Department of Forestry
Michigan State University
Graduate Studies

Programs of Study

Biometry

With increasing and conflicting demands on forests there is a growing need for information for decision-making. Forest biometry may provide this information.

Forest biometry applies the principles and practice of statistics to forestry. Sampling for stand and tree attributes, modeling individual tree growth and yield, and using multivariate methods for ordination, analysis, and interpretation are all part of biometry.

At MSU, graduate students and faculty in forest biometry concentrate on research problems in modeling growth and yield, sampling issues, and multivariate methods. Recent projects have included developing and testing individual tree growth models, using multivariate methods to select homogeneous sites for gradient analysis, modeling the effect of cutting methods on stumpage prices for national forests, and comparing multistage to multiphase sampling using LANDSAT imagery.

Ecology

Understanding forest ecology - that is, how environmental factors and human activities affect tree growth and forest community dynamics - is essential in developing successful management programs and conserving forest resources.

At MSU, graduate training in forest ecology combines courses in soil science, botany, plant pathology, ecology, conservation biology, and evolution with studies in forest ecology to provide a firm foundation for both research and management.

Ongoing forest ecology research includes understanding the mechanisms of plant competition and nutrient utilization and cycling; plant community dynamics at the landscape level; photosynthate allocation in response to environmental stress; and physiological and ecosystem responses to global change.

Students who have strong interests in interdisciplinary forest ecology studies may choose to complete masters or doctoral degree studies in the Ecology and Evolutionary Biology Program. Faculty from several university departments with training and interests in one or more areas of ecology and evolution serve as program advisors. Because the program is interdisciplinary, it can be tailored to meet each student's particular interests, capabilities, and professional goals.

Entomology and Pathology

To ensure healthy forests for the future, it's necessary to understand the role of insects and diseases in forest ecosystems. Forest entomologists and pathologists study the biological and ecological aspects of insects and diseases in relation to the management of forests and urban forests.

Graduate studies and research in forest entomology and pathology at MSU focus on the impacts of insects and diseases, insect biodiversity, the effects of environmental stress on forest insects and diseases and developing long-term strategies to control forest pests. As an enrichment to the learning environment, students may collaborate with scientists and pest managers from the MSU Integrated Pest Management Program, Michigan Department of Natural Resources, and the U.S. Forest Service, and may participate in forest and Christmas tree extension activities.

Environmental Toxicology
Students in soils, hydrology, or ecology who have particular interest in studying the effects of chemicals on the environment may wish to enroll in the Environmental Toxicology Program, a multidisciplinary program administered by the College of Veterinary Medicine.

This doctoral degree program requires students to complete a core curriculum with either an environmental or toxicological focus, then develop an individual curriculum that combines courses in forestry with courses in toxicology, environmental dynamics, economics, policy and law, waste management, and analytical chemistry.

Before enrolling in this program, students must first be accepted for graduate study in forestry. Applicants must have a bachelor's degree and a minimum 3.0 gradepoint average in sufficient biological, behavioral, and physical sciences to indicate probable success in the program. Admission is approved by the faculty of the Environmental Toxicology Program and the guidance committee must include two faculty from the program.

Genetics
Ensuring forests for our future requires research in forest genetics to identify and enhance important genetic traits, such as growth rate and form, disease and insect resistance, and adaptive plasticity. Breeding and developing new tree varieties and hybrids are also major components of ongoing research.

In addition to these concerns, forests geneticists probe more theoretical questions, such as the effects and causes of genetic instability in tissue culture, quantification of gene flow between species, the mode of inheritance and organization of organelle genomes, and the use of molecular techniques to increase breeding efficiency.

As a graduate student in the forest genetics program at MSU you create your own program of study. You may choose to study any aspect of forest genetics - from conventional quantitative breeding to organelle genetics or the molecular basis of gene expression. Recent graduate student research has examined genotypic enhancement of in vitro performance for tissue culture, the inheritance of cpDNA and mtDNA in the genus Picea, and the expression of novel genes in transgenic woody plants.

Resource Economics
Selected faculty from six departments in the College of Agriculture and Natural Resources and The Eli Broad College of Business administer the Graduate Specialization in Resource Economics. Students develop a solid background in economic theory and quantitative methods and apply these principles to natural and agricultural resource problems. Recent research projects have focused on economic theory; bioeconomic modeling; resource dependent employment; and environmental concerns in an international context.

Students who wish to enroll in this program must be accepted by the Department of Forestry and then recommended for admission to the interdepartmental program.

Soils and Hydrology
As fundamental elements of forest ecosystems, soils and hydrology are critical components in developing long-term strategies to ensure forest integrity and productivity. Topics in these areas include the dynamics and sustainability of nutrient capital, watershed management, stream and groundwater quality, and the distribution and function of forest communities, soils, and water in relation to landscape level processes.

The program in forest soils and hydrology at MSU focuses on understanding soil and hydrological principals and mechanisms, as well as on the classification and survey of forest lands based on integrated ecological factors and landscape processes. Training and research emphasize the design and improvement of sustainable management systems that protect biodiversity and environmental health. At MSU, research has ranged from assessing the chemical, physical, and biological properties of soils in upland and wetland forests, to the role forests play in producing consistent yields of high quality water and minimizing erosion and pollution, to monitoring the risks of herbicide leaching in forest soils and groundwater.

Silviculture
To flourish, a tree requires cultivation - fertilization, control of pests, occasional selective cutting around it, and pruning. Forests benefit from these same cultivational practices.

Silviculture, the art and science of cultivating forests, integrates the principles of ecology, physiology, genetics, forest protection, forest engineering, and economics with silvicultural techniques to ensure forest viability, productivity, and future options. For effective results, silviculturists must be sensitive to both societal expectations and landowner objectives in developing prescriptions for managing forestlands.

As a graduate student in silviculture at MSU, you develop this sensitivity. While enhancing your knowledge of traditional silvicultural techniques, like thinning, prescribed burning, natural and artificial regeneration, and vegetation management, you learn to apply these techniques in both traditional settings, like a forest industry plantation, and nontraditional settings, like an old growth tract or an endangered

Training and research emphasize ways to meet conservation and production goals, such

as using of prescribed burning in multiple-use management of red pine or employing short-rotation silvicultural systems for fast-growing hardwood trees to produce energy and fiber.

Social Forestry
Because of the threat to and demise of world forests and the consequent impact on human populations, there is great need to develop land-use systems that sustain both human and forest ecosystems. Social forestry and agroforestry address this need.

Social forestry directly involves the values, needs, institutions, and priorities of local people in the management of trees and forests. Agroforestry is a sustainable, synergistic land-use system that integrates trees, agricultural and horticultural crops, and animals to meet the needs of local farmers. Its goal is to optimize land use by conserving the natural resource base to attain a more diversified or sustainable production than exists under current forms of land use.

At MSU, the multidisciplinary programs in social forestry and agroforestry focus on forestry and its role in international development. Training and research emphasize solutions to biological, economic, and social problems while recognizing and accounting for the needs of local human populations. Current international projects include developing silvopastoral management systems on small farms in Jamaica, synthesizing endogenous and scientific knowledge systems to enhance agroforestry development in Rwanda, community-driven forestry in the city of Detroit, intercropping of Paulownia winter wheat in China, quantifying the relationship between photo-synthetically active radiation (par) and yield, and integrating social forestry into primary and secondary school curricula in Thailand.

Agro Forestry
Agro forestry is a production and livelihood system that is practiced around the world, and includes the planting of perennial trees and tree crops along with annual crops. Agroforestry is a collective name for land use systems and practices in which woody perennials are deliberately integrated with crops and/or animals on the same land management unit. The integration can be either in a spatial mixture or in a temporal sequence. There are normally both ecological and economic interactions between woody and non-woody components in agroforestry. It is an important form of production in the tropics and developing countries where such farming systems have substantial environmental and economic benefits.

There is also considerable evidence that forests and agroforestry (the planting of trees on farms) in developing countries provide substantial benefits to rural dwellers, national economies, and the environment. Trees provide a range of products for home use such as food, timber, firewood, medicines, and fodder as well as products for sale, boosting farm incomes, rural economies, and national exports. Trees on farms and in forests can also provide a range of environmental services, such as conserving biodiversity, reduced soil erosion and sedimentation in rivers and lakes, and increased soil fertility. Moreover, what is often unrecognized is that while forested area is declining in developing countries, tree

cover on farms is rapidly increasing, as farmers substitute for the tree products they formerly accessed from forests and seize market opportunities for selling tree products. Agricultural land now accounts for over double the area of forested land in Africa, giving justification to the slogan that, "the future of trees is on farms.

Graduate training in Agro Forestry is approach from an interdisciplinary perspective, integrating bio-physical, social and economic aspects. Although the MSU program is often focused in developing countries, students gain a firm foundation of understanding from the technical and economic perspective that can be applied anywhere.

Graduate students also have the opportunity to work along side faculty research programs that focus on a range of issues, including:

(1) Investigating the driving forces - the biophysical and socioeconomic conditions - for agroforestry development
(2) Assessing the contribution of agroforestry to agricultural production and rural livelihoods
(3) Examining the spatial and temporal patterns of intercropping
(4) Carbon sequestration and small holder systems for carbon markets
(5) Small holder rural development and ecosystem services
(6) Evaluating the effectiveness of shelterbelts in mitigating desertification and soil erosion

Tree Physiology
From boreal to tropical ecosystems, understanding the functions and vital process of trees is essential to forest conservation. To most effectively grow trees and forest we must know how they grow.

At MSU, tree physiology studies can range from the cellular level to whole trees or stands in the natural environment, and from growth mechanisms in woody plants to managing environment-genome interactions. Because of its long history of outstanding programs in plant science, MSU offers many courses in plant physiology. Instruction in silviculture, agroforestry, urban forestry, ecology, genetics, soils, pathology, and entomology complements study and research in tree physiology. In addition, the U.S. Department of Energy Plant Research Laboratory, a major plant physiology facility, is located on the MSU campus.

Michigan State University offers unique opportunities for graduate students to pursue research in tree physiology. Traditional strengths have been in physiological ecology and physiological genetics of hardwood and coniferous trees. Studies may be pursued in well=equipped laboratories, campus greenhouses, or field locations.

Urban and Community Forestry
Urban forestry concerns establishing, planting, and managing trees in or near urban areas. For more than 55 years, the Department of Forestry at MSU has focused on using live forests to improve urban environments.

Michigan State University's urban forestry program addresses a variety of urban environmental problems. Research has aimed at identifying ways to improve aesthetics, ameliorate microclimate, reduce noise and air pollution, and control sail erosion in urban areas, as well as determining what species, numbers of trees, and design patterns of forests can be employed to achieve these goals.

At MSU, research has dealt broadly in plant health care issues from nutrient deficiencies and soil improvement to planting practices, management practices and budgeting in cities across America, attitudes of urban residents about their trees, alternative treatments for adjudicated youths in tree care, and the status of street trees in America.

The urban forestry program has a dual curriculum, so graduate students can choose either the biological or managerial-administrative specialty. In addition, students may enroll in interdisciplinary urban forestry programs leading to both masters and doctoral degrees in forestry and urban studies.

Wood Science

Wood science integrates general material science with several branches of engineering to solve problems related to the manufacture and processing of forest products. Along with its focus on products, such as lumber and veneer for furniture, wood-based composites, reconstituted wood, and paper, the discipline has expanded to encompass these as a way of more efficiently using and therefore preserving forest resources.

Graduate study in wood science at MSU combines studies in forestry with complementary studies in engineering. Research is frequently conducted in cooperation with the Composite Materials and Structures Center of the MSU College of Engineering. Faculty and graduate student research has explored the use of recycled newsprint as furnish for wood composition board, the mechanism of hygroscopic distortions of laminated panels and other wood-based composites, and laser cutting of wood.