THE ROLE OF UNIVERSITY-INDUSTRY RESEARCH COOPERATIVES IN DIFFUSING NEW TECHNOLOGY

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Abstract

University-industry cooperatives exist from the early 1950s. They have served a useful purpose in furthering the cause of forestry by encouraging the collaboration between public and private agencies on projects that require decades of basic and applied research. For a cooperative to be successful, a real need rather than a perceived need has to exist, and a product has to be delivered. The delivery includes the application of results. Many of the cooperative programs have failed within the last decade because of failure of the university administrators to interact closely with their members, and others have struggled mightily because of the industry dispensing of their forest land. Cooperatives that remain viable are the ones that are constantly changing, such as those that have melded the expertise of faculty between universities. The prognosis is that only the most innovative university-industry programs will continue to thrive, and that private research organizations will largely conduct the research of the future. Extension of the research results will fall to the forest owner or to public agencies.

Introduction

The mold for university-industry cooperative programs was fashioned about 50 years ago. Without exception, the first such cooperatives in the United States, and the world for that matter, were on tree improvement. The pioneering programs in the U. S. were Texas A&M University (1951), University of Florida (1954), North Carolina State University (1956) and Western Forest Genetics Association (1956) (Zobel and Talbert 1984). Since then a multitude of university-industry cooperatives have been formed that span an array of topics: Hardwood Silviculture, Forest Genetics (as opposed to Tree Improvement), Forest Fertilization/Site Productivity, Nursery Management, Biometrics, Wood Products, Forest Equipment, Pest Management, Gene Conservation and others.

During the past half century dramatic changes have occurred in the world: vital organs are transplanted from one human to another; plants are genetically engineered for faster growth, improved nutrition and resistance to pests; man has walked on the moon; and cyberspace permeates every walk of our lives. In contrast, the forest products industry has changed at a snail's pace. We still cruise (inventory) the forest from on-the-ground plots and we still process timber one log at a time. But things are changing with forest ownership, and we either evolve with those changes or we wither on the vine. That axiom pertains specifically to university-industry cooperative programs.

Timberland Ownership

The industrialization of America stems from about 1880 onward. Prior to that time the forests were largely cleared for settlement, with great amounts of timber burned, dumped into rivers or left to rot. Toward the end of the century the burgeoning demand for lumber resulted in vast tracts of timber being harvested, first in New England, and then in the Lake States, Appalachia, South and Pacific Northwest. The norm for the multitude of sawmills that were dotting the landscape was to buy the timber inclusive of the land. When the timber was harvested the disturbed landscape was left to regenerate, or not, on it own. Accusations of cut out and get-out' were apt descriptions of the slaughter. Many of our National Forests and State Forests, and even portions of National Parks occupy lands that were forfeited for taxes after the timber had been pillaged.

Lest we be too hard on the 'cut-out and get-out' crowd let's take a look at history. Prior to passage of the Clark-McNary Act in 1924, forest land was taxed as personal property, just as were draught horses, houses, and farm land. The economics of artificially regenerated cutover land for a crop that might be 80 years in the making just didn't meet land expectation value. In addition to the Clark-McNary Act clearing the way for creation of National Forests in the eastern U. S., it advocated programs to combat forest wildfires and for the states to develop tax systems compatible with sustainable forestry. Thus, was borne capital gains taxation and its derivatives.

Depletion of the timber base across the U.S. in addition to the emphasis on forest fire control and favorable taxation of timberlands was cause for reputable timber companies to begin artificial regeneration programs. Notable examples include Great Southern Timber Company in Louisiana (McCleery 2004) and Weyerhaeuser Timber Company (known today as Weyerhaeuser Company) in Washington and Oregon. It is of interest to note that Weyerhaeuser Timber Company created a separate company, Weyerhaeuser Logged Off Land Company, that existed from 1925 to 1936 to deal with that very issue (Sensel 1999).

Prior to about 1930, sawmills were the major users of wood in the Southern Appalachians, South, Lake States and Pacific Northwest. Pulp mills were primarily a Nordic convention. Their concentration in North America was in Canada, New England and upstate Wisconsin. The reason for the restriction to those northern latitudes was the presence of spruces and firs, the long, narrow fibers of which are the Cadillac of all species for paper and paperboard manufacture. Even though controversy exists over the first pulp mill in the southern pine belt, whether at Roanoke Rapids, North Carolina or Orange, Texas in 1907, the point is made that the plethora of pulp mills did not locate to the South until the late 1920s and early 1930s. The events took place because of the pioneering work of Dr. Charles Herty in Savannah, Georgia who demonstrated that the high-resin southern pines could be converted to pulp of good strength and quality by use of the kraft process. Location of pulp mills in the Pacific Northwest commenced about the same time, but there the emphasis was on timber utilization. Western hemlock, a species often intermixed with vast stands of Douglas-fir, was poorly utilized because of its inferiority for construction-grade lumber. The sulphite pulping process helped to solve that problem with the installation of a pulp mill at Longview, Washington in 1931 (Sensel 1999).

Because of the emphasis on lumber production in the Pacific Northwest large landholdings had been amassed by individuals and companies since the early 1900s. Their primary product continued to be lumber, with the residue destined for pulp mills. Not so with the U.S. South. Even though a scattering of sawmills with significant timberlands existed, the pattern was for pulp mills to be built with the resource being second-growth pines that had naturally regenerated on fields that had been abandoned from soil depletion and invasion of the cotton boll weevil. In 1937-38, 18 new pulp mills spanned the coastal area from Virginia to Texas. Almost without exception the principals of those mills amassed a land base to support the raw material needs.

Following World War II the concern developed that insufficient wood was available to support those mills (Alig *et al.* 1985). In unison, the pulp and paper companies initiated plantation programs, first on abandoned agricultural land and then on cutover lands. To complement the silvicultural practices associated with plantation establishment, university-industry cooperative programs were borne.

University-Industry Cooperatives and Programs

A distinction is made between university-industry cooperatives and university-industry programs. In the first instance, the industrial cooperators, inclusive of public agencies are

equal partners. They contribute to the cooperative a predetermined sum of money each year for operational purposes. In addition, they contribute the necessary land base for research trials, and the manual labor and equipment to establish and maintain the trials allocated to them. To prevent quibbling about the organizations with large land bases receiving preferential treatment, the common method of operation was that 'one size fits all', *i.e.*, everyone shares equally in the research results, and in the money and energy expended in obtaining the results.

As contrasted to university cooperatives, university programs are commonly devoid of a field component in which each cooperator shares equally. The model is for a predetermined and equal amount of money to be contributed to the central authority (program) and the program (receiving party) does the research and distributes the results to the members. Equipment development and biotechnology research are common examples of university-industry programs. University-industry programs are more apt to have a fixed life than do many of the university-industry cooperatives. Our discussion for the remainder of this treatise will be devoted to university-industry cooperatives.

Prescription for Success

Ingredients for success of university-industry cooperatives include the willingness to: (a) be a paying member, the money of which is for administration of the cooperative, inclusive of graduate student stipends, (b) be an equal partner in conduct of the work load, (c) share research results and plant material with all other members (d) honor the publication of research results in refereed journals, and in internal and external reports, and (e) host technical meetings and workshops.

The Working Model for Cooperatives and its Demise

In the early days, the model worked to near perfection because the general managers or vice presidents of the forestry organization were individuals steeped in forestry, and their CEOs were the same people that had originally amassed the land base. They held no secrets. Their philosophy was that everyone was on the same learning curve, be it in plantation forestry or in timber utilization, and that an advantage gained by one was good for the whole. With time, however, leadership within the various companies changed due to retirement or reassignment. The new leadership sometimes came from allied industries where the competition from one installation to another was sometimes fierce. That philosophy began to permeate the forest products organizations and, consequently, the university-industry cooperatives. New rules of conduct were developed, but some organizations ceased membership because of being unable to adhere to the new standards. That factor alone was not the reason for failure of some of the university-industry cooperatives, but it was a contributor.

A factor larger than the protection of 'intellectual property' that led to the demise of some university-industry cooperatives is the changing forest land base. At the height of industrial ownership in the U. S. South in the 1970s, forest products companies owned 22% of the 500-million-acre commercial timberland base. The remainder was distributed between the non-industrial private owners and public agencies, at 67 percent and 11%, respectively. During the tumultuous economic times of the early 1980s, the economy of

the forest products companies was performing significantly below that of the U.S. economy which, in itself, was being hotly contested by the burgeoning Japanese economy. Some sharp-eyed entrepreneurs sensed the plight of the forest industry and began buying companies at the on-going, low-market stock price. That group, called arbitrageurs, would then dissect the company and sell the parts for greater amounts than was paid for the whole. Household names, such as Crown Zellerbach, Continental Can and Scott Paper, ceased to exist. Others, such as St. Regis and Hammermill survived the arbitrageurs only because they were consumed by 'white knights' Champion and International Paper. That loss of companies seriously affected university-industry cooperatives, even to the point that some cooperatives ceased to exist, and those that did survive were destined for reorganization.

The 1990s were a period of relative prosperity for the pulp and paper industry, but toward the end of that decade and in the early years of the new century a wave of mergers and amalgamations (M & As) hit the forest products industries. Those M & As consisted of one forest product company buying or merging with a sister company. Over the span of a few years, Fort James, which itself resulted from a union between Fort Howard and James River, became part of Georgia-Pacific; Federal Paper Board, Union Camp and Champion became part of International Paper; MacMillan Bloedel and Willamette became part of Weyerhaeuser, and Mead Paper merged with Westvaco Corporation. The amalgamation of one company into a second one further reduced the base of support for the university-industry cooperatives.

To add to the turmoil, Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs) became major players. Those organizations own and manage forest land for institutional investors and stockholders as the case may be. The behemoth of the TIMOs is Hancock Timber Resource Group (HTRG) who owns or controls about 3.5 million acres of forest land. Their REIT counterpart, Plum Creek Timber Company, has over 8 million acres of forest land under its control. The land purchased by these two groups was and is, almost without exception, industry lands (Lutz 2005). These changes are further reducing the membership and the land base supporting the university-industry cooperatives.

All is not lost to the university-industry cooperatives with the timberland buying activity of the TIMOs and REITs. Because the REITs manage timberland for the benefit of their stockholders, they see the value in practicing intensive silviculture, inclusive of tree improvement and site productivity, and continue to support the cooperatives. TIMOs on the other hand, parcel their land by investor group, usually on a 10- to 20-year payout. Because of that short timeframe they were initially not interested in investing in research, such as would come from university-industry cooperatives. That strategy appears to be changing because of the huge amount of land being amassed. Membership in selected cooperatives is being realized by those two entities.

The Future of University-Industry Cooperatives

The university-industry cooperatives that have thrived over the years have one or both of two ingredients: (a) something of tangible value, and (2) extension of research results into

application. The first example is exemplified by tree improvement where genetically improved seeds or plant materials are the product. The attributes from tree improvement are many: improved tree growth, form, wood properties, pest resistance, adaptability, and gene conservation. With the advent of forest biotechnology that includes clonal forestry, plant genomics and genetic engineering the benefits from tree improvement in the broadest sense are never ending. The challenge will be to fine tune the structure of the cooperative to accommodate the different types of cooperators. In 1985, for example, the membership of the NC State-Industry Cooperative Tree Improvement Program consisted of 25 forest industry units and 3 state forest service organizations. In 2005, that membership had changed to 5 forest industries, 5 state forest organizations, 2 independent research organizations, 2 REITs, and 2 TIMOs. The prognosis is that the membership will evolve more heavily to the REITs and TIMOs in coming years.

The other type of university-industry cooperative that has prospered is the one where science and extension have been melded to benefit the member. Nothing supplants good science in furthering productive and sustainable forest practices. But good science is of limited value when it is not put to good use. Publication of results is not enough. The practitioner has to meld the science with operational forestry. That is done by on-the-ground training, inclusive of short courses, and field guides. It is also done by inclusion of experts from related fields, one model of which exists between NC State and Virginia Tech. The two leading scientists in site productivity at those two institutions are co-directors of the University-Industry Site Productivity Cooperative. Membership in that Cooperative is flourishing, inclusive of industrial organizations in Latin America in addition to those in the U. S. South.

A number of university-industry cooperatives have failed in recent years. The model for failure is when the director remains in the ivory-tower setting while administering from afar. Successfully directing a cooperative program, in combining science and extension, is equivalent to obtaining good coverage of an herbicide with an emulsifier on a noxious plant.

The Model to Succeed University-Industry Cooperatives

The plethora of university-industry cooperatives and their separate administrations have aggrieved some of the leading forest products companies because of the need to hold membership in the separate cooperatives. One model to alleviate the problem is the formation of a mega-cooperative in which the annual fees of the cooperators are directed to a central authority, and are then distributed as grants to researchers from throughout the region who conduct the research that meet the goals of the financial contributors. The example of this kind of cooperative exists at the University of Georgia under the aegis of the Southern Forest Research Partnership, Inc. Even though that program remains active, there is question about the appropriateness of the model because some of its members continue to support individual university-industry cooperative programs. The dual membership defeats the intent of the mega-cooperative.

I predict that the emerging model for the conduct of forest research will fall to the private sector. Examples that have emerged in recent years include **ArborGen** and **CellFor**,

both of which are private companies that have an emphasis on forest biotechnology. In addition to conducting basic forest biotechnology research, they sell their technology and/or plant material to forest products companies and other forestry organizations. With the downsizing and deletion of the research and development units of the remaining forest products companies, it will only be a matter of time before other components of forestry research will be the domain of stand-alone companies.

Summary

There is no better way to diffuse new technology than by personal involvement. Personal involvement means interacting with the clients on their turf. In that way, the scientist can share how the research results will aid the client in accomplishing internal goals and, in the process, the scientist will learn about the challenges facing the client and will incorporate those components into the university research program. The second best way to deploy research results from a university-industry program is by the conduct of workshops and conferences. The commonality of these two initiatives is interaction between the university and client regardless of whether the client represents a public or private entity.

Publications are an essential part of a university-industry program. To be effective, they must be structured for the intended audience. Publications fall into four categories: (1) intended audience, (2) historical, (3) scientist to scientist, and (4) publish or perish syndrome. The first two categories apply to the mission of this program, with the message “keep it simple, stupid”.

The lament is that by adhering to these principles insufficient time is left for research or research administration. In that situation, partitioning of time is essential. Financial support from forestry organizations soon wanes when insufficient attention is given to outreach initiatives.

Despite the value of university-industry cooperative programs to the forestry sector the prognosis is that those programs are on the wane. A major reason is the changing forest-industry land base. Only those cooperatives with a specific product to market, such as genetically improved plant material, and those that combine the talent of separate universities such as the union between NC State and Virginia Tech on forest nutrition, will continue to survive. Even then, it is envisioned that that forestry research will migrate to private entrepreneurs. The model being provided by ArborGen and CellFor, both forest biotechnology companies, will transcend into the silviculture of fast growing plantation forestry, inclusive of all the ramifications associated with growing, harvesting and manufacturing timber and timber products.

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