



Assessing the potential supply of biomass cooking fuels in Kilimanjaro region using land use units and spatial Bayesian networks



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ABSTRACT

In East Africa, charcoal and firewood will remain the main sources of energy for cooking for the next two to three decades. Corresponding energy policies are needed that set proper priorities and improve the sustainability of the biomass energy sector. In this paper, we assess the supply potentials of wood-based and non-woody biomass fuels in the Kilimanjaro Region of Tanzania, and formulate recommendations to support sustainable biomass energy strategies in East Africa.

We differentiate between tree types of potentials: the supply potential, the access potential, and the production potential. In order to calculate these potentials, we use a spatial Bayesian network that specifically enables accounting for uncertainties in the data and model.

The main results show: (1) that agroforestry and small-scale mixed farming are the land use types with the highest potentials, (2) that firewood, charcoal, and biogas have substantial potential, whereas crop residue briquettes and Jatropha oil have only minor potentials, and (3) that such estimates can be subject to substantial uncertainties.

Based on these results, we recommend that biomass energy strategies in East Africa consider the specific assets and limiting factors of the various fuel types and land use types in order to improve the supply of sustainable biomass cooking fuels.

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Introduction

Background

Despite the efforts of national governments in East Africa to foster “modern” energy services, biomass fuels, especially charcoal and firewood, remain the dominant source of energy at the household level (UNECA, 2014). Demand forecasts (IEA, 2014) predict that biomass will remain the most important source of cooking fuel for the next two to three decades, and that pressure on woody biomass will almost certainly continue to rise due to population growth.

Researchers and practitioners agree that three measures must be taken to avoid resource depletion and prevent an energy crisis: (a) available biomass fuels must be managed sustainably and used as efficiently as possible (Felix and Gheewala, 2011); (b) biomass energy strategies must take into consideration the potentials of alternative fuel resources (Felix, 2015); and (c) incentives are needed to promote improved biomass fuel production and utilization technologies (Klas,

2012; Smeets et al., 2012; UNECA, 2014). However, experts also agree that these measures face major challenges.

First, the degree to which the potential for biomass fuel supply can be harnessed depends on a number of socio-economic factors, such as education and awareness about alternative solutions, the ability to invest in improved technologies, and access to markets (Rosillo-Calle et al., 2015; Sharma et al., 2016). Supporting measures are required to decrease or eliminate those factors that hinder implementation of a sustainable biomass energy strategy, and to strengthen those that enable it.

Second, biomass energy strategies that rely on diversified use of multiple fuels cannot be implemented uniformly across multiple contexts (Souza et al., 2015). In order to steer the biomass energy sector into sustainable pathways, policymakers and development partners must adapt their strategies to accommodate the varying supply potentials of specific geographic contexts. Concretely, this means largely departing from current mainstream strategies of biomass fuel utilization, which lead to resource depletion in some areas and neglect of readily available biomass resources in others.

Third, estimations of energy supply potentials are often subject to a high degree of uncertainty (Stecher et al., 2013), and quantification of these uncertainties is rarely provided. Overlooking such uncertainties can modify decisions and lead to the omission of important management

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options (Grêt-Regamey et al., 2013). Further, there is no generally accepted definition of “potential” (Thrän et al., 2010; Offermann et al., 2011; Bentsen and Felby, 2012), making it difficult to compare different studies; and because most studies focus on one type of biomass fuel, it is almost impossible to make comparisons between fuels.

Considering the urgency of the biomass energy situation in East Africa, priority setting is crucial to tackle the challenges outlined above: in particular, it is necessary to identify those supporting measures that will make the biggest difference – in specific contexts

and for particular fuels – towards improving the sustainability of the biomass energy sector.

Objectives

Against this background, the overall goal of this research is to assess the supply potentials of wood-based and non-woody biomass fuels in the Tanzania's Kilimanjaro Region, and to derive recommendations from this case study area in support of sustainable biomass energy

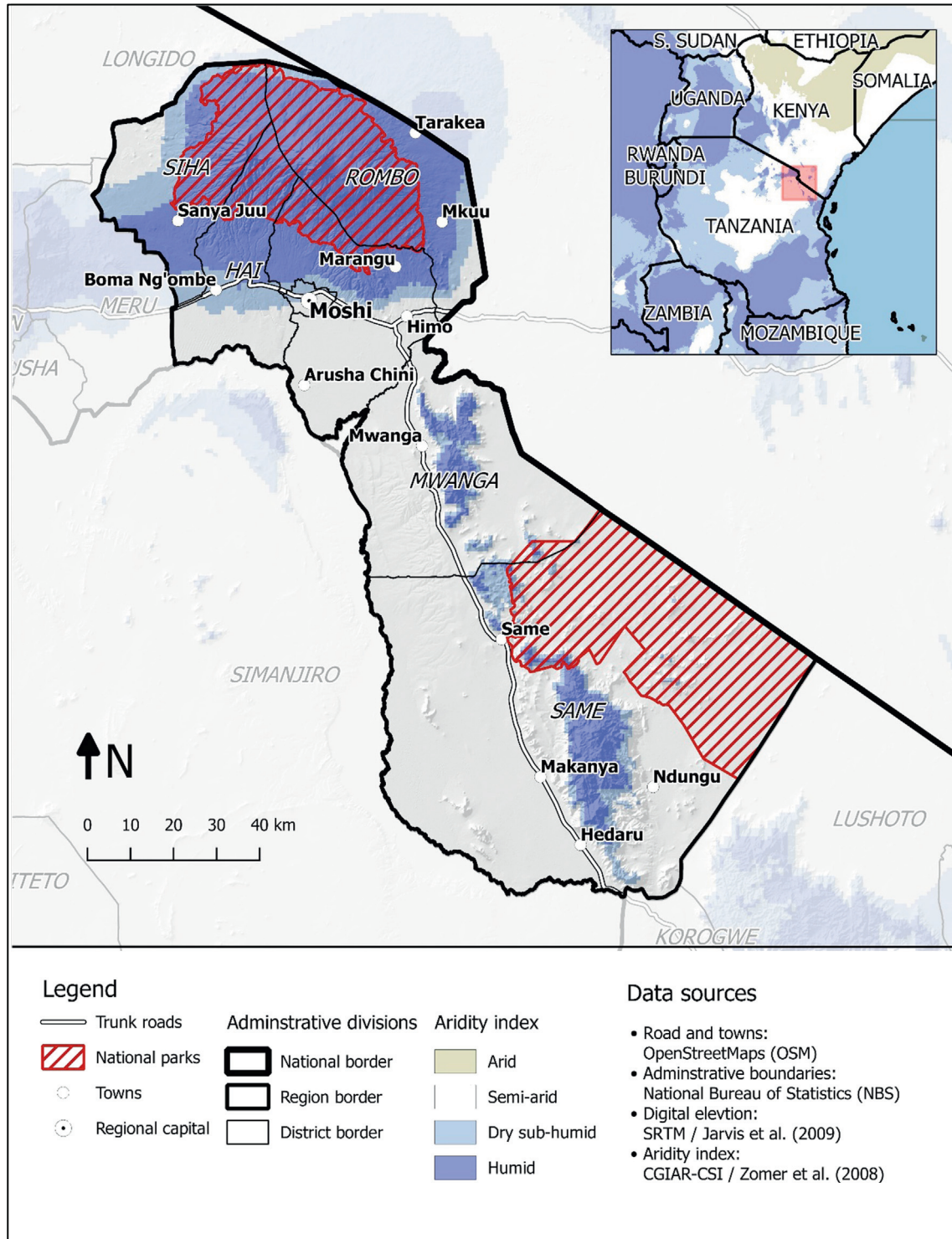


Fig. 1. Case study area of Kilimanjaro Region.

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