



Biomass resources and their bioenergy potential estimation: A review



Huiling Long^{a,b,**}, Xiaobing Li^{a,*}, Hong Wang^a, Jingdun Jia^c

^a State Key Laboratory of Earth Surface Processes and Resource Ecology, College of Resources Science and Technology, Beijing Normal University, Beijing 100875, China

^b Beijing Research Center for Information Technology in Agriculture, Beijing Academy of Agriculture and Forestry Sciences, Beijing 100097, China

^c China Rural Technology Development Center, The Ministry of Science and Technology, Beijing 100045, China

ARTICLE INFO

Article history:

Received 16 August 2011

Received in revised form

17 May 2013

Accepted 20 May 2013

Available online 25 June 2013

Keywords:

Biomass

Bioenergy potential estimation

Current and future

Different scenarios

Reviews

ABSTRACT

Biomass and bioenergy potential estimation has been worldwide research highlights in renewable energy field to get comprehensive understand of bioenergy development, especially under the situation of energy crisis. This paper reviews the results of previous studies that investigated biomass resources and their bioenergy potential estimation. It is organized from the perspectives of traditional vs. newly-introduced approaches and present vs. future. First, according to the methods used in relative studies, existing studies were divided into two categories: statistical data based and RS-GIS based. Second, concerning about the future of bioenergy, biomass and bioenergy potential estimation under different scenarios in the future were also reviewed and summarized according to the dominant factor considered in simulation. At last, based on the reviews above, questions and the future of bioenergy potential estimation were proposed so as to provide some instructions for bioenergy development.

© 2013 Elsevier Ltd. All rights reserved.

Contents

1. Introduction	344
2. Categories of biomass resources	345
3. Biomass resources and their bioenergy potential estimation	346
3.1. Estimation based on statistical data	346
3.1.1. Methods	346
3.1.2. Biomass and their bioenergy potential estimated from statistical data	346
3.2. Estimation integrating RS and GIS techniques	347
3.2.1. Bioenergy potential based on remotely-sensed biomass estimation	347
3.2.2. Land availability for bioenergy based on RS and GIS	348
4. Bioenergy potential estimation under different scenarios in the future	349
4.1. Climate change	349
4.2. Economic and technical development	349
4.3. Land use change	349
5. Questions and the future	350
Acknowledgements	350
References	350

* Corresponding author at: State Key Laboratory of Earth Surface Processes and Resource Ecology, College of Resources Science and Technology, Beijing Normal University, Beijing 100875, China. Tel./fax: +86 10 58808460.

** Corresponding author at: Beijing Research Center for Information Technology in Agriculture, Beijing Academy of Agriculture and Forestry Sciences, Beijing 100097, China. Tel.: +86 10 51503676; fax: +86 10 51503750.

E-mail addresses: longhl@nercita.org.cn (H. Long), xbli@bnu.edu.cn (X. Li).

1. Introduction

With the development of human society and the population growth, the surging demand for food and energy is forcing human beings and earth's terrestrial ecosystems confronting with unprecedented pressures. Since industrial revolution, the demand and consumption of energy have increased significantly. Energy shortage and security have become key issue all around the world. On

Table 1
Biomass resources categories according to their origination.

Categories		Representative materials	
Productive biomass	Terrestrial	Carbohydrate	Sugar cane, corn, sweet sorghum
		Starch	Maize, cassava, sweet potato
		Cellulose	Tropical grasses, poplar, sycamore
	Aquatic	Hydrocarbon	Eucalyptus, green coral
		Grease	Oil palm, rapeseed, sunflower
		Freshwater	Water hyacinth ^a
Unused biomass	Residues from Agriculture Forestry Fisheries	Ocean	Large kelp ^a
		Microorganism	Green algae, photosynthetic bacteria ^a
		Agriculture	Wheat bran, straw Vegetable residues, processing residues
	Waste	Animal Husbandry	Animal manure ^b Farm residues ^b
		Forestry	Secondary forest Woodland remnants Crippled material in plants
		Fisheries	Jettisoned and dead fish ^b
	Municipal Waste	Municipal and pulp sludge ^b	
	Garbage	Family garbage, feces ^b	

Note: The table is re-generated according to reference [4].

^a Indicate the amount of these types of biomass can hardly be estimated.

^b Indicating that the amount of these types could only be collected through statistical data. Besides statistical data, RS and GIS methods could be integrated into the estimation method of rest ones.

the other hand, greenhouse gases generated from fossil fuels are continuously accumulating in the atmosphere, which are the major pollutants of air pollution and important factors for global climate change. Facing the dual pressures mentioned above, more environmental friendly and more economical alternative renewable energy sources are gradually coming into view. Global climate change, food security and energy security are pressing us to seek a more sustainable way when developing our production, life and national economy. Bioenergy is one indispensable form of renewable energy among many from other sources (wind, solar, hydraulic, geothermal etc.) [1]. The use of biomass and bioenergy can significantly reduce greenhouse gas emissions. The carbon dioxide it gives off when it is burned is counterbalanced by the amount absorbed when the plant in question was grown. Thus, bioenergy production based on biomass resources is an essential substitute for fossil energy and has attracted general attention around the world. It currently contributes about 9–13% of the total global energy supply [2].

Biomass, as a renewable energy source, is biological material from living, or recently living organisms, most often referring to plants or plant-derived materials¹. Bioenergy is renewable energy made available from materials derived from biological sources. Biomass can either be used directly, or indirectly—once or converted into another type of energy product such as biofuel. Biomass resources estimation is a thorough spatial and statistical count of all the types of biomass. While, bioenergy potential estimation, is the estimation of potential amount of energy contained in biomass resources. Since the use of bioenergy could not only supplement the shortage of fossil fuels, but also stabilize atmospheric concentrations of greenhouse gases below dangerous levels and help achieve the objectives of the framework convention on climate change (FCCC), the question about how much and how far bioenergy could help arises. Studies about bioenergy potential estimation could give a thorough understanding of the sources, types, amount and distribution of bioenergy potentials. All these aspects can help assess how much bioenergy can substitute and supplement energy shortage, the possible degree to which bioenergy could contribute to decrease greenhouse gas, and how to arrange rational development and utilization of bioenergy.

Bioenergy potential estimation is the first step to understand bioenergy from the industrial chain and its development potential in the future. In order to take a thorough look at the bioenergy industry, researchers have done considerable studies about biomass and bioenergy potential, not only in global and regional scale, but also in national and local scale. In this paper, we review existing researches about biomass and bioenergy potential estimation through different aspects. The main objective of this paper is to reveal current research progress of biomass and bioenergy potential estimation, from the perspectives of methods, results, current situation and the future. Based on analysis above, the questions and the future of biomass and bioenergy potential estimation are discussed to look forward to its further development.

2. Categories of biomass resources

According to the definition of biomass by European Commission, there are various kinds of biomass resources such as products, by-products and residues from agriculture, forestry and relative industries, as well as the non-fossil, biodegradable parts of industry and municipal solid waste (MSW) [3]. Existing biomass resources categories are mostly based on their use and purpose. There are two wide-accepted ones. The first is productive biomass and unused biomass. The other divides biomass resources into agricultural, forestry and aquatic biomass, waste biomass and planted biomass [4]. Table 1 gives a detailed category of biomass resources and examples for every type, as well as the potential estimation methods.

When estimating the amount of biomass resources, the types are selected according to the accessibility of data in a certain region, thus it is hardly to find studies gathering all the resources types in their estimation. For example, in the estimation study of global bioenergy resources in 2050 done by Smeets et al., their first choice is energy plant, woods, residues and wastes including agricultural and forestry collection and processing residues, excrement and urine, MSW, etc. [5]. Li et al. considered four main types of biomass when estimating biomass potential in China's agricultural residues and wastes and forestry processing waste, firewood, excrement and urine and MSW [6]. Crop residues are the most commonly considered biomass types [7,8]. While, some food crops are adopted as main raw material for energy production in some

¹ Biomass Energy Center. Biomassenergycentre.org.uk. Retrieved on 2012–02–28.

Download English Version:

<https://daneshyari.com/en/article/8121445>

Download Persian Version:

<https://daneshyari.com/article/8121445>

[Daneshyari.com](https://daneshyari.com)