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CLIMATE MITIGATION, BIOCHAR PRODUCTION AND APPLICATION: LEGAL PROSPECTS IN MALAYSIA

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Abstract

Biochar is relatively a new and unfamiliar product to many, but biochar usage involves converting agricultural waste into a soil enhancer which help soil retain nutrients and water. The use of biochar may store carbon in the soil for a period of time for several hundreds of years as well as reduce the emission of nitrous oxide that in turn has its own potency to combat climate change. Despite this promising prospect on mitigating environmental damage from climate change, it is contended that the application of biochar still indicates uncertainties in its usage. With the lack of scientific and economic knowledge pertaining to biochar, such uncertainties are further compounded by unclear regulatory support that hampers or even prevents initiation of biochar projects. This article will review relevant regulatory framework, policies and standards at the international level in regards to the application and production of biochar. Further, the aim of this article is to investigate the potential of legal implication practiced in the biochar industry, thus providing a general insight on developing laws, policies and regulations for this industry in Malaysia. Hence, a sustainable legal framework for biochar could be adapted from existing international frameworks for bioenergy for development of a framework for sustainable biochar industry to tackle challenges of climate change in Malaysia.

Keywords: Legal, biochar, climate change, Malaysia.

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1. Introduction

Biochar is a ‘concept which covers all solid thermally degraded biomass products produced in the process of pyrolysis, including Torre faction and hydrothermal carbonization with different features and applications’ (Wang, Lurina, Hyytiäinen, & Mikkonen, 2014). The International Biochar Initiative, a non-governmental organization registered in the United States defines biochar as ‘solid material obtained from the thermochemical con-version of biomass in an oxygen-limited environment. Biochar can be used as a product itself or as an ingredient within a blended product, with a range of applications as an agent for soil improvement, improved resource use efficiency, remediation and/or protection against particular environmental pollution, and as an avenue for greenhouse gas (GHG) mitigation’ (Laufer & Tomlinson, 2013). It undergoes a process known as a carbon sequestration technique with possible significant potential to combat climate change because it may store carbon in the soil for a period of time for several hundreds of years (Lehmann, Gaunt, & Rondon, 2007).

The production of biochar involves the combustion of biomass that comprises mostly carbon, hydrogen, oxygen and nitrogen (Richards, 2016). When biomass is heated up to 100ºC, the water molecules will be removed. As the temperature rises above 200ºC, other volatile, flammable gases evolve, and progressive chemical changes start to take place in the hemicellulose, cellulose and lignin components of the biomass (Yang et al., 2004). If enough O2 (or air) is available within the hot zone (fire) and temperatures are high enough then eventually all of the hydrogen and carbon will be ‘oxidised’ or transformed to heat and gases (mainly H2O and CO2) leaving behind ash (minerals, metals, salts that were part of the biomass) (Werther & Ogada, 2004). The atmospheric N2 is relatively inert but at temperatures above 1000C, it can react with O2 to form NOx resulting in complete combustion. However, combustion is often incomplete due to a lack of O2 and/or cooling of the remaining mass and this is where the charcoal, smothered in the ash bed of any combustion device can be extracted (Richards, 2016). This is why some chars can be extracted from combustion systems (Bridgwater, Meier, & Radlein, 1999)

The charcoal is the residual carbon that does not have enough oxygen before cooling below reaction temperatures. This is called as pyrolysis, where this process eliminates oxygen (air) from the heating zone so that the oxygen cannot react with carbon. In this process, the carbon starts to combine to form very stable 6-sided aromatic rings of almost pure carbon. Biomass also often retains its original porous plant structure which is one of biochar’s most important attributes. Slow pyrolysis is generally the preferred option for charcoal and biochar production because of optimizing the retained amount of carbon and providing sufficient time for the char formation chemistry to take place. However, low-temperature fast pyrolysis biochar has also been utilized to help enhance the fertility of soil (Brewer, Unger, Schmidt-Rohr, & Brown, 2011).

It is noted that all relevant policies and regulations pertaining to the biochar industry in Malaysia are ambiguous due to the fact that the production of biochar is really complex and thus, the current policies and regulations are still vague on the application of biochar. Hence, further research is needed to study the legal implications of this industry.

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2. Problem Statement

As already noted, current policies and regulations are still in their infancy on the application of biochar and the legal implication of this industry in Malaysia. The focus of further considerations must be built around the issue of definition of biochar and under which category it falls i.e. waste or by-products. Despite this unanimity, biochar is considered as waste, and is thus, regulated under waste management laws in Malaysia. However, based on the explanation provided, biochar products should be considered as a new sustainable form of energy prompting new legislative mechanisms to govern its usage.

3. Research Questions

The broad objectives of these research questions in this study are to provide for regulation on biochar production and its application in Malaysia as a form of climate change mitigation through sequestration of carbon. The specific objectives focus on:

3.1. identifying the present laws and policy in Malaysia for biochar production activities.

3.2. examining the limitations to biochar and its application under the legal framework to appropriately place its potential as one of the key players that may reduce or mitigate effects of climate change.

4. Purpose of the Study

There are no existing laws and policies specifically on biochar production resulting in limiting opportunities to add to the economic value of biochar, despite its known advantage in mitigating climate change. Hence, there is a vital need for relevant laws and policies to be developed on biochar in Malaysia.

5. Research Methods

In order to achieve the purpose of this study on biochar production, existing data from primary and secondary sources including legal documents, policy documents, published and unpublished research articles and other relevant literature were explored. Generally, this is a socio-legal study of the usage and benefits of biochar to alleviate climate change impacts.

6. Findings

Discussions on climate change and environmental problems identify open burning of crops waste and land clearing as amongst the major contributors to environmental pollution throughout the world. The slash and burn practice is the main culprit contributing to the annual haze episodes in South East Asian that affect Indonesia, Malaysia and Singapore (Koe, Arellano, & McGregor, 2001). The haze pollution is often experienced especially during the dry season between March to October annually in these countries. According to Erik Meeijard (2015), the haze which occurs regularly in Southeast Asia has been deemed the biggest environmental crime in the 21st century that led to a loss of USD$35 billion in Indonesia alone in the 1997-98 catastrophe. Although a state of emergency was declared for a month in Indonesia, there was no declaration of a national fire emergency on all television channels and there was an absence in deterring

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or penalizing any polluter. Furthermore, the neighbouring countries affected by the haze were left to their own devices where each country had to mobilise national disaster management procedures to alleviate the impact of the pollution caused and subsequent effects of climate change.

In relation to this, soil amendment through the conversion process of biochar can minimize the effect of CO2 and could mitigate climate change and environmental deterioration caused by air and haze pollution (Richards, 2016) Biochar is argued to be a powerful agent to reduce the climate change effect by carbon sequestration where plants assimilate CO2 from the air through photosynthesis and accumulate the carbon as biomass. When pyrolyzing biomass to biochar, around half of the biomass C is returned to the air as CO2. Around 40% of total biomass is sequestered, for instance locked up for long periods, as biochar from the remaining 10% is altered. By reducing N2O emissions, this will also inhibit the emission of the strong greenhouse gas nitrous oxide (N2O), where up to 90% (lab trials) and 70% (field trials) reductions in the release of the gas have been reported. The most probable mechanism to explain this is a combination of a "pH effect" with an additional mechanism such as strong biochar absorption of nitrous oxide followed by reduction of N2O to N2 with biochar-absorbed organic molecules serving as electron donor (Schmidt, Pandit, Cornelissen, & Kammann, 2017). This could lead to the evolution of a new rural cottage industry supplying biochar to plantation companies and farmers resulting in a new economic potential in biochar production (Koe et al., 2001).

At the international level, the policies and regulations relevant to climate change mitigation and adaptation characteristics of biochar may perhaps have an influence on the biochar industry. The incorporation of biochar in a revised EU emissions-trading mechanism or in the Clean Development Mechanism (CDM) of the Kyoto Protocol 1992 which is currently the main key organization dealing with the development of a biochar industry on product standards (European Commission) is a good example. The development of such standards is essential to create a biochar industry as biochar is a new product in agricultural management. Hence, standardization of the biochar-making process is a pre-condition to describe biochar according to its required characteristics, independent of its production method and the biomass of which it is produced (van Laer et al., 2013). The biochar needs to comply with certain standards in relation to biochar-making process as to avoid detrimental effects on the environment and on human and animal health while maximising its benefits to reduce CO2 and reducing effects of climate change (van Laer et al., 2013).

In Germany, biochar is regulated under the European Biochar Certificate, 1999. However, there is no threshold in the German Fertilizer Ordinance for polycyclic aromatic hydrocarbons that are often generated in the carbonization processes. The German Federal Soil Protection and Contaminated Sites Ordinance 1999 (*Bundesministerium Justiz & für Verbraucherschutz*, 1999) gives precautionary values for soil with low (< 8%) and high humus content (>8%) of the total content of 16 priority PAH[1], and is further defined by the Environmental Protection Agency of the United States (EPA) as 3 mg/kg soil and 10 mg/kg, respectively. Biochar is intended to rest in soil for long periods so it seems prudent to also apply comparable quality parameters as thresholds for biochar soil application (*Bundesministerium Justiz & für Verbraucherschutz,* 1999).

[1] Polycyclic aromatic hydrocarbons

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In Italy, edition No. 186 of the Italian law gazetted the *Gazzetta Ufficiale Della Republica Italiana*' which was published on 1 August 2015 as a modification of the amended Annexes 2 and 7 of the fertilizer decree number 75 of 29 April 2010 (*Decreto Legislativo, 29 Aprile 2010*). With these modifications to the amendment, the Italian Ministry of Agriculture, Food and Forestry included includes biochar in the list of soil amendments which are permitted for use in the Italian agricultural sector and defined technical specifications for this product.

However, there is a strong debate on whether biochar is considered as waste or product in Europe. The 'waste' is defined very broadly as ‘any substance or object which the holder discards or intends or is required to discard’ (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008). If biochar is produced from the biomass which has been discarded (e.g., waste streams for agriculture), it may be treated as waste and the production is considered as the waste treatment.

There is another interpretation of biochar according to the European waste legislation (named the legislation to avoid confusion). According to the European waste legislation, it may be interpreted in other ways as it incorporates two other definitions for wastes that include ‘by products’ [‘A substance or object, resulting from a production process, the primary aim of which is not the production of that item’ (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008) and the status end of waste. The former refers to ‘A substance or object, resulting from a production process, the primary aim of which is not the production of that item’ (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008). The latter is defined as ‘the waste that has undergone a recovery, including recycling, operation and complies with specific criteria’ (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008) which will be developed for several materials (e.g., scrap metals)].

Based on the above definition, if biochar meets all the conditions to qualify as ‘by-product’ or ‘end of waste’, it is not seen as waste but a product; thus biochar does not have to comply with all European legislations regarding waste. At this juncture, by products may be subject to the other regulations, namely REACH (Registration, Evaluation, Authorisation & Restriction of Chemicals) Regulation (Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006) which contains some other legal measures to ensure that sufficient information on chemical substance hazards or risks to the human environment are readily available.

The production of biochar which requires the use of biomass may either be seen as a product (when the production process only or mainly aims at the production of biochar) or as a by-product (Van Laer et al., 2013). In both situations, biochar will not be subject to waste legislation measures (if all preconditions regarding the by-product status of Article 5 of Directive 2008/98/EC are met), but may be subjected to constraints imposed by the REACH regulation. Whether or not biochar will be subject to the restraints described below, is thus partially dependent on the input material used (Van Laer et al., 2013).

If biochar falls under the definition of waste, it will have several legal constraints. The main legal constraints may be related to waste transportation regulations, which will lead to the application of several registration and other administrative requirements particularly, Regulation 1013/ (2006/EC Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December). Furthermore, the installations in which the biochar has been stored and transferred, removal and usage will be defined as

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installations for the processing of waste materials. In Flanders, these installations require an environmental permit for the storage, transfer, useful application and possibly the disposal of waste. Such requirements have often been neglected as the farmers or other individuals, using biochar to improve soil capacities, will not be willing to obtain such permits prior to the application of biochar. In Flanders, the competent authority for waste management currently seems to take into consideration the end of waste status of biochar (Van Laer et al., 2013).

Although the waste regulation is no longer in existence, biochar may be regulated by the REACH regulation (Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006) due to the chemical composition of the biomass changes during the pyrolysis. The REACH regulation imposes very costly administrative burdens upon manufacturers and importers of chemicals before these chemicals can be placed on the market. Naturally, there would be a preference to avoid such administrative constraints to produce biochar. Research on a possible exemption for biochar within the framework of the REACH regulation is still on-going (Van Laer et al., 2013).

In Malaysia, waste management is governed by the Solid Waste and Public Cleansing Management Act 2007 (Act 672). Section 2 of the Act defines "solid waste" as:

a. Any scrap material or other unwanted surplus substance or rejected products rising from the application of any process;

b. any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled; or

c. any other material that according to this Act or any other written law is required by the authority to be disposed of, but does not include scheduled wastes as prescribed under the Environmental Quality Act 1974, sewage as defined in the Water Services Industry Act 2006 or radioactive waste as defined in the Atomic Energy Licensing Act 1984.

Solid wastes have a mass, weight, and constant volume (World Bank, 2014). However, solid waste does not include scheduled wastes as prescribed under the Environmental Quality Act 1974.

According to Biomass-sp (2014), the following are some unanimity definitions of biomass at the European and international level:

a. United Nations Framework Convention on Climate Change (UNFCCC) on the definition of renewable biomass: "The biomass is the non-fossil fraction of an industrial or municipal waste."

b. Organisation for Economic Co-operation and Development (OECD) on definition of solid biomass: "Biomass is defined as any plant matter used directly as fuel or converted into other forms before combustion."

c. EU's Waste Framework Directive: "bio-waste" means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants"

d. International Energy Agency (IEA) on definition of biomass: "Renewable energy from living (or recently living) plants and animals; e.g. wood chippings, crops and manure."

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e. European Biomass Association (AEBIOM) on definition of biodegradable waste: "Biodegradable waste is the biomass that can cover several forms of waste such as organic fraction of municipal solid waste, wood waste, refuse-derived fuels, sewage sludge, etc."

In Malaysia, industrial waste means any solid waste generated from any industrial activity as defined in the Solid Waste and Public Cleansing Management Act 2007 (Act 672) which include rubbish, ashes, demolition and construction wastes. Some of the waste could also include hazardous and special waste. However, hazardous waste is defined as any waste falling within the categories of waste listed in the First Schedule of the Environment Quality (Scheduled Wastes) Regulations 2005. This is a special group of waste and could contain substances posing substantial danger or hazards to humans, plants, or animals as well as the environment. The waste is categorized as such due to its ignitability, corrosivity, reactivity, toxicity or infectivity. Usually clinical waste (causing infectivity) is categorized separately. Sometimes it could also be categorized as radioactive waste, chemical waste, biological waste, flammable waste and explosive waste (Pariatamby, 2017).

Thus, the concern as to whether biochar can be categorized under the term 'waste' or 'by products' depends heavily on the nature of its production process and application. Research on the legal application and implication of biochar is underdeveloped.

Malaysia is the second largest palm oil producer in the world after Indonesia. In 2015, Malaysia produced around 19,760, 00 tonnes of palm oil with total area of is 4691,160 ha (Shafie, Mahlia, Masjuki, & Ahmad Yazid, 2012). The palm oil sector generates the largest amount of biomass, estimated at 80 million dry tonnes in 2010. This is expected to increase to about 100 million dry tonnes by 2020, primarily driven by increases in yield (Malaysian Innovation Agency, 2016). As oil palm is the largest crop plantation in Malaysia, generating huge amounts of biomass, oil palm biomass waste has been identified as having good potential for biomass projects as envisaged by the National Biomass Strategy (NBS) 2020. This prospect is further driven by the lack of landfill space and a ban on agricultural open burning. In order for the oil palm industry to play its role in mitigating global warming as well as improving its productivity, new approaches are needed to convert the industry into a sustainable, carbon-negative economy. Hence, the biomass production from the palm oil sector is seen to be a capital investment from the economic and environmental protection perspectives. Based on the Functions of Innovations Systems (FIS)[2] analysis, the functions; entrepreneurial activities, knowledge development, and resources mobilization are well established in the Malaysian biomass innovation system (BIS). However, the functions of guidance of search, creation of legitimacy, knowledge diffusion and market formation are underdeveloped resulting in the low penetration of bioenergy in Malaysia. Other factors include fossil fuel subsidies, numerous or conflicting energy policies and weak collaboration between academia and the industry (Nyakuma, 2018).

Since the development of the palm biomass industry in 2001 in Malaysia, a number of policies have been revised and implemented to adapt to the global trend and new demands in the palm oil industry (KeTTHA, 2012). For instance, the renewable energy sources utilization was encouraged under The Small Renewable Energy Program (SREP) in 2001(KeTTHA, 2012) and thus, the waste generated from the oil

[2] Approach developed by Dutch and Swedish researchers to assess level of development and diffusion of the biomass innovation system in Malaysia.

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palm industry has been identified as one of these potential renewable energy sources. Through SREP, a renewable energy-based power producer is allowed to sell its generated electricity to the national grid at a maximum capacity of 10 MW (KeTTHA, 2012).

Similarly, amongst the prominent agricultural waste, rice husk has been identified as a major potential source of biomass in Malaysia after palm oil. The statistical data shows that in 2008 paddy production in Malaysia was around 1632,507 tonnes. Paddy straws and rice husks are the main residues from paddy cultivation that are generated during the harvesting and milling processes. The paddy straw is left in the paddy field and rice husk is disposed of into a landfill or via open burning (Shafie et al., 2012). In Tanjung Karang, a paddy planting area in Malaysia, a system for making biochar known as Rotary Husk Furnace (RHF) has been popular (Mohammad Hariz et al., 2015). This is due to the biochar product which has been widely used as media for rice transplanting seedlings. RHF is based on continuous processes of fast pyrolysis which attributes to higher biochar yields as compared to batch processes (slow pyrolysis). Thus, the system provides the farmers with benefit of lesser time for production (few minutes) as compared to batch processes (few hours). The proposed research on charring of residues in an incomplete combustion process produces biochar as an efficient option for rice residue/waste management (Haefele, Knoblauch, Gummert, Konboon, & Koyama, 2009). The charred material subsequently can be incorporated into paddy soils and used as soil conditioner. A study on a local producer in the Tanjung Karang area has estimated annual production of 81.43 tonnes of RHB for use as media for rice transplanting seedlings (Mohammad Hariz, Noor Sarinah, & Mohd Fauzi, 2010).

In 2010, the National Renewable Energy Policy was implemented to further increase the exploitation of local renewable energy resources, such as oil palm, and contribute to national energy security and sustainable socio-economic development. Malaysia has proposed the Feed-in Tariff (FiT) from USD 0.09 kW/h onwards for biomass-based renewable energy production (KeTTHA, 2011b). The Renewable Energy Act 2011 (Act 725), which contains the FiT allows the producer or industries to trade in any surplus energy to the national power grid or utility companies. In addition, incentives will be offered to the industries employing renewable energy. This approach is expected to further promote the adoption of renewable energy sources (Ng, Lam, Ng, Kamal, & Lim, 2012).

In addition, Malaysia has implemented Promotion of Investments Act 1986 or Investments Incentives Act 1968 (Act 327) to promote and offer incentives to companies that generate energy from renewable resources that is then either sold to other companies or retained for self-consumption. The incentives offered include the granting of Pioneer Status and the Investment Tax Allowance (ITA). Pioneer Status allows for income tax exemption on statutory income, whereas ITA offers tax allowances on qualified capital expenses. The palm oil mill, which produces biofuel or renewable energy, is eligible for the incentives application.

The approach taken in European region could apply to biochar as a new sustainable form of energy as it aligns to Malaysian policies to combat climate change and encourage a minimization of waste. In Malaysia, there is yet to be a specific policy or legal framework for this industry. However, it is believed that the government will introduce new policies soon to control and direct the development of the biochar industry (Ng et al., 2012).

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7. Conclusion

Ongoing research shows promising prospects that biochar could be a mitigation factor of climate change and contribute to the fertility of agricultural soil. The European Union has moved forward to standardize the legislation and policies in regards to production of biochar to encourage the growth of this industry. However, in Malaysia, existing policies do not sufficiently incorporate the production of biochar. Currently, in most countries particularly in the European region, biochar is still considered a waste of a burning process and regulated under the waste laws as discussed above. This limits the opportunity to add to the economic value of biochar, despite its known advantage in upgrading soil fertility. The adoption of pyrolysis could provide an opportunity to explore new sustainable forms of waste management, biomass usage, and renewable energy production as well as of production of soil amendments. It is contended that biochar is a by-product of pyrolysis, hence the standardization of laws and policies is vital to develop this industry which can help to combat climate change in the world. Thus, the European Union legislative framework on biochar may be adopted in Malaysian laws to regulate the production and usage of biochar in Malaysia. A thorough negotiation and cooperation between different related bodies (legal, scientific, economical, etc.) is required to develop a legal framework for biochar to overcome obstacles in the production and use of biochar. Hence, several existing regulations will have to be evaluated and modified with regard to the production and use of biochar, by providing the necessary exemptions.

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