Impacts of Global Warming on the Forest Sector in the Mackenzie Drainage Basin: Case Studies in the Peace and Liard Drainage Basins

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The Mackenzie Basin is the sixth largest drainage basin in the world and the largest in Canada. The vegetation within the basin ranges from grassland through boreal forests to arctic tundra. Land uses in the area range from subsistence hunting and trapping through to agriculture, forestry, and mining.

The Socioeconomic Impacts of Global Warming on the Mackenzie Basin, sponsored by the Atmospheric Environment Service provides a platform for information and data exchange and the opportunity to look at the forest sector in relation to other sectors, particularly with regards to potential competition for land use and resource access.

The size of the study area and the complexity of the forest sector limits the ability for detailed analysis of the impacts of climate change on the forest industry in the Mackenzie Basin. To address this issue, the forest industry component will deal with a case study region within the Mackenzie Basin. The Peace-Liard drainage study area provides an opportunity to investigate the potential impacts on the forest sector in a variety of physioclimatic regimes and the potential to extrapolate results into similar physioclimatic areas throughout the Mackenzie study area.

The Peace-Liard study area is composed of five predominant physiographic regions. These are: the Liard plateau, the Rocky Mountain trench, the Rocky Mountains, the foothills region, and the Alberta plateau. This last region is the largest and most uniform of the regions. Its uniformity and continuance into the prairies provide the opportunity to extrapolate models and results into other areas of the Mackenzie Basin.

Study Components

Database

(R. Benton, Pacific Forestry Centre)

Much of the current year has been spent in the accumulation and aggregation of the database required for the various researchers to conduct their individual studies. The database is still under development and is expected to be completed by mid-1993.

When completed, the database will contain information on forest cover, species mix and age, soils, site quality, economic (census) data, pest data, climate, protected areas, topography, drainages, transportation, and other factors important to the understanding of the forest sector.

Growth and yield

(P. Marshall, University of British Columbia)

There is potential for marked increases in the forest growth due to a longer growing season and the possibility of carbon dioxide fertilization. This component of the study, in conjunction with the species dynamics segment, will ultimately drive the wood supply and economic analysis section. This study will provide estimates of the available timber supply based on estimates in changes to the potential growth response of the trees with the changing climatic conditions. Several growth and yield models exist which could be used for this purpose. One such model relates site quality for major species to climatic variables. Assuming that site quality does not rapidly decline, it is possible to compare model outputs using climate parameter values from current and future climate scenarios.

Stand dynamics
(P. Marshall, University of British Columbia)

There is an expectation that species will migrate as the climate changes with projected global warming. While many factors are involved with species habitation of a given location, it is possible to estimate the potential range of species movement given current knowledge of soil and species limitations and the estimated climate outputs from the GCMs.

The ability of a species to survive or expand will determine potential shifts in the availability of a given resource. It also has implications for the maintenance of biodiversity of a given region or potential ecological reserves and other protected areas.

The species dynamics component of the forest sector study has been initiated this year, looking at the relationships between major forest types and current climatic conditions. Present knowledge of species tolerances and site limitations is being used in conjunction with future climatic conditions to estimate large scale changes in forest cover.

Disturbances

Disturbance factors are largely driven by climatic parameters such as temperature, precipitation, and extreme events. This component of the study is intended to address some of the potential impacts on the forests, given current knowledge of the relationships between climatic variables and forest pest and fire occurrences.

Fire
(L. Kadonaga, University of Victoria)

Forest fire frequency and intensity is projected to increase in areas where the climate becomes warmer and drier. The fire component of the forest sector study deals primarily with the sensitivity of fire susceptibility size to climate changes.

Pests
(B. Sieben, University of British Columbia)

The study region suffers from four significant forest pests. Spruce weevil, spruce beetle, and spruce budworm are all present in the study area. Forest tent caterpillar is also a hazard to a more limited extent in the Alberta plateau region.

A study by a University of British Columbia graduate student, working in conjunction with researchers from the B.C. Ministry of Forests, is currently under way to investigate the sensitivity of spruce weevil attack to climatic conditions, particularly changes in heat sums during critical insect and vegetation development periods.

Further studies being conducted at the Pacific Forestry Centre may provide insights into the cyclical nature of other major forest pests in the study region using time series analysis methods. The results of this study may be used in conjunction with GCM outputs to investigate the potential changes given global warming.

Wood supply and economic analysis
(G. Armstrong, University of Alberta and B. White, Northern Forestry Centre)

Both hardwoods and softwoods are harvested in the region. The primary forest products from the region are pulp and pulpwood products, particularly from the Alberta plateau portion of the region. Saw logs are also produced but make up a smaller proportion of the overall forest utilization.

Global warming potentially means warmer winters, thus later freeze up and earlier spring breakup conditions. Harvest operations stand to be significantly impacted, as much of the harvesting is done in the winter months to allow access to areas that would otherwise be unavailable for use, and to limit the environmental impacts. While this issue will not be specifically addressed, an attempt will be made to incorporate estimates of freeze-up and breakup into estimates of available wood supply.

Outputs from the growth and yield and stand dynamics components of the study will be used to estimate future wood supply using currently existing models. Forest level wood supply models (such as MUSYC, TRIM, or ATLAS) will be used for the economic study component. Inferences as to economic impact can be derived based on comparisons between model outputs from runs using present day and future estimated wood supply/requirement data. These inferences may be limited, however, in that the impacts of climate change on the world's forests and their related economies may far outweigh subtle changes in smaller regional areas.

Protected areas
(D. Pollard and R. Benton, Pacific Forestry Centre)

An additional study undertaken with the forest sector component investigates protected areas within the study area. The intent of this component of the project is to examine the implications of global warming on protected areas (reserves) from the standpoint of resource conservation, and to stimulate interest in assessing the protected areas network of the Mackenzie Basin. To date, an inventory of the areas protected for ecological, wilderness, recreational, and other purposes has been conducted and summarized.