

Bioenergy and social sustainability in Yucatan, Mexico: an elaborated understanding based on energy justice

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Abstract:

A few years back jatropha projects were promoted in Yucatan, Mexico like many other countries in the global south for bioenergy production mainly by federal agencies. The aim was that jatropha biodiesel projects would provide energy security along with rural economic revitalization. When the projects started their operations, community members living proximate to the projects got localized employments that benefited them in some ways. However, some years later, the projects closed down due to several reasons. In this paper, we present results of our qualitative study conducted in rural Yucatan to understand how the communities were affected by the projects, and how the projects did not ensure long-term socio-economic sustainability of the area. We also show that though the Yucatecan bioenergy projects were aimed to solve fossil-fuel energy-based problems like energy crisis and climate change at national and international levels, these projects did not solve localized energy-related problems. Community members themselves continued using firewood in traditional three-stoned fire pits for their domestic cooking while working in jatropha plantations for producing biodiesel meant for national or international consumers. Based on our results, we argue that while planning bioenergy projects or any other renewable energy projects, it is critical and just to ensure how such projects can improve localized energy access related issues especially when such projects are sited in marginalized rural communities.

Introduction

Human development is undeniably interlinked with type and quantity of energy consumption in a nation (Martinez and Ebenhack 2008). However, around 1.6 billion people around the world continue to remain without access to electricity, another 1 billion have access to unreliable electricity supply, and 38 % of the worlds' population use biomass fuel for cooking and heating (IEA 2012; IEA 2016; UNDP 2010). On the other, in response to the growing concern stemming out of the climate impacts of fossil fuel-based energy emissions, new renewable energy (RE) options are increasingly diversifying energy portfolios worldwide (Sawin et al. 2016). The critical question that arises here is how do we provide for the energy needs for all in the present generation along with ensuring reduced climate-impacting atmospheric greenhouse gas accumulation for future generations? In other words, how do we ensure intrageneration energy justice along with intergenerational climate justice? It can be done with a substantial increase in the RE sector worldwide (Rockström et al. 2017). However, these systems should ensure both intragenerational impacts to be truly sustainable solutions. Not surprisingly, in the last couple of years, researchers have increasingly identified the importance of 'just transition' to stress that

transitioning to low-carbon economy should be socially (Goldthau and Sovacool et al. 2012) and environmentally just (Newell and Mulvaney 2013). Therefore, replacing fossil fuel with RE not only requires a readjustment of the existing socio-technical systems and socio-cultural practices, but it also calls for such transitions to be socially and environmentally just. In other words, when there is a transition to low-carbon economy, justice not only adoption of renewable energy technologies, but also includes a just distribution of who gets what share of the benefits of burdens of the transition with a minimal impact on life-sustaining environmental resources (Gross 2007; Devine-Wright 2014).

However, transitioning to low-carbon economy is contingent largely on government policies (Sovacool 2009, Painuly 2001). Through policies, governments can promote energy generation from renewable resources, nurture a nascent RE sector at time protecting it to compete with traditionally established means of power generation and consumption, and help create innovative opportunities where RE entrepreneurs to can participate in the sector (Haas et al. 2004). The huge arena of policymaking opens a plethora of issues of how to make right decisions in current time whose impacts and outcomes will be visible in future periods, how to deal and distribute positive and negative externalities of new developments, and how to solve myriad societal energy-related challenges. What adds to this problem is that decisions and policies useful in establishing new energy projects often have little or no representation from people impacted by those projects as decision-making processes lack due processes to ensure representation (Sovacool and Dworkin 2014).

This article reports on the finding of a study done in rural Mexico that was affected by bioenergy development to show how exclusionary decision-making processes following a top-down approach fail to ensure long-term sustainability of the projects. Using a case study approach, the central argument of the article is to point out that avoiding justice in procedural terms that considers the representation of the critical stakeholders can impact policy success and negatively impact people affected by projects implemented due to the policies. As low-carbon transition should aspire to provide energy justice, the study also indicates some of the challenges in such achievements.

The article henceforth is organized into five sections. Before presenting the case study and the results, a brief overview of energy justice and procedural energy justice is provided with a discussion of how principles of each aspect of justice can be followed for an inclusive energy transition. Then the community and the case of low-carbon energy development is introduced along with explaining the methods used for the research. After that, the results of the study are presented followed by a discussion of the results and a concluding section.

Energy justice and its tenets

The concept of energy justice is defined as “a global energy system that fairly disseminates both the benefits and costs of energy services and one that has representative and impartial energy decision-making” (Sovacool and Dworkin 2015, p. 436). Therefore, if justice is to be achieved, not only the process of who gets what is to be fair but also the decision-making processes of

impact allocation should have representations of affected stakeholder groups. Such decision makers also not only have opportunities to participate in decision-making platforms and adequate information required to come to an unbiased decision, but they also have legal processes in place to have access in case of any redressal (Walker 2012). Policy makers representing one group of stakeholders thus will have no more influence on the issue on the agenda than another and will be arriving at decisions where one group of stakeholder may not enjoy a good or a service resulting from the decision at the expense of another group of stakeholder. The implicit assumption here is that the stakeholder representatives are held their position by representing individuals who have elected or nominated them exercising their political rights free from any threat or favor (Scholsberg 2003). Therefore, there is a recognition of the representation of the diverse perspectives on the issue in the decision-making agenda that are based on different social, cultural, and economic pluralities (Scholsberg 2003).

As the ideal condition for low-carbon transition is to be socially and environmentally just, it is ideal that the supply chains also promote energy justice (Heffron and McCauley 2014). However, to evaluate whether the supply chain stages are energy just it is critical that energy systems follow three fundamental tenets of distributive, procedural and recognition justice. Distributive energy justice proposes that just energy systems will have the ills and burdens of the energy system being distributed equitably across all people (Sovacool et al. 2013). To ensure distributive justice, it is critical that all stakeholders are engaged in the process of making distribution decisions (Young 2011). The tenet of recognition justice provides that in distributing the benefits and detriments, a particular group of people is valued lesser than any other (Fraser 1999). However, such tenets should not just be followed in the distribution stage of burdens and benefits of energy projects but should be followed before the low-carbon project are implemented at the planning stage when where and how to implement projects are decided. Cutter (1995) terms it “outcome equity” when procedural justice is adhered to in the distribution of externalities and “process equity” when different stakeholders participate in the policy process that produces the outcomes. Some recent research has suggested that the tenets of energy justice have been followed or approved by people, in variable extents, in Denmark, Germany, Australia, and other developed nations (Heffron and McCauley 2014; Zoellner et al. 2008; Walter and Gutscher 2010). In these cases, different stakeholder groups have information of the development, are aware of their rights and in the rights of the others and have participated in exercising their rights, and their rights supported by institutional facilities that support their participation in decision making.

The outcomes of the studies mentioned above signal that procedural justice and recognition justice entail functional democracies. However, in many developing countries, public participation in policymaking is limited. In the following sections, a case of low-carbon energy transition is presented to illustrate a top-down approach to policymaking that flouts the tenets of procedural and recognition justice. Using this case, some of the problems associated with achieving procedural and recognition justice of also highlighted.

Materials and methods

The communities of rural Yucatan, Mexico

The research was conducted in six villages in the state of Yucatan in southeastern Mexico under the municipalities of Abala, Muna, and Tizimin in 2013. People in the villages considered themselves of Mayan descent, and their pre-Hispanic roots are evident in the local mounds or on the bricks in the local church build during the Hispanic colonization of the country. The communities have a high degree of marginalization with elevated levels of poverty, low rates of formal education, and low average domestic income (INEGI 2010). People lived in either permanent houses or Mayan wood houses with roofs made from palm leaves. The villages were at a distance from the local municipal town, and due to the lack of public transport, people accessed the town on their personal transport like motorbikes and bicycles. A typical village would be connected with the main two-lane highway with an unpaved road. Ideally, each village had a community center, a health center, and a primary school. Community members were mainly peasants or worked in local low skilled jobs. Members of many households in the villages also migrated to local tourist centers like Cancun and Playa del Carmen for jobs occasionally visiting family and remitting money to relatives. Many others members of the community traveled to local areas for seasonal jobs like octopus fishing or archaeological digging jobs. Large tracts of lands surrounded the villages that were either covered with subsistence food crops in traditional milpas, pasture crops, or secondary vegetation. Villagers used the surrounding secondary vegetation as biomass for cooking and heating water for bathing.

Jatropha biodiesel- a case study of low-carbon energy transition

From 2004 to 2013, Mexican crude oil production has come down from 3476 thousand barrel to 2562 thousand barrels (US EIA 2013). Petroleum is the main source of energy in Mexico. Therefore, the decline in production of crude oil that started in 2000 is a cause of concern in the country. Apart from that, CO₂ emissions from fossil fuel use have significantly risen from 378 metric tons in 2004 to 454 metric tons in 2013 with an average growth rate of 4.3% of non-biogenic CO₂ emissions (US EIA 2013). To fulfill these two pressing needs, the Mexican government announced a series of laws in the year 2008 to promote renewable energy technologies in the country and enable the transition towards sustainable development. The objective of the “Ley de Promocion y Desarrollo de Los Bioenergetics (Law of the Development and Promotion of Bioenergy henceforth mentioned as the Bioenergy Law of 2008) is to promote bioenergy in the country. Other laws like the “Ley para el Aprovechamiento Sustentable de la Energia” (Law for the Sustainable Use of Energy) and the “Ley para el Aprovechamiento de Energias Renovables y el Financiamiento de la Transicion Energetica (Law for the Use of Renewable Energy and Financing the Energy Transition) concentrated on renewable energy resources in the country in general.

Three different ministries under the federal government of Mexico, Secretaria de Energia or SENER (Secretariat of Energy), Secretaria de Agricultura, Ganaderia, Desarrollo Rural, Pesca y Alimentacion or SAGARPA (Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food) and the Secretaria de Medio Ambiental y Recursos Naturales(Secretariat of Environmental and Natural Resources) came together to provide technical support, financial incentives, and looking after the overall achievement of the policies to reduce GHG emissions

(Eastmond and Becerril 2014). The aim of these departments under the Bioenergy Law of 2008 was to establish a competitive national bioenergy sector providing alternative sources of energy without jeopardizing the food security of the country (Romero-Hernández et al. 2011).

The Mexican Secretary of Energy (Secretaria de Energia or SENER) proposed ethanol production from sweet sorghum, sugarcane, and cassava whereas rapeseed, soybean, *Jatropha Curcas* (henceforth *jatropha*), sunflower and safflower for biodiesel leaving out corn for being the main food crop of the country. *Jatropha* was chosen as one of main biodiesel feedstock crops as *jatropha* trees could provide additional re-forestation benefits restoring Mexico's degraded forest lands (Skutsch et al. 2011). Under the ProArbol program, the Comisión Nacional Forestal (the National Forestry Commission of CONAFOR) planned to provide incentives to farmers who planted *jatropha* trees on their lands or to companies that opened plantations and employed local people (SAGARPA 2009). SAGARPA provided economic incentives to propagate *jatropha* seed and cultivar production in rural Mexico. Thus, multiple states like the Chiapas, Michoacán, Veracruz and Yucatán cultivated thousands of hectares of *jatropha* in the southeastern part of the country (Rodríguez et al. 2014).

Jatropha was planted in 200,000 hectares in Veracruz, 20,000 hectares in Chiapas, 9,500 hectares in Yucatán, and 6,000 hectares in Michoacán (Eastmond and Becerril 2014, Rodríguez et al. 2014). States like Veracruz and Yucatan collaborated with international companies to establish plantations in the state that would hire local people. The state government provided the *jatropha* seedlings whereas the Comisión Nacional Forestal (National Forest Commission or CONAFOR) provided subsidies to the companies by providing minimum wages to around 120-135 workers in initial two years of operation.

A Mexican subsidiary of the Global Clean Energy Holdings (GCEH)Inc., with its headquarters in California, USA, arrived in the community of Sucopo in 2008 and bought 6,000 ha of erstwhile abandoned private ranch land (SCS, 2012). Two other companies with foreign and local joint ownership named Kuosol and Lodemo also opened other smaller plantations in the region near other communities like Abala, and Muna planting *jatropha* in an additional 3,500 ha of land. During the consultation with village people, company officials from GCEH informed them that the company would start their operation of producing sustainable biofuels by planting *jatropha* crops and employ residents in the plantations for 15 to 30 years. This company also offered higher salaries, and the working conditions were better than other plantation companies in the region. Around 500 workers were employed from neighboring communities as day laborers where men worked in the main plantation and women worked in the *jatropha* nurseries.

Local jobs provided by the plantations had considerable positive impacts on many people of to the communities. With fixed local jobs, the need to migrate to urban and tourist centers reduced. Some plantation workers could afford loans to buy motorcycles that helped them in transport. In the meanwhile, the GCEH plantation also got certified by the Roundtable on Sustainable Biofuels (now Roundtable on Sustainable Biomaterials). However, within few days of the certification, the company started firing the workers as the plantations could not produce any biodiesel profitably. During the fieldwork in 2013, all the plantations in the area were closed

its operation and what was left of the plantation was 9500 ha of jatropha fruitless jatropha trees that was useless as biodiesel feedstock or any other use.

Research methods

Data presented in the results section of this research was gathered using ethnographic methods and conducting semi-structured interviews with plantation workers. The focus of the research was to understand the perception of community members on the jatropha plantations close to their community to explore whether this case of low energy transition followed the different tenets of energy justice. Data was also collected with intensive discussions with local government workers and federal agency employees. Additionally, information was collected through documentary research of government policies and the Mayan history of the region.

A protocol with a pre-defined set of open-ended questions was used to interview people. The interviews were semi-structured to have a nuanced understanding of the community members' perception of the impacts of local jatropha-based bioenergy developments. Questions focused on understanding community members' knowledge of the benefits and problems in their communities, what changes in their socio-economic conditions they have seen in the past and how they see the future, and whether they or members of their family migrated to another region to improve their economic conditions. Participants were asked about their perception of the jatropha-plantation companies, whether these companies benefitted them, and what they liked or disliked about working at the plantations. Questions were also asked about where the participants worked before joining the plantation companies, and what did they do after they stopped working there after being laid-off or leaving the job at their will. We also asked the interviewees their views on what ails the burgeoning jatropha projects in their community, why did they think the plantations were facing those problems and on the long-term changes they have seen in their natural surroundings.

The protocol was approved for human subject research by an institutional review board, and no personal information was collected to maintain the anonymity of our interviewee participants. The interviewers each time read a confidentiality statement before each interview informing the interviewee of the confidential nature of the data and took their verbal consent to start the interview. Each interviewee was also told about their rights to deny answering any question or stop the interview at any point. Interviews were audiotaped after the verbal consent of the interviewee on the recording process for data collection.

A total of 38 interviewees (22 female and 16 male) were interviewed using a snowball sampling method (Biernacki and Waldorf 1981). This approach was used as the researcher was looking for people who worked on the plantation or their spouses used to work for the plantation. As the data of the person who worked for the jatropha companies was not available and impossible to collect, the village headman or the ejidatario in each village was approached to help recruit interviewees. Each interviewee was asked to refer us to their colleagues so that we could approach them. The interviewees had a direct connection with projects rather than an outside community member who were asked to comment on the projects without having their

experience in it. The data collected is firsthand knowledge gathered by the interviewees while working with the plantations and experiences after the plantations laid them off.

Results

A typical interviewee in this study fell into the low-income category, and a majority (80%) of them were recipients of government welfare programs like health insurances, educational programs that induced parents to send their kids to school, or housebuilding aid to construct permanent houses and bathrooms. Their houses had semi-permanent structures made from locally available materials like mud and trees branches for roofing. They also had one permanent structure that was built with government aid. Most interviewees (67%) had owned the land where they grew some food crop for their consumption (45%) planting mostly corns and vegetables, some grew hay for sale to local ranches and rest maintained a balance between selling and consuming what they grew in their land. A majority (87%) of them had some fruit trees growing citrus fruits that helped them augment their food sources and few interviewees (33%) additionally raised poultry on the land surrounding their house. A standard fixture in all the households where the interviews were conducted was a three-stoned traditional cookstove that a majority (80%) of the interviewees used for their domestic energy needs. Firewood was typically collected by predominantly by male household members from surrounding public lands or their milpa land. Few interviewees had liquid petroleum stoves that they used for emergency use in their kitchen inside the house. Wood, to them, was a cheap fuel that was almost free to collect other than the opportunity cost of the time spent in the collection.

Though growing crops for commerce and subsistence did provide work to the interviewees, most the interviewees (53%) pointed out that their communities faced job crisis. They were of the view that it was difficult for people in the community to start their own business because financial resources were scarce, and infrastructural facilities like proper roads, lack medical services, lack of education were also detrimental towards enhancing local economic conditions. Most interviewees (60%) also expressed the view that jobs have dwindled over the last ten years in their area. Interviewees (79%) also pointed out that agricultural profitability is erratic as local climate systems have changed over the years with rains that supported irrigation-less agriculture have reduced. As local jobs were few and agricultural activities were increasingly unprofitable, a majority of the interviewees (61%) or their family members worked in distant urban centers remitting money to their family working as domestic help or construction workers.

Though the interviewees were mostly (71%) not aware of jatropha before the companies opened their plantations, nearly two-third of the interviewees (64%) believed that the jatropha plantation businesses in their community was a good thing for their community as they provided local jobs enabling them to live in the community and a paycheck at regular interval. More than half (52%) of the people we interviewed thought that they or their close family members were paid fairly by the jatropha companies when they worked there. Both men and women working for the companies were paid in the range between 700-900 pesos per week. They pointed out that they also got insurance, voucher payments and in some cases severance pay when they were laid-

off. Less than one-third (22%) of the people who worked on the plantations were of the view that the companies did not pay them sufficient salary and the benefits provided to them was good. However, these views differed from company to company as not all interviewees worked in one plantation company.

At the time of the interviews in 2013, most of the interviewees (60%) were laid off from the plantation jobs. Others decided to leave the job either due to personal reasons or as working conditions were increasingly becoming difficult for them. Only a few (18%) were employed in other jobs at the time of the interviews. Others either worked on their land or took care of their families living off the compensation they got from the companies and on government welfare payments. Most interviewees (74%) pointed out that the jatropha plantations didn't work as the plants that did not die from sunburn or disease bore little or no fruits as they even when a lot of fertilizers, fungicides, and pesticides were applied. At one point, no further seeds were planted as the cost of upkeep of the existing plants became too high, and the companies were out of funds. Thus, after around five years, the companies left.

Discussion

Though a successful low-carbon bioenergy sector can be beneficial in mitigating climate change, the way the projects unfolded in Yucatan has different issues that are discussed in this section. First, jatropha projects in Yucatan were not shaped to solve localized energy access and poverty related issues. People in the area continued to depend on traditional biomass that has many negative impacts like carbon emissions and pollution, indoor air pollution and associated health impacts, and time poverty where people lack time to pursue other economic activity as much time is spent in firewood collection as evidenced by numerous research articles (Bond et al. 2013; Lim et al. 2012). What promoted the jatropha projects or the bioenergy policy were shaped by events that happened miles away in the federal government in Mexico. Therefore, the low-carbon transition solutions were more targeted towards solving problems at large scales at national or even international levels when people in the communities themselves continued to use biomass in the most pollutive and negatively health impacting forms.

The above leads to the second problem point. Policymaking in many nations is a top-down approach. It is centrally assumed that policies will solve policy problems when implemented. In the case of jatropha bioenergy, Mexican policymakers also adopted the same top-down process evident from the discussion in one of the earlier sections where a brief overview is provided. The idea was that the plantations would open new economic opportunities that will provide jobs to local people. However, interviewees reported that though the companies began large plantations in the area, production was hit due to the unsuitability of the crop with localized environmental conditions. Thus, though initially jobs were created and people could afford a better standard of living, the conditions deteriorated over time. The outcomes point to the lack of proper planning backed with research on the part of the government as well as the investors of how jatropha biodiesel can provide sustainable solutions. Also, feedback from local farmers would have informed jatropha investors about soil fertility, rain, and plant disease-related problems in the

area. Such critical information was missing that would have helped the jatropha industry in the area. It is also interesting to note that no further policy decisions were made to revive the biodiesel sector in the country. Therefore, the one-time bioenergy policies implemented taking a top-down approach were also unable to provide long-lasting economic benefits to the people.

The results also point towards a third problem pointing towards a current understanding of sustainability, its scale, and the problems with implementation. Biodiesel for the transportation is a low-carbon alternative adopted considering its long-term sustainability impacts. However, it was found that for the communities, it failed to bring any sustainable changes. Interviewees reported that the jobs were good as long they lasted and these new plantation jobs did not significantly change the socioeconomic conditions in the area. The villages continued to remain underdeveloped and inaccessible. Moreover, the plantation workers did not learn any additional skills while working on the plantations that would open opportunities for them in other sectors. The community members also pointed out that the plantations were good as they created local jobs and could not identify any other type of benefit they received from local bioenergy development. Therefore, when thinking about sustainability, it is also essential to understand it social, economic along with environmental aspects. The research also found that one company was certified sustainable by the Roundtable of Sustainable Biomaterials after which the company closed the plantation within few months. These all points towards a lack of understanding of what is meant by sustainability certification and how it can be implemented in different cases.

Liberalization policies in the 1990s have made rapidly helped commoditization of land especially in Latin America, Asia, and Africa (Brenner and Theodore 2007; Zoomers 2010). With the availability of foreign direct investment, land-rich countries in these continents have become critical for new types of actors like enterprises requiring large tracts of land to operate like bioenergy plantations (United Nations 2008). Additionally, national governments also encourage such kind of foreign entrepreneurship due to the economic opportunities they produce (Zoomers 2010). Therefore, private investor led land acquisition has happened in different countries like Argentina, Brazil, Lao, Malaysia, Indonesia, and other nations for bioenergy (Sulle and Nelson 2009). However, these massive land transfer often create risk for different types of rural livelihoods (Cotula et al. 2009), and they may not also have adequate skills to adopt other livelihoods (Zoomers 2010). The results of this study suggest that the interviewees were dependent on their land and they continued to grow food crops and other crops in their land when the plantations closed, and they lost their jobs. Though they did not lose access to their land due to plantations, such possibilities existed if the plantations expanded further. These competing issues of land for the people who works on it or land for the most efficient producers complicates the matter further (Zoomers 2010).

Top-down policymaking is based on an imbalance where political elites can exercise their power in who benefits from an energy development and is very common in fossil fuel-based energy production. Following a top-down approach helps the government to manage who gets the advantage of the development and how the energy generation processes operate (Sovacool et al. 2014). However, transitioning to a low-carbon economy is an alternative to the problems created by large, centralized fossil fuel-based energy generation and following the tenets of

procedural and recognition justice ensuring pluralistic viewpoints in the energy, decisions can help build just energy systems. Procedural and recognition justice theories make opportunities for public participation in decision-making. Stakeholders who would be affected by new energy development would be able to express their opinions, and all interested parties will have equal recognition irrespective of their social, cultural and economic background.

Conclusion

This study documents an example of how bioenergy projects were a few years back jatropha projects were promoted in Yucatan, Mexico mainly by the federal government and implemented by the federal agencies. The aim was that jatropha biodiesel projects would provide energy security along with rural economic revitalization. When the projects started their operations, community members living proximate to the projects got localized employments that benefited them in some ways. However, some years later, the projects closed due to lack of productivity of the plants. The results suggest that the jatropha projects did not provide any long-term benefits to the people in the community along with the inability to produce any biodiesel. Such results indicate that there is a need to rethink how low-carbon transition should be made appropriate to the condition in a nation or even in a region rather than following one-size fits all model of implementation. Public participation in policymaking that is fundamental to procedural justice can create channels for participation of different groups of stakeholders impacted by low-carbon technology transition.

However, the challenge of procedural and recognition just energy systems it lies elsewhere. A just energy system in procedural terms can only be possible when people in the society are willing to be active members of their community and express their choice and opinions as well as social organizations that provides opportunities for citizens to participate in the decision-making processes freely (Sovacool et al. 2014). This is not always the case in many countries where governments are less accountable to the people they serve and people also become indifferent about government functioning and their rights over time due to the indifference. Therefore, a just low-carbon energy society requires systematic restructuring of social and political systems conforming to the norms of democracy.

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