BRITISH COLUMBIA | Ministry of Agriculture and Food

Cariboo Silvopasture Demonstrations

Case Study - Silvopasture Planning on Private Land

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Silvopasture is an agroforestry system which purposefully blends the management of livestock, forages and trees on the same site – allowing interactions among components to be optimized throughout the production cycle.

BACKGROUND

The Cariboo Silvopasture Demonstrations were initiated by the cooperating landowners and the B.C. Ministry of Agriculture and Food to build and transfer knowledge about silvopasture applications among agriculture producers, private landowners and natural resource professionals. The Cariboo sites differ from other silvopasture demonstration projects in B.C. because they were implemented on private land, rather than Crown land.

The purpose of this brochure is to identify some of the considerations when planning silvopasture applications on private land using two examples in the Cariboo region. The two silvopasture case studies serve as useful examples for highlighting some of the experience gained through the planning and implementation process.

THE PLANNING CONTEXT

The main difference in planning on private land versus Crown land, is related to land use objectives and scale. Land use objectives on private land are specific to an individual owner, and with some exceptions apply to a relatively small land base. On the other hand, Crown land use objectives are established by provincial legislation and policies, and planning occurs on a much larger scale – at the level of a Natural Resource District or Timber Supply Area.

Both the planning scale and management objectives can substantially affect the balance of costs and benefits, and therefore the opportunities, associated with integrating timber and forage production.

In addition to direct costs and revenues associated with timber harvest and livestock grazing, there are also “non-market” benefits to consider in silvopasture planning. For example, tree cover has a modulating effect on local micro-climates, can slow rates of snow melt, and play an important role in overall watershed function. Some of the non-market benefits (sometimes called ecosystems services and amenity benefits) include:

- Watershed function
- Riparian area function
- Visual quality
- Fine fuel reduction and wildfire risk mitigation
- Wildlife habitat including forage values
- Climate regulation

Having clear objectives is essential for choosing among different management options and setting a course of action for a silvopasture application on private land. It is practically impossible to account for all the costs and benefits at this scale of operation, especially over the longer time frames associated with a sustainable timber harvest. However, clear objectives that reflect landowner values, combined with a resource assessment, partial budgeting and or other economic analysis will help support sound silvopasture management decisions.

DEMONSTRATION SITES AND PLANS

The sites represent two very different, but common, forest environments in the Cariboo region. The 144 Mile site was in the dry Douglas-fir belt on the Fraser Plateau, and the Beaver Valley site is in the wetter sub-boreal spruce zone just east of the Fraser Plateau closer to the Cariboo Mountains.

144 Mile Site

The 144 Mile demonstration was focused as a planning demonstration, the site was located just south of 150 Mile house, in the rolling terrain of the San Jose valley. The site was part of a larger ranch property covering approximately 477 ha (1180 acres) lying in the Interior Douglas-fir very dry mild subzone (IDFxm). The forested area, which was predominantly Douglas-fir, with some spruce occupying low lying areas, covered about 90 ha. The area had been logged periodically over the last 100 years or more, with the last significant logging occurring in the late 1960s. The Douglas-fir stands had a varied and partially ingrown structure typical of this disturbance history (Figure 1).

Uneven tree sizes sometimes leads to a mistaken assumption that a stand is uneven-aged (see Tree Age and Productivity pullout box page 4). In this case study, the site index ranged from 12.4 on most of the area, to as high as 16 in small pockets in the drainages. At the time the understory produced little in the way of forage for livestock, except where there were small openings

Figure 1. Typical forest stand structure at the 144 Mile site

Site Index

Site index is used to describe the relative productivity (growth capability) of forestland. It is comparable to the land capability classification used for agriculture. The index for a site is the average height that the dominant and co-dominant trees will reach in 50 years. A site index of 15 means that the main species of tree on the site will be 15 meters tall at 50 years.

Objectives

Objectives for the silvopasture application were identified over several meetings with the landowners, and ordered to meet the long-term goals and operational circumstances of the ranch (Figure 2). They included an overarching economic objective that silvopasture treatments were, at minimum, revenue neutral on a straight cash flow basis. Some objectives also included sub-objectives. For example, the ecosystem function objective incorporated wildlife habitat and riparian functions.

Figure 2. Landowner objectives for the 144 Mile silvopasture demonstration

Timber Site Assessment

An assessment of the current condition of the timber resource is necessary to plan silvopasture. This may include a combination of reconnaissance, timber cruise, stocking survey, mapping, and the use of existing reference materials like soils reports. In this case, a reconnaissance and timber cruise were conducted to establish site conditions and estimate both the total volume of merchantable timber and the distribution of tree diameter classes.

Through the process of the site assessment, two major forest map units were established to meet the land owner objectives:

- Spruce areas reserved to protect riparian areas, watershed function, and maintain wildlife corridors.
- Douglas-fir harvest areas with planned 50% volume reduction focused on smaller, less productive trees.

The recommendations for the harvest areas included:

- Sufficient tree retention to approach Mule Deer Winter Range guidelines[1].
- Summer logging to increase mineral soil disturbance in harvest lanes and landings to allow establishment of seeded agronomic forage species.
- Harvest areas with 30-70m buffers to maintain visual quality objectives (Figure 3).
- Protection of large veteran trees used by wildlife in the forest grassland interface.

Figure 3. Plan for buffers along the forest-grassland interface of designated harvest areas to meet the visual quality objective

Increased Forage Production and Timber Harvest

Predicting the amount of increased forage production from timber harvest treatments in the Interior Douglas-fir zone is not easy. When there is a partial harvest, remaining trees and site characteristics; including slope, aspect, and latitude, determine how much light can reach the forest floor stimulating understory forage production. Determining the trees to be left is a function of the existing forest stand structure and how much flexibility this allows in the harvest prescription. For example, greater forage production might be expected in a clump selection cutting scenario that removes small groups of trees, leaving completely open spaces for forage and fir regeneration.

[1] Cariboo Forest Region Research Section. 2000. "Structural Definitions for Management of Mule Deer Winter Range Habitat in the Interior Douglas-Fir Zone." Extension Note #25A. Research Section, Ministry of Forests, Cariboo Region.

TREE AGE AND PRODUCTIVITY AT THE 144 MILE SITE

Ingrown Interior Douglas-fir stands can have the appearance of being multi-aged (i.e., uneven-aged), when in fact trees are close to the same age. Small, but old, trees put on very little growth each year and use water and nutrients that could be used more effectively by larger, better growing trees. Tree core samples taken from 4 trees in a single cluster at the 144 Mile site showed two trees 6 inches in diameter were in the same age class as a 12-inch diameter tree:

- 10 cm (4") = 65 years
- 15 cm (6") = 109 years
- 16.5 cm (6.5") = 112 years

Forage production can also be enhanced by orienting the main harvest corridors in a north-south direction, with secondary trails going in southeast and southwest directions in a herringbone arrangement. However, physical site factors, including the presence of drainages and steep slopes may determine the harvest layout. The relatively easy topography and southerly aspect on the 144 Mile site allow opportunity to orient skid trails to maximize light when a future harvest is planned.

A fair estimate of useable forage on this site, following harvest would have been around 250 kg/ha (223 lbs/acre). In an unharvested state at the time of assessment, forage production was on the order of 50 kg/ha in the timbered areas. While the estimate of forage production after treatment is not comparable to that of pasture or open range, it is a substantial increase over the existing production.

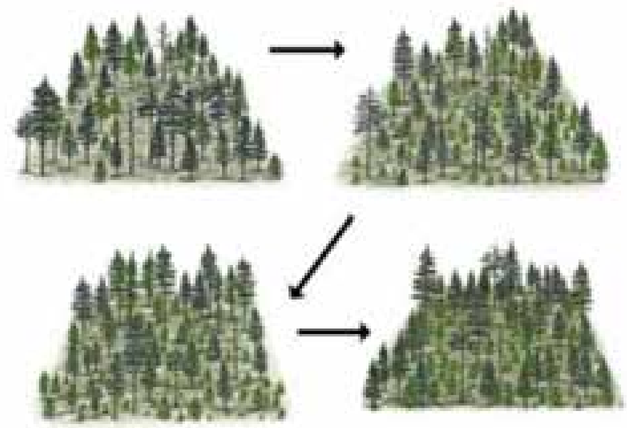

Figure 4. A single-tree selection system removes individual trees and small clumps to achieve or maintain an uneven-aged stand structure. Larger clump removal can vary from under one mature tree-length to over one tree-length, depending on stand structure and objectives.

Source: British Columbia. Ministry of Forests. Forest Practices Branch. 2003. Silvicultural Systems Handbook for British Columbia. For. Pract. Br., BC. Min. For., Victoria, BC.

Timber Economics

When reserve areas and buffers are taken out, the total harvestable timber area on the ranch at that time was about 50 ha. Creating a cash flow from an annual timber harvest on an area of this size, under the slow growing conditions found at the 144 Mile site, is impractical.

Modelled growth projections for the site suggest it is reasonable to assume a harvest of 50 m^3/ha every 30 years, while still meeting the land owner objectives for maintaining a residual stand.[2] If the first harvest were delayed by 10-15 years on half the area, then harvest entries could be staggered

[2] Seaton, Robert. 2016. "Brief Report : Timber Supply Optimization for 144 Mile Ranch." Brinkman and Associates.

to produce income on 15-year intervals. The trade-off would be the loss of 15 years of improved production created by enhanced stand growing conditions following a harvest treatment.

The net value of the harvest is highly dependent on the harvest plan and the choice of contractor and equipment used. Harvest costs include:

- Marking
- Tree cutting by feller-buncher
- Grapple skidding
- Loading
- Trucking

Marking the trees to be cut is necessary to achieve timber and forage production objectives in a complex selective system and should be considered in cost projections. At the time of planning, logging under similar conditions at the nearby UBC Alex Fraser Research Forest produced very marginal returns of around $5/m^3 due to the high harvest costs.[3] However, the silviculture objectives for the UBC site were additionally complex and it is expected that total harvest costs at the 144 Mile site would have been somewhat lower using the feller-buncher and grapple skidder system. Costs would also be expected to be lower in future harvests when there would be fewer small stems to deal with. For planning purposes a marginal net value of $10-$15/m^3 for the 144 Mile site was a reasonable assumption.

Forage Economics

Some broad assumptions are needed to consider the economics of the added forage production. The full increase is not likely to be realized until at least two years after the timber harvest, and then it can be expected to decline starting mid-way through the 30-year cycle up to the point of the next harvest. This is another reason why it may be beneficial to set up staggered timber harvest areas, then grazing could be shifted from one treatment area to another, as the forest stand infills. This may also serve to help manage grazing to protect fir regeneration, which in this system would be from the cone production on the retained trees.

In this example, it is also assumed that no new range developments were needed since the timber harvest areas were part of existing pastures. However, range developments need to be considered in silvopasture planning and could be required in other circumstances. Additional fencing might be needed if multiple harvest areas are set up in a large pasture unit.

If the net increase in useable forage were 200 kg/ha over the 50 ha, this would equate to about 28 additional AUMs of grazing.[4] If the AUM is valued at $25 per AUM (a custom private land grazing rate at the time) this represents an additional annual value of $700. Part of the additional forage in this example is the result of seeding agronomic forages on skid trails and other disturbed areas. A reasonable estimate of the skid trail area for the future harvest would be 15%, or 7.5 ha. Seeding cost would have been around $180/ha for a total cost of $1,350. Forage seeding costs were relatively high in this example due to the prices for species that fit the objectives and are adapted to the dry conditions of the site.

Post Planning Status

Given the information and scenarios identified during the planning process, the landowners of the 144 Mile site evaluated the options identified by the silvopasture planning process and did not proceed with a timber harvest at that time. This is reasonable, considering that log prices rose on average $10/m^3 over the two years following planning being initiated. The assessment at the time was that they would likely continue moving upward. The Douglas-fir Beetle outbreak in the Cariboo was also a major factor in this decision. A harvest entry would have substantially increased the risk of a beetle infestation, resulting in lost timber value.

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[3] Koot, Cathy, Ken Day, Stephanie Ewen, and Don Skea. 2015. "Harvesting on Mule Deer Winter Range under Gen- eral Wildlife Measures for Shallow & Moderate Snowpack Zones: Approach and Lessons Learned Following a Second Harvest Entry after 30 Years." Technical Report. UBC Faculty of Forestry Alex Fraser Research Forest.

Beaver Valley Site

The Beaver Valley Site is located approximately 65 km from Williams Lake just west of Opheim Lake. The silvopasture area covers about 59 ha, one of five lots totaling approximately 261 ha that make up the ranch. The site is in a transition zone between the moist, hot Sub-boreal Spruce (SBSmh) and the dry, warm Sub- boreal Spruce (SBSdw1) subzones. The site index ranges from 17.6 over most the property to 16.7 on steeper sections in the middle, which make up about 24% of the total area.

The silvopasture lot was bought by the current owner in 2005 after it had been logged of nearly all merchantable timber (Figure 5). The area became a silvopasture demonstration in 2011. During 2012-13, the area was cross-fenced into three units and two water developments (a dugout and spring) were constructed. In 2013, a brushing/spacing treatment was applied on a total of 10 ha in two of the units. The original silvopasture plan and producer objectives were revisited in 2015 as part of the Cariboo Silvopasture Demonstrations Project.

Figure 5. View to the northwest taken from the south unit of the Beaver Valley site in August 2015

Objectives

Timber and forage production objectives for the silvopasture application were established over several meetings with the land owners. The objectives were ordered to meet operational circumstances at the time and long-term goals. The site differs from the 144 Mile site in that forage production is higher in the order of objectives (Figure 6). This is in part, because much of the rest of the ranchlands are in riparian areas and subject to spring flooding. Being more upland, the silvopasture is valued for late-winter feeding and early spring grazing. There is also a stated objective to use the site as a teaching opportunity to help develop knowledge on grazing practices, and an overarching economic objective.

Figure 6. Landowner objectives for the Beaver Valley silvopasture site

Site Assessment

The assessment at the Beaver Valley site included detailed reconnaissance and mapping, as well as a stocking survey and timber cruise. The stocking survey showed that the site was not sufficiently stocked with young trees using either even-aged or multi-layer provincial standards. Some smaller areas of sufficient stocking were noted. The timber cruise estimated a total merchantable volume of 1,173 m^3 for the entire site. The site reconnaissance provided the following observations:

[4] For this brochure, an AUM is defined as 366 kg of forage measured on dry matter (DM) basis, which represents the forage demand of a 450-kg beef cow with or without calf, consuming 12 kg of forage DM per day for 30.5 days. An animal unit equivalent factor should be used to account for the forage demand of larger or smaller animals when determining stocking rates.

- Shrubs (beaked hazelnut, thimble berry, willow and rose) and aspen were the dominant cover in some areas.
- Soil compaction associated with livestock use had negatively affected the vigor of some conifer seedlings.
- The 2005 logging and the 2013 brushing/ spacing treatment resulted in resprouting of cut aspen stems (Figure 7).
- Winter feeding (bale grazing) areas had increased forage, soil organic matter and nutrients, and decreased shrub cover.

Integrating timber and forage production

The main challenge for meeting objectives on this site was the substantial shrub and aspen regrowth stimulated by the logging in 2005 prior to purchase. This is a typical response on similar sites in this zone and where a future tree crop is desired, additional site preparation, planting and vegetation control is needed immediately after harvest.

Figure 7. Aspen re-sprouting an effect of a brushing/spacing treatment implemented in 2013

Seeding agronomic forage species and livestock grazing can also be used to help control vegetation to provide growing space for tree seedlings. Ordinarily, these prescriptions would be developed before the timber harvest. However, this option was not available because the land was logged by the previous owner before being sold. A lapse in the treatments to reforest or convert parts of the site to pasture allowed the competing shrub vegetation to dominate. Therefore, the optimal point (i.e. before logging), for planning beneficial treatments for integrated timber and forage production was missed.

The result was that more efficient economic options for improving either timber or forage production on the site were limited. The brushing and spacing treatment implemented in 2013 was intended to reduce the shrub component, space crop trees and improve forage values. However, it appears there was insufficient conifer regeneration at the time and it was too young to benefit from release. Aspen suckering was also encouraged by the treatment. The cost of the slashing/spacing treatment (approximately $1000/ha) was one factor that led the landowner to consider grazing management as a primary tool for achieving objectives. This included creating bladed corridors with a small dozer so that portable electric fencing could be used to control stock density. The objective of this practice was to increase browsing on shrubs and deciduous trees. At that point, bale grazing was introduced as a tool to reduce shrub cover, and increase forage values (Figure 8).

Figure 8 Improved forage values from Orchardgrass establishment after bale grazing in the south unit of the Silvopasture

The revised silvopasture plan placed a greater emphasis on the location, timing, and intensity of grazing. Two upland areas with better drainage were designated as bale grazing areas. This was intended to avoid pugging and soil compaction from cattle during spring breakup. The objective for the bale grazing areas was to convert shrub and dense aspen to open aspen with increased forage production in the understory (Figure 9). Bale placement was intended to minimize damage to large healthy well-spaced aspen and pockets of conifer regeneration.

Timber retention areas, which included the steeper slopes, were intended for more extensive grazing use. During the fall grazing period pasture units are not usually subdivided with portable electric fencing and stock densities are lower. It was recommended that additional timber reserve areas be considered at 3 years (2020) and again in 2023. This would allow sufficient growth among the existing 0.5 to 1.5m trees to identify suitable regeneration patterns and establish new timber retention areas within the strategic grazing plan. A 2m spacing criteria would be suitable for establishing these crop-tree retention areas. Another 30-40 years of growth would likely be necessary before a forest harvesting plan was required. Three temporary exclosures and 15 permanent photo monitoring points were established in the grazing areas to help identify the effects of grazing management on the vegetation.

At the time of original publication, it was too early to fully judge the effects of targeted grazing in shrub dominated areas. Most aspen were too tall to receive much, if any, browsing, although occasional breakage was observed. There was some browsing on smaller shrubs in the early spring grazing period. The more focused bale grazing approach was implemented in early spring 2016 and achieved the desired results. Even greater impacts on shrubs and aspen were achieved in early spring 2017 in the second area, however, conditions overall were wetter than 2016 and this again raised concerns about soil compaction.

In this example, it was also assumed that no new range developments were needed since the timber harvest areas were part of existing pastures. However, range developments need to be considered in silvopasture planning and could be required in other circumstances. Additional fencing might be needed if multiple harvest areas are set up in a large pasture unit.

Figure 9. Bale grazing in designated areas is part of the revised management plan for the silvopasture

Timber Economics

Substantial investment would be required to improve the timber value on the site, because of the competing shrub vegetation and the delayed establishment of spruce and fir regeneration. Some of the costs associated with treatments for improving timber production were explored during planning. One of the scenarios, which included machine mulching to control shrubs is shown in Figure 10.

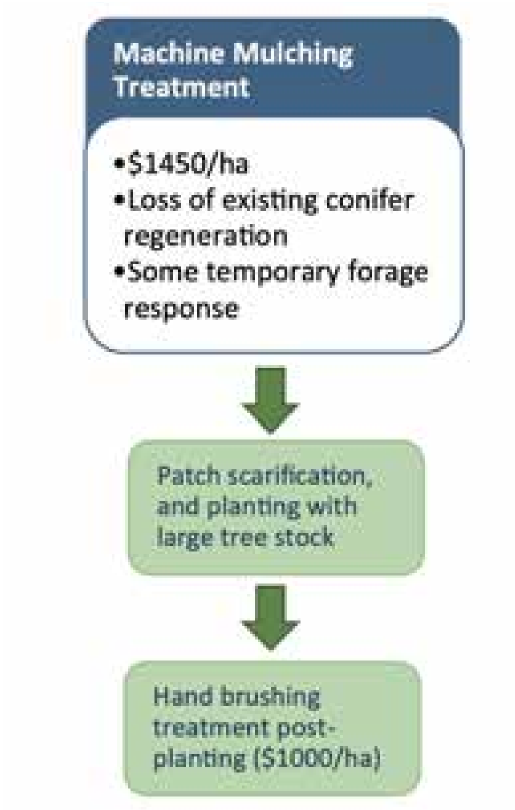

Figure 10. Potential treatment scenario for improving timber production on the Beaver Valley site (2017)

Growth and yield projections and estimates of harvest costs and log prices are needed to assess whether this kind of investment meets economic objectives. An appropriate risk factor is needed in an analysis of treatments because the cost of treatment failure would have to be absorbed by this single piece of land, rather than being apportioned over a larger forest management unit. Similarly, equipment and trucking costs are more significant in the cost-benefit analysis if they cannot be spread over a reasonably sized treatment area.

In this case however, the improvement of forage values was a higher order objective, while the objective for timber was to retain a sustainable and opportunistic harvest. For this reason, there was no need to consider the substantial investment required to improve timber values on site any further.

Forage Economics

A previous economic analysis found a positive residual cash flow and net present value for the capital investments made in fencing and water on the silvopasture when grazing use is 156 AUMs per year or more.[5] The scale of the cattle enterprise in 2017 meant actual grazing use had averaged 100 AUMs (with about 30 animal units) or 65% of this amount for the prior five years. Fewer animals had also limited how much area was covered with the bale grazing treatment each year, and required smaller pasture subdivisions to achieve adequate stock density for targeted grazing in shrub areas.

Winter Feeding

Winter feeding has a cost no matter where animals are being fed. However, feeding costs at the silvopasture site, for the several weeks in late-winter, were higher because hay was transported from the main hay storage and feeding site about two km away.

The main benefit of this practice was that animal impacts and nutrients were moved from a flood prone area (the main winter feeding location) to the silvopasture where these inputs could be used to meet silvopasture objectives.

More conventional methods of pasture conversion to increase forage on the silvopasture unit were also considered as options in the plan. A small area that was part of an old field in the 1940s, but that had grown back to timber, was included in the scenario. There were limitations with doing this type of economic analysis at such a small scale, like those highlighted in the improved timber production scenario above.

[5] Joynt, Howard. 2013. "Cariboo Silvopasture Demonstration Project Zirnhelt Ranch Big Lake, British Columbia: Financial Considerations." British Columbia Agroforestry Industry Development Initiative.

Expected revenues were based on a forage production response and the breakeven point is quite sensitive to these assumptions. Also, the additional forage must be grazed to provide the return on investment. Costs for creating pasture were based on:

- Stumping with D7 dozer with piling blade
- Double pass with heavy-duty breaking disc
- Forage seed and broadcast application
- Floating or dragging after seeding

The total cost for creating permanent pasture was estimated at around $1000 per ha in 2017. At this rate, the capital investment could not be justified when using conservative assumptions for future forage production, and when a fair risk factor, and equipment hauling costs were included. This type of conversion would become more economic with less risk, if the pasture were developed over a longer period with smaller producer- owned equipment. Small patch pasture conversion may be a reasonable objective; because it accommodates more tree retention which can produce additional non-market benefits (see Planning Context page 1).

Status

The landowners of the Beaver Valley site adopted the silvopasture plan developed under this project. Grazing and bale grazing practices were monitored and adjusted on an on-going basis to ensure they continue to support the silvopasture objectives.

WHAT HAVE WE LEARNED?

Silvopasture systems that include complex timber and forage production objectives require a high degree of planning and management expertise. The silvopasture applications described above have additional complicating factors that make them even more challenging to plan and manage. Those factors include physical and environmental constraints, limits in operational scale, and changed land ownership resulting in different land use objectives:

- The 144 Mile site involved selective harvest of Interior Douglas-fir, with very specific stand management requirements, resulting in high harvest costs.
- The Beaver Valley site, while an operational silvopasture, was logged by a previous owner. Therefore, planning beneficial treatments for integrated timber and forage production at the optimal time (i.e., before logging) was not possible for the current landowners.
- Both demonstration sites are in the lower range of productive capability in their respective zones.
- The operational scale for planning timber production was constrained at both sites, which adds additional risk, and does not allow for economies of scale in treatments.

Some general observations were made through the process of planning the Cariboo Silvopasture demonstrations:

- Increased forage production can be expected to occur naturally following timber harvest, and while there are opportunities for grazing enhancement within these systems, expectations need to be realistic. Increased forage may be short-term, unless it can be planned and integrated with subsequent timber harvest and regeneration or other stand treatments.
- If a sustainable timber production objective is part of the silvopasture application, then adequate steps need to be taken for tree regeneration in a pre-treatment plan.
- Appropriate stocking and spacing of regeneration is critical to produce healthy and viable crop trees.
- Integrating the long-term planning required for sustainable timber production with the annual harvest of forage on private land is likely to remain challenging.

- The overall demand for forage in the livestock enterprise should be considered to determine whether an investment in silvopasture is worthwhile. Alternative investments in improved forage production elsewhere on the ranch may provide better returns.
- There is likely some potential for planned silvopasture applications in operations that already manage a Woodlot tenure and have livestock operations.
- Consideration of non-market resource values, such as riparian area function and visual quality, by landowners can influence decision making in silvopasture applications on private land – as they have in these examples.

ADDITIONAL CONSIDERATIONS

- The long-term sustainability of operations will increasingly depend on management of non-market resource benefits to help mitigate the impacts of climate change. For example, managing tree cover for local climate regulation.
- Complete removal of trees on some sites, particularly in the Interior Douglas-fir zones, may limit future tree growth and reduce site productivity. Use of a selective harvest system with adequate retention in this zone is important for the sustainability of the timber resource.
- Harvest treatments in the Interior Douglas- fir zones can also minimize risk from wildfire by reducing fuel loads and changing the forest stand structure.

SOME BASIC SILVOPASTURE PLANNING GUIDELINES AND INFORMATION

1. Identify objectives – clear objectives are necessary to guide decision-making and produce desired outcomes. Objectives should support higher-level goals of the landowner, and fit with the operational circumstances and the productive capability of the site.
2. Know your resource – timber is valuable and will become increasingly more so with an expected shortage in the mid-term timber supply.
3. Know the productive capability, zone and moisture regimes of your site.
4. Seek professional expertise to assist with the site assessment and planning – an experienced professional forester with both harvest planning and silviculture experience will know appropriate site preparation treatments and tree regeneration requirements. Refine objectives based on professional input.
5. Identify and map management or treatment units to support objectives.
6. Economics – Use realistic assumptions, and include a risk factor (i.e., an added cost) in the analysis, to account for uncertainty in treatment outcomes. It is important to consider current costs and returns, but also long-term and non-market benefits, such as:
   a) Watershed function
   b) Riparian area function
   c) Visual quality
   d) Fine fuel reduction and wildfire risk mitigation
   e) Wildlife habitat, and
   f) Climate regulation
7. Planning costs – assume at least some costs for professional site assessment and planning, especially in the Interior Douglas-fir zone. A timber cruise and summary report was around $6000 per 100 ha in 2017. Once cruise data is entered in a timber cruise software package different cutting scenarios can be produced at minimal cost.
8. Employ conscientious and experienced contractors who understand management objectives and can practically implement them on your site.

9. Consider BC Worksafe requirements if you are the landowner and plan to do the work yourself.
10. A private timber mark is required to transport logs cut on private land. Information on timber marks and registration can be found at: Private Timber Marks - Province of British Columbia
11. Interior log market reports are available at: Interior Log Market Values - Province of British Columbia
12. Information on forage seeding for silvopasture and other applications can be found in the BC Rangeland Seeding Manual at: bc_rl_seeding_manual_web_single_150dpi 0904.pdf
13. A handy tool for creating and pricing forage seed mixtures is available at: Forage U-Pick – An interactive forage species selection tool for Canada

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