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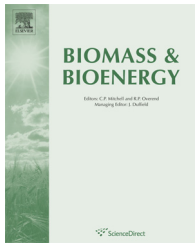

Combining bioenergy and food security: An approach and rapid appraisal to guide bioenergy policy formulation

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ABSTRACT

In the bioenergy discourse that ties energy and agricultural markets closely together, evidence based policy formulation is key to ensure integrated food and energy systems are developed when viable. Bioenergy is a particularly complex form of renewable energy as it covers a broad range of disciplines thus requiring a multidisciplinary approach to ensure viability. If built in a specific manner it has the option to target and provide investments in agriculture, a key sector for a number of developing economies.

Due to the complexity of the issue, generating information, especially when resources are limited, can be cumbersome. We present a multidisciplinary approach, the Bioenergy and Food Security (BEFS) Rapid Appraisal, that can provide a first level of information within the decision making process.

The analysis within the BEFS Rapid Appraisal defines the country context, estimates the biomass available for bioenergy production and ties this amount to specific bioenergy supply chains. Available biomass originating from agriculture is calculated net of current and foreseen uses and needs, thus accounting for food security. The bioenergy production potential is evaluated by quantifying the feedstock available, identifying income and employment opportunities, and energy access options. We present an application of the BEFS Rapid Appraisal for rural electrification options in Malawi.

1. Introduction

Energy plays an essential role in modern life, is central to development and enables food security. In fact, both in the Post2015 debate and under the UN's Sustainable Energy for All Initiative, the central role of energy and the need to ensure universal energy access is recognized and targeted [1,2].

At present, the energy sector heavily relies on fossil fuel supply and is the source of two-thirds of global greenhouse

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gas emissions. Consequently, current and future energy pathways will be pivotal in determining whether or not climate change goals will be achieved [3]. This is especially important when considering the differences in current energy access levels across the globe. Energy policy decisions of emerging and developing countries will play an important role. Developing countries still use a lot less energy compared to developed countries, although differences are forecasted to reduce over coming years, but will still remain large. For example, average per capita energy consumption in Africa is estimated to be less than one third of the global average in 2035, while emerging economies and their energy strategies will become the center of gravity for future energy demand [3]. Finding alternative energy strategies is vital to ensure climate change targets are met and that fossil fuels are not seen as the only solution to meet additional demand. As part of an alternative energy mix, bioenergy could play a role in developing countries, this could be especially attractive for those countries that are resource abundant and heavily rely on the agriculture sector [4–6]. The question to be answered is if, and what role bioenergy can play in contributing toward achieving energy security within the overall energy mix [7], while safeguarding food security.

The debate on bioenergy has been controversial. On one hand, bioenergy is seen as a source of additional demand for agricultural feedstock, putting pressure on resources, competing with food production, resulting in increased food insecurity [8,9]. On the other, some find that bioenergy can be a driver for increased agricultural production and productivity through investment in agriculture, rural development, job creation and income and contributing to climate change mitigation [4,5,10]. In addition, growth that targets the agriculture sector can better target poverty reduction [6]. The experience of those countries that have succeeded in reducing hunger and malnutrition shows that economic growth does not automatically ensure success – the source of growth matters too. Growth originating in agriculture, in particular in the smallholder sector, is at least twice as effective in benefiting the poor as growth in non-agricultural sectors [11]. This is not surprising since most of the poor in today's developing countries live in rural areas, where their incomes are directly or indirectly tied to agriculture [12,13].

It is generally acknowledged that the use of agricultural feedstock for energy production has strengthened the links between energy and agricultural markets [4]. Recent research in this area has also underlined how the idea of non-food competing feedstock is not the solution and that impact of biofuels on food security may not differ markedly from that of other agro-industrial crops [5,14,15].

From an energy point of view, bioenergy is a particularly complex form of renewable energy with implications across a number of disciplines. From an agricultural point of view, bioenergy is a market outlet for agricultural production [14].

For a policy to be evidence based, it is necessary to have a clear understanding of the feedstock production potential, how and where the feedstock can be sourced and what conversion technology is the most efficient to fulfill the specific energy demands. This is particularly challenging because bioenergy bridges across natural resource sciences, economics and engineering. Combining these disciplines allows addressing the complexities involved, resulting in a more robust analysis and delivery of information and evidence for the policy formulation process [16,17].

This paper presents a rapid appraisal multidisciplinary approach of in country bioenergy potential to meet energy needs, while considering the agricultural, economic and social context. Feedstock production is analyzed based on food production requirements and environmental considerations. All biofuel options are considered covering options for heating and cooking, electrification and transport. The paper first discusses the methodology integrated in the Bioenergy and Food Security (BEFS) Rapid Appraisal tools and then presents their application for the assessment of bioenergy options for rural electrification in Malawi.

2. Material and methods

The BEFS Rapid Appraisal consists of a set of excel based tools that are globally applicable and are used for a first level of analysis of bioenergy options. The analysis can be tailored for country or area level assessment depending on country size and data availability. The BEFS Rapid Appraisal has four areas of analysis [17], namely 1) Country context, 2) Natural Resources: Biomass Potential Assessment, 3) Energy end use options: Techno-economic Analysis and 4) Energy end use options: Socio-economic analysis. Area 3 and 4 of the analysis are presented jointly. Fig. 1 presents the areas of analysis and the interlinkages across sections of analysis.

The analysis carried out within the BEFS Rapid Appraisal covers the whole biofuel supply chain from feedstock production to processing plant gate or the final consumer. The analysis starts with the description of the country context, within which key agricultural features and current energy supply and demand are described and bioenergy pathways of interest defined. Based on this biomass types for the analysis are identified, the potential feedstock availability is estimated, and the competitiveness of the bioenergy pathway options and respective socio-economic implications and tradeoffs are assessed.

At the feedstock level, the biomass potential from forestry, crop production and agricultural residues can be assessed. At the energy end user level, heating and cooking options, rural electrification options and transport are covered. Outputs of one area of the analysis are used to define the underlying context, or are used directly as input parameters into the following step, of the analysis. Where possible, the tools provide default values which can support the analysis, when country specific data is not available. Default values are the result of literature research and reviews, relevant sources per set of default values can be found in the BEFS Rapid Appraisal Manuals [18–30]. Based on the BEFS Rapid Appraisal results, it is possible to define the areas for more detailed analysis that should support the policy formulation.

Food security considerations are interwoven throughout the framework. Based on FAO's definition [17], food security is related to production, access, utilization and the stability of the previous three dimensions. However, stability is not explicitly considered in the BEFS Rapid Appraisal.

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