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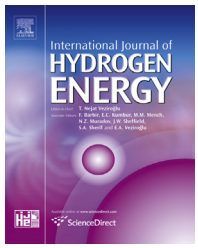

Econometric applications for measuring the environmental impacts of biofuel production in the panel of worlds' largest region

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ABSTRACT

The environmental impacts of biofuel production are one of the striking areas for policy debate in the academic and research arena since last few decades. This study empirically measured the environmental impacts of biofuel production in the panel of six largest regions of the World including East Asia & Pacific, Europe & Central Asia, Latin America & Caribbean, Middle East & North Africa (MENA), South Asia, and Sub Saharan African region, over the period of 1990–2013. The study used number of promising indicators for socio-economic and environmental indicators coupled with the biofuels production that have a considerable impact on the climate change, agricultural land, water productivity, natural resources and biodiversity across the globe. The results show that production of biofuels exuberate the Hydrochlorofluorocarbons (HCFCs) in East Asia & Pacific region, Latin America & Caribbean region, South Asia, and Sub Saharan African region, while in Europe & Central Asia, biofuels production significantly lessen the amount of HCFCs in the region. The results of aggregated World panel data signify the positive relationship between biofuels production and climate change during the study time period. The positive influence of biofuels production on agricultural land traced out in the East Asia & Pacific region, and MENA region, however, the result is inverted in the Latin America & Caribbean region. The production of biofuel intensify the water productivity in the East Asia & Pacific, South Asia, and Sub Saharan African region, while this result is evaporated in the Latin America & Caribbean, MENA, and World's aggregated region. The results are mixed in order to evaluate the impact of biofuels production on natural resource depletion, as biofuels production significantly decreases the natural resource depletion in the East Asia & Pacific, Europe & Central Asia, and World's aggregated region, while in the South Asia, and Sub Saharan African region, biofuels production significantly associated with the natural resource depletion. Finally, Biofuels production sustained the biodiversity in the East Asia & Pacific, Latin America & Caribbean, South Asia, and World's aggregated region, while the results are reversed in Europe & Central Asia and Sub-Saharan African region. The results of the study raise the serious concerns on the 'Kyoto protocol' which promote to expand the

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biofuels to ensure the environmental sustainability, as biofuels production on agricultural land jeopardy for climate change, water resources, natural resources, and biodiversity across the globe.

Introduction

In recent past, a surge in biofuel production is noted from 45,933 million L (in 2006) to 117,715 million L (in 2013) across the globe. In 2013, 75% of this biofuel production comprised of bioethanol and remaining 25% comprised of biodiesel. An increase of 39,187 million L (in 2006) to 83,353 million L (in 2013) is examined considering the production of bioethanol. The USA and Brazil are considered as the two largest bioethanol producers and accounted for 86% of the global production. Among which, USA managed to produce 50,397 million L bioethanol in 2013. While, Brazil managed to produce 25,530 million L during the same year. France, China, Canada and Africa are also involved in the production of bioethanol. On the other hand, the production of biodiesel increased from 6746 to 29,545 million L during 2006–2013. With the total production of 12,103 million L in 2013, European Union is the largest producer of biodiesel [25], while, Argentina, USA and Brazil are also involved in the production of biodiesel.

Biofuels can be produced through many feed stocks. For instance, sugar cane molasses, wheat, cassava, sugar cane, sweet sorghum, sweet potato and other crops are the source to produce bioethanol while, palm oil, soybean oil, rapeseed oil, animal fats and vegetables are the source of biodiesel. The above stated sources of biofuel are called 'first generation' while, energy crops, wood waste and municipal solid waste are known as 'second generation' biofuels [14].

Most of the countries, across the globe, are focusing on the production of biofuels and because of this stakeholders like users, biofuel producers and policymakers are emphasizing its sustainability. Sustainability not only includes multiple objectives instead of current or future, but also assessments using alternative routes to meet these objectives [9]. Sustainability incorporates social, economic and environmental processes and effects that are indirectly and directly measured using sets of indicators [10]. Inherently placed-based achievement is the main challenge in addressing sustainable goals [23]. The relationship between biofuels and economic growth always remain the key attention for the policy makers for devising a sustainable growth across the globe. Ozturk and Bilgili [37] confirmed the strong correlation between biomass consumption and economic growth of Sub-Sahara African countries and concluded that there is one-to one close association between economic growth and biomass consumption in a region. Bilgil and Ozturk [5] further show the significant and positive correlation between biomass energy consumption and economic growth in G-7 countries and confirm the "growth hypothesis" in a region. Al-Mulali and Ozturk [1] evaluated different socio-economic-political and environmental factors for sustainable development in MENA region and concluded that energy consumption, trade liberalization policies, urbanization and industrial activities damages the natural environment. The sustainable agenda for strengthening this region required long-term policy reforms to conserve the ecosystems and natural environment. Therefore, before progress towards sustainability goals understanding regarding biofuel system is essential to address.

Biofuel production and climate change

The climate changes are not the first time in the history of globe [45]. It's roots can be tracked back by looking at Ice Age around 11,500 years ago, assumed to be happened due to the variation in the earth orbit. That incident affects the sunlight to warm the earth. Earlier cycles of cooling and warming incurred slowly. However, the situation is entirely different this time as an unexpected rapid change is observed in the climate, for which humans are responsible [55]. The largest anthropogenic contribution to the climate change started with the industrial revolution, when fossil fuels began to burn (i.e. gas, coal and oil etc.) and increased greenhouse gases in the ambiance [7].

A rapid increase in the global temperature is noticed along with intensifying storms, melting glaciers, changed pattern of precipitation and rising sea level [3]. On the other hand, Africa has adverse impact of the climate change as most of African are dependent upon its natural resources and are lacking in adaptability. The prime focus of Africa should be on adaption as their contribution in global Greenhouse Gas (GHG) emission is insignificant. GHG has 300 times more global warning potential comparing carbon dioxide (CO_2). Therefore, there is a need to control burning of fossil fuels and found its substitutes [7]. To mitigate these petroleum-based fuel related factor of climate change, countries are focusing on biofuel production from agricultural residues [12]. According to the US policies, biofuels have sixty percent lower GHG (Greenhouse Gas) emissions comparing petroleum-based products [42].

Today, majority of the developing and developed countries are shifting their dependency of gasoline and diesel to biofuels, which will contribute 5–20 percent within the period of eighteen years (i.e. 2012–2030). According to the statistics of ELOBIO [13], the global biofuels consumption is expected to increase up to 125 Mtoe in 2030 which is 75 Mtoe in 2015.

Biofuel production, land-use changes and natural resources

Land-use change is linked to degradation of carbon sequestration in water quality, air and nutrient cycling etc. Changed

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