Landmarks

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EDITORIAL TEAM AND CONTRIBUTORS

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INTRODUCTORY NOTE

On behalf of the Editorial Team, we are proud to present you the first volume of Landmarks: The Undergraduate Geography Journal, a new annual publication of exemplary undergraduate work in the field of geography at the University of Toronto.

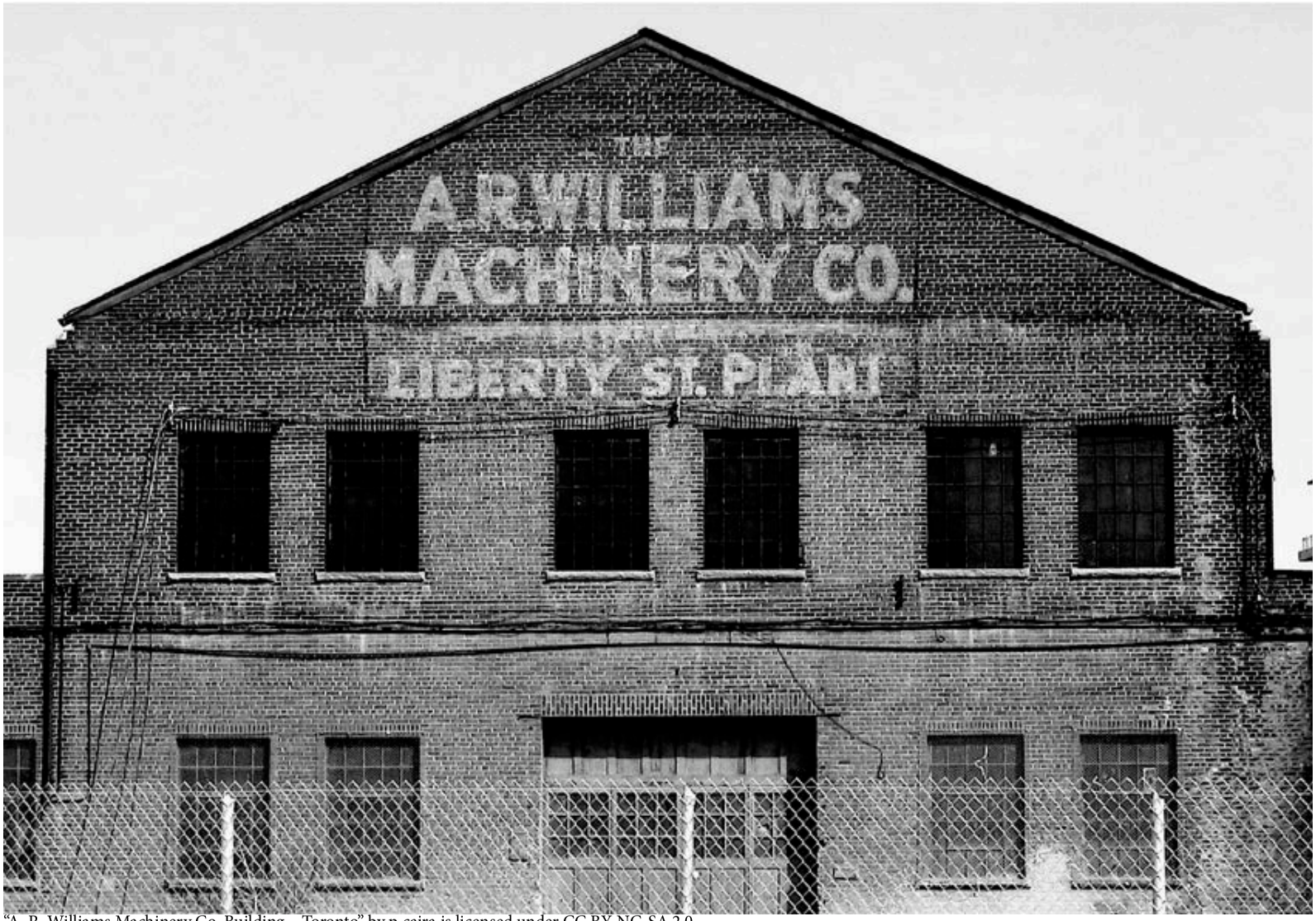
The 2014-15 academic year produced remarkable pieces of research and writing across several streams of geography. Thank you to the many students who submitted their papers for publication — we were spoilt for choice in just our first year.

Landmarks is a testament to the incredible, often under-appreciated diversity of topics explored in the field of geography. This volume includes submissions that cover resistance to gentrification in New York's Lower East Side, revisit the redevelopments of Liberty Village and the Distillery District in Toronto, study the role of climate change on carbon fluxes, critically examine the effects of NAFTA on the agricultural sector in Canada and Mexico, highlight the role of discourse in contemporary land-grabbing processes, and analyze Toronto's transit expansion plans using G.I.S. analysis.

This journal could not have been put together without the collaborative efforts of our dedicated editors and talented authors who graciously offered their time to help make this project a reality. Furthermore, we would like to thank the Toronto Undergraduate Geography Society, Department of Geography & Program in Planning, and Arts & Science Students Union at the University of Toronto for assisting us in the production of this journal.

We sincerely hope you enjoy the first volume of Landmarks,

Shahrukh Ahmed (Editor-in-Chief) & Elsie Lewison (Managing Editor)



Understanding Liberty Village as the creation of the entrepreneurial city

Élyse Comeau

Since the turn of the century, new urban policies, guided by entrepreneurial governance approaches, have focused increasingly on inner-city neighborhoods, which have become increasingly desirable for their proximity to the downtown core and their lucrative real estate. . Through a case study of Toronto's Liberty Village, this paper analyzes the ways in which neoliberal power dynamics between public and private sectors have converged in the creation of a master planned urban village. Specifically, this paper will analyze the development of Liberty Village as representative of Toronto's shift towards an entrepreneurial city model, as well as its role in contributing to the spatial and social polarization of the city along socioeconomic lines.

Introduction

During the latter half of the 20th century, many North American cities underwent redevelopment in response to the forces of deindustrialization and the increasingly competitive nature of the post-Fordist era. One of the key ways in which cities were transformed was through the redevelopment of industrial lands into mixed-use spaces of residential and commercial land. Discourses of the advanced capitalist world suggest that "positive benefits are to be had by cities taking an entrepreneurial stance to economic development" (Harvey, 1999, p. 4). Exemplifying this entrepreneurial approach, Toronto's municipal government has adopted a new model of governance, which has sought inexpensive strategies for economic development through partnerships with private actors. In the 1990s, the municipal government, specifically through city reports and the drafting of a new Official Plan, promoted the construction of compact urban districts seeking to attract private investment and skilled labor to the downtown core.

In this essay, I will discuss the alliances as well as the specific economic policies and strategies involved in the creation of Liberty Village. These alliances and policies transformed the area into a self-sufficient, homogeneous landscape of residential and commercial space, catering to a young urban professional class and a thriving cluster of media and technology firms. Liberty Village exemplifies the ways in which partnerships between the private and public sector restructured inner-city neighborhoods to meet the changing demands of capitalist growth (Wilson & Anderson, 2014). First, I will illustrate the ways in which Toronto's entrepreneurial urban government facilitated the formation of alliances between public and private sectors. I will then discuss how commercial and residential interests influenced the planning of this urban village. To conclude, I will examine the role of the Liberty Village Business Improvement Area (LVBIA) in perpetuating the economically driven agenda of the entrepreneurial city.

New Growth Plan and Public Private Partnerships

Since the 1980s, the structure of urban governance around the world has shifted from comprehensive-rational planning models under Fordism to a more "piecemeal, proj-

ect-oriented and entrepreneurial planning model" (Kipfer & Keil, 2002). Reflective of the shifting socio-political context of the late 20th century, Ontario's Conservative government amalgamated the six municipalities comprising Metropolitan Toronto into one single municipality in 1998, known as the City of Toronto. Under this structure, new financial arrangements were made, such as the transferring of costs for social housing, public transit, and other social programs from the province to the municipality. This financial restructuring burdened the City of Toronto with millions of dollars in added budget pressures on its property tax base, consequently forcing the city to engage in fiscal partnerships with the private sector (Kipfer & Keil, 2002). In 2000, the city published a report entitled Toronto at the cross roads: Shaping our future, written for consultative purposes in setting out policy and planning directions for the new Official Plan (Bedford & Dill, 2000). In order to limit suburban sprawl and accommodate Toronto's growing population, the report placed strong emphasis on intensifying land uses, such as the selective revitalization of downtown districts (City of Toronto, 2000b). In light of this new model of governance, as well as the city's urban policy initiatives, planners, private consultants, and developers began targeting deteriorating inner-city neighborhoods as potential spaces for the new economy to flourish (Catungal et al., 2009).

When industries began shutting down their operations on the 45-acre site located within King Street West, Dufferin Street, and Strachan Avenue in the 1980s and 1990s, the site instantly became the subject of real estate speculation (Wieditz, 2007). Involved in the area since 1983, the CanAlfa Group discerned the potential of this industrial parcel of land, located minutes away from Toronto's downtown core (Flomen, 2006). The brownfield land was purchased to create a self-contained urban village of townhouses, condominium towers, and refurbished warehouses. CanAlfa partnered with IBI Group, a Toronto based architecture and urban planning consulting firm, to transform this underutilized area into an attractive place where people could both live and work (Starr, 2012). With the support of the city, the corporate partnership became the driving force in the creation of Liberty Village's master-planned neighborhood (Brennan, 2001). However, they were not alone in shaping the village. Early in the neighborhood's construction, Monarch Home Builders purchased a parcel of land from CanAlfa to build three colossal condominium towers (Van de Ven, 2002). As such, in order to "economically reclaim these environments as sites for capitalist growth" (Wilson & Anderson, 2014, p. 115), inner-city neighborhoods such as Liberty Village are planned and constructed under the authority of various private actors, with the support of the city. This approach to redevelopment is representative of the entrepreneurial shift in the urban governance of Toronto.

The formation of competitive and entrepreneurial planning policies in Toronto is predicated on the reorganization of alliances and growth coalitions (Kipfer & Keil, 2002). Under entrepreneurial auspices, the municipal government has transitioned from its role as a large-scale producer to the role of a facilitator (Harvey, 1999), working directly with the private sector (Shapely, 2011). It is, however, important to note that the city and the developers have different motives. The main interest of CanAlfa and subsequent developers in the creation Liberty Village was to generate a profit by creating a residential development in close proximity to the downtown core. On the other hand, the city supported the plan because it corresponded with Toronto's Smart Growth policies emerging from the era of neoliberalism, which placed importance

on the intensification and transformation of inner-city neighborhoods into economically prosperous ones (Bunce, 2004). Even though the initial objectives of the developers and the municipal government differed, their motives coalesced into a mutually beneficial relationship, due to the nature of their alliance and subsequent codependence on each other (Hall & Hubbard, 1996). Thus, reflective of Toronto's economic climate at the turn of the century, Liberty Village emerged as the product of partnerships between the public and private sector engaging in new scales of intervention specifically at the neighborhood level (Catungal et al., 2009).

The Planning of an Urban Village

The planning policies in Toronto have undergone changes in order to allow the redevelopment and intensification of inner-city neighborhoods. These changes are emblematic of Toronto's shift from a managerial to an entrepreneurial city centered on partnerships between public and private sectors. In the late 1990s, the municipal deregulation of land uses drew in private interests to Liberty Village's formerly industrial 45-acre site (Wieditz, 2007). In particular, the relaxation of zoning by-laws for mixed residential and commercial uses facilitated the construction of condominiums, townhouses, and retail spaces on industrial brownfields (Mason, 2003). Additionally, the city's Smart Growth initiatives facilitated the emergence of policies encouraging profitable land use in the planning sphere, as illustrated by the development of numerous downtown condominium towers marketed for Toronto's young professional and middle-classes (Bunce, 2004). In 2000, the City of Toronto gave permission to CanAlfa and other developers to begin the construction of Liberty Village (City of Toronto, 2004). Subsequently, in 2002, the City of Toronto WES (Works and Emergency Services) staff approved comprehensive plans to provide basic services in the area, such as new roads and plumbing (City of Toronto, 2004). Constructed in several phases, Liberty Village soon became complete with a grocery store, retail facilities, coffee shops, restaurants, offices, townhouse complexes, refurbished studios and lofts, as well as various condominium developments (see Figure 1) (Belford, 2001).

a. Residential

The construction of Liberty Village has been geared towards providing a residential space for a certain urban demographic. Since the 1990s, Toronto's real estate profit has been dictated by the needs of young middle-class professionals who generally desire one to two unit dwellings in proximity to transit, work, and downtown amenities (Hanes, 2012). In drafting the master plan for the area, CanAlfa's director Walter Jensen and realtor Michael Wilson, President of International Home Marketing, engaged in discussions with potential buyers in order to learn exactly what they were looking for in a downtown residence best suited to their lifestyle (Brennan, 2001). As a result of the overwhelming demand by young professionals for affordable and trendy bachelor and one-bedroom units close to work, Liberty Village's developers created a vibrant landscape of condominiums, lofts and townhouses (Noik-Bent, 2004). Therefore, Liberty Village's residential spaces proved mutually beneficial to both the developer's profit seeking agenda and to the city's policy goals of reducing urban sprawl through the capitalization of land use and revitalization of inner-city neighborhoods.

b. Commercial

The master planned community of Liberty Village quickly became a creative hub, accommodating a variety of new technology and media firms. Prior to the construction of Liberty Village, the area was home to an ar-

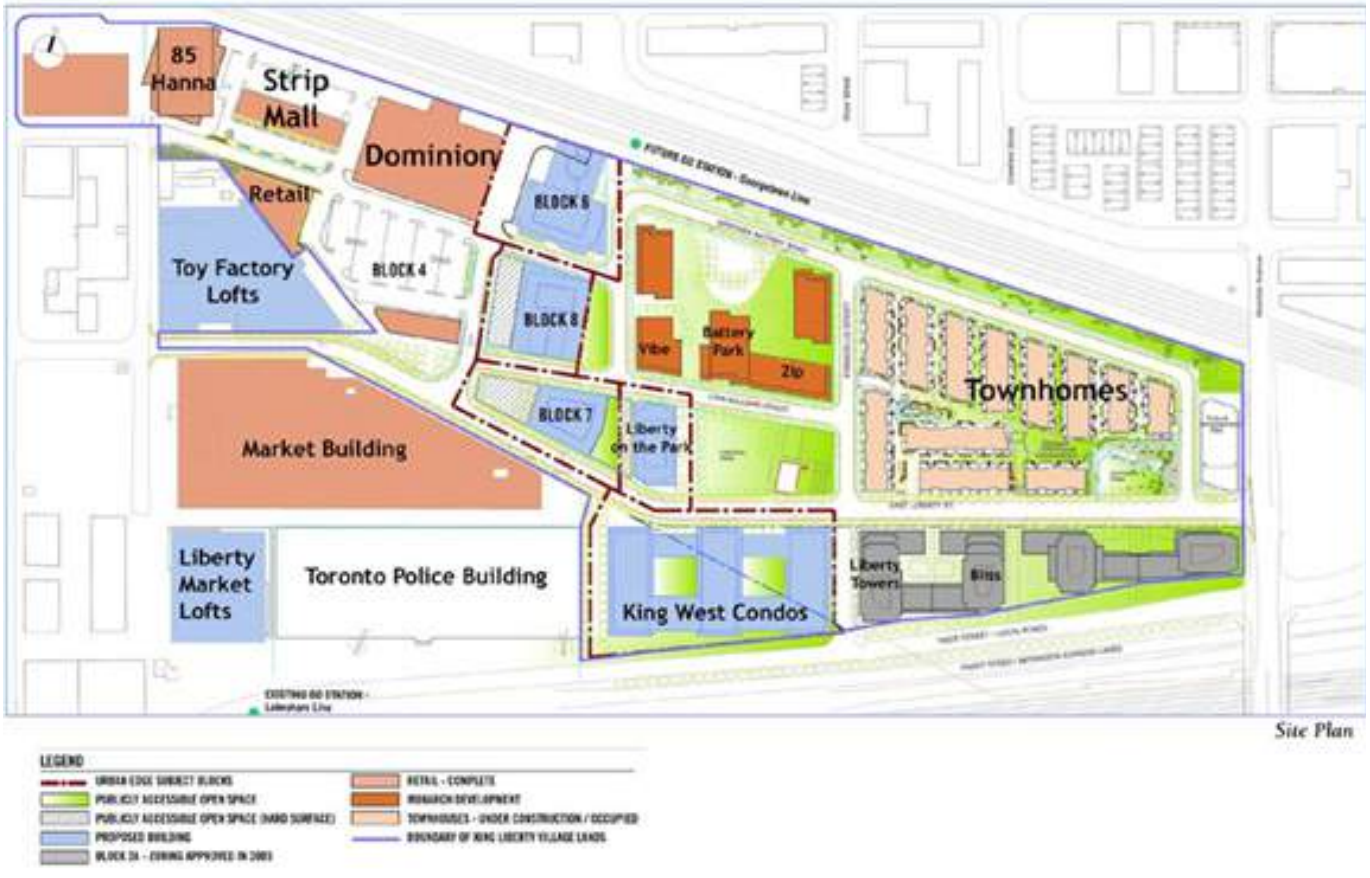


Figure 1. Context Plan for Liberty Village (City of Toronto, 2004, p. 6)

tistic community who took advantage of the large affordable living and workspaces offered by the abandoned factories (Catungal et al., 2009). Among other influences, this pioneering artistic community served as a stimulus to the developers for creating an economic cluster out of this space, composed of more economically viable creative businesses, such as radio, television, technology, and media companies (Wieditz, 2007). A business cluster is a geographical concentration of interrelated companies belonging to a specific field (Porter, 1998). Clusters are particularly attractive to governments, developers, and businesses alike for several reasons. The economic cluster theory dictates that once a cluster begins to form, a "self-reinforcing cycle promotes its growth, especially when local institutions are supportive and local competitive is vigorous" (Porter, 1998, p. 84). As clusters expand, so do their influence with governments and with private institutions. Generally, they represent prosperous spaces in every national, regional, and metropolitan economy, as exemplified by San Francisco's prosperous Silicon Valley or Montreal's Aerospace industry (Dixon, 2000). In terms of providing the necessary infrastructure to accommodate the incoming new media and technology firms, Liberty Village's condominiums provide office spaces on its lower levels (City of Toronto, 2004). Additionally, many of the spaces in the refurbished industrial buildings have been converted into large and open-concept offices (Brennan, 2001).

The new media and technology economic cluster of Liberty Village reflects the city's Smart Growth objectives of enhancing Toronto's economic competitiveness (Bunce, 2004). As the old industrial factories were refurbished by various developers working in accordance with CanAlfa's master plan, such as the Monarch Group and Lanterra Developments, several media firms as well as start-up companies began moving into the available offices (Noik-Bent, 2004). In addition to the affordable rents of the new neighborhood and the close proximity to downtown, companies were also drawn to the advantages of economic clusters (Southworth, 2000) (Porter, 1998). Among the various benefits of business clusters, three are particularly applicable to the case of Liberty Village. First, due to the clustering of similar businesses within the area, companies in clusters have the freedom to tap into a pool of specialized employees, thus avoiding the search and transaction costs of recruiting (Porter, 1998). Second, by being part of an extensive market where technological information continuously accumulates, all firms in the cluster have access to specialized information normally unavailable to them if separated geographically (Porter, 1998). The conditions created by Liberty Village's creative media and technology hub make information easily transferable between firms. The interaction between neighboring businesses allow for the creation of personal relationships and trust, which thereby facilitates the flow of information (Porter, 1998). The third advantage offered by the clustering of firms in Liberty Village is that of complementarities, where the good performance of one cluster member can boost the success of the others, since they are mutually dependent (Porter, 1998). For example, entertainment law offices share the floor with interior designers and a shipping business inside the old Toronto Carpet Factory (Palmer, 2000). A hotbed for like-minded high tech companies, the neighborhood is also home to computer software companies such as Adobe, animation companies such as Nelvana, and satellite television specialty channels such as YTV (Palmer, 2000).

The Role of the BIA in the Entrepreneurial City

Business Improvement Areas (BIA) play a vital role in organizing particular neighborhoods for market-oriented growth (Catungal

& Leslie, 2009). Subsequent to the sudden rapid growth in Liberty Village, an urgent need for new infrastructures arose, such as streetscaping, lighting, and parking (City of Toronto, 2000a). Due to its inability to fund most of these improvement projects, the city of Toronto approved the creation of the Liberty Village Business Improvement Area (LVBIA) in 2001 (Catungal & Leslie, 2009). The LVBIA, made up of local property owners and businesses, is financed through a levy on municipal business taxes, administered by the BIA, and collected by the city (Catungal & Leslie, 2009). In such, the BIA acts as an outlet through which local businesses and property owners can advocate for a variety of infrastructure improvements, specifically emphasizing the aesthetics, business functionality and safety of the area (Catungal et al., 2009). Through its intermediary function, the goal of the LVBIA is to enhance the physical appearance of the neighborhood and to encourage the creation of business-to-business relationships (Catungal & Leslie, 2009).

BIA's, embodying a new sphere of public-private partnerships, reflect contemporary entrepreneurial modes of urban governance (Mason, 2003). Their creation reflects the ways in which property owners, developers, business owners, and the local state have much to gain from forging a local alliance to protect their economic interests, and "ward off threats of local devaluation" (Ward, 2007, p. 784). However, BIA's represent more than just new ways of governing inner-city neighborhoods. They represent the qualitative restructuring of the state towards decentralization and entrepreneurialism, as they revise and reassess the economic performance of firms within their areas (Ward, 2007).

One goal of the BIA is to promote and maintain the presence of economic activity within Liberty Village (City of Toronto, 2000a). A strategic way in which the LVBIA nurtures the partnerships between firms is by organizing networking events within the neighborhood. Property owners and developers actively intervene to construct productive relationships between individuals and firms. For example, with its refurbishing of the Toronto Carpet Factory building, York Heritage Properties have created a large office complex, which accommodates many new media firms (Catungal & Leslie, 2009). The close proximity between the offices in turn enhances the economic activity of the companies. As explained by Lynn Clay, the executive director of the LVBIA, "one business talks to a similar business and we are getting that clustering where you have similar industries location in the area" (Lighthall, 2004).

Aside from their intermediary role in ensuring economic growth within a particular district, BIA's adopt a gatekeeping function, where they selectively include and exclude actors, based on their potential economic contribution to the area. As a "self-billed advocate for creative collaboration," the goal of the LVBIA is to attract certain businesses, while excluding others (Catungal & Leslie, 2009, p. 2585). Gatekeeping represents an important governing tactic in ensuring that Liberty Village maintains its economic purpose as a prosperous cluster by attracting high technology firms that will generate revenue (Catungal & Leslie, 2009). Consequently, as illustrated by the objectives of the Liberty Village Business Improvement Area, BIA's play a critical role in overseeing the contemporary restructuring of inner-city neighborhoods (Ward, 2007).

Entrepreneurial Geographies of Exclusion

Economically prosperous districts such as Liberty Village can be understood as the result of changing planning policies and new growth strategies. However, some question has been raised as to whether the development of Liberty Village has been entirely positive (Kipfer

& Keil, 2002). As a consequence of the development, most artists and non-profit organizations in the area were directly displaced due to increasing rents and the commercial pressure for "more value added services and products" (Lehrer & Wieditz, 2009, p. 154). While the planning initiatives undertaken in the creation of Liberty Village have been successful in both the revitalization of the area and the formation of a new media cluster, the policies of the entrepreneurial city intensify prevalent urban problems such as income inequality, racialised poverty, and gentrification (Catungal et al., 2009). The urban fabric of city downtowns have been restructured and aestheticized along upper-middle-class lines, while working-class and low-income interests are dismissed (Wilson & Anderson, 2014). As such, Toronto's planning process and subsequent decision-making is controlled by the profit-seeking agenda of a small concentration of city planners and private actors such as development firms. The centralization of power in planning in Toronto and other cities around the world is simultaneous to the privatization of planning practices and communicates the dissociation of urban development from former managerial city politics and planning practices of redistribution (Kipfer & Keil, 2002). In the adoption of Smart Growth initiatives designed to ensure the economic growth of the downtown core (Hubbard, 1996), as exemplified in the creation of Liberty Village, the public-private partnerships shaping the built form of inner-city neighborhoods actively contribute to the spatial and social polarization of Toronto.

Conclusion

From industrial powerhouses under the Fordist era to deindustrialized landscapes at the end of the twentieth century, inner-city neighborhoods are now being redeveloped through public partnerships with private actors, into spaces that are conducive to new forms of economic growth (Wilson & Anderson, 2014). Within the last twenty years, Toronto's municipal government has adopted an entrepreneurial stance to economic development, where private actors play an increasingly important role in shaping the future of the city. The creation of Liberty Village as a master-planned urban community led by partnerships between the public and private sectors reflects the economically driven agenda of the entrepreneurial city. However, the exclusionary nature of entrepreneurial planning initiatives, as illustrated in the case of Liberty Village, contributes to both the displacement and exclusion of lower-income individuals. As such, while cities of the contemporary capitalist world function as engines for investment, profit making, and growth, they also exacerbate the polarization of the urban landscape along socioeconomic lines.

References

Bedford, P. & Dill, P. (2000). Toronto at the crossroads: Shaping our future. Toronto: Urban Development Services.

Belford, T. (2001, November 10). Suites available in city village: New digs. National Post, p. PH1.

Brennan, P. (2001, October 20). A new village takes shape in an old area. Toronto Star, p. P08.

Bunce, S. (2004). The emergence of 'smart growth' intensification in Toronto: Environment and economy in the new official plan. Local Environment, 9(2), 177- 191.

Catungal J.P. & Leslie, D. (2009). Placing power in the creative city: Governmentalities and subjectivities in Liberty Village, Toronto. Environment and Planning A, 41(11), 2576-2594.

Catungal, J.P., Leslie, D. & Hii, Y. (2009) Geographies of displacement in the creative city: The case of Liberty Village, Toronto. Urban Studies, 46(5&6), 1095-1114.

City of Toronto. (2000a). Intention to Designate Liberty Village Proposed Business Improvement Area (BIA) (Trinity-Niagara). Toronto: The Economic Development and Parks Committee.

City of Toronto. (2000b). Toronto at the crossroads: Shaping our future. Toronto: Toronto Plan Directions Report.

City of Toronto. (2004) King Liberty Village Urban Design Guidelines. Retrieved from https://www1.toronto.ca/city_of_toronto/city_planning/community_planning/files/pdf/KingLiberty.pdf.

Dixon, G. (2000, October 18). Toronto, Montreal rate among top cities for tech jobs: study. The Globe and Mail, p. B3.

Flomen, D. (2006, October 12). Liberty Village by CanAlfa. Retrieved from-http://www.jeffreyteam.com/liberty-village-by-canalfa/

Hall, T. & Hubbard, P. (1996). The entrepreneurial city: New urban politics, new urban geographies? Progress in Human Geography, 20(2), 153-174.

Hanes, T. (2012, May 22). GTA condo sellers give lowdown on highrises, low-rises. Toronto Star. Retrieved from http://www.thestar.com/life/homes/newinhomes35years/2012/05/22/gta_condo_sellers_give_lowdown_on_highrises_lowrises.html

Harvey, D. (1999). From managerialism to entrepreneurialism: The transformation in urban governance in late capitalism. Geografiska Annaler B, 71, 3-17.

Hubbard, P. (1996). Urban design and city regeneration: Social representations of entrepreneurial landscapes. Urban Studies, 33(8), 1441-1461.

Kipfer, S. & Keil, R. (2002). Toronto Inc.? Planning the competitive city in the New Toronto. Antipode, 34(2), 227-264.

Lehrer, U. & Wieditz, T. (2009). Condominium development and gentrification: The relationship between policies, building activities and socio-economic development in Toronto. Canadian Journal of Urban Research, 18(1), 140-161.

Lighthall, W.D. (2004, September 18). Artistic, residential mix makes Liberty Village work. Toronto Star, p, P01.

Mason, M. (2003). Urban regeneration rationalities and quality of life: Comparative notes from Toronto, Montreal and Vancouver. British Journal of Canadian Studies, 16(2), 348-362.

Noik-Bent, S. (2004, April 24). A whole new game. National Post, p. PH1.

Palmer, K. (2000, April 17). Art and business live in Liberty, a vision for Toronto: Funky

community inspires high-tech vision for port lands. Toronto Star, p.1.

Porter, M. (1998). Clusters and the new economics of competition. Harvard Business Review, (November/December), 77-90.

Shapely, P. (2011). The entrepreneurial city: The role of local government and city-centre redevelopment in post-war industrial English cities. Twentieth Century British History, 22(4), 498-520.

Southworth, N. (2000, August 7). Well primed for new economy: Many say Toronto about to become key centre for producing original internet content. The Globe and Mail, p. A13.

Starr, R. (2012, November 3). Lifetime changed Liberty Village: Developer a pioneer in neighbourhood that once housed industry. Toronto Star, p. H14.

Van de Ven, L. (2002, November 23). Groundbreaking at Liberty Village: More blocks to sell: CanAlfa starts first block of townhomes. National Post. p. PH6.

Ward, K. (2007). Creating a personality for downtown: Business Improvement Districts in Milwaukee. Urban Geography, 28, 781-808.

Wieditz, T. (2007). Liberty Village: The makeover of Toronto's King and Dufferin Area (Research Bulletin No. 32). Centre for Urban and Community Studies, University of Toronto, 1-6.

Wilson, D., & Anderson, M. (2014). Urban economic restructuring. In L. Benton-Short, (Ed.), Cities of North America: Contemporary Challenges in U.S. and Canadian Cities (113-142), Lanham, MD: Roman and Littlefield.

Can squatters and anarchists save a neighbourhood from gentrification?

Kristy Bard

In this paper I explore the squatter movement that arose in New York City's Lower East Side as a response to increasing gentrification in the area starting in the 1980s. In seeking to answer how successful activists have been in slowing gentrification, and the viability of squatting as an alternative to homelessness, I use the punk collective ABC No Rio as a case study to unravel the complicated tensions and contradictions that exist amongst and between housing activists, squatters, and gentrifiers. Squatting can be both a political tactic and a survival mechanism, but it can also attract unwanted gentrification to an area. Squatters who "sell out" or are co-opted through the process of legalization can be seen to hurt the movement as a whole, but their success in obtaining the legal right to remain in a squatted building encourages further actions by others.

Introduction

Gentrification has transformed the fabric of New York City neighbourhoods, propelled by free market forces that have sent real estate prices soaring. As the cost of housing skyrockets beyond the means of average working people, the importance of viable housing alternatives becomes increasingly urgent. In response to gentrification resulting in resident displacement, activist groups such as Take Back the Land have emerged to fight back against the commodification of housing, arguing that housing is a human right (R. Robinson, personal communication, September 5, 2014). They do this through direct action campaigns such as organizing squats of vacant buildings, preventing evictions through physical blockades and legal support, and constructing tent cities on vacant lots to protest government failures to build public housing (Take Back the Land pamphlet, n.d.). But can this sort of activism actually stem the speed of gentrification, let alone stop it? In this paper, I will explore this question by focusing on New York City's Lower East Side. I will draw on academic literature on squatting and gentrification, newspaper and popular sources like activist websites, as well as first-hand accounts obtained during the University of Toronto's September 2014 New York City field course.

Gentrification in the Lower East Side (LES)

Smith and DeFilippis (1999) write that for over a century, the Lower East Side (LES) was a working-class neighbourhood home to numerous waves of immigrants. It has long been a hotbed of counter-culture and political activism, for example attracting the Beat generation in the 1950s and hippies in 1960s. After a period of disinvestment and decline, intense gentrification financed by landlords, real estate developers and politicians aimed to rebrand the area via cultural boosterism (Smith & DeFilippis, 1999). This rebranding and capital reinvestment in the form of luxury condo developments, new bars, restaurants, and cafes attracted professionals willing and able to pay high prices to live in an area marketed for its cultural vitality. This influx resulted in increased rents, evictions and displacements, which in turn engendered a squatter's movement of anti-gentrification and anti-homeless resistance (Smith & DeFilippis, 1999). LES became a site of contestation between those

seeking to profit from gentrification and those attempting to build alternatives outside of dominant capitalist structures through, for example, cooperative traditions and punk collectives such as ABC No Rio.

ABC No Rio: A Case Study

ABC No Rio is a functioning cooperative that arose out of resistance to neighbourhood change in LES, and continues to persist despite gentrification. It opened as a collective art gallery in 1980, debuting with an illegal exhibition critical of the gentrification that was then just beginning (Barrett, 2013; E. Siodmak, personal communication, September 2, 2014). In 1989, in the midst of the Tompkins Square Park protests against evictions of homeless people from the park and squatters from nearby buildings, ABC No Rio began operating as an all-ages punk venue with principles of participatory democracy (Barrett, 2013).

With its long association with anti-gentrification, ABC No Rio is an example of what Martínez López (2013) refers to as a social centre, which acts as a hub for squat activism, symbolically legitimizing and promoting squatting as a successful movement with the ability to influence urban politics. The formation of networks through collective action and political empowerment can translate into increased social capital for otherwise marginalized groups (Martínez López, 2013). Martínez López (2013) describes squatting as part of a larger social movement challenging the capitalist production of urban space that facilitates affordable housing shortages and market speculation, while prioritizing private property interests over residents' right to the city. In addition to organizing political activities, squatting encourages collective self-management, mutual aid, and do-it-yourself (DIY) ethics through skills development (Martínez López, 2013).

The use of direct action tactics, such as occupying the building to prevent eviction, allowed ABC No Rio to effectively resist numerous eviction attempts. The city eventually agreed to sell the building to the group for $1 in an agreement that required ABC No Rio to raise sufficient money for renovations and to remove squatters (Barrett, 2013). Despite the city's attempts to frustrate the collective by repeatedly increasing the amount needed for renovations, public support for ABC No Rio was so strong, and their activist tactics so successful, that not only were they able to legally purchase the building, but in 2009 the city granted them $1,650,000 to assist their rebuild project (Barrett, 2013).

Despite the formal purchase of the building, Barrett (2013) notes that direct action was used by ABC No Rio punk activists not to access dominant institutions they rejected, but to create spaces conducive to organizing collective modes of living outside of dominant institutions, resulting in the development of numerous other cooperatives. The long-term viability and success of such groups, however, is debateable. Bullet Space is one of the few remaining LES squats that have not formally converted into legal cooperative housing (E. Siodmak, personal communication, September 2, 2014). This conversion of illegal squats into formal residences is viewed by some as a successful outcome, but by others as co-optation, or selling out the broader affordable housing movement for the gains of a small minority. The Museum of Reclaimed Urban Space (MoRUS) is another still existing squat that houses exhibits documenting the LES squatter movement. The fact that MoRUS, Bullet Space, and ABC No Rio continue to exist alongside gentrification points to some success of squatter activists. However, the situation today is a far cry from the hundreds of squats that existed in LES throughout the 1980s and 1990s, when numerous aban-

doned buildings were available for the taking (Moynihan, 2007).

Squatting as a Viable Alternative to Homelessness

According to Moynihan (2007), in the 1980s a mix of families, tradespeople, anarchists and artists took advantage of warehousing practices in LES, in which landlords purposely kept buildings vacant until their values rose. The squatters moved into dilapidated buildings and made repairs to make them habitable. Over the following decades, however, land values increased through processes of gentrification that were fuelled by waves of investment and disinvestment, as well as what Smith (1996) refers to as a new urban frontier ideology that justified violent working class displacement and social polarization. As a result, the number of warehoused buildings in LES has diminished. But that does not mean there are not still some vacant properties for squatters to take advantage of. The old heritage designated school located at 605 East 9th Street, for example, has sat unused for a decade (E. Siodmak, personal communication, September 2, 2014). Given the boom and bust cycles of global capitalism, there are bound to always be some abandoned buildings despite the pace of gentrification. For example, Smith and DeFilippis (1999) identify how gentrification in LES was interrupted from 1989-1994, precipitated by a wave of disinvestment following the 1987 stock-market crash. More recently, the 2008 economic crisis resulted in thousands of vacancies from foreclosures and abandoned construction sites, creating new opportunities for squatters to move in (Lennard, 2010).

While the city does not keep official statistics on vacant properties, in 2010 the Right to the City Coalition canvassed low-income areas such as Bushwick and South Bronx and found 4,092 vacancies (Lennard, 2010). As long as housing is commodified, it will be profitable (and therefore rational) for speculators to keep buildings empty even as rates of homelessness increase. Given these conditions, it seems certain that squatting will continue, though perhaps secretively. This change in visibility is significant. As housing activist Rob Robinson cautions, there is a big difference between publicity tactics such as demonstrations or temporary takeovers used to raise awareness of the affordable housing crisis, and a squat that must remain secret if those living there hope to remain long-term (Lennard, 2010).

There are a number of strategies and resources for maintaining low profile squats. According to Frank Morales, who has lived in the same squatted apartment in lower Manhattan since the 1980s, the best buildings to squat are those owned by the city or a bank (Lennard, 2010). Morales also advises squatters to have mail delivered in their name to the address. This way, they can prove valid residency over time and are not deemed trespassers under the law, meaning whoever owns the building must go through the a long legal process to get them evicted (Lennard, 2010; Jaffe, 2007). At this point, squatters could enlist the help of the New York Anti-Eviction Network, which works to prevent displacement and fights for community control of land (Robertson, 2014). The squatter movement's network also extends to skilled tradesmen, so people with the know-how can arrive on site to connect water and electricity. Utility companies generally don't care who owns the building, as long as the bills are paid (Lennard, 2010).

Squatters at the long abandoned Metropolitan Transportation Authority (MTA) Powerhouse, which came to be known as the Gowanus Batcave, benefited from the know-how of LES squatters in 2004 when they equipped the building with rainwater flushing

Figure 1. ABC No Rio, 156 Rivington Street. Photo by K. Bard.

Figure 2. This old school at 605 East 9th Street used to operate as a Community Space until 1998, when it was bought. Plans for condo development were squashed in 2006 when the building was heritage landmarked byv the city. There are a series of expired building permits posted outside.
Photo by K. Bard.

Figure 3. Gowanus Batcave, former squat with revolving political graffiti. "End Stop & Frisk – Hands Off the Kids" protests controversial NYC police procedures that encourage racial profiling. Whole Foods, prime signifier of gentrification, is now located across the street. Photo by K. Bard.

toilets and electricity (Tempey, 2013). While this demonstrates how activists can empower themselves through squatter networks, Gowanus Batcave also became an example of how squats can fail by becoming well known. After the Daily News published a 2006 exposé that implied that all the homeless people evicted from Tompkins Square had relocated to the Batcave, developers who owned the site welded the doors shut and hired private security to keep squatters out (Tempey, 2013). This reinforces the point stressed by Robinson that squats need to be kept secret if they are to remain squats, particularly when the building is owned privately instead of by the city or a bank.

While the long-term viability of squatting may seem uncertain, Lennard (2010) notes that 11 buildings that were occupied by squatters like Morales in the early 1980s remain under their control today. The fact that this is possible indicates that squatting has the potential to serve as an alternative to homelessness and gentrification. Though activists were evicted by the city from some buildings during the 1995 13th Street riot—part of what Smith (1996) refers to as gentrification's frontier violence—others were sold to the Urban Homesteaders Assistance Board (UHAB) for $1 each (Lennard, 2010; Tempey, 2013). While UHAB is the official owner, the squatters—now legal residents—continue to control decision making processes of these low-income co-ops now known as Housing Development Fund Corporations (HDFCs). UHAB facilitated loans necessary for squatters to renovate the buildings up to code, taking them off the speculative housing market by allowing the squatters to remain (Lennard, 2010; Moynihan, 2007). While this certainly sounds like a good outcome, critics allege that such institutionalization is a form of co-optation that serves to undermine the squatter movement as a whole (Martínez, 2014). Not only does institutionalization require at least partial integration into dominant systems rejected by anarchists, but former squatters who previously paid virtually nothing for housing are now required to pay rent. However far below market rates these rents may be, this change still represents a loss rather than a win in the eyes of some activists (Colectivo Piloto & MoRUS, 2012).

Squatting as a Political Tactic

Squatter activists use direct actions such as non-violent civil disobedience to create space to affect public housing policy as well as alternative structures such as land trusts and land banking, which serve to take housing off the free market and instead be governed and owned by the community (R. Robinson, personal communication, September 5, 2014). Such meaningful change requires activists to take personal risks, such as arrest. Despite the potential risks, Martínez Lopez (2013) writes that squatting can be both a means and an end. The point of many squats is not necessarily to stay long-term. Rather, it is a political tactic like the occupation of Zuccotti Park. On the other hand, enduring squats and social centres like MoRUS provide strategic symbols to communicate the movement's success and the worthiness of risk-taking strategies. Squats provide autonomous spaces in urban politics for collective self-management, direct democracy, communal living and the administration of free or cheap access to goods and services (Martínez Lopez, 2013). For example, recycling, dumpster diving, and shared resources allow people to live cheaply in the city, outside of mainstream culture, politics, and economy. There is an inherent tension between activists who participate in squats as a public, political tactic, and those who squat as an alternative to homelessness, and therefore wish to keep their location unknown so they can avoid eviction.

Yet, I would argue that the city was compelled to legalize at least some anarchist squats

not just as a way to exploit this tension, but rather because operating outside of the state, poses potentially the biggest threat to state power and authority. That DIY power didn't just threaten the profits of developers who could benefit from gentrification. LES activists had proven they didn't need the government to provide them with affordable housing; they had the effective power to take it for themselves. Formalizing a few squats into cooperatives was the city's way of neutralizing activist's power, effectively co-opting the movement. While legalization is "pragmatically convenient for most squatters", it serves to erode squatters' capacity, and reason, for protest (Martínez, 2014, p. 647). If squatters and anarcho-collectives could prevent this neutralization of their political power by the state, while at the same time obtaining the legalization that is so central to their success, perhaps they would be better positioned to prevent gentrification.

There is additional complexity in the relationship between squatters and gentrification, however. Moynihan (2007) argues that LES squatters who barricaded themselves inside their buildings every time the police showed up to carry out evictions, forced confrontations that required an armoured response from the state. Tanks in the streets did not sit well with the public, or LES gentrifiers who did not appreciate whole city blocks being shut down simply to evict a few squatters. This dynamic created a situation whereby the city determined it was no longer politically feasible to carry out such violent evictions, and as a result made a deal with UHAB to allow some squatters to stay (Moynihan, 2007). Could it be, as Moynihan suggests, that the gentrification that squatters so actively protested in fact allowed for their preservation? Meanwhile, Alex-Lute (1995) notes that it was the squatters moving into vacant LES buildings and making improvements to them that initially resulted in the decrease in crime and drug trafficking that made the area attractive for gentrification in the first place. The relationship between squatters and gentrifiers is therefore immensely complex. Squatters, just like artists, not only attract gentrification, but also have the potential to be both beneficiaries and victims of the process (Smith & DeFilippis, 1999).

One thing that is clear is that gentrification and squatting continue to exist alongside each other in LES. As expressed by historian Bill Weinberg (Colectivo Piloto & MoRUS, 2012) while there is a tremendous sense of loss in LES over the changes, there is also a sense of pride and comfort in what the squatters' movement was able to save. Many squatters were evicted to make way for gentrification, but collectives that facilitate and educate a new generation of squatters continue to flourish. The work of groups like Take Back the Land and the Anti-Eviction Network ensure that marginalized residents will continue to find ways to intervene in New York City's urban politics. They may not be able to win, in the sense of defeating gentrification, but in fighting against its worst outcomes they also do not always lose. As Martínez Lopez (2013) argues, squats do have the ability to contribute to broader social movements in ways that can influence a city's future agenda.

Conclusion

As we have seen, there have been both winners and losers in the process of gentrification, and resistance to it, in New York City's Lower East Side. While a minority of squatters were able to remain—in effect bought out by the state through legalization—many more were displaced as the housing market heated up and gentrifiers moved in. Squatters played a part in creating the conditions that made LES attractive to gentrification, and through direct action some were able to carve out the

legal means to stay in the neighbourhood. The experience of ABC No Rio demonstrates how squatters and anarchists can achieve success, if not for the movement as a whole, then for some individuals participating in it. This possibility of success, combined with the lack of affordable housing and increasing cost of living, ensures that squatters will continue to take over abandoned buildings in New York City. The experiences in LES seem to indicate that while they may not be able to save a neighbourhood from gentrification entirely, there is hope in saving their own place within it.

References

Axel-Lute, M. (1995, May/June). Battle over 13th street. Shelterforce Online.Retrieved from http://www.nhi.org/online/issues/81/squat.html

Barrett, D. (2013). DIY democracy: The direct action politics of U.S. punk collectives. American Studies 52(2), 23-42.

Colectivo Piloto and MoRUS. (2012). Building the Lower East Side Community [Video file]. Retrieved from http://vimeo.com/64447385

Jaffe, A. (2007). Frank Morales interviewed by Aaron Jaffe in the Odessa coffee shop, Avenue A, Lower East Side. In C. Patterson (Ed.) Resistance: A radical social and political history of the Lower East Side (193-212). Seven Stories Press: New York.

Lennard, N. (2010, May 12). You don't know squatting: A movement returns. Salon. Retrieved from http://www.salon.com/2010/05/12/squatters/

Martínez López, M.A. (2013). The squatters' movement in Europe: a durable struggle for social autonomy in urban politics. Antipode 45(4), 866-887.

Martínez, M.A. (2014). How do squatters deal with the state? Legalization and anomalous institutionalization in Madrid. International Journal of Urban and Regional Research 38(2), 646-674.

Moynihan, C. (2007). Squatting. In C. Patterson (Ed.) Resistance: A radical social and political history of the Lower East Side (104-108). Seven Stories Press: New York.

Smith, N. (1996). "Class struggle on Avenue B": The Lower East Side as Wild Wild West. In N. Smith.

The New Urban Frontier: Gentrification and the Revanchist City (3-29). Routledge: New York.

Smith, N. & J. DeFilippis (1999). The reassertion of economics: 1990s gentrification in the Lower East Side. International Journal of Urban and Regional Research 23(4), 638-653.

Take Back the Land Movement. (n.d.). Housing as a human right: Community control over land [Pamphlet]. Washington D.C.:. Take Back the Land Movement.

Tempey, N. (2013, March 13). Party's over at Gowanus Batcave, but mysterious millionaire will make it "fucking cool". Gothamist. Retrieved from http://gothamist.com/2013/03/11/under_patronage_of_mysterious_phila.php

'Creative' exclusion: Examining creative development & social exclusion in Toronto's Distillery District

Nadi Abusaada

This paper examines the redevelopment of the Gooderham & Worts Distillery, a historic industrial site located between downtown Toronto and the Portlands, into what later became known as the Distillery District. I focus on the transformation of the district from a site of mass production to a site of localized consumption and I argue that the Distillery's transformation is part of a general move towards cultural consumption in post-industrial North American cities. The Distillery uses its historic architecture, local stores, and on-site production to portray itself as a romanticized entertainment site. Nevertheless, this idealized image of the Distillery stands in tension with simultaneous processes of social exclusion through inaccessibility, securitization, historic preservation, and de-politicization.

Introduction

This paper examines the redevelopment of the Gooderham & Worts Distillery, a historic industrial site located between downtown Toronto and the Portlands, into what later became known as the Distillery District. In 2001, the site's industrial buildings were repurposed to suit new uses including local cafes, bars, art galleries, theatres, and retail stores transforming the district from a site of mass production to a site of localized consumption. I argue that the Distillery's transformation is part of a general move towards cultural consumption in post-industrial North American cities. The Distillery uses its idealized historic architecture, local stores, and on-site production to portray itself as a romanticized entertainment site. Nevertheless, this idealized image of the Distillery stands in tension with simultaneous processes of social exclusion through inaccessibility, securitization, historic preservation, and de-politicization. In order to highlight these tensions, academic literature and information retrieved from the City of Toronto, Cityscape, and Artscape websites are examined to help understand the historical processes that led to the redevelopment of the Distillery to its current form as a site of 'creative' development. The shift towards 'creative' development in Toronto is then illustrated to situate the Distillery in the context of post-industrial North American entertainment districts. Site observations and wider academic literature on urban redevelopment are later used to understand social exclusion produced through the Distillery's redevelopment project.

Background

The Distillery District houses Victorian industrial buildings constructed for alcohol production in the late nineteenth century by the firm Gooderham and Worts. The site's proximity to the Canadian National Railway line and its adjacency to the previous Don River route into Lake Ontario facilitated shipping to locations in Canada and around the world. In the 1870s the distillery's annual production capacity exceeded 2 million gallons of whisky, mostly exported for the world market (Kohn, 2010). This earned the company the distinction of being the 'largest distillery in the British Empire' (Mathews & Picton, 2014). The City of Toronto website (2014)

states that "in its time, The Gooderham and Worts Distillery played an important role in the growth and wealth of both the city and nation… the company at one time contributed more to Federal coffers than any other enterprise in the country". In 1923, the distillery was bought by Hiram Walker Co., another large Canadian distiller. In 1957, the merge resulted in the transfer of most production to the Hiram Walker plants in Walkerville, Ontario (Mathews & Picton, 2014). By 1990, the remaining distillery operations were all transferred to Walkerville (Kohn, 2010). During the 1990s, the abandoned distillery started attracting numerous film shoots and became an important film location in Canada and across North America (Distillery District, n.d.).

Meanwhile, after alcohol production ceased in at distillery, site owners and the City of Toronto initiated a planning framework to change the zoning from industrial to general use and approved mixed use redevelopment of the site. In 2001, the owners sold the property to Cityscape, a private real estate company specializing in loft conversions (Kohn, 2010; Mathews & Picton, 2014). Cityscape realized that the site's historic architecture could be appropriated as a potential way of advertising the site as an alternative to the downtown shopping experience, while the site's proximity to downtown core was seen as an opportunity to introduce commercial and residential complexes. In order to achieve its vision, Cityscape partnered with Artscape, a local non-profit organization that delivers "programs and services that promote creativity and cultural space development" (Artscape, 2011). Artscape leased a twentieth century building providing below-market rent studios and offices for artists, craftsmen, and local cultural organizations (Kohn, 2010). This had two major benefits for Cityscape. Firstly, by attracting cultural producers including artist, craftsmen, and cultural organizations, Cityscape was able to develop the distilley as a 'creative zone' (Distillery District, n.d. that could attract highly educated individuals interested in innovation and cultural production, or the 'creative class' as identified by Richard Florida (2002). Secondly, the conditions of the lease arrangement satisfied the requirement of 'community benefits' for Cityscape to be approved by the City of Toronto to build profitable new high-rise residential developments on the site.

'Creative' development

The shift towards 'creative' development was already taking place in Toronto at the private and public levels prior to the redevelopment of the distillery. In 1986, Artscape became involved in securing studio spaces in several buildings in the city. In 1995, it opened West Queen West, the first artist work/live building in Toronto which triggered the revitalization of an, at the time, underdeveloped area (Artscape, 2011). During the late twentieth century, there was a growing concern at the municipal-level of the pricing-out of artists from the city, especially after the gentrification of areas like Yorkville in the 1960s and King Street West in the 1980s (Mathews, 2014). In 1991 the City of Toronto Planning and Development Department (CTPDD) issued a report that addressed the issue of increasing rental prices in the city and specifically the impact of this increase on the flow of artists out of the city. It called for immediate action to reverse this flow through an increase in funding for art venues (Mathews, 2014). This shift towards 'creative' development at the public and private sector levels in the city was a key factor in encouraging the provision of space for artists in the redevelopment of the distillery.

Moreover, the incorporation of the artists in the redevelopment of the distillery reflects a general shift in North American urban development towards art consumption catering

to the creative class. This shift, however, is not a temporally isolated one, but rather is rooted in decades of urban change. After North American cities lost jobs in heavy industry and retail, some cities, including Toronto, worked to maintain a reputation as sites of history, culture, and creativity (Kohn, 2010). This produced a new form of post-industrial urban economic policy that invests in tourism, leisure, and consumption (Kohn, 2010). As Hackworth (2007) illustrates, one of the ways in which this new form was manifested is through both public and private initiatives to create and maintain sites of urban entertainment. Zukin (1998) illustrates how the redevelopment of historic urban destinations into sites of cultural consumption has become an essential tool for economic development in post-industrial cities. These destinations are usually constructed around a general theme such as sports or history and have incorporated multinational chains and franchises (Kohn, 2010). Examples of historic sites that were repurposed into themed urban entertainment districts that emerged in the late twentieth century include Ghiradelli Square in San Francisco, renovated in 1965, and the Horton Plaza in San Diego, redeveloped in 1985. Both redevelopment projects were fitted to suit a middle class desire for art consumption.

A local (elite) alternative

Unlike North American entertainment districts like Ghiradelli Square and Horton Plaza, the Distillery District promotes local artisanal production and rejects the conventional injection of chains and franchises in redeveloped historic sites. This localization at the distillery creates an impression of departing from the downtown's globalized, neoliberal consumption model, populated by McDonald's and Starbucks'. The freelance artists, local cafes, and the authentic architecture all convey an image of a local alternative to the global brands widely available on Bloor Street or in the Toronto Eaton Center. However, this image veils the neoliberal agenda that promotes public support for a private development project motivated by the maximization of profit in the distillery. Kohn (2010) argues that the Distillery District is very much a commercial venture, and that part of Cityscape's vision was to establish an arts and entertainment community in the neighborhood to inflate the value of surrounding land and raise the price of condominium apartments in their city-approved high-rise residential developments. Moreover, the distillery's redevelopment can be seen as a profit-driven model that uses the historic aesthetic as a stage for a consumer culture designed to appeal to the creative class. The expensive trendy cafes, bars, restaurants, and art centers attracts an elite demographic that, as Kohn (2010) illustrates, benefited the most from deindustrialization and globalization. Therefore, the distillery does not depart from the North American pattern of excluding lower income groups from urban redevelopment projects, but achieves it more 'creatively'.

Social exclusion: securitization and inaccessibility

The exclusion of undesired social groups in the distillery is best manifested through securitization and inaccessibility. The use of monitoring and surveillance in the distillery stands as a reminder of the site's private ownership. Signs such as the one pictured in Figure 1, are placed all over the distillery's walls as reminders that the site is "monitored by security cameras" and that "actions and activities may be recorded for the security and safety of the site". In this case, surveillance cameras are not only used to record crime, but also to create a feeling of being watched, translating into self-policing of behavior. The surveillance cameras thus work to ensure the exclusion of undesired behavior to comfort upper class visitors while they spend their money in the distillery's shops, cafes, restaurants, and galleries.

Similar to other North American entertainment districts, the distillery is geographically adjacent, yet isolated, from the surrounding city. The shops, restaurants, and galleries of the distillery are not accessible from public streets, but only through private walkways or the ground floors of Artscape's private high rise buildings. The distillery's hard edges draw a clear distinction between the district and its surroundings. The northern edge of the distillery with Mill Street (see Figure 2) is marked by elements that convey a sense of inaccessibility to the public street with an iron gate, a guardhouse, and a high brick wall. The southern edge of the Distillery faces a parking lot used by car owners who park at Distillery Lane and enter the site as pedestrians. Despite the site being pedestrian only, it is in many ways more welcoming to higher income individuals and tourists who arrive by private cars or buses than it is to pedestrians using adjacent public streets. Although the case of the distillery is not as extreme as what Dennis Judd (1999) identifies as 'tourist bubbles' surrounded by severe urban decay, but as an isolated site of cultural development the distillery can be understood as a creative bubble of sorts.

Social exclusion: historic preservation and de-politicization

The City of Toronto made it clear that the redevelopment project would have to at least preserve the facades of the original buildings; and prior to the functional distillery's closure, the federal government had designated the district a site of "National Historic Significance" (Caulfield, 2005, p. 87). Cityscape's redevelopment of the Distillery preserved most of the site's original exterior built form, and implemented a minimal exterior preservation approach that reduced costs and maximized the site's perceived authenticity (Kohn, 2010). However, the redevelopment project stripped the buildings of their industrial histories and transformed them into nicely packaged shells for contemporary consumption (Mathews, 2014). The redeveloped distillery narrates its historic identity in a way that corresponds to the monetary and experiential consumption

Figure 1. Photograph of surveillance sign at the Distillery.

demands of the creative class (Mathews, 2014; Jacobs, 1996). This narrative conceals historic facts that might disturb the visitors' idealistic romanticized image of the Distillery.

The distillery is staged as a locally oriented site of pre-industrial modes of production both in its buildings. Artscape leases its spaces for local cafes, bars, art galleries, a microbrewery, and a chocolate factory that implement on-site production rather than mass production. What is not represented, however, are the histories of mass production at the Gooderham & Worts Distillery; a macro-brewery that captured a large share of the national market and drove several smaller breweries out of business during the late nineteenth century (Kohn, 2010). This resulted in less competition, plant closures, job losses, and less choices for consumers. Failing to address

Figure 2. Photograph showing the iron gates and guardhouse at the Distillery's northern edge

this history of mass capitalist production, the information signs used in the distillery either celebrate its progress and growth, provide technical information about machinery and equipment, or are merely diagrams that aid people's movement through the repurposed spaces. These representations also ignore the histories of oppression and racial discrimination against ethnic minorities in the distillery. For example, an interview with Jim White, a former millwright in the Gooderham & Worts Distillery, reveals that job applicants were asked about their ethnic background and that employers preferred workers who come from British origins (Historica Research Limited, 1994). The historically preserved buildings produce a state of historic amnesia among the site's visitors and residents. This is not a neutral act, but one that represents a sanitized site concealing facts about the site's history that might disturb its idealistic image.

Conclusion

Although the Distillery District appears to be distinct from arts development in North American entertainment districts with its localized production, it follows the pattern of private profit maximization and targeting high-income social groups. Excessive securitization and surveillance are used in the distillery to ensure the exclusion of "undesirables" and to maintain the comfort of high-income visitors. In addition, the current on-site small scale production at the distillery obscures the historic status of the Gooderham & Worts Distillery as a large industrial plant that drove smaller distilleries out of the market, as well as current ownership by Cityscape, a firm that has leased spaces for expensive stores and built condominium developments on the site to maximize return on capital. Furthermore, the idealized authentic image of the preserved buildings obscures the histories of discrimination and oppression sanitizing that history to suit the desires of high-income consumers of experience. The distillery might appeal to the eyes of its visitors as a neutral 'creative' site, but just like sight can be deceiving so can representations of space that selectively exclude 'undesired' visitors and conceal 'unsanitized' histories.

References

Artscape. (2011). Retrieved from Artscape: http://www.torontoartscape.org/

Caulfield, J. (2005). The Distillery District. Urban Planning Overseas, 85–97.

City of Toronto. (2014). The Distillery Historic District. Retrieved from The Distillery District: http://www.toronto.ca/311/knowledgebase/32/101000043432.html

Florida, R. (2002). The rise of the creative class. New York, NY: Basic Books.

Hackworth, J. (2007). The neo-liberal city: Governance, ideology, and development in American urbanism. New York: Cornell University Press.

Historica Research Limited. (1994). Gooderham & Worts Heritage Plan Report #3. Toronto.

Jacobs, J. M. (1996). Edge of empire: Postcolonialism in the city. London: Routledge.

Judd, D. R., & Fainstein, S. S. (1999). The tourist city. New Haven, CT: Yale University Press.

Kohn, M. (2010). Toronto's Distillery District: Consumption and nostalgia in a post-industrial landscape. Globalizations, 7(3), 359-369.

Mathews, V. (2014). Incoherence and tension in Culture-Led redevelopment. International Journal of Urban and Regional Research, 38(3), 1019-1036.

Mathews, V., & Picton, R. M. (2014). Intoxifying gentrification: Brew pubs and the geography of post-industrial heritage. Urban Geography, 35(3), 337-356.

Rofe, M. W. (2004). From "problem city" to "promise city": Gentrification and the revitalisation of Newcastle. Australian Geographical Studies, 42(2), 193–206.

The Distillery District. (n.d.). Our Story. Retrieved from The Distillery District: http://www.thedistillerydistrict.com/our-story/

Tunbridge, J. E. (2001). Ottawa's Byward Market: A festive bone of contention? The Canadian Geographer, 45(3), 356–370.

Zukin, S. (1982). Loft living: Culture and capital in urban change. Baltimore, MD: John Hopkins University Press.

Regional incompatibility under the North American Free Trade Agreement: An embeddedness approach to agricultural development

Caroline Kamm

This paper takes a critical approach to the North American Free Trade Agreement and its effects on development in the agricultural sector. Drawing on Karl Polanyi's 'embeddedness' approach, the effects on agriculture in Ontario, Canada and Chiapas, Mexico are examined within the context of their respective social and political institutions. While free trade reforms seek to maximize total commodity output, regional developmental inequalities and cultural ties to food production either facilitated or inhibited rapid industrial change. While Ontario created a booming agricultural economy following NAFTA, Chiapas suffered from the further marginalization of smallholder farmers, both effects being largely tied to their respective institutional and historical context. Subsequently, this paper offers a critique of the dominant understanding of economic development and free trade, suggestion in its place a socially embedded market approach.

Introduction

Experiments in neoliberalism have cast a universalizing gaze across the world. Different goods are reduced to price units and treated just the same, while identical sets of liberal economic principles are deemed efficient and effective for all given locales. These assumptions have led to some of the most destructive tendencies of neoliberalism, and as such they require a deeply critical analysis. One such critical perspective comes from Karl Polanyi's 'embeddedness' approach, through which economic processes are taken to be not wholly market-based, but deeply rooted in social institutions. Subsequently, each player within the global marketplace cannot be treated identically, nor be subjected to the same economic models, as this denies the role that existent social and political structures play in the functioning of the economy. Moreover, commodities cannot be treated as equivalent based on the price mechanism alone, as this measure insufficiently accounts for the cultural significance and inherent values that are unique to each particular good (Block & Evans, 2005).

Free trade agreements are one particularly powerful mechanism of neoliberal homogenization, through which domestic structures are altered to facilitate the free movement of goods across borders (Milner, 1999). This paper will examine the comparative effects of the North American Free Trade Agreement (NAFTA) in two regions of North America – Ontario, Canada and Chiapas, Mexico – to underscore the link between existing social and political structures and development following trade liberalization. This analysis will focus particularly on the agricultural industry within each region, as an indicator of economic and social change. Not only is agriculture a backbone of both regional economies, but it also serves as a relevant case for a market good that is culturally significant and a life necessity, challenging the supremacy of price mechanisms for determining market value.

I argue that Ontario's social-political institutions and the existing structure of its agricultural industry were more adaptable and better suited to economic liberalization than those in Chiapas, leading to a more innovative agricultural system under NAFTA. Each region's change in agricultural development is directly linked to the style of agriculture being practised prior to NAFTA – in Ontario, highly industrialized farming and Chiapas a mixture of small-scale subsistence and market produce – as well as their positions with respect to the much stronger US market. This process of adaptation is locally specific, constrained by existing institutions, and driven by the powerful force of globalized neoliberalism. While adaptations in Ontario are the result of embedded institutions working with trade liberalization, the less developed or shrinking market in Chiapas results from institutions that are incompatible with homogenizing market policies.

This paper begins by laying out some of the failures of the neoliberal model, proposing as an alternative an embedded economic approach to the agricultural industry. Included in this section will be a discussion of NAFTA and its implications for the players involved. The next two sections will place the agricultural industries in Ontario and Chiapas within a historical context, focusing on the organization of agriculture prior to NAFTA, and their subsequent adaptations. The paper concludes with a comparison of the process and results of trade liberalization in each region, and some shortcomings of free trade agreements as a developmental policy within socially embedded markets.

Agricultural trade and homogenized markets

Neoliberalism here refers to a particular set of policies and institutions that promote minimal state intervention in economic markets, while simultaneously facilitating free and open trade internationally. Creating this type of interdependent system requires structural adjustment at a number of scales, from local to the global, as well as within multiple spheres of society. Though it necessarily touches on and alters various aspects of society, the neoliberal economic model is insufficient to explain these supposedly endogenous factors, such as the political system needed to carry out free trade policies, or the cultural implications of commercialized society. This indicates one of neoliberalism's greatest shortcomings: an inability to look beyond the market toward historical and locally specific social institutions (Block & Evans, 2005).

Block and Evans (2005) highlight the ignorance of non-market forces in neoliberal reform, criticizing the uniform application of homogenous institutions onto historically specific localities, what they call 'institutional monocropping' (p. 511). This process takes identical versions of policies and institutions from advanced economies and applies them to less developed or more protected states, under the assumption that they will achieve the same rapid developmental results. As Block and Evans indicate however, there are a number of material issues with this approach, not least of which being the interaction of existing institutions (pp. 511-521). The model that they propose, which will be further developed later in this section, understands reform and development within an intertwined state and economic model.

Just as an understanding of neoliberal reform must address the interdependence of economic and social institutions, it should also recognize that the pressure to exact change comes from powerful global actors at a number of different scales, carried out through instruments of targeted change. For instance, trade policy formulated entirely within the United States strongly influenced less developed countries (LDCs) to liberalize their own economies. Moreover, beginning

in the 1980s, international institutions such as the International Monetary Fund and the World Bank joined this bilateral pressure from the United States, forcing states to lower trade barriers with little to no negotiation. Threatening restricted access to the attractive US consumer market, or the withholding of desperately needed debt-relief, left LDCs with little choice but to liberalize their economies (Milner, 1999).

Less concrete international influence over domestic policies becomes firmer when manifested in multilateral free trade agreements. As far as such agreements go, NAFTA is a particularly unique case, in that it binds the economy of a developing country to those of two highly advanced industrialized nations. The agreement was initiated on January 1, 1994, setting into motion a fifteen-year transition toward liberalization, eventually impacting virtually every kind of trade and investment within the three economies. Mexico in particular began reforms long before this date however, in an effort to 'groom' political and economic institutions for increased flows of trade and investment. The Mexican legal code, ostensibly a domestic issue, was subsequently altered to better reflect the private property regime in the United States and Canada. Most significant for agriculture, was the requirements that Article 27 in the Constitution, which permitted collective ownership of rural land to be eliminated entirely (de Janvry, Sadoulet, & Davis, 1997).

Trade liberalization for the agricultural sector involves a number of specific changes, including the deregulation of input prices, decreased subsidies to farmers, lowered trade barriers such as tariffs and quotas, and withdrawal of state intervention in the agricultural industry (Wohlgemuth, 2014). Under NAFTA, it was expected that these changes would alter patterns of intra- and inter-industry trade, equalize trade deficits, and encourage agricultural specialization. In general, this strategy claims to maximize efficiency by focusing on comparative advantage so that within the trade region output is maximized and consumer prices is minimized (de Janvry et al., 1995).

This model of the market fails to take into account locally specific and socially embedded agricultural systems. Caliskan and Adaman (2010) critique the way that neoliberal ideologies treat agriculture, arguing that the reductive nature of these models does not capture the non-price value of food, or the importance of existing systems of production. They argue that Karl Polanyi's (1957) 'embeddedness approach' is more appropriate for understanding agriculture, as it highlights forces outside of the market, which construct and sustain systems of production and price. In examining free trade agreements with such inherent inequalities between and within member states, the concept of economic embeddedness is key (Caliskan & Adaman, 2010). Ultimately, the exclusion of social factors and regional particularities from a comparative advantage oriented trade strategy is what led to such disparity between Ontario and Chiapas.

Ontario: large-scale agriculture and food clusters

The structure of Ontario's agricultural industry prior to NAFTA had two main features, an industrial model with modernized farms and heavy government support, embedded in an urbanizing society that was predominantly unattached to regionally specific food or land. These features together constitute an agricultural system that was highly economically developed, with relative cultural detachment from farming, but significant requirements for government support and ongoing domestic and foreign investment. Beginning with liberalization in the 1980s and leading up to the enactment of NAFTA, Canada grappled with

the question of how to simultaneously decrease government protection of agriculture and food related industries, while increasing market competitiveness (Donald, 2009). The strategy in Ontario was to direct resources toward a food cluster called the Golden Horseshoe, which locates each level of the food supply chain within a single region, taking advantage of agglomeration effects to more efficiently produce and transform food for the North American market (Greater Toronto Area Agricultural Action Committee, 2012).

The agricultural system in Ontario is built on a legacy of private ownership and wage-labour. Extracting profit from land that was once communally managed by indigenous people began with settler colonial understandings of market-based landed property. Subsequent development in the agricultural industry was built on forcible removal and a paradigm in which the people who work the land are not the ones who own it (Parr, 1985). Settler colonist private ownership provided the ideal context for agricultural industrialization following the Second World War, which once more restructured the spatial patterns of the food system in the US and Canada. This process subjects the supply, production, and processing of agricultural goods to the type of factory logic that focuses on efficiency and output, as one would for any generic commercial good. While the specific level of industrialization varies over time and space, the general model focuses on economies of scale, increased mechanization, more chemical inputs, and the substitution of capital for labour (Troughton, 1985).

Agricultural industrialization continued in Ontario until the 1960s, when Canadian food production went one step further. Rather than simply maximizing output, the food industry turned to wealth maximization in the global marketplace as the industry standard. This encouraged not only the continued agglomeration of agribusiness, but also the orientation of industry toward profitable crops and value-added food products (Parson, 1999). For Ontario, this reorientation of the agricultural market coincided with increased integration with the US market, a shift that required a more efficient economic model if Canada were to effectively compete.

This altered model took two forms: food clustering and targeting niche markets (GTA-AAC, 2012). Focusing on farming clusters is essentially a new developmental model, which differs largely from the previous model known as Import Substitution Industrialization (ISI). ISI requires government support and protection to develop a new industry, by importing technology like those used in mechanized farming, rapidly increasing output, and then exporting the product (Donald, 2009). The cluster model however, is much more locally specific. It rests on the idea that each production region would be more efficient if it specializes based on a particular set of natural resources, human capital, institutions, markets, and geographies. Woods and Cook (2003) argue that regional production clusters are more of a locally embedded system, as many of the most important technologies or innovations cannot simply be imported, rather they are unique to a certain set of social and economic institutions.

The province of Ontario developed a number of policies throughout the early 2000s to orient the agricultural industry toward a regional cluster model, culminating in the Growth Plan for the Greater Golden Horseshoe in 2006. The Golden Horseshoe is a highly diversified economic region stretching along Lake Ontario, comprising the regions of Durham, Halton, Niagara, Peel, York, and the Cities of Hamilton and Toronto. Policy implementation and development policy for the region is coordinated predominantly by the Greater Toronto Area Agricultural Ac-

tion Committee (GTAAAC), alongside other industry organizations and governmental bodies. Since its establishment, the region has become a powerful public private partnership with an increasingly important role in Ontario's economy (GTAAAC, 2012).

The GTAAAC defines a food and farming cluster as a region that is:

> comprised of enterprises and institutions involved in growing, harvesting, processing and distributing food, beverage and bioproducts derived from agriculture. [...] Essential supporting activities that are a vital part of the cluster are those that provide services, impart skills and training, undertake research and innovation and enable commercialization (pg. 3).

Broadly speaking, Industry Canada has indicated that factors such as these – shortening the length of the value chain by attracting supporting industries and knowledge-based skills – could help blunt the advantage that a large economy like the United States might have over a smaller one like Canada. This clear intention indicates that the development of the Golden Horseshoe was not an inevitable process, but rather a planned structure, set in place by the government of Ontario and private partners, to strengthen local competition and effectively integrate into the North American market (Globerman, 2001).

The second adaptation to continental integration following NAFTA has been specialization in niche goods, much more a reactionary development growing out of a renewed sense of the 'local'. Donald (2009) notes that in the last two decades we have seen a shift not only in the amount of agricultural goods going to market, but also in the types. She argues that this shift is linked to a changing social, cultural, political, and ecological value system, which adds new collective sets of meaning to the foods that we eat. For example, in the first ten years of the 2000s, the Ontario food sector grew about 2-3% per year, while what she calls the 'creative food sector' (including organic, speciality, and ethnic foods) grew at a rate of 20-25% a year.

This type of shift was only possible in a society that lacked strong roots to a particular food or farming culture, however it developed in a locally specific way. On the one hand, the ability to change farming culture so rapidly may link back to the colonial acquisition and definition of land as market-based rather than communal, cultural, or inherently valuable. However, there is also a highly modern development at play here, in which global consciousness collides with local hardship, to produce preferences for new markets of socially conscious goods. The ability of Ontario's farmers to take advantage of this changing preference may in part be due to shifting cultural roots, but the fact that such a movement exists at all, also points to a sense of local responsibility to farmers and the land (Donald, 2009).

There is clearly a multifaceted reaction going on in Ontario to the integration of the North American agricultural market. On the one hand, the food industry in Ontario has become diverse and centralized, to compete with the larger US market. However, within this centralized system there is also a movement toward re-localization, to capture niche markets for speciality goods, which foreign producers cannot meet. This adaptation has been possible due to the high degree of government support for agriculture, which facilitated the development of a food and farming cluster, in addition to changing local institutions related to the desirability of certain foods.

Chiapas: a legacy of rural displacement

Turning now to Chiapas, Mexico, the historical backdrop and subsequent effects of NAFTA have been wildly different. Agricul-

ture is the backbone of the socio-economic system in Chiapas, which makes changes to its structure all the more disruptive. This is not to say that NAFTA was the first aberration in a history of relative calm; rather it was a particularly distinctive point in a century of socio-economic fragmentation and marginalization.

Economic liberalization under NAFTA disadvantages the smallholder peasant class in Chiapas, increasing existing social polarization within the state. By emphasizing the commercial value of farming, rather than the cultural and social significance, trade liberalization oriented the market toward large-scale farmers and cash crop cultivation, rather than small-scale subsistence farming (Davis & Eakin, 2013; Keleman et al., 2009). While opening up markets for niche goods has benefited some small farmers, liberalizing the economy required altering a number of social and political institutions along the way (Wohlgemuth, 2014).

One of the challenges of a free trade agreement such as NAFTA is that it brings together states and regions at entirely different levels of industrial development. While Canada had to struggle to keep up with the larger US economy, it was at the very least a highly industrialized economy by 1994. Mexico on the other hand, had a much smaller gross national product with large regional variation in levels of industrial development, which created locally specific challenges to liberalization (de Janvry et al, 2010; Davis & Eakin, 2013). Chiapas in particular had a unique demographic makeup and history of marginalization and political dissent, which made it all the more difficult to smoothly integrate the region into a free trade agreement (Wohlgemuth, 2014).

Located at the southern tip of Mexico on the border with Guatemala, Chiapas is considered to be one of the most diverse and isolated Mexican states. This is in part due to its much higher density of Mexico's indigenous peoples, and the partial autonomy through relative exclusion that many of those communities seek from the Mexican state. While precise population counts are difficult to find throughout much of the 20th century, prior to NAFTA 27 percent of the state's population still spoke an indigenous language, as opposed to 13 percent for the country as a whole (Wohlgemuth, 2014; Minority Rights Group International, 2005).

The indigenous population in Chiapas has remained present largely due to self-segregation and economic marginalization, results of 20th century policies of land seizure and redistribution. One of the main legacies of colonialism in Chiapas is the creation of great landed estates called haciendas, which covered much of the fertile lowlands. This system of agriculture severely disrupted the peasant class, by forcing indigenous people into marginal farmland which was unsuitable for fully subsistence living, requiring dependence on wage labour on the lowland haciendas to supplement their livelihood (Davis and Eakin, 2013). Unlike Ontario however, in which the large wage-labour class also had industrial opportunities within a mechanized farm system, farming in Chiapas was a culturally significant practice with little to no viable alternative. This meant that in addition to concentrating wealth into the hands of the few, this early 20th century system put land tenure and traditional agrarian life at the heart of indigenous political demands (Wohlgemuth, 2014).

The remainder of the 20th century developed as a push-pull between the agrarian population and the Mexican state. Following the Mexican Revolution, which was largely driven by the indigenous and non-indigenous southern peasant class, a number of redistributive demands were met. Most notably, Article 27 in the Constitution of 1917 established pub-

lic lands under the ejido system, which were functionally owned by whosoever farmed them, leading to the proliferation of smallholder farming in Chiapas. However, smallholder farming continued alongside, and often in competition with, large commercial farms. By the 1970s the agricultural market was becoming a contentious place, as government policy supported exports by large farms and cheap imports for staple goods, undermining the ability of smallholders to compete (Wohlgemuth, 2014).

Prior to NAFTA, the social system within Chiapas highly valued land tenure and agriculture as not only economic necessities, but as cultural and political rights as well. Subsequent neoliberal changes within the agricultural industry not only altered economic structures, but the intersecting institutions which had been historically constructed to provide public land to smallholders, and which had inscribed the practice of farming with cultural significance. In the "grooming" period prior to 1994, the Mexican government under the leadership of President Salinas de Gortari, amended Article 27 to end the ejido system, shifting the land tenure paradigm toward private property rights. Changing the legal framework in turn signalled a cultural shift from peasant farming toward private ownership, commercialized agriculture, and soon welcoming foreign investment (Caliskan & Adaman, 2010).

Since 1994, the agricultural sector in Chiapas has needed to adapt to freer trade and competition with a highly developed agricultural market. As previously indicated, one of the main paradigms behind NAFTA was specialization through comparative advantage, which is ultimately the route that Mexico took (de Janvry et al., 1997). The agricultural industry focused predominantly on cash crops like coffee, while importing basic staples, an approach that disrupted many of the traditional growing patterns within the region. Not only does this approach force Mexico into a state of food dependence on cheaper US goods, but cash crops like coffee are also a luxury good that is both pegged to US interested and vulnerable to fluctuations in market price (Wohlgemuth, 2014). Large-scale farms were able to adapt fairly easily, oftentimes by substituting capital-intensive methods for labour to decrease input costs (Keleman, Hellin & Bellon, 2009). Some smallholders were also able to access niche markets, such as organic or fair-trade, shifting more of their time and resources away from subsistence and toward commercial agriculture. However, one of the main effects of this adaptation was increased marginalization of the peasant class, many of whom grow basic crops that enter the market at much lower prices than what they can meet (Wohlgemuth, 2014).

The effects that NAFTA has had on the agricultural industry in Chiapas are far reaching. What is clear is that the historical process of land reform and its collective social significance are beyond the reach of reductionist economic models. While NAFTA has increased agricultural production and investment on the whole, a regional analysis reveals numerous local inequalities (de Janvry et al., 1997). Throughout much of Chiapas, it is the smallholder farms that feel the global market pressure, resulting in shifting land-use away from traditional crops, economic marginalization, and at worst land forfeiture and rural flight (Keleman, Hellin & Bellon, 2009; Wohlgemuth, 2014).

Conclusion

In crafting a free trade agreement that brought together two developed economies with a lesser developed one, NAFTA represents a common neoliberal trap; it lauded the universal efficiency of free market principles, without taking into account the social,

political, and economic institutions at the local level. This output maximization and comparative advantage approach, paired with an inability to see beyond a unitary state model, resulted in regional disparities in adaptation. For the more advanced economy in Ontario, with ample government support and a culture that was detached from farming practice, innovation came easily. In Chiapas however, government policies favouring large interests over the peasant class, lead to economic and social friction within agrarian society.

Treating agricultural products as simple commodities suitable for mass-production, and considering every economy to be uniform, may achieve system efficiency, but at the expense of equality. While there have been some reactionary movements toward an embedded market approach – take for example niche markets like organic or fair-trade, which consider the inherent social value of food – the dominant approach has been reductive and universalizing. The danger in free trade agreements is that they will continue the perspective that economic institutions are the only ones that matter, a view that comes at the detriment of non-market social practices. These social institutions however, are what allow local articulations to spring out of seemingly uniform economic policies. The farming cluster in Ontario and commercialized cash cropping in Chiapas are not mere accidents, rather the result of embedded markets working with and altering pre-existing institutions. Future free trade agreements, if they strive to incorporate principles of equality as well as efficiency, should emphasize a historicized and embedded view of particular industries, to better understand the varied functioning of local markets.

References

Block, F. & Evans, P. (2005). The state and the economy. In N. J. Smelser & R. Swedberg (Eds.), The handbook of economic sociology, 2nd edition (505-526). Princeton: Princeton University Press.

Caliskan, K. & Adaman, F. (2010). The logic of neoliberal agricultural reform initiatives: Perspectives and consequences. In B. Karapinar, F. Adaman, & G. Ozertan (Eds.), Rethinking Structural Reforms in Turkish Agriculture: Beyond the World Bank's Strategy (87-103). New York: Nova Science Publishers, Inc

Davis, J. & Eakin, H. (2013). Chiapas' delayed entry into the international labour market: A story of peasant isolation, exploitation, and coercion. Migration and Development 2(1). 132-149.

De Janvry, A., Sadoulet, E., & Davis, B. (1997, April). NAFTA and agriculture: An early assessment (Working Paper No. 807). California Agricultural Experiment Station. Retrieved from http://ageconsearch.umn.edu/bitstream/25089/1/wp807.pdf.

Donald, B.,(2009, February). From Kraft to Craft: Innovation and creativity in Ontario's food economy. Martin Prosperity Institute. Retrieved from http://martinprosperity.org/media/pdfs/From_Kraft_to_Craft-B_Donald.pdf.

Globerman, S. (2001, April). The location of higher value-added activities (Occasional paper no. 27). Industry Canada. Retrieved from https://www.ic.gc.ca/eic/site/eas-aes.nsf/vwapj/op27e.pdf/$file/op27e.pdf

Greater Toronto Area Agricultural Action Committee. (2012, January). Food and farming: An action plan: 2021. Retrieved from https://ontarioculinary.com/gta-

ac-plan-2021-summary/.

Keleman, A., Hellin, J., and & Bellon, M. R. (2009). Maize diversity, rural development policy, and farmers' practices: Lessons from Chiapas, Mexico. The Geographical Journal, 175(1), 52-70.

Milner, H. V. (1999). The political economy of international trade. Annual Review of Political Science 2, 99-114.

Minority Rights Group International. (2005). Mexico profile. World Directory of Minorities and Indigenous People. Retrieved from http://www.minorityrights.org/4456/mexico/indigenous-peoples.html.

Parr, J. (1985). Hired men: Ontario agricultural wage labour in historical perspective. Labour/Le Travail, 15(Spring), 91-103.

Parson, H. E. (1999). Regional trends of agricultural restructuring in Canada. Canadian Journal of Regional Science 22(3), 343-356.

Polanyi, K. (1957). The economy as instituted process. In Polanyi, K. Arensberg, C. M., & Pearson, H. W. (Eds.), Trade and Market in the Early Empires: Economies and History and Theory (243-270), Glenco, IL: The Free Press.

Troughton, M. J. (1985). Industrialization of US and Canadian agriculture. Journal of Geography, 84(6), 255-263.

Wohlgemuth, N. H. M. (2014). Alternatives to rural development: Organic agriculture and indigenous communities in Chiapas, Mexico. Journal of Latin American Geography, 13(1) 67-88.

Woods, T. & Cook, R. (2003). A path dependency and cluster competitiveness framework to examine regional marketing systems and conflicts. Journal of Agricultural and Applied Economics 35(2), 305-312.

The language of land-grabbing and development in Africa as discussed by NGOs and IGOs

Danielle Culp

Demands for food are continuing to rise, and subsequently are driving foreign investors to acquire agricultural land in various countries around the globe to secure food for their populations, particularly in Africa (Deininger, Byerlee, & The World Bank, 2011). This paper examines the issue of foreign land acquisition through the different discourses related to land grabbing and development used by Non-Governmental Organizations (NGOs) and International Governmental Organizations IGO's. Through an analysis of policy documents from NGOs and IGOs, as well as case studies of land grabbing in Africa, results indicate that language is used in different ways by development organizations to influence peoples' perceptions of foreign land acquisitions. Findings illustrate how IGOs use the term "Responsible Agricultural Investment" (RAI) to promote the benefits of land-acquisition, while NGOs use the term "land grabbing" to suggest the negative repercussions of foreign land acquisition. RAI is found to be associated with the Washington Consensus and neo-liberal policies, and to favour investor interests rather than host-country interests. Findings also suggest that policy language must be closely re-examined in in order to reduce uneven development and unequal distribution of benefits between countries.

Introduction

With an increase in demand for food, foreign investors have begun to acquire agricultural land in countries around the globe to secure food sources for their populations (Deininger, Byerlee, & The World Bank, 2011). According to the World Bank (2011), approximately 56 million hectares of land has been acquired or invested in, in less than a year (pp. xxxi-xxxii). This increasing interest in foreign land acquisition is occurring all over the world, but it is most prevalent in Africa, as 29 million of the 56 million hectares of desired land were located in Sub-Saharan Africa (Deininger, Byerlee, & World Bank, 2011, pp. xxxi-xxxii). It is unclear whether foreign land acquisition has positive or negative impacts on the development of countries whose land is being acquired (Liversage, 2010, p. 3). Despite this ambiguity, this paper argues that the language and discourses used by different development organizations work to influence peoples' perception of land-acquisition and agricultural investment. While International Government Organizations (IGOs) adopt the language of "Responsible Agricultural Investment (RAI)" to highlight the benefits of foreign land-acquisition and agricultural investment, this conceals the ways in which responsibility is limited by lack of enforcement and lack of sustainability. In contrast, NGOs use the term "land grabbing" to suggest the negative repercussions of land-acquisition.

The Washington Consensus and Responsible Agricultural Investment (RAI)

Contemporary foreign land acquisition practices and Responsible Agricultural Investment (RAI) are often associated with The Washington Consensus. The Washington Consensus consists of a set of "10 policies that the US government and the internation-

al financial institutions based in the US capital believed were necessary elements of "first stage policy reform" that all countries should adopt to increase economic growth" (WHO, 2013). The Washington Consensus can be understood as a predecessor of Responsible Agricultural Investment, since it focused on neo-liberal policy approaches that supported American founded development initiatives for less developed nations through the promotion of Foreign Direct Investment (FDI) (Williamson, 2004). Similarly, Responsible Agricultural Investment theoretically aims to provide necessary agricultural resources to developing countries as well as providing these countries with capital investments in exchange for land and food. As a development initiative based in the developing world, Responsible Agricultural Investment serves the development priorities of the Washington Consensus.

The Washington Consensus was, however, the subject of controversy. At its core, the Washington Consensus places an emphasis on "the significance of macroeconomic stability and integration into the international economy—in other words a neo-liberal view of globalization" (WHO, 2013). Many NGOs in particular found such ideals to be contentious, as they implied a sense of American Exceptionalism and equated the Washington Consensus with development. As a result of this opposition, a post-Washington Consensus was developed to provide a more humanitarian-based set of principles supposed to promote a more promising form of development for all participants (WHO, 2013).

Yet, similar to the Washington Consensus, the ideals of the post-Washington Consensus are designed to protect the market, not the needs of the masses, although, the post-Washington Consensus shifts the focus from a purely neo-liberal operation of "perfect" markets, to that of institutionally driven economic outcomes. Although it is supposed to have reformed the Washington Consensus, the post-Washington Consensus reinforces many of its predecessor's neo-liberal policies. It carefully selects which institutions are to intervene and how, limiting control of the market and development to particular groups, and thus confirming the continued corruption and uneven distribution of power in relation to development (WHO, 2013).

This continued uneven distribution of power under the post-Washington Consensus is apparent in Responsible Agricultural Investment practices. Although RAI seeks to use idealistic, humanitarian principles to promote "favourable" development for both hosts and investors, power over such land deals remains heavily concentrated in the hands of those with greater economic capital and favours economic gains over humanitarian ones (Saad-Fliho, 2010). Furthermore, RAI tends to translate to policies that favor investor interests over host-country interests. This has led to considerable controversy over the nature of foreign land acquisition and Responsible Agricultural Investment. While IGOs have packaged foreign land acquisition, in the form of Responsible Agricultural Investment, as "responsible" and "humanitarian"—highlighting how it encourages sustainable development—NGOs have critiqued this depiction of land acquisition, specifically using the language of "land grabbing" to highlight its negative impacts.

The controversial nature of RAI or "land grabbing"

Land grabbing is not a new issue in contemporary society. However, as a result of the recent global economic crisis of 2008, food prices around the globe have dramatically increased, which has generated fears around food and energy security for global populations (Roberts, 2013). To combat these anxieties, foreign investors have begun to acquire

agricultural land in other countries in order to secure food for their own populations (Deininger, Byerlee, & The World Bank, 2011; Roberts, 2013). As Figure 1 illustrates, the majority of these acquisitions are taking place in developing countries, where land is abundant, arable, and affordable. As of 2013, 227 million hectares of land in Africa, South America, and Asia had been purchased by foreign investors (Roberts, 2013, p. 111). Due to the increasingly global scale of foreign land acquisitions, much attention has been recently focused on practices of land grabbing and land acquisition between the developed and developing world.

There are many discrepancies and complexities in defining land grabbing, due to issues around who is defining it, whose interests it serves, and its nature as a growing area of interest. Land grabbing is often closely associated, and used interchangeably with definitions of land acquisition, and specifically foreign land acquisition. This contributes to the confusion and controversy surrounding the issue. For example D'Odorico, Rulli and Saviori (2013) define land acquisition as "the transfer of the right to own or use the land from local communities to foreign investors through large-scale land acquisitions" (p. 892). A similar definition of land acquisition is "a measure used by some governments (and corporations) to meet their food and energy requirements by acquiring land in a foreign country" (p. 892). Similar to D'Odorico et al.'s (2013) definition of land-acquisition, Daniel & Mittal (2009) define land grabbing as "the purchase or lease of vast tracts of land by wealthier, food-insecure nations and private investors from mostly poor, developing countries in order to produce crops for export" (Daniel & Mittal, 2009, p. 1). While the term land grabbing is thus similar to, and rooted in, definitions of land acquisition, there are important differences between the two. The term land grabbing is often used to suggest the unfavourable consequences of land acquisition and investment activities. In contrast, the term land acquisition, particularly when it is represented in terms of Responsible Agricultural Investment, is used to suggest more favourable benefits of such exchanges.

The differences between the implications and uses of these two seemingly similar terms stems from controversy surrounding foreign land acquisition practices. Theoretically, foreign agricultural investments in developing countries should be embraced. The apparent intention of these investments is to provide an exchange of necessary agricultural resources, providing investment capital to hosts, and securing food and energy for investors. However, the scope, conditions of agreement, and the speed of land acquisition have prompted resistance in some countries (Meinzen-Dick & Von Braun, 2009). Arslan, Khalilian, and Lang (2011) argue that investors and IGOs view land deals as development opportunities, whereas NGOs tend to view these deals as exploitative, with negative consequences for developing countries. These very different perspectives on land acquisition and investment ultimately lead to differences in the language used by IGOs, investors, and NGOs. While IGOs and investors tend to use a rhetoric of investment and more neutral terms like "land acquisition" and "Responsible Agricultural investment," NGOs tend to highlight the negative impacts of these acquisitions and investments by referring to them as "land grabs" (Arslan, Khalilian & Lang, 2011, p. 1). This language highlights the fact that IGOs and NGOs have different perspectives on the same phenomenon. These perspectives will be outlined in further detail in the following sections.

IGOs and "Responsible Agricultural Investment"

According to IGO's such as the Food

and Agricultural Organization (FAO), International Fund for Agricultural Development (IFAD), United Nations Conference of Trade and Development (UNCTAD), and the World Bank (2011), investment in agriculture will reduce food insecurity. These organizations argue that principles are needed to encourage positive social, environmental, and economic outcomes while minimizing the risks associated with agricultural investment and land acquisition (UNCTAD, 2011, p. 2). While Principles for Responsible Agricultural Investment (PRAI) are not mandatory for land-acquisition and foreign investment in agriculture, they were first proposed by the FAO, IFAD, UNCTAD and the World Bank in 2009 and revised in 2011 to act as a guide for investment that promotes preferred outcomes and reduces negative consequences (UNCTAD, 2011, p. 2). Such principles address "all types of investment in agriculture [including biofuels], including between principal investors and contract farmers" (UNCTAD, 2013). It is important to note the various actors that are involved in Responsible Agricultural Investments. They include, but are not limited to: IGOs and international development agencies such as the World Bank, FAO, IFAD, UNCTAD; source governments, host governments, investors[including] "operating companies in the agro-food, biofuels, and extractive industries institutional investors such as pension funds and insurance companies; private equity funds; governmental or government-linked companies such as sovereign funds; and individual entrepreneurs, local communities and farmers" (World Bank, 2011, p. 4).

There are seven principles of Responsible Agricultural Investment (PRAI). Three of the seven are of utmost importance in relation to development and the language of land grabbing, as these are the principles which generate the most controversy, tend to be the least respected, and most heavily critiqued by NGOs. They are as follows: "investments do not jeopardize food security but rather strengthen it"; "investments generate desirable social and distributional impacts and do not increase vulnerability"; and "existing rights to land and associated natural resources are recognized and respected" (UNCTAD, 2011, pp. 11-12). IGOs use these principles, and the term RAI to suggest the positive impacts investment has on development. While all principles are included to promote such development benefits, the first principle, which addresses the recognition and securitization of land rights, best exemplifies this (UNCTAD, 2011, pp. 11-12). IGOs note that by having both a formal and customary based policy of land acquisition, government officials and local chiefs are the dominant actors who are approached by foreign developers and hold the final decision making power in land development and ownership. IGOs claim this voluntary principle helps acquire land more smoothly and that it works in the interest of the local population. This implies that agricultural investment is implemented in socially responsible ways by respecting the host-country's land acquisition policies. Through the eyes of investors and government organizations, this process generates benefits for local landowners. However, this pro-investment representation of foreign land acquisition by IGOs can also be seen as biased as it seeks to protect the agenda of the investors over the goals of local populations.

The second PRAI principle, addressing the impacts of investments on food security (UNCTAD, 2011, p. 11), is also used by IGOs to highlight the benefits of RAI for local populations. IGOs argue that "increasing investment in agriculture is vital to achieving higher productivity and greater food production, thereby supporting global food security and poverty reduction" (Gordon & Pohl, 2010, p. 3). This shows how IGOs equate investment with development, assuming that all foreign

investments in agriculture it will translate to reduced food insecurity for the residents of the host-countries in which they are investing. An example of this principle in practice is the case of foreign investors who introduced hybrid seeds for agriculture production in Uganda (Arias, Hallam, Koroma & Lie, 2013, p. 146). "Farmers reported that before the introduction of the DEKLAB hybrid maize, one acre of land could produce 200 kg of maize, from which farmers could reserve seeds for replanting for the next season. Presently, with the DEKLAB Hybrid and other hybrids on the market, one acre produces between 2 and 3 tonnes, an increase of up to 12-fold" (Arias, Hallam, Koroma, & Liu, 2013, p. 146). This case shows how changes in policy to incorporate technology can benefit production of food and, by increasing yields, can enhance food security for the host-country. Such cases are used to demonstrate how investors are making responsible choices in agriculture, and how RAI can aid in sustainable development. This reaffirms how the rhetoric of RAI is used to promote the benefits of land grabbing. However, policy measures are needed to ensure that private sector involvement occurs in a responsible way, with full regard to sustainable development (Gordon & Pohl, 2010, p. 3). In the case of many IGOs, it is unclear what constitutes "responsible" behavior, and although the Principles of RAI are promoted, they are not required, which may be problematic in ensuring favourable outcomes of agricultural investment.

IGOs also use the sixth principle, that investments should create positive social impacts, to highlight how RAI can be used to promote job creation. In Ghana, for example, a foreign owned company called Solar Harvest, created multiple casual labor, land clearance, and husbandry-related employment opportunities for locals (Arias, Hallam, Koroma, & Liu, 2013, p. 215). Further, multiple IGO publications, like those of The World Bank, UN, and FAO, discuss how land acquisition can offer necessary investment in agriculture and rural areas, which in turn provides infrastructure such as schools, health facilities and roads (Arias, Hallam, Koroma, & Liu, 2013). In addition to the job creation outlined above, Solar Harvest has showcased how land acquisition can benefit the community, as it has provided two small dams (Arias, Hallam, Koroma, & Liu, 2013, p. 214). Further, land compensation often is recycled into the community, which demonstrates how land acquisition supports social infrastructure indirectly (Deininger, Byerlee, & World Bank, 2011, p. xxxiii). Thus, according to various IGOs, foreign land-acquisition can have positive outcomes for local communities such as job opportunities, and can result in economic growth. However, these claims have also been met by significant critique from NGOs.

Questioning the "responsibility" of RAI

Although IGOs support "Responsible" Agricultural Investments, NGOs associate foreign agricultural investment with land grabbing and dependency. Critics argue that RAI principles are often not enforced, which raises questions regarding "responsibility". For example, the first RAI principle, which addresses responsible securitization of land and land rights, is interpreted by critics as self-motivated and not "responsible." The majority of locals are uninvolved in the consultation process, as those acquiring land often only conduct business with officials and leaders, as opposed to small-scale landowners or the affected public. This results in unclear and often varying explanations of conditions of land acquisition agreements for local populations. An example of the negative repercussions of this lack of community consultation is illustrated by a local landowner, who explains the limits of employment opportunities after Solar Harvest, a foreign company operating

in Ghana, acquired her land. The landowner stated that "there was no proper acquisition of my farmland. It was just taken away from me under instructions of the chief…[and though] in the beginning, the company employed me as a casual worker, I have now been laid off and am suffering because I cannot get alternative land to farm and was not given compensation" (Arias, Hallam, Koroma, & Liu, 2013, p. 213). This point illustrates how the idea of "responsible" investment may differ from the reality of how land acquisition impacts local populations.

RAI is also critiqued by NGOs for being short term, unsustainable, and not enforced. A recurring example of this is how land is acquired from local farmers by foreign investors, who offer employment to the farmers as compensation for their land. Often, such opportunities are temporary and result in locals being unable to sustain their socio-economic needs, leading to an increase in vulnerability, and specifically contradicting the RAI principle that argues investments create favorable social conditions and reduce vulnerability (Arias, Hallam, Koroma, & Liu, 2013, p. 213). Further, in the case of Solar Harvest in Ghana, the company originally promised positive community outcomes such as the building of schools, health centers, and roads when it first acquired land in 2008. Over a year later, it had not achieved, nor begun any of its promised initiatives (Arias, Hallam, Koroma, & Liu, 2013, p. 214). This case demonstrates that the principles of RAI are not necessarily enforced once land ownership is transferred. This in turn raises questions around "responsibility", as it is unclear how responsible these principles really are, who is held accountable for irresponsible actions, and who truly benefits from these Principles of Responsible Agricultural Investment.

NGO's such as GRAIN, a non-profit that works to support small farmers in their struggles for community-controlled food systems (GRAIN, 2011), also question the RAI principles surrounding food security and sustainability. GRAIN (2011) argues that investors' decisions to introduce technology negatively impact local populations' ability to sustain their livelihoods. An example of this is the use of genetically modified seeds to increase yields and profit, which were provided by foreign landowners to farmers in Uganda. Local agricultural workers complained that they were coerced into purchasing costly Monsanto hybrid seeds each season to ensure maximum yields, in order to protect foreign investors profitability, at the expense of the local farmers' wellbeing (Arias, Hallam, Koroma, & Liu, 2013, p. 146). This case reaffirms how foreign land acquisition reinforces the interests of select few investors over the welfare of local populations (Baxter, 2010). Further, this exemplifies how genetically modified seeds and imported fertilizers that often accompany foreign land acquisitions can contribute to negative environmental effects and also create financial hardships for local populations. GRAIN (2011) suggests that this implementation of "responsible" agricultural technology to combat food insecurity can thus damage the soil and foster dependency on foreign investors' technology to maintain high crop yields (Baxter, 2010, p16).

The language of land acquisition

These questions surrounding the responsibility of RAI are closely linked to the differences in language used by IGOs and NGOs in discussions of land acquisition. Ferguson and Lohmannn (1994) argue that development agencies distort the reality of "developing" countries to fit them into a development category to suit their own needs (Ferguson & Lohmann, 1994, p. 176). Like IGOs' implementation of the term "Responsible Agricultural Investment" to support land acquisition, Ferguson and Lohmann (1994) argue that the

bureaucratic development agencies use language to promote their own agenda, by using the terms "developing" and "Third World," to imply that certain countries are in need of economic and social interventions (Ferguson and Lohmann, 1994, p. 176). Language can thus be understood as a powerful tool for achieving particular objectives.

Ferguson and Lohmann use the example of Lesotho to illustrate this point. The World Bank, a prominent development agency, claimed that "agriculture provides a livelihood for 85% of the people in Lesotho" (Ferguson & Lohmann, 1994, p. 177). In reality, however, 70% of income is resulting from wage labor and a mere 6% is from domestic crop production (Ferguson & Lohmann, 1994, p. 177). The goal of these statistics was to show that Lesotho is underdeveloped, and that agricultural intervention imposed by development agency aid would contribute to positive outcomes for small-scale farmers in Lesotho. However, pointing to the proletarian nature of agricultural employment in Lesotho, the authors argue that the true intention of identifying Lesotho as less developed, is to ensure investors and development agency interests are achieved (Ferguson & Lohmann, 1994).

This kind of manipulation of language can also be seen in RAI. Mitchell (1991), for example, notes how foreign investment in Egypt negatively impacts development and the interests of the population. Mitchell argues that one outcome of the growing production of meat and other animal products, which has been largely imposed on Egypt by American investment, is that "the Egyptian government, supported by large American loans, has encouraged this diversion by subsidizing the import of staples for consumers, heavily taxing the production of staples by farmers and subsidizing the production of meat, poultry and dairy" (Mitchell, 1991, p. 21). This suggests unequal power distribution between the developed and developing countries, as Egypt must abide by American investors' wishes or risk the loss of financial support and investment in its agriculture. This example further suggests that foreign companies who acquire land are mainly concerned with their production needs, while viewing domestic food production conditions as insignificant. This suggests that investors and development agencies may not have local populations' best interest in mind, and that what IGOs promote as sustainable and responsible agricultural investment, is not in fact sustainable for all. Like Ferguson and Lohmann (1994), Mitchell (1991) demonstrates how foreign investment is not always responsible, in spite of the rhetoric of "responsible" and "humanitarian" investment.

Conclusion

Foreign land acquisition is a pressing and controversial problem in relation to development. The controversy surrounding land acquisition can be seen in the different language and rhetoric used by IGOs and NGOs. This paper has demonstrated how International Government Organizations (IGOs) use the term "Responsible Agricultural Investment" (RAI) to promote the benefits of land-acquisition, while NGOs use the term "land grabbing" to suggest the negative repercussions of land-acquisition. In doing so this paper highlights how language is used by different development organizations to influence peoples' perceptions of land acquisition and the power of language as a tool for achieving particular objectives.

References

Arias, P., Hallam, D., Koroma, S., & Liu, P. (2013). Trends and impacts of foreign investment in developing country agriculture: Evidence from case studies (Trade and Market Publication). Rome: Food and Agriculture Organization of the United Nations (FAO).

Arslan, A., Khalilian, S., & Lang, M. (2011). Dealing with the race for agricultural land (No. 31). Germany: Kiel Institute for the World Economy.

Baxter, J. (2010, January). Africa's land and family farms- up for grabs? Seedling, 13-16. Retrieved from http://www.grain.org/article/entries/4076-africa-s-land-and-family-farms-up-for-grabs.

Cotula, L., Keeley, J., Leonard, R., & Vermeulen, S. (2009). Land grab or development opportunity? agricultural investment and international land deals in Africa (No. 12561). Rome: IIED/FAO/IFAD.

Daniel, S., & Mittal, A. (2009). The great land grab: Rush for world's farmland threatens food security for the poor [Report]. Oakland Institute. Retrieved from http://www.oaklandinstitute.org/great-land-grab-rush-world's-farmland-threatens-food-security-poor

Deininger, K. W., Byerlee, D., & The World Bank. (2011). Rising global interest in farmland: Can it yield sustainable and equitable benefits? Washington, DC: The World Bank. Retrieved from http://siteresources.worldbank.org/INTARD/Resources/Joint_Issues_Note_54_v6.pdf

D'Odorico, P., Rulli, M., & Saviori, A. (2013). Global land and water grabbing. Proceedings of the National Academy of Sciences, 110(3), 892-897.

Ferguson, J. and Lohmann, L. (1994) The Anti-Politics Machine: "Development" and Bureaucratic Power in Lesotho. The Ecologist, 24(5), 176-181.

Gordon, K., Pohl, J. (2010). Freedom of investment process: Responsible investment in agriculture. France: Organisation for Economic Co-operation and Development (OECD).

GRAIN. (2011). It's time to outlaw land grabbing, not to make it 'responsible'!. GRAIN, 1-6. Retrieved from http://www.grain.org/article/entries/4227-it-s-time-to-outlaw-land-grabbing-not-to-make-it-responsible

Liversage, H. (2010). Responding to 'land grabbing' and promoting responsible investment in agriculture (No. 2). International Fund for Agricultural Development (IFAD). Retrieved from http://www.ifad.org/pub/op/2_e.pdf

Mitchell, T. (1991) America's Egypt: Discourse of the Development Industry. Middle East Report, 169, 18-36. Retrieved from http://www.merip.org/mer/mer169/americas-egypt

Mollett, S. (2010) Está listo (Are you ready)? Gender, race and land registration in the Río Plátano Biosphere Reserve. Gender, Place & Culture, 17(3), 357-375.

Power, M. (2003). Development thinking and the mystical 'kingdom of abundance'. In Rethinking Development Geographies (71-94). New York: Routledge.

Roberts, W. (2013). The no-nonsense guide to world food. Toronto: Between the Lines.

UNCTAD. (2013). The Principles for Responsible Agricultural Investment (PRAI). Retrieved from http://unctad.org/en/Pages/

DIAE/G-20/PRAI.aspx

UNCTAD. (2011, June 3). Options for promoting responsible investment in agriculture: Report to the high-level development working group. Retrieved from http://unctad.org/sections/dite_dir/docs/diae_dir_2011-06_G20_en.pdf

The World Bank. (2011). Rising global interest in farmland and the importance of responsible agricultural investment (No. 56583). Washington, DC: The World Bank. Retrieved from http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/09/15/000333038_20100915010822/Rendered/PDF/565830BRI0Box31nt1Issues1Note1541v6.pdf

The World Bank. (2013). The World Bank glossary. Retrieved from http://www.worldbank.org/depweb/english/beyond/global/glossary.html

The World Health Organization. (2013). Washington Consensus. Retrieved from http://www.who.into/trade/glossary/story094/en

von Braun, J. & Meinen-Dick, R. (2009). Land grabbing by foreign investors in developing countries: Risks and opportunities (Policy Brief No. 13). Washington, DC: The International Food Policy Research Institute (IFPRI).

Williamson, J. (2004). The Washington consensus as policy prescription for development. Institute for International Economics, 1-22. Retrieved from http://www.iie.com/publications/papers/williamson0204.pdf

Figure 1. Map of Distribution of land grabbed countries and land-grabbing countries. (Source D'Odorico, Rulli, & Saviori, 2013).

A quantitative analysis of Metrolinx's "The Big Move" expansion plan for the City of Toronto and Regional Municipality of York using GIS techniques: A case study of subway and Advanced Light Rail Transit

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This thesis was completed for a graduate level geographic information systems (GIS) research course offered through the Department of Geography and Program in Planning at the University of Toronto. The growing problem of congestion in the City of Toronto and Regional Municipality of York is evident through not only gridlock but in the high rate of urbanization displayed in both cities. The objective of this study was to determine whether Metrolinx's proposed transit expansion plan could optimally meet the demand in the City of Toronto and Regional Municipality of York using GIS analyses. In addition, several recommendations were made on how to ameliorate the proposed transit expansion plan and identify which lines should have the higher priority.

Multiple indicators were studied to locate the areas of highest priority: Commute time, household size, ageing, and population density representing social indicators; income level, unemployment rate, and occupational type representing economic indicators. Lastly, land cover type, air pollution level, and terrain relief represent environmental and topographic indicators.

This study concludes that there are census tracts in the City of Toronto and Regional Municipality of York that will continue to be underserviced based on Metrolinx's transit expansion plan.

1. Problem definition

Public transportation infrastructure in the Greater Toronto Area (GTA) has been growing slowly since the first subways were constructed in the 1950s. "The Big Move" is a plan proposed by Metrolinx, aiming to improve the Toronto Subway, Scarborough Rapid Transit (SRT), Light Rail Transit (LRT), and GO Transit throughout the GTA (Metrolinx: Linking People to Places, 2008). Through a more effective public transit system, the goal of this plan is to reduce ground traffic congestion and exhaust emission, in turn improving the quality of life for GTA residents and protecting the urban environment.

As forecast by Metrolinx (2008), 265.3

million riders are serviced by the current rail transport system every year. This number will increase to 564 million with the development of additional transit lines. Derrible and Kennedy (2010) argue that the transit expansion plan in Toronto has potential to improve in terms of coverage, directness, and connectivity. As such, this research assumes that analytical errors may exist in Metrolinx's "The Big Move" expansion plan. Thus, the objective of this study is to determine whether the proposed transit expansion plan can optimally meet the demand in the City of Toronto and Regional Municipality of York using GIS analysis. In addition, several recommendations will be made on how to ameliorate the proposed transit expansion plan and identify which lines should have higher priority.

2. Definition of study area

The scope of this study is the subway and advanced LRT expansion throughout the City of Toronto and Regional Municipality of York region. If more time was available, it could be expanded to a larger area and other transit modes. In this study, the statistical unit is based on census tracts (CT's) because it can provide dependable and suitable statistical data. CT's are not as small as dissemination areas, however they are the ideal size as they contain enough detailed information in comparison to neighborhoods while being large enough to have relevance to our study. The study area is shown in Figure 1.

3. Literature review

In this section, we reviewed the related articles and separated the previous studies into three parts, consisting of public transit systems, indicator identification, and spatial analysis.

3.1 Previous studies on public transit systems

Litman (2005) compared a variety of rail transit systems in major U.S. cities including the communities of "Large Rail, Small Rail, and Bus Only", and evaluated the benefits of each transit system based on a comprehensive analysis of its performance. In particular, the 50 largest U.S. cities such as New York, Boston, and San Francisco belong to the community of "Large Rail". In comparison with the cities of "Small Rail" or "Bus Only", it was found that "Large Rail" cities have higher transit ridership, lower average vehicle ownership and annual mileage (per capita), less traffic congestion, lower traffic death rate, lower consumer expenditure on transportation, and a higher cost for transit service recovery (Litman, 2012). Specifically, Litman (2012) argued the rail transit system is more important in rapidly growing cities as it can be a cost-efficient investment to lower costs of congestion. Nevertheless, the authors pointed out that rail transit systems required appropriate consultation and supportive transport and land use policy to result in significant benefits for cities. Additionally, Litman (2012) found that rail transit systems attract the discretionary riders who have the options to drive or ride transit due to its superiority to bus systems. According to Metrolinx (2008), the congestion cost in the GTA totaled $3.3 billion in 2006, which results from travel delays, increased impacts to the environment, increased vehicle costs, and increased chances of vehicle collision. From this perspective, Metrolinx's "The Big Move" expansion plan will benefit the GTA as it can remarkably reduce these negative impacts.

Indeed, the target of Metrolinx's "The Big Move" expansion plan is to expand the current transit system to relieve severe traffic congestion induced by rapidly growing population across the GTA. Case studies from cities around the world are also facing similar problems, thus emphasizing the complexities surrounding transit development. As the economic center of the United Kingdom (UK),

London has made a major contribution to the prosperity of the entire country. Crossrail is a new east-west railway for London, running 118 km from Maidenhead to Heathrow. It will be able to transport 1.5 million people within between key business districts in London within 45 minutes. Crossrail can increase the capacity of London's rail transit system by over 10%, helping to relieve congestion of both the current transit system and road network. The study conducted by Schabas (2005) evaluated the financing methods of Crossrail. As the largest civil engineering project in Europe, the estimated expense of Crossrail is £15.9 billion. This is being financed in three ways: Users, business owners who agree to contribute, and taxes. Schabas (2005) argued that the construction of Crossrail can stimulate greater economic development around stations. Business owners will be able to offer better services for current employees and better attract skilled labour pools in the future due to this improved transit connection. However, transit development in the GTA has has followed the principle of "build it and they will come" since the Yonge subway line was constructed in 1954. In Toronto, private business owners were not engaged in the decision of transit system expansion. To avoid the low ridership seen on the Sheppard line, it is of great necessity to investigate the anticipated performance of Metrolinx's "The Big Move" expansion plan.

According to the Canada 2011 Census, the Greater Vancouver Area (GVA) is the third most populous metropolitan area in the country after Toronto and Montreal. Recently, urban planning in the GVA has concentrated on the investment of rapid transit infrastructure to spur urban development (Siemiatycki, 2007). A study focusing on the GVA conducted by Siemiatycki (2006) evaluated the effectiveness of the design-build-finance-operate (DBFO) private-public partnership process. Siemiatycki (2006) argued that the DBFO model seeks to balance "the advantage of government control of the strategic allocation of scarce resources in the protection of the broad public interest, with the benefit of infusing competitive forces into the delivery of public services to increase efficiency" (p. 137). Since Toronto is the most populous city in Canada and is still growing appropriate transit expansion is required. Metrolinx's "The Big Move" is a 25-year, $50 billion expansion. Although transit projects worth $16 billion are currently underway, there are still $34 billion remaining to be debated. Thus, our study aimed to evaluate if the proposed Metrolinx's "The Big Move" expansion plan would provide the greatest public service with consideration to social, economic, and environmental indicators.

Derrible and Kennedy (2010) compared the proposed 15- and 25-year transit expansion plans of Metrolinx with other world-class transit systems. Three key indicators related to ridership (coverage, directness, and connectivity) provided an effective way to analyse the transit systems. The authors argued that the existing transit system in Toronto is overstressed, and will likely become increasingly serious with the growing population in the immediate future. Under this context, the authors identified seven possible improvements to the network design of Metrolinx to increase coverage, directness, and connectivity, further positioning Toronto amongst the most transit-efficient cities around the world. For instance, the Jane line could connect with the Etobicoke–Finch West line and the western segment of the Spadina–University–Yonge line at a single station. The eastern terminal of the Etobicoke–Finch West line could reach the Sheppard–Yonge station, hence facilitating transfers with the Sheppard Subway line. Moreover, the Etobicoke–Finch West line and the Bloor Subway line could intersect with the Eglinton Crosstown line. In addition, the

Queen Subway line could terminate at Jane Station instead of Dundas West, as currently planned. Lastly, the Sheppard Subway line and the Sheppard East LRT line could be continuous as well as the Eglinton Crosstown line and the Scarborough Malvern line. Overall, the proposed improvements would further increase the coverage, directness, and connectivity of the transit system, increasing ridership by 134%. This study will identify whether Metrolinx's "The Big Move" expansion plan can provide sufficient service for the areas in most need of transit.

3.2 Previous studies on indicator identification

This research requires the identification of appropriate indicators to examine whether the proposed Metrolinx's "The Big Move" expansion plan can satisfy the growing public transit needs. Of the commonly used city transit planning indicators listed by Shah et al. (2013), this study chose commute time and population density to characterise the demand, context, affordability, and accessibility of public transit. In addition, ageing, income, and air pollution were also selected as the indicators selected from "The Big Move" Baseline Monitoring Report (2013). Furthermore, the research adopted household size, unemployment rate, occupational type, land cover type, and topographic relief indicators. In summary, we selected 10 indicators closely related to the GTA transit system that are categorized into three aspects: Social, economic, and environmental and topographic factors.

3.2.1 Social indicators

1. Commute time

The CT's with the residents who are experiencing longer commute time are in the greater need of public transportation. As argued by Wardman (2004), the development of public transit infrastructure could reduce the average commute time by 32.7% in congested areas. Thus, commute time is an important indicator to determine the affordability and accessibility of the potential transit lines (Shah et al., 2013).

2. Household size

The CT's with larger households (i.e., over three people) are unlikely to take advantage of public transportation because they prefer to use private cars rather than rail transport systems (Dieleman, 2002; Shalaby, 1998).

3. Ageing

Since senior citizens tend to give up driving over the age of 65 (Hakamies-Blomqvist &Wahlström, 1998), the development of public transit is more beneficial for the CT's with more elder residents.

4. Population density

It is indicated by Frank and Pivo (1994) that the CT's with higher population density are always associated with greater demand of public transportation. Also, Shah et al. (2013) strongly supported the notion, population density should be a powerful indicator for transit planning as it is able to reflect the potential public transit demand.

3.2.2 Economic indicators

1. Income level

Glaeser et al. (2008) find that private automobile use is associated with higher incomes due to its high costs. Thus, the CT's with lower income households are considered a higher priority of transit expansion.

2. Unemployment rate

Access to job opportunities is limited by a lack of affordable, un-privatized transportation options (Sanchez, 2007).

3. Occupational type

In general, occupational types can be categorized into four classes: (1) management, business, finance, government, education and law as professional; (2) health occupations, and natural and applied science as general office; (3) arts, cultural, recreational, sales and services as retail; and (4) trades, equipment operator, natural resources, agriculture and manufacturing as manufacturing. In contrast with retail and manufacturing groups, individuals working for professional or technical companies are unlikely use public transportation (Schwanen & Mokhtarian, 2005), which indicates that the CT's with a large number of individuals in such occupations will not benefit from public transit.

3.2.3 Environmental and topographic indicators

1. Land cover type

From the environmental perspective, it is apparent that the desirable SRT and LRT expansion should be constructed on the land cover of urban built-up area, rather than urban green space or ecological land (Jothimani & Yamamura, 1995).

2. Air pollution level

For a CT, the air pollution level measured by the Air Quality Index (AQI) is able to indicate the necessity of public transit as public transportation can relieve the air pollution by reducing traffic congestion (Briggs, Collins, and Elliott, 1997; Jong and Schonfeld, 2003).

3. Terrain relief

Terrain relief should be taken into consideration in the case of public transportation planning because areas with gentle terrain slopes are more suitable to construct transit stations (Jong & Schonfeld, 2003).

3.3 Previous studies on spatial analysis

*3.3.1 Getis-Ord-Gi**

To identify the higher priority of transit station construction for an indicator, the index of Getis-Ord Gi* was calculated based on the statistical unit of CT. Theoretically, Getis-Ord Gi* measures the degree of association that results from the concentration of weighted points (Getis & Ord, 1992). In other words, it characterises the CT with a high or low spatial cluster to its neighbors, which are named by "hot" and "cold" values of each indicator (Appendix B5).

3.3.2 Global Moran's I

As a spatial autocorrelation index, Moran's I is often utilised to measure the difference of the indicator value in a CT and those in surrounding CT's (Moran, 1948). Since Global Moran's I is able to measure the spatial heterogeneity for an indicator, this study will adopt Global Moran's I to determine the weight of each indicator. In this study, the indicators within the social, economic, and environmental and topographic aspect were separately overlaid. If an indicator shows lower or no heterogeneity, it will contribute less or zero to the weighted overlay. Therefore, the indicator with the lower Global Moran's I was given the lower weight.

3.3.3 Dasymetric mapping

As indicated above, population density was selected as a social indicator. However, a normal choropleth map might not be sufficient to provide the accurate population distribution within each CT because the population is usually distributed based on different land uses such as residential, commercial, and industrial. As Mennis (2009) argued, the dasymetric mapping can use an ancillary dataset of area-class map to disaggregate the CT-level choropleth map and to produce a dasymetric

map displaying the distribution of population more accurately.

3.3.4 Network service area

A service area analysis is able to create zones around a given set of trip origins to exclude the activity beyond a specified walking-distance limit. It should be the first alternative to obtain the service area around the transit stations. In this study, the area within a certain distance of service area zone to a station would be considered as equal accessibility. Without considering the presence and quality of the transportation network (Liu & Zhu, 2004), conventional buffer analysis neglects indirect paths, obstructions, and breaks in the network, which might need a longer distance traveling to reach the target. Moreover, the circle-shape buffer zones are not mutually exclusive unless the distance between any two stations is over twice the buffer radius (Barranda et al., 2004). Under this context, network service area overcomes the above two defects of traditional buffer analysis. A network service area is a region that encompasses all accessible streets.

4. Data acquisition

This paper uses data created by Statistics Canada consisting of the 2011 Census and National Household Survey (NHS) to spatially map social and economic indicators based on the statistical unit of CT. The data for the environmental group of indicators will come from the GTA land cover map of 2002 (Ontario Ministry of Natural Resources, 2002), the AQI of 19 stations in the southern region of Toronto (Ministry of the Environment, Ontario), and digital elevation model (DEM) data of 2002 (DMTI Spatial Inc., 2002). In addition, the shapefiles of current subway lines were obtained from the 2012 Route Logistics dataset (DMTI Spatial Inc., 2002) but those of prospective transit lines in the Metrolinx's "The Big Move" expansion plan were digitized manually based on their report.

5. Methods

This section provided detailed information for geoprocessing methods, including the overlay of social, economic, and environmental and topographic indicators, the generation of four scenario maps, the newly proposed transit lines based on the underserviced areas, and the determination of Metrolinx's "The Big Move" expansion transit line construction sequence. Specifically, all the geoprocessing methods are the basic or extensive functions implemented in the ArcGIS software package.

5.1 The overlay of social indicators

As mentioned previously, four social indicators were adopted to measure the priority of transit station construction for our study area. In addition, average commute time, population over the age of 65, and household size follow the same three processing steps before the implementation of overlay. First, the Z-score of Getis-Ord-Gi* was applied to locate the high value clustering CT's of each indicator (Hot Spot Analysis). Then, the Global Moran's I was calculated to measure the spatial heterogeneity for each indicator (Spatial Autocorrelation). Lastly, the vector-based shapefile was converted to the raster-based file to overlay the indicators (Polygon to Raster).

Meanwhile, the fourth indicator of population density used the dasymetric mapping tool developed by the United States Geological Survey, an extension tool of ArcGIS. The dasymetric mapping tool employed two files to create a dasymetric output, including a vector-based population file and a raster-based land use file. This research found an appropriate land use file from the Ontario Ministry of Natural Resources and reclassified it into four categories: High-density residential, low-den-

sity residential, non-urban inhabited, and uninhabited. In our study, a raster-based file of population density was produced based on the high-density residential land use. Finally, this research converts the output file to a shapefile for calculating the Global Moran's I (Raster to Polygon).

To stay consistent, all four social indicators were reclassified into 10 classes (Reclassify) and overlaid with the different weights calculated by the normalized Global Moran's I (Weighed Overlay). The geoprocessing model of social indicators is shown as

5.2 The overlay of economic indicators

In contrast to the use of social indicators, only three economic indicators were adopted to measure high priority CT's for the study area. Individual income, unemployment rate, and occupational type followed the same three processing steps before the implementation of overlay. First, the Z-score of Getis-Ord-Gi* was applied to locate the high value clustering CT's of each indicator (Hot Spot Analysis). Then, the Global Moran's I was calculated to measure the spatial heterogeneity for each indicator (Spatial Autocorrelation). Next, the vector-based shapefile was converted to a raster-based file to overlay the indicators (Polygon to Raster). Lastly, all three economic indicators were reclassified (Reclassify) and overlaid with the different weights calculated by the normalized Global Moran's I (Weighed Overlay). The geoprocessing model of economic indicators is shown as Figure 3.

5.3 The overlay of environmental and topographic indicators

Three environmental & topographic indicators were adopted to measure the priority of transit station construction for the GTA, including land cover type, air pollution level, and terrain relief.

According to the 2002 GTA land cover map (OMNR, 2002), the land cover types of the study area consisted of urban, urban water, urban green space, deep clear water, shallow sediment water, open wetland, treed wetland, coniferous forest, mixed forest, deciduous forest, sparse forest, pasture-marginal land-winter wheat, cropland, and bare rock. This study categorized all the land cover types into three classes, indicating the priority of land cover types that would be suitable for the construction of a transit station. Particularly, the land cover types excluding urban and urban green space were regarded as the lowest priority as all of them belong to ecological lands. Further comparing urban and urban green space, the latter has lower priority considering the significance of urban green space in the urban environment. Thus, urban, urban green space, and the other land cover types were reclassified as high, medium, and low priority with the value of 10, 5, and 1, respectively (Reclassify). It is worth noting that the dominant land cover type which contributes the largest area in a CT was used to represent the whole CT (Zonal Statistics).

Among the range of air pollutants, this study focused on the NOx concentration which is most closely related to public transit (Cunningham & Cunningham, 2012). The total ppb of NOx per year was calculated by the raw daily data collected from 19 AQI stations in the southern region of Toronto. The inverse distance weighted interpolation was employed to produce the NOx concentration of the whole study area. Differing from the indicator of land cover type, the NOx concentration was reclassified into ten classes representing the priority from 10 to 1 (Reclassify). To keep consistent in using the CT as the statistical unit, the mean value was calculated for each CT as the representative (Zonal Statistics).

With respect to terrain relief, the mentioned DEM data was adopted to generate the

slope of our study area (Slope), which was also reclassified into ten classes (Reclassify). The mean value was calculated for each CT as the representative (Zonal Statistics).

All the raster-based files above were further converted to the shapefiles for calculating the Global Moran's I for the three indicators (Spatial Autocorrelation) as the weights for overlay (Weighed Overlay). The geoprocessing model of environmental and topographic indicators is shown as Figure 4.

5.4 The generation of four scenario maps

Based on three of the overlay maps presented above, this study created four scenario maps: Social, economic, environmental, and equal scenario. For the first three scenarios, 60% was assigned as the weight of the dominant indicator for overlay while 20% was given to the other two factors (Weighed Overlay). For example, the social scenario applied 60% as the weight of social indicators, and 20% as the weights of economic, environmental, and topographic factors. On the other hand, the equal scenario assigned an equal weight to all the three factors (Weighed Overlay) for further determination of "The Big Move" expansion transit line construction sequence as it is a compromising scenario with the consideration of social, economic, and environmental and topographic factors.

5.5 The newly proposed transit lines based on the underserviced areas

To propose new transit lines in addition to the Metrolinx's "The Big Move" expansion it is important to determine which areas of the GTA are underserviced. Initially, a service area was created within a walking distance of 1200 meters on a traversable road network (Network Service Areal). These service areas were intersected with each of the social, economic, and equal high priority areas (Intersect).If the intersecting portion covered less than 50% of the CT, the CT would be considered underserviced. Finally, this study digitized three new transit lines to cover as many underserviced CT's based on visual inspection.

5.6 The determination of "The Big Move" expansion transit line construction sequence

The determination of "The Big Move" expansion transit line construction sequence was started by converting the top two classes of high priority CT's, based on the equal scenario, to their corresponding centroids (Feature to Point). Thereafter, the centroids were spatially joined to all the existing and prospective transit lines (Near). The process counted the number of centroids of the top two high priority classes. As a result, transit lines with higher numbers signalled a higher priority to build.

6. Results and discussion

6.1 The overlay of social, economic, and environmental & topographic indicators

As mentioned above, ten indicators were selected in terms of social, economic, environmental, and topographic factors. The choropleth maps of each indicator are attached in the appendices.

With respect to social aspects, four indicators were taken into consideration including commute time, household size, ageing, and population density. The research obtained the map of high value clustering points for each indicator through Getis-Ord-Gi* analysis. This study overlaid the above four indicators with their respective weights calculated by normalizing the Global Moran's I (Table 1). Table 1 outlines that the weights of commute time, household size, ageing, and population density are 34%, 16%, 22%, and 28%, respectively. The weighted overlay map of the four social indicators is shown as Figure 6. The

overlay choropleth map of social factor clearly shows that almost all the areas under Finch Avenue except the southwestern region have the higher priority of 6-8 to construct a transit station. On the other hand, the northern and western parts of the entire study area have the lower priority of 1-3 with less demand for public transportation from the social perspective.

Income level, unemployment rate, and occupational type were considered as the economic factor indicators. Similar to the social indicators, this study adopted the Getis-Ord-Gi* analysis to produce the map of high value clustering points for each indicator. This process overlaid the three indicators listed above with their respective weight calculated by normalizing the Global Moran's I (Table 2). The weights of income level, unemployment rate, and occupational type were calculated as 21%, 41%, and 38%, respectively. It is worth noting that income level contributes the least to the weighted overlay in comparison with the other two indicators. The weighted overlay map of the three economic indicators is depicted as Figure 6, from which the reader can observe that areas with higher priority for the construction of a transit station (7-10) form a U-shape across our study area.

From an environmental and topographical perspective, land cover type, air pollution level, and terrain relief were taken into account to evaluate the construction priority of transit stations. The research overlaid the above three indicators with their respective weights calculated by normalizing the Global Moran's I (Table 3). The weights of land cover type, air pollution level, and terrain relief are 36%, 21%, and 43%, respectively. The weighted overlay map of environmental and topographic indicators is demonstrated as Figure 8. Based on the overlay analysis, the research observes that more than half of the study area is suitable for the construction of a transit station with a relatively higher priority of 7-10. Figure 8 shows that north and east GTA are unsuitable for construction station due to a large area of ecological lands including different types of forested areas. On the contrary, the northwest of the study area is most suitable for construction of a transit station.

6.2 The choropleth maps of social, economic, environmental, and equal scenarios

This study proposed three scenarios to highlight social, economic, and environmental and topographic factors, as well as an equal scenario to make a compromise for the above three factors.

In the social scenario, the research hypothesized that Metrolinx considered social indicators the most important factor in the process of determining the priority of transit line construction. Thus, this study applied a 60 percent weight on social indicators and 20 percent on economic and environmental and topographic indicators. The choropleth map of this scenario is shown as Figure 9. This scenario retains most of the same characetristics observed from the weighted overlay map of social indicators (Figure 6). This is likely due to the dominant role of social indicators. In the study area, the CT's with the higher priority of 5 and 6 form an inverse U-shape. Meanwhile, Figure 9 shows that most CT's above Finch Avenue have a lower priority (1 and 2) for the construction of transit stations, indicating lower demand for public transportation from the social perspective.

If the stakeholders of the transit expansion project were interested in the CTs of the GTA that would have the most ridership potential mainly based on economic conditions, the set of economic indicators needed to be given the highest weight of 60%. The choropleth map of economic scenario is shown as Figure 10. It is not difficult to notice from Figure 10 that the CTs with the higher priority (6-8) form a

U-shape distribution, as indicated by Figure 7. Specifically, the CTs at the southwestern and northeastern corners demonstrate the greatest need of public transit with the highest priority of 8. On the contrary, the central and northern CTs of the GTA are not the areas with the high priority to construct a transit station from the economic perspective.

For the environmental scenario, the set of environmental and topographic indicators were weighted 60 percent. The choropleth map of the environmental scenario is shown as Figure 11. It inherits most of the characteristics from the overlay choropleth map of environmental and topographic indicators (Figure 8) as such factors greatly contribute to this scenario. However, it is apparent to notice that the most suitable areas are shrinking to few CT's, mainly distributing around the southwest GTA.

While each scenario leads to informed discussion of potential biases in the research, it should be noted that the best way to eliminate as much bias as possible is to weigh every indicator equally. To determine which areas are truly in need of improved transit stations, the research weighted each set of indicators equally to provide an equally representative presentation of data to interpret. As can be seen in Figure 12, there are small pockets of CT's in the highest priority (7) for transit options. These pockets of CT's are less spread out than anticipated when all inputs that went into creating the maps are considered. After examining the map, it is clear that in this case an equally weighted scenario allows for small-scale analysis and aids in determining which areas to focus on.

The clusters of CT's that exhibit the greatest need for more transit options are largely within the inner suburbs. These areas have, until recently, been automobile-oriented. Lower incomes in these CT's are resulting in lower automobile usage. As the economic scenario (Figure 10) presents, there is clearly a cluster of high priority neighbourhoods in the same area (west-central Toronto). Thus, it is possible that households in these areas cannot afford the cost of operating an automobile and therefore be forced to use poor transit options, or, must spend a high share of disposable income on an automobile. The same can be said for the environmental scenario. The same CT's are labeled as highest priority, which indicates high levels of pollution in that area. The high automobile usage of nearby 400-series highways and suburban roads may contribute to such indicators. The social scenario does not show a correlation between high priority ratings and the same areas. The equal scenario helps to remove any accidental over-weighting in the analysis and allows for the most accurate overview of CT's and if they need improved transit infrastructure.

6.3 The underserviced areas and newly proposed transit lines

To determine the underserviced areas within the study area, the research examined the above four scenarios and determined which scenario would be the best to use in the analysis. Of the above four scenarios, the only one that was omitted was the environmental scenario. When constructing a transit station, environmental and topographic indicators should be considered due to the destruction of the ecological environment. However, transit expansion should be based on demand rather than environmental and topographic indicators. Thus, only the social, economic, and equal scenario were to be analysed. Additionally, assigning greater importance to either the economic or social scenario than the equal scenario would not accurately examine the need for public transit expansion in the GTA. From this perspective, the equal scenario provided the least biased and most accurate representation of the city and its respective

CT's. In this section, the paper examined both the social and economic scenarios but mainly focused on the equal scenario.

The green CT's in Figure 13 represent the underserviced areas for the social scenario. The CT's highlighted in red tend to be in clusters; however there are also a few separate CT's that could be labeled as "outliers". This study did not use these 'outlier' CT's as it is not economically viable to construct new transit lines to isolated CT's, rather, emphasis was put on the clustering of high priority CT's.

The economic scenario created a much more modest grouping of CT's with the higher priority need for transit line construction. Similarly, the red CT's represent the underserviced areas in the economic scenario (Figure 14), which show signs of both clustering and scattering. Particularly, the results showed several CT's that are not labeled as the serviced areas despite the fact that they are close to the 50 percent coverage by the network service area of Metrolinx's "The Big Move" expansion transit lines.

With respect to the equal scenario, underserviced CT's concentrate on the west-central part of Toronto (Figure 15). The largest CT cluster is in between the Bloor line and Eglinton Crosstown line (soon to be completed). These CT's will be able to access the Eglinton Crosstown line when it is completed. However, they will still remain to be underserviced because more than half of the area is out of the 1200 m network service area zones. Metrolinx's "The Big Move" expansion plan was designed to increase transit accessibility for the residents of Toronto. Thus, it is a big problem that there will still be portions of the population who are underserviced by public transit even after the plan is complete.

To overcome the problem, this study proposed three new transit lines that would increase transit access to underserviced areas. It is important to keep in mind that proposed lines are hypothetical, thus should not be interpreted by their exact geographic location. Specifically, this study recommended transit lines based on the equal scenario as it treated the social, economic, environmental, and topographic factors equally, therefore providing a neutral perspective. As shown in Figure 16, this study recommended the Jane North line, New Scarborough line, and Pearson Express line.

1. Jane North line

As an extension of the Downtown Relief line, the Jane North line runs across the Eglinton Crosstown line and ends at the intersection of the Finch West LRT line and the Spadina SRT Expansion line. The Jane North line can benefit underserviced areas in west-central Toronto, and increase connectivity within the public transit system. The Jane North line also provides an alternate route to Pearson Airport by transferring from the Downtown Relief line.

2. New Scarborough line

The New Scarborough line is a minor adjustment to the current proposed Scarborough RT Replacement line, which runs across underserviced areas in Scarborough.

3. Pearson Express line

The Pearson Express line is an extension of the Eglinton Crosstown line to the Pearson Airport. In addition to providing public transit around underserviced areas in west-central Toronto, this line can make it more convenient to take transit to the Pearson Airport to and from downtown Toronto.

6.4 The construction sequence of Metrolinx's "The Big Move" expansion transit lines

As indicated in Figure 1, there are seven subway and advanced light rail lines within the framework of Metrolinx's "The Big Move" expansion transit plan. This study determined a new construction sequence based on the 2008 original expansion proposal Refer to Section 5.6 to understand the process taken in determining priority lines.

Phase 1. Eglinton Crosstown (13 high priority CT's)

Phase 2. Sheppard East LRT (5 high priority CT's)

Phase 3. Finch West LRT (3 high priority CT's)

Phase 4. Scarborough RT Replacement (2 high priority CT's)

Phase 5. Downtown Relief Line (1 high priority CT)

Phase 6. Spadina SRT Expansion (1 high priority CT)

Phase 7. Yong Extension (0 high priority CT's)

Nevertheless, it is unfeasible to change construction sequences for transit lines already under construction. Therefore, the Spadina SRT Expansion and Eglinton Crosstown line have been fixed to Phase 1 and 2 respectively. For 2014, this study's construction sequence is identical to the phases outlined by Metrolinx as shown below.

Phase 1. Spadina SRT Expansion

Phase 2. Eglinton Crosstown

Phase 2. Sheppard East LRT

Phase 3.Finch West LRT

Phase 4. Scarborough RT replacement

Phase 5. Yonge SRT Expansion

Phase 6. Downtown Relief Line

7. Conclusions

It is widely accepted public transit plays a crucial role in urban transportation, especially in a large city such as Toronto. With a main focus on the City of Toronto and Regional Municipality of York, this study evaluated "The Big Move" expansion plan by Metrolinx from the perspective of satisfying the demand of public transportation. This research chose ten indicators in terms of social, economic, and environment & topographic factors to identify the CT's in most need of transit expansion. In addition, this study created a social, economic, environment, and equal scenario to determine the underserviced areas of Metrolinx's "The Big Move" expansion plan. Based on the underserviced high priority areas of the equal scenario, this study proposed three new transit lines including the Jane North line, New Scarborough line, and Pearson Express line. Lastly, we recommended two adjusted sequences for the construction of the seven transit lines outlined in the Metrolinx expansion plan. Results demonstrated the Metrolinx's "The Big Move" expansion plan had the potential to improve if it could be redesigned in 2008. Meanwhile, the consistency of the altered sequence from 2014 and the construction phases outlined by Metrolinx verified the rationality and robustness of our analysis.

This study includes two major limitations: lack of up-to-date data and existing bias in current data. First of all, the most recent NHS and the Canadian Census were conducted in 2011 so our study was based mainly on data three years old. Also, the latest land cover and DEM data were collected in 2002, which are nine-year earlier before the other statistical data. Second, our results might be biased, as the NHS was voluntary leading to a non-response rate of up to 33%.

In the future, if time persisted this research would have like to take a closer look

at other forms of transportation within the Toronto Transit Commission's system such as bus routes. With more time and funding this paper may have been able to add additional indicators thus increasing accuracy and precision. This research has made connections with other studies such as Derrible and analyses have great potential to reveal much more about the current Toronto Transit Commission's system with proper funding and time.

References

Azar, K.T,, Ferreira Jr, J. & Wiggins. L. (1994). Using GIS tools to improve transit ridership on routes serving large employment centers: The Boston South End Medical Area case study. Computers, Environment and Urban Systems 18(3), 205–231.

Baseline Monitoring Report. (2013). The Big Move Baseline Monitoring Report. Toronto.

Briggs, D.J., Collins, S. Elliott, P., Fischer, P., Kingham, S., Lebret, E., Pryl, K., van Reeuwijk, H., Smallbone, K., & Van Der Veen. A. (1997). Mapping urban air pollution using GIS: a regression-based approach." International Journal of Geographical Information Science 11(7), 699-718.

Derrible, S.,& Kennedy, C. (2010). Evaluating, comparing, and improving metro networks. Transportation Research Record 2146 (1), 43–51.

Dittmar, H, & Ohland, G. (2003). The new transit town: Best practices in transit-oriented development.

Esri. (2013). How hot spot analysis: Getis-Ord Gi* (Spatial Statistics) works. ArcGIS Resources, 1–4.

Frank, L.D., & Pivo, G. (1994). Impacts of mixed use and density on utilization of three modes of travel: Single-occupant vehicle, transit, and walking. Transportation Research Record, 44–52.

Geertman, S.C.M., & Van Eck, J. R. (1995). GIS and models of accessibility potential: An application in planning. International Journal of Geographical Information Systems 9(1), 67–80.

Getis, A. & Ord, J. K. (1992). The analysis of spatial association by use of distance sta-

tistics. Geographic Analysis 24(3), 189–206.

Glaeser, E.L., Kahn, M.E., & Rappaport, J. (2008). Why do the poor live in cities? The role of public transportation. Journal of Urban Economics 63, 1–24.

Hakamies-Blomqvist, L. & Wahlström, B. (1998). Why do older drivers give up driving? Accident Analysis & Prevention 30(3), 305–312.

Jong, J.C. & Schonfeld, P. (2003). An evolutionary model for simultaneously optimizing three-dimensional highway alignments. Transportation Research Part B: Methodological 37, 107–128.

Jothimani, P. & Yamamura, E. (1997). Spatial changes in urban landuse and ecosystems arising due to subway network: A case study in Sapporo, Japan using Geographical Information Systems. The Japan Section of the Regional Science Association International 26(1), 247–255.

Kennedy, C.A. (2002). A comparison of the sustainability of public and private transportation systems: Study of the Greater Toronto Area. Transportation, 459–493.

Lakshmana R.K.M. (1996). Regional network planning and the development of rural transportation using remote sensing techniques. International Journal of Remote Sensing 17(17), 3453–3466.

Litman, T. (2005). Impacts of rail transit on the performance of a transportation system. Transportation Research Record 1930(1), 21–29.

Liu, S. & Xuan Zhu. (2004). An integrated GIS approach to accessibility analysis. Transactions in GIS 8(1), 45–62.

Metrolinx. (2007). Toronto-York Spadina subway extension (TYSSE). Toronto.

Metrolinx: Linking People to Places. (2008). Transforming transportation in the Greater Toronto and Hamilton Area. Toronto.

Mobility, Complete. (2010). Complete mobility in the Greater Toronto and Hamilton Area. Siemens Examining Complete Mobility Solutions.

Moran, Patrick. (1948). The interpretation of statistical maps. Journal of the Royal Statistical Society 10(2), 243–251.

Murray, A.T., Davis, R., Stimson, R.J., & Ferreira, L. (1998). Public transportation access. Transportation Research Part D: Transport and Environment 3(5), 319–328.

Prichard, J.R.S. (2010). On track : Moving transit forward in the GTHA.

Salsberg, L. (2014). Metrolinx Meeting. Manager of Strategic Policy and Planning, Senior Advisor, and Transportation Analyst, Metrolinx.

Schabas, M. (2005). Paying for crossrail: The business case. Economic Affairs 25(1), 12–19.

Schwanen, T. & Mokhtarian, P.L. (2005). What affects commute mode choice: Neighborhood physical structure or preferences toward neighborhoods? Journal of Transport Geography 13(1), 83–99.

Shah, Y., Manaugh,K., Badami, M., & El-Geneidy, A. (2013). Diagnosing Transportation. Transportation Research Record: Journal of the Transportation Research Board 2357(1), 1-12.

Siemiatycki, M. (2006). Implications of private-public partnerships on the development of urban public transit infrastruc-

ture. Journal of Planning and Education Research 26(2), 137–151.

Siemiatycki, M. (2007). What's the secret? Confidentiality in planning infrastructure using public/private partnerships. Journal of the American Planning Association 73(4), 388–403.

Upchurch, C., Kuby, M., Zoldak, M., & Barranda, A. (2004). Using GIS to generate mutually exclusive service areas linking travel on and off a network. Journal of Transport Geography 12(1), 23-33.

Wardman, M. (2004). Public transport values of time. Transport Policy 11(4), 363–377.

Woo, L. and Judy Knight. (2011). Union Station 2031 and related planning studies. Toronto.

Young, D. & Keil, R. (2009). Reconnecting the disconnected: The politics of infrastructure in the in-between city. Cities 27(2), 87–95.

Table 1. Global Moran's I and overlay weight of each social indicator

Social indicator	Global Moran's I	Equation	Overlay weight
Commute time	1.25	1.25 / (1.25+0.60+0.80+1.05)	34%
Household size	0.60	0.60 / (1.25+0.60+0.80+1.05)	16%
Ageing	0.80	0.80 / (1.25+0.60+0.80+1.05)	22%
Population density	1.05	1.05 / (1.25+0.60+0.80+1.05)	28%

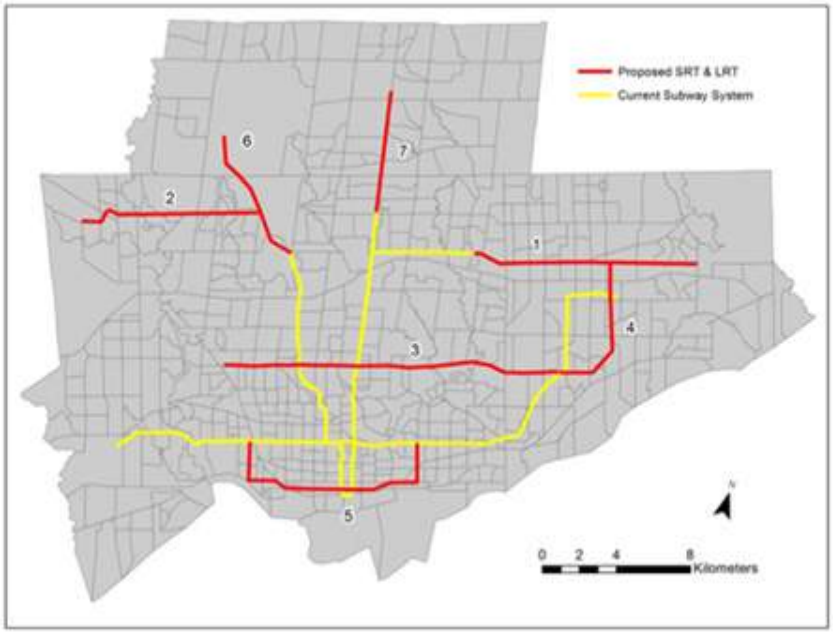


Figure 1. The study area of the City of Toronto and Regional Municipality of York region with the prospective lines in the Metrolinx's "The Big Move" expansion plan, including 1.Sheppard East LRT, 2.Finch West LRT, 3.Eglinton Crosstown LRT, 4.Scarborough RT, 5.Downtown Relief Line, 6.Spadina SRT, and 7.Yonge SRT

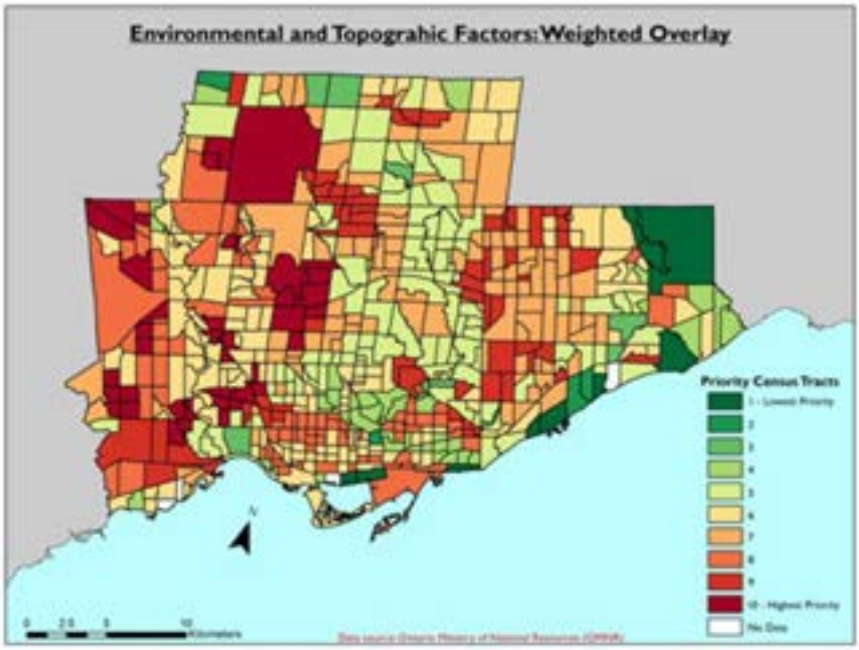


Figure 8. The overlay choropleth map of environmental and topographic indicators

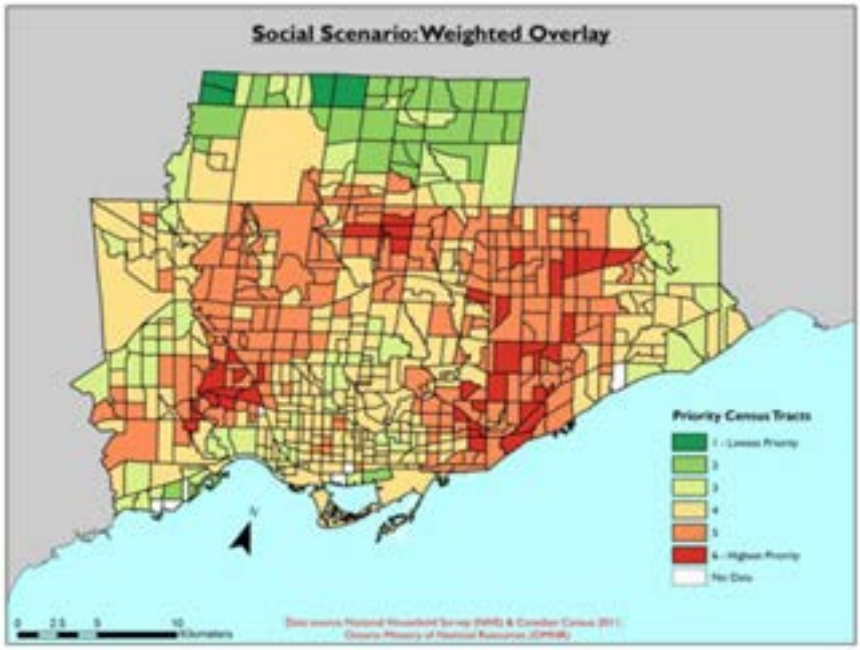


Figure 9. The choropleth map of social scenario

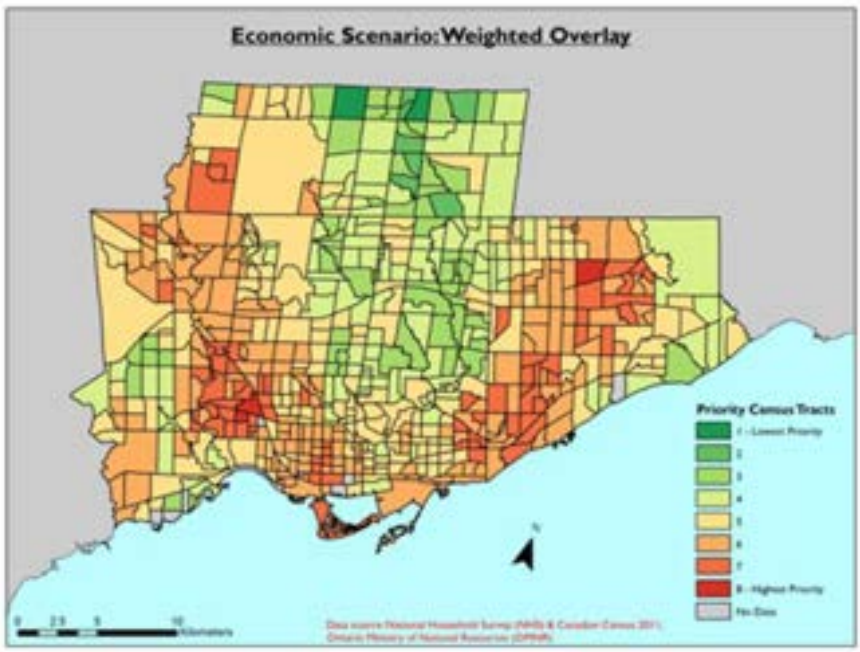


Figure 10. The choropleth map of economic scenario

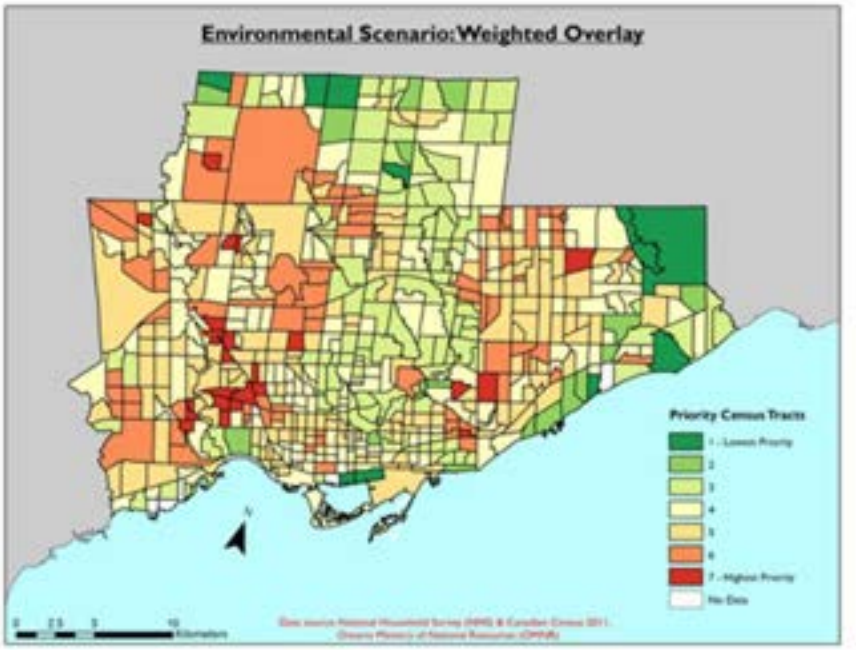


Figure 11. The choropleth map of environmental scenario

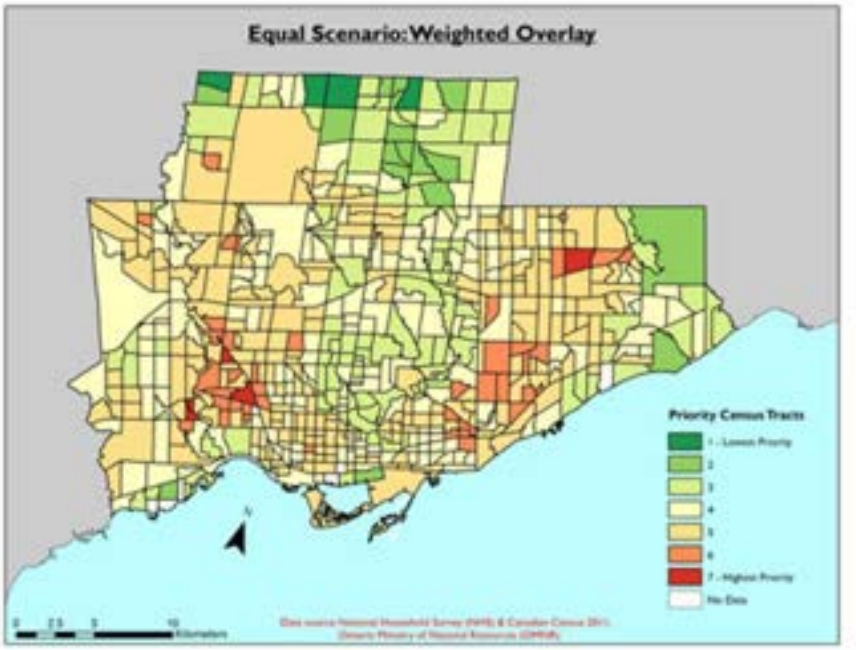


Figure 12. The choropleth map of equal scenario

Figure 13. The underserviced areas on the social scenario

Figure 14. The underserviced areas on the economic scenario

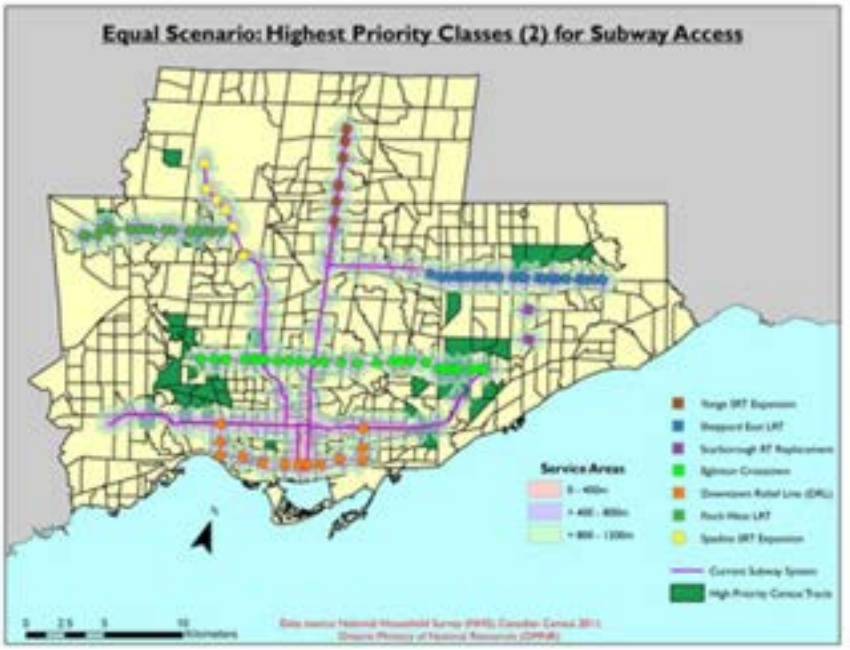


Figure 15. The underserviced areas on the equal scenario

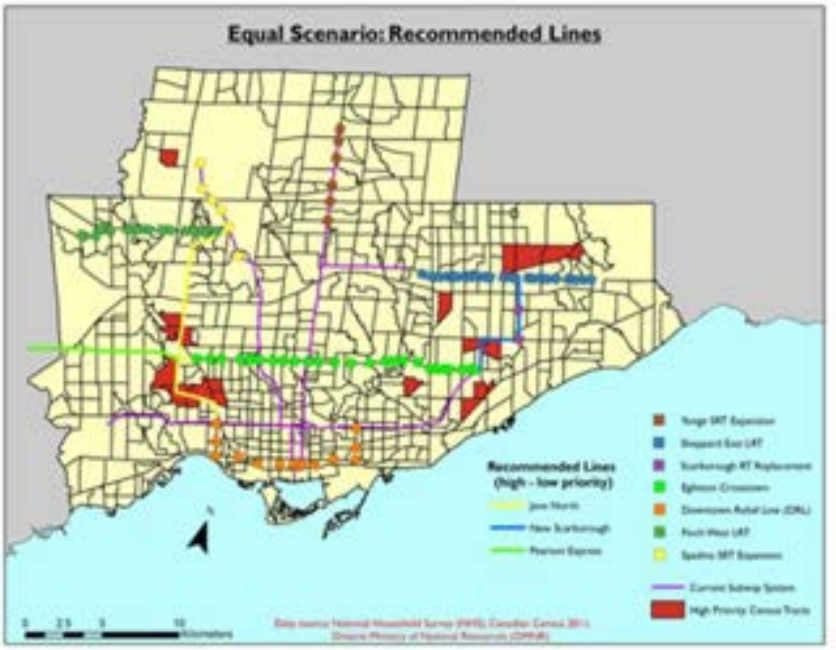


Figure 16. Three newly proposed three transit lines on the equal scenario

The role climate change has on carbon fluxes and ET using BEPS-Terrain Lab V2.0 modeling framework

Michael D. Di Febo

The study of regional climate change is critical in understanding how global warming will influence earth's system in the near future. Some estimate global climate change has been on the rise since 1979 with an average increase of 0.13°C to 0.22°C in the troposphere (Eystein et al. 2007). However, minimalists argue since 1880 average land and ocean surface temperature have only warmed by ~0.85°C (University Corporation for Atmospherc Research 2014). Prior to the industrial revolution in the 19th century, earth's air and sea temperature were relatively stable minimally fluctuating annually (Eystein et al. 2007). In this research a spatial modeling approach using BEPS-TerrainLab V2.0 was applied to evaluate the influence rises in minimum, maximum, and mean temperature have on carbon fluxes and evapotranspiration.

This study found an increase in temperature ranges from 5.0°C to 10.0 °C resulted in a fairly linear correlation of evapotranspiration from yearly averages of 0.587 to 0.880 to 1.126 mm/year. However, when gross primary production is modeled a non-linear correlation was formed. Yearly average values increased from 1.967 to 2.134 gC yet once ranges were increased to 10.0 °C, Gross Primary Product (GPP) values declined to 1.956 gC. Net primary productions model a downward non-linear trend as temperature is increased. Untreated yearly average values fell from 0.987 to 0.900 gC and continue to decrease to 0.991 gC/year. When net ecosystem production was modeled an exponential decrease was experienced. This dramatic change of Net Ecosystem Production (NEP) values from -0.07 to -0.249 to -0.610 gC/year coincide with a increase in temperature from 5.0 to 10.0°C, respectively. Finally increases in temperature present a relatively stable positive correlation as microbial respiration values increase from 1.057 to 1.150 and ultimately 1.271 gC/year.

It can be predicted an increase in temperature will cause an increase in photosynthesis and soil and organism respiration influencing all carbon fluxes and evapotranspiration.

1. Introduction

Global warming, the gradual increase of earth's surfaces and atmospheric overall temperature attributed to increased levels of CO2, chlorofluorocarbons, and other pollutants, is a global phenomena increasing steadily since the 1860's (Liu, 2014a; Oxford University Press, 2010). Over the past 100 years Canada's mean daily air temperature has dramatically fluctuated on a yearly basis, however a gradual upward long term trend is evident (Liu et al., 2002, Fig. 1). It is through the warming effects of greenhouse gases that, "there is very high confidence that daytime maximum and minimum temperature will increase," magnifying heat advisory days, and heat waves resulting in a lower number of frost days (WMO 2001, p. 1). Moreover, the recently released report by the Intergovernmental Panel on Climate Change (2014) under the UN outlines five main takeaways on the current situation surrounding global warming. Climate change is happening right now and is not a future hy-

pothetical, the impacts of climate change are currently damaging communities and ecosystems globally, the risks will become greater in the future, various regions of the world climate change will contribute to food instability, and finally climate change is destroying oceans (Field et al., 2014). As argued based on the above points, global warming will increase conflict over food and water, and may result in mass migration in the world as, "climate change has a tendency to act as a threat multiplier whatever the current rage of stressor is" (Field et al., 2014, p. 15–20).

1.1 Past studies of global warming

Temperature changes have influenced profound impacts on primary productivity and respiration in the natural ecosystem. Human induced warming has triggered a significant alternation in organism physiology, and the distribution of ecosystem function (Tait & Schiel 2013). While carbon fixation via primary productivity is essential for ecosystem functionality, secondary additions through the introduction of greenhouse gases has shown devastating increases in ecosystem carbon balances (Tait & Schiel 2013). When values of NPP, GPP, and respiration are compared, Tait and Schiel (2013) argue that global warming has created a negative relationship with NPP, resulting in rising temperature severely influencing respiration and altering GPP levels.

Cao and Woodward (1998) argue that rises in global carbon stock would increase net primary and ecosystem production. This study experimented with the doubling of atmospheric CO2 concentrations and corresponding climate. It was concluded that NPP levels would rise from 57.0 Gt C/year to 69.9 Gt C/year and NEP values would increase from 133 Gt C/year to 160 Gt C/year, respectively, ultimately confirming that, "climate change [will] result in a substantial increase in carbons stock in vegetation and soils," globally (Cao and Woodward 1998, p. 185).

Similar studies modelling CO2 emissions have investigated soil respiration in response to the global warming epidemic. Jenkinson, Adams and Wild (1991) found that a global temperature increase of a 0.03°C would result in an additional release of 61 × 1015 gC by soil respiration over the next 60 years. This addition of carbon is equivalent to ~19% of the global fossil fuel combustion for 60 years modelled at 1991 emission rates (Jenkinson, Adams, & Wild 1991).

Liu, Zhang, and Wan (2009) found that field experiments were idealistic when attempting to study the influence of temperature on soil and microbial respiration. Testing multiple times through the year for a semiarid Eco region in Northern China from 2005 – 2007, produced substantial results to model and measure Microbial Respiration (Rh) values. Liu, Zhang and Wan (2009) argue that precipitation was positively related to inter annual variations in Rh, soil respiration, and microbial biomass. However, when experimental warming was tested results concluded that warming caused a significant reduction in Rh, soil respiration, and microbial biomass. These observations suggest that a stronger negative effect influenced by warming is induced on the ecosystem, resulting in strain on soil water availability below the soils optimum threshold (Liu, Zhang, & Wan, 2009).

Krischbaum (2000) studied whether changes in soil organic carbon influenced by global warming would act as a positive or negative feedback on the environment. Warming was studied for both net primary production and the rate of soil decomposition. Laboratory based incubations, and field measurements estimated that warming would influence decomposition rates of organic carbon greater than NPP. Moreover both of these processes have greater temperature sensitivity and will

likely lead to an increase in both variables (Kirschbaum, 2000).

1.2 Research Objectives

The main purpose of this research is to study the influence global warming has on multiple outputs produced in BEPS-TerrainLab V2.0. Through the experimental computer simulated testing, conclusions will be made on whether or not global warming has a significant influence on photosynthesis and respiration.

2. Methods

Two scenarios were identified to be useful in testing climate change, one on a global scale and the other on regional. Original ET, GPP, NEP, and NEP models displaying variations in the Chibougamau watershed are shown in A1-4.

2.1 BEPS-TerrainLab V2.0 Applications and Description

BEPS-TerrainLab V2.0 (Boreal Ecosystem Productivity Simulator) was developed during the Boreal Ecosystem-Atmosphere study (BOREAS) in 1990 (NASA Earth Data - ORNL DAAC 2014). Its software was developed on the principles of the Forest BioChochemical Cycles model (Forest-BGC) (Liu et al., 1999). Its goal was to prove the understanding of responsive processes between the atmosphere and boreal forest to better understand their crucial roles in global warming. Canopy radiation, stomata dynamics, and ecological activities are modeled spatially using a simple parameterization model to present hydrological controls of multiple eco-physical processes (Govind et al. 2009). These eco-physical processes are used to simulate flux patterns of energy and mass through the ecological network in a contiguous pattern.

Version 2.0 was adapted from V1.0 to improve the basic hydro-ecological models mapped. Through the inadequate representation of boreal hydrologic ecological models, improvements were made to hydrological, eco-physical, and biogeochemical processes allowing for a better representation of the boreal ecosystem. (Govind et al., 2009)

2.2 Model 1: 5.0°C temperature increase

The initial scenario examined an increase of 5.0°C in minimum, maximum, and mean temperature. This was done to determine the influence of global warming on evapotranspiration, net primary production, net ecosystem production, gross primary production, and microbial respiration. This specific scenario will interpret the influence of an increase in temperature globally. This series of original data are shown in A5-8 displaying ET, GPP, NPP, and NEP, respectively.

Time series data collected from the Eastern Old Black Spruce (EOBS) tower on the Chibougamau watershed each column in excel coinciding with minimum, maximum, and mean temperature were selected. Then the equation was applied to alter the maximum, minimum, and mean temperature by 5.0°C. Lastly when BEPS TerrainLab V2.0 was run, the modified meteorological data was climate-interpolated.

2.3 Model 2: 10.0°C temperature increase

The second scenario examined an increase in minimum, maximum, and mean temperature of 10.0°C. This was done to determine the role global warming plays in evapotranspiration, net primary production, net ecosystem production, and gross primary production. While an increase of 10.0°C globally is unrealistic, an increase of 10.0°C is reasonable to study the influence of global warming on a regional scale. This series of treatment are shown in A9-12 displaying ET, GPP, NPP, and

NEP, respectively.

Time series data collected from the Eastern Old Black Spruce (EOBS) tower on the Chibougamau watershed each column in excel coinciding with minimum, maximum, and mean temperature were selected. Then the equation was applied to alter the maximum, minimum, and mean temperature by 10.0°C. Lastly when BEPS TerrainLab V2.0 was run, the modified meteorological data was climate-interpolated.

2.4 Study area

This modeled experiment was conducted across the Chibougamau, Quebec watershed, A22. The Eastern Old Black Spruce (EBOS) study area of the Fluxnet Canadian Carbon Program is located at 49.69°N latitude and 74.34°W longitude at an elevation of 400m (Coursolle, Stowe, and Giasson 2006, p. 8). The site is located on the Boreal Shield, with a soil classified as a silty sand texture resulting in a water table ~50cm deep past the ~15 - 40cm organic solid horizon. Predominate canopy vegetation for the site includes black spruce (Picea marina), and aspen (Populus tremulodes) with tamarack (Larix larandicina) distributed spatially. Shrubs and low laying vegetation include alder (Alnus crispa), sheep laurel (Kalmia angustifolia), and Labrador tea (Rhododendron groenlandicum) developing in the region's drier habitats (Coursolle, Stowe, and Giasson 2006, 8) The contrasting vegetation's can be classified into three categories:, wetland, coniferous, and mixed wood regions. According to Govind et al., (2009) this area has an annual mean temperature of 0°C and annual precipitation levels accumulate to 960mm.

It is important to note that carbon flux footprint levels are measured approximately 500m in all directions from the center of the site, with the exception in the SE direction where a radius of 350m is experienced due to the peat lands extent (Coursolle, Stowe, and Giasson 2006, p. 8).

3. Results and discussion

Five variables were studied to understand the influence of warming on the environment. Evapotranspiration, gross primary production, net primary production, net ecosystem production, and microbial respiration.

3.1 Evapotranspiration (ET)

Evapotranspiration of vegetation including, over story, understory, and moss layer, is the amount of water lost or transferred from land to the atmosphere. This value combines water loss by evaporation from vegetated surfaces, the soil, and transpired by plants. ET is computed using the Penman-Monteith method (Liu, 2014b; Oxford University Press, 2010):

$$E_{ti} = \frac{\Delta R_{ni} + \rho c_p \dfrac{e_s - e}{r_{ai}}}{\lambda_v \left(\Delta + \gamma\left(1 + \dfrac{r_{ci}}{r_{ai}}\right)\right)} \quad (1)$$

Where E*ti* is the amount of water lost through transpiration, R*ni* is the amount of net radiation, ρ is density of moist air, cρ is the specific heat of air, e*s* is the saturated water vapor pressure, e is the air water vapor pressure, r*ai* is the aerodynamic resistance, λv is the latent heat of water vaporization, Δ is the slope of the saturated vapor pressure, γ is the psychrometric constant, and r*ci* is the canopy resistance to vapor transport (Jing M Chen et al. 2005).

Table 1 and 2 display values associated

with temperature change and its influence on evapotranspiration. An upward trend is observed between temperature and ET. As a 5.0°C temperature increase is applied, ET increases from an annual average of 0.587 mm to 0.881 mm. This trend continued as temperature is increased to 10.0°C as evapotranspiration values rise to 1.125 mm. This fairly linear relationship is modeled in A14, where a constant upward trend or fairly linear relationship is experienced. Moreover, the steady increase in the mass of carbon is visually apparent in A12, as daily ET values are modeled. While minimal differences are noticed prior to day 100 and post 309, the in-between values show dramatic peaks that result in the upward trend.

Experimental testing over a period of three years also found that warming increased evapotranspiration values, this rise was attributed to reduced soil water availability suppressing plant growth, root and microbial activities (W. Liu, Zhang, and Wan 2009). As argued by Wentz et al., (2007) climate models have indicated that a surface warming of 1.0 Kelvin would result in a 7% increase in atmospheric water. Moreover, precipitation and atmospheric water have already been increasing at the same rate for the past 2 decades (Wentz et al. 2007). In addition, "biotic characteristics such as ... surface albedo and transpiration rates," will be effected by changes in soil temperature and soil moisture influencing ecosystem processes (Harte et al. 1995, p. 132).

3.2 Gross Primary Production (GPP)

Gross primary production is the total amount of CO2 fixed by vegetation through the chemical process of photosynthesis (Liu, 2014a):

$$GPP=NPP=Ra \quad (2)$$

Where NPP is the net primary production and Ra is autotrophic respiration.

Table 1 and 2 display values associated with temperature change and its influence on gross primary production. The original yearly average of GPP for the Chibougamau watershed is 1.968 gC. Once temperature is increased by 5.0°C, GPP levels rise to 2.135 gC/year. However, once temperature ranges increase by a value of 10.0°C an unforeseen yearly average is produced. GPP levels dropped to 1.956 gC, substantially lower than an increase of 5.0°C and slightly lower from the original reading. A16 models this sudden shift in GPP. Data between days 183 and 253 fluctuate dramatically modeling this sharp increase followed by decrease, A15.

The initial increase in temperature resulted in an upward shift in the amount of chemical energy produced influencing GPP. However, once temperature was increased to 10.0°C a downward change in the optimum temperature range for photosynthesis occurred (Raulier, Bernier, and Ung 2000). As the total amount of CO2 fixed by plants through photosynthesis increased the optimum level of temperature was passed, this slowed the production of chemical energy as biomass. A16 demonstrates a positive relationship prior to an increase of 5.0°C and a negative relationship post an increase of 10.0°C. Tait and Schiel (2013) also note that through laboratory experimenting GPP was severely influenced by rising temperatures. Primary producers use a portion of fixed energy created for cellular respiration while the remaining fixed energy, mass is modeled by GPP (Amthor & Baldocchi, 2001).

3.3 Net Primary Production (NPP)

Net primary production is the difference between the total amount of CO2 fixed by a plant through photosynthesis and the total amount of CO2 lost through autotrophic res-

piration (Jane Liu, 2014a):

$$NPP=GPP-Ra \quad (3)$$

Where GPP is the gross primary production and Ra is autotrophic respiration.

Table 1 and 2 display values associated with temperature change and its influence on net primary production. When no treatment was applied the yearly NPP average value measured 0.987 gC. However, once maximum, minimum, and mean temperature was increased by 5.0°C the yearly average mass of carbon reduced to 0.900 gC. Finally, once all temperature fields were increased by 10.0°C, a further downwards shift was noticed to 0.661 gC/year. Once daily NPP values were modeled, A17, observations were made on the dramatic shifts in values produced for both scenarios at the 5.0°C and 10.0°C changes. A18 illustrates the yearly averages of NPP associated with each temperature fluctuations. There is an initial moderate downward trend followed by a considerable downward shift. This downward trend can be explained by extreme temperature shifts made during the middle of the year, A17.

Carbon fixation through primary production is essential to ecosystem function. Shifts in the carbon flux created by temperature has the ability to alter carbon dioxide levels in an ecosystem (Tait & Schiel, 2013). These treatments made obvious that "rising temperature ... parameters showed a decline in NPP," moreover this relationship produces a considerable downward shift, A18 (Tait & Schiel, 2013, p. 1). This increase in temperature resulting in a downward change in NPP indicated that the rate at which plants in an ecosystem produce useful chemical energy is negatively effected. This fall in NPP slows the growth and reproduction of primary producers and limits the consumption of herbivores.

3.4 Net Ecosystem Production (NEP)

Net ecosystem production is the difference between the net primary production of a plant and the total amount of CO2 respired by soil microbes also termed heterotrophic respiration (Liu, 2014a, 2014b):

$$NEP=NPP-Rh \quad (4)$$

Where NPP is the net primary production and Rh is the total amount of heterotrophic respiration.

Table 1 and 2 display values associated with temperature change and its influence on net ecosystem production. The yearly NEP average associated with no treatment is -0.070 gC. However when a 5.0°C temperature increase was applied, NEP sharply decreased to -0.250 gC/year. Moreover, once temperature was further increased to 10.0°C an exponential correlation was produced. The annual NEP value dropped to -0.610 gC. A20, represents this downward exponential trend for NEP values based on x and y-scenario, respectively. Moreover, as observed in A19, the shading of color coincides with an increase in temperature, and the scatter plot representing NEP values for a 10.0°C are lower than those of a 5.0°C scenario and both of these are significantly lower than the original NEP values.

This exponential downward trend is attributed to the influence temperature has on heterotrophic respiration. Oberall, the influence temperature has on heterotrophic respiration refers to the increase in total amount of CO2 that is respired by soil microbes accredited to an increase in temperature. In response to climatic variations influencing plant photosynthesis, carbon allocation, little production, and soil organic CO2 decomposition Cao and Woodward (1998) sought to understand the role a rise in atmospheric CO2 had on carbon fluxes. Their model, which doubled CO2,

found that when total atmospheric CO2 values were increased by a factor of 2 a considerable increase in total NEP was noticed (Cao & Woodward, 1998).

3.5 Microbial Respiration (Rh)

Microbial respiration is the total amount of heterotrophic respiration, or the total amount of CO2 that is respired by soil microbes (Cao & Woodward, 1998; Liu 2014a, 2014b):

$$R_h = R_{10} f(\overline{T}) = R_{10} Q_{10}^{\frac{\overline{T}-10}{10}} \quad (5b)$$

Where R10 is the respiration rate at 10.0°C (Liu, 2014a). However, BEPS-TerrainLab V2.0 does not produce Rh values, hence the below equation was applied:

$$Rh=NPP-NEP \quad (5a)$$

Where NPP is the net primary production and NEP and the net ecosystem production. Microbial respiration is explained as the production of CO2 when soil organisms produce energy, typically in the form of oxygen intake and the discharge of CO2 from the oxidation of compound organic matter.

Table 1 and 2 display values associated with temperature change and its influence on Rh. Values for Rh were derived by subtracting NPP from NEP in Excel as BEPS-TerrainLab V2.0 does not produce Rh outputs. When an initial scenario of a 5.0°C temperature increase was applied, it was observed that the yearly average for Rh rose from 1.057 gC to 1.150 gC. Moreover when a 10.0°C treatment was applied representing a regional temperature change, the annual average rose to 1.27 gC. This considerably linear trend is modeled in A21 expressing a positive correlation. Moreover, when daily Rh was modeled, a gradual increase was experienced from no treatment to the first and second scenario, A20.

Warming has been shown to positively correlate with heterotrophic respiration. Through the intensifying of warming, the total amount of CO2 respired by soil microbes increases due to the oxidation of complex organic substances (Jane Liu 2014a). Moreover, studies in black spruce forests of Saskatchewan, Canada measured a positive correlation between increases in soil temperature and heterotrophic respiration (Chen et al. 2009, fig. 3). Furthermore Chen et al., (2009) argue that while a rising trend is evident, it is critical to observe that the influence of temperature on respiration is nonlinear, as this may cause considerable errors in respiration estimation.

4. Conclusions

It is widely accepted that global warming plays a crucial role in our current ecosystems. At the current rate of fossil fuel combustion it is only a matter of time before earth's sea levels begin to drastically raise devastating ecosystems and habitats. This study evaluated the influence global warming has on respiration and photosynthesis and whether these influences would dramatically alter the global carbon-flux and evapotranspiration values. In this study two experimental scenarios were tested. An initial scenario predicted a 5.0°C minimum, maximum, and mean temperature increase to represent a global temperature shift, while a second scenario predicted a 10.0°C minimum, maximum, and mean temperature increase to represent the influence of global warming on a regional scale. Results demonstrated that 5.0°C and 10.0°C temperature increases influenced all variables studied. While evapotranspiration and microbial respiration were influenced positively, gross primary production, net primary production, and net ecosystem production were

influenced negatively.

Had there been more time and funding allocated to this research, it would have been wise to incorporated ERDAS for models generating Microbial Respiration (Rh) as BEPS-TerrainLab V2.0 does not produce such outcomes. Rh values for this study were derived from NPP and NEP. Given the time frame of the research it would have complicated matters greatly if teaching myself ERDAS was attempted. This would have led to a better-rounded analysis but it could not be completed given the short timeframe. Future research into this subject may study a more complicated topic such has modeling carbon fluxes or meteorological data for the past century and projecting data for 2100. This paper's assumption is that findings from this research would be relatively similar as global warming is a definite global phenomenon, however it is inappropriate to conclude anything definitively.

References

Amthor, J. S., & Baldocchi, D. (2001). Terrestrial higher plant respiration and net primary production. In Roy, J. et al (Eds.) Terrestrial Global Productivity (33-59). Elsevier

Cao, M. & Woodward, I. (1998). Net Primary and ecosystem production and carbon stocks of terrestrial ecosystems and their responses to climate change. Global Change Biology 4(2), 185–198.

Chen, J. M., Huang, S. E,. Ju, W., Gaumont-Guay, D., & Black, T. (2009). Daily Heterotrophic respiration model considering the diurnal temperature variability in the soil. Journal of Geophysical Research 114(G1), G01022.

Chen, J. M., Chen, X., Ju, W., & Geng, X. (2005). Distributed hydrological model for mapping evapotranspiration using remote sensing inputs. Journal of Hydrology 305, 15–39.

Coursolle, C., Stowe, D., & Giasson, M. A. (2006). QC Flux Metadoc v3.

Eystein, J., Overpeck, J., Briffa, K. R., Joos, F., Olago, D., Peltier, W. R., Rahmstorf, S. et al. (2007). Coordinating Lead Authors: 1–37.

Field, C., Barros, V., Mastrandrea, M., Mach, K., Abdrado, M., Adger, N., Anokhin, Y., Arent, D., Barnett, J., & Burkett, V. (2014). Climate change 2014: Impacts, adaptation, and vulnerability (March): 1–44.

Govind, A., Chen, J. M., Margolis, H., Ju, W., Sonnentag, O., & Giasson, M. A. (2009). A spatially explicit hydro-ecological modeling framework (BEPS-TerrainLab V2.0): Model description and test in a Boreal ecosystem in Eastern North America.

Journal of Hydrology 367(3-4), 200–216.

Harte, J., Torn, M., Chang, F., Feifarek, B., Kingzig, A., Shaw, R., & Shen, K. (1995). Global warming and soil microclimate: Results from a meadow-warming experiment. Ecological Applications 5(1), 132–150.

Jenkinson, D., Adams, D., & Wild, A. (1991). Model estimates of CO2 emissions from soil in response to global warming. Nature 351, 304–306.

Kirschbaum, M. (2000). Will changes in soil organic carbon act as a positive or negative feedback on global warming ? Biogeochemistry 48, 21–51.

Liu, J, Chen, J. M., Cihlar, J., & Chen, W. (2002). Net primary productivity mapped for Canada at 1-Km Resolution. Global Ecology and Biogeography 11(2), 115–129.

Liu, J., Chen, M., Cihlar, J., & Chen, W. (1999). Net primary productivity distribution in the BOREAS Region from a process model using satellite and surface data. Journal of Geophysical Research 104(D22), 735–754.

Liu, J. (2014a). Class 7 The Global Carbon Cycle. Toronto: University of Toronto.

———. (2014b). Class 2 Shortwave and Longwave Radiation. Toronto: University of Toronto.

Liu, W., Zhang, Z., & Wan, S. (2009). Predominant role of water in regulating soil and microbial respiration and their responses to climate change in a semiarid grassland. Global Change Biology 15(1), 184–195.

NASA Earth Data - ORNL DAAC. 2014. BOREAS Project Page.

Oxford University Press. (2010). Dictionary. United States of America: New Oxford American Dictionary.

Raulier, F., Bernier, P., & Ung, C. H.. (2000). Modeling the influence of temperature on monthly gross primary productivity of sugar maple stands. Tree Physiology 20(5-6), 333–345. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12651449.

Tait, L., & Schiel, D. (2013). Impacts of temperature on primary productivity and respiration in naturally structured macroalgal assemblages. PLoS One 8(9), 1–10.

University Corporation for Atmospherc Research. 2014. How much has the global temperature risen in the last 100 years UCAR - University Corporation for Atmospheric Research.

Wentz, F. J., Ricciardulli, L., Hilburn, K., Mears, C., & Wentz, F. (2007). How much warming more bring? Rain Will Global 317(5835), 233–235.

WMO. (2001). 'Climate change 2001: Impacts, adaptation and vulnerability', the contribution of working group II to the IPCC Third assessment report. Intergovermental Panel on Climate Change.

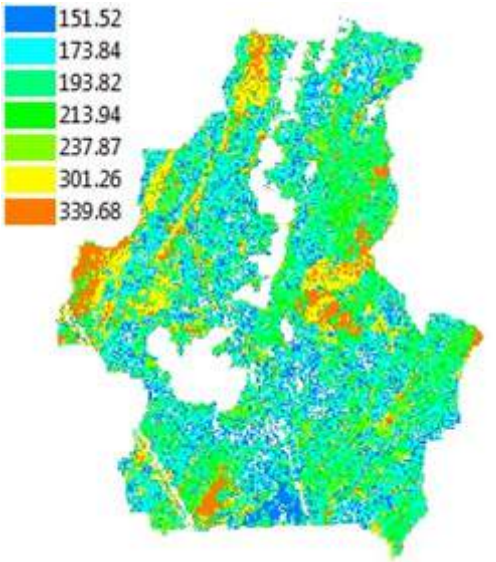
Table 1. Yearly Totals for ET, GPP, NPP, NEP, and Rh in mm/year and gC/year

Treatment	ET (mm/year)	GPP (gC/year)	NPP (gC/year)	NEP (gC/year)	Rh (gC/year)
Original	214.41	718.21	360.48	-25.52	386.00
+5.0°C	321.48	799.14	328.61	-91.13	419.74
+10°C	411.13	713.99	241.35	-222.73	464.08

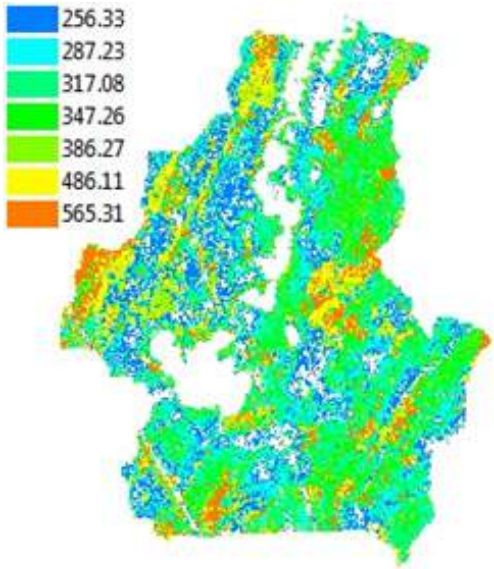
Table 2. Yearly Averages for ET, GPP, NPP, NEP, and Rh in mm/year and gC/year

Treatment	ET (mm/year)	GPP (gC/year)	NPP (gC/year)	NEP (gC/year)	Rh (gC/year)
Original	0.587	1.968	0.988	-0.070	1.058
+5.0°C	0.881	2.135	0.900	-0.250	1.150
+10°C	1.125	1.956	0.661	-0.610	1.271

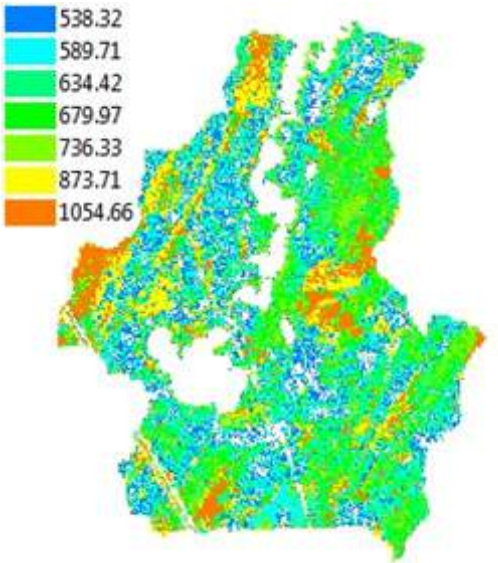
Appendix A



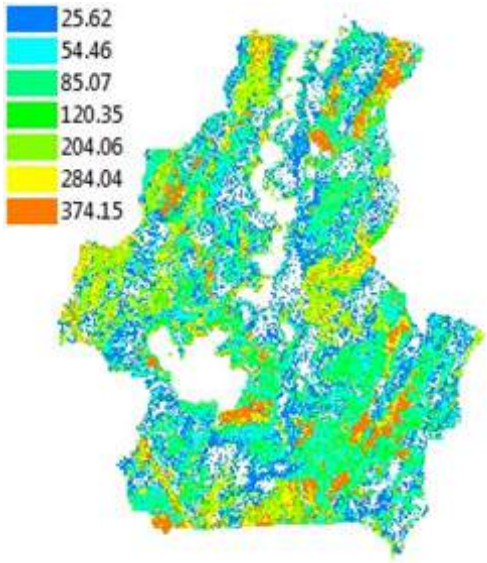
A1: Yearly Total of ET with no treatment



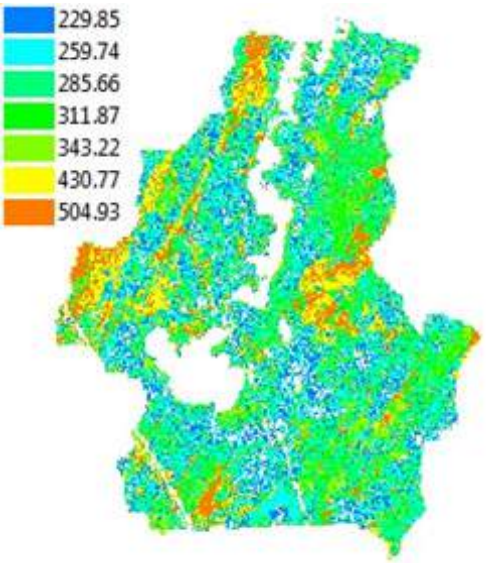
A3: Yearly Total of NPP with no treatment



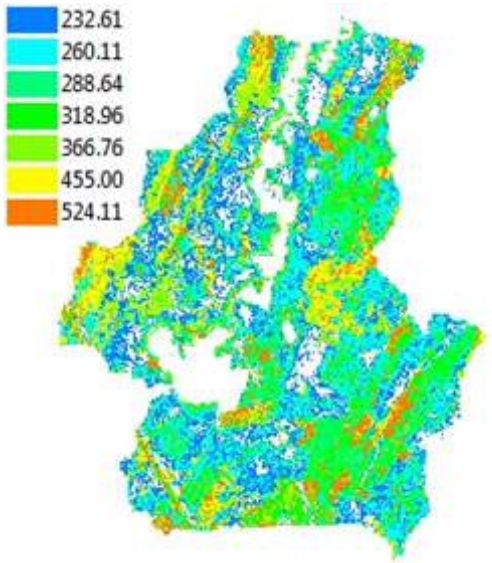
A2: Yearly Total of GPP with no treatment



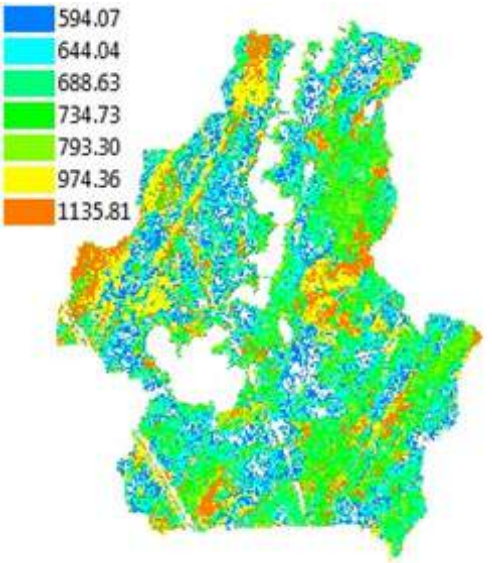
A4: Yearly Total of NEP with no treatment



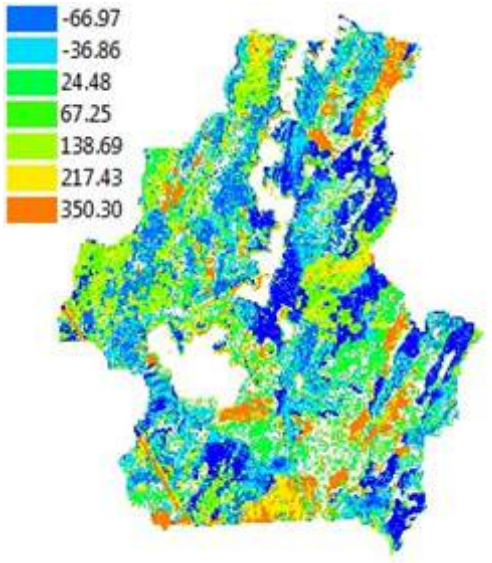
A5: Yearly Total of ET with a 5.0°C increase to maximum, minimum, and mean temperature



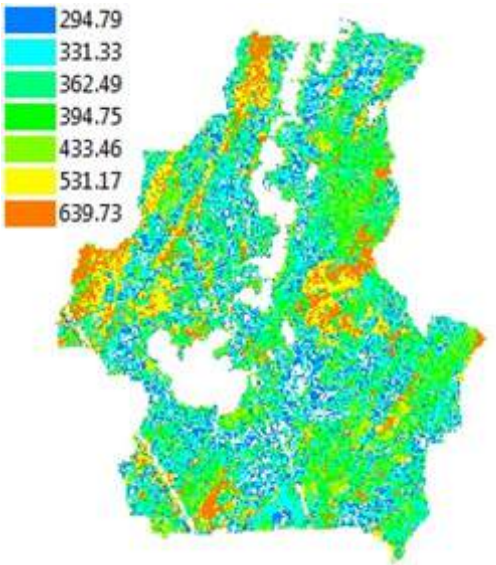
A7: Yearly Total of NPP with a 5.0°C increase to maximum, minimum, and mean temperature



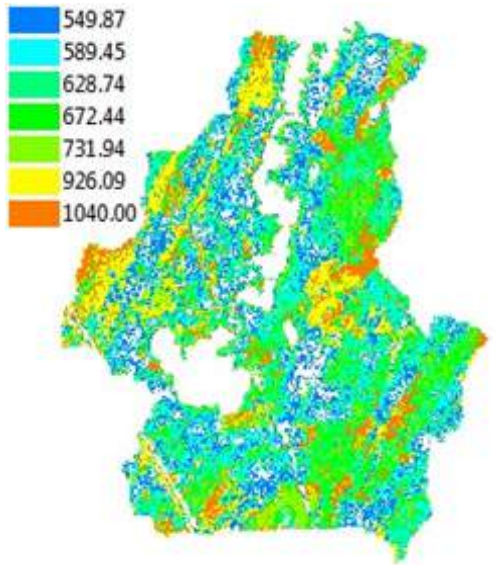
A6: Yearly Total of GPP with a 5.0°C increase to maximum, minimum, and mean temperature



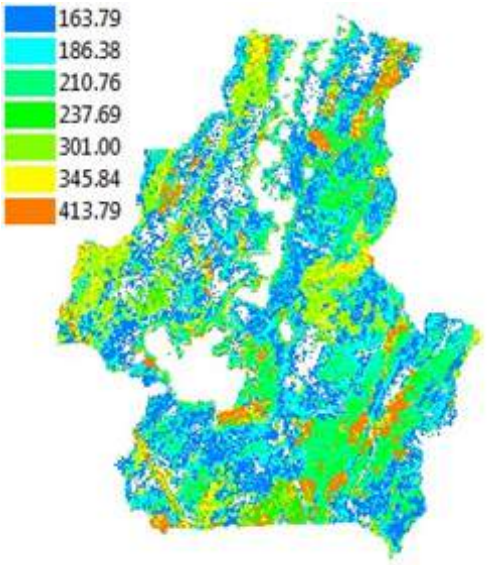
A8: Yearly Total of NEP with a 5.0°C increase to maximum, minimum, and mean temperature



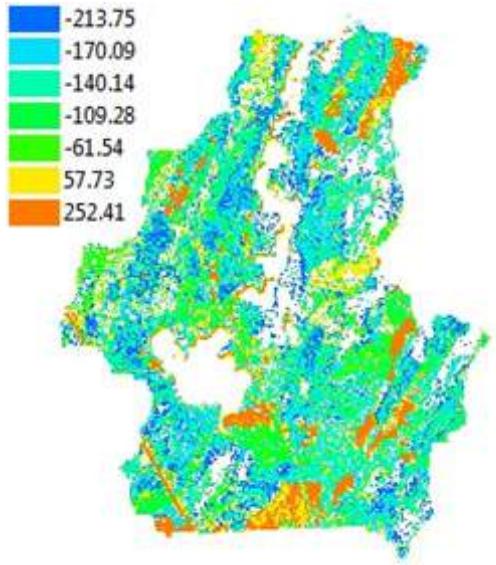
A9: Yearly Total of ET with a 10.0°C increase to maximum, minimum, and mean temperature



A10: Yearly Total of GPP with a 10.0°C increase to maximum, minimum, and mean temperature



A11: Yearly Total of NPP with a 10.0°C increase to maximum, minimum, and mean temperature



A12: Yearly Total of NEP with a 5.0°C increase to maximum, minimum, and mean temperature