Exploring the Socioeconomic Composition of Wind Farm Communities in Ontario: Implications for Wind Farm Planning and Policy

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Abstract
This research explores the socioeconomic composition of sixteen wind farm communities in Ontario, Canada, for wind farms commissioned between 2006 and 2012. Past research has shown that wind farms are disproportionately developed in socioeconomically disadvantaged areas and that socioeconomic factors influence wind farm support, an important factor in wind farm planning. This research finds that wind farm communities do not exhibit characteristics of disadvantage compared to host counties. Investigating the association between when wind farms were commissioned and community-scale characteristics, this research observes that communities with wind farms operational before 2009 had significantly lower median income compared to communities with wind farms operational after 2009. This provides one perspective on how community-scale characteristics may shape wind farm planning, specifically the influence of local opposition and financial incentives on the location of wind farm developments.

Keywords: wind farm planning, renewable energy planning/policy, socioeconomic characteristics, income

Résumé
Les approches conventionnelles d'évaluation des emplacements éoliennes utilisent l'emploi des terres, et les critères environnementales et techniques. Ces approches ne considèrent pas les dimensions socioéconomiques, malgré leur importance a la planification des parcs éoliens, le solution des fermes de turbine, et l'opinion des fermes opérationnelles. Les caractéristiques socioéconomiques peuvent aussi influencer les réponses aux sondages employes par les planificateurs et les rechercheurs pour étudier les communautés des fermes éoliennes.

Ces recherche examinent les caractéristiques socioéconomiques de huit communautés de fermes éoliennes en Ontario, Canada et étudient les liens entre les variables socioéconomiques et le taux des réponses aux sondage. Collectivement, les communautés des fermes éoliennes ont montre un nombre de modèles distincts en comparison au niveau provincial, y inclus la pauvrete plus élevée en comparison , avec le revenu médian et le pourcentage de résidents recevant les paiements de transfert gouvernement. Les implications de ces tendances socioéconomiques sur le développement de parcs éoliens et la planification sont discutées, mettant en évidence le potentiel pour les planificateurs municipaux d'intégrer les contextes socioéconomiques a la planification des fermes éoliennes. Le taux des réponses aux sondages correspondaient positivement au le pourcentage des familles à faible revenu au niveau de la communauté, incitant la nécessité d'une enquête plus approfondie sur les résultats du sondage.

Mots clés: planification de vent de ferme, ferme de turbine / emplacement de vent, caractéristiques socio-économiques, les taux de réponse aux sondages

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1.0 Introduction

Wind farm planning is one of the primary challenges to developing wind farms and furthering on-shore wind energy production (Agterbosch, Meertens, and Vermeulen 2009; Loring 2007). Past research has observed that socioeconomic characteristics of wind farm communities are associated with approval of wind farm projects and also influence individual-scale perceptions and opinions of local wind farm projects (van der Horst and Toke 2010; Firestone and Kempton 2007). Despite the importance of local characteristics to wind farm planning, little past research has analyzed the socioeconomic composition of wind farm communities and investigated how these factors may influence wind farm planning (Mulvaney, Woodson, and Prokopy 2013).

Ontario is an interesting case study for this research, as it has experienced growth of wind energy projects and related planning conflicts (Walker, Baxter and Ouellette 2014; Mulvihill, Winfield, and Etcheverry 2013). In Ontario, there were approximately 10 turbines in 2003, increasing to 1,852 in 2014 (Deignan, Harvey, and Hoffman-Goetz 2013; Canadian Wind Energy Association 2015). The first wind farm composed of ten or more wind turbines (Rowlands and Jernigan 2008) was commissioned in 2006 and sixteen wind farms were operational at the end of 2012. This increase in wind energy capacity was due, in large part, to provincial policies that established feed-in-tariff programs and streamlined the wind farm planning process (Stokes 2013; Watson, Betts, and Rapaport 2012).

Broadly, this research explores the socioeconomic characteristics of sixteen wind farm communities in Ontario, Canada, and is motivated by two research questions. First, what was the socioeconomic composition of wind farm communities commissioned between 2006 and 2012 and do communities exhibit characteristics of socioeconomic advantage or disadvantage? Following past research, we hypothesize that wind farms will be located in socioeconomically disadvantaged areas when compared to their regional contexts (van der Horst and Toke 2010). Second, is there an association between community-scale socioeconomic characteristics and when wind farms were developed? We hypothesize that because of the economic benefits of hosting wind turbines and past research indicating that high-income residents are more opposed to wind farms (Ladenburg 2010), socioeconomically disadvantaged communities were the first locations of wind farm developments in Ontario.

This paper begins with a review of past research focusing on the influence of socioeconomic characteristics on wind farm planning, specifically project approvals, public support, and local opposition. This is followed by a brief overview of renewable energy policy in Ontario and the wind farm and socioeconomic data used for analysis. Next, results are shown and we discuss patterns of wind farm development and how socioeconomic factors may influence wind farm planning. Importantly, because this research is exploratory and analyzes all wind farms in the province over a six-year period, the results of this research provide broad provincial-scale insights into wind farm development and planning. Concluding, we highlight limitations of this study and recommend future research directions.

2.0 Socioeconomic characteristics and wind farm planning

Generally, socioeconomic characteristics of wind farm communities have been shown to be associated with the location of wind farm developments as well as support and opinion of wind farm proposals and projects. Past research has observed that wind farms are more likely to be developed in areas that exhibit higher levels of socioeconomic disadvantage. Specifically, van der Horst and Toke (2010) compared the community characteristics for wind farm proposals that were accepted and rejected in rural England and found that, on average, communities where wind farm applications were rejected were significantly "better off" than in areas where wind farm applications were approved, as measured by voting turnout, crime rates, and lifespan variables. This study observed that income was not associated with approval or rejection of wind farm proposals, but did not measure other conventional socioeconomic variables such as education, ethnic composition, or housing (van der Horst and Toke 2010).

One possible explanation for higher rates of wind farm development in socioeconomically disadvantaged communities is that they do not possess sufficient levels of social, financial, and political capital to effectively mobilize opposition and engage in the planning process (Loring 2007). More effective opposition to wind energy developments is expected in communities where residents have higher income and higher levels of education, as this enables individuals to operate more effectively within planning and political systems (Bell, Gray, and Haggett 2005). For example, in a case study in Cape Cod, it was well-connected and well-financed communities in Cape Code who were most effective in organizing a group that opposed offshore wind farm development (Bohn and Lant 2009), and in a similar geographical context, Firestone and Kempton (2007) note that wind farm opposition is typically politically connected and able to mobilize news media coverage around their efforts.

Attitudes towards wind farm developments are influenced by a variety of criteria including the phase of wind farm development (often being more negative during planning and more positive when turbines are operational (Firestone, Kempton, and Krueger 2009)), aesthetic preferences, environmental degradation, and perceived changes to property values (Fast, Mabee, and Blair 2015; Agterbosch, Meertens, and Vermeulen 2009), as well as socioeconomic characteristics. More negative attitudes of wind farms are associated with higher income and higher educational attainment while more supportive attitudes of wind farms are found among employed residents (Ladenburg 2010; Thayer and Freeman 1987; Firestone and Kempton 2007).

In a study of wind farm attitudes in three counties in Indiana, Mulvaney, Woodson, and Prokopy (2013) found no statistically significant associations with demographic or socioeconomic characteristics, but from stakeholder interviews identified low socioeconomic status as a predictor of wind farm support because individuals with low incomes receive financial compensation for leasing land for wind turbine operation. This is consistent with literature that observes high public support for wind farms when individuals receive financial benefits from leasing land or when community resources such as schools receive financial contributions from wind farm developers (Slattery et al. 2012; Wolsink 2000; Mulvaney, Woodson, and Prokopy 2013). Interestingly, individuals who benefit financially from wind turbines are more likely to have higher exposure to noise yet are less likely to feel annoyed (Bakker et al. 2012).

Often, studies exploring the determinants of local wind farm opposition focus on "not in my backyard" (NIMBY) perceptions (Devine-Wright 2005; Eltham, Harrison, and Allen 2008; Aitken 2010). NIMBYism is characterized by high support for development in general, but active opposition of wind turbines or wind farm development locally (Krohn and Damborg 1999; Wolsink 2000; Breukers and Wolsink 2007; Swofford and Slattery 2010). Unpacking the motivations of NIMBY opposition, Bell, Gray, and Haggett (2005) identify three possible explanations for the difference between high support for wind energy and low success in wind farm developments: the democratic deficit, qualified support, and the social gap. The democratic deficit explanation argues that development decisions are influenced by a minority of residents who actively oppose wind farms, the qualified support explanation suggests that support for wind farm development depends on a number of other criteria (e.g., environmental and visual impacts), and the social gap explanation hypothesizes that individuals make decisions based on self-interest and that the individual costs of hosting wind turbines (e.g., visual obstruction of the natural landscape, noise) outweigh the benefits to the common good (i.e., a small amount of wind energy produced) (Bell, Gray, and Haggett 2005).

Studies of local NIMBY opposition have also found that the wind farm planning process influences support and opposition for wind farms. Excluding local residents from the planning process and administering renewable energy planning at non-local governance levels (e.g., province rather than municipality) may lead to increased opposition to developments, increased dissatisfaction with the planning process, and may alienate wind farm supporters (Toke, Breukers, and Wolsink 2008). A participatory planning process that engages local residents, on the other hand, may increase support for wind farms and result in projects that incorporate local preferences (Agterbosch, Meertens, and Vermeulen 2009; Eltham, Harrison, and Allen 2008).

2.1 Renewable Energy Policy and Wind Farm Planning in Ontario

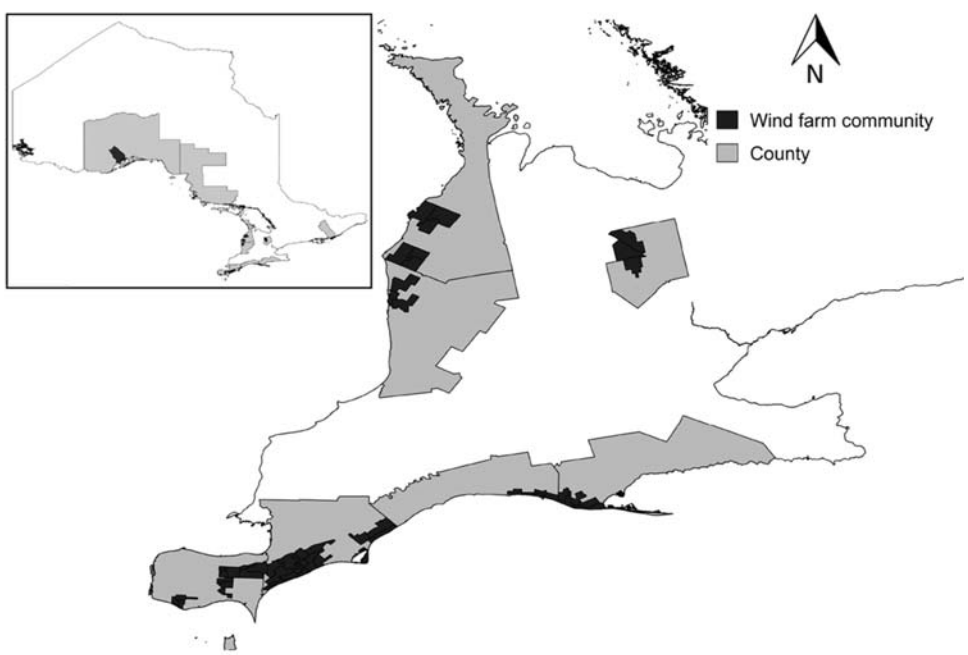
In 2006, the Ontario government adopted the Renewable Energy Standard Offer Program (RESOP), which established a feed-in-tariff program for small renewable energy projects. Briefly, feed-in-tariff programs support the development of renewable energy projects by ensuring long-term financial security for infrastructure investments through guaranteeing to a pay set amount per kilowatt-hour for a period of time to renewable energy producers (Pirnia, Nathwani, and Fuller 2011; Stokes 2013; Mulvihill, Winfield, and Etcheverry 2013). Within two years, 443 renewable energy contracts were secured under the RESOP, with approximately 400 for solar and wind (Mabee, Mannion, and Carpenter, 2012). Because of the arrangement of the RESOP, most wind farms developed during this time period had a large number of turbines and were owned and operated by large corporations (Etcheverry 2013).

The RESOP had a number of limitations that impeded renewable energy development including a lack of access to the existing electricity grid and limited financing for feasibility studies. To overcome these limitations, the Green Energy and Green Economy Act (GEGEA) was adopted in 2009, establishing a more comprehensive feed-in-tariff program for both small- and large-scale renewable energy projects as well additional incentives for rural and First Nations land owners (Stokes 2013; Winfield et al. 2010; Christidis and Law 2012). With the GEGEA, the government also became more directly involved in renewable energy planning and policy implementation (Yatchew and Baziliauskas 2011). Specifically, the Renewable Energy Approvals Process (REA) was also adopted to streamline the approval process for renewable energy projects by exempting feed-in-tariff projects from municipal planning approvals and instead, approvals were issued by provincial ministries (Watson, Betts, and Rapaport 2012; Winfield and Dolter 2014). The REA limited the capacity of local stakeholders, including residents and planners, to influence proposed wind farm plans as well as project approvals (Walker, Baxter, and Ouellette 2014).

3.0 Wind farm and socioeconomic data

In Ontario, there were sixteen wind farms commissioned between 2006 and 2012, representing all operational wind farms in the province at the end of 2012. Nine wind farms composed of 592 wind turbines were commissioned between 2006 and the end of 2009 (from largest to smallest): Melancthon, Enbridge, Wolfe Island, Prince, Erie Shores, Port Alma, Ripley, Kingsbridge, and Frogmore. Seven wind farms composed of 301 wind turbines were commissioned between the 2009 and the end of 2012 (from largest to smallest): Comber, Raleigh, Greenwich, Chatham, Talbot, Harrow, and Gosfield (Table 1). Geographically, fourteen wind farms are concentrated in southwestern Ontario close to the Great Lakes (Hill and Knott 2010) (Figure 1). For reference, only Greenwich and Prince wind farms were located in northern Ontario.

Figure 1. Sixteen wind farm communities analyzed in Ontario. Wind farm sites are shown in black and host counties are in grey. The province of Ontario and northern Ontario wind farms are shown (inset).



Individual wind turbine locations were geocoded to points with geographic coordinates (x,y) by University of Waterloo researchers. Wind turbine locations were linked to 2006 Canadian census socioeconomic data at the census dissemination area (DA) scale using a point-in-polygon method in ArcGIS 10.1, resulting in wind turbine counts for each DA. For reference, DAs are the smallest geographic areal unit of analysis for which Canadian census data is available (Statistics Canada 2012). DAs were chosen as the unit of analysis because they most directly align with the geographic boundaries of wind farms.

Table 1. Ontario wind farm statistics and host counties

Wind farm	County	Year commissioned	Turbine count
Melancthon Phase I and Phase II	Dufferin	2006	133
Prince	Algoma	2006	75
Erie Shores Wind Farm	Elgin and Haldimand-Norfolk	2006	66
Kingsbridge I Wind Power Project	Huron	2006	22
Ripley	Bruce	2007	38
Port Alma	Chatham-Kent	2008	44
Frogmore, Cultus, and Clear Creek Wind Farm	Norfolk	2008	18
Enbridge Ontario Wind Farm	Bruce	2009	110
Wolfe Island EcoPower Centre	Frontenac	2009	86
Chatham	Chatham-Kent	2010	44
Talbot	Chatham-Kent	2010	43
Harrow	Essex	2010	24
Comber East and West Wind Project	Essex	2011	72
Raleigh Wind Power Partnership	Chatham-Kent	2011	51
Gosfield	Essex	2011	22
Greenwich	Thunder Bay	2012	45

Ten variables were selected from the 2006 Canadian Census to characterize the socioeconomic environments of wind farm communities based on seven dimensions: poverty, family composition, housing, ethnic composition, residential stability, employment, and education (Messer et al. 2006). Poverty was operationalized through median income and percent of residents receiving government transfer payments, family composition through percent of low-income families and percent of lone parent families, and housing was operationalized through percent of dwellings in need of major repair. Ethnic composition was measured through percent of immigrant residents; residential stability through one-year residential mobility rate, employment through unemployment rate; and education through percent of residents with post-secondary education (a university certificate, diploma, or degree). Population density was also included because it has been shown to have an effect on installed wind energy capacity (Bohn and Lant 2009) and may be an indicator of conflicts between local population and wind farm development (Toke, Breukers, and Wolsink 2008). Wind farm community and county averages are shown in Table 2. Provincial averages are shown for context in Table 2 (but not used in analysis).

4.0 Methods and Results

To understand the socioeconomic composition of wind farm communities and investigate if they were relatively more advantaged or disadvantaged in the regional context, we compared ten wind farm community- and county-scale socioeconomic characteristics using Wilcoxon-Mann-Whitney tests (Table 2). Counties are the spatial unit used for regional planning, and provide for more geographically targeted insights compared to larger spatial units such as the province (Statistics Canada 2013). For analysis, county DAs (excluding wind farm DAs) were compared to wind farm DAs.

Compared to host counties, wind farm communities had significantly lower percentages of lone-parent families, lower one-year residential mobility, and fewer immigrant residents ($p < 0.05$). Wind farm communities also had significantly higher percentages of dwellings in need of major repair, fewer residents with post-secondary education, and significantly lower population densities ($p < 0.05$).

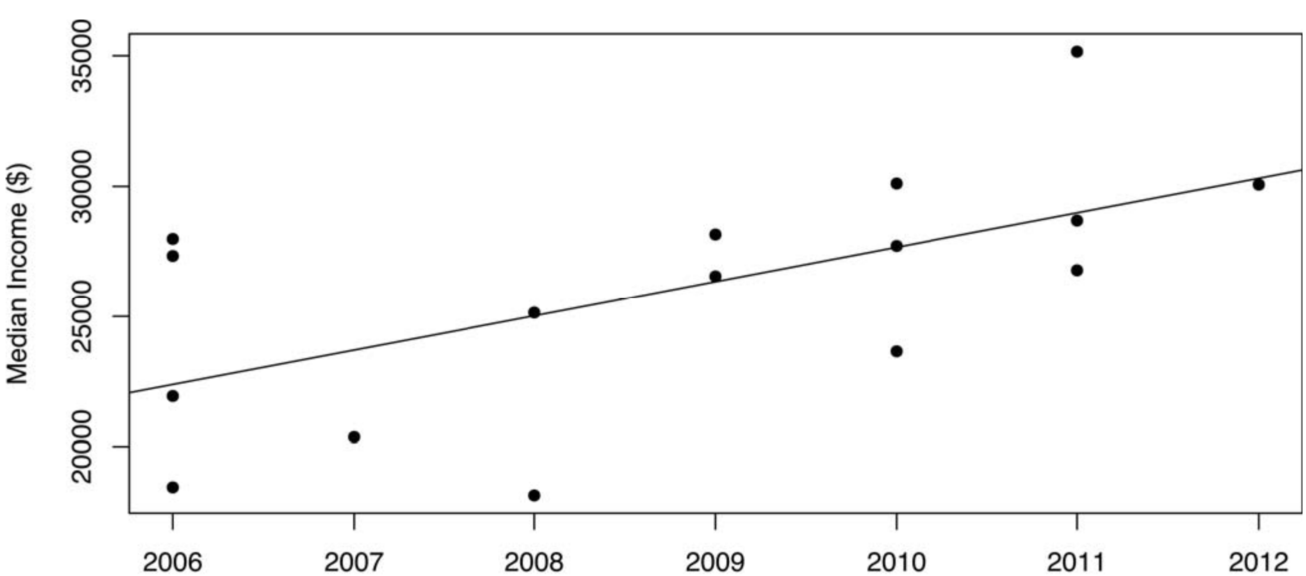
Table 2. Results of Wilcoxon-Mann-Whitney tests comparing wind farm community and county characteristics, with provincial averages for context

Characteristic	Wind farm community average	County average	Provincial average
Median income ($)	26,232.81	27,272.72	27,258.00
Government transfer payment (%)	12.35	12.78	8.80
Low-income families (%)	3.67	6.20	8.60
Lone parent families (%) *	8.32	15.53	15.80
Dwellings in need of major repair (%) *	10.28	7.14	6.59
Immigrant residents (%) *	11.26	13.61	28.26
One-year residential mobility (%) *	7.29	11.74	13.40
Unemployment (%) **	5.96	7.33	6.40
Post-secondary education (%) *	8.94	15.61	24.62
Population density (per km^2) *	0.02	1.75	12.26

* $p < 0.05$
** $p < 0.10$

To explore if there was an association between community-scale socioeconomic characteristics and when wind farms were developed, we plotted each wind farm community socioeconomic variable by the year when wind farms were commissioned. Socioeconomic variables were all based on values from the 2006 Canadian Census and standardized in order to compare graphs for variables with different scales. Fitting a linear trend line to estimate the change between 2006 and 2012, the only variable showing a moderate amount of change and with a trend line that explained greater than 30% of the variance over this time period was median income (Appendix A). Median income increased from about $23,924 for the four wind farms commissioned in 2006 to an average of about $30,176 for the four wind farms commissioned in 2011 and 2012 (Figure 2).

Figure 2. Community-scale median income (2006) for when wind farms were commissioned. The trend line has a slope of 0.29 and R^2 of 0.36.



To further examine the differences between communities where wind farms were developed first and where wind farms were developed later over the time period of 2006 to 2012, we applied Wilcoxon-Mann-Whitney tests to each socioeconomic variable to compare communities where wind farms were commissioned before and after 2009 (Table 3). We chose 2009 because this is the middle of our dataset and divides wind farms into early and later wind farm developments.

It was found that communities with wind farms commissioned before 2009 had significantly lower median income compared to communities commissioned after 2009 ($p < 0.05$). We also found that communities with wind farms commissioned before 2009 had higher percentages of residents receiving government transfer payments and lower population density ($p < 0.10$). No other characteristics exhibited statistically significant differences.

Table 3. Results of Wilcoxon-Mann-Whitney tests comparing wind farm community characteristics before and after 2009.

Characteristic	Before 2009 average	After 2009 average
Median income ($) *	23,361.29	28,949.00
Government transfer payment (%) **	13.84	10.93
Low-income families (%)	4.43	2.66
Lone parent families (%)	7.41	8.78
Dwellings in need of major repair (%)	10.10	10.11
Immigrant residents (%)	13.76	8.94
One-year residential mobility (%)	6.74	7.49
Unemployment (%)	5.80	5.90
Post-secondary education (%)	9.52	8.39
Population density (per km^2) **	0.013	0.024

* $p < 0.05$
** $p < 0.10$

5.0 Discussion

This research finds that wind farm communities generally exhibit lower levels of lone-parent families, immigrant residents, and one-year residential mobility compared to host counties (Table 2). So, for the dimensions of family composition, ethnic composition, and residential stability, wind farm communities are comparably socioeconomically advantaged in the regional context. This is contrary to our hypothesis that wind farm communities would be more likely to be located in socioeconomically disadvantaged communities and also conflicts with past research in rural England that found that wind farm proposals are more often rejected in "better off" communities and that wind farm proposals are more often accepted in socioeconomically disadvantaged areas (van der Horst and Toke 2010).

Wind farm communities do exhibit characteristics of socioeconomic disadvantage for housing and education dimensions, as measured through dwellings in need of major repair and post-secondary education rates, respectively (Table 2). It is possible that highly educated individuals are actively opposed to wind farms and this limits development (Ladenburg 2010; Bidwell 2013), however with significantly lower population densities and higher percentage of dwellings in need of major repair among wind farm communities, these characteristics are indicative of the rural nature of wind farms in Ontario (Mulvihill, Winfield, and Etcheverry 2013; Hill and Knott 2010). This may reflect the combination of where there is suitable land for wind turbines and planning preferences to locate wind turbines away from higher population density areas, particularly given required minimum 550m-setback distances from residential land uses (Watson, Betts, and Rapaport 2012; Hill and Knott 2010).

Applied to wind farm planning, this research suggests that in general, wind farms in Ontario are not developed in communities that are socioeconomically disadvantaged (compared to host counties) and that the potential negative effects of industrial wind turbine operation such as noise, vibration, and annoyance, are not disproportionately located in communities with low socioeconomic status. This community-scale analysis does not eliminate the possibility that wind turbines are located closer to disadvantaged households or individuals within communities. Further research that analyzes socioeconomic characteristics for individuals or households within a given distance of wind turbines would help clarify this finding (e.g., less than 1000m (Pedersen and Waye 2004; Hill and Knott 2010)).

Comparing the socioeconomic characteristics of communities where wind farms were commissioned before and after 2009, this research finds that wind farms commissioned before 2009 were located in communities with significantly lower median income ($p < 0.05$) and lower percentages of residents receiving government transfer payments ($p < 0.10$) (Table 3). Past research has found that financial benefits from wind turbine development are associated with greater levels of wind farm support, particularly among low-income residents (Bidwell 2013; Mulvaney, Woodson, and Prokopy 2013). Extrapolating this to the community-scale, we propose that communities with low median income were more supportive of the early wind farm developments because of the financial benefits of leasing land for development and operation of wind turbines (Slattery et al. 2012; Toke, Breukers, and Wolsink 2008; Wolsink 2000). In Ontario, leasing land for wind turbines is valued at approximately $8,000 per year per turbine (Canadian Wind Energy Association 2008; Walker, Baxter, and Ouellette 2014).

A second explanation for this finding is that communities with higher incomes were more effective at opposing wind farm proposals and were able to delay wind farm development. Also, larger wind farms were developed prior to 2009, as measured by more total turbines (592 compared to 301) and as turbines per wind farm (65.78 compared to 43) (Table 1). High-income communities may have more individuals that oppose wind farm developments and have the financial resources to organize effective opposition, particularly for large wind farms (Mulvaney, Woodson, and Prokopy 2013; Bohn and Lant 2009; Firestone and Kempton 2007; Ladenburg 2010). As a result of effective opposition, wind farm proposals in these communities, then, may have endured long planning processes that resulted in smaller wind farms, negotiated financial benefits, and delayed development and operation.

For wind farm planning and policy, this research finds that low-income communities were the first locations of wind farms in Ontario. Support of wind farms has been shown to be associated with both individual- and community-scale financial benefits, such as payments in exchange for land leases and contributions to local schools, respectively (Slattery et al. 2012; Wolsink 2000). If lower-income communities are more willing to host wind farms because of financial benefits, then the wind farm planning process should work to ensure that communities receive fair compensation (Walker, Baxter, and Ouellette 2014). Furthermore, high-income communities may not be opposed to wind farms for self-interested reasons, but are "qualified supporters," whereby support depends on criteria such as impacts on the natural landscape and the environment, as well as financial benefits (Bell, Gray, and Haggett 2005).

Participatory planning is one approach to ensure that communities receive appropriate compensation for wind turbine development and operation. Engaging local residents allows for planners to identify specific reasons that residents are not supportive of projects, such as large wind farm size and insufficient financial benefits, and provide feedback to wind farm developers to ensure that wind farm proposals simultaneously maximize energy production and minimize public opposition. Participatory planning approaches have ancillary benefits in renewable energy planning, including increased satisfaction with the planning process and increased support of wind farms.

One limitation of this research is that it is a cross-sectional analysis of all wind farms in Ontario commissioned over a six-year period and as such, we are limited to general and provincial-scale observations into where and when wind farms were developed. More detailed explanations for wind farm planning outcomes as they relate to socioeconomic characteristics would be better analyzed through mixed methods research at the individual or household scale and incorporating data for wind farm approvals and rejections (Walker, Baxter, and Ouellette 2014). A second limitation of this research is that wind farm communities may not be best measured using the DAs where wind turbines are located. Similarly, we assume that the composition of areas closest to wind farm developments have the most influence on the political process (van der Horst and Toke, 2010) and that in the absence of community-scale research that analyzes support for wind farms, research findings from individual-scale research can be scaled to the community. A third limitation of this research is that we use data provided by the Canadian Census, which may not measure other socioeconomic factors that shape wind farm planning, such as social capital or financial capital. These characteristics may be best captured through surveying local residents.

7.0 Conclusion

This research explores the socioeconomic characteristics of sixteen wind farm communities in Ontario, Canada for wind farms commissioned between 2006 and 2012. Analyzing all wind farms in Ontario, it was observed that wind farm communities do not exhibit characteristics of socioeconomic disadvantage and instead, exhibit characteristics representative of relatively rural areas. This research also investigated if there was an association between community-scale characteristics and when wind farms were developed, identifying that early wind farms developed before 2009 were located in communities with median income significantly lower than wind farms developed after 2009. This may be because low-income communities are more supportive of wind farm developments because of financial compensation and because higher-income communities are more capable of effectively opposing large wind farms and engaging in prolonged negotiation over wind farm size and financial compensation.

Future research should analyze a geo-referenced dataset of wind turbines and wind farms for a longer time period. This would help identify the influence of policy changes on wind farm development patterns, specifically how centralizing decision-making through the REA has affected the types of communities where wind farms are located. Contextualizing the findings of this research with more in-depth analysis of specific wind farm developments and planning processes would improve understanding of how socioeconomic characteristics influence the wind farm planning process and wind farm development. It would be interesting to compare the findings of this research to the results of similar analysis in other Canadian provinces or regions elsewhere, if comprehensive and geo-referenced wind turbine datasets are available.

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