Social contracts and community forestry: How can we design policies and tenure arrangements to generate local benefits in the forestry sector?

by

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Dipl. (Environmental Technology), Camosun College, 2002

Research Project Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Resource Management

in the
School of Resource and Environmental Management
Faculty of Environment

SIMON FRASER UNIVERSITY

Summer 2012

Approval

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Project No.: **542**

Degree: **Master of Resource Management**

Title of Project: ***Social contracts and community forestry: how can we design policies and tenure arrangements to generate local benefits in the forestry sector?***

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Abstract

I examine the forest tenure system in British Columbia and evaluate recent attempts to create community-based forest tenures in a broader context of industrial forestry. I focus on whether community forests provide more local benefits compared to various other industrial tenure arrangements, and assess how indicators of local benefits have been affected by major changes in policy instituted in the 2003 Forest Revitalization Plan. Results demonstrate that at a large regional scale, the policy changes were not a large perturbation to indicators of local benefits. Additionally, although community forests do not necessarily meet all expectations in every community, taken as a group, they performed equal to or better than other types of tenures as measured by indicators of local benefits. However, large variation among individual community forests is evident, highlighting the disparate strategies used by communities to promote local benefits and the influence of market forces in the forestry sector.

Keywords: community forestry, tenure arrangements, local benefits, trade-offs, fibre flow analysis

Acknowledgements

After nearly a decade out of school, I was hesitant about throwing myself back into the academic arena, but I can now look back on my experience in the School of Resource and Environmental Management as one of the most worthwhile and enjoyable pursuits of my life. Without question, the friends, colleagues, and teachers that I had an opportunity to share ideas with are responsible for my fond memories of the past few years. Most notably, my supervisors Dr. Ken Lertzman and Dr. Evelyn Pinkerton were instrumental in guiding me through the research process and took time to impart some of their vast wisdom on me.

I am also extremely grateful to everyone involved in the community forest project more broadly, including fellow graduate students David Mealiea, Lauren Rethoret, and Ashley Smith, as well as Dr. Murray Rutherford, Dr. John Welch, Dr. Ron Trosper, Dr. Thomas Maness, and Dr. Ajit Krishnaswamy. Additionally, the involvement of the British Columbia Community Forest Association added credibility and direction to our research. I would also like to thank the staff and board members of each community forest that we visited, as well the community members that participated in our interviews for being so generous with their time – without them this research would not be possible.

Funding through the Social Sciences and Humanities Research Council, the Chad Day Graduate Fellowship in Resource Management, the Simon Fraser University Graduate Fellowship, and the Jim Fulton Bursary helped make this project feasible.

I would also like to thank my parents, Jerry and Janet, who have always been a source of great encouragement throughout my life. Finally, the ultimate reason for my success over the past several years is due to the love and support from my wife, Valerye, and children, Jonas and Karina.

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List of Acronyms

BC	British Columbia
CFA	community forest agreement
FL	forest license
FRP	Forest Revitalization Plan
HBS	Harvest Billing System
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
TFL	tree farm license
TSL	timber sale license
WL	woodlot license

Introduction

There is an ongoing debate around the world about the most successful strategies for managing commonpool resources. To achieve sustainability, academics, governments and other actors have advocated various policies, including those focused on resource ownership and governance (Agrawal, 2001; Acheson, 2006). Private stakeholders, central governments, and communities have all been suggested as the most sustainable form of ownership, but an increasing body of evidence suggests that universal solutions cannot solve sustainability problems because there are numerous conditions that influence outcomes (Dietz et al., 2003; Ostrom et al., 2007). Although theory and practice are beginning to recognize that diversity, complexity, and multiple levels of interaction need to be accounted for in social-ecological systems, entrenched paradigms which don't reflect this are still all too pervasive in resource management (Holling & Meffe, 1996; Berkes, 2007).

In forest management in particular, one of the most contentious and divisive issues related to sustainability centers on benefits: what benefits are most important; who should receive benefits; and how should benefits be provided? These questions are especially salient in forest-based communities because, like many forms of resource extraction, timber harvesting affects ecosystem services and produces negative externalities at the local level (Glück, 2000). Thus various actors often recognize that a certain degree of local benefits should be directed towards communities in compensation for local impacts of resource management that largely direct economic

benefits elsewhere (Wunder, 2001). However, stakeholders often disagree about the best strategy to achieve goals focused on local benefits, particularly those related to distributional impacts and equity, which are critical to sustainability more broadly (McDermott, 2009; Dhakal and Masuda, 2009).

One mechanism used by governments to provide local benefits to forest-based communities is through broad top-down policies that place constraints on the flow of wood fibre from forestlands to manufacturing facilities (Pearse, 1976; Power, 2006). However, due to criticism by economists and industry stakeholders about such large-scale policies, alternative tenure arrangements focusing on communities are increasingly being put forth as a more effective way to foster local benefits from forest management (Bradshaw, 2003; Niquidet et al., 2007). One hypothesis postulates that community-based forest management of various forms – generally falling under the umbrella of "community forestry" – will have greater prospects for generating local benefits compared to central states or corporate stakeholders (see Pagdee et al., 2006 and Charnley & Poe, 2007 for a review of community forestry). Charnley & Poe (2007) identify some of the rationale underlying this view: communities can prioritize their own interests; locals can efficiently and effectively respond to their own needs; and community forestry can create a more equitable platform for developing local policy. However, although many insightful studies have examined how governance affects coarse–level ecological outcomes such as changes in forest cover or other attributes of forest condition (for example, Ostrom & Nagendra, 2006; Nagendra, 2007), the paucity of solid data about the relationship between forest ownership and indicators of human well-being is widely recognized (Agrawal et al., 2008; Bowler et al., 2012).

British Columbia (BC), Canada provides a revealing case study for investigating these types of questions because of changes in forest policy and tenure arrangements over the past decade, and because this province has undertaken the most substantial measures to implement a community forestry program of any jurisdiction in Canada or the United States (McCarthy, 2006). Further, BC is prominent at a global scale because it is one of the world's largest producers of wood products (UNECE/FAO, 2011), has significant areas of high conservation value forests (MacKinnon, 2003), and it has been at the center of many internationally focused environmental conflicts – the "war in the woods" (Hayter, 2003). BC is also distinct because of the degree to which forestry occurs on public land, as the BC government has jurisdiction over approximately 94% of the land area of the province and 95% of the forest land base (Haley & Nelson, 2007; BCMFML, 2010). In terms of developed countries, this makes BC an outlier internationally in terms of the retention of public control of forest land and, in principle, its ability to exercise direction over the degree to which local versus corporate values dominate the policy agenda. The lack of private ownership has contributed to BC adopting a tenure system focused on allocating rights to access the public forest resource, and policy about forest tenures has been a major instrument shaping the economic growth of the forest industry and the province as a whole (Pearse, 1976).

Forest tenures in BC are essentially leasing arrangements that confer rights and responsibilities associated with public forests to the private sector, in exchange for which the government receives payments through a stumpage system. Historically there were various policies that sought to ensure local benefits through a suite of social obligations which encumbered tenure holders. Such tenure conditions were framed as the "social contract" between tenure holders and communities and were manifest through various

policies including those which put spatial and temporal restrictions on the flow of wood fibre (Niquidet, 2008). In particular, to generate local employment there were often appurtenance clauses – more commonly know in BC as “appurtenancy” – associated with tenures, which stipulated that a proportion of all harvested timber must be supplied to a specific local mill: access to public timber was tied to a commitment to local milling jobs.

Appurtenancy and other policies linked to local benefits were changed in legislation associated with the Forest Revitalization Plan (FRP) in 2003, which attempted to make the forest industry more responsive to market forces. The goal of these changes was to appease the United States over the longstanding softwood lumber dispute as well as to allow timber to be distributed more efficiently throughout the province (see BCMF, 2003; Niquidet, 2008). The changes in the timber tenure system associated with this plan represent an enormous shift in the structure of the system, reflecting almost unprecedented changes in policy, particularly those related to local benefits (Nelson et al., 2006, Niquidet, 2008). These changes were, however, highly controversial, to the extent that many prominent actors involved in the forest sector proclaimed a “broken social contract” (Nelson et al., 2006). One of the biggest concerns was that small community-based mills would be rationalized and consolidated, resulting in logs being shipped out of communities instead of manufactured locally (Nelson et al., 2006). Although several excellent studies have examined the effects of the FRP changes (see Nelson et al., 2006; Niquidet et al., 2007; Niquidet, 2008) the extent to which fibre flow patterns actually changed in response to the FRP is not well documented in the literature.

Partly as a small compensation for the broken social contract, the FRP also included policy that re-allocated some harvesting rights to community forest agreement (CFA) tenures, a co-management arrangement originally legislated as a pilot project in 1998 (see McCarthy, 2006; Teitelbaum et al., 2006; and Pinkerton et al., 2008). As one interviewee from our research put it (qualitative methods discussed below):

> When you change something as fundamental as [appurtenancy]… and then all of a sudden you just pull the plug, and then all of a sudden at the same time you got the Softwood Lumber Agreement putting the pressure. I mean it was like a perfect storm to try and wipe out all the small communities in BC, and so you can see that [community forestry] is going to try and re-establish some kind of economic diversity in that area. I think community forestry from my personal perspective is the only good news that came along when appurtenancy was removed from tenure in B.C. That if you didn't have community forests starting up everywhere, you had a lot of ghost towns on your hands.

Needless to say, there were high expectations for the ability of CFAs to restore the social contract and enhance local benefits. For example, the goals of the overall CFA program, as well as that of many individual community forests relate to generating a suite of local benefits such as diversifying local economies, enhancing local employment, investing in community projects, and creating more value from the forest.

Despite the many assertions about the broken social contract and the subsequent expansion of community forestry, there is little evidence to indicate if either negative or positive consequences for patterns of fibre flow actually emerged from these policy changes or new tenures. I focused on examining these relationships by considering how policy and tenure arrangements affect indicators of local benefits in BC. Our research team conducted 75 interviews in 5 different communities and I evaluated fibre flow patterns via a large dataset of over 12,000 cutting permits representing over 300 million cubic meters of wood between 2000 and 2008. To my knowledge this is the

first such analysis of this kind of data and provides an empirical basis for debates in BC and elsewhere in the world that are frequently more conceptual or ideological in nature.

The assertions from our interviews and from the broader public discourse can be expressed as a series of working hypotheses about the relationships among local benefits, policy, and tenure arrangements. On the one hand, a neo-classical economic perspective might assert a null hypothesis of *no difference* in local benefits across policies or tenure arrangements because market forces ultimately drive forest sector outcomes. Alternatively, if, as many have stated, community forestry is positively associated with local benefits and the FRP is negatively associated with local benefits, then various of the following alternative hypotheses may hold:

1. To support local employment, community forest agreements are providing more locally based fibre flows than the major tenures.

2. To support economic diversification and maximize value, community forest agreements are supplying fibre to more mills than the major tenures.

3. Since the Forest Revitalization Plan, fibre is being shipped further distances from where it is harvested to where it is processed.

4. Since the Forest Revitalization Plan, fibre is being shipped to fewer mills.

Background and Methods

Tenure arrangements in British Columbia

Over a dozen types of forest tenures are legislated in BC, each with their own unique set of characteristics (BCMFR, 2006). Details of these tenures have been discussed in theoretical papers related to tenure reform (Haley 1985; Haley & Nelson, 2007) and studies examining the effect of tenure security on silviculture investment (Zhang & Pearse, 1996), forest management investment (Nautiyal & Rawat, 1987), and reforestation (Zhang & Pearse, 1995). Instead I focus on a tenure characteristic that has not been analyzed in great detail: the degree to which tenure holders are community-based (Table 1).

Currently, *community forest agreements* (CFAs) are the only form of tenure that explicitly requires that the holder be community-based, but these tenures account for less than 2% of the overall harvesting rights in BC (BCMFR, 2010). In contrast, 74% of the provincial harvesting rights are encompassed within just two industrial tenure types: *forest licenses* (FLs) and *tree farm licenses* (TFLs), often described as the "major" tenures (BCMFR, 2010). These licenses are mostly held by a relatively small number of multinational companies: 42% of the provincial harvesting rights, representing over 35,000,000 m^3 of cut a year are allocated to the ten largest operators (BCMFLM, 2010). Moreover, many of these operators have corporate linkages through larger parent companies (BCMFR, 2007), so some scholars estimate concentration to be as high as 93% if only longer-term renewable tenures are considered (Maness and Nelson, 2007).

Table 1. Selected attributes of tenure types used in study (Interior BC).

Tenure Type	Tenure Holder	Appurtenancy (prior to 2003)	Harvest 2008 (m^3)	Harvest 2008 (%)	Total licenses 2008	Average harvest 2008 (m^3/license)
Community Forest Agreement	Only community authorities	No	1,001,777	2	16	62,611
Woodlot License	Mostly local individuals	No	1,304,700	3	351	3,717
Tree Farm License	Mostly large companies	Most licenses	3,413,177	8	19	179,641
Forest License	Mostly large companies[1]	Most renewable licenses	27,793,795	63	238	116,781
Timber Sale License	Various	No[2]	8,255,349	19	460	17,946

[1]Forest licenses can be either renewable or non-renewable with larger companies generally being associated with renewable forest licenses.

[2]Although timber sale licenses prior to the Forest Revitalization Plan did not have appurtenancy clauses, certain timber sale licenses had appurtenancy-like characteristics under the Small Businesses Forest Enterprises Program, with bids being evaluated on criteria such as local manufacturing.

I have also considered two additional forms of tenure in this study – *woodlot licenses* (WL) and *timber sale licenses* (TSL) – even though they are not my primary focus. Woodlot licenses are relatively very small tenures, mostly held by local individuals and families because one of the criteria for being granted a license is the proximity of a licensee's primary residence to the forest land base (Cathro et al., 2007): though they are not formally community tenures, they are typically tenures held by community members. TSLs, in contrast, are larger, usually shorter-term tenures, administered by a Crown corporation of the provincial government named BC Timber Sales. TSLs are included in my study because certain types of these tenures had socio-economic conditions like TFLS and FLs prior to 2003 under the Small Business Forest Enterprise Program, but these were removed in legislation associated with the Forest Revitalization

Plan. Additionally, TSLs encompass roughly 18% of provincial harvesting rights (BCMFR, 2010) and function as a baseline for the market-based timber pricing system utilized in BC (Niquidet et al., 2007).

Fibre flow analysis

The movement of logs from the location of harvesting to the point of processing is referred to as a fibre flow. In BC, the Ministry of Forests, Lands and Natural Resource Operations (BCMFLNRO) monitors and maintains a database through the Harvest Billing System (HBS) of all trees harvested and scaled (measured and graded) on provincial, federal, and private lands. This information is used for a variety of strategic purposes such as tracking harvest rates and calculating government royalties. Therefore, effort is expended to ensure that these data are reasonably accurate. Thus this database is potentially of great value in analyzing patterns of fibre flow. One constraint of using the HBS to perform fibre flow analyses, however, is that the data only identify the *scaling* location, not the actual primary processing location of harvested timber. I assumed that the scaling location is a good proxy for the location of primary processing. The assumption that scaling occurs at or near the processing facility, however, is more valid in some areas than others. On BC's coast, for example, logs are often scaled, boomed, and then transported by water, sometimes over long distances, for processing, therefore invalidating this assumption. In contrast, the higher cost of ground transportation in the province's interior makes it more reasonable to assume that scaling location is a proxy for processing location for that portion of the province and, as a result, has been used in fibre flow analyses conducted by the provincial government (see http://www.for.gov.bc.ca/het/fibre.htm). Interviews with several scaling officers also

corroborated the validity of this assumption. I therefore confined my study area to the interior of BC (Figure 1).

Figure 1. ***Map of study area used in fibre flow analysis, as well as locations of community forests visited during field research.***

Indicator: How locally based are fibre flows?

Description of the indicator

The majority of BC forestry jobs are created through manufacturing and this is one kind of indicator of value which could be captured in local communities. Thus, I examine the degree to which fibre is retained for processing close to where it is harvested as an indicator of local employment in the forest products sector. My measure of this indicator is the distance which fibre moves from the location where it is cut to

where it is scaled: shorter distances should correlate with more value captured locally. The threshold for what constitutes meaningfully being "within a community" will differ depending on the local context and my indicator is unlikely to be sensitive to subtleties in this regard. However, on average, more local fibre flows should lead to greater local employment in mills.

Analysis of indicator

To estimate how fibre flow distance has changed over time for various tenures, I calculated the linear distance between the geographic coordinates of the harvest and scaling locations. I estimated the *harvest location* at the cutting authority level by calculating the central point of digital cutblock polygons using the mean center function in ArcGIS 9.0 (file: Forest Tenure Cutblock Polygons FTA 4.0, accessed from the British Columbia Land and Resource Data Warehouse at http://lrdw.ca). However, because the number and spatial distribution of cutblocks within a cutting authority can vary, the spatial area represented by a particular centroid varies. The BC Interior Appraisal Manual, however, requires all cutblocks within a cutting authority to be within an area no greater than 10 km (BCMFLNRO, 2011a), so my estimates consequently have this degree of spatial uncertainty associated with them.

No spatial data exist for individual *scaling locations* in BC, only a list updated by the BCMFLNRO that included an address, a land district lot designation, a town name, or some combination of these descriptions. Additionally, some scaling locations did not have any associated information that could be used to make a reasonable estimate of location, or were not confined to one specific site (for example, portable mills or scaling locations with general descriptions such as "District Manager"). I eliminated from further analysis harvest data for which spatial information on scaling site was missing or

unsuitable. After deductions, the proportion of total harvested volume in my study area that I used in this fibre flow analysis varied from year to year and rose from over 42% of the total volume in 2000 to roughly 87% in 2008.

I calculated geographic coordinates for town center, land district lot, and address descriptions using base map GIS files and online mapping sources. Overall, the level of accuracy associated with the different scaling location descriptions decreased in sequence from “address” to “land district lot” to “town,” and was, therefore, used in this priority if the list contained more than one description. To quantify the accuracy of town centers, which represent a large spatial area compared to specific addresses, which represent a much more precise location, a random sample of 30 scaling locations was chosen which included both of these descriptions. Of this sample, the average difference between the address coordinate and the town center coordinate was less than four km, suggesting that estimates that lack addresses or land district lot information are on average accurate within this distance. After compiling all geographic coordinates for the harvesting and scaling locations, I merged this information into a dataset based on the Harvest Billing System, so that every fibre flow datum had associated geographic coordinates. I then used the Great Circle Distance formula to calculate “as the crow flies” fibre flow distances.

I estimated the average fibre flow distance for each tenure type in each year by analysis of variance using the generalized linear mixed effects model function *lmer* in the statistical programming language R (version 2.10.1; lme4 package; www.r-project.org), with tenure type as the fixed effect and license as the random effect. This model allowed me to account for the non-independence of observations because individual licenses are nested within the broader tenure types. I also performed this analysis with *year* as one of

the random effects to estimate the effect of tenure averaged across all years. Because these distances represent fibre flows of different sizes, I weighted the distances by the volume of wood associated with each flow. I took the natural log of the dependent variable, distance, and then ran diagnostics to validate my model. I used the *pvals* function to estimate 95% Markov chain Monte Carlo (MCMC) generated credible intervals for each tenure type, and then back transformed the data to get associated distance values in kilometers. I compared whether the 95% credible intervals overlapped to determine statistical significance. It is important to note that different tenure types have different sample sizes because the number of licenses within each type varies considerably (Table 1). Additionally, the average volume of wood harvested per license varies by tenure type, with the major licenses generally harvesting more in a given year than CFAs, TSLs or WLs. In total, this analysis represents approximately 300 million cubic meters of wood throughout the study period.

Indicator: How diverse is the population of recipients receiving fibre flows?

Description of the indicator

The number of mills supplied with fibre per license is an indicator that reflects several local benefits. Maximizing the value of a forest's timber profile, for instance, will usually occur by sending wood to a variety of mills that manufacture different end products. In principle this allows specific targeting of various elements of the profile to their highest value destination, rather than sending everything to a single, commodity-based mill. Focusing on value and diversifying the forest products sector has been espoused for decades, but many commentators contend that the industry is still focused too much on maximizing volume and throughput in large regional mills (Barnes & Hayter, 1992; Kozak et al., 2003). However, certain areas of the operating land base are better

positioned to maximize value than others, depending on a number of different variables I discuss later. Sending wood to more mills will not maximize value in all situations, but on average, should be correlated with maximizing value. Moreover, as long as the advantages of sending wood to more mills is not negated by transportation or sorting costs – as I discuss later, these are indeed important costs – then maximizing value should also maximize profits for tenure holders. Unlike major tenures, however, which often distribute profits to external shareholders, profits generated by community forests are a particularly important local benefit because they act as the funds for myriad community investments. Last, the number of mills that are supplied with wood via diverse fibre flows also has obvious implications for economic diversification. I assume that if fibre is sold to two mills rather than one, for example, that the second mill is (a) offering a higher price for the same product because they are adding value or competing with the first mill, or (b) the second mill is accepting species or grades of wood that the first mill will not accept or pay sufficiently for.

Analysis of indicator

I examined the relationship between the type of tenure and the number of mills supplied with fibre by summing the number of scaling locations associated with each license in each year. There is an analytical trade-off in which metric to employ: the number of scaling locations per license or the number of scaling locations per volume of wood harvested. Using the former may bias against smaller tenures because they typically harvest less wood and, thus, have less volume to distribute. In contrast, using the latter may bias against large tenures because there may be a limited number of destinations to supply wood, limiting their performance in a destinations per unit volume

metric. I analyzed the data using both methods, but chose scale locations per license for my final statistical model because the bias was less pronounced.

I estimated the number of scaling locations for each tenure type by analysis of variance using the generalized linear model function *glm* in R. I used a Poisson error structure to account for the non-normal distribution associated with my count data, and ran diagnostics to validate my model. I then calculated 95% confidence intervals using the *confint* function and compared whether they overlapped to determine statistical significance. I also estimated the effect of tenure averaged across all years by analysis of variance using the generalized linear mixed effects function *lmer* with *tenure* as the fixed effect and *year* as the random effect. This analysis used 100% of the total harvested volume within my selected tenures, therefore representing over 430 million cubic meters of wood throughout the study period.

Was the Forest Revitalization Plan a perturbation to fibre flow patterns?

I performed the fibre flow analyses described above for the years 2000-2008, thereby capturing the perturbation represented by the policy changes in the 2003 Forest Revitalization Plan. Using this time series, I tested whether a significant change can be detected in fibre flow patterns in the years since this legislation was passed. Because the FRP was announced on March 26, 2003, and a draft framework was released two months prior in January, for explicit comparisons of the cumulative effect of the FRP I evaluated differences between 2002 and 2008.

Qualitative methods from field research

To provide a qualitative context to the fibre flow analysis, our interdisciplinary research team, which consisted of four graduate students and six faculty members from Simon Fraser University and the University of British Columbia, spent two weeks in five different Interior BC communities during the summer of 2009. Four to five members of the research team were present at each location. These five communities are all associated with community forestry – four of them as tenure holders of CFAs (Likely-Xats'ull Community Forest Ltd., McBride Community Forest Corporation, Harrop-Procter Community Cooperative, and Creston Valley Forest Corporation) and one as a tenure holder of a TFL (Revelstoke Community Forest Corporation). All of these tenures were located in the Southern Interior Region of BC, and were selected because of the ecological similarities of their land bases (predominately within the Interior Cedar-Hemlock and Engelman Spruce-Subalpine Fir Biogeoclimatic Zones; Meidinger and Pojar, 1991), the relatively small infestations of mountain pine beetle, and because these community forests were among the oldest in the province.

Within each community, we conducted semi-structured interviews with a diverse range of stakeholders from the community forests, government, major tenure holders, mills, loggers, non-governmental organizations, as well as the wider community. In total, we interviewed 75 participants, with each interview typically ranging from 1 to 2 hours in duration. Each interview was recorded, transcribed, and subsequently coded and analyzed to provide data related to my research questions. We also conducted site visits, reviewed documents in the community as well as the broader literature, and compared the qualitative data to my fibre flow analysis to verify and enhance the interpretation of that analysis. For more details about the study sites, the qualitative

methods used by our research team, and other results, refer to Rethoret (2010), Mealeia (2011), and Pinkerton & Benner (2012, under review).

Results

How locally based are fibre flows?

The mean fibre flow distance for CFAs was lower than other tenures in all years analyzed (Figure 2). Averaged across all years, fibre flow distances for CFAs were 56% of the fibre flows distance of FLs (95% MCMC credible intervals – or CIs – do not overlap, therefore statistically significant) and 66% of the fibre flow distance of TFLs (95% CIs do not overlap; CFAs: μ = 28.3 km, CIs: 17.8-36.9; FLs: μ = 50.0 km, CIs: 47.9-52.5; TFLs: μ = 42.8 km, CIs: 39.4-46.3). WLs are associated with the second shortest average fibre flow distance (μ = 34.7 km, CIs: 33.6-36.0), and TSLs with the longest average fibre flow distance (μ = 59.0 km, 57.9-60.0).

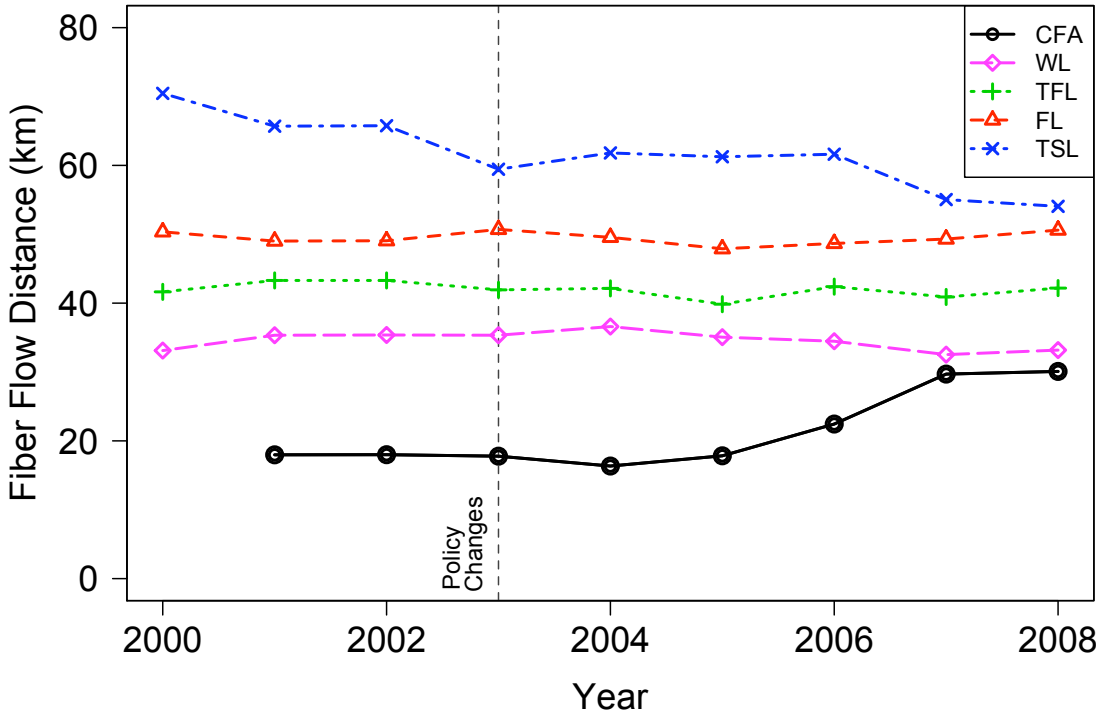

Figure 2. ***Estimates of the mean fibre flow distance per tenure type from 2000 to 2008 (CFA = community forest agreement; WL = woodlot license; TFL = tree farm license; FL = forest license; TSL = timber sale license). Of all tenures analyzed, fibre flows from CFAs travel the shortest distance from the forest lands to manufacturing facilities.***

Despite having results over multiple years, comparisons based solely on 2008 are, in some ways, the most appropriate: this year has the largest sample size of CFAs; the licenses are most representative across the study area; and the data used in the analysis encompass the largest proportion of the total harvest. However, the forest sector was experiencing a severe downturn during 2007 and 2008, so data from these years are not entirely representative of normal operating conditions. During 2008, the average fibre flow distance for CFAs was 59% of the fibre flow distance of FLs (95% CIs do not overlap) and 71% of TFLs (95% CIs overlap; CFAs: μ = 30.1 km, CIs: 22.8-43.3; FLs: μ = 50.6 km, CIs: 47.9-55.1; TFLs: μ = 42.2 km, CIs = 35.1-55.6; Figure 3).

Collectively, these results suggest that there is a meaningful difference between the fibre flow distance for CFAs and the major tenures.

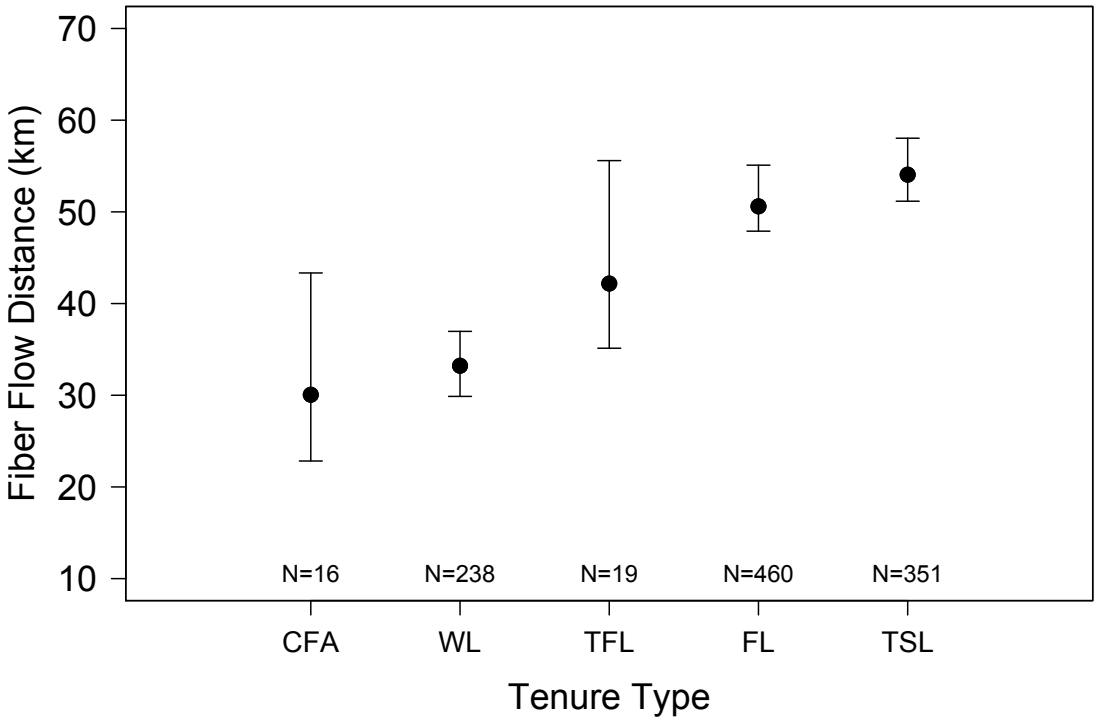

Figure 3. ***Estimates of the mean fibre flow distance per tenure type in 2008 (CFA = community forest agreement; WL = woodlot license; TFL = tree farm license; FL = forest license; TSL = timber sale license; error bars are +/- 95% credible intervals; N represents the number of licenses used in the analysis of each tenure type). Fibre flows from CFAs travel the shortest distance from the forest lands to mills.***

How diverse is the population of recipients receiving fibre flows?

The mean number of mills supplied with fibre by CFAs varied quite dramatically over the study period, and was generally less than the major tenures early in the study period and greater since 2004 (Figure 4). Averaged across all years, the number of fibre

recipients for CFAs were 125% of the number of fibre flow recipients of FLs (95% CIs do not overlap) and 81% of the number of fibre recipients of TFLs (95% CIs overlap; CFAs: μ = 5.4 mills/license, CIs: 4.6-6.4; FLs: μ = 4.3 mills/license, CIs: 4.1-4.6; TFLs: μ = 6.7 mills/license, CIs: 6.0-7.4). WLs and TSLs had the lowest number of average fibre flow recipients, but this is mostly because of the relatively small volumes of wood associated with these types of tenures (WLs: μ = 2.4, CIs: 2.3-2.5; TSLs: μ = 1.9, CIs: 1.8-2.0).

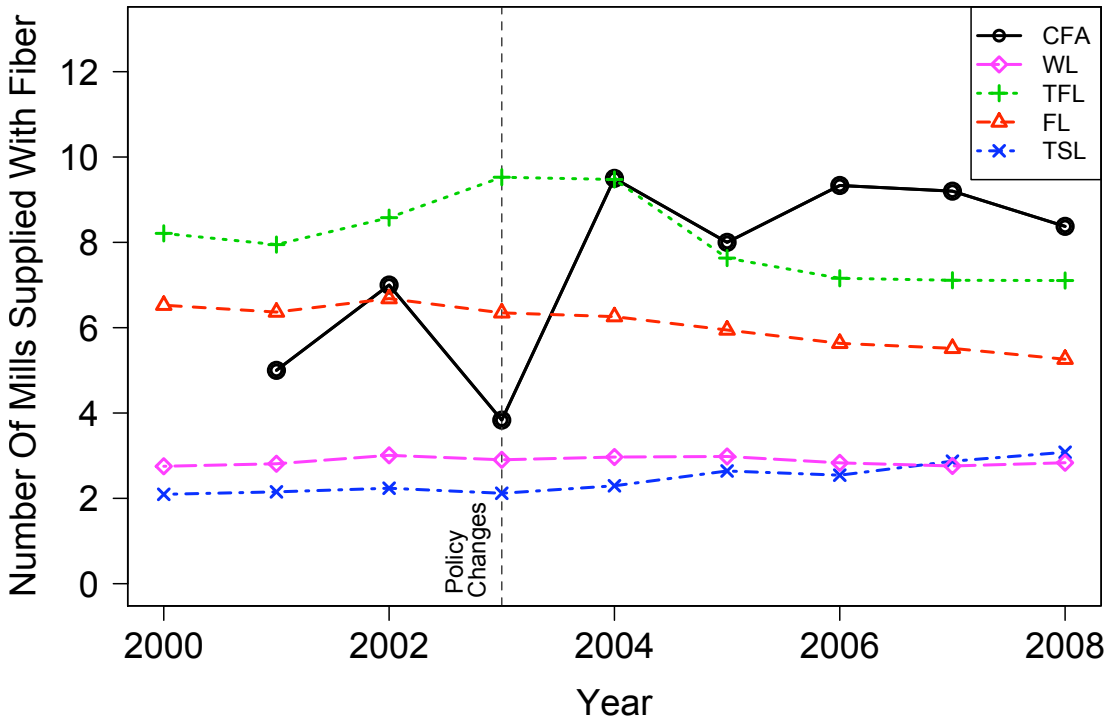

Figure 4. ***Estimates of the mean number of mills supplied with fibre per tenure type from 2000 to 2008 (CFA = community forest agreement; WL = woodlot license; TFL = tree farm license; FL = forest license; TSL = timber sale license). CFAs provide fibre to the most mills of any tenure from 2004 to 2008.***

For reasons outlined above, 2008 is the most appropriate year for making comparisons among tenure arrangements. In this year, the number of fibre recipients for

CFAs were 159% of the number of fibre recipients of FLs (95% CIs do not overlap) and 118% of the number of fibre recipients of TFLs (95% CIs overlap; CFAs: μ = 8.4 mills/license, CIs: 7.0-9.9; FLs: μ = 5.3 mills/license, CIs: 5.0-5.6; TFLs: μ = 7.1 mills/license, CIs: 6.0-8.4; Figure 4). For CFAs, the mean is heavily influenced upward by one licensee, which supplied the most mills with wood of any tenure in BC. Therefore, the median difference between CFAs and the major tenures is less pronounced.

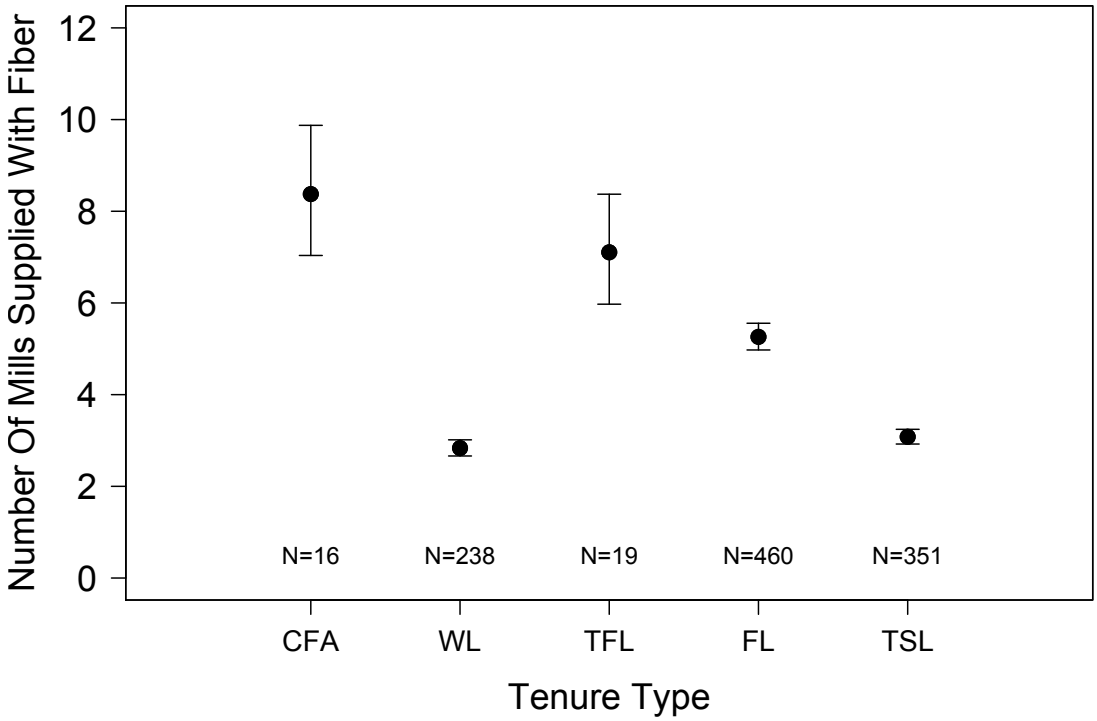

Figure 5. ***Estimates of the mean number of mills supplied with fibre per tenure type in 2008 (CFA = community forest agreement; WL = woodlot license; TFL = tree farm license; FL = forest license; TSL = timber sale license; error bars are +/- 95% confidence intervals; N represents the number of licenses used in the analysis of each tenure type). CFAs provide fibre to the most mills of any tenure.***

Was the Forest Revitalization Plan a perturbation to fibre flow patterns?

The 2000-2008 time series for fibre flow distances does not show a large perturbation following the 2003 policy changes (Figure 2; Figure 4). When averaged across all tenures in the interior BC, neither fibre flow distance nor fibre flow diversity display a significant difference between 2002 and 2008 (95% CIs overlap), and little fluctuation is evident within this period. For just the major tenures, the change in fibre flow distance was also negligible but the average number of mills supplied with fibre in 2008 was 79% of 2002 for FLs (95% CIs do not overlap), and 83% of 2002 for TFLs (95% CIs overlap). Of all tenures, CFAs had the largest aggregate changes in fibre flow patterns over the study period. But this change mostly stems from a few licensees, who consistently supplied the majority of their fibre locally but to relatively few mills, exerting less of an influence on the overall CFA mean as the program expanded and the number of licenses increased, instead of resulting from individual licensees drastically changing their behaviour.

Qualitative data from field research

During our fieldwork, interviewees identified many issues that potentially influenced fibre flow patterns (Table 2). Many interviewees felt that tenure arrangements, and in particular CFAs, have the ability to affect fibre flows and the resulting local benefits that are derived from forests. But in the case of CFAs, precisely how fibre flow patterns are altered by community decisions depends on the specific local benefit being emphasized. Both across and within communities there was large variability in the opinions expressed by stakeholders about the best strategy for generating local benefits,

and whether the focus should be on, for example, generating local employment via localized fibre flows or on maximizing community profits via diverse, often less localized, fibre flows. There was also mixed opinion regarding how well community forestry is fostering local benefits relative to the major industrial tenures more generally. The majority of interviewees felt that community forests were achieving some of their objectives about local benefits – sometimes by way of fibre flows and sometimes via other tactics – but others articulated their disappointment that a greater difference between the tenure types was not evident.

In part, the inability of CFAs to meet all interviewees' expectations about generating local benefits stems from the inherent trade-offs in decision making, but market forces and the realities on the ground for a particular land base also play an influential role in fibre flows. For instance, people claimed that a tenure's relative positioning in the forest products sector is important to outcomes, including the competition and diversity of markets in the area, the distance to these markets, and the ecological attributes of a particular land base. Finally, interviewees blamed a number of mill closures since 2003 on policy changes associated with the Forest Revitalization Plan and felt that fibre flow patterns had changed because of these restructurings.

Table 2. Factors identified by interviewees as influencing fibre flow patterns (strength of evidence and consistency of opinion indicated by number of asterisks: * = weak; ** = moderate; *** = strong)

Influence	Topic	Example quote from interviews	Effect on fibre flow distance	Effect on fibre flow diversity
Community Forestry***	Community objective to generate community funds	"Many people felt that the community forest should sell all logs to local mills. They were looking for deals, but we won't sell to them at below market value. The community forest doesn't subsidize businesses, which has made it viable."	Less Localized	More Diverse
Community Forestry***	Community objective to generate local employment	"It boils back into my belief that fiber shouldn't travel more than a hundred miles because it's their wood, it's their backyard, it's their watershed."	More Localized	Less Diverse
Market Forces***	Lack of markets and competition	"So if somebody offers you more money for a small amount of spruce and you sell to him, and [a major mill] finds out about it, good luck selling to them the next year."	N/A	Less Diverse
Market Forces**	Cost of supplying logs to mills	"The shipping costs have gone up so much that shipping to mills further out is just not happening any more."	More Localized	Less Diverse
Market Forces**	Ecological composition of land base	"A lot of the cut in the last few years has been low value wood, small diameter pine. I've seen a lot of value added attempts fail, and people get burned. In a more ideal situation, they would have been able to do more, and have more manufacturing locally, but the cost and capital of getting something started like that would probably have outweighed the benefit."	N/A	Less Diverse
Forest Revit. Plan***	Changes to forest products sector	"[The removal of appurtenancy] makes it easy for licensees to shut down mills and sell to the next mill down the road. They don't have to have the headache of keeping a mill going. There are lots of communities in BC where they just truck it up to 500 km away."	Less Localized	Less or More Diverse

Discussion

Local benefits through community forestry

Do community forests provide more local benefits than the major industrial tenures?

Alternative models of forest governance such as community forestry have created huge expectations about their ability to provide greater local benefits than could otherwise be accrued if corporate stakeholders or central governments were managing the forests (Charnley & Poe, 2007). In British Columbia, the Community Forest Agreement tenure has been heralded as a vehicle to generate community benefits, particularly in forest dependent regions of the province that have been adversely affected by a declining forestry sector (Ambus et al., 2007). My study demonstrates that community forests perform equally well or better than other forms of tenures for selected indicators of local benefits. For example, in 2008 CFAs supply wood that is 40-68% more locally based, and 18-59% more diverse in recipient compared to the major industrial tenures (FLs and TFLs, respectively).

Therefore, my first and second alternative hypotheses about community forests supporting more local employment, diversification, and value than the major tenures, as measured by the indicators above, has some support. But the null hypotheses cannot be rejected outright because not all quantitative comparisons were statistically significant, and many interviewees described the robust effect of market forces in the forestry

sector. The relative influence of market forces versus tenure arrangements is discussed in the next section below.

Although many stakeholders that we interviewed felt disappointed that community forests were not generating greater local benefits, my study shows that the CFA program on the whole is achieving some of its goals. Moreover, because tenure reform is a ubiquitous topic in forest sector debates throughout BC (BCMFR, 2009), more studies involving large multi-year datasets and interdisciplinary research methods, such as this research, need to be carried out so that decision makers have better information about the effect of re-allocating tenure. These decisions should, ideally, be based on the empirical effectiveness of policy alternatives, rather than unsupported political or ideological preferences. Finally, the findings from this research bring forth new empirical evidence about the relationship between forest governance and human well-being, an under-researched yet important body of literature related to sustainability (Charnley and Poe, 2007; Bowler, 2012).

Variability in fibre flow patterns arising from heterogeneous land bases and forest sectors

As with many studies about such complex topics, there is a degree of ambiguity in my results: some of the comparisons with the major tenures were not statistically significant in certain years, and some individual CFAs performed poorly in relation to indicators of local benefits. Therefore it is important to tease out these nuances across tenures and time. As I asserted as a null hypothesis, market forces are considered to be a key determinant of industry structures and outcomes, overwhelming the specifics of tenure arrangements. The variability within my fibre flow data coupled with numerous statements from our interviews reinforces the idea that such factors are indeed

important. For example, a common observation of our interviewees was that the price of logs relative to the cost of transportation often dictated fibre flow patterns, even when alternative strategies may have aligned more closely with a community's goal related to diversity of markets. Combined with such logistical barriers, the flexibility to distribute wood freely is also constrained by the commodity-focused, oligopolistic structure of the forest products sector in parts of BC's interior, which makes it difficult for tenure holders to access diverse markets (Pinkerton et al., 2008).

These barriers are partly responsible for the fibre flow patterns that emerged in certain areas of the province as well as the large degree of variability within both my quantitative data related to community forests and opinions expressed in interviews. But there are numerous other intertwined factors underlying this variability and here I identify several of the main drivers. First, my study area encompasses a vast geographic area and, consequently, communities can reside in distinct local and regional forest products sectors. A community that is adjacent to a regional milling hub with lots of manufacturers producing a variety of different products, for instance, will typically have different outcomes from a community that is isolated from markets, or a community located next to a single large mill. Second, forests across the interior of BC vary substantially in terms of their ecological composition and structure, which ultimately influences the marketing options and potential forest products that can be produced. For example, a community forest located in the Cariboo region of BC's interior, dominated by dying lodgepole pine, has less fibre flow options than a community forest in the Kootenay region, with its great diversity of tree species. Third, operational and marketing strategies can influence outcomes as some communities choose to sell the entire volume of wood from a cutting

permit to a single mill while other communities might allow individual loggers to market their own wood.

Variability in fibre flow patterns arising from heterogeneous strategies for generating local benefits

In addition to the influences listed above, variability in fibre flow outcomes are affected by the goals and specific local policies established by communities. Broad goals such as promoting economic diversification, generating local employment, maximizing timber value, and reinvesting money into the community are frequently mentioned in communities across the province. But when these goals need to be prioritized and decisions implemented on the ground, trajectories often bifurcate leading to different outcomes. The different paths taken by community forests in BC suggest that a particular mix of local benefits inherently contain trade-offs, as reflected in the correlation between my two main indicators: the degree to which fibre flows are locally-based and the number of manufacturing facilities supplied with fibre (Figure 5). Put differently, a community that wants to have all of its timber manufactured locally to support local employment may not be able to maximize timber value if the variety or capacity of local mills is limited. In contrast, communities endeavouring to maximize timber value and potentially re-invest money back into the community may need to market logs outside the community to achieve this, thereby decreasing opportunities for local manufacturing jobs.

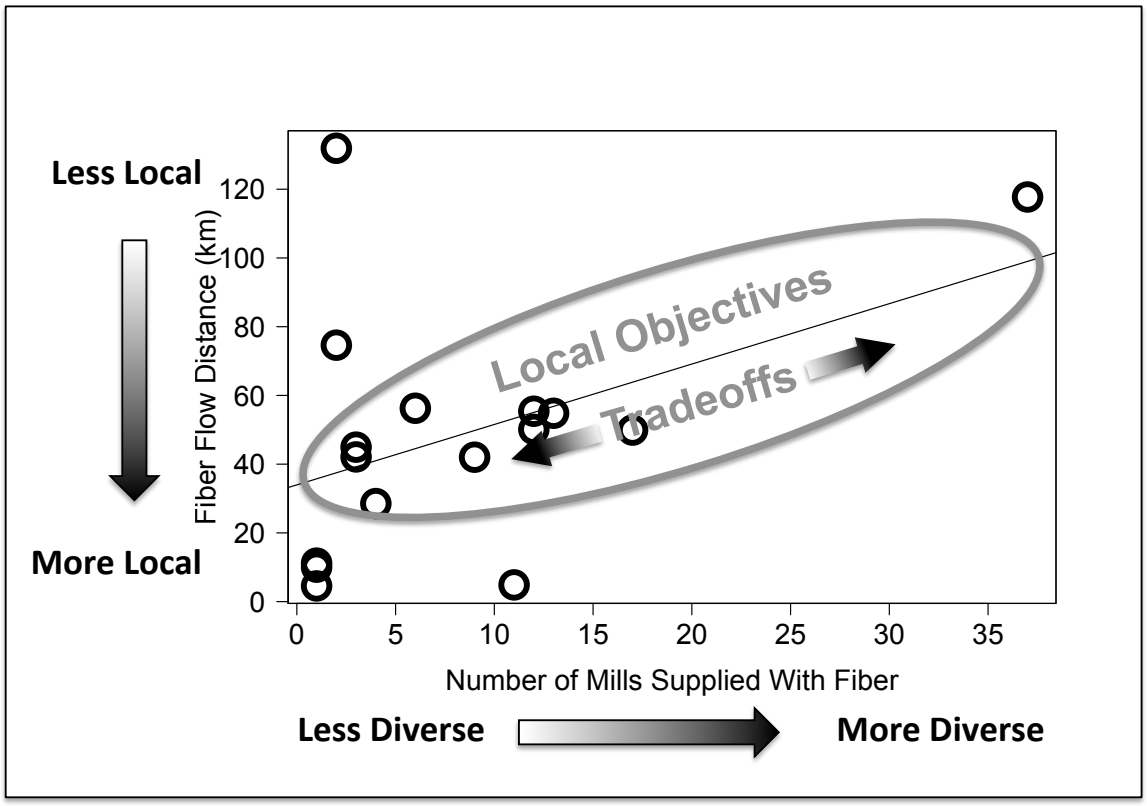

Figure 6. ***Regression of fibre flow distance (km) plotted against the number of mills supplied with fibre for individual community forest agreements in 2008 (R^2 = 0.20). Overall, these data display a large amount of variability among CFAs, but all points represent actual fibre flows. Most CFAs would probably prefer to have fibre flow patterns that would position them in the bottom right hand corner of the graph, meaning that they are maximizing local benefits by supplying wood to many different mills and also having all of their wood milled locally. This position is difficult to achieve because of the inherent structural trade-offs at a given community size: no licensees are actually in this corner. Instead, community forests tend to align on an axis emphasizing either local processing or diverse processing outlets. However, because BC's forest products sector is not homogenous, market forces combine with local constraints and opportunities to push certain community forests away from this regression line. As well, these local and regional factors influence which end of this spectrum poses a more realistic option for a particular community.***

Of the community forests visited in our field study, this trade-off played out differently depending on the local context, but ultimately was one of the most contentious topics in our interviews. In one particular community forest (identified as the top-right

point in Figure 4, which represents the least localized and most diverse fibre flows of any community forest in our study), these decisions were a major source of conflict. On the one side, interviewees made statements which reflect the principles inherent in appurtenancy: “we wouldn’t mind giving [logs] away for free here, to keep people going”, or “we need to keep this wood here... brokering wood to whomever is going to pay the most dollar for the best log should be out”. Conversely, others felt that the community forest should act in a manner consistent with free market capitalism so that maximum profits are available to reinvest back into the community. As one interviewee put it: “we’re here to make money and pave the streets”. Regardless of these disparate points of view, however, and the complexities involved in determining “the greatest good” as former U.S. Chief Forester Gifford Pinchot so famously stated, a large proportion of stakeholders that we interviewed thought that community forestry was the best way to manage these difficult decisions:

> If [the community forest] were going to export the wood out of the community, it would be a community decision, not big government or companies. They may want to export right out of the country, but at least its decided by the community. They may [alternatively] want to take less money and supply value added because it employs people. They can do that.

In the end, successful governance requires that rules evolve (Dietz et al., 2003), so, despite the conflicts mentioned above, community forests should be well positioned to deal with these contentious issues effectively because the scale of decision-making is amenable to differences both within and among communities as well as to changing public values and priorities.

Local benefits through “social contract” policies

Large-scale policies related to the movement of resources from the location of extraction to the point of processing have been key mechanisms used by governments to distribute benefits, be it at the scale of a community, a province / state, or a nation (Power, 2006; Sun et al., 2010). For instance, a high-profile debate around such an issue is currently being waged in western Canada regarding whether petroleum extracted from the Tar Sands in Alberta should be refined within the province or be allowed to travel unprocessed via the proposed, yet highly controversial, Keystone XL or Northern Gateway pipelines (see http://www.cbc.ca/news/business/story/2012/04/20/oil-refining-canada.html). Similarly within timber producing nations, many countries impose non-tariff trade barriers that restrict the amount of raw logs that can be exported, because they do not want to lose manufacturing jobs (Sun et al., 2010). At a more local scale, policies such as appurtenancy in British Columbia, which tied timber rights to the operation of a local mill, were directly responsible for the creation of numerous community mills that became the primary source of employment in many rural areas. With the elimination of appurtenancy from tenures, the emotions and assertions about this representing a broken social contract should, therefore, be no surprise. What may be more surprising, though, is that my analyses failed to show substantial changes to fibre flow patterns since the removal of appurtenancy. In other words, in contrast to many interviewee opinions or comments within the BC forest sector, wood in the interior of BC is not traveling, on average, significantly farther or to fewer mills since the Forest Revitalization Plan in 2003. My third and fourth alternative hypotheses, therefore, are not supported by my analyses of the fibre flow data.

Several factors might explain the lack of change associated with these fibre flow patterns after the removal of appurtenancy. To begin with, the quantitative results are partly a reflection of the scale of analysis, as province-wide trends can mask changes occurring at more local levels. For example, our interviewees identified many individual mills that closed down in communities after 2002, but the total number of medium and large size mills in BC's interior only decreased from 73 to 62, a 15% total reduction from 2002 to 2008 (BCMFLNRO, 2011). We must note, however, that 2008 was not the end of the downturn and a further nine medium / large size mills did not operate in 2009. Many more mills than this actually closed, but the creation of new mills elsewhere – typically larger facilities in regional centers, as indicated by total mill capacity actually increasing from 2002-2008 (BCMFLNRO, 2011) – compensated for these reductions when considered at a large regional scale. It is entirely reasonable, therefore, that interviewee statements based on local observations were not consistent with larger scale fibre flow trends, and that they reflect the real experience of local communities. Other factors which complicate and confound fibre flow trends between 2003 and 2008 include the large number of other policy changes during this period (for example, tenure re-allocation and the elimination of some tenure transfer restrictions; Nyquidet, 2008), the forest sector restructurings associated with the mountain pine beetle epidemic (Patriquin et al., 2007), and surging transportation costs which made more localized fibre flow strategies increasingly profitable. Adding to this complexity, is the fact that even though the removal of appurtenancy allowed community mills to close (potentially decreasing fibre flow diversity), it also provided tenure holders with greater flexibility to distribute their fibre throughout the province because fibre flows were no longer constrained to one particular mill (potentially increasing fibre flow diversity). In summary, the removal of appurtenancy does not seem to be associated with dramatic changes in

fibre flow patterns at a regional/provincial scale of analysis. It certainly changed fibre flows, but was just one of many factors influencing provincial fibre flow patterns over the study period. Despite this coarser scale result, this policy change did affect local fibre flow patterns quite dramatically in some areas, which consequently had dislocating impacts on individual communities.

Conclusion

This research demonstrates that community forests in BC, Canada perform well with regard to selected indicators of local benefits, as they are associated with fibre flow patterns that are generally more localized and diverse relative to other tenure arrangements. Perhaps not surprisingly, market forces and the realities of a particular land base's location within the forest sector also play an important role in fibre flow outcomes and a community's ability to generate specific local benefits, even in tenures or policies designed to achieve local objectives. Although market forces will always influence fibre flow patterns for tenure holders, it is possible that some of the challenges surrounding generating local benefits will persist until the forest products sector is more diversified. One potential way to achieve this goal is through tenure reform policies which promote greater diversity in the forest tenure system and substantially increase the allocation of public forest land to communities and other small tenures.

Despite these broad results about tenure arrangements and policies, the variability within my quantitative data as well as the often conflicting statements from our interviewees indicate that there is no panacea that will provide all of the local benefits that communities want in all situations because of the inherent trade-offs among different objectives, as well as the heterogeneity of values across and within these communities. Although these differences are not always evident from looking at goals in forest management plans, they are often revealed by outcomes on the ground, indicating that real world decisions require trade-offs that will resolve differently depending on the local

context. These conclusions reflect research showing the high degree of diversity and complexity within social and ecological systems (Liu et al., 2007), and echo the following summary by Acheson (2006):

> To manage resources effectively, we will have to be quite imaginative. We will need to combine various elements of privatization, government control, local control, and managerial techniques in ways we have not imagined could be done. The exact combination used will have to vary with the specific resource and place.

Therefore, if community forestry is going to be considered legitimate and equitable, and will make a distinct contribution to "localizing" the benefits of forestry, the strategies used to generate local benefits must reflect the goals of the community through transparent and democratic processes. To ameliorate future conflict in these communities, it is critical for strategic planning in social, economic, and ecological dimensions be developed proactively instead of in reaction to disputes in the community. Finally, if successfully providing local benefits is determined by negotiating trade-offs and finding a balance that is appropriate for individual communities, then people actually living within these communities are probably in the best position to determine these strategies. So although community forests will not "solve sustainability" and are not a blueprint solution for providing local benefits, the decisions filtered through this tenure arrangement likely reflects the desires of specific communities better than broad top-down policies or forest management by companies based outside the community. In other words, even if community forests do not necessarily always generate *more* local benefits, they should generate *more suitable* and socially acceptable local benefits.

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