WORKSHOP PROCEEDINGS

LINKAGE OF RESEARCH, TRAINING AND PRODUCTION DEVELOPMENT FOR RESTRUCTURING THE FORESTRY SECTOR IN VIETNAM

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Linking Universities, Forestry Research, and Its Applications

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1. FOREST LANDS, FOREST MANAGEMENT, AND FOREST RESEARCH

1.1. Forest lands and forest management in the U.S.

In the U.S. forests occupy about 3,000,000 km² or one-third of the land area. Private non-industrial ownership accounts for 59% of the total forest land in the U.S., and these are generally second-growth natural forests that are not intensively managed and often not harvested at all. Only 14% of the forestland in the U.S. is managed by companies as industrial timberlands for timber and pulp production. Public lands are managed primarily by federal agencies such as the U.S. Forest Service (USFS), National Park Service, and the Bureau of Land Management, and public lands account for about 27% of the total forested area. National Forests account for about 10% of the total forested area, while states and counties generally manage only a small fraction of the total forest land.

The National Forests represent the largest proportion of public forested land, and they also are more actively managed than most other public forests. The National Forests were authorized by the 1891 Organic Act, and they were originally established for two main purposes: 1) to provide a continuing supply of timber; and 2) secure favorable conditions of water flow. Over time there has been a major shift in how the National Forests are managed, with one of the first major shifts occurring in 1960 when the Multiple Use Sustained Yield Act was passed. This required the federal government to administer the National Forests for multiple use and sustained yield of not only timber and water as stated in the Organic Act, but also for recreation, wildlife, and range (grazing by cattle and sheep). The second major shift has been due to the 1973 Endangered Species Act, and this requires the federal government to designate all threatened and endangered plant and animal species. Once designated, federal agencies like the U.S. Forest Service are required to give priority to protecting the habitat of these species and helping these species recover. The requirement to protect the habitat of key endangered species, particularly birds like the spotted owl and numerous salmonid fishes, has further reduced timber harvest because many of these species depend on old growth or mature forests and healthy streams. The combination of these two laws, plus the changes in public values (increased environmental awareness) has led a sharp decline in timber harvest on National Forests, particularly in the past two decades. At present the National Forests are being managed more for recreation,

environmental protection, and ecosystem services. Only about 30% of the area in National Forests is now designated for possible timber production, but in fact a much smaller portion is being actively managed for timber production. This means that the growth rate greatly exceeds the harvest rate.

There also has been a net increase in forested area over the last one hundred years as marginal areas that were cleared for agriculture have been abandoned and returned to forest cover.

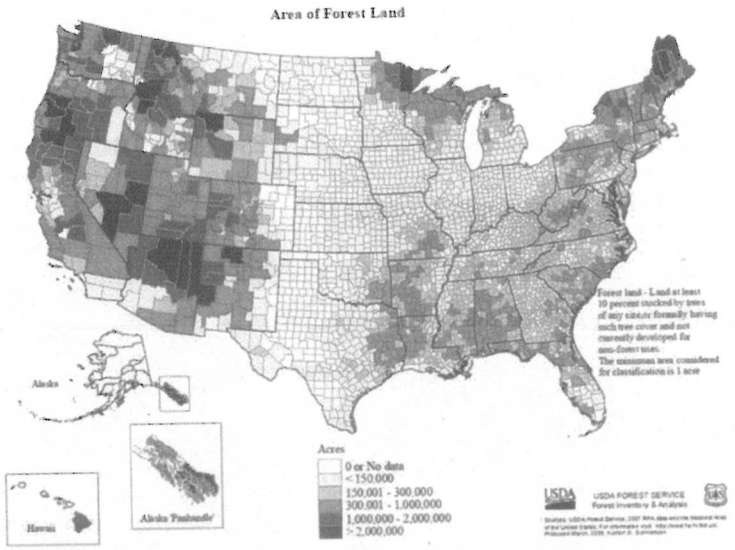

Figure 1. Map of forestlands in the U.S. Shading represents the number of acres in each geographic area (one acre equals approximately 0.4 ha).

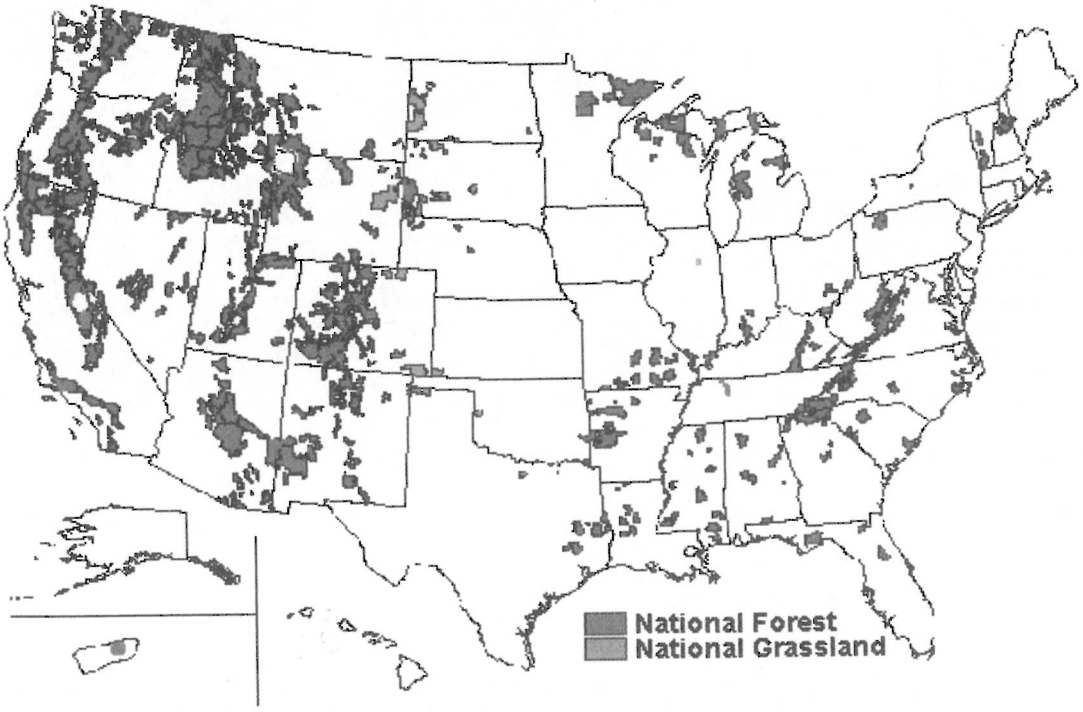

Figure 2. Map of the National Forests and National Grasslands in the United States.

The second, more recent trend in the management of National Forests is the increasing concern over

wildfires. In the western U.S., forest fires are increasing in number, size, and severity. Many people live in the patches of land within or near national forests, and the increase in fires is increasing the loss of life and property in the "wildland-urban interface" (WUI). Wildfires can greatly increase runoff and erosion rates, and these changes can severely degrade water quality and increase flooding. Over the past 30 years the costs of fire suppression by the federal government has increased from about $250 million per year to about $1.75 billion per year. In the western U.S., where most of the wildfires occur, forest thinning is the primary forest management activity on National Forest lands; the goal of this thinning is to reduce fuel loads and the risk of high-severity forest fires. A side benefit of this thinning is to produce stands with larger trees that provide improved habitat for certain threatened and endangered species that prefer more mature forest types. Over half of the budget of the U.S. Forest Service is now being spent on fire suppression and fuels management, so the acronym of USFS is now being jokingly interpreted as the "U.S. Fire Service". This focus on fires and forest thinning greatly limits the funding available for other management objectives.

1.2. U.S. Forest Service Research

Research by the U.S. Forest Service is conducted by a completely separate research branch, as the National Forests are not allowed to conduct research. There is a very extensive network of experimental forests and research stations throughout the country (Figure 3), but the majority of these experimental forests have a very little ongoing research. On the other hand, a few of the research forests have a very intensive,

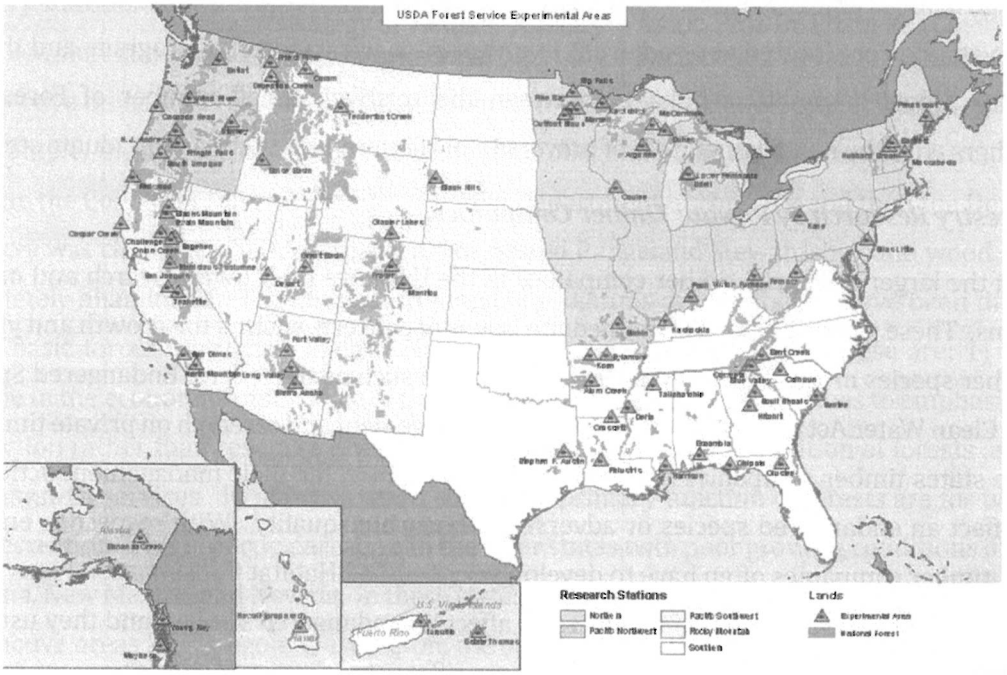

Figure 3. Experimental forests managed by, or in cooperation with, the U.S. Forest Service

Long-term research program where measurements have been made for up to nearly 100 years.

Much of our knowledge about the effects of forest management on annual water yields, peak flows,

and low flows have come from the watershed-scale experiments conducted at the Coweeta Experimental Forest in the southeastern U.S., Hubbard Brook in the northeastern U.S., Fraser Experimental Forest in the central Rocky Mountains, and the H.J. Andrews Experimental Forest in the northwestern U.S.

The increasing emphasis on fire protection has contributed to the longer-term decline in the proportion of the US Forest Service budget devoted to research. The number of researchers has been declining, and the researchers now have to find outside funding to conduct much of their research. The National Forests are prohibited from doing research, but they can provide funds to researchers from the U.S. Forest Service for "administrative studies". The decline in U.S. Forest Service research funds means that the researchers in the U.S. Forest Service are increasingly dependent on this type of project funding. The net result is that the research by U.S. Forest Service has been shifting from basic science being driven by the particular interests of the researchers to shorter-term studies that are more applied and directly relevant to the management concerns of the National Forests. The National Forests also can provide funds to universities for projects that cannot be labeled as research, but can be labeled as "monitoring" or "effectiveness evaluations". Although the projects sponsored by the National Forests cannot be labeled as "research", these projects often involve careful, intensive observations over time that result in publishable results, so the distinction between research and monitoring or administrative studies is really only a difference in terminology. Much of my own research ("monitoring") has been supported by grants from different National Forests, and the advantage to me is that I often don't have to compete for these grants. Most of the U.S. Forest Service research stations are located at or adjacent to universities with a forestry program, and this spatial proximity provides symbiotic linkages between the relatively small number of Forest Service researchers with the much larger pool of university professors, scientists, and graduate students.

1.3. Forestry Research by Private Timber Companies.

Some of the larger industrial timber companies in the U.S. have their own research and monitoring programs. These generally focus on immediate issues of concern, such as the growth and yield of the key timber species or the use of herbicides. Legislation such as the federal Endangered Species Act and the Clean Water Act has greatly affected forest management and research on private timber lands. In some states timber companies are required to get permits for their management activities that could affect an endangered species or adversely affect water quality. With respect to endangered species, timber companies often have to develop very detailed Habitat Conservation Plans (HCPs) to help ensure that their activities don't adversely affect an endangered species, and they usually have to carefully monitor the effects of their activities on different endangered species.

Similarly, the protection of water quality is managed by the states under the supervision of the U.S. Environmental Protection Agency. In many states companies and individuals are required to get a permit to harvest timber on their land, and these permits require management practices intended to

protect water quality ("Best Management Practices"). These BMPs typically require companies to reduce timber harvest and the use of heavy equipment for 15 to 100 m from fish-bearing streams, and these "riparian protection zones" can significantly reduce the amount of timber that can be harvested from a given watershed. BMPS also guide road construction and maintenance practices, use of equipment on wet soils, and many other forest management operations.

In states without mandatory harvest permits the use of BMPs is usually voluntary, but state forestry and water quality agencies usually monitor BNP implementation and effectiveness. Thirty-nine states have assessed forestry BMPs in the last three years, and the overall BMP implementation rate is estimated to be approximately 90%. This high implementation rate is due to continuing state inspections, education programs, public pressure, and fear of increased regulations if current practices are not adequate.

The timber companies have a direct interest in documenting how their management activities are affecting endangered species, runoff, and erosion, as this information will eventually affect how much timber can be harvested in the future and how they can manage their lands. The studies conducted by the timber companies generally do not result in peer-reviewed publications, as the companies are often reluctant to release all their data and they may not have the time and expertise to write up the results.

1.4. Universities and Forest Research

In every state at least one university has a forestry program. Like the National Forests, there has been a marked shift in the focus of these programs from traditional forestry and wood science to a broader perspective on natural resources management and ecosystem science. At Colorado State University, for example, the College of Forestry became the College of Forestry and Natural Resources, then it became the College of Natural Resources with a Department of Forestry, and then the Department of Forestry was changed to a Department of Forest and Rangeland Stewardship, and wood science was completely abandoned. The changes in forestry programs at universities have been driven by the same basic forces that have changed National Forest management, and these are: 1) the relative decline in the economic importance of timber; 2) the change in societal values to emphasize resource protection rather than resource exploitation; and 3) the greater recognition of forests as a provider of ecosystem services. In many western states the primary function of forests are for water supply and recreation. This is particularly true in the drier states with poor growing conditions like Colorado, Arizona, New Mexico, and Nevada. In these states it is much cheaper to simply wood from other, more productive areas like Oregon, Washington, the southeastern U.S., or Canada. The reduced emphasis on timber production has adversely affected the number and size of forestry programs at universities, and the type and amount of research being conducted.

University faculty typically has appointments that are divided among teaching, research, and outreach/service. A typical appointment at the larger, better known research universities like

Colorado State is about 40% teaching, 45% research, and 15% outreach/professional service. The 40% teaching component typically converts to about three or four 3-credit courses per year, with each course involving three to five contact hours per week; courses with laboratory or discussion sections typically require more contact hours. Promotion is based primarily on research productivity, as professors only need to do an adequate job with respect to teaching and service.

Research productivity is evaluated primarily by the number and quality of published articles in peer-reviewed journals. Other important metrics include the amount of research funding and the number of graduate students advised by the faculty member. Typical expectations are at least one peer-reviewed publication per year, graduating about one graduate student per year, and bringing in some external research funding. At more prestigious universities such as Yale and the University of California at Berkeley, the expectations for faculty productivity are significantly higher. For promotion to associate professor one also is expected to have a national reputation, and for full professor one should be able to demonstrate an international reputation. There are relatively few regional journals in the U.S., and publications in these journals, technical reports, book chapters, and U.S. Forest Service publications are much less important in the tenure and promotion process than publication in journals that are more international and widely-cited.

It is important to realize that most U.S. professors are only on 9-month appointments for the academic year, so they do not receive any pay from the universities for the three summer months. The universities do not provide research funding, so professors only get office space, lab space, and perhaps a computer. Graduate students are usually full-time students, and to attract a good graduate student a professor has to offer a competitive stipend of around US$1500-2000 per month plus tuition, or a total of around US$30,000 per year!

All this means that if a professor wants to receive any summer salary, attract high quality students, buy field equipment and conduct field research, or attend conferences; they need to obtain outside funding. Most forestry universities expect professors to obtain around $100,000 per year of outside funding. This funding can come from different federal agencies such as the National Science Foundation, but such grants are extremely competitive. The typical success rate for a grant from the National Science Foundation, for example, is around 10-15%. This means that most professors have to spend a relatively large proportion of their time applying for grants.

External research funds also are very important for the universities, as public universities are funded by the states rather than the federal government, and the amount of state funding has been shrinking over the past couple of decades. At Colorado State University, for example, only about 10-15% of the university's budget now comes from the state government and the rest of the funding comes primarily from tuition and research grants. The decline in state funding is why tuition rates have been rising very rapidly; tuition for in-state students at public universities typically is around $10,000 per year, while the tuition for out-of-state students is around $25,000 per year. Universities are now

competing with each other to attract as many out-of-state and international students as possible, as the tuition from these students is greater than the marginal cost of educating one more student.

The other important source of revenue for the larger universities is the "overhead" from research grants. Each university has an office devoted to the submission and supervision of funded research projects, and each research project requires some space and other facilities (office space, laboratory space, computer support, etc.). Hence universities add an overhead charge onto each grant, and the usual overhead rate for most agreements is about 50%. This means that to obtain $100,000 of funds, the principal investigator has to receive 50% more, or $150,000, with $50,000 going to university overhead. This overhead is primarily kept by the central administration, with progressively smaller portions going to the colleges and then the department. Professors typically receive little if any of the overhead from the grants they bring in; I've probably brought in about $3 million in external funding, but have received less than 1% of this for purchasing personal computers, travel, or other expenses.

The net result is that both professors and universities are highly dependent on external funding. The professors need grants to conduct their research, support their students, and obtain their summer salary, while the universities need the overhead from the grants to help offset their costs as the amount of state support declines. It should be noted that professors can also teach or do consulting during the summer, but these activities generally will not contribute to their promotion because they will not lead to peer-reviewed publications.

In the past professors who did more applied research tended to be less highly regarded than professors who did more basic research, and a relatively limited amount of funding is available for forestry research. Figure 4 shows that the largest federal source of funding is the National Institute of Health (NIH), followed by much smaller amounts from the Department of Defense (DoD), NASA, and the Department of Energy (DOE). Of these agencies, only NASA is likely to support some work on forestry, and then only if it has a strong remote sensing component. The National Science Foundation (NSF) provides a similar amount of funding as DoD, NASA, and DOE (around US$7 billion per year), but they generally have not provided funding for applied forestry research; only recently has NSF used research relevance and applications as an important criterion for allocating its funds. NSF generally will not support applied research, such as silvicultural studies or tree breeding.

The U.S. Department of Agriculture (USDA) is the only federal agency that explicitly funds forestry research, but its research funding is much less than many of the other federal agencies (Figure 4). Most of the research funding from USDA is devoted to agriculture, as this is at least an order of magnitude economically more important than forestry. The only grant program explicitly for forestry is McIntyre-Stennis funds, which were established in 1962 for forestry education and forestry-related research at state-certified forestry schools. The problem is that the total amount of McIntyre-Stennis funds is less than $30 million per year, so

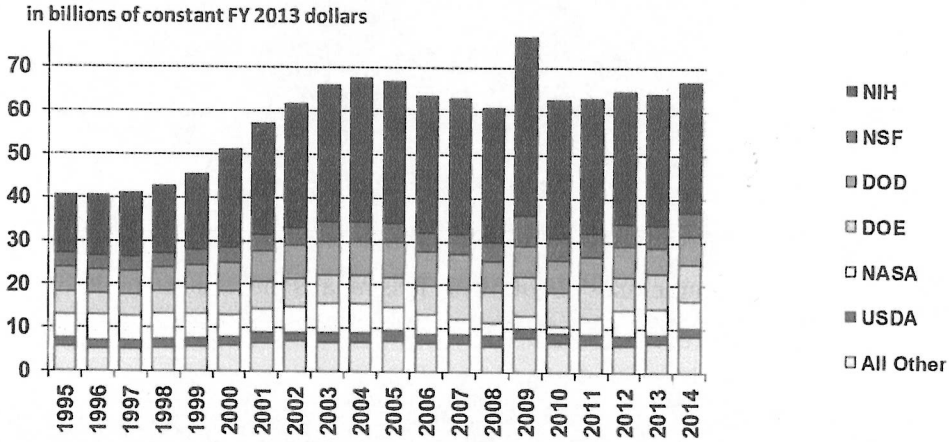

Figure 4. Federal research spending by agency, 1995-2014

NIH is the National Institute of Health, NSF is National Science Foundation, DOD is Department of Defense, DOE is Department of Energy, NASA is the National Aeronautics and Space Administration, and USDA is U.S. Department of Agriculture, which includes the U.S. Forest Service.

total funding for Colorado State University is around $400,000 per year, and at least some of this is used to help pay faculty salaries. A few universities, such as Oregon State University, do obtain substantial research funds to work on timber harvest issues from state forests and taxes on the timber industry, but this is exceptional and can be traced back to the importance of the timber industry in Oregon and the historically strong ties between Oregon State University and the timber industry.

The net result is a quite different situation for forestry research in the U.S. versus Vietnam. In the U.S. applied research is generally less well regarded than basic research, and the larger funding agencies tend to focus on improved understanding rather than solving immediate management problems. The National Forests are not allowed to support research. In contrast, my understanding is that most of the forest-related research funding in Vietnam comes from the ministries, and this tends to be more applied. Graduate students are usually part-time in Vietnam as compared to full time in the U.S., and this means that the professors do not have to raise funds to provide student stipends, but on the other hand the students generally can spend a much smaller proportion of time on their research. As noted above, professors in the U.S. have to always focus on whether a given project can generate publications in peer-reviewed international journals. Applied research that leads to improved management practices have historically not been as important for tenure and promotion, and have tended to be considered less valuable than basic research.

The lower regard for applied research in the U.S. is slowly weakening for several reasons. First, federal agencies need to better justify their research programs, and this is pushing them to be more applied so they can demonstrate that their work is having a practical benefit. Second, the criteria for funding have changed to put more emphasis on how the research results can be used to help solve

real world problems. Third, the total amount of funding is not increasing, so university professors are looking more for other, non-traditional and more applied funding sources. These other sources can include local government agencies with very specific problems, the National Forests, and private industry. These forces have combined to generate new, more applied sources of funding, such as the Joint Fire Science Program, where several agencies combine funds to support research related to wildland fire behavior, effects, and mitigation (http://www.firescience.gov/).

For researchers the advantage of these sources is that they are typically much less competitive; the primary disadvantages are that the work tends to be more problem-driven and applied, so the researcher has less flexibility to pursue their own interests, and the results may be regarded as less valuable than basic research. I personally have been very successful in pursuing this more applied model, as my interests in topics like post-fire erosion, road erosion, and cumulative watershed effects are directly relevant to the management agencies. Once I established my reputation, management agencies like the National Forests would come to me with a suggested project and the funding to carry it out! For these projects I would not just collect the data needed to solve their immediate problem, but do additional and more intensive measurements to better understand the underlying processes; this additional understanding would make the results readily publishable in peer-reviewed international journals even though it was technically not defined as "research".

2. TRANSFERRING FOREST RESEARCH RESULTS

There are a series of mechanisms for transferring forest research from universities to different user groups. As indicated above, peer-reviewed journal articles are the primary mechanism for universities to transfer information, as journal articles are the primary concern for university researchers. Professors who are engaged in forestry research incorporate their research results into their teaching, but this is more true at the graduate level than the undergraduate level. Professors also may organize, or be asked to lecture at, training courses and workshops put on by the US Forest Service and other land management agencies. In my experience the dissemination of research results is rapidly improving for several reasons: 1) the internet makes it much easier for people to access information, and many professors make their publications available on their web sites; 2) funding agencies are now requiring that projects have a specific plan to disseminate the research results and to make the data publicly available; and 3) universities are recognizing their need to be more relevant in order to maintain their state funding. The so-called land grant universities also have a very specific mandate to conduct extension activities, and they have extension departments that are designed to provide practical guidance to farmers, foresters, and resource managers. This guidance is often derived from applied research studies, and this information is transferred through much applied publications and workshops.

U.S. Forest Service research is responding to many of the same pressures, and they also try to disseminate their results through a series of different publications aimed at different audiences.

These include more technical publications and research notes, and other newsletters that are aimed more at the general public. All of these are disseminated through the internet. A few of the technical publications become widely recognized and disseminated, but the Forest Service researchers are increasingly publishing their results in peer-reviewed journals rather than internal Forest Service publications. The reason for this shift is because the researchers are evaluated and promoted primarily on the basis of their external journal articles rather than U.S. Forest Service publications.

A final trend that is helping the dissemination of research is the overall increase in the educational level of National Forest employees. In the past a bachelor's degree was often sufficient for someone to obtain a permanent position as a forester, hydrologist, soil scientist, or other technical position. A master's degree is now needed for nearly all of these positions, and the additional training helps facilitate the transfer of knowledge from universities because the employees are more used to reading the scientific literature. The same tendency is true for most other federal land management agencies, such as the National Park Service. The larger timber companies also tend to hire technical specialists with a master's degree rather than just a bachelor's degree, as they can get a much better person for a relatively small increase in salary.

3. CONCLUSIONS AND RECOMMENDATIONS

A variety of forces are causing both federal and university researchers to do more applied research and to place more emphasis on disseminating their results. The push towards more applied research is due in large part to the need of the funding agencies to demonstrate their usefulness and relevance. University and agency researchers quickly respond to this change by trying to make their research proposals more relevant, and strengthening the outreach and dissemination component of their proposals. Within the universities there is an increasing acceptance of more applied research as long as it leads to peer-reviewed journal articles.

The improvement in the dissemination of information is largely due to the explosion of information available on line. Both management agencies and timber companies are also tending to hire more qualified individuals, and this also facilitates the dissemination and use of research results.

From these trends and my experience I can recommend the following:

1. University professors should look to the management agencies and private companies for applied research projects. These are less competitive and will reduce the time spent writing proposals, allowing more time for research and the dissemination of the results.

2. Federal land management agencies, universities, and private timber companies should build more partnerships to combine datasets and pool their limited funds for research and monitoring. As timber harvest on federal lands decreases, private timber companies are taking the lead in producing timber for U.S. needs. While the regulations governing timber harvest and forest management are becoming more stringent, the specific benefits of these practices are not well documented in the peer-reviewed

scientific literature. University researchers can greatly enhance the data collection and data analysis being done by state agencies and timber companies, and this collaboration can be a very a cost-effective partnership that results in more applied research and a better documentation of forest management effects.

3. University professors should be rewarded more for their dissemination and outreach efforts, and for work that leads to improved resource management. The present focus on peer-reviewed publications should be balanced by providing more credit for outreach and efforts to improve resource management.

4. In Vietnam the situation is almost reversed, as much of the funding for forestry research comes directly from the ministries. This means that the research is directly relevant and has immediate application, but much less of the research is of sufficient quality to publish in international peer-reviewed journals. The publication of this research in international journals is also limited by the writing abilities of the people conducting the research.

5. The development of Advanced Degree programs in English should, over time, both strengthen the English capabilities and lead to a greater internationalization of Vietnamese forest science and management.