

Working Together: A Reciprocal Wood Flow Arrangement to Mitigate the Economic Impacts of the Mountain Pine Beetle in BC

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I. Introduction

The issue:

- Unprecedented mountain pine beetle infestation in the BC interior.
- Current infestation can be traced back to 1990, and has affected 8.5 million hectares of forestland in BC.
- Big changes are expected for future wood supply in communities:
 - Initial up-lift (there are mill capacity issues)
 - Long-run down-fall (there will be negative spin-off effects)



I. Introduction

Government response:

Federal Government:

- *Mountain Pine Beetle Emergency Response: Canada-BC Implementation Strategy*
 - Directs \$38 million (\$CDN) to impacted communities for economic development planning and fuel management treatments.

Provincial Government (BC):

- *Northern Development Initiative Trust Fund* - \$185 million.
- *Southern Interior Development Trust Fund* - \$50 million.
- Provide financial support for regional beetle action coalitions.



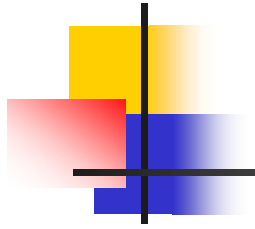
I. Introduction

Questions to consider:

- (1) What are the economic impacts of the infestation under policy-as-usual?
- (2) Could affected and unaffected communities work together to mitigate the negative economic impacts of the infestation?

The Reciprocal Wood Flow Agreement (RWFA) idea:

- The affected region allocates their excess salvaged timber to the unaffected region who reduces their AAC proportionately.
- In the future, the unaffected region reciprocates an equal amount of AAC to the affected region.



II. Study Region

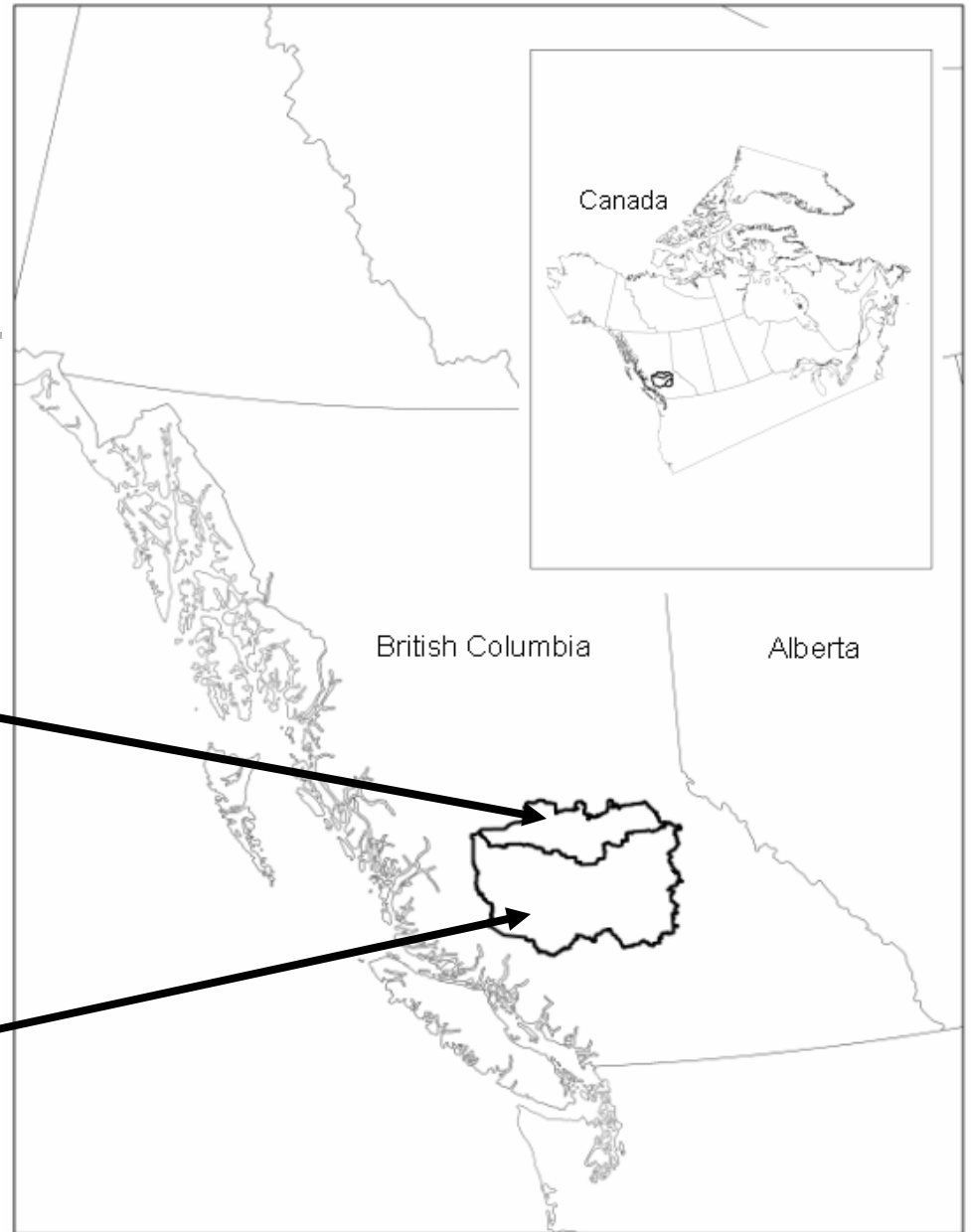
Two case-study communities:

Region 1:

- Quesnel Timber Supply Area.
 - High Beetle Pressure
 - AAC increased in 2005

Region 2:

- Williams Lake & 100 Mile House Timber Supply Areas.
 - Low Beetle Pressure
 - No change in AAC





III. Previous Literature

“Booms” and “Busts” in forest-dependant communities

- Forest-dependent communities in BC tend to have higher economic indicator levels than other communities (Stedman et al. 2005).
- Resource-dependent regions typically exhibit booms and busts from market and environmental changes.
 - “Booms” are characterized by increased economic output, income, employment, in-migration, crime, etc. (Wilson 2004).
 - “Busts” are characterized by the opposite.
- Repeated cycles tend to cause much community instability... policy is designed to smooth the cycles (Smith et al. 2001).



III. Previous Literature

Economic modeling approaches:

- IO, SAM, and CGE models have traditionally been used to examine the economic impacts of changes in natural resource markets and policies.
- Many studies use CGE models to examine the economic impacts of changes in provincial or state AAC levels (Alavalapati et al. 1996; Das et al. 2005).
 - A few studies examine economic impacts at the community level (Alavalapati et al. 1999; Lantz and Yigezu 2003).



IV. Methods

- We calibrate a CGE model to each case-study community, and simulate economic impacts of beetle-induced changes in AACs under different policy (or RWFA) scenarios.

General structure of the CGE model:

- The CGE model used in this analysis follows the stylized version developed by Johansen (1974):
 - A static and deterministic model.
 - Economies under consideration are small, perfectly competitive, open to trade, and exhibit CRS production technologies.



IV. Methods

General structure of the CGE model:

- Six major sectors are defined:
 - Agriculture
 - Forestry
 - Service
 - Public
 - Visitor
 - All other
- Three primary factors of production are defined:
 - Labour
 - Capital
 - Land
- Three groups of economic agents are represented:
 - Consumers
 - Producers
 - Government



IV. Methods

General structure of the CGE model:

Consumers:

- Demand commodities in a way that maximizes their consumption utility subject to their income and prices.
- Supply inputs to producers at a market price and receive government expenditures.

Producers:

- Supply commodities in a way that maximizes their profit subject to technology constraints, prices, and royalties.
- Demand inputs from consumers at a market price.

Government:

- Collects royalties from producers and redistributes to consumers via lump-sum government expenditures.



IV. Methods

General structure of the CGE model:

- Wage rates are assumed rigid.
- Capital and land are assumed sector-specific.
- Export demand is exogenously determined.
- Equilibrium in the model is achieved when a set of input and commodity prices in each sector clears the market (supply equals demand).

AAC change scenarios are simulated through changes in export demand.



IV. Methods

Economic indicators examined:

Economic Indicator	Description
Net Regional Product (NRP)	Sum of all direct and indirect dollar payments for inputs net of capital depreciation (GDP at factor cost).
Royalties	Payments made to government for use of publicly owned resources.
Labour Income	Payments made by firms in a sector to their employees.
Employment	The number of jobs directly related to a sector.



IV. Methods

Model calibration:

- Data for each region was collected using a hybrid method of both primary and secondary sources (Patriquin et al. 2002).
 - Secondary sources:
 - Provincial I/O data, AAC levels, Employment, Income
 - Primary sources:
 - Conducted a business survey of each community, based on a stratified sample of 25% of businesses (40% response rate).
- Information was organized into a SAM, and used to compute various parameters of the model.



IV. Methods

Scenario Design:

- Pre-infestation AACs in Regions 1 and 2 were just over 3 million and 5 million cubic meters, respectively.
- Government reports indicate the following changes in Region 1:
 - A short-term AAC uplift of just over 2 million cubic meters.
 - A long-term AAC downfall of just under 2.5 million cubic meters.

Summary of anticipated changes in each region's AAC.

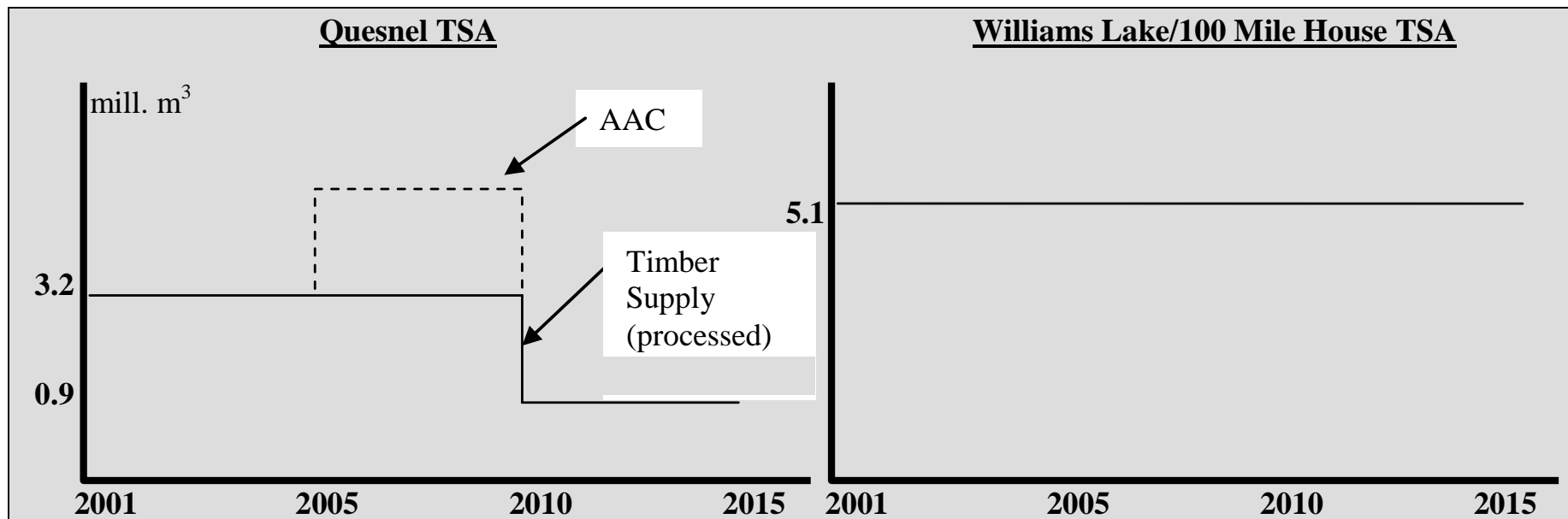
Region	2001-04	2005-09	% Change	2010-14	% Change
1	3,248,000.0	5,280,000.0	62.6	900,000.0	-72.3
2	5,102,400.0	5,102,400.0	0.0	5,102,400.0	0.0
Total	8,350,400.0	10,382,400.0	24.3	6,002,400.0	-28.1

IV. Methods

Scenario Design:

Scenario 1:

- Based on existing policy (no RWFA).
- AAC uplift in Region 1 assumed to immediately flow out of the region due to capacity constraints in mills.

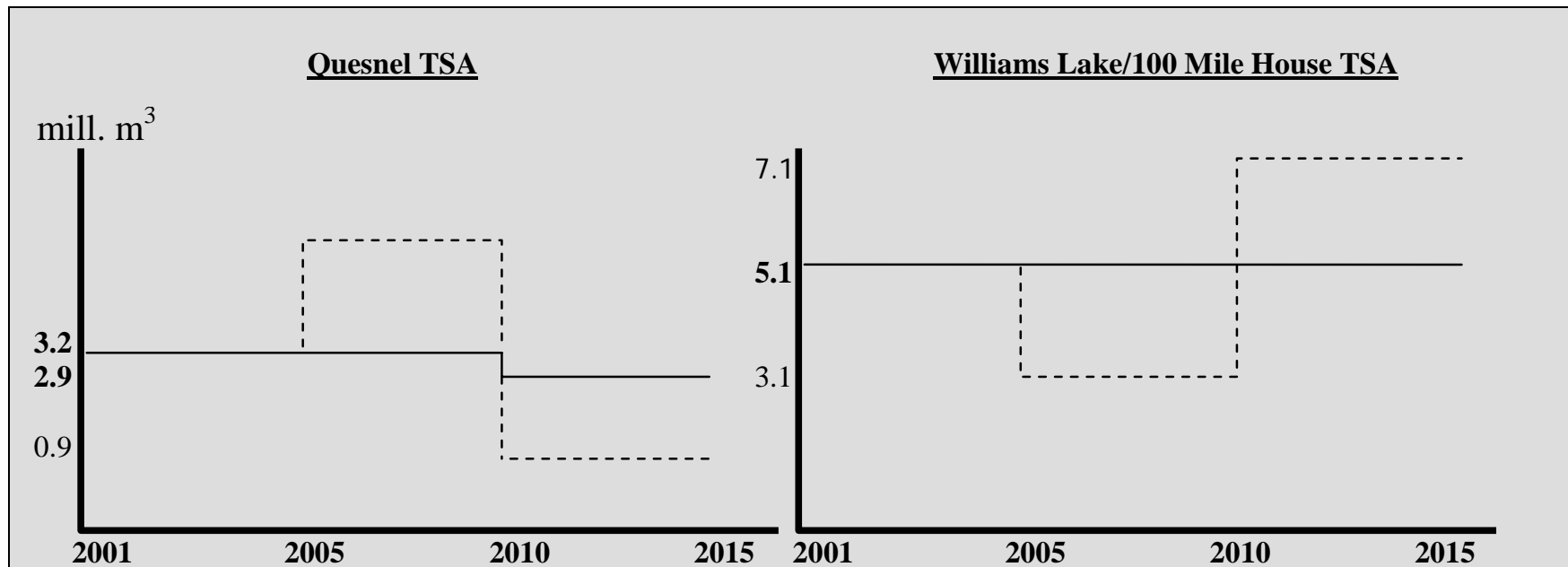


IV. Methods

Scenario Design:

Scenario 2:

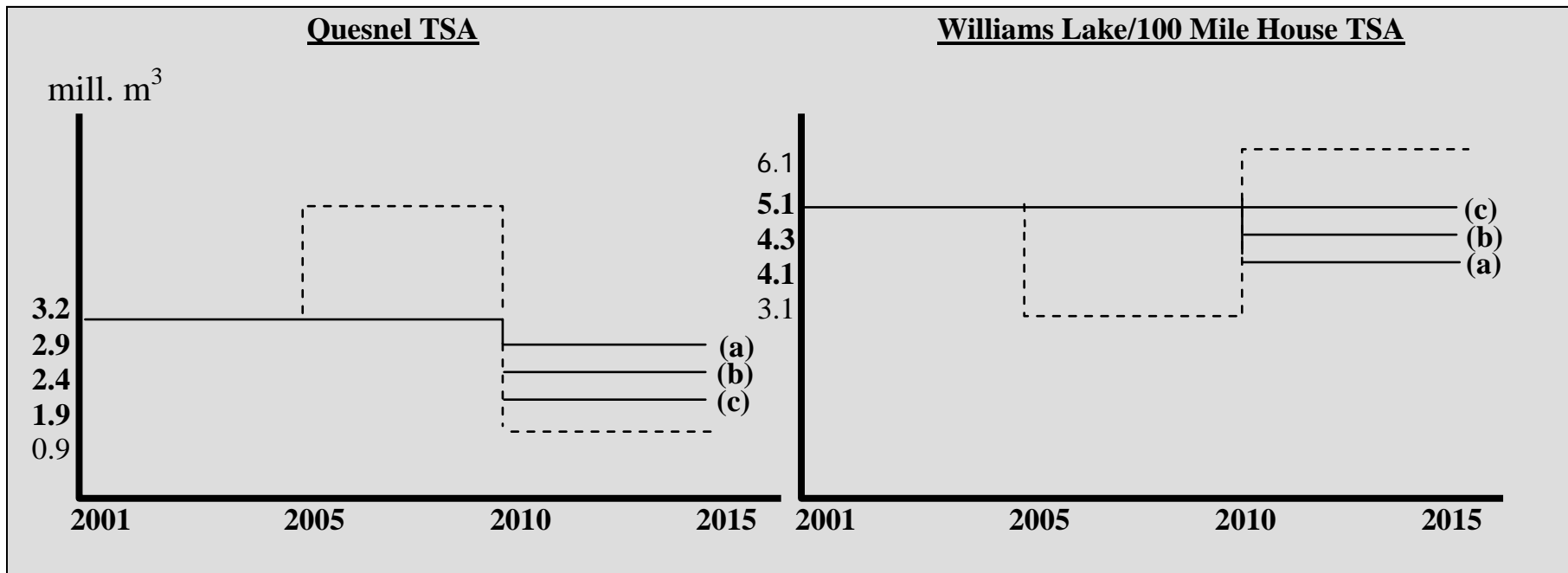
- Based on a RWFA where Region 2 salvage harvests Region 1's excess AAC instead of using their own.
- Region 2 reciprocates the AAC in the future without experiencing any shortfall.



IV. Methods

Scenario Design:

- Scenario 3: • Based on the same RWFA as Scenario 2, but now there is a 1 million cubic meter shortfall in the future AAC in Region 2...
- Scenario 3a,b,c: • Region 2 assumes the shortfall; Both regions share the shortfall; Region 1 assumes the shortfall.





V. Results

Baseline (2001 & 2001-14) indicators without beetle infestation.

Indicator	2001			2001-14		
	Region 1	Region 2	Combined	Region 1	Region 2	Combined
NRP (\$GDP)						
Agriculture	4.9	14.7	19.6	54.1	161.3	215.4
Forestry	383.0	453.5	836.5	4207.8	4982.5	9190.2
Services	232.6	318.0	550.6	2555.0	3493.0	6048.0
Public	64.2	141.7	205.9	705.3	1556.7	2262.0
Visitor	55.8	94.0	149.8	613.2	1033.1	1646.3
ROE	64.9	180.6	245.5	713.1	1983.6	2696.7
Total	805.5	1202.5	2008.0	8848.5	13210.1	22058.7

^a All dollar values are reported in present value (2001) terms using a 4% discount rate.



V. Results

Baseline (2001 & 2001-14) indicators without beetle infestation.

Indicator	2001			2001-14		
	Region 1	Region 2	Combined	Region 1	Region 2	Combined
Royalties (\$mill.)						
Agriculture	1.6	4.8	6.4	17.8	53.1	70.9
Forestry	117.5	139.1	256.6	1290.6	1528.2	2818.8
Services	79.0	108.0	187.0	867.9	1186.5	2054.4
Public	4.9	10.9	15.8	54.2	119.6	173.8
Visitor	7.0	11.8	18.8	77.2	130.0	207.2
ROE	8.1	22.6	30.7	89.2	248.2	337.5
Total	218.2	297.3	515.5	2396.9	3265.7	5662.6

^a All dollar values are reported in present value (2001) terms using a 4% discount rate.



V. Results

Baseline (2001 & 2001-14) indicators without beetle infestation.

Indicator	2001			2001-14		
	Region 1	Region 2	Combined	Region 1	Region 2	Combined
Labour Income (\$mill.)						
Agriculture	1.7	5.0	6.7	18.6	55.5	74.1
Forestry	200.7	237.7	438.4	2204.9	2610.9	4815.9
Services	77.9	106.5	184.4	855.6	1169.8	2025.5
Public	52.2	115.2	167.4	573.4	1265.5	1838.9
Visitor	44.1	74.3	118.4	484.6	816.4	1301.0
ROE	42.0	116.9	158.9	461.7	1284.2	1745.9
Total	418.6	655.6	1074.2	4598.9	7202.2	11801.1

^a All dollar values are reported in present value (2001) terms using a 4% discount rate.



V. Results

Baseline (2001 & 2001-14) indicators without beetle infestation.

Indicator	2001			2001-14		
	Region 1	Region 2	Combined	Region 1	Region 2	Combined
Employment (# of person yrs.)						
Agriculture	471	1275	1746	6594	17850	24444
Forestry	3054	4,025	7079	42756	56350	99106
Services	3140	4125	7265	43960	57750	101710
Public	2385	4825	7210	33390	67550	100940
Visitor	1185	2035	3220	16590	28490	45080
ROE	2270	6310	8580	31780	88340	120120
Total	12505	22595	35100	175070	316330	491400

^a All dollar values are reported in present value (2001) terms using a 4% discount rate.



V. Results

Economic Indicators from Scenarios 1 & 2 over the 2001-14 period.

Indicator (\$mill. or as specified)	Scenario 1			Scenario 2		
	Region 1	Region 2	Combined	Region 1	Region 2	Combined
NRP	7608.2	13210.1	20818.3	8681.6	13210.1	21891.7
Royalties	2025.2	3265.7	5290.9	2346.9	3265.7	5612.6
Labour Income	3974.4	7202.2	11176.7	4514.8	7202.2	11717.1
Employment	154462	316330	470792	172297	316330	488627

^a All dollar values are reported in present value (2001) terms using a 4% discount rate.



V. Results

Economic Indicators from Scenarios 3a,b,c over the 2001-14 period.

Indicator (\$mill. or as specified)	Scenario 3a			Scenario 3b			Scenario 3c		
	Region1	Region2	Combined	Region1	Region2	Combined	Region1	Region2	Combined
NRP	8681.6	12770.3	21451.8	8425.9	12983.2	21409.1	8153.3	13210.1	21363.5
Royalties	2346.9	3139.5	5486.4	2270.3	3200.6	5470.8	2188.6	3265.7	5454.3
Labour Income	4514.8	6976.6	11491.5	4386.1	7085.8	11471.9	4248.9	7202.2	11451.1
Employment	172297	307486	479783	168049	311766	479815	163520	316330	479850

^a All dollar values are reported in present value (2001) terms using a 4% discount rate.



V. Results

**Economic impacts from the infestation under policy-as-usual
(Base-case vs. Scenario 1):**

Indicator	Loss (\$mill.)		
	Region 1	Region 2	Combined
NRP	1240.3	0	1240.4
Royalties	371.7	0	371.7
Labour Income	624.5	0	624.4
Employment	20608	0	20608

**Economic impacts from the infestation under a best-case RWFA
(Base-case vs. Scenario 2):**

Indicator	Loss (\$mill.)		
	Region 1	Region 2	Combined
NRP	166.9	0	167
Royalties	50	0	50
Labour Income	84.1	0	84
Employment	2773	0	2773

**RWFA with shortfall
assumed by Region 2
(Scenario 3a)**

Indicator	Loss (\$mill.)		
	Region 1	Region 2	Combined
NRP	166.9	439.8	606.9
Royalties	50	126.2	176.2
Labour Income	84.1	225.6	309.6
Employment	2773	8844	11617

**RWFA with shortfall
sharing
(Scenario 3b)**

Indicator	Loss (\$mill.)		
	Region 1	Region 2	Combined
NRP	422.6	226.9	649.6
Royalties	126.6	65.1	191.8
Labour Income	212.8	116.4	329.2
Employment	7021	4564	11585

**RWFA with shortfall
assumed by Region 1
(Scenario 3c)**

Indicator	Loss (\$mill.)		
	Region 1	Region 2	Combined
NRP	695.2	0	695.2
Royalties	208.3	0	208.3
Labour Income	350	0	350
Employment	11550	0	11550



VI. Further Research

- Need to model forest regeneration and mortality following pest outbreaks to generate better AAC estimates over time and space.
- Refining the CGE model to examine individual forest sectors, and including more flexible functions would provide more accurate estimates.
- A multi-regional CGE model could explicitly account for trade between communities.
- Spacial harvest information, haul distance, and costs at mill are needed to examine financial feasibility of the RWFAs.