Chapter 2
Approach to Biofuel Issues from the Perspective of Sustainability Science Studies

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2.1 Introduction

Biofuels have been increasing in popularity, since they are promising substitutes for fossil fuels and are expected to contribute to reductions in greenhouse gas (GHG) emissions. Moreover, the production of biofuels is a means of alleviating poverty and developing both rural and agricultural areas. However, many researchers and institutions, such as the Organization for Economic Co-operation and Development (OCED) and the Food and Agriculture Organization (FAO), voice scientific scepticism about the expected contributions of biofuel use. They also stress that the production and use of biofuels will lead to deforestation, water supply contamination and water depletion. The production and use of biofuels will have enormous impacts on the environment, the economy and the society. Clearly, these impacts are multitiered and complex. Therefore, strategies for biofuel use must be established through comprehensive analyses and scientific evaluations, with consideration given to complex socioeconomic issues, in order to achieve global sustainability. It is also important to consider that optimum solutions among boundary levels, such as global, regional and national levels, may vary and that these strategies must be coordinated in order to meet the demands of different optimum solutions. From this perspective, an interdisciplinary and integrated approach is best. However, many

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studies on biofuel, including those in the natural and social science fields, fail to use this type of approach. The aim of the present research is to comprehensively analyse the use of biofuels at global, regional and national levels using the sustainability science approach and attempt to assess biofuel use strategies from an interdisciplinary perspective. Sustainability science is a new academic area that addresses complicated issues, such as biofuel production and use, by restructuring problems and then proposing policy options.

2.2 What Is the Sustainability Science?

As discussed, biofuel utilization has a complex background and broad impacts on many fields and sectors, such as the environment, the economy and the society. Therefore, the establishment of a sustainable biofuel strategy that contributes to a sustainable society is only possible by analysing the complex features of biofuels in a comprehensive manner.

The concept of sustainability has previously been discussed, since sustainable development was discussed in the WCED (World Commission on Environment and Development) in 1987, an event known as the Brundtland Commission that was led by the Prime Minister of Norway, Brundtland (Maeda and Hibiki 2008). Through active debate in an international arena such as the UNCED (United Nations Conference on Environment and Development) and WBCSD (World Business Council for Sustainable Development), the atmosphere of building sustainability science required to maintain fundamental links between science and technology without policy bias has been enhanced in academia globally (Komiyama and Takeuchi 2006). These active debates for sustainability science have developed a common recognition of the need for transboundary/transdisciplinary academic systems, which are different from traditional academic systems that are segmentalized in each academic field. A definition of sustainability science was propounded by Kates et al. based on the historical debate and common recognition. This definition states that sustainability science sets out to solve global agendas of human subsistence, such as global warming, from the view point of sustainability (Maeda and Hibiki 2008).

A feature of sustainability science is solution-oriented science. Therefore, various research results are brought to various researchers from many academic fields in a transboundary/transdisciplinary manner to solve global agendas. For example, global warming, which is a problem shared by the entire human race, cannot be resolved by existing traditional approaches on a disaggregated basis, such as independent analyses regarding individual issues for individual regions or partial optimization analysis.

The development of sustainability science, which is being led by Europe, the United States and Japan, is still ongoing. However, a common feature of sustainability science in academia is that a transboundary/transdisciplinary approach should be applied to resolve issues that have multitiered and complex features by

recognizing those relationships (Komiyama and Takeuchi 2006; Clark and Dickson 2003; Kates et al. 2001; Lele 1991). In addition, resolving global agendas by the application of sustainability science includes the coordination of related stakeholders.

Although the IPCC (Intergovernmental Panel on Climate Change) has an influence on the establishment of sustainability science, its role and existence are affected by the discussion of sustainability science. An extremely significant contribution of IPCC is its presentation of the impact of global warming as anthropogenic, which became a united opinion due to the research evidence that the IPCC amassed. That scientific knowledge has contributed to policy decision-making processes by nations and international institutions, including the UNFCCC (United Nations Framework Convention on Climate Change). Currently, the role of science has moved from the clarification of the global warming phenomenon to the building of adaptation and mitigation strategies for global warming.

Sachs and Reid note that an investment in poverty reduction is critical for environmental policy. Furthermore, they also note that an investment in the environment is important for the success of poverty alleviation. In addition, they insist that a global assessment scheme for mutual relationships between poverty alleviation and environment protection should be established by the United Nations, IPCC and MEA (Millennium Ecosystem Assessment). They advocate that a global network of scientists, including environmentalists, economists and social scientists, can inform policy makers and the general public of the latest scientific findings and that the network can additionally overcome the opaqueness originating from vested interest groups by structuring required research freely. Therefore, strategies built on transboundary/transdisciplinary foundations are needed for sustainable development. An affirmation of Sachs and Reid is believed to be the links among poverty alleviation, agricultural production, and sustainability science.

2.3 Feature of Biofuels from the Sustainability Science View

Biofuel features are reported in this section from the sustainability science viewpoint.

Biofuel impacts are spread across a wide area. First, an impact of biofuels on the economy is noted. Since 2006, “agflation” has become a serious problem all over the world. It is noted that biofuels are seen as one of the factors contributing to agflation. Although further research on the relationship between agflation and biofuels is required, it is undeniable that biofuels cause agflation. As a result, many developing countries are in socio-political dislocation. Some of these countries regulate food export and agricultural prices. Although those policies tend to be chosen from the view point of food security in these countries, agflation threatens to shrink the international cereal market and further increase pricing pressure. The poorest segments of the population experience difficulties obtaining food because of agflation. As the FAO notes in Food Outlook 2007 (FAO 2008), this situation

leads to further socio-political confusion in LDC (least developed countries), LIFDC (low-income food-deficit countries) and NFIDC (net food-importing developing countries). However, a rise in the price of agriculture may stimulate agricultural production in both developing countries and developed countries.

It is noted that the extensional expansion of agricultural production for biofuels might not only fail to contribute to reductions in GHG emissions because of the outflow of carbon storage in the soil but also have adverse effects on agricultural production because of biodiversity loss and decreased land productivity. Furthermore, increasing agricultural production on the basis of economic incentives induces the use of chemical fertilizers and pesticides (Fike et al. 2006; Parrish and Fike 2005). Increases in agricultural production resulting from economic incentives seem to be predominant, which is inferred to induce adverse effects on the ecosystem.

The consideration of importing biofuels and agricultural products for biofuels by Japan, EU and some other countries is subjected to criticism, since the import of biofuels and agricultural products for biofuels that are derived from agricultural production in developing countries promotes environmental degradation. A valid judgement is required for this issue. However, it cannot be denied that increased agricultural production for exports plays a role in rural development. Areas with high levels of environmental degradation have an advantage for biofuel production. Biofuel production or agricultural production for biofuels in those areas might improve the welfare of the world in terms of the efficiency of resource allocation (FAO 2008).

2.4 Conclusion

While research results on the effects of biofuels on the environment from the natural science perspective have accumulated gradually, there is still room for biofuel research to be analysed. Not only existing scientific results regarding biofuels but also new scientific knowledge should be consolidated for policymakers and stakeholders as scientific evidence. Biofuel utilization should be considered a trilemma of global warming, energy security and food security, the promotion of agriculture, in other words. Moreover, biofuel utilization is seen as one of the factors contributing to an acute increase in food prices. It is imperative to coordinate among international institutions, policymakers in many nations and other stakeholders to establish sustainable biofuel utilization strategies based on adaptation/mitigation strategies supported by various scientific results on biofuel utilization. Applying the concept of sustainability science allows us to build these strategies. In addition, applying sustainability science to establish sustainable biofuel utilization strategies may contribute to the global increase in building sustainability science.

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