# AN INTRODUCTION TO INDUSTRIAL FORESTRY GIS SYSTEMS AND OBJECTIVES

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## ABSTRACT

Geographic Information Systems applications by industrial forestry organizations share many features in common with other natural resources applications of GIS. Organizational constraints, data complexity, multi-user environments, and geographically distributed databases are some of these shared features. However, industrial forestry geographic information systems are frequently more mature than systems in other forestry organizations. This may mean that they have evolved and improved, or that they have become saddled with the baggage of "legacy systems". Also, the intensity of forest management in forest industry in the South has implications for data management in a GIS environment.

## INTRODUCTION

The purpose of this paper is to provide a context and background for a discussion on applications of GIS in industrial forestry. General characteristics of industry systems will be described, and some of the unique aspects of GIS in a forest industry setting will be highlighted.

First, it is necessary to discuss "industrial forestry". Typically, the forest industry is taken to mean "…companies or individuals operating wood-using plants" (Hansen et al. 1992). A more appropriate emphasis would be on organizations conducting what might be called "production forestry" (Smith 2000). These might include organizations traditionally considered to be forest industry, but would also include companies that own timberland for production purposes, but do not themselves own forest products manufacturing plants. The most common example would be a "timberland investment management organization", or TIMO (Binkley et al. 1996). Thus, for the purposes of this paper and this session, the terms industrial forestry and production forestry are used with the same perspective: organizations involved in managing forests to supply commercial products.

Applications of GIS in production forestry organizations are similar in many ways to other forestry applications of GIS. These include types of data contained in the systems, the

interrelatedness of the natural resource data layers, the types of forest management applications, and the organizational setting for an information technology such as GIS. However, production forestry GIS implementations are shaped by the industry objectives and the business environment, and as a result may differ in significant ways from other forestry GIS operations.

## SHARED CHARACTERISTICS

Two of the distinctions of forestry GIS systems are the complexity of the data stored therein, and the multiple purposes for which the GIS is applied (Smith and Prisley 2000). This applies to production forestry settings as well as others. Despite some commonly held beliefs about timber industry objectives, land managed by these organizations is almost always managed for multiple uses. Production forestry organizations don't have the luxury of making large investments in management practices that have no prospects for commercial returns. This does not mean that industry can escape the need to conduct the traditional multiple-use management that foresters are familiar with; it means they must be extremely judicial in making multiple-use prescriptions. Production forestlands are managed for wood products as well as forest-based recreation, wildlife habitat, water quality, and protection of special sites (Prisley 1995). The need to be efficient in multiple-use allocation of resources creates a great demand for improved data to support these decisions. Thus, production forestry organizations are investing heavily in developing the landscape-level information needed (Odom 1996, 1998).

In many forestry organizations, there are multiple users for GIS products. Production forestry organizations are no exception. High-level managers need summaries of data contained in GIS, as well as maps of specific sites that are of particular interest, such as tracts being sold or traded, lands involved in regulatory or legal negotiations, or sites being used in public communications programs. Foresters throughout the "line" organization routinely use GIS products to communicate goals, track activities, develop plans, monitor progress, and report results. Research and technical staffers are routine data users for special studies, experiments, field trials, and training exercises. Other staff specialists such as wildlife biologists, public affairs officers, regulatory compliance inspectors, and others frequently need GIS products for implementation of programs under their supervision.

Production forestry GIS shops, like most others, face numerous institutional challenges in the successful implementation of GIS. Vagaries of the "corporate culture" will influence the ability of even the most technically adept GIS professionals to create a responsive, reliable information system. Staffing restrictions will limit what can be done more often than technical capabilities. Budgetary limits will set the pace for achievements. Frequently, projects, tours, and demonstrations will arise that will divert the GIS staff from their stated goals. These distractions may be viewed as necessary as a firm's public affairs efforts, but they have a cumulative impact that can sidetrack important efforts and cause deadlines to slip. Frequently, GIS staffs exist outside of line organizations, and therefore must be adept at generating goodwill among their internal customers, avoiding politically dangerous intrusions on projects outside their power base, and developing strong ties and support structures across lines of authority.

Most land management organizations, including production forestry groups, have geographically distributed organizational structures. They might have district offices located in small towns in the counties where they own land. They might have regional offices where the higher levels of the organization are located and the staff groups are located. And they probably have headquarters offices, possibly far removed from the land base, from where their entire organization is administered. This type of structure challenges the implementation of any information system, and raised issues of centralized versus distributed data management (Smith and Prisley 1989, Bettinger 1999). While the Internet reaches farther and farther into rural areas, some of these issues may become moot. However, it is likely that among the last locations in the U.S. to obtain reliable Internet connections will be places that forestry offices are located!

Finally, production forestry organizations are like others attempting to practice forest management beyond the level of the timber stand: there is a need for resource information on lands beyond the ownership boundaries. If foresters are to manage in the context of landscapes, ecosystems, or watersheds, it is necessary to have some level of information and understanding about land cover, land use, and likely future management for the larger area. This means moving beyond traditional inventory techniques and managing multi-resolution databases.

## DIFFERENCES IN PRODUCTION FORESTRY GIS

The primary characteristic that seems to distinguish production forestry in the South is intensity of management. For the purposes of this discussion, intensive management has several aspects. First, management prescriptions tend to be site-specific rather than "cookbook" management regimes applied broadly across a wide variety of sites and conditions. Second, multiple combinations of treatments (e.g., site prep, weed control, fertilization, etc.) may be applied over time, especially in plantation establishment. Third, the expense of these treatments often dictates that results be followed closely, which implies a need for a detailed monitoring system.

This level of management intensity has numerous important impacts on GIS data management and applications. Such active management entails keeping detailed activity records, many of which must be spatially located and may require unique data structures (Murray et al. 1996). The precision of prescriptions (tailored to site conditions) implies that important parameters (soils, landscape position, planting stock) be located with more spatial precision than may be necessary in less intensive management. Third, the level of activity means that data are very dynamic, and maintaining a current database becomes more difficult yet more essential.

Another characteristic of production forestry GIS is the general level of maturity of these systems. As early as 1983, forest industry experiences with GIS were being described in an inventory conference (Munro 1983, Masse and Greene 1983, Peck 1983). At the time, the industry formed the primary business sector for one of the first commercial GIS products, sold by Comarc Systems (Bailey, 1983). In a 1990 survey, Reisinger (1990) found that about 60% of

forestland owned by 30 large forestry companies was included in GIS databases. The nine early adopters in this group had an average of 10 years of experience with GIS by that time; 11 companies that had partially integrated GIS in their operations had an average of five years experience.

Companies have been using GIS for such a long time have experienced waves of technology, requiring multiple hardware and software upgrades, database redesign, system reconfiguration, and revision of data collection procedures. Each of these events introduces organizational stress, but also presents opportunities for systems to evolve and improve. If support is not available in an organization to conduct these evolutionary processes, then another set of difficulties is introduced: the challenge of maintaining antiquated, "legacy" systems. Witness the cost and difficulty encountered by such organizations when preparing for Y2K problems. Few GIS user segments have had the long-term history with GIS that some production forestry organizations have had.

It's tempting to believe that forestry companies have simpler responsibilities than, for example, public forestry agencies. The common conception is that a company simply does what the CEO says, and the CEO is responsible to shareholders. The truth is that production forestry organizations have many responsibilities and restrictions, and many of these responsibilities impact the GIS departments of these companies. The following are just some examples of information requirements involved in production forest management.

1. **Taxes:** As taxpayers, production forestry organizations must collect reliable inventory data for tax reporting purposes. When harvested timber is sold (even within a company), the cost of producing that timber (the basis) is deducted from revenue before taxes are computed. Maintaining such depletion records can impose a burden on inventory systems. If depletion accounts are geographically-based, the GIS may be heavily involved.

2. **Recordkeeping for owners:** Publicly traded companies have reporting requirements that may require substantial effort and recordkeeping by GIS or inventory departments. Forestland investment companies have numerous specific reporting requirements for their various investment portfolios. Production forestry organizations involved in land transactions have numerous responsibilities in obtaining, managing, and interpreting information in order to make informed and responsible transactions.

3. **Regulatory records:** Production forestry is heavily regulated by a variety of federal and state agencies. A huge amount of data is needed to fulfill responsibilities for diverse laws relating to land use, threatened and endangered species, water quality, worker safety, hazardous chemicals, timber harvesting, smoke management, air quality, and other concerns.

4. **Stakeholders:** Companies have responsibilities to shareholders, customers, and employees that may require demonstrations or communications based on GIS data. Production forestry organizations have responsibilities and interactions with neighboring landowners that may involve GIS.

5. **Public:** Increasingly, production forestry organizations recognize a responsibility to the public to inform and sometimes include them in decision-making processes about forest management. Part of this public responsibility is reflected in efforts such as the Sustainable Forestry Initiative of the American Forest & Paper Association (Berg and Cantrell 1999).

This myriad of responsibilities means that successful production forestry organizations must be able to clearly conduct and communicate a high level of professionalism in their forest management; GIS is integral in this process.

## SUMMARY

Applications of GIS in production forestry are similar in many ways to other forest management organizations. Data are complex and used for a variety of purposes. Multiple users with varying levels of expertise are the customers of GIS products and services. The organizational setting and organizational culture are critical determinants of success or failure for GIS. GIS are often applied in geographically distributed configurations.

Production forestry organizations may differ in the maturity of their systems, their data, and their applications. The intensity of the forest management practiced by these organizations has a tremendous impact on data requirements, volatility, and resolution.

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