Extension Note

BC Journal of Ecosystems and Management

Arrow IFPA Series: Note 4 of 8

Sustainable forest management basecase analysis: The Lemon Landscape Unit pilot project

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Abstract

This extension note is the fourth in a series of eight that describes a set of tools and processes developed to support sustainable forest management planning and its pilot application in the Arrow Timber Supply Area (TSA). It describes a pilot project designed to evaluate the use of criteria and indicators in developing a sustainable forest management (SFM) basecase and to provide decision support for managers in creating SFM plans. This note outlines how indicators can be used to define management objectives, planning units, and harvesting constraints or "initial thresholds," and how the resulting SFM basecase was evaluated in trade-off and sensitivity analyses. The process revealed some priority issues in which management objectives for some indicators had significant effects on a measure for the timber criterion (harvest volume) and others had minimal effect. Although the SFM basecase was intended to emphasize non-timber criteria, it nonetheless yielded a greater short- and long-term timber supply than a scenario based on Forest Practice Code rules. This note provides an example of the first iteration of a decision-support process requiring the participation of decision makers and allowing public feedback. Initial results suggest that this decision-support approach has merit and could form an important part of an SFM framework based on criteria and indicators.

KEYWORDS: *sustainable forest management, thresholds, timber supply analysis, trade-offs.*

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Wells, R. and J. Nelson. 2006. Arrow IFPA Series: Note 4 of 8. Sustainable forest management basecase analysis: The Lemon Landscape Unit pilot project. *BC Journal of Ecosystems and Management* 7(1):67–75. URL: *http://www.forrex.org/publications/jem/ISS34/vol7_no1_art4.pdf*

Introduction

In a criteria and indicators (C&I) approach (see Arrow IFPA Extension Notes 1 and 2), indicators are used to assess success in meeting sustainable forest management (SFM) criteria (sustainability goals). As such, indicators are often discussed from a monitoring context, in which monitoring is intended to evaluate how well criteria are met. By their nature, however, indicators (and related thresholds) can, and should, provide the focus for planning and associated decision support.

Because forestry involves large areas and long time frames, models are required to assess practices and policy related to SFM. Models allow the evaluation of trade-offs among indicators and the tracking of trends for various indicators. In this way, both conflicting and complementary management objectives can be identified, and thresholds and plans refined. In this extension note and others in the series (see sidebar), we describe a process that used three closely linked models:

1. ATLAS for harvest scheduling;
2. FORECAST for estimates of growth and yield and stand-level habitat attributes; and
3. SIMFOR for habitat modelling (results presented in Extension Note 5).

By their nature, indicators can, and should, provide the focus for planning and associated decision support.

Our goal in this study was to demonstrate a decision-support process that could help decision makers develop and assess management plans, and facilitate public consultation processes.

Sustainable Forest Management Pilot Basecase Analysis Process

Analyses and modelling to support SFM can occur at both a strategic (e.g., timber supply analysis for a large management unit such as a timber supply area) and a tactical level (e.g., more detailed planning objectives for a smaller unit such as a landscape unit). We selected a smaller unit on which to pilot a decision-support process for the tactical-level planning outlined in the SFM framework document (see Extension Note 1). As such, we focussed on relatively detailed, tactical-level questions and used a small planning unit (Lemon Landscape Unit) as our study area (see Figure 1, Extension Note 1). This 42 000-ha

The IFPA Sustainability Project

The Arrow Innovative Forestry Practices Agreement (IFPA) was established as a co-operative effort between the five licensees* in the Arrow Timber Supply Area (see Figure 1, Extension Note 1) and the B.C. Ministry of Forests' Nelson Forest Region. The Sustainability Project was an important initiative of the Arrow IFPA that partnered forest practitioners and academic researchers to develop a comprehensive approach to planning and implementing sustainable forest management.

The result of this work has been the Sustainable Forest Management Framework, which is now being used by Canfor* to guide certification and sustainable forest management planning in their British Columbia operations. For further background, refer to: *http://www.sfmportal.com*

Disclaimer

The ideas presented in this extension note form part of a project (outlined in a series of eight notes) that was initiated to develop a system for evaluating management options under a criteria and indicators framework. These ideas do not represent real management options for the Lemon Landscape Unit, or the Arrow TSA, although they could form the basis of such options.

* The Arrow Forest Licensee Group was comprised of Slocan Forest Products, Kalesnikoff Lumber, Atco Lumber, Riverside Forest Products, and Bell Pole. In 2004, Slocan Forest Products Ltd. was acquired by Canadian Forest Products Ltd.

landscape unit in the Arrow Timber Supply Area (TSA) is bounded by Slocan Lake and the community of Slocan to the west and Kokanee Glacier Provincial Park to the east.

The pilot planning process (Figure 1) includes four main steps:

1. Choosing criteria and setting management objectives for the planning unit of interest.
2. Using indicators to define management objectives and thresholds.
3. Defining the SFM basecase, analyzing trade-offs and sensitivities.
4. Determining priority issues and revising thresholds.

These steps are defined in the following sections.

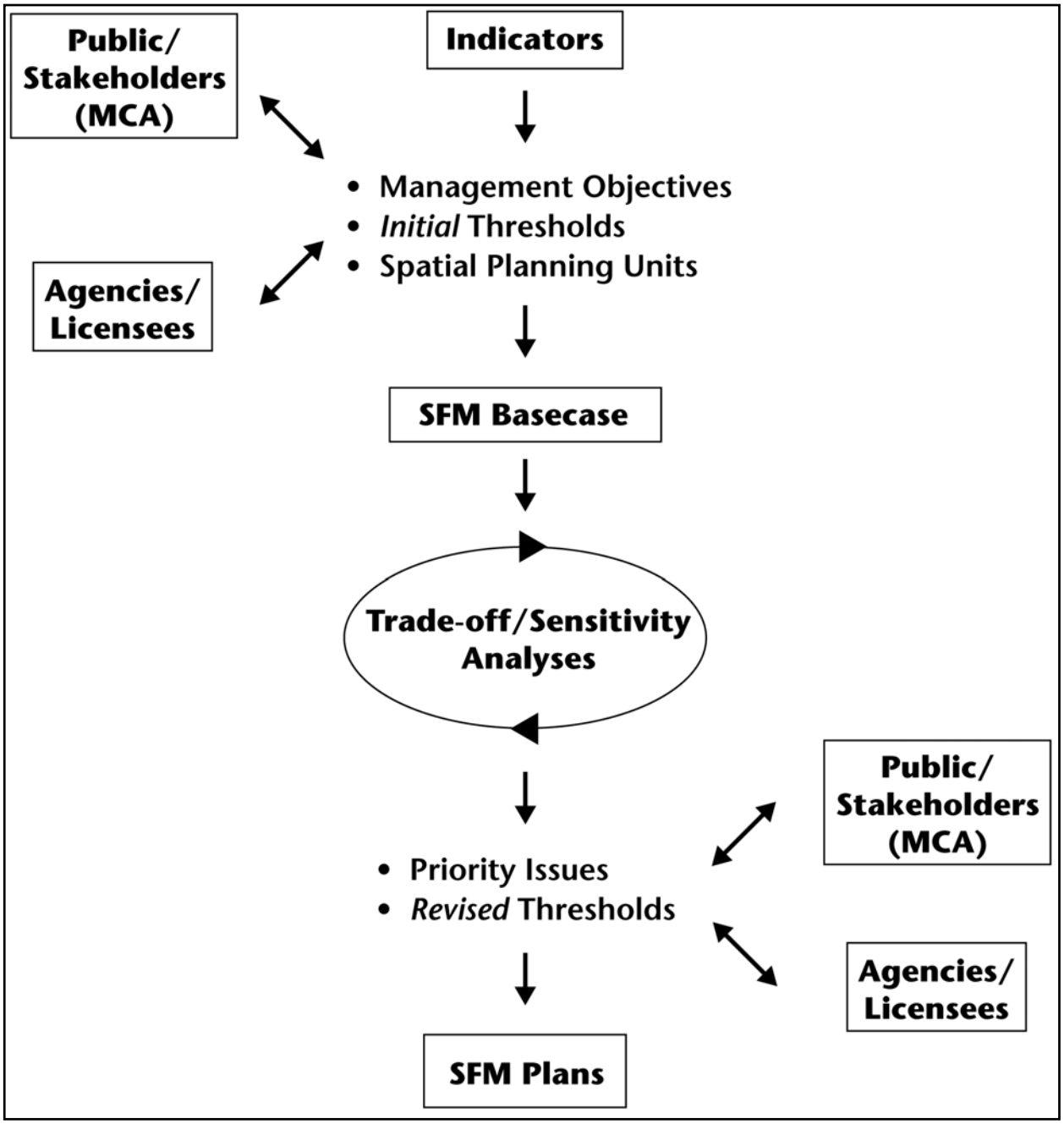

FIGURE 1. Decision support process for indicator-driven basecase analysis.

Choosing Criteria and Setting Management Objectives

Although all criteria should be met over the entire planning area to which C&I apply (e.g., the Arrow TSA), they may not apply to all subunits of the area or be weighted equally throughout the planning area. We selected a subset of criteria for the Lemon Landscape Unit. This subset was based on the results of a TSA mail survey and a multi-criteria analysis (MCA) (see Extension Note 3). Criteria selection was also based on the results of a scenario planning workshop that was held in Fall 2001 and attended by local practitioners and University of British Columbia researchers associated with the Arrow IFPA.

Criteria chosen for the Lemon Landscape Unit were:

- Criterion 1 – Biodiversity
- Criterion 2 – Soils/Productivity
- Criterion 4 – Timber Economic Benefits
- Criterion 6 – Water Quality/Quantity
- Criterion 9 – Quality-of-Life Benefits

See Extension Note 2 for a detailed description of these criteria. Based on the scenario planning and MCA workshop results, we gave non-timber criteria priority over Criterion 4 (timber-related economic benefits).

Using Indicators to Define Management Objectives and Thresholds

An important step in the process, this phase has three components.

1. Using indicators to guide the choice of appropriate management objectives for the planning unit and level of planning detail (strategic or tactical).
2. Setting initial thresholds and defining best management practices related to management objectives (see Extension Note 1).
3. Defining the spatial planning units to which the management objectives and thresholds will apply (e.g., Figure 2).

At this stage, the initial timber harvesting land base (THLB) and non-timber harvesting land base (NHLB) designation is developed (see Extension Note 1; see also the discussion related to representation thresholds for Indicator 1 in Extension Note 5). For the Lemon Landscape Unit pilot project, several teams worked together to set management objectives and thresholds for indicators associated with the chosen criteria (Extension Notes 5–8). Literature review, expert opinion, and some modelling and analysis were applied to develop thresholds and define spatial planning units.

Defining the Basecase, Analyzing Trade-offs and Sensitivities

A sustainable forest management "basecase" is developed by combining spatial planning units and associated initial thresholds. The SFM basecase defines the starting point from which trade-off and sensitivity analyses can begin. We used ATLAS harvest scheduling software (Nelson 2003) linked to the FORECAST stand growth model (Seely *et al.* 2002) to determine the effects of various non-timber indicator thresholds on the timber volume measure. Other thresholds were applied as constraints to harvesting, both individually and in combination, to determine individual and combined sensitivities for timber supply. For some indicators (e.g., snags), thresholds were not determined; rather, measures for these indicators were tracked as part of the basecase analysis.

Analysis may reveal where thresholds are exceeded or where trends for some indicators are considered significant enough to warrant further consideration. This can lead to alternative scenarios that incorporate changes to practices in the THLB or additions or removals from the NHLB. Further trade-off and sensitivity analyses must be developed thoughtfully because the number of potential analyses can be impractical. For this reason, analyses are best done iteratively with review between each iteration.

To support a comprehensive trade-off analysis, sensitivities should be examined among other indicators in addition to timber volume. For example, for the biological richness criterion, visual thresholds could be applied as a constraint to evaluate different habitat indicators such as snags (Extension Note 5).

Determining Priority Issues and Revising Thresholds

The basecase trade-off and sensitivity analyses provide two important types of information.

1. The analysis helps to identify priority management issues. Analysis can reveal that some management objectives for some indicators are either complementary or have relatively little effect on unrelated indicators; others have high impact suggesting further evaluation.
2. After identifying where indicators are in conflict, decision makers may choose to revise thresholds. This is where trade-offs are determined, informed by decision support. Decision makers may also incorporate information from public review of the trade-off analysis.

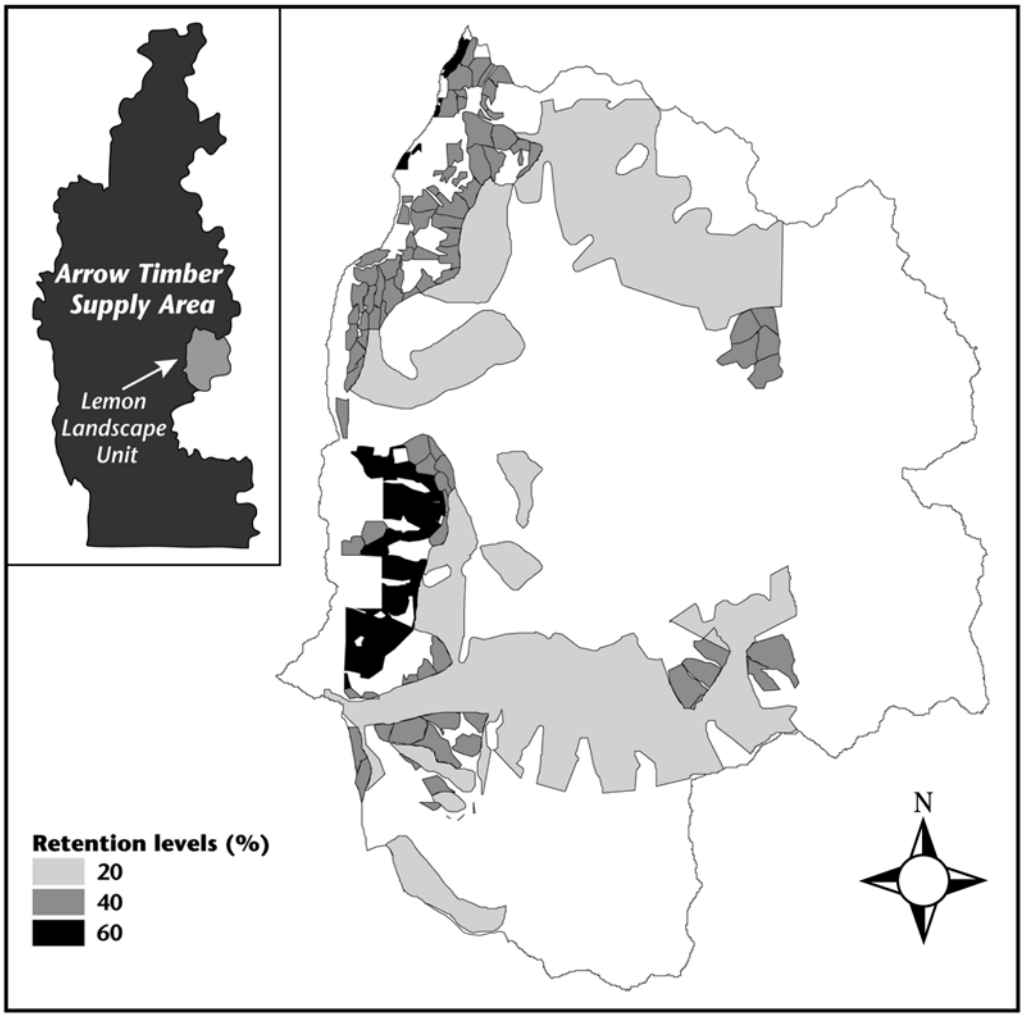

FIGURE 2. Spatial planning units and initial thresholds for a visual quality indicator in the Lemon Landscape Unit.

Natural Disturbance

Consideration of natural disturbance events is necessary when evaluating scenarios, especially where indicators are tracked in the NHLB (many of the Criterion 1 indicators fall into this category). Natural disturbance was incorporated in the ATLAS runs for the NHLB based on turnover rates found in the Forest Practice Code *Biodiversity Guidebook* (B.C. Ministry of Forests and B.C. Ministry of Environment 1995). A 20% decrease in rates was applied to account for fire suppression. An example risk analysis was also incorporated based on the assumption that shelterwood harvesting in the Lemon Landscape Unit could result in a volume loss of up to 50% due to root rot (D. Delong, B.C. Ministry of Forests, [former] Nelson Forest Region, pers. comm., 2002).

Results

The initial thresholds and planning units for each criterion in the Lemon Landscape Unit pilot analysis are described in Extension Notes 5–8. If thresholds were not determined, then measures were proposed to track the effects of the scenario assumptions on indicators. Spatial units were defined in ATLAS as "cliques" (i.e., spatial units to which rule sets are applied), and thresholds were applied as constraints to harvest for each clique. One exception related to 40% and 60% retention thresholds for visual objectives on the Lemon Landscape Unit (Extension Note 8). In this case, shelterwood growth and yield curves were generated in FORECAST and then applied to 40% and 60% visual retention harvest units on the Lemon Landscape Unit (Figure 2).

After applying management thresholds (constraints in ATLAS; Table 1) and the appropriate growth and yield curves, the relative effects of different indicators on timber supply were evaluated with ATLAS (Figure 3). All constraints were 100% retention (no harvest) or handled by ATLAS as in-block reductions to volume for partial constraints (e.g., recreation 40% retention). Equivalent clearcut area (ECA) constraints for water quality were generally 30% ECA, although an "H60" ECA of 25% was applied above 1600 m.

TABLE 1. Constraint definitions used for the SFM pilot basecase analysis

Criterion	Constraint	Description	Threshold	Location
Biodiversity	Ecosystem Representation	Ecosystem representation reserves	No harvest	Various
	Riparian Habitat	Riparian buffers 40–200 m wide	No harvest	S2, S3 and S5 streams
	Lemon Hardwoods	Hardwood patches on Lemon Creek	No harvest	Lemon Creek
	OGMAs	Late seral management reserves	No harvest	Various
	Lemon Mule Deer	Mule deer winter range, Lemon Creek	No harvest	Lemon Creek
	Springer Mule Deer	Mule deer winter range, Springer Creek	No harvest	Springer Creek
	Enterprise Mule Deer	Mule deer winter range, Enterprise Creek	No harvest	Enterprise Creek
	Bull Trout	20-m riparian buffers for bull trout	No harvest	Lemon S5 streams
Water Quality	ECA	Equivalent clearcut area	25% and 30%	Sub-basins (Springer and Lemon)
	Riparian Water Quality	10-m riparian buffers	No harvest	Sub-basins (Springer and Lemon)
Quality of Life	Recreation 20%	Area with recreation objectives	20% in-block	Various
	Recreation 40%	Area with recreation objectives	40% in-block	Various
	Recreation 100%	Area with recreation objectives	No harvest	Various
	Visual 20%	Area with visual quality objectives	No harvest	Various

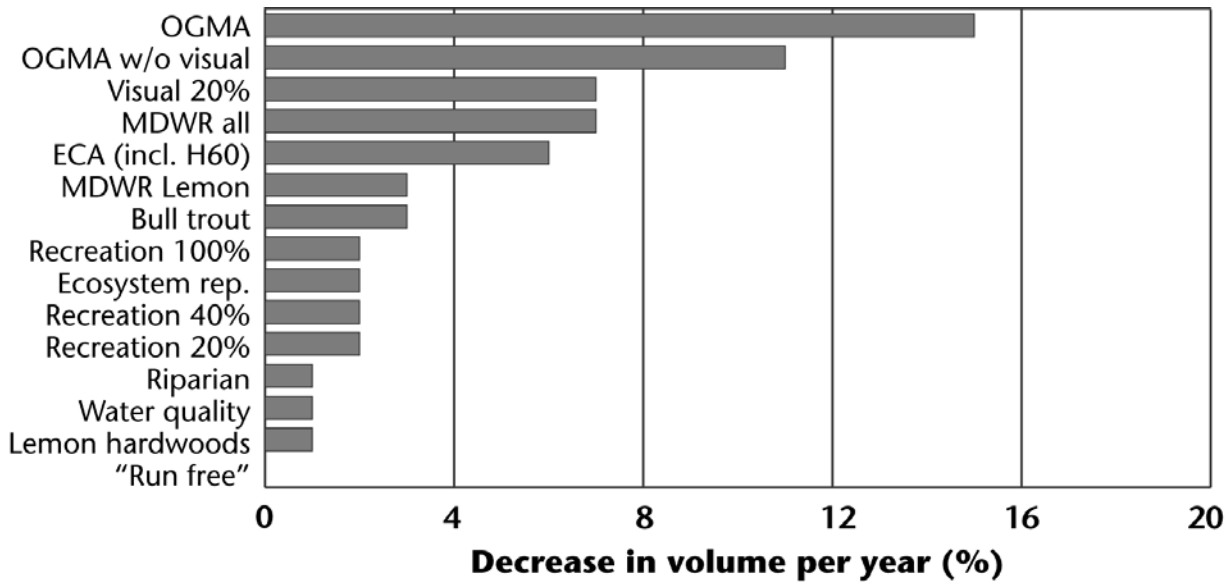

FIGURE 3. Timber volume impacts of indicator thresholds, considered individually (% decline in m^3/year relative to no constraints; "*Run free*").

In general, the analyses demonstrate that no-harvest thresholds for riparian habitat and water quality have relatively small individual effects on timber supply (Figure 3). Ecosystem representation and 100% retention for recreation also have relatively low (2%) effects on timber volume. More importantly, these two thresholds were complementary: after ecosystem representation thresholds were considered, the 100% recreation threshold had little cumulative effect (Nelson 2002). This occurred because much of a proposed reserve for recreation in the Enterprise Creek drainage of Lemon Landscape Unit (Extension Note 8) coincided with the location of an under-represented ecosystem type (Extension Note 5). Old Growth Management Areas, Visual Quality Objective 20% retention, and mule deer winter range all had greater impacts and should be considered for further review. These latter thresholds fall under the "priority issues" category of Figure 1. Further review must consider measures for other indicators, not just timber (e.g., changes to Old Growth Management Areas will directly affect measures of snag density as well as timber).

We projected long-run timber supply of the scenarios and sensitivity runs (Figure 4). Included as baselines are the Forest Practice Code (FPC) and zoning scenarios prepared previously for the Lemon Landscape Unit (Nelson 2001). The SFM basecase and sensitivity runs all produced higher timber volumes in the short term than the 2001 scenarios. Most runs, with the exception of the basecase, also produced higher timber volumes over the long term than did the FPC and zoning scenarios. The higher short-term timber volumes in the SFM scenarios were the result of shelterwood harvests in the visually sensitive, high-retention areas of the Lemon Landscape Unit (Figure 2). We also evaluated the contribution of shelterwood and clearcut harvesting to the total basecase harvest (Figure 5). We found that for some decades, shelterwood provides a substantial proportion of the timber supply. During those decades, we found that the timber supply was vulnerable to losses under a root-rot scenario that assumes a 50% loss of volume in a partial-cut regime (Figure 5).

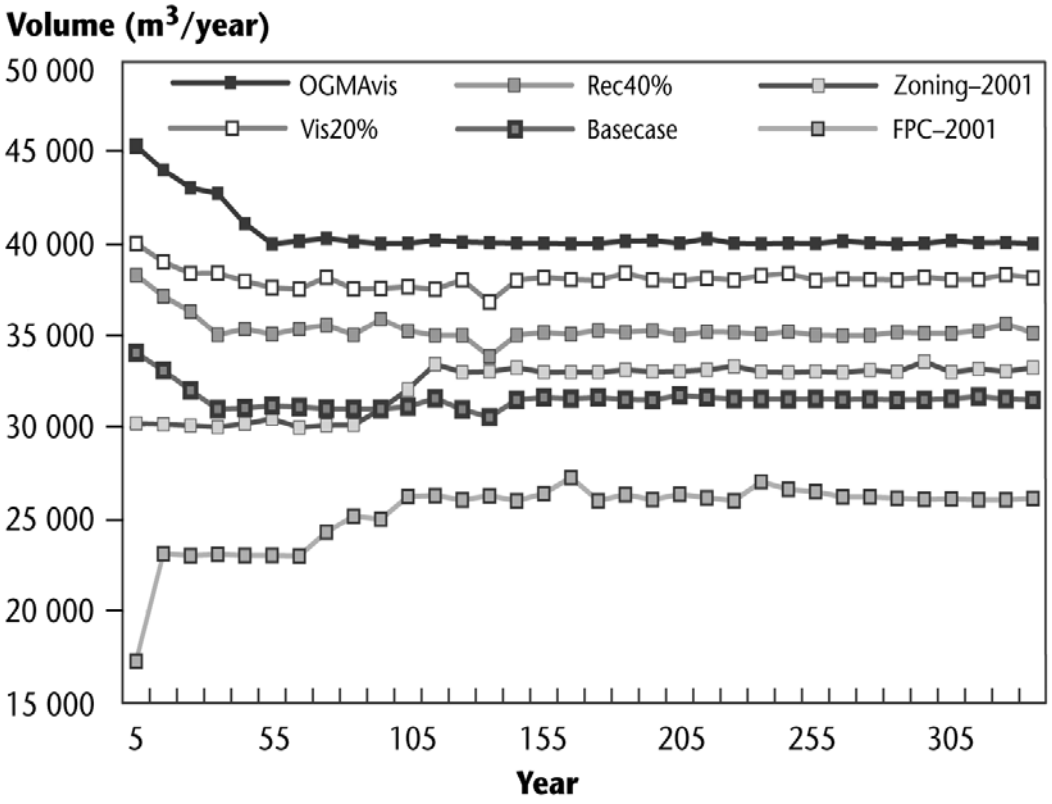

FIGURE 4. Harvest forecasts for the Lemon Landscape Unit, including the Forest Practices Code and zoning scenarios.

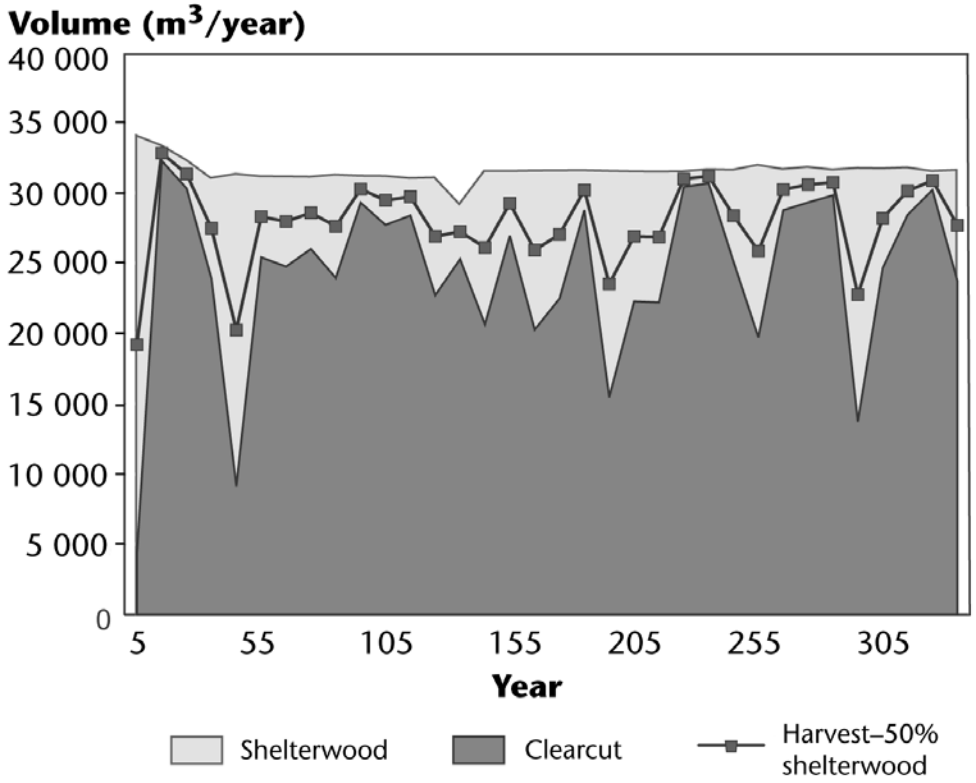

FIGURE 5. Distribution of harvest volume by shelterwood and clearcut silviculture systems for the basecase. Included is the total harvest under the assumption of 50% losses due to root rot in the shelterwood systems.

Future Directions

Overall, we believe the SFM basecase analysis for the Lemon Landscape Unit demonstrates that a C&I framework allows for effective decision support. Indicators ensure that the definition of spatial units and the setting of initial thresholds is a transparent process. Indicators should ultimately provide clear linkages between initial criteria (sustainability goals), resulting SFM plans, and operational implementation of harvesting.

This SFM basecase analysis examined only the initial stages of the overall decision-support process. Analyses should be iterative, so that results from previous stages focus the direction of later stages. Each stage should also identify areas that support easy decisions (win–win, such as complementary representation and recreation objectives), which have immediate planning dividends. Our results suggest that some riparian, recreation, and ecosystem representation goals could be achieved with minimal effects on timber supply, while other goals (e.g., those related to a Visual Quality Objective of 20% retention, mule deer winter range, and root-rot related volume losses) could receive further evaluation. Ideally, learning at the tactical level can inform and improve strategic analyses. For example, riparian assumptions could be "scaled up" to evaluate whether results for the Lemon Landscape Unit are confirmed in a TSA-wide analysis. This would inform decision makers who are considering the application of new SFM indicator-based riparian guidelines over the Arrow management unit.

We believe that further attention is required in the following three important areas:

1. involving decision makers and the public,
2. undertaking risk assessments, and
3. maintaining transparency.

Involve Decision Makers and the Public

An important next step is to bring decision makers into the process. This could be an individual licensee, or a larger group of agencies and licensees. Regardless of scale, without the direct involvement of decision makers there is little chance that decision-support processes will inform real decisions. Furthermore, the process outlined in this extension note should facilitate public participation processes, both in communicating management objectives and in receiving feedback from stakeholders.

We believe the SFM basecase analysis for the Lemon Landscape Unit demonstrates that a C&I framework allows for effective decision support.

This could involve public advisory committees formed for certification purposes or more formal stakeholder processes such as those included in the MCA (see Extension Note 3).

Undertake Risk Assessments

A second area that requires attention is risk assessment. Quantifying the potential effects of natural disturbances, such as beetle outbreaks or landslides (identified in the MCA process as a public concern), is necessary and possible with existing tools and models. Appropriate risk assessments should be included in sensitivity analyses. In the pilot SFM basecase analysis, we projected disturbance events in the non-harvesting land base and looked at potential effects of root rot in partial-cut stands in the Lemon Landscape Unit. The results from the root-rot sensitivity analysis underline the importance of undertaking these assessments.

Maintain Transparency

We have already noted that the use of indicators facilitates transparency by making objectives clear. This is not enough. Our experience suggests that the effective communication of analysis objectives and crucial model assumptions to participants of modelling workshops is critical to success. Good technical documentation of modelling objectives, assumptions, and results is also important for extending results to decision makers or the public. Information and analysis reports commonly provided for strategic timber supply analyses provide an excellent model for documentation.

Acknowledgements

The ideas presented in this extension note evolved significantly during a series of scenario planning workshops at the University of British Columbia (UBC) over Winter 2002. They reflect the input of UBC Arrow Innovative Forest Practices Agreement (IFPA) members and others involved in the Arrow IFPA Sustainability Project. We offer special thanks to Arnold Moy for developing the many databases required for this pilot project in a timely manner.

Publication of this series of extension notes has been supported by Atco Lumber, Bell Pole, Kalesnikoff Lumber, Riverside Forest Products, and Slocan Forest Products, the Ministry of Forests' small business program, and the University of British Columbia, as well as by the British Columbia Ministry of Forests and Range through the Forest Investment Account, Forest Science Program.

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ARTICLE RECEIVED: **July 15, 2005**
ARTICLE ACCEPTED: **February 1, 2006**

Test Your Knowledge . . .

Arrow IFPA Series: Note 4 of 8 – Sustainable forest management basecase analysis: The Lemon Landscape Unit pilot project

How well can you recall some of the main messages in the preceding extension note? Test your knowledge by answering the following questions. Answers are at the bottom of the page.

1. What were the four steps applied in the Lemon Landscape Unit pilot planning process?

2. How does a "basecase analysis" help determine priority issues?

3. In the example analysis discussed in this extension note, what risk analysis demonstrated a potential impact on timber supply?

ANSWERS

1. The pilot planning process includes four main steps:

- *Choosing criteria and setting management objectives for the planning unit of interest.*
- *Using indicators to define management objectives and thresholds.*
- *Defining the SFM basecase, analyzing trade-offs and sensitivities.*
- *Determining priority issues and revising thresholds.*

2. A well-designed analysis can reveal that some management objectives for some indicators are either complementary or have relatively little effect on indicators for other criteria. These would be low priority for further review. Others may have high impact on one or more indicators, suggesting further evaluation is necessary to resolve the conflict.

3. The analysis on the potential impact of root rot in partially harvested stands.