



INTEGRATED LAND MANAGEMENT OF LOW CAPABILITY PUBLIC LAND IN THE
CARIBOO-CHILCOTIN

LWS 548 Major Project

By

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Executive Summary

Increasingly, expectations of social, economic, and environmentally conscious solutions are at the forefront of land management discussions. The reality is that conventional segregated approaches are unable to address all opposing resource user's concerns adequately. Integrated land management, a landscape approach, seeks to rectify this divergence and attempts to accommodate the value and aspiration of all stakeholders into a biophysical public land-use plan. In the Cariboo Regional District of British Columbia, such an attempt occurred, albeit unsuccessfully, increasing tension and distrust between resource users. The potential benefits of such processes are comprehensible in the literature but would realistically require more equitable and sensitive strategies in practice. Simultaneously, a sound scientific foundation is necessary to advocate for environmentally sound practices. On public lands, there is a practical opportunity to harmonize cultural values with ecological protection and development through public lands grazing, especially on landscapes of marginal quality, as the opportunity costs remain low.

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Introduction

Formidable challenges face agricultural production worldwide; while food demand increases, inequity and poverty affect its safety and availability, climate change alters the industry, land clearing accelerates greenhouse gas emissions, and polluting practices put pressure on the available land base. Breakthroughs in agriculture efficiency and technology throughout the 1950s and 1960s were able to meet a rapidly expanding world population's food requirements (Pimentel, 1996; Tilman, 1999). Despite the world population no longer exponentially increasing, food demand continues to climb as developing countries shift towards resource-intensive, protein dominant diets under new purchasing power while developed nations exemplify overconsumption (Popkin, 1998; Godfray et al., 2010). Once again, agriculture production must expand to meet these demands. Debate surrounds the solution to this expansion as land clearing for agriculture releases greenhouse gases and reduces biodiversity; yet, the idea of intensification is often colloquially attributed to industrial environmentally destructive practices.

While agriculture continues to demand more resources, environmental protection is increasingly critical for ecosystem service provision. Acknowledgement grows that it is the totality of the landscape functioning which provides this. Synchronously, allocating land uses is difficult to decouple from societal demands; a landscape needs to be multifunctional to meet food production demands, improve livelihoods, and maintain ecosystem integrity simultaneously. There are numerous definitions of what a landscape is. A landscape may be a conceptual idea referring to the interactive influence of history; others refer to it as simply a biophysical space (Sayer et al., 2013; O'Farrell & Anderson, 2010). This elusive definition makes defining the landscape approach even more challenging; one of the only agreements in the literature is the lack of a single normative description (Reed et al., 2016). Generally, the landscape approach in this paper refers to the various approaches aimed at integrating policy and practice for multiple competing land uses through the implementation of adaptive and integrated management systems (Sayer et al., 2013; Reed et al., 2016). Creative, socially conscious, and transdisciplinary solutions to public lands management are necessary to achieve this rather than sectorial approaches. Multiple theories under the umbrella of the landscape approach attempt to reconcile these opposing demands; there are both integrated land management and

“ecoagriculture” landscapes, or working lands for conservation (Scherr & McNeely, 2008; Sayer et al., 2013). Integrated land management allows for the consideration of diverging objectives and values of public lands and seeks to find a consensus of stakeholders before planning and eventual practice (Sayer et al., 2013; Duff et al., 2009). ‘Ecoagriculture’ landscapes (Scherr & McNeely, 2008), or working lands for conservation, also combine the goals of natural landscape protection with sustained production and livelihood consideration by suggesting biodiversity conservation can occur on agriculturally productive landscapes. These processes create opportunities for an area's biophysical plans to reflect its unique valuation and qualities. This paper will argue that the landscape approach can improve resource use of marginal quality public lands. This idea sits at the continuum of concepts, that consensus-based decision-making is imperative for meaningful solutions- but science-based consideration for marginal land is critical as the backdrop to this. Strong environmental values and policy as a backbone to the landscape approach allow for the unity of stakeholder values, while still maintaining ecologically sound best practices for the specific location.

The distinction between private and public lands is valuable, the idea of accommodation cannot carry between the two as what may be optimal for a single producer on their land may not benefit society at large, and vice versa, making this discussion more relevant for public lands where many viewpoints come in to play. For a further discussion of private land resource management, the relevancy of positive incentives for action comes to mind and through adequate policy, these may eventually become a commonplace practice. This report focuses on public land due to its potential for large-scale resource management, but certainly, appropriate private land management is also necessary and should not be ignored. Ranching operations especially engage both private and public land, showcasing the potential for resource opportunities and user conflicts.

An example of a region that has performed an integrated land management process and exemplifies working lands for conservation is the Cariboo Chilcotin Region of British Columbia (BC). A unique area, the Cariboo-Chilcotin has a high proportion of poorly drained soils compared to the rest of the province, many of which are organic soils formed under historic wetland conditions (British Columbia Ministry of Agriculture & Cariboo Poorly Drained Soils Development Extension Committee, 1992). The combination of poorly draining soils and dry cold climate (Annas et al., 1979) make the Cariboo Regional District's portion of Agricultural

Land Reserve (ALR) land primarily of lower value and productivity. Despite these limitations, the Cariboo Chilcotin contributes value to the agriculture sector of BC and has a beef production sector while maintaining the integrity of the dry grassland ecosystem. The ranching industry serves as an example of a pertinent stakeholder at the table of the integrated landscape discussions. Producers here utilize the unique ecosystem and perform integrated land use planning as defined by the BC Government, “planning that considers the full range of resources and values present on public lands and aims to blend or coordinate management strategies and implementation requirements across jurisdictions” (1997). Doing so enables a landscape typically considered “marginal” to contribute an annual average of \$60 million in gross farm receipts to BC’s GDP (Powell, 2007).

Some argue that the world’s solutions point towards reducing beef consumption as the continuous land clearing for cattle emits greenhouse gases while degrading unsuitable biomes and diversion of prime land for human food production to animal feed production continues (Godfray et al., 2010). Realistically it appears some level of beef consumption will always be present; this portion of the diet is deeply entrenched in many cultures worldwide, making such an immense deviation in the global diet unrealistic in the near future. Plus, the industry supports the livelihood of many worldwide, including approximately 600 million smallholder farmers (Herrero et al., 2009). While the entire sector may not cease to exist, there is potential for a reduction in overconsumption. Remaining livestock rearing may then occur on lands otherwise unsuitable for crop-based agriculture, such as arid grasslands (Godfray et al., 2010). Ruminants are efficient digestors of food otherwise inedible for monogastric animals, making them particularly suitable for grazing on marginal arid landscapes. Exploration of marginal land for grazing is a part of this discussion as an example of the rancher stake. The complication of marginal land use for agriculture arises when practices are too intensive, leading to environmental degradation and ultimately more clearing of otherwise natural "wild" lands, resulting in biodiversity loss. Working lands for conservation is a potential solution to this issue, and on marginal lands, the opportunity cost of protecting or restoring habitats is lower (Scherr & McNeely, 2008).

The purpose of this paper is to discuss the benefits and limitations of integrated land management and showcase the potential it may have on regions with low fertility classifications through an assessment of the Cariboo Chilcotin. We cannot exist and are not separate from

resource consumption and the landscapes we occupy. The acknowledgment of such complexity is imperative when discussing conservation versus working lands theories to appreciate the dichotomy. Indigenous people showcase land-dependent ways of living time immemorial and exemplify land stewardship without removing oneself from nature. To meet the increasing world demand for resource-intensive produce and livestock, producers and governments can utilize what they have on public land by aligning their objectives through compromise. By providing clear and proven methods to do this, future producers will be well-equipped regardless of circumstance. The information provided through this paper can support recommendations for integrated land management on marginal public lands as a strategy to raise livestock under environmentally and socially conscious conditions in addition to supporting and uplifting communities with opposing resource objectives.

Background

Location

The Cariboo-Chilcotin spans 80,252 square kilometres on the Fraser Plateau between the Coast and Cariboo Mountain ranges in the central interior of BC (Cariboo Regional District, n.d.; Annas et al., 1979) (Figure 1). The Cariboo Regional District exists as a defined boundary for this region and provides regional government initiatives and services. Geography is diverse in the area; biogeoclimatic zones transition over varying elevations and precipitation regimes across the region (Annas et al., 1979). Areas of interest identified for special protection and management include bunchgrass ecosystems and Interior Douglas Fir ecosystems (Grasslands Conservation Council of British Columbia, 2018). The Cariboo-Chilcotin region is best known and pictured for its rolling grasslands adjacent and on the benchlands of the Fraser and Chilcotin Rivers with dry Douglas-fir and lodgepole pine forests at the higher points above them (Figure 2) (Grasslands Conservation Council of British Columbia, 2018). Prior to colonization, a disturbance regime of frequent fires kept grasslands in flux; conifer encroachment from fire suppression now alters the landscape once more (Grasslands Conservation Council of British Columbia, 2003). While total land for farming has been reducing, 14.6% of farmland within BC remains in the Cariboo (Ministry of Agriculture, 2017). Between 919 to 1411 farms were reported in 2016 in the region with an average size of 410 hectares (Ministry of Agriculture,

2017; BC Agriculture Council and the Investment Agriculture Foundation, 2020). Farmer income is, however, often augmented by other sources of income. The land is mainly used for cattle and feed production and is home to 18.5% of BC's beef cattle (Ministry of Agriculture, 2017). 70.6% of farmland in the Cariboo falls under the class “natural land for pasture”; 12% of farmland in the region is cropland, tame or seeded pasture takes up 5.9%, then summer fallow follows at only 0.04% (Ministry of Agriculture, 2017). Despite the average farm size of only 410 hectares (Ministry of Agriculture, 2017), many ranches have ancillary access to public lands through grazing leases, licenses or permits, referred to as crown land in Canada. Public lands made up 85% of the grazing area of BC in 1993 (Wikeem et al., 1993). Crown land grazing agreement holders must submit a range use plan to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development for approval, showcasing adequate strategies to protect land and resources. The mosaic of private and public land makes up the rangeland in the Cariboo. This utilization of public land for different resource operations is a part of what makes this region successful as farmers can access supplementary land possessing land use classifications better suited to their operations, a combination of site-specific management with a landscape approach.

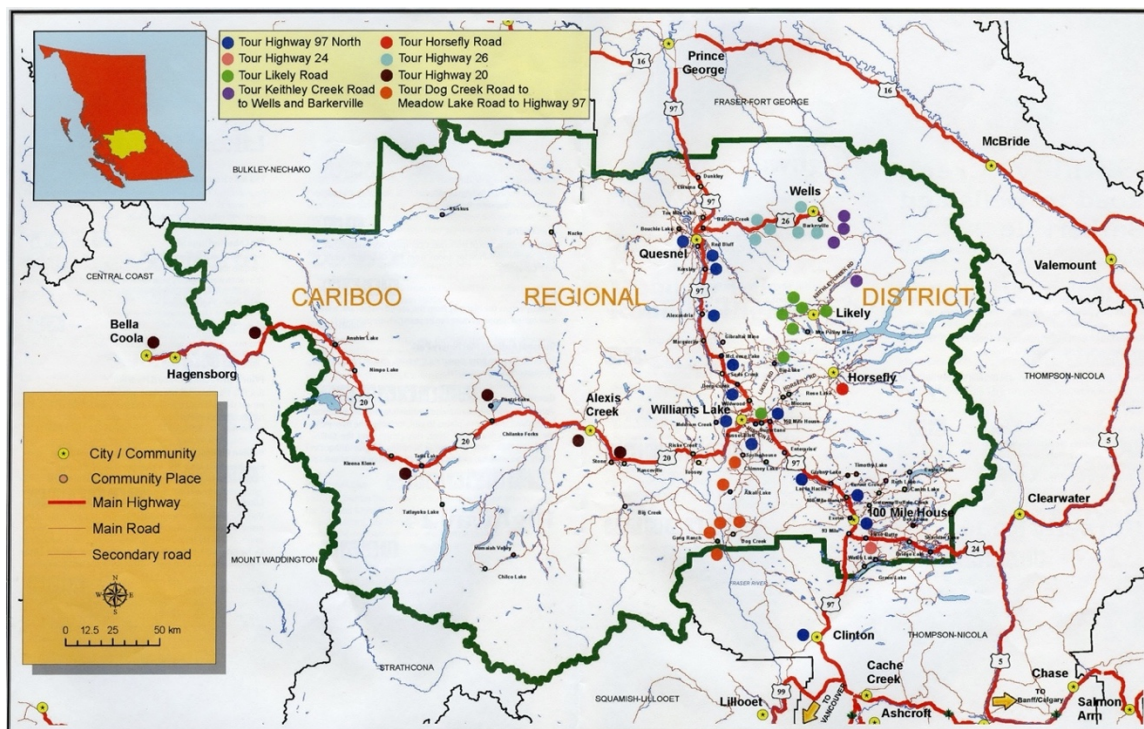


Figure 1: Map of Cariboo Regional District and its major routes and settlements. From Historic Driving Tour Guide, Cariboo Regional District (2021).



Figure 2: Chilcotin River taken on July 21, 2021. Lat 52.4'58.8', Long 123.20' 36.97"

History

When discussing this region, it is impossible to ignore the complexity of the social structures in this paper. The history of the area and across BC is fraught with colonization and displacement of indigenous communities. BC is unique due to the sheer amount of unceded territory and land claims throughout the province. The Cariboo is home to a 17.2% indigenous population (Statistics Canada, 2017) and is the unceded territory of various First Nations communities where debates surrounding land title and rights continue. In 2014, the Supreme Court of Canada confirmed the Tsilhqot'in Nation's aboriginal title to more than 1,700 square kilometres of land in the Chilcotin Plateau west of Williams Lake (Tsilhqot'in Nation v. British Columbia, 2014), much of it being in direct conflict with current grazing agreements creating uncertainty surrounding the longevity of crown land grazing leases. The social complexity and abhorrent practices of the past can make management decisions even more difficult as meaningful consultation with First Nations governments is imperative and beneficial for necessary change and reconciliation. Meanwhile, land claims continue to go through the courts.

Unique Features

The Chilcotin and Fraser Rivers cut through the region, creating localities of more fertile land adjacent to the riverbanks allowing for more resource-intensive crops, such as hay, to be grown on the flood plains. Moving laterally away from the river and increasing in elevation, terraces and river benches have irrigated hay production. Above these, in the uplands, cattle graze throughout the landscape and across seasons (Government of British Columbia, 2021a). These open grassland steppes give way to forested rangeland (Annas et al., 1979). Dryland ranching is predominant (Nielsen et al., 2018). Other than beef and forage operations, there are potato, honey, dairy, sheep, horse, poultry and a variety of fruits and vegetable production, mostly concentrated on private land in the major valley bottoms adjacent to rivers (Powell, 2005) (Figure 3). Agriculture is but one of the pertinent stakeholders of the region; forestry is a substantive industry along with small-scale mining operations, manufacturing and increasing tourism. Due to the geographical and topographical constraints on land capability in this region, there is an opportunity to use a holistic landscape approach that integrates biodiversity protection- along with industry and individual values.



Figure 3: Small private greenhouse agricultural operation on banks of Fraser River taken from Soda Creek Road on July 20, 2021. Lat 52.26'21.21', Long 122.23'42.98"

Ranching in the Cariboo is uniquely cultural and ingrained in many facets of life within the region (Figure 4). As previous recommendations from the government and other organizations have led to disruptions in ways of life, many ranchers are wary of prescriptive approaches coming from those who do not live and work on the land (Reid, 2010). Preservation of the rural nature and lifestyle in the Cariboo Regional District is a part of bylaw discussions (Cariboo Regional District, 2019). Mixing this social and cultural factor into agricultural policy is a severe challenge. Attempts to appreciate the tenacity of ranching work will aid mutual understanding and collaboration as resource users may express new ideas and impart new valuation.



Land Classification

British Columbia

The designing of land classifications was initially done to combat the previous destructive ways humans were using resources (Jurdant et al., 1973). Environmental research scientists across Canada were concerned about careful long-term land planning. They wanted to ensure the foundation was sound with an understanding of the entire natural ecosystem, including its function at various levels (Jurdant et al., 1973). Prioritizing this undertaking, scientists began the task of inventorying these ecosystems and their relevancy to differing management objectives, thus creating the biophysical land classifications in use today throughout BC (Jurdant et al., 1973).

In British Columbia, agricultural land is classified numerically from 1-7, dependent on capability by the Land Capability Classification for Agriculture (Agriculture Land Commission, 2013). Classes 1 to 4 have the lowest limitations to production and are the most fertile. Only 37% of the ALR within the Cariboo is Class 1-4, the second-lowest proportion of all regional districts throughout BC (Agriculture Land Commission, 2013). This higher value land is found mainly in low elevations on river benches (Grow BC, 2014). Division of the remaining 63% of ALR land is between Classes 5 to 7. Land that falls under Class 5 faces limitations to producing perennial forage crops. Class 6 is un-arable other than the growth of native and uncultivated forage crops. The harshest classification, Class 7, has no capacity for arable or even sustained grazing (Agriculture Land Commission, 2013). Limitations to Class 5 land include the small number of growing degree days and a currently short frost-free season (Vold, 1979). Therefore, with climate change, there is a potential for heightened productivity and altered classifications as growing degree days increase (Dawson, 2008). Yet, predictions include little to no change for summer precipitation, suggesting any heightened crop production will result in increasing irrigation water demand (Dawson et al., 2008; Neilsen et al., 2018).

Other Regions

Other regions also classify their land capability on scales similar to that of BC. In the United States (US), a capability class from 1-8 designates the general limitations of soil existing each step (US Department of Agriculture, 1961). In Australia, the land capability is rated from 1

to 5 and alternatively depends on the intended land use (Stuart-Street et al., 2019). Meaning the same parcel of land could be a 1, highly capable with low risk of degradation for one land use or class 5, highly degrading, for another more un-suitable land use (Stuart-Street et al., 2019).

Marginal Lands

While there is no unique definitive definition for marginal lands, the economic depiction suggests marginal land sits at the tipping point of profitability. The term, however, is often used subjectively to describe poor quality, barren, or “less than ideal” land. In this paper, marginal lands will be considered lands with an agricultural rating of 5 and 6. Climate change is expected to worsen human-induced land degradation leading to a growing base of marginal quality land (Intergovernmental Panel on Climate Change, 2019). One of the biggest concerns surrounding the use of marginal land for agriculture is the potential environmental impacts. For example, soil on steep slopes may be more inherently erodible through wind and water as they have reduced soil depth and more readily experience overland flow (Lubowski et al., 2006). Due to the inherent erosivity of steep slopes, cropland agriculture can experience lower soil productivity. To combat this, producers in the Cariboo Chilcotin Region utilize the slopes for integrated grazing on natural grassland transitioning into the forest and instead use terraces near the river for crop production where river water is accessible for irrigation. Likewise, similar concerns regarding nutrient runoff on marginal lands from enhanced erosion can be dealt with by adequate land management; examples such as nutrient management programs that prescribe low fertilizer inputs in wet periods and slopes retained exclusively for grazing showcase this potential. As a part of their rangeland strategy, ranchers must include their actions to avoid cattle destruction of riparian zones. Regulation dictating appropriate herd size is a strategy to avert excessive soil compaction from intensive grazing. This utilization of marginally productive land for grass-based agriculture is attributed to increased environmental and ecosystem benefits over cropping (Wang et al., 2021). This selection of grass-based agriculture is also associated with higher profit potentials when undertaken on marginal land (Wang et al., 2021). Instead of farmers spending exorbitant amounts of money to squeeze a profit from crops grown on marginal land, low-impact grazing, especially on natural grassland habitat, can allow them to maintain a rural lifestyle without the detrimental effects of excessive fertilizer.

One must be careful prescribing any one land management or practice as a solution to the broader issues of climate change and desertification. The discussion is rather a mere insight into the complexity of land use, human ideals, economic feasibility and ecosystem preservation. Sweeping suggestions can become very popular as they validate the choices of some but are not beneficial for long-term conversations about altering agriculture and land use planning. Instead, appreciation for the practices in place is helpful to build trust for future consensus-based land approaches where farmers are but one stakeholder at the table.

Marginal Land Retirement

Land of marginal quality has always been present; however, the utilization of much of this land has shifted back and forth over time as economic conditions through commodity pricing and production costs make it either favourable or not to produce (Lubowski et al., 2006). A large and continuous debate exists regarding the retirement of marginal land versus intensification. The environmental impacts of marginal land are not the only detracting factor to their use in agriculture; many attributes reduced yields to crop-based agriculture on marginal land. More land set aside for agriculture means less land “saved for nature”; the rhetoric that the use of marginal lands leads to a loss in ecosystem services provided through nature. In the US, throughout the 1980s, promotion for the retirement of marginal lands was rampant with programs such as the Reinvest in Minnesota bill in 1986 (Larson et al., 1988) and the Conservation Reserve Program (Kang et al., 2013). This undertaking is to conserve wildlife habitat and to avoid soil loss and nonpoint source pollution. Retiring marginal land is done under the hypothesis that intensification would occur on only the highest producing quality plots and that underperforming land could be spared as biodiversity hotspots. However, other than the creation of protected zones and parks, how likely is it that these previously marginal plots of land would remain wild rather than fall victim to urbanization encroachment? The success of land sparing then solely relies on the strength of policies restricting the development or creation of nature reserves (Garnett & Godfray, 2012). I agree with the hypothesis that it is beneficial to take marginal lands out of production when the management is over-extractive and causes more detriment to the landscape than the benefits provided through food production. However, there are ways to utilize this land more similarly to the natural processes and act as stewards for the ecosystem services while still producing food. For natural forest ecosystems, forest expansion is

an indicator of regeneration (Lambin and Meyfroidt, 2011), yet, this metric is not applicable for natural grassland habitat, dampening the relevancy of concerns surrounding deforestation and agricultural expansion. Grasslands have been in flux for years as fires, cultivation, and tree encroachment alter the zones (Grasslands Conservation Council of British Columbia, 2003). Protection of these grasslands is crucial for natural cycles and ranching processes. The loss of critical rangelands will result in animal units densifying, further worsening environmental conditions (Grasslands Conservation Council of British Columbia, 2003). This feedback highlights the importance of rangeland expansion and sharing resources on public lands as outlined in the Cariboo-Chilcotin Regional Land Use Plan. Another proposal for marginal farmland has been biofuel expansion exclusively on marginal quality land. Conceptual modelling suggests this exclusion would not be feasible as temptations to outcompete and expand to better land would drive up food prices (Bryngelsson & Lindgren, 2012). Improving livestock yields while reducing environmental impacts through sustainable intensification is an opposing theory often associated with high-tech industrial practices (Garnett & Godfray, 2012). This proposal has generated concern that going too far will lead to systems of poor animal care and that climate change mitigation will justify unnecessary animal suffering (Garnett & Godfray, 2012).

Working Lands Conservation

The solution, potentially considered a compromise by some (Reid, 2010), has been the implementation of something similar to working lands conservation. Working lands for conservation moves past the protected area or park approach and considers other factors such as livelihoods and culture to complement environmental protection (Garnett & Godfray, 2012). The goals of working lands conservation still include protecting biodiversity and the ecosystem resilience it provides. Clear examples of this include the Empire Valley Ranch at Churn Creek located within a protected park, grazing agreements remaining on public lands, along the continuous ecological monitoring practices and workshops held in the Cariboo (Reid, 2010). This consideration of multiple land valuations is in line with the goal of genuine accommodation through integrated land management; however, the use of this theory is never explicitly mentioned in the land use plan. Working lands conservation is also referred to as land sharing, wildlife-friendly farming and ecoagriculture, while conservation is titled land sparing in some circles (Fischer et al., 2008; Phalan et al., 2011). Land sharing has the dual goal of producing

food while protecting biodiversity through some farming method and seeks to integrate activities on a heterogeneous landscape (Fischer et al., 2008; Phalan et al., 2011). Highlighting the idea of working lands conservation is paramount as it showcases the potential for various stakeholder prerogatives integration when looking at the landscape as a whole rather than fragments. To be economical with working lands conservation there is the debate about stocking rates for rangeland, a dispute shown in Dr. Pitt's conflicting recommendations for the Churn Creek protected area where the ecologically conscious herd size of 200 cattle did not meet what some ranchers considered to be economical (Reid, 2010). One of the strongest arguments for land sharing is the difficulty of enforcing pure land sparing; without strong governmental regulation preventing intensive farm expansion, the benefits will not be realized (Garnett & Godfray, 2012).

In past debates surrounding the loss of the grassland ecosystem and future conservation, the immediate response is often to find fault with the cattle ranchers of the region. Responses to degraded soil have suggested inadequate economic incentives for ranchers to maintain grassland values (Grasslands Conservation Council of British Columbia, 2005). However, as ranchers depend on the future viability and biodiversity of the landscape for the success of their operations, many take offence to the suggestion that they are responsible for destroying the ecosystem they work upon (Reid, 2010). The NGO, Grassland Conservation Council of BC, as of 2021 on their website, has been quoted as saying, "Stewardship is about sustainable use, not preservation or protection from human use. The sustainable use of grasslands has included animal grazing for thousands of years." Some have theorized that if the cows and ranchers were not there that these landscapes would instead be developed for some industrial heavy mechanized purpose or other feedlot agriculture (Iverson, 2003). These large-scale grazing systems are also present across Europe where high structural diversity at different scales means many different habitats are available, including at the micro-level where disturbed bare soil from trampling can make way for necessary plant succession (Hopkins & Holz, 2006). The loss of these otherwise low-quality, open landscapes would also mean the endangerment of many faunal species and communities, such as wild ungulates and birds (Hopkins & Holz, 2006). It is this low-input farming and grazing approach that allows the continuous migration-dependent, open landscape to thrive.

Integrated Land Management

Initially, indigenous peoples' views on resources and the natural world's inherent value and respect were predominant. Through colonization and industrial expansion, resources became regarded as something to be conquered for an individual's use and benefit (Jurdant et al., 1973). Following this, eventually, concerns grew regarding ecosystem degradation and the non-renewable nature of many resources, and people became more aware of the abuse of resources and their pollution effects (Jurdant et al., 1973). These changing views led to the development of different approaches to land and resource management. It began with the biophysical classification of land and its capability (Jurdant et al., 1973). The complexity of public land management comes with the many vested interests to consider during planning; recognition of this complexity is apparent in documents discussing BC's beef industry which highlight the future emphasis on integrated use as a solution (Wikeem et al., 1993). The necessity of consultation with relevant parties, and the difficulty of managing trade-offs, including land protection, initiated the development of integrated land management as a strategic framework. Integrated land management is only one of a plethora of terms used in the discipline, chosen in this paper due to the use by the BC government. Integrated land management is a variation of the landscape approach, of which many researchers have rebranded, making differentiation of terms over practice difficult (Reed et al., 2016).

There is no formula for ideal agricultural use in this region. Instead, there is a wide range of practices possible across the entire landscape. This intricacy creates an opportunity to read the landscape, its physical properties and value to the people and subsequent planning to follow this through the landscape approach. While the land may be marginal for one use, it likely has a more suitable classification. It is suggested that regional specialization in the locally most appropriate land use would increase the global efficiency of land use (Lambin & Meyfroidt, 2011). Integrated land management is a tool also mentioned in Alberta documents to manage government lands and their associated resources while minimizing human disturbance (Alberta Environment and Parks, 2012). The government website promotes successful examples of opposing industries coming to working agreements, such as the co-existence of forestry and oil companies. Integrated land management seeks to facilitate discussion and cooperation and encourages land stewardship with the goal of land-use integration (Alberta Environment and

Parks, 2012). It is a method of policy mixing where cumulative impacts of different resource users on large-scale ecological systems are the focus.

BC Government Approach

Ninety-four percent of British Columbia is provincial public land (Government of British Columbia, 2021b), making resource and land use planning a critical issue. Before the 1990s, this land-use planning was done on a situational basis and had no widespread integration of communities or regions. In 1992 there was an announcement of a land-use commission, Commission on Resources and Environment (CORE), established to create land-use plans throughout the province (Forest Practices Board, 2008). Simultaneously, sub-regional planning was occurring under the process called Land and Resource Management Plans (LRMPs). The disbanding of CORE in 1996 did not mean the end of integrated land management planning but instead the body that performed these regional plans. Integrated Land-use Planning for Public Lands in BC is a policy document that highlights the move towards a comprehensive consensus-based land-use planning model (Government of British Columbia, 1997). The document outlines the process of integrated planning for using the land and resources of BC public lands and the principles to consider when undertaking this approach. Integrated planning is defined as, “planning that considers the full range of resources and values present on public lands and aims to blend or coordinate management strategies and implementation requirements across jurisdictions.” (Government of British Columbia, 1997). The government took a shared decision-making approach defined as,

“Shared decision-making means that on a certain set of issues, for a defined period of time, those with authority to make a decision and those who will be affected by the decision are empowered to jointly seek an outcome that accommodates rather than compromises the interests of all concerned.” (CORE, 1992)

Nine principles are to be upheld throughout these planning processes and are found in Table 1, displayed next to the ten principles brought forth by Sayer et al. (2013). The differences between these approaches become clearer regarding stakeholder inclusion, Sayer et al. (2013) address the importance of rights and responsibility clarification which replaces the command-and-control approach, something that the 1.2.8 principle “Defined decision-making authority” follows by outlining upper-level government officials as those holding approval authority. The newer Sayer

et al. (2013) principles also recognize that multiple stakeholders are necessary (Principle 5), and the high demands the integrated land management processes make of these stakeholders (Principle 10), the identification of this is a step towards more equitable representation. In contrast, the BC Government (1997), while recognizing that “public involvement is a fundamental requirement of integrated planning” (Principle 1.2.3), does not specifically address conflicts and issues of trust and power in stakeholder representation. Generally, the underlying values in Sayer et al. (2013) appear to be more tailored to creating ethical outcomes, whereas the BC government principles (1997) seem to have the goal of creating an effective and efficient process.

Table 1: Two different approaches of Integrated land Management. On the left the BC government principles in place during the Cariboo Chilcotin Land Use Plan Creation are displayed. On the left the ten principles brought forth by Sayer et al. (2013), which have become a major part of the discipline.

Government of British Columbia (1997)	Ten principles for a landscape approach (Sayer et al., 2013)
1.2.1. Procedural Fairness	Principle 1: Continual learning and adaptive management
1.2.2. Interdisciplinary approach	Principle 2: Common concern entry point
1.2.3. Consultation before action	Principle 3: Multiple scales
1.2.4. Access to information	Principle 4: Multifunctionality
1.2.5. Systematic procedure	Principle 5: Multiple stakeholders
1.2.6. Plans address problems	Principle 6: Negotiated and transparent change logic
1.2.7. Socio-economic analyses	Principle 7: Clarification of rights and responsibilities.
1.2.8. Defined decision-making authority	Principle 8: Participatory and user-friendly monitoring.
1.2.9. Responsiveness	Principle 9: Resilience
	Principle 10: Strengthened stakeholder capacity

The CORE method (1992) allows for an interdisciplinary collaborative process that seeks an acceptable balance between protection, conservation, and development. By looking at the full range of resources available and values present from all stakeholders, the process can allocate and manage appropriately and fairly. Participation has improvement potential through such approaches, as does the actual integration of differing viewpoints when the appropriate context for re-evaluation exists. Benefits of these strategic land-use plans include: “improved communication, learning, understanding and inter-agency cooperation through stakeholder and agency participation” (Integrated Land Management Bureau, 2006). Three decision-making levels exist, the provincial level, the regional/sub-regional level, and the local level. These levels increase in detail as the scope decreases. The regional and sub-regional levels appear to have the most direct influence on the vision of public land utilization, a trade-off being the increasing number and variety of stakeholders to include. The provincial level, while far-reaching, does require cabinet approval and cannot address as fine-tuned, specific locations. On a local level, an example may be something such as a community watershed plan. While the hierarchy of plan levels is ideal, it is not always realistic in the application as different needs drive the creation of plans and some issues are not applicable at all scales. Rather, as plans come to exist in the future, they may be nested within context to one another and their predecessors.

Cariboo-Chilcotin Regional Land Use Plan

Following the principles laid out in the Integrated Planning approach, the Cariboo-Chilcotin Regional Land Use Plan (CCLUP) was created, not without serious dispute. This process ultimately ended in no consensus and has been attributed to intense distrust between opposing stakeholders (Reid, 2010). The lack of approbation meant relevant government officials did have the final say (Forest Practices Board, 2008). One of the paramount concerns surrounding the 1990s CORE process and creation of the Cariboo Regional Land use plan is the lack of meaningful consultation and engagement of indigenous people (Clogg, 2007). Assessment of the experience shared by the public has also been severely negative (Booth & Halseth, 2011). A better and more effective public engagement that considers the needs, education, background, and outside influences of public participation would serve future committees well (Booth & Halseth, 2011). The stakeholder approach also receives criticism as individuals feel stuck to their assigned agenda or stake without adequate room to compromise

(Booth & Halseth, 2011). There are currently updates to land use planning underway, including the "modernizing of land use planning" which now specifically addresses reconciliation and works collaboratively with indigenous governments (Government of British Columbia, 2021b).

The Cariboo region distinctly permits grazing in protected areas. This practice reflects the area's historical practices and significance. Continuing grazing in protected areas is an example of an integrated management decision as multiple opposing land uses are accommodated and can coexist in the same geographic space. Grazing permission is, however, viewed as a failure by those who had the intent of creating more protected, isolated spaces (Reid, 2010).

Land use practices in the Cariboo

Farmers in the region attempt to use regenerative practices such as management intensive grazing, rotational grazing, and hay production with low fertilizer inputs but economic barriers deter (Hett, 2021). Better support for farmers in these endeavours is necessary as reduced outputs turn away potential regenerative practice adopters. The addition of crown land provides forage-rich grazing opportunities for ranchers.

The open grassland range and movement of livestock make extensive use of ecosystem services and return nutrients through animal waste to the landscape, rather than confinement production. Of course, when eventually removed from the land for slaughter, there is some level of nutrient loss. Ruminants like cattle can convert the low-quality grasses into beef, a high-protein product, and when appropriately stocked and managed, can do so with low environmental consequences (Tilman et al., 2002). Cattle raising occurs in systems that can be referred to as silvopasture, as they live under trees and in forested regions, considered a mixed land use that benefits carbon storage and biodiversity (Jose & Dollinger, 2019). Beef cattle are different from dairy as they require more food over shorter periods to reach adequate weights for human consumption.

Environmental Issues

As with any resource-intensive industry, there are certainly going to be environmental impacts. In the Cariboo-Chilcotin, issues such as forest encroachment, urban encroachment, riparian contamination by cattle and overgrazing are continually a part of the dialogue (Cariboo-Chilcotin Grasslands Strategy Working Group, 2001). The grasslands here support up to 30% of

the province's endangered species and are under threat from these same issues (Cariboo-Chilcotin Grasslands Strategy Working Group, 2001). Forest encroachment is attributed to fire suppression practices now commonplace (Cariboo-Chilcotin Grasslands Strategy Working Group, 2001). Some hypothesize that the presence of livestock on the grasslands mitigates the ingrowing of trees through its replication of the grazing of the once prevalent keystone species bison (Collins et al., 1998), while others attribute the proliferation of trees to reduced species competition and the churning of the ground by cattle (Strang & Parminter, 1980). The continuous logging done throughout the region plays a role in forest mitigation. The loss of grassland to forest encroachment means maintaining ecologically sound animal herd size is impossible, as cattle herds concentrate in remaining locations and push towards riparian zones. The encroachment of trees on rangeland is not unique to the grasslands of the Cariboo; documentation of the phenomenon is worldwide and of concern to grassland protection and even forage availability for livestock (Anadón et al., 2014).

Assessment of Success and Utilization of Integrated Management

Despite the perceived failure of the integrated public lands management process, the report laid the groundwork for resource use in the area to this day (Roseland et al., 1998). Benefits to the process are still tangible as so many different participants could communicate, bringing forth important information that would have otherwise not been sharable. The process initiated further work to fill knowledge gaps discovered and led to the investigation of protected area proposals (Roseland et al., 1998). One critical metric unsnarled from the process was the 6.75 million hectares of public land available for sustainable natural resource development, making up 80 percent of the public land base (Government of BC, 1995). Deep appreciation and connection between the resources of the Cariboo and the way of life exist, meaning maintaining the unique value of the land while ensuring adequate access to natural resources by which people make their living is of utmost importance. By allocating 80% of the land base to sustainable resource management, the respect of these values continues while creating economic and social potential in the region. The use of public lands or crown land without significant exclusion of different groups is a factor that aids in the region's success. Forestry permits can coincide with that of grazing. Elimination of permitted exclusion of the public is occurring slowly as grazing

leases allowing this are no longer released instead replaced with grazing licenses (Government of BC, 2021a).

Some environmentalists consider a supreme failure of the process was conceding national park creation (Reid, 2010). Instead, the process led to the eventual allowance of grazing on protected areas and even a ranch within the Churn Creek Protected Area (Reid, 2010). Betrayal also exists on the side of ranchers who were allegedly promised the return of the Junction Sheep Range Wildlife Reserve (Reid, 2010). While conservation and ranching can intersect geographically, as suggested in this paper, the tension generated through this process between the opposing stakeholders may be a failing in itself (Roseland et al., 1998). These are glimpses into the limitations of integrated land management, that regardless of the impact of a collaborative resolution- some resource users may perceive any compromise as a failure. The hope is that adequate information and goal sharing can avoid the severity of these views.

The Forest Practices Board is an independent board that handles complaints from tenure holders and makes pertinent decisions and recommendations dependent on BC's Forest Practice legislation, Forest and Range Practices Act (FRPA). Their council is of interest to this discussion as often complaints are dealt with on both sides from ranchers and forestry companies alike. Looking at the long-term consequences of actions and weighing the benefits and trade-offs of each response is another example of the meaningful dialogue between resource users. One specific example was a decision made in 2010 by the Forest Practices Board,

“Ultimately, a system of objectives and regulation coupled with respectful, mediated solution-seeking would be more equitable for the people involved, and more effective for stewardship of the many tenured interests that the province has vested on the landscape.”

Acknowledgement of the vested interests present and the complexity of direct interaction is a valuable part of this discussion. Assessing the success includes looking at when resource users interact, whether this is a positive or a negative experience. Other complaints end without successful resolution for one party (Forest Practices Board, 2002), but ultimately decisions are made upon the long-term success of the land. This process strays away from the collaborative and transdisciplinary idea behind integrated land management and instead has a single overarching body making decisions for the resource, or commons, at large. Perhaps collaborative

processes like integrated land management would avoid these resolutions that leave some stakeholders feeling unheard while others are unaffected or even rewarded. Dedication of many more resources would, however, be imperative.

Paper Critiques

Livestock Farming and Resource Intensity Debate

Concerns surround the heavy consumption of meat and calorie-dense food by the developed world, the growing trend towards this diet, and the “westernization” of the developing world (Popkin, 1998; Intergovernmental Panel on Climate Change, 2019). These concerns have validity as the industrial-style cattle operations popular in the developed world deplete landscapes of fertility while simultaneously promoting disease in close quarters, increasing pharmaceutical use, and grim animal care (Horrigan et al., 2002). If these factors are all true, then one may be critical of this paper’s position in supporting and promoting livestock grazing as a best practice for public land conservation. Yet, there is still potential for sustainable and non-intensive livestock rearing. Some of the strongest arguments against beef cattle are their grain consumption otherwise suitable for human consumption and the subsequent clearing of land to feed cattle. Land clearing leads to feedback where greenhouse gas emissions accelerate, and the clearing of valuable land leads to a net calorie loss (Horrigan et al., 2002; Intergovernmental Panel on Climate Change, 2019). In the Cariboo, cattle do not compete with crop production for humans; their diet is low in corn or food otherwise available for humans and primarily graze natural grasses too tough for human consumption. They are good livestock using the natural landscape. Another possible comparison is manure disposal which can be a considerable problem for intensive beef production; on rangeland such as in the Cariboo, there is a more natural displacement of waste products as cattle roam relatively free, returning critical nutrients. The US Department of Agriculture (USDA) Agricultural Research Service found that moderately grazed land (one cow per 16 acres) had more biodiversity than un-grazed or heavily-grazed land by filling an ecological niche (Comis, 1999). The issues with these beef, cow-calf operations come in the supply-chain post ranch where long-haul transport takes cattle to abattoirs and far markets willing to pay. Local producers combat this by selling direct to consumers. Other solutions such as regulation to improve local beef markets and create a nearby abattoir seem possible (Powell, 2007) and would shorten the supply chain, as recommended by the International Panel on

Climate Change (2019). Trade-offs to this concept are that livestock without grain finishing would not reach the desired slaughter weight as fast and would spend more time on the range, potentially producing more methane and consuming more forage. Other theories to improve livestock production have been sustainable intensification, where improving livestock yields simultaneously reduces environmental impacts. This concept is often associated with technologically intensive industrial practices and even ideas of yield improvements of individual animals; this generates concern that climate mitigation will justify excessive animal manipulation and potential animal suffering (Garnett & Godfray, 2012). Ethical considerations surrounding meat consumption -plus cattle's quality of life are relevant discussions. However, if there is to be a way to manage livestock, a rebuttal is that on open ranch land is the most humane way to do so as it replicates the natural non-confined nature of these large ungulates.

Other concerns surround the healthiness of high percentage meat diets and their correlation with obesity and chronic diseases (Popkin, 1998). Findings suggest grass-fed beef has a more favourable and decreased fat composition and preferable improved antioxidant content over the grain-fed beef commonly produced commercially (Daley et al., 2010).

Missing from this assessment is the vital discussion surrounding the concerns of water contamination by cattle. Water as a resource across public land is unique as it flows continuously regardless of property lines, meaning resource users often experience conflict or at least contrasting objectives. Protection of source water from cattle is of interest to this paper, and further investigation into the practices currently in place would be beneficial. In addition, further analysis into wildlife and cattle interaction would be helpful to discuss in such a paper as many endangered species are present on the grasslands which deserve adequate protection, seemingly presenting a limitation to the rangeland potential for conservation.

Limitations to Integrated Land Management

The complexity of such planning undertakings means several hurdles are in place before success. One is removing the sectorial approach commonplace in Canada and many other regions that keep decisions discrete and create weak links between agencies (Kennett, 2006). Another caveat to the recommendation of integrated land management is the sheer amount of time and resources necessary for the process, making it difficult to sustain in areas of low economic status; careful consideration of this factor is essential before implementation (Sayer et al., 2013). In

addition, traditional optimization and performance assessments may not be appropriate as the process involves compromise and an influence of human aspirations (Sayer et al., 2013). A substantial critique of the discipline is the failure to address limitations, instead prioritizing its marketability (Reed et al., 2016). This omission leads many to question the validity of a transition from research to reality (Reed et al., 2016).

One further complex discussion is that of the role of indigenous governments in such integrated land management processes. Indigenous communities may not view themselves as separate stakeholders. This difference may make consensus-based approaches invalid or contrastingly exemplify their ideals as in many ancient traditions' nature is considered the commons and decisions are communal. The commitment to indigenous reconciliation adds tremendous challenges to future resource planning in BC as collaboration with indigenous governments needs to have these viewpoints in mind. Integrated land management also presents an opportunity to utilize and share traditional knowledge.

Recommendations

While the general approach to land-use through strategic planning and integrated land management is feasible and preferable in many regions. It is the unique and local properties of an area that make up a successful land-use plan. The successes of the Cariboo Chilcotin region do not come from a prescriptive proposal given by those who have never set foot on the land; instead, these plans come from the debates of resource users and people present who can look at the landscape holistically and designate and allocate appropriately. Generally, integrated land management is best suited for other regions where there is a large amount of publicly owned land, areas with no regional strategic land use plan, landscapes with many competing interests and marginal land where diversification will aid farmers and the community. Recognition of the importance of ecosystem functioning for benefits to humans continues to grow; combining this acknowledgment with action must involve open dialogue and firm policy. Involving people in the process and eventual solution provides an opportunity to impart the value of the ecosystem to all resource users.

The BC government often refers to its many integrations of activities on public land; this may lead to term confusion when trying to distinguish between the integration of ideas and

values on the landscape or the integration of actual resource use on public land. In the future, using the term integrated landscape management may aid in this differentiation instead of integrated land-use planning as it is titled in policy documents (Government of BC, 1997). This diction may seem like a minute difference but referring to the unit of land as a landscape connects it to the larger theory at play, the landscape approach. The extensive lexicon can be detrimental for meaningful dialogue with people outside the discipline; a future consensus on terms would be beneficial.

Working lands for conservation deserves more in-depth research than the limited discussion of this paper; future quantitative studies of large-scale endeavours are recommended. The opportunity that integrated land management provides to meet Sustainable Development Goals should be explored further. Other broad recommendations include the continued exploration of the idea to continue beef production on marginal landscapes instead of extensive land clearing in otherwise productive areas. The efficiency of ruminant digestion means otherwise uninhabitable areas can support grazing, which will benefit producers and local economies.

Conclusion

Strategic planning will be necessary for the future as resource scarcity and climate change impact each location uniquely. Across the landscape differing objectives and values will continue to be held; purposeful integration of these with a sound scientific and policy background will enable public land planning to address multifaceted issues. Instead of making prescriptive optimized statements, science can inform discussions of land and resource use, human values and aspirations may complement this (Sayer et al., 2013). Integrated land management allows for areas typically considered “marginal” to meet food demands and simultaneously support conservation goals. This achievement is possible through the inclusion of objectives like rural livelihood protection, conservation, and development. Best practice discourse may sometimes be too far removed from the reality land practitioners face; it is a goal of integrated land management to rectify this divergence and gain meaningful perspective to make far-reaching land-use decisions. The Cariboo-Chilcotin is a unique region with valuable lessons to learn from its contentious land-use plan. The working lands conservation debate is a critical component of public lands planning as it provides a potential opportunity to utilize the

landscape holistically. The marginal classification of public lands in the Cariboo highlights this chance to implement ranching, an activity culturally viewed as fundamental, as something also capable of protecting the natural ecosystem. By looking realistically at what values and resources are held presently on the landscape, other regions can similarly make plans of an integrated nature. Land-use planning must be dynamic in an ever-changing world; utilizing an integrated approach will aid in this challenging task.

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