Renewable and Sustainable Energy Reviews 29 (2014) 517–527

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Bio-diesel—A global scenario

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ARTICLE INFO

Article history:
Received 18 May 2013
Received in revised form
21 July 2013
Accepted 2 September 2013
Available online 24 September 2013

Keywords:
Bio-diesel
Developing countries
Developed countries
Land use
Sustainability

ABSTRACT

Recent days, underground carbon resources are dwindling at a faster rate. This triggered primary interest in development of bio-fuel as substitute to Petroleum-based fuel for alleviating world energy and economic crisis. This review explores the environmental impacts of bio-fuels on the road transportation and a large-scale impact of bio-fuel crops on food-based agricultural lands, which are now more gainfully used for churning out vehicle fuel. A global bio-diesel production is depicted with an appropriate data from 1991 to 2012. Also this article explains in detail the bio-diesel status (which includes crop type, climatic conditions, yield, oil concentration, land use/availability, and policy impacts) of 27 different countries across the world. In addition, this article extends to classify the potential bio-fuel feedstocks obtainable in each country.

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http://dx.doi.org/10.1016/j.rser.2013.09.007

1. Introduction

Nowadays, an interest in alternative fuel has become an important cornerstone to deal with, and it is likely to be driven by further research and development in upcoming decades. Due to global energy crisis, we find ourselves on the brink of depletion of underground carbon resources, economic crisis and environmental catastrophes.

The impact of using bio-fuels in road transportation is an important topic to debate with. The oil spill in Gulf of Mexico is an example of such environmental threats that fossil fuels pose [1]. The researchers from Swiss federal institute for materials science and technology have provided a complete picture of environmental benefits and costs of 26 different bio-fuels. The study revealed that most (21 out of 26) bio-fuels considerably reduced the green house emissions by 30 per cent when compared to fossil fuels. However, nearly half of them have exhibited greater environmental costs than gasoline. Also, the study disclosed that the fuels which showed over 50 per cent reduction in green house gases when compared with fossil fuels were bio-diesel made from several sources [2].

Bio-diesel is a common name given to an alternative fuel that is produced from edible or inedible vegetable oils and animal fats [3–6]. Recently, micro algae based bio-diesel is a newly emerging field, because high potential bio-diesel could be derived by micro algal biotechnology [7]. The higher heating values (HHVs) of bio-diesel are lower than that of gasoline (46 MJ/kg) and petro-diesel (43 MJ/kg), whereas HHVs of bio-diesel is higher than that of coal (32–37 MJ/kg). Although bio-diesel poses an advantage of environmental friendly fuel when compared to petro-diesel, its production cost is nearly double that of diesel [8]. The notion of using vegetable oil as an alternative fuel was first invented by the inventor of compression ignition (C.I.) engine, Rudolph Diesel, using peanut oil [9]. During Second World War, Brazil used Cotton seed oil as an emergency fuel. The country had prohibited the export of Cotton seed oil in order to substitute for imported diesel fuel [10]. After Second World War, the United States used corn oil and cotton seed oil, and their blends with neat diesel as a substitute to imported diesel [11]. The pressing need to go for alternative fuel was triggered after petrol crisis in 1973 and gulf war in 1991 [12]. Today, bio-diesel is produced in various countries worldwide and each country has allocated certain percent of land for cultivating crops for producing bio-diesel, as well each country pose their own bio-fuel policy. For example, the European union (EU) promotes bio-fuel policy by achieving 20 per cent of energy used in EU and almost 10 per cent of each member state's transport fuel must come from the renewable energy sources by 2020 [13].

Though there have been numerous case-studies on bio-diesel scenario, a very few is concerned with bio-diesel status of various countries. Based on the above actualities, one such attempt has been made to present the positive and negative impacts of bio-diesel on the crop production and land use. Also, this article extends to elaborate the bio-diesel scenario of various countries across the globe.

2. Impacts of bio-diesel

The political unsteadiness in the Organization of Petroleum Exporting Countries (OPEC) has paved way for higher prices of fossil fuels. Alternatively, the countries with small fuel production and those without fossil fuel production would gain from the utilization of existing land resources for the plantation of bio-fuel crops. The list of countries producing petroleum products (based on geographical regions) is depicted in Table 1. As a result, the production of bio-diesel increases year by year, and in near future, bio-diesel is likely to remain the main bio-fuel produced worldwide [14]. The world bio-diesel production from 1991 to 2012 is depicted in Table 2. One could perceive from Table 2 that the world bio-diesel production gradually increased since 1991, and it kept on increasing up to 2012. This picture shows the demand of bio-diesel in the world fuel market. Since the use of bio-diesel in road transportation vehicles have dominated the use of petro-diesel, now, it is time to critically analyze the positive and negative impacts of using bio-diesel in such transportation vehicles.

Rowe et al. [15] attempted to study the potential environmental impacts of bio-fuel crops in the United Kingdom (UK). The study was primarily focused on the second generation bio-energy crops, such as *Miscanthus* (a bulky variety of grass) and short rotation coppice (SRC), such as Willow and Poplar trees when compared with traditional first generation crops (wheat and oil rapeseed). The study revealed that the land availability in the UK to raise bio-fuel crops is not sufficient to meet UK's target for renewable energy production, and the water demand from many bio-fuel crops is very much higher than that of traditional crops. The review also projected the potential benefits of second generation crops, such as improvements in soil quality, carbon sequestered in

Table 1
List of countries producing petroleum products [1].

Geographic regions	*Oil producing countries*
Europe & Central Asia	Lithuania, Russia, Azerbaijan Turkey, Kazakhstan, and Turkmenistan
Latin America and Caribbean	Barbados, Belize, Cuba, Guatemala, Trinidad and Tobago, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador (OPEC Member), Guyana, Peru, Suriname, and Venezuela (OPEC Member)
Middle East and North Africa	Algeria (OPEC Member), Bahrain, Iran (OPEC Member), Iraq (OPEC Member), Kuwait (OPEC Member), Libya (OPEC Member), Oman Qatar (OPEC Member), Saudi Arabia (OPEC Member), Syria, United Arab Emirates (OPEC Member), and Yemen
SubSaharan countries	Angola (OPEC Member), Cameroon, Chad, Côte d'Ivoire, Democratic Republic of the Congo, Republic of the Congo, Egypt, Equatorial Guinea, Gabon Kenya, Nigeria (OPEC Member), South Africa, Sudan, and Tunisia.