"OBSELETE ARCHAISM, UTOPIAN DREAMS AND Manure": Biogas and Dairy Livelihoods in Vermont

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ABSTRACT

Biofuels have been a major growth area among "alternative" energy sources in recent years as a response to concerns about dwindling fossil fuels. While biofuels expansion has been controversial due to perceived negative environmental and social outcomes, social science and human geography literature has only recently begun to address these issues. This article will give a brief overview of issues surrounding biofuels and then provide a case study example focusing on biogas development on dairy farms in Vermont. While such development was initially viewed with extreme optimism, market realities surrounding both milk and energy prices have led to difficulties in guaranteeing producers a fair share of revenues, thus necessitating the introduction of government-backed priced stabilization. Focusing on the effects that biogas production has had on farmers directly involved in production, this article will argue that while this specific instance of biofuels use may not be a good long term solution for energy and climate problems, the benefits to the livelihoods of struggling farmers serve to make the program worthwhile. Adopting a similar attitude towards other instances of biofuels production could help to mitigate some of the worst environmental and social repercussions. *Keywords: Agriculture, Dairy, Energy, Sustainability, Vermont.*

Introduction

Anxieties surrounding potential threats posed by climate change and the rapid depletion of fossil fuel stores have led to an explosion of debate around sustainability and the promotion of "alternative" lifestyles and energy technologies to help mitigate environmental and social damage caused by poor resource use policies. Writing in 1990, I.G. Simmons (1990, 98) described this new preoccupation placing environmental crises at the forefront of media coverage and policy discourses as "the world … being viewed through tinted glass of a greenish hue." In the more than two decades since those words were written, green(ish) discourses and behaviors have grown tremendously as predictions regarding climate and energy insecurity have become increasingly dire and celebrity personalities such as former Vice President Al Gore and writers such as Michael Pollan, Eric Schlosser and Colin Beavan have helped to bring sustainability issues to a wider audience. Given that the root cause of environmental ills is often identified, whether rightly or wrongly, as the overreliance on fossil fuels, much focus has been placed on expanding alternative energy production as an effective way to counter the apocalyptic nightmares burned into the popular imagination by films such as *The Day After Tomorrow* and *An Inconvenient Truth*. While the success of alternatives promotion policies in solving existing crises is furiously debated, a whole host of new environmental and social issues related to expanded alternative energy production have arisen. Although warranting serious debate akin to that associated with other environmental issues, these new challenges rarely receive the attention they deserve.

Biofuels (energy sources derived from organic matter) in particular have come under criticism for exacerbating existing environmental and social inequalities as much recent production expansion has occurred in already impoverished areas of the developing world and could not be described as sustainable or environmentally friendly (see Farrell et al. 2006). In their influential report, *Bio-fuelling Poverty*, Oxfam (2007, 2) notes,

> Under the right conditions, biofuels offer important opportunities for poverty reduction by stimulating stagnant agricultural sectors, thus creating jobs for agricultural workers and markets for small farmers … Unfortunately such conditions, including national and corporate policies with clear pro-poor, environmental, and social objectives, are not evident in the emerging agro-industrial model. Instead, a scramble to supply the European market is taking place in the South, and poor people are getting trampled

Similar charges have been leveled by Jacques Diouf (2007, 1), the former director-general of the United Nations Food and Agriculture Organization, who adds that, "We urgently need to draw up an international bio-energy strategy. In the absence of such a plan we run the risk of producing diametrically opposite effects: deeper poverty and greater environmental damage." Indeed, it is no accident that such criticisms focus on the damage that First World energy needs do to Third World livelihoods as much of the First World debate around biofuels focuses solely on economic viability and ignores environmental and social ramifications (see for example Gillon's (2010) discussion of the privileging of ethanol agribusiness needs over those of local corn farmers in Iowa). While the issues surrounding biofuels production (third world development, environmental degradation, climate change, resource use, etc.) would appear to make biofuels a topic ripe for academic research, social scientists have entered the conversation in a forceful way only recently and biofuels have received hardly any attention in human geography.

This article will provide a brief overview of biofuels literature in the social sciences and geography, paying particular attention to strengths and weaknesses of existing research. The literature review will be followed by a short history of biogas technology and a related case study focusing on the environmental and social effects of biogas development on dairy farms in Vermont. This article will then conclude with recommendations for future biofuels development that can serve the needs of both energy consumers and biofuels farmers.

Biofuels and Social Science

Issues of political economy and the environment have long held purchase in environmental social science and under the interdisciplinary umbrellas of human, cultural and political ecology. Perhaps the key factor that separates such methods of inquiry from apolitical ecologies is the notion that humans have had as much, if not more, impact upon the "natural" environment than nature has had on humans. Such ideas have been expressed as far back as 1914, when sociologist E.C. Hayes (1914) asserted that humans were not simply passive vessels molded by their physical environmental, a la Semple (1911), but active transformers of both the social and natural world through their use of technology. Geographers too have played an important role in the development of these three ecologies with Harlan Barrows (1923, 3) declaring in his Association of American Geographers presidential address, "Geography as Human Ecology," that it is important to avoid, "the danger of assigning to the environmental factors a determinate influence which they do not exert" and Blaikie, Cameron, and Seddon (1977, 17) noting, "space is what the political economy makes it, and it is constantly defined and redefined by the dominant mode of production." While these three ecologies have been influenced by theories as diverse as Systems Theory, Marxism, and Actor-Network-Theory, the core theme of human transformation of the environment has remained constant.

As issues such as development, inequality and environmental degradation are the bread and butter of the three ecologies, one would expect environmental social scientists to have expanded their existing research into biofuels at a rapid pace. However, social science, and human geography in particular, have been largely silent on biofuels until very recently, often mentioning them only in passing as part and parcel of other resource struggles. Although Third World food security has long been identified as one of the pitfalls of Green Revolution technologies (Cleaver 1972), it is only within the past five years that social scientists have begun focusing on the so-called "food vs. fuel" debate and the negative effects associated with replacing food crops with biofuel crops, which Vandana Shiva (2008) refers to as "soil not oil." In their introduction to *The Journal of Peasant Studies* special issue "Biofuels, Land and Agrarian Change", Borras, McMichael, and Scoones (2010) note that food vs. fuel concerns came to a head as a result of the 2007-2008 food price crisis and have been exacerbated by the post-2007 global financial crisis. In another article in this same special issue, McMichael (2010) argues that food vs. fuel is yet another in a long line of failed neoliberal agricultural policies. Indeed, such a focus on neoliberalism, which has dominated much critical scholarship on biofuels, has led to a focus on global "land grabbing" with few case studies of local manifestations of biofuels, despite calls from authors such as Novo, et al. (2010) to move towards research that takes into account the specificities of place.

Biofuels research in geography also tends to focus on the global rather than the local, although examples all together are quite sparse. As Bridge (2011, 824-825) notes, citing only 3 examples, that, "processes of enclosure, land conversion, social transformation and ecological exchange are at work around the development of biofuel resources, although to date there has been relatively little work by geographers on the complex geographies and political ecologies of biofuels." Much of the geographic scholarship that does exist such as Tenerelli and Carver's

(2011) agro-spatial modeling and Mabee and Merck's (2011) evaluation of forest resources in Ontario is often of the apolitical variety, favoring quantitative techniques and including little field-based qualitative data. Even political ecology influenced research such as Walker's (2011) article on biofuels in Amazonia focuses on global processes at the expense of the local. The one example that attempts to tie changes at the global level to the experiences of biofuels farmers is Cope, McLafferty, and Rhoads' (2011) article on switchgrass production in Illinois, which gathered data using both surveys and GIS-aided focus groups. As similar localized, qualitative studies are few and far between, the following review of biogas technology and the related case study will serve to fill in gaps that are often not addressed by focusing solely on food vs. fuel and neoliberal agriculture.

A Short History of Biogas Production

Biogas is a type of biofuel created by extracting gaseous components (usually methane) from decaying organic material (biomass), with animal manure, which will be the focus of this article's case study, being one of the more commonly used biomass. The extraction process is often sped up using a machine called an anaerobic digester, which maintains a warm, high carbon dioxide environment where bacteria that aid in decaying can flourish. While biogas has been used as an energy source since the late 18th century, it is only in the post-World War II era that industrial-scale digesters have become widespread. Cheap and plentiful fossil fuels available in the Western World during the 1950's and 1960's led to little research and development into alternative energy technologies, thus these large digesters were used mainly by farmers looking for ways to better manage their excess manure and the resulting biogas was usually flared off. However, in rural areas of Asia where peasants either could not afford or had little access to fossil fuels, manure biogas was used to provide heat and electricity to resource-strapped communities (Gautam, Baral, and Herat 2009; Chen et al. 2010). Concerns about methane emissions in the 1970's led to the creation of cheaper and more efficient digesters and Western farmers adopted them more frequently, yet they were still rarely used for electricity provision outside of the rural Third World (Abassi, Tauseef, and Abassi 2011).

Since the 1970's, biogas for energy has grown quite slowly in the West despite manure, both human and animal, commanding a growing share of energy production in places such as rural India (Jewitt 2011). As of March 2012, AgSTAR (a joint venture between the Environmental Protection Agency (EPA), United States Department of Agriculture (USDA) and the Department of Energy (DOE) which promotes and provides funding for anaerobic digesters) has 186 operating manure digesters (split between cow, pig and chicken manure, with dairy being responsible for 153 digesters) listed in its registry, approximately half of which are capable of producing electricity. However, having the capacity to produce electricity does not always guarantee off-farm use, as farms often have difficulty integrating with the existing methods of electricity provision that would allow their electricity to reach the market. Many farms are not connected to "smart grids" (advanced automated grids that provide electricity on an efficient, as needed basis) and other grid-connected (GC) systems that are necessary for electricity produced outside of power plants to be fed onto a larger electric grid. Traditional fossil fuel electrical utilities, which often have exclusive control over large swaths of the electrical grid due to deregulation in the 1990's, strongly oppose the construction of such efficient systems as they feel it would weaken their authority and profitability and lead to the eventual phasing out of fossil fuels (Warwick 2002; Bouffard and Kirschen 2008; United States Department of Energy 2010). Therefore, construction on these new types of grids has been slow (especially in rural areas where most digesters are located) and biogas farmers have had uneven opportunities to sell their electricity. Our case study, however, will show that a successful biogas program that is well integrated with new grid technologies can exist, while also providing manure management and income benefits for farmer producers.

Case Study: Vermont's Cow Power™ Biogas Program

In the early 2000's, customers of Central Vermont Public Service (CVPS), a publicly owned utility, began asking if it would be possible to receive their electricity from alternative sources. Being somewhat familiar with existing biogas generation systems in states such as New York, Pennsylvania, and Wisconsin, farm efficiency expert Dave Dunn began investigating the possibility of creating a way to use Vermont's large number of dairy farms to meet these demands. Many farmers whom Dunn approached were already interested in anaerobic digestion as a way to manage their manure and were excited by the prospect of being able to earn extra income in order to cushion themselves against swings in milk prices (Dave Dunn, Cow Power™ Coordinator, telephone interview 4 March 2011). Thus, this new, voluntary program, dubbed Cow Power™, in which customers would pay a nominal fee to help fund digester development, was born. While this program would likely have met with resistance from utilities were it proposed in other states, as Vermont's utilities are all publicly owned, have exclusive service territories and have their prices set by the Vermont Department of Public Service. Thus, there was little reason for utilities to oppose alternative energy development on the grounds that it would lead to a weakening of their authority or hurt their bottom line. Indeed, Vermont utilities have been cooperating since the 1930's and such has also been the case with Cow Power™ as it has extended beyond CVPS's service territory (Dunn 2011, telephone interview). Other strong factors allowing Cow Power™ to get off the ground were the strong support of state politicians, grants provided by AgSTAR and the USDA Rural Development and concerted efforts to modernize the state's electrical grid (D'Ambrosio 2011; Baird 2011). Thus, although it should not be assumed that it was easy for Cow Power™ to be operationalized (as will be demonstrated shortly), many of the stumbling blocks that have prevented adoption in other areas are not present in Vermont and the program was actively encouraged and supported by those who would traditionally be classified as opponents. Indeed, as this case study will show, despite being a program that has been considered by all involved a success, Cow Power™ has not been without its growing pains.

A major obstacle that many farmers have faced in setting up digesters and generators has been cost. With a total sticker price of approximately $1.5 million, securing financing, particularly in a tight credit market, can be difficult. While this may have discouraged many from attempting to set up Cow Power™ in the first place, due to the interest of AgSTAR, USDA Rural Development and state level agencies such as Vermont Clean Energy Development Fund and

Vermont Agency of Agriculture, most farmers were able to secure grants that covered a majority of their costs and loans that could be paid off without expending all biogas income. Farmers have noted that while they were pleased with these terms, they felt that the true cost of the project has been far more than expected. Although Vermont has made significant progress in upgrading their electrical grid, many individual farmers had yet to install the newer technologies that would allow them to connect up. This was a significant cost for several farmers, particularly those located further from power substations, with one farmer noting that he knew several farmers who wanted to join Cow Power™ but felt that the grid conversion necessary would be either too expensive or too cumbersome to make joining worthwhile. Each phase of the project, from approval to construction to going online, required many different feasibility studies and assessments by local and national regulatory agencies. These assessments proved to be not only a significant extra expense, but were also viewed by farmers as being redundant and often useless. Given that many of these assessments were required due to Vermont's strict environmental laws, one farmer described the process as, "being forced to buy a Cadillac when a Toyota would do the same job." Farmers felt that the lack of transparency and the often contradictory messages sent by different funding and regulating agencies made the process far more convoluted than they felt it should have been. One farmer, whose entire implementation process took more than 3 years, addressed his situation thusly:

> The number of agencies that we dealt with were about 12 and I can't say that any certain agency was actually "difficult" to deal with but you needed to jump through every hoop placed in front of you and so combined, it was an administrative nightmare. We are glad that we took the steps that we did and saw this through completion, but hope that we never have to build another one...the thought sends shudders down our spines.

Indeed, while all farmers have been satisfied with their systems once they began operating, they felt that getting to that stage was the most unpleasant part.

Another area that farmers have expressed displeasure with is income derived from biogas. As mentioned above, one of the major reasons that farmers were interested in joining Cow Power™ was to provide extra income in the event of rapid milk price swings, which occurred frequently during the years 1995-2011 (University of Wisconsin, Department of Agricultural and Applied Economics 2012). From January 2005 (when the first Cow Power™ farm came online) to April 2008, farmers received good returns on the sale of electricity as price per kilowatt-hour remained high. However, from mid-2008 to early-2009, wholesale electric prices and the share that farmers received dropped precipitously to a low of 8 cents per kilowatt-hour (previous prices had fluctuated between a high of 15 cents and a low of 9 cents). This price drop came at a very bad time for farmers as milk prices also dropped to the lowest since 2004. As a result, biogas farmers agitated for relief from the state government, which responded by making available through its Sustainably Priced Energy Development Program (SPEED) a 20-year contract that would guarantee farmers a fixed-rate of 18 cents per kilowatt hour through a mechanism known as a feed-in-tariff (FIT) (Wang et al. 2011). All farmers interviewed were asked if at any point they felt they had made a mistake by signing up with Cow Power™ and several felt that they experienced such feelings when they were not being paid what they felt was a fair price for their electricity. Many noted they would be in severe financial trouble if they did not have the FIT, particularly given the debts that they incurred as a result of the milk price crash. However, farmers have been extremely pleased with the FIT and are glad that it has allowed the program to continue.

While the biogas to electricity portion of Cow Power™ has gone less than smoothly, one area that all parties involved consistently rate as being excellent is manure management and the beneficial changes it has made to pollution and farm operations. Digester and generator operations in particular provide opportunities for farmers to both reduce cost and improve the health of their animals. Although farmers are not able to use the electricity they produce directly, when the biogas is converted via a generator, this generates a significant amount of heat. This heat can then be piped into various buildings around the farm including barns, machine shops and greenhouses. Many farmers noted the difficulty and expense of keeping cows and calves warm, especially during winters, thus they have been extremely pleased with this benefit. Indeed, one farmer whose digester had yet to be completed at the time of interview, expects she will save upwards of $4,000 per month during some of the colder months. Farmers are also able to save money by using leftover manure solids as bedding for cows, which is not only far more sustainable than sawdust or hay, but far cheaper; sawdust has become a popular biofuel in its own right, as it can be pelletized and used as clean burning fuel in wood stoves, thus its price has increased as much as five fold in some cases (Millman 2008). One farmer interviewed expected to save $100,000 per year on sawdust while another estimated he could save twice as much. This bedding also has significant effects for both cattle health and milking operations as these processed solids do not carry the risk of introducing pathogens that comes with bringing in outside bedding (Cheroski, Li, and Mancl 2011). Cows on several farms have shown dramatic decreases in somatic cell counts, which functions as both a measure of a cow's overall health and the quality of its milk. Thus, cows are sick less often and spend less time out of the milking regimen, costing farmers less in terms of medical care and allowing them to make greater profits in milk sales.

Digestion and combustion not only aid in milking, but also have significant environmental benefits. As Cow Power™ farms are technically factory farms, or Confined Animal Feed Operations (CAFOs), they are subjected to EPA regulation under the Clean Air and Clean Water Acts. CAFOs are specifically identified as "point sources" of pollution and thus subject to stricter standards than operations that pollute indirectly (Till 2010). One farmer felt that the EPA was one of his biggest problems as they have been "overzealous" in attempting to regulate farm emissions and end up hurting farmers more than they help the environment. Thus farmers have been pleased with the digestion process, which converts a large portion of methane into carbon dioxide, which although still of concern is far less detrimental in terms of atmospheric warming than methane (U.S. Department of Energy 2011). Manure effluent, which in the case of post-digested manure is usually the liquid pressed out of solids destined for bedding, is also made less toxic. Several farmers noted that this was extremely important as it not only helps to satisfy regulators, but also helps to reduce eutrophication, much of which has been blamed on agricultural runoff, in nearby Lake Champlain and Lake Memphremagog (Creaser 2009). Indeed, although farmers have had their quibbles with Cow Power™, many have felt that it is one of the few things keeping dairy farming alive in Vermont, particularly because it allows for the sustainable preservation of the working landscape, which is often listed by farmers as their most important task.

Conclusions

What does Cow Power™ mean for biofuels scholarship and the three ecologies?

As mentioned previously, the three ecologies have rarely focused on biofuels and has rarely addressed them using localized case studies. Therefore, Cow Power™ is important for both "political" ecologies and biofuels research as it provides a concrete example that helps to connect a specific instance of biofuels production to the larger global political economic concerns that form the bedrock of much environmental geography and social science. Indeed, Cow Power™ not only helps to add more biofuels research to political ecology (see Bridge 2011), but fits in well alongside existing research in areas such as rural development, agricultural geography and energy geographies that focus on more traditional ecologies such as coal and oil. Thus, while this article provides only one example of a localized biofuel, it can serve as a springboard to future research that contributes to both political ecology and environmental geography, but also biofuels scholarship and environmental social science more generally.

Is Cow Power™ a good long-term strategy and what can it teach us about other instances of biofuels production?

Perhaps the biggest question that this study has peaked is whether Cow Power™ is sustainable, both in terms of the cleanliness of the energy produced and the long-term viability of the economic model on which the program operates. Regarding the former, while trapping methane and producing biogas is certainly better than letting manure fester, as the origins of this manure are in environmentally unfriendly industrial agriculture, biogas can be seen as somewhat of a greenwashing of larger unsustainable practices. Eisentraut (2010) has argued that unless the entire supply chain from which biofuels emanate is green, the energy produced cannot be considered green. In terms of economics, Cow Power™'s position could be stronger. Now, for the first time, biogas production has outpaced customer demand, forcing CVPS to sell the programs renewable energy credits to out-of-state utilities, often at below market value (CVPS Cow Power™ 2012). Indeed, while farmers are currently protected by the FIT, if Cow Power™, which was never intended to make CVPS a profit, is seen as too much of a financial loser, it could put future developments in doubt.

Given the above evidence, Cow Power™ may not be able to deliver on the promise of sustainable and economically sound biofuels. However, the benefits that struggling farmers receive should be reason enough to support this and other similar programs. When so many biofuels developments serve to undermine agricultural communities, any instance that actually strengthens them should be commended. Indeed, when Cow Power™'s long-term livelihood benefits, rather than merely its short-term profitability, are taken into account, keeping Cow Power™ a viable enterprise is well worth any economic losses.

Thus, the lesson that Cow Power™ can provide for biofuels production as a whole is the importance of balancing the needs of those involved in the growing and processing of biomass stocks with those of energy consumers. Scholars such as Shiva (2008) and McMichael (2010) have argued, the interests of Western businesses and governments are often placed ahead of those of people living in areas where biomass is cultivated. This results in a situation reminiscent of colonialism in which wealth is transferred to wealthier nations while those supplying the resources are left to bear the burdens of extraction. As a counterpoint to exploitative production systems, Cow Power™, while perhaps not the most successful program in purely economic terms, teaches us that biofuels can be used to both solve energy and climate problems and strengthen rural communities. However, such a balance cannot be achieved without some sacrifice on the part of energy and profit-hungry energy users. Indeed, while climate change is an issue that must be dealt with, it must not be done in a fashion that creates a "climate of injustice" which protects wealthy First World residents at the expense of the poor (Roberts and Parks 2007).

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