

Faculty of Forestry, University of Toronto

Comments on the Ministry of Natural Resources and Forestry Proposal, “Naturally Resilient: MNR’s Natural Resource Climate Adaptation Strategy”

Submitted to the Environmental Registry on March 13, 2017 by Dean Mohini Sain

Introduction

The Faculty of Forestry, University of Toronto commends the Ministry of Natural Resources and Forestry on two decades of working on initiatives to mitigate and adapt to climate change, culminating in the development of its climate adaptation strategy for natural resources and a call to action in ‘Naturally Resilient’. It is our position that society needs to be reminded how important forests are to climate change; and it is the role of the Faculty of Forestry and other forest researchers to communicate the strong connections suggested in our research.

Faculty Research

An overview of the Faculty’s research program is provided as an Attachment to this submission. Our work is concerned not only with invasive species, but also that climate change will lead to increasing frequency and intensity of pest population outbreaks such as spruce budworm and the eastward expansion of mountain pine beetle, with devastating consequences for Crown forests. The Faculty is currently the only group in Canada looking at the use of bio-char in mining and value-added products in a forestry context. We are examining its effects on the local environment (from a lifecycle analysis framework), on mitigating negative effects of salination and other forest stressors, its economic viability as a means of increasing forest productivity, and its potential to create a carbon negative forestry sector. This work is essential to achieving Goal 2 of MNR’s strategy: Build Resilience and Biodiversity.

Fire Management

The Aviation, Forest Fire and Emergency Services (AFFES) branch of the MNR has a long-standing and very well deserved reputation for investing in forest fire science and developing and implementing science-based decision support systems to enhance its planning and decision-making. We are pleased that Goal 3 addresses the importance of increasing science, research and knowledge and “modelling studies to improve data on the predicted impacts of climate change.” We are also encouraged that Goal 5 addresses the need and importance of “enhancing the amount of trained and capable staff available to respond during extreme natural hazard events” and resource sharing as well as the “development of multi-jurisdictional response plans to address periods of emergency escalation”. The faculty and students in our Fire Management Systems Laboratory have for many years, collaborated with the staff of the AFFES branch to carry out and implement the results of research that will assist the AFFES in achieving both of those goals.

The Faculty is very supportive of the draft strategy's recognition of the importance of addressing the impact of climate change on the Indigenous peoples that live in Ontario. We hopefully assume that the Natural Hazard Vulnerability Map described on page 17 will address the risk to the First Nations communities across Ontario, which are often threatened by forest fires.

Partnerships

The implementation of the five goals proposed in the document 'Naturally Resilient' relies on working with partners (Goal 1.5) and building collaborative partnerships (Goal 3.4) as well as promoting awareness of and understanding of climate change impacts and opportunities for adaptation both inside MNRF (Goal 4.4) and the public (Goal 4.5). The Faculty applauds the MNRF for recognizing the importance of science and research. The Faculty of Forestry, and other universities and colleges, are considered by the public to be credible authorities for explaining the research associated with climate change and forests. Please consider us early on in these partnership initiatives.

The Faculty supports the logic of MNRF's strategy with respect to its view of adaptive management: 'the complex and uncertain nature of climate change impacts on the natural environment demands continued evaluation, learning and adjustments to courses of action.' We note, however, that the proposal might lead to some debate because of the perception that there are few specifics about how the goals will be implemented. For example, the Wildlife Conservation Society reasonably wants to see more targets and focus connected with research actions and tangible climate change outcomes. Similarly, the Ontario Nature 'Take Action' campaign is calling for more commitment and timelines.

It is the view of the Faculty that we can play a key role in informing MNRF, and broader provincial, policy learning about climate change with research science and technical expertise. The "sooner rather than later" implementation of the five goals proposed in the document "Naturally Resilient" is of keen interest to the Faculty for many reasons including our educating sustainable forest management practitioners and scientists.

Economics and Supporting Industry

The Faculty is well-placed to expand its efforts to assist Ontario in the transition to a low-carbon economy and the fight against climate change as directed by the Premier's Mandate Letter to the Minister of MNRF. The Faculty has an excellent record of supporting industry efforts.

It is the Faculty's view that the economic implications of climate change require a different perspective (i.e., low carbon, ecosystem resilient, 'green') on natural resources if Ontario and Canada are to experience sustained economic growth. Ontario's progressive and leading-edge research in natural resource value-added products could be a cornerstone for sustained manufacturing jobs.

The Faculty recommends that research focus on four primary themes: 1. a biological approach to enhance the productivity of high value biochemicals and biomaterials derived from forest floor biomass; 2. an improved understanding of the chemistry of isolation and purification of fine chemicals, and chemical process integration to upscale their production; 3. to develop separate value chains for lignin, hemicellulose and micro/nanocellulose as three distinctly identified, advanced forest products; and 4. to re-direct the forest bioenergy industry towards high energy density applications/products such as DMA, DME (i.e., woody biomass derived dimethyl ether (DME) for truck biodiesel) and, at the same time, exploiting additional benefit from co-products such as biocarbon (popularly known as biochar and mentioned above). A better understanding of the fundamental science underlying the efficacy of the chemi-biological processes, and knowledge developed in the process of carrying out focused applied research, will make Ontario and Canada leaders in the advanced forest products industry. It will create high value jobs and help our nation to diversify our export partners, an important consideration given the uncertainty of the ongoing softwood lumber disputes with the United States.

Other industry sectors are eyeing our forests, and the renewable resource sector, to help them adapt to a carbon negative economy. Consequently, businesses such as the construction industry (steel, concrete, building), and plastic, packaging, automotive fuel, additive and part manufacturing industries, as well as the fine chemical industry, will be the new consumers for, and innovators of, advanced forest products. For example, Faculty partners such as Total, a giant petroleum company, is already strategically advancing their future markets by procuring green businesses, while automakers such as Ford already took significant measures to create a new supply chain for alternative energy and materials.

The Faculty fully supports the climate change mitigation efforts in Ontario's Climate Change Strategy and Action Plan to which the MNRF is contributing by 'advancing low carbon research and innovations through the development of a research program for tall wood frame buildings'. We believe this is an important initiative, both in terms of creating sustainable construction processes and jobs, as well as the demonstration/educational impact on the public of the innovative means of combatting and adapting to climate change. The public wants to know, what is the connection between tall wood buildings and climate change mitigation? Building more with wood will spur the development in Ontario of a research and commercialization program for using low carbon wood and wood residues for building construction and other sectors such as transportation. A few innovative examples of what can be achieved are: VOC-free structural glues and biocarbon reinforced lumbers; replacing all indoor and outdoor furniture, windows, doors, floorings, siding and ceiling products with flame retardant WPC; cellulose nanotechnology for one-coat paint and flexible lighting devices indoor applications; carbon-dioxide and woody biomass derived fuel for house-hold stoves and burners.

Urban, Peri-Urban and Rural Forests

The Faculty thinks the strategy is incomplete in an important aspect. It excludes urban, peri-urban and rural forests in settled landscapes, predominantly on private lands.

The fragmented landscape of southern Ontario, where most Ontarians and taxpayers live, is vulnerable to the effects of climate change and underlines the important link between land use and forests. Urban development, competition for land use, invasive species, and pollutants, among other pressures, are well understood to be the main challenges to sustainability. Forests are the predominant Natural Heritage System component and are the main building blocks of green systems. As climate change impacts range from global to local scale, it is prudent to build regional scale green systems that will serve as the ‘backbone’ of healthy, resilient and functional working landscapes.

Southern Ontario forests are important and multifunctional: they provide traditional forest uses and are managed for traditional values (i.e., wood, firewood, maple syrup). They are critical for biodiversity, wildlife, ecological goods and services, improving the quality of urban life, for recreation, and for carbon sequestration. With climate change, it is expected that tree species distribution will shift north; Southern Ontario forests and their tree species will become more indispensable for their diversity and seed sources that support mitigation and migration. Climate change amplifies both the importance of forests and the threats to their resilience and the people and businesses relying on them.

Other government bodies acknowledge the importance of ‘green infrastructure’ in urban and peri-urban areas, which mostly comprises trees and forests. For example, the climate change strategy of the Ministry of the Environment and Climate Change discusses the contribution of green infrastructure to mitigation and adaptation activities as do the Ministries of Housing and of Health about the benefits of forests to human health. The *Provincial Policy Statement* mentions the importance of natural heritage systems but gives no guidance. Ontario and Quebec have been in the process of developing Urban Forest Offset Protocol Adaptation for cap and trade systems. Finally, the Premier in her Mandate letter to the Minister of Natural Resources and Forestry also directed her to promote urban forestry.

It is also in the urban landscape that medium and tall wood buildings, as discussed earlier, should be considered as playing a major role in terms of the Canadian economy, job creation and carbon storage. Moreover, we need to look at canopy coverage to maximize the potential of CO₂ sequestration in an urban area and develop strategies to capture additional CO₂ to convert into new building/construction and energy alternatives.

Now more than ever there is a critical need to incorporate forests and trees in long-term land use planning and decision making, and strategic policy development that supports adaptive management for climate change. We contend it is the MNRF that has the history, understanding and expertise to make these links.

In closing we suggest that at least one reference be added to the list in your proposal.

“The key role of forests in meeting climate targets requires science for credible mitigation”, Giacomo Grassi, Jo House, Frank Dentener, Sandro Federici, Michel den Elzen & Jim Penman *Nature Climate Change* **7**, 220–226 (2017) doi:10.1038/nclimate3227 Received 28 February 2016 Accepted 19 January 2017 Published online 27 February 2017

Attachment: Faculty of Forestry, University of Toronto Research Programme

Scope, Quality and Relevance of Faculty Research Activities

A community inspired by nature and motivated by technological drive

As Canada's first faculty of forestry, our world-class, award-winning faculty is globally recognized as a power house in scientific advancement and technological creativity, with pioneering programs in Forest Conservation, Forest biomaterials, Urban Forestry and Green Infrastructure, and Bio-nanotechnology and Bio-refinery. Together with our many academic, government, industry, and community partners, we take an interdisciplinary and collaborative approach to forestry, expanding on the art and science of managing our forests to meet both our current needs, and those of future generations.

Unique in capacity, demography, and diversity

Our faculty members, students and graduates provide leadership that strengthens our sector through innovative and collaborative work that reflects a convergence of disciplines and interests within our field. We focus on cutting edge-research and professional advancement programs, with innovative and unconventional approaches, and projects spanning all five continents.

The Urban Forest and Green Infrastructure

Over 80 per cent of the world's population is now living in cities, and many of tomorrow's forests will be urban. Increasing global recognition of the value of green infrastructure to human health and well-being, and to a city's infrastructure as a whole has given a new importance to term 'urban forestry', first coined here at the University of Toronto's Faculty of Forestry and now recognized widely. If managed properly, urban forests help to mitigate climate change and urban heat island effects, and act as carbon sinks, air filters, water purifiers, air conditioners, noise dampeners, wildlife and/or biodiversity refuges, and green spaces for benefitting human health.

A world leader in urban forestry

We continue to grow and develop the urban forestry legacy, which began here with our own Dr. Eric Jorgensen in the 1960's, who first introduced and defined the "urban forest." Today, the Faculty is a go-to place for Toronto's diverse forest communities: we provide scientific and advisory information to promote evidence-based policy and planning, and conduct research focused on the development of practical tools that can enable communities and local governments in long-term and sustainable urban forest planning. In collaboration with the City of Toronto and the Toronto Regional Conservation Authority, we provide scientific and advisory support for the diverse urban forest challenges both within our city and beyond.

Innovative and practical research

Invasive species control involves research into novel forms of bio-control, policy, and management to deal with invasive species such as the Emerald ash Borer, dog strangling vine (in partnership with the City of Toronto and TRCA), earthworms, and honeybees.

- Promotion of Community stewardship – development of techniques and protocols - such as the Neighbourwoods Protocol, used widely by community groups and municipalities in southern Ontario, that encourage and empower communities to care for their urban forests in a responsible and sustainable way.
- The issue of native and non-native biodiversity as it applies to the urban forest and their effects on ecosystem services and values.
- The use of Bio-char as a way to capture biomass resources and return them to the city's ecosystem.
- Research into sustainable urban practices that support agriculture
- The effects of disturbance on the Urban forest, mitigation measures

Forest Ecology and Restoration

Building on more than 100 years of forestry tradition, our research into forest ecology has a wide scope and an unconventional, inter-disciplinary approach. Our research is rooted in maintaining the highest scientific standards, with a focus on quantification, fieldwork and practical application. We seek to better understand biodiversity and ecosystem services, climate change, and the role of forests and the forest sector in combating climate change and other human-induced pressures. We strive to reach beyond academics, and into the application of scientific knowledge to better forest stewardship and appreciation.

Wide reaching, international applicability

Our program is aimed at informing global issues, and we work with a multitude of stakeholders both locally (from the Niagara escarpment to the Hudson Bay Lowlands to Essex county), throughout Canada (locations as diverse as the Yukon and Haida Gwaii in BC), and internationally (with projects in the Brazilian Amazon, Malaysia, and the Democratic Republic of Congo, for example).

Diverse, relevant projects

Ongoing programs in forest ecology and silviculture extend across many ecosystems and climactic zones, comparative ecology of trees, forest canopy biology, and the ecological aspects of global environmental change, provide our partners and society with quantifiable and rigorous scientific studies to inform forestry practice and policy.

Our projects:

- Furthering our understanding of forest diversity and biodiversity globally.
- The effects of Bio-char on forest dynamics and as a form of waste management.
- The impacts of wood utilization and its effects on biodiversity.

- Forest interactions in a changing climate; using the climate envelope modelling framework.
- Harvesting impacts on non-organic environmental factors such as atmospheric and greenhouse gasses, and soils.
- Mining restoration and Vegetation.

The Faculty is currently the only group in Canada looking at the use of bio-char in a forestry context. We are concerned with its effects on the local environment (from a lifecycle analysis framework), on mitigating negative effects of salination and other forest stressors, its economic viability as a means of increasing forest productivity, and its potential to create a carbon negative forestry sector.

Biorefinery, Biofibre, and Biocomposites

Globally there is an urgent need to examine the role of carbon (e.g., the life time of petroleum) within the context of sustainability. It can only happen if, and only if, a substantial replacement can be made available. When the price of oil and other products made from non-renewable fossil fuels fluctuates, there is a growing interest in the development of technologies that can derive suitable alternatives from renewable resources. The Faculty of Forestry's pioneering Bio-refinery and Nano-Bio-Composite programs, which combine bio-technology with nano-technology by using forest biomass as feedstock for such innovative materials and chemicals, is poised to revolutionize the chemical, electronics, automotive, and construction industries. Through the conversion of forest waste products into bio-based green chemicals and bio-nano-materials including plastics, lightweight composites, carbon fibre and foams, we explore more sustainable practices, and increase forest sector efficiencies.

Collaborative, innovative programs, for a greener tomorrow

Current programs work with stakeholders and industry partners to create value-added products including lightweight bio-composites, nano-cellulose, cellulose-based composites and products, and industrial plastics. We work in the intersection of many sectors beyond forestry, including the chemical, automotive and construction industries, and we foster a practical and collaborative process.

Some of our projects include:

- Green chemicals and adhesives from forestry biomass conversion
- OLED and battery substrates from nano-cellulose substrates
- DLFT for automotives
- Green bio-based composites and products from renewable forestry resources
- Development of novel nano-cellulose crystal based composite films
- Development of light weight sandwich panels for construction and automotive applications
- Paper-based inexpensive sensors and devices
- High yield pulp utilization in digital printing papers
- Bark Bio-refinery project
- Bio-car project
- Bio-carbon fibre project

The bark bio-refinery project is collaboration among multiple universities, the forest, chemical, and automotive industries, and the public sector. This project aims to replace petroleum-based materials with green value-added products developed through the conversion of bark. The outcomes of research will enhance the competitiveness of Ontario's forestry sector, and will contribute to "Bio-Economy and Clean Technology" focus area of the provincial Innovation Agenda. In addition, this project forms the basis for a bio-refinery process which uses tree bark as the chief component for insulation, automotive, building and construction applications (www.barkbiorefinery.com).

Bio-economy and Forest Sustainability

The forest sector is integral to the growing Canadian and global bio-economy (or "green economy"), and requires the **support of excellent forest economics research to inform responsible decision making in the coming years. There is a need for the refinement and adaptation of conventional forest economics issues such as forest tenure, timber pricing, and international trade of forest products, if it is to remain globally competitive.** Ontario, more specifically Toronto, is uniquely situated to play a leading role in the development of a sustainable bio-economy because of its **vast supplies of forest biomass, strong industrial base, and scientific and technological capabilities.**

Building a sustainable forest industry

The Faculty of Forestry's interdisciplinary and integrative approach to the emerging bio-economy strives to promote responsible economic choices in the forests and natural resource sector through research; training of undergraduate and graduate students and Post-Doctoral Fellows; and through collaboration with local governments, international universities, and the Ontario Ministry of Natural Resources and Forestry.

Our goals:

- Enhance the global competitiveness of Ontario's forest-based bio-product sector (as well as the traditional forest products sector) by better understanding the global business environment and providing research inputs to provincial policy formulation.
- Enhance the understanding of the forest-based bio-economy (that includes products as well as services) and its contributions to regional, provincial, and national economies.
- Enhance the economic understanding of various forest sector issues such as forest tenure, timber and forest bio-fibre pricing, international trade of forest products, softwood lumber disputes, and managing forests as economic assets.
- Provide support to and build the capacity of the Ministry of Natural Resources and Forestry in the area of forest economics and forest-based bio-economy.

Prepare the future workforce for Ontario and beyond with excellent economics, management, and research skills in forest economics and the forest-based bio-economy.