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THE JOINT PRODUCTION OF TIMBER AND ENVIRONMENTAL VALUES: DEMONSTRATION FOR THE WESTSIDE OF WASHINGTON STATE
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Bruce Lippke and B. Bruce Bare, Professors
Weihuan Xu, Jeffrey Moffett, and Bill Turner, Research Assistants
Center for International Trade in Forest Products
College of Forest Resources, University of Washington
Box 352100, Seattle, WA USA 98195-2100
email: blippke@u.washington.edu, bare@u.washington.edu

ABSTRACT: Regulatory requirements to protect habitat have increased, requiring forest managers to include measures of biodiversity, habitat, and streamside protection in their plans. A demonstration of environmental and economic impacts for a range of timber management alternatives was developed for Western Washington. Economic and environmental impacts were characterized for current and prospective regulations as well as for several management alternatives designed to achieve environmental objectives similar to those produced by the regulations. Tradeoffs between environmental and economic impacts were developed for the landowners decision process. As a basis for policy analysis, tradeoffs between the benefits and costs to rural and urban communities were identified, demonstrating who gains and who loses under various management alternatives.

Integration of timber growth and yield models with habitat models in a mathematical programming framework was used to produce the biological and economic measures associated with different management strategies. Experimental choice analysis among management alternatives was then used to develop public preference values for measures of forest biodiversity, aesthetics, rural job losses, and costs as surrogates for the economic/environmental tradeoffs. Results showed that regulations and proposals that focus on preservation without considering long-term motivation to produce non-market forest amenities result in significantly less value to the public and less equitable treatment across urban and timber rural communities than do alternatives that seek to jointly produce timber and non-market amenities.

KEY WORDS: Timber supply, forest economics, habitat protection, biodiversity, non-market valuation, linear programming

1. INTRODUCTION

Regulations affecting U.S. forest practices on state and private forest land have changed several times since 1990, driven largely by the Endangered Species Act and other efforts to conserve environmental amenities valued by the general public. Different owners have been required to meet different standards, and the economic impacts have been substantial. However, until now no comprehensive assessment of the cumulative effectiveness of policies to meet environmental goals has yet been completed.

This study examines the cumulative economic and environmental impacts of forest practice and policy changes on the forested lands of the Westside of Washington State (referred to as Western Washington). Government regulations on forested land in Western Washington generally have required the preservation of existing habitat. This study evaluates the impacts of these regulations as well as the effectiveness of active management strategies in achieving environmental objectives. Results show that while environmental amenities are increasing under regulatory changes to forest practices, it is at a significant cost. Recent research on the public's value preferences for ecosystem management is used to determine to what extent the public has experienced a net increase in their utility value from the economic and environmental changes.

Assessing public utility values concerning how much the public values environmental benefits relative to economic costs provides a new method in determining the best strategies for environmental restoration while also being responsive to community equity issues.

Measures of economic and biological progress are crucial to such an analysis. Therefore, economic comparisons are benchmarked to a base case for the market potential of the land base to determine the cumulative economic loss. A biodiversity index of partial restoration to pre-European conditions is used to benchmark environmental progress. These economic and environmental measures provide the setting for assessing public preferences for economic and environmental tradeoffs.

2. SIMULATION OF MANAGEMENT ALTERNATIVES

Forest inventory data were updated to 1996 as a starting point for analysis. Acreage categories were defined as either upland or riparian management zone (RMZ). RMZs are based on distance from streams and for this study are defined as areas within 150 feet of fish-bearing streams and 50 feet of non-fish-bearing streams.

Average site classes were selected for each owner forest type and land category to reflect the average site index noted in the Westside timber supply analysis (Adams et al. 1992). With these starting inventories: by land category, age class, and by owner for three sub-regions of the Westside, each of several possible management alternatives was simulated with growth and yield simulators. Stands over 40 years of age were assumed to be essentially unmanaged with growth projections taken from empirical yield tables. Stands under 30 were assumed to be under an active management regime with restocking. In this study, they were simulated by DFSIM adjusted for empirically observed stocking levels. The age 30-40 class was assumed to be half in one category and half the other. Biological measures were linked to the growth and yield simulations by including management requirements for leave trees, snags, downed logs, and debris. The functional stage of the forest over time is then determined as a consequence of growth and yield and these management requirements.

The management treatment alternatives used in this study included a range of practices, from commercial to habitat management strategies to no-management. They are defined as follows: (1) no-management with aging of stands without disturbances; (2) natural growth with final harvest; (3) commercial rotations with pre-commercial thinning (PCT) and commercial thinning (CT) at age 30, or as appropriate, and final harvest at age 50 or more; (4) biodiversity management pathways (Lippke et al. 1996) with 3 periodic thinnings that leave debris, downed logs, and snags culminating in forests, with the functional equivalent features of old forest in about 100 years, and with rotations of 100 or more years; (5) a partial cut in 60-70 year old stands, followed after 20 or more years by either commercial or biodiversity pathways to accelerate old-forest conditions more quickly; and (6) partial cut sequences like the biodiversity pathway for the riparian zone (with no clearcut of the overstory), including retention of large trees for stream recruitment.

Revenue, economic activity, jobs, and state and local tax receipts were then determined for each treatment alternative in every decade in addition to stand structure classifications, habitat and biodiversity indices, and aesthetic measures.

A harvest/treatment schedule was then determined over a 200-year time horizon with the objective of maximizing the landowner's net-present value subject to no-management zones required by regulations or habitat goals (minimum standards over time) and operational harvest flow constraints (restricted decade to decade change in harvest level). Thus, for each policy and management strategy scenario, a time profile of economic attributes and a time profile of environmental attributes were determined for a 200-year future.

Measuring changes between different management scenarios provided an analysis of the effectiveness of each strategic scenario. The output for each scenario included a rich array of economic impacts and environmental attributes over time as well as cumulative effects. Hence, quantitative measures of progress driven by regulatory or alternative policy goals are provided. Since the treatments were limited to statistical

characterizations within a region, management zone, and ownership, spatially sensitive characteristics within these categories are not available. However, for studies of this scale (almost 10 million acres), it is the description across the total region that is important. Operational scale implementation of spatial features should not deviate significantly from these simulated results at this larger scale.

3. MANAGEMENT SCENARIOS AND RESULTING PHYSICAL ATTRIBUTES

Scenarios/Alternatives include a base case representative of commodity management with low environmental constraints (Case 1: Base); minimum 1996 Washington State Forest Practices regulations (Case 2: Minimum Regulations); habitat conservation plans and state proposed riparian buffers (Case 3: Proposed Regulations); and finally two active management alternatives: one on state and private land (Case 4: Alts. Non-Federal) and one that includes Case 4 lands but also adds unreserved, federal timber land hereafter referred to as federal timber land (Case 5: Alts. All Owners).

For each case, Table 1 summarizes the impacts for four different economic measures (landowner NPV, average harvest, rural employment in the first two decades and the second century sustainable employment rate, and average state and local tax receipts for the first two decades. Impacts for four biological measures are also shown for current conditions and longer-term averages (late-seral % of acres, late-seral % of RMZ by 5th decade, biodiversity index and mature & over mature stands as a % of acres).

Tab. 1: Economic and Environmental Impacts of Alternative Management Strategies

CASES:	1 Base	2 Minimum Regulations	3 Proposed Regulations	4 Alts. Mgmt-Non-Federal	5 Alts. Mgmt-All Owners
Economic Measures:		Change from Base (Case 1)			
Timber Rev. NPV (US$ billions)	48	-10.5	-20.6	-9.8	-5.1
Harvest (average mmbf)	6,380	-1,040	-1,991	-1,090	-540
Rural jobs, first 20 years (000's)	134	-31	-63	-31	-18
Rural jobs sustained 100+ years (000's)	130	-19	-37	-5	+14
State/Local taxes, first 20 years (US$millions/year)	1,490	-320	-680	-310	-150

CASES:	Current	1	2	3	4	5
Environmental Measures:						
Late-seral % (average)	11	3	17	25	29	21
Late-seral Rip % by 5th decade	11	3	12	16	56	48
Biodiversity Index (average)	56	56	67	70	73	66
Mature & Over-mature % (ave.)	15	22	34	42	46	39

3.1 Base - Low Constraints Commodity Management (Case 1)

Green tree retention and green-up requirements (5% harvest loss) as well as 85-foot, no-management buffers on fish bearing streams (2.5% of all acres) are included in the Base Case. To avoid rapid liquidation of the excess mature inventory, harvest constraints were imposed on federal timber land (no change in harvest level from decade to decade) and Other Public and Private (plus or minus 5% per decade change), resulting in economic losses of 52% federal timber land, 11.5% Other Public, and 4% Private from a less restrictive 25% flow constraint. These different losses reflect the potential of each group to convert excess mature inventory into product in the first several decades, potentials they have not exercised. Any excess mature Private inventory shown is largely non-industrial.

Under the Base Case, the net present value of future income (NPV) of Westside lands is US$48 billion, using a consistent 5% real discount rate assumption to discount future revenues to the present. This harvest schedule supports 134,000 rural employment over the first two decades with 130,000 sustained over the long term. In addition, the forest sector Gross Domestic Product of US$11 billion supports US$1.5 billion in state and local taxes.

The Base Case harvest level of 6.4 billion board feet (with commercial management over the 200-year period) does not retain forest structures of importance to some species due to the late-seral structures declining from 11% currently to only 3% (also 3% in the RMZ) in 200 years. This, of course, was the motivation for regulations that reserve more of these critical habitat structures, which are in declining supply. The Biodiversity Restoration Index—a measure of the diversity across the mix of stand structures benchmarked to 100 for pre-European forest conditions—falls to 56, a substantial loss in the diversity of forest types.

3.2 Minimum Regulations (Case 2)

The Minimum Regulations (Case 2) characterizes the impact of placing federal timber land under FEMAT (the management option that was selected by the US Government Administration and developed by the Forest Ecosystem Management Assessment Team), with additional reserves included on state and private lands as required by the 1996 Washington State Forest Practices Board for the protection of endangered species. Private and Other Public harvest flow constraints were relaxed (to 25% change per decade) so as to not overly constrain meeting the regulatory minimums, thus being conservative in understating the economic impact of the regulatory change from the base.

The most significant change under current regulatory minimums is the removal of federal timber land from the available harvest. Under FEMAT, only 21% of federal timber land appears to be available for harvest activities, and the requirements for volume left as debris were estimated to reduce any harvest volume an additional 10% over the other management alternatives. The unmanaged federal acres outside of the defined RMZ are 66% of the total acres. Since the simulation using these assumptions supports a 233 million board foot harvest which appears to be well above USFS projections, even these assumptions may overstate the volume of future Federal harvests. For state and private lands, prior studies estimated the impact of owl circles under different regulations. For state managed lands, 105,000 acres of mostly mature forestland were estimated to be in owl circles (6.3%)(Bare et al. 1997) and these reserves were adopted for Other Public. The comparable private acreage was 82,000 acres (1.5%). These estimates may understate the full impact of minimum owl and murrelett regulations as they assume a high degree of overlap between owl and murrelett habitat and may not consider the long-term affects of other acres being impacted as forest land matures. Nevertheless, this estimate should be adequate to demonstrate the impact of different policy driven management alternatives in providing comparable habitat protection.

In this Minimum Regulation case, the NPV to timberland is reduced by US$10.5 billion from the base (-22%), with 80% of the loss on federal timber lands. The 1 billion board foot reduction in harvest reduces the support for rural employment by a sustained 19,000 and 31,000 in the first 20 years. The early losses are greater as the set-asides remove a larger share of currently mature and harvestable timber. Even so, these early losses may be understated as the harvest flow constraint was relaxed from the Base Case to avoid excessive constraints in substituting available mature timber for mature reserves. The state and local tax receipts are reduced by US$320 million.

The environmental benefits are quite notable, with the share of late-seral acres rising from 3% in the Base Case to 17%, 54% above the current 11% level. Improvement in the RMZ by the fifth decade is not as notable, increasing from 11% to only 12% since most all except the federal reserves are uplands. The biodiversity index increases from 56 to 67, a 20% improvement.

In comparison to the Base Case, this Minimum Regulation case characterizes the tradeoff between biological gains and economic losses with most of the landowner losses on federal timber lands but with

substantially reduced employment in rural communities. The 14% improvement in late-seral (1.3 million acres) resulted in a US$7,950 NPV loss per acre of late seral improvement as a gauge of effectiveness.

3.3 Proposed Regulations (Case 3)

Increasing the reserves on Other Public timber lands under the Washington State Department of Natural Resources Habitat Conservation Plan (DNR HCP) along with no-management within the RMZ on Private timber lands as one proposal to improve salmon habitat, increases the unmanaged reserve acres substantially. Reserve acres are increased by 23% on Other Public timber land and 13% on Private timber lands.

The additional .95 billion board foot reduction in harvest reduces the NPV another US$10.1 billion, all on non-federal. Support for rural employment is reduced by an additional 18,000 sustained jobs and 32,000 jobs in the first 20 years. Again, the early losses are greater as the set-asides remove a larger share of currently mature and harvestable timber. The state and local tax receipts are reduced an additional US$360 million.

The environmental benefits are greater, with the late-seral percentage rising an additional 7% to 25%. Improvement in the RMZ late seral by the fifth decade is another 4%, rising to 16% of the RMZ, substantially less than across all acres. The biodiversity index increases another 3 points, to 70.

In comparison to the Base Case, the Proposed Regulation case characterizes a more severe tradeoff between biological gains and economic losses. The 22% improvement in late seral (2.1 million acres) resulted in a US$9,930 NPV loss per acre of late-seral improvement, a substantially higher cost per acre than the Minimum Regulations.

3.4 Management Alternative (Biodiversity Management) - Non-Federal (Case 4)

In this scenario, instead of placing the primary emphasis on no-management reserves, minimum habitat goals are enforced to produce an equivalent quantity of habitat as produced under Minimum Regulations; however, management strategies are used to accelerate the creation of that habitat. Nesting-Roosting-Foraging habitat, as defined under forest practice rules, was used for the minimum goal to insure that the mix of old and young habitat was biased toward the more fully functional older habitat. In the RMZ, biodiversity pathways were used to accelerate the restoration of old-forest functionality up to a 20 foot, no management stream bank buffer. No clearcuts were allowed in this RMZ. Treatments designed to produce large trees for stream recruitment and other old-forest functionality were used.

The environmental benefits were greater than either the Minimum Regulations or the Proposed Regulations cases and perhaps reflect targets higher than necessary. Late-seral rises to 29 %, 164% above current levels and 70% above Minimum Regulations. Improvement in the RMZ late seral by the fifth decade is even more notable, rising to 56%, essentially full restoration of old-forest functionality (within the RMZ). The biodiversity index increases to 73, 6 points above that of the Minimum Regulations scenario.

Even more notably, in Case 4 the economic losses were generally found to be less than those under Minimum Regulations and substantially less than those under Proposed Regulations. The harvest loss was essentially the same as under Minimum Regulations, with the sustained job losses much lower (-5,000 vs. -19,000). This is a result of the biodiversity management treatments (Case 4) producing larger trees and higher growth per acre over the long term and supporting increased employment in forest management, primary and secondary processing as well as indirect employment. The employment support for the first two decades however is no better than that found in the Minimum Regulations, -31,000, but far better than Proposed Regulations at -63,000.

In comparison to the Base Case, this Alternative Management case demonstrates more cost-effective achievement of the biological goals implicit in the regulations. The 26% improvement in late seral (2.5

million acres) results in a US$4,000 NPV loss per acre of late seral improvement, about half the cost per acre as from minimum regulations.

3.5 All-Owner Management Alternative (Case 5)

The benefits noted in Case 4 are extended to all owners in Case 5 by opening one third of the federal timber lands to the alternative management regimes, thereby accelerating the rate at which these stands take on late-seral functionality. In this demonstration, a mixture of reserve and active management strategies are applied to these federal timber lands.

The environmental benefits provided by this scenario are comparable to those of the Minimum Regulations scenario and substantially better in the RMZ. Late-seral increases to 21%, or almost 100% above current levels.

The economic losses are substantially less than those found under Minimum Regulations, representing an improvement from current conditions. The harvest loss is only half of that found under the Minimum Regulations scenario, with the sustained job support showing a net gain over the Base Case assumptions, and a first two decades loss of 18,000 jobs is 13,000 better than the 31,000 job loss under Minimum Regulations. State and local tax losses are reduced to US$150 million, a gain of US$170 million over current Minimum Regulations and US$530 million over Proposed Regulations.

The addition of adaptive management on one third of the federal timber land further increases the cost effectiveness in reaching biological goals. The 18% improvement in late seral (1.7 million acres) results in a US$3,000 NPV loss per acre of late-seral improvement, about 30% of that from Proposed Regulations or 38% of Minimum Regulations.

Even though this scenario can be considered more cost effective in reaching critical habitat goals, it does not establish the net benefits to the public, who benefits and who pays. By using these environmental and economic attribute tradeoffs, estimates can be made of who the beneficiaries are and who bears the burden by estimating public preferences across these management alternatives.

4. ESTIMATION OF PUBLIC UTILITY VALUES

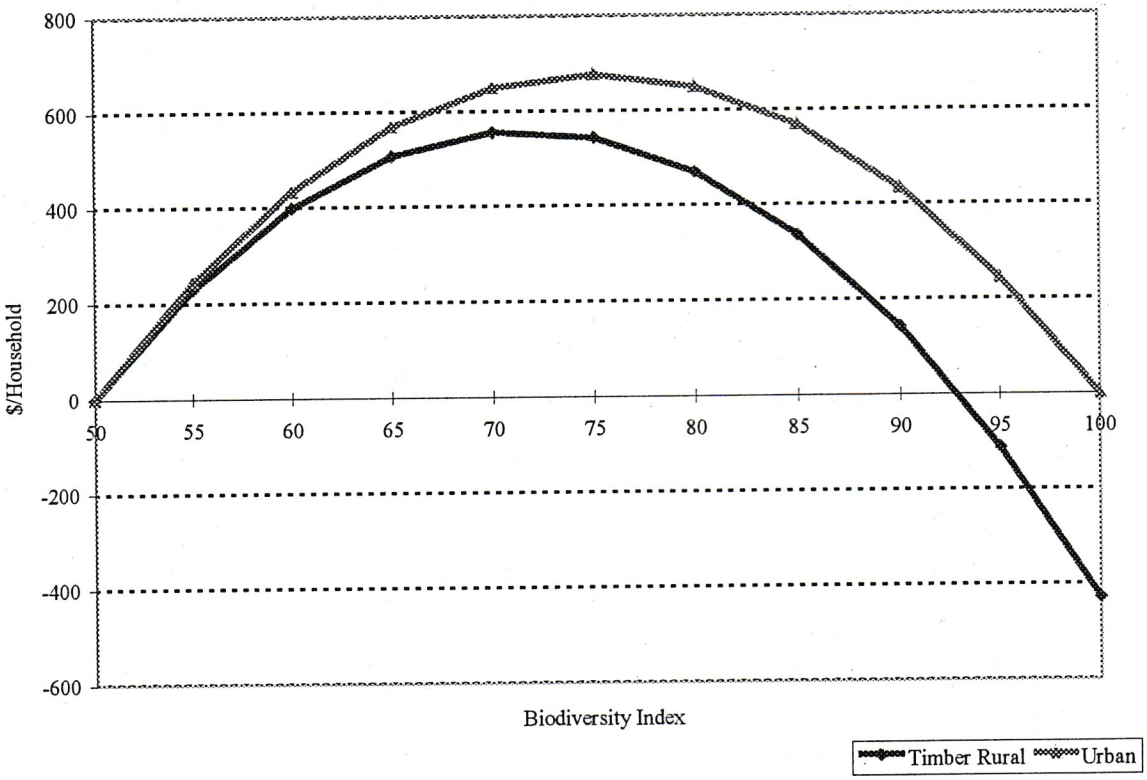
A random sample of residents from urban, timber-dependent rural, and other rural communities was administered a survey that characterized a wide array of forest management alternatives across the Westside of Washington, resulting in a 65% response rate (Xu 1997). Respondents were first familiarized with the nature of tradeoffs among managing for biodiversity, aesthetics, rural employment, and out-of-pocket costs such as taxes and product costs. They were then given sets of four alternative management strategies and asked to select their preferred management alternative, knowing the predicted economic and environmental outcomes for each. Since the alternatives they were exposed to included a full range of economic and environmental tradeoffs, their preferences across economic and environmental alternatives were estimated. Their willingness to pay (WTP) for environmental gains in terms of their out-of-pocket costs and willingness to accept (WTA) job losses defines their economic utility among the tradeoffs as though their environmental values could be purchased in the market. The model estimated their non-market utility value for both the environmental attributes and the rural employment and cost attributes so they can be compared directly and so that best tradeoffs could be evaluated. The test statistics were remarkable in that significant differences were observed between timber rural and urban populations, and every economic and environmental attribute was deemed important (Xu 1997).

Tests of reasonableness were also noted since the public placed a high value on restoring environmental measures but with declining returns in relation to the amount of restoration. Using out-of-pocket costs as the common denominator allows for characterizing the public's utility value of increased biodiversity or aesthetics in terms of their willingness to pay for a given amount of each attribute. The two environmental factors, biodiversity and aesthetics, provide two surrogates for the public to relate to in considering their

own uses of the forest. The two economic variables, cost and rural job losses, characterize the competing economic impacts that are also valued by the public.

Figure 1 shows the willingness of urban and timber-dependent rural communities to pay for biodiversity gains. Not surprisingly, it shows urbanites willing to pay more, but both groups see it as wasteful to go much beyond 70% to 80%, where 100% would be full restoration to pre-European conditions. The study shows that each urban household is willing to pay as much as US$600 annually for improved biodiversity, meaning that if they had to pay that amount, they would see no net benefit between their cost and their non-market benefit. Since the Base Case forest management strategy results in a biodiversity value of 56, rising to 67 under Minimum Regulations, the urban household biodiversity value increases from US$278 to US$600 for a US$322 increase.

Fig. 1: Willingness to Pay for Biodiversity



Similar results for willingness to pay for aesthetic improvements are shown in Figure 2, indexed to the percentage of mature and over-mature stands as a good proxy for aesthetics.

These gains in environmental and losses in economic utility values can be accumulated across the key contributing factors, which are biodiversity, aesthetics, rural employment, and cost. The willingness to accept job losses (Figure 3) demonstrates a declining willingness to pay more than a certain amount as the number of rural job losses increases. The lack of any significant differences between rural timber-dependent and urban communities is consistent with their reaction that it is other people's jobs, not their own, that are at risk.

Fig. 2: Willingness to Pay for Aesthetics

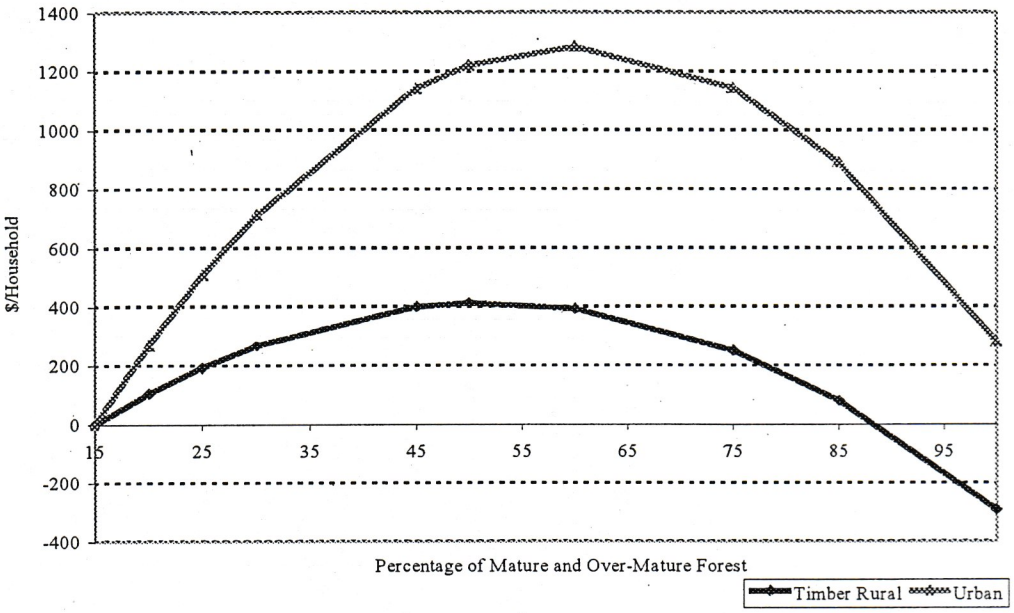
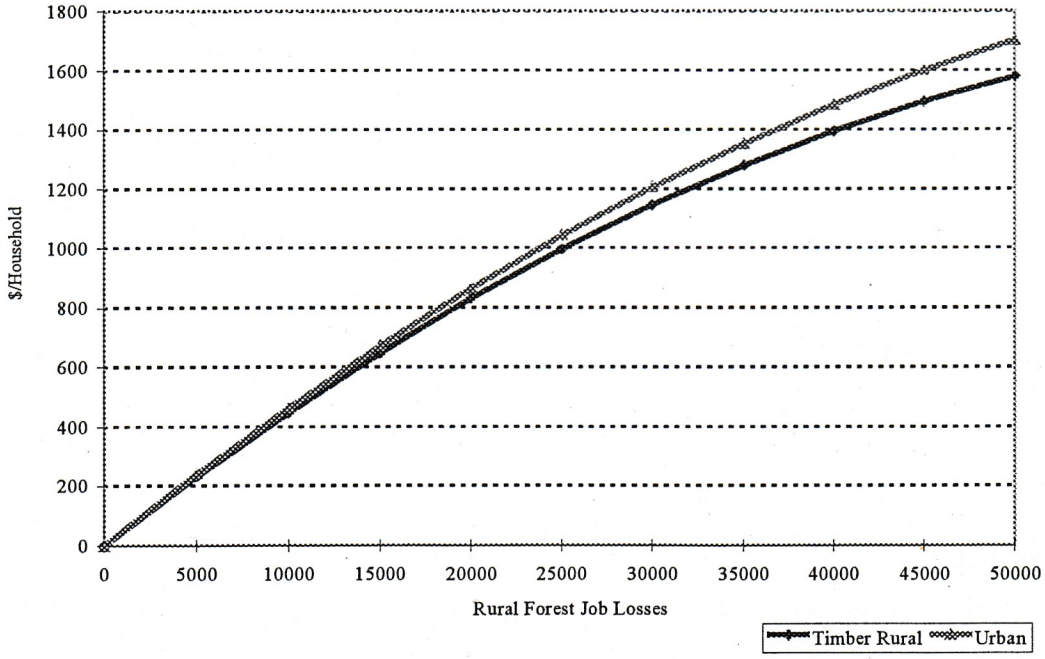


Fig. 3: Willingness to Accept Rural Job Losses



5. HOUSEHOLD UTILITY VALUES FROM MANAGEMENT ALTERNATIVES

Table 2 displays the utility values for each competing factor across the five management alternative scenarios as well as the total utility value for timber-dependent rural and urban households.

Tab. 2: Economic Utility by Household: Willingness to Pay for Gains or Accept Losses (US$ per household (Hh))

CASES:	1 Base	2 Minimum Regulations		3 Proposed Regulations		4 Alts. Non-Federal		5 Alts. All Owners	
WTP Biodiversity									
Timber Rural	0	266		287		287		254	
Urban	0	322		364		387		304	
WTP Aesthetics									
Timber Rural	0	175		242		261		214	
Urban	0	486		710		791		608	
WTA Job Losses									
Timber Rural	0	-964		-1,437		-427		+73	
Urban	0	-1,008		-1,532		-441		+75	
WTA Cost									
(with & w/out compensation)		with	without	with	without	with	without	with	without
Timber Rural	0	-413	-1,414	-778	-3,443	-309	-127	-123	-621
Urban	0	-413	-321	-778	-532	-309	-326	-123	-192
Total Value									
Timber Rural	0	-936	-1,937	-1,686	-4,351	-188	-6	+417	+1,161
Urban	0	-612	-520	-1,236	-990	+428	+411	+864	+795

Since Cases 2 through 5 all show improvement on environmental attributes compared to the Base Case, they all show utility value increases over the Base Case but not much differentiation as each of the alternatives fall in a range that approaches peak biodiversity benefits. The value gains for aesthetics show a larger difference between urban and rural households as well as a larger range across the 5 Cases.

No significant difference appears between urban and timber-dependent rural communities with regards to their willingness to accept employment losses. Both groups would be willing to pay a considerable amount to avoid employment losses, about US$42 per household for each thousand rural jobs for the first 10,000 jobs, with the amount per job declining as the job losses increase. The negative impact of these job losses on total utility exceeds the sum of the environmental values for both Minimum (Case 2) and Proposed Regulations (Case 3) but not for Management Alternatives (Case 4).

Finally, there is the actual cost per household, which could be different by community. The study treats the change in state and local taxes as a cost and assumed an insignificant change in product costs given the potential for global trade. The remaining issues are who pays and whether rural landowner losses are compensated or not. Table 2 shows the results "with compensation," which means that the cost to the household is not different between timber-dependent rural and urban communities. It also shows the result "without compensation," which recognizes that the out-of-pocket losses to the timber-dependent rural communities are different than for urban communities. Revenue losses to timber-dependent communities include the 25% of federal timber revenues paid to counties in lieu of taxes, 50% of Other Public revenues that remain with the counties, and 95% of private landowner revenues (after a 5% yield tax). Those losses, when not compensated, become offsetting gains by the non-timber communities since they do not contribute their share thus leaving the total cost unchanged.

The net utility value across all factors is generally less positive for the timber-dependent rural households then it is for the urban households and is positive for both of these groups only under the All Owner Management Alternative (Case 5). For the regulatory cases for which no compensation has been provided,

the rural household loss is 4 times as large as that of the urban households, with the loss ranging from US$2,000 to US$4,000 per household going from Minimum Regulations to Proposed Regulations. These losses are substantially reduced under the Management Alternative with compensation that shows only -US$188 for timber-dependent rural, which becomes a US$428 gain to the urban and non-timber-dependent households. For these alternative management cases, compensation would almost certainly be required so that landowners would alter their management to achieve habitat goals. With compensation, both timber-dependent rural as well as urban and non-timber-dependent households receive net positive utility values under Case 5. Even under Case 4, which does not involve federal timber lands and is essentially under state control, the utility values are much improved over current Minimum Regulations, (from -US$1937 per timber-dependent rural household under Minimum Regulations to -US$188 under Management Alternative-Non-federal, and -US$520 to +US$428 for urban households).

6. COMMUNITY UTILITY VALUES ACCUMULATED ACROSS HOUSEHOLDS

Multiplying household values by the number of households in each community produces statewide utility values for Westside timber management. Table 3 shows that the environmental values (WTP Biodiversity & Aesthetics) approach a US$2 billion increase over the Base Case in Case 4; however, the economic value losses (WTA Job Losses and Increased Costs) are even greater than the environmental gains under the Minimum Regulatory alternatives (Cases 2 and 3). These economic losses are less than the environmental gains under Alternative Management (Cases 4 and 5). The net utility value ranges from -US$2.5 billion (Case3) to +US$1.5 billion (Case 5).

Compared to Minimum Regulation or Proposed Regulations, the Alternative Management cases (4 and 5) with compensation offer substantial gains to both these communities (timber-dependent and urban/other rural), while reducing the inequitable differences on who gains and who pays.

Tab. 3: Regional Economic Utility by Community

	1 Base	2 Minimum Regulations	3 Proposed Regulations	4 Alts. Mgmt-Non-Federal	5 Alts. Mgmt-All Owners
All Community (US$ millions)					
WTP Biodiversity & Aesthetics	0	1,366	1,802	1,969	1,535
WTA Job Losses and Increased Costs	0	-2,686	-4,349	-1,419	-88
Total Value	0	-1,321	-2,547	+550	+1,447
By Community (US$ millions)		**No-Compensation**		**Compensation**	
Timber Rural	0	-306	-688	-30	+66
Urban & Other Rural	0	-1,015	-1,859	+580	+1,382
Equity Differences by Community Households (US$/household)					
Timber Rural Value per household	0	-1,937	-4,351	-188	+417
Urban Value per household	0	-520	-990	+428	+864

The environmental gains of almost US$2 billion in utility value per year are nearly as large as the market value of the harvest. However, without compensation, there is no payment made from the largely urban beneficiaries to the rural producers of these values. Under the regulatory cases (Cases 2 and 3), NPV losses to landowners of US$10 to US$20 billion correspond to unrealized tax losses of US$3 to 6 billion. These funds could support annualized payments of US$150 to US$300 million in annual incentives to motivate forest land managers to change their management practices, enough so as to provide the incentive needed to manage under the alternatives (Lippke et al. 1996). While the utility value for environmental gains suggests that the land value should be increased over its timber market value when it also produces increased non-

market amenities, the regulatory emphasis on set-asides (forested land taken out of production and put in reserves) substantially lowers the asset values, working contrary to market efficiencies. For all communities to benefit, landowners need to be provided incentives to compensate for the non-market values they produce at no cost to the largely urban beneficiaries.

7. CONCLUSIONS

The illustrated cases may not accurately reflect the impact of prior and proposed regulations, as it is sometimes difficult to determine the full impact of regulations. Nevertheless, the examples are sufficient to demonstrate the direction and range of specific management impacts. The tradeoffs between economic and environmental attributes are large and affect communities and groups differently. Strict commodity management of the forests that produces economic benefits also reduces old-forest functionality to the degree that some species become endangered. Regulatory approaches that rely only on no-management set-asides to retain the forest structures that are in declining supply are more costly and take much longer to produce equivalent levels of late-seral stand structures important to endangered species. Active management approaches can restore forest structures that are in decline in a shorter period of time. As a consequence, management alternatives are substantially less costly than regulatory set-asides in restoring habitat. Estimates of the public's utility values show that there do exist alternatives with increased net utility value over the low constraints commodity market baseline. However, the regulatory alternatives fail to produce enough environmental gains to offset the negative utility from reduced timber-dependent rural employment and increased cost to each household.

To achieve utility value gains, landowners would need to be motivated to manage their forest lands to produce both environmental and economic benefits simultaneously. This could be in the form of compensation for producing structures that meet habitat goals. Urban communities could provide that compensation and still be substantial net winners, while reducing the disparity in equitable treatment under current and proposed regulations. Regulatory approaches reduce the value of the land asset in order to achieve environmental objectives instead of increasing the asset value to reflect the increased environmental attributes, making markets less efficient in producing environmental values. Even recapturing the tax losses imposed by regulations through conservation easements and in lieu of regulations would likely be sufficient to provide the incentives for alternative management. Opportunities to improve the effectiveness of achieving non-market, social benefits from forested lands are great and win/win solutions do exist.

8. REFERENCES

Adams, Darius, et al. 1992. *Future Prospects for Western Washington's Timber Supply.* Institute of Forest Resources Contribution **#74**. College of Forest Resources, University of Washington. Seattle, WA USA. 200 pp.

B. Bruce Bare, Bruce R. Lippke, Weihuan Xu, Chadwick D. Oliver, Jeffrey Moffett, Thomas R. Waggener. 1997. *Demonstration of Trust Impacts from Management Alternatives to Achieve Habitat Conservation Goals on Washington Department of Natural Resources Managed Lands.* (Available as **CINTRAFOR RE-42**.) College of Forest Resources, University of Washington. Seattle, WA USA. 236 pp.

Lippke, Bruce R., John Sessions, and Andrew B. Carey. 1996. *Economic Analysis of Forest Landscape Management Alternatives: A final report of the Working Group on the Economic Analysis of Forest Landscape Management Alternatives for the Washington Forest Landscape Management Project.* Sponsored by USDA Forest Service, PNW Research Station, and Washington State Department of Natural Resources. (Available as **CINTRAFOR SP-21**, College of Forest Resources, University of Washington, Seattle, WA USA.) 157 pp.

Xu, Weihuan. 1997. *Experimental Choice Analysis of Non-market Values for Ecosystem Management with Preference Heterogeneity* (Dissertation). College of Forest Resources, University of Washington. Seattle, WA USA. 155 pp.