [3]. These approaches aim to design methods to address more comprehensively, and in a more integrated manner, the three pillars of sustainability, as well as stakeholder participation in (bio) energy planning. Unlike in the previously mentioned technology assessment approaches, the focus of their enquiry is broader and more comprehensive. In addition the methods they outline would seem to have significant utility as they stand, for sustainability assessment of bioenergy projects, plans, programmes and strategies. However, they have followed the conventional approach of investigation: looking at the three pillars first, with integration later [4].

Considering the previous approaches and learning from SA, key considerations and components of SA of bioenergy projects, plans, programmes and strategies, should be that:

A. A comprehensive LCA approach must be taken from feedstock production through to final use of the fuel produced;
B. Inputs, outputs, interactions and interdependencies at each stage of the supply / value chain must be comprehensively identified, understood and investigated;
C. All ecological, social and economic issues arising at every step in the supply chain, and all of the interdependencies and interactions between them, must be comprehensively investigated; and
D. All of the above must take place in a deliberative process of continuous engagement with all stakeholders throughout the entire planning for sustainability process. [4]

5 THE RE-IMPACT FRAMEWORK

This output comprises the application of the theoretical SA framework outlined above which has been used to evaluate the Indian situation with regards to bioenergy production. It is expected that this tool will help to guide and support planning and decision making for bioenergy production in countries such as India, where bioenergy development must be viewed within the context of existing poverty and prevalent resource management systems, i.e. the operating economic, social and environmental conditions and their interrelationships. In the RE-Impact project, a sustainable rural development SA framework has been developed for assessing bioenergy projects, and initial testing has been completed in India. This framework is presented in Fig. 1 below.

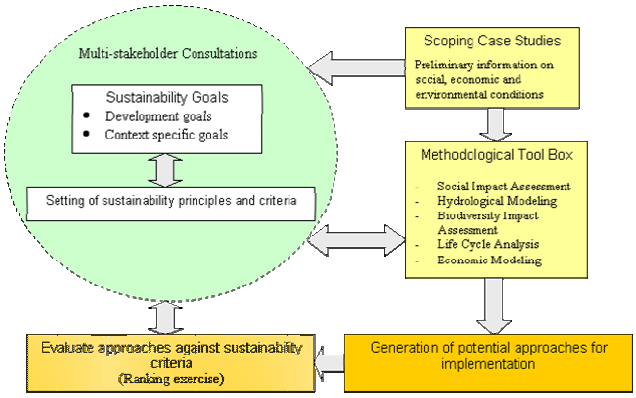

Figure 1: Proposed Sustainable Rural Development Framework for Bioenergy Projects from RE-Impact.

The prototype framework in Fig. 1 is based in large measure on the SEA approach used in South Africa [6], and the SA approach proposed by the Australian Government [14], as well as the recent research on and

analyses of SA [13; 7]. As shown in Fig. 1, a key process of the SA is the MSC within which the sustainability goal, principles and criteria have been developed for the Indian State of Chhattisgarh. Detailed stakeholder mapping was completed in the State to identify, for example, those stakeholders who are at risk, and who have the most power in implementation of the Program, and to map out the stakeholder hierarchy. MSC of the identified stakeholders has been taking place in Chhattisgarh since the project inception in early 2006, and reflects key consideration D (section 4.3), as it is a process of continuous, ongoing engagement. As discussed earlier in section 3, the goal is the central point upon which planning of a development proposal should be focused and the criteria are then used to determine how successful current proposed interventions are at meeting that goal. These criteria will inherently take into account the context specific vision of the unique group of stakeholders [4].

In the Indian case the overall goal of the Biofuels Program has been defined as rural development. This has been continually drawn out from semi-structured interviews with stakeholders at all levels throughout the country, and in the State of Chhattisgarh. The sustainability criteria identified include rural employment, increased livelihood diversity, degraded land rehabilitation, rural electricity provision and economic gains from sale of feedstock. Stakeholders did not see biodiversity as a central criterion, and the issue of carbon storage and CDM was a secondary consideration, but only for potentially large scale producers. The interrelating aspects could be identified early on in the process; for example village electrification could be described as a social issue but often electrification is required for agronomic irrigation purposes, so the impact on water resources could also become a consideration for water availability in an entire catchment. This understanding, right from the start, of how the social, economic and environmental aspects are interrelated; helps to fulfil key considerations A and C; investigation of the interactions at all levels of the supply chain.

The stakeholder consultations were initially supported by scoping case studies that assimilated preliminary information on the social, economic and environmental conditions in the area of intervention, Chhattisgarh State in this case, as well as relevant secondary information and data. The impact assessment studies listed under the methodological tool box represent a set of detailed assessment tools covering social, economic and environmental aspects of bioenergy projects. The findings from these studies will also feed back into the MSC once completed, where they would facilitate the following objectives:

1. Provide a scientific basis for planning and decision making by the stakeholders
2. Provide the opportunity to integrate the learning from each of these studies in a manner that is most suitable to that particular context and for that set of stakeholders. [9]

Currently application of the SIA methodology developed under RE-Impact to directly feed into the SA is well underway, as a direct result of stakeholder identification of social issues as being central to the sustainability of the Biofuels Program. At this time the SIA into the production stage of the bioenergy production chain is complete, and the other stages will be considered in due course (though they have been identified as having lesser impact overall). In addition very detailed water resources modeling has been completed for the State, considering current and future climate change scenarios under existing and possible future increased levels of bioenergy feedstock cultivation. These extensively applied methodologies represent clearly the inclusion of key consideration B; looking at all stages of the supply chain. It is possible that carbon baseline assessment of areas planned for large scale plantations of jatropha may be completed, and simple economic modeling is currently in the early stages, so these will also be disseminated to stakeholders as they progress. So far the methodological tools have proved successful, and learning is feeding back into the MSC to enable optimisation of the most suitable options for sustainable bioenergy production in the State of Chhattisgarh.

It should be reiterated in conclusion that the MSC has been the process by which the particular detailed studies, selected from the methodological tool box, have been identified; and that not all are required in all cases. On the other hand the scoping case studies and the methodological studies are assisting in generating options for potential approaches for implementation, rather than simply satisfying the assessment of those particular criteria. These approaches can then be evaluated against the defined sustainability criteria and the most appropriate will be selected, again through a consultative process. This entire procedure is iterative and dynamic, requiring active participation from all stakeholders. This remains the key challenge of the SA approach. It is through this ongoing consultative process, supported by scientific studies, that the RE-Impact team continues to test this framework in the Action countries.

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