Opportunities

Three factors seem to have driven change on California's forest lands and forest products industry during the last decade. These are: 1) market and natural factors in the industry that relate to profitability; 2) the impact of regulations to protect air, fish, and wildlife that limit available timber supply and increase costs; and 3) public support for open space and conservation expenditures.

Profitability

Production factors vary by timber growing, lumber production, and manufacturing. All require land, labor, and capital investment and all are responsive to technological change. Over the last 20 years, important advancements have taken place within the forest resource industry including improvements in forest productivity, wood fiber utilization, product quality, and reductions in the environmental impacts associated with harvesting and manufacturing processes.

Today, the forest resources industry is able to recover twice as much wood from a single log as it could in 1970.

Over the last two decades, raw material utilization has doubled. Today, the forest resources industry is able to recover twice as much wood from a single log as it could in 1970. In addition, the forest resources industry makes engineered wood products from wood fiber that was unusable 20 years ago. The technologies that made these new products possible also led to challenging new jobs requiring advanced skills, particularly in the computer area. These jobs have more than made up for the initial job losses due to automation. In addition, improvement in product quality and strength has caused reductions in the amount of wood used per square foot of building space (California Forestry Association, 2002; USFS, 2000).

Future wood fiber availability in California is highly dependent on harvest policies for public and private lands. This is especially true because of the age class structure of forest stands on private and public lands. On private lands, 77 percent of the timberlands are less than 100 years old, while on public lands nearly 70 percent are over 100 years of age. There is also a relative abundance of early and mid-seral age classes of trees on private lands, especially on forest industry lands. This means relatively low volumes and smaller tree products are currently available compared to previous decades. A considerable portion of future harvests will probably come from stands in the late mid-seral and late seral categories. Much of this will be on other private lands that have not been harvested as actively as forest industry holdings over the past few decades. Public and private harvesting policies thus have major implications on the mix of the size of the logs cut, as well as the types of timber stands for harvesting and regeneration.

Despite serious constraints, some opportunities exist for the enterprises of forest landowners and the forest industry to remain profitable. These include:

(1) application of better growing and forest management techniques;
(2) stand rehabilitation and improvement;
(3) improved harvesting and utilization of existing forest materials;
(4) use of a broader range of species;
(5) creation of new products and niche markets; and
(6) development of e-commerce and customer-based market strategies.

Technology and management for improved growth and better forest health

Tree improvement programs are being used to select trees with more rapid growth rates, disease and pest resistance, wood fiber quality, and even adaptability to climatic variation. Traditional breeding practices are also being combined with tissue culture and genetic technology to improve quality of reforestation stock. One example is genetic manipulation of redwood at the cellular level (Olson et al., 1997). Another example is in seeking to improve the resistance of white pines (such as sugar pine) to white pine blister rust, which has done more damage than any other conifer disease. The resistance gene from sugar pine has been mapped and researchers are seeking to clone this gene and ultimately breed in more resistance to white pines (Institute of Forest Genetics, 2002a). This research is one of several projects in a basic molecular genetics research program by the Institute of Forest Genetics that employs genomic science technologies to comprehend the function of genes controlling important traits in forest trees (Institute of Forest Genetics, 2002b).

Tree improvement programs are being used to select trees with more rapid growth rates, disease and pest resistance, wood fiber quality, and even adaptability to climatic variation.

Examples of possible financial gains from future biotech innovations are mentioned by Sedjo in his 2001 lecture at the College of Natural Resources at University of California (UC), Berkeley (Table 13).

Table 13. Possible financial gains from future biotech innovations

Innovation	Benefits	Additional operating costs
Clone superior pine	20 percent yield increase after 20 years	$40/acre or 15-20 percent
Wood density gene	Improved lumber strength	None
Improve fiber characteristic	Reduce digester cost $10 per cubic meter	None
Reduce amount of juvenile wood	Increase value $15 per m3 (more useable wood)	None
Reduce lignin	Reduce pulping costs $15 per m3	None

Source: Sedjo, 2001

At the management level, over the last decade the use of global positioning system (GPS) equipment to map ecosystems has increased. Mapping is much more efficient because backpack GPS units receive signals from satellites that inform the user of their exact location in the field. Further refinements in aerial mapping have come from the application of laser technology and related instrumentation.

In addition, there has been expanded use of technical modeling and Geographic Information Systems to analyze management options. For example, several models have been developed to predict potential sensitivity of watersheds to impacts of management activities. For more information, see the online document Major Projects: Watersheds (FRAP, 2002).

Investment in rehabilitation and improvement of forest stands

Hundreds of thousands of acres of publicly and privately owned timberlands in California are not stocked with conifer species or are understocked. To address conditions in forest stands that limit growth and productivity requires a willingness by landowners to make long-term investments. Investments in

timber growing requires a much longer time to realize profit and in some places can be riskier than many other forms of investment.

Returns from forest land investment: Historically, inflation adjusted returns from United States forest land investments have averaged between eight and 10 percent. In recent years, many investors have seen acquisition of timberland investment as a hedge against inflation and cyclical economies. This view is based on the presumption of growing global demand for forest products and increasing limits on raw material supplies. Investors have purchased thousands of acres of timberlands worldwide and usually established plantations of rapidly growing commercial species. The price of timberlands in North America, Western Europe, and New Zealand are at the highest ever (Best et al., 1999).

Historically, in many cases, timber companies in California have acquired forest land with a high proportion of debt. Through leveraging debt, firms minimize their own cash contribution and increase their return on investment. Service of debt requires relatively high and reliable levels of cash flow that may put strong pressure on harvest inventory. In contrast, institutional investors, like pension funds, may be able to acquire timberland without leveraging debt. In California it remains to be seen to what extent institutional investors will acquire additional lands and if such acquisition means increased investment.

Timber companies and individual forest landowners vary greatly in their willingness to invest in rehabilitation and improvement of forest stands. Mendocino Redwood Company, for example, acquired property with young timber and significant acreage of understocked stands. Since purchasing the property, the company has planted over 500,000 trees a year and has made other improvements. While the company does not expect its activities to generate a significant return to its owners for the next decade, it believes that a high level of environmental stewardship is good business and will result in fair profits over time. Similar activities have taken place by other industrial owners (Mendocino Redwood Company, 2000a).

The goal of companies seeking to rehabilitate lands dominated by hardwoods to conifers is to improve the economic returns on their land.

The goal of companies seeking to rehabilitate lands dominated by hardwoods to conifers is to improve the economic returns on their land. Rehabilitation costs can be very expensive and success requires control of brush. Costs vary from $200 to $400 per acre for site preparation and $160 to $200 per acre for trees and planting (California Environmental Resources Evaluation System (CERES), 2001). These costs can be prohibitive, especially for smaller landowners.

Several government programs are designed to aid landowners in their reforestation efforts. See the Assessment document Public Involvement, Information and Education for more information. One such program is the California Forest Improvement Program (CFIP), created by the California Forest Improvement Act of 1978. Landowners can receive up to a 90 percent cost share for management plans, registered professional forester supervision, site preparation, tree planting, thinning, pruning, follow-up, release, land conservation, and improvement of fish and wildlife habitat. The program is limited to landowners who own between 20 and 5,000 acres of forest land in California. Landowners that own less than 20 acres may qualify if they submit a joint application with neighboring landowners and the combined acreage is a minimum of 20 contiguous acres of forest land (CERES, 2001). Funding for the program has varied from year to year, but the Davis administration provided $2.2 million in CFIP funding and increased the staff from three to six to assist forest landowners (California Resources Agency and CDF, 2001).

Another program is the federal Forestry Incentives Program (FIP). This program, first authorized in 1978 and then extended with the 1996 Farm Bill, is intended to provide a cost share for tree planting, timber stand improvements, and related practices on non-industrial private forest lands. The Natural Resources Conservation Service (NRCS) and USFS administer the federal FIP. Over half a million dollars was obligated to 94 contracts between 1997 and 2000. The majority of contracts and dollars went to the Northern Sierra (NRCS, 2001).

Doerksen tree farm in Sonoma County; recipient of FIP grant to convert vineyards back into forest land (NRCS, 2001).

The 2002 Farm Bill ended FIP and carried some of its focus into the Forest Land Enhancement Program under the U.S. Forest Service. The $100 million program will be effective from 2002 through 2007 and will assist non-industrial private forest landowners. Funding will be distributed through state forestry agencies. See the online paper Forest Land Enhancement Program: Briefing Paper for further discussion (USFS, 2002a).

Improved productivity and utilization

According to the USFS, industrial wood productivity increased in the United States by 39 percent from 1900 to 1998. Gains in industrial wood productivity mean that proportionately more useful wood products are being produced from the trees that are harvested for wood products (industrial roundwood). Industrial wood productivity has increased most rapidly since around 1950 due to gains in the use of wood residues (chips, slabs, edgings, and planer shavings from sawmills and planer mills). Since the mid-1980s, much of the further gains in wood productivity occurred as a result of increased paper recycling (Ince, 2000).

Industrial productivity defined: The productivity of industrial wood use in the United States is indicated by the quantity (e.g., tons) of industrial wood product output produced per unit (e.g., ton) of industrial roundwood input. Industrial roundwood input is the estimated amount of timber harvested for the manufacture of industrial wood products. Industrial wood products do not include fuelwood but include all manufactured wood products produced in the United States economy (Ince, 2000).

In the last two decades, forest residues have also been used as forest biomass. Biomass generated by sawmill wood wastes and timberland thinning can be effectively used to produce composite lumber, particleboard, ethanol, and electricity. California started producing its biomass electricity in the early 1980s to reduce the dependence on non-renewable energy sources. Along with other organic wastes, biomass used by more than 40 operating plants has produced up to two percent of energy power used in California. Technology development to reduce production costs of biomass energy may further expand the existing industry and biomass demand. See the Assessment document Forest and Range Related Energy Industry for more information.

In addition, for a variety of reasons, there has been an accumulation of wildfire fuels in many areas of California (CDF, 1996). See the Assessment documents Trends in Wildland Fire and Wildfire Risks to

Assets for further discussions. Several studies have pointed to the need to reduce fuel loads and to the role that a strong biomass industry could play in this kind of program. See the Assessment document Forest and Range Related Energy Industry for more information.

Within the paper industry, new chemical, mechanical, and biological processing technologies are being tested. While not much of an issue in California, wood pulping and papermaking have received much regulatory overview, especially in the use of complex chemical, thermodynamic, and mechanical processes that can generate toxins. As pulp and paper companies deal with these issues, there may be spin-offs that improve technologies in other parts of the forest products industry.

Harvesting technology

In California, there is continued concern about harvesting on steep slopes and use of even-aged harvest systems. Cable logging, which uses a winch and wire cables to transport trees to a haul road, has largely replaced rubber-tired skidders or crawler tractors. Research has continued to improve flexibility for operating on steep slopes including visual guidance systems for yarder operators, guyline tension monitors, artificial cable anchors, and cable-towed vehicles. See the online document Forest and Fiber Engineering for further discussion (Department of Biological and Agricultural Engineering, 2002).

CTL forwarders can operate with less than five percent soil disturbance.

Another emerging logging system used for reduced ground impact and for improved productivity is "mechanized harvesting" using "cut-to-length" (CTL) logging equipment. These systems utilize harvesters and forwarders that can operate with less than five percent soil disturbance, which allows longer operation times in wetter conditions (if allowed by FPR). See the online paper Green Machines for a further discussion (Edwards, 2001).

Cost of this equipment is often relatively high and requires harvest of sufficient volume to justify purchase. In addition, a number of environmental considerations limit the use of larger machinery. Hence, development of small-scale equipment that is cost-effective and flexible on smaller tracts and that meets safety and environmental considerations is ongoing. Also, research is ongoing concerning equipment that can prepare sites for planting and is able to clear larger fuel buildups while retaining organic matter and some shade cover to lower soil temperatures (Department of Biological and Agricultural Engineering, 2002).

However, there are a number of environmental and economic trade-offs in the use of smaller scale systems. Lighter equipment that is easier to maneuver will usually cause less residual stand damage but may also result in more skid trail construction than would be the case for larger machines. Smaller scale systems may be less safe to operate, require more labor to use, and require more operator skill to maximize productivity when compared to larger machines (Updegraff and Blinn, 2000). In addition, the cost of smaller scale systems may be relatively high since much of the equipment is made outside of the United States. This, combined with other factors, makes lower productivity of smaller scale systems a

great challenge to more widespread in California and elsewhere in the United States. See the online document Harvesting Heads – What's New, What's Hot, What's Available for more information (Timber/West, 2001).

Hardwoods

California is a major consumer market for hardwood flooring, furniture, and other hardwood products. In response, California has developed a furniture-manufacturing sector that uses more than one MMBF of hardwood lumber per year. About 80 percent of the hardwood materials are shipped from the eastern half of the United States and about 10 percent are imported from tropical regions. Less than five percent of the total, mostly red alder, comes from western United States species (Shelly, 2001).

California has developed a furniture-manufacturing sector that uses more than one MMBF of hardwood lumber per year.

California has almost ten billion cubic feet of hardwood net growing stock on timberland. Among these are high-density hardwood timber, such as tanoak, Pacific madrone, California black oak, and white oak. Hardwood stands in northern California are spread throughout the conifer forests, existing as smaller stands or understory. This makes it difficult to get economies of scale in milling hardwoods.

Compared to the hardwood industry in the eastern United States, the California hardwood timber is fragmented and not well utilized (California Technology, Trade and Commerce Agency (TTCA), 1997). Currently, there are more than 30 sawmills and 60 secondary manufacturers working on a wide variety of native California hardwood species. However, many of these mills produce less than 50 MBF per year. In 1999, the total production of hardwood products was only about 4 MMBF (Shelly, 2001). Lack of drying capacity is a big limitation to developing a larger hardwood industry. In 1996, the total 1.3 MMBF of annual hardwood lumber kiln drying capacity in California was estimated to be only one percent of the west coast hardwood lumber demand (Shelly, 1997).

In 1996, a California Hardwoods Initiative commenced with the goal of developing a sustainable hardwoods industry in California. The USFS, the TTCA, and others staffed the Statewide Hardwood Industry Task Force. The goal of the group was to identify and resolve strategic problems that limited development of the hardwood industry. The initiative focused separately on two types of producers: 1) established primary producers with annual productions greater than one MMBF, with both California softwood mills and hardwood mills in other states being considered; and 2) small hardwood sawmills, micro-businesses, and casual producers (Shelly, 1998). The initiative has been a challenge, as the industry is in its infancy, characterized by low production, limited capital investment, and a shallow pool of vertically integrated manufacturers (TTCA, 1997).

Creation of new wood products

A number of creative product applications are being made using portable band sawmills. Examples are to saw custom hardwood post beams for timber-frame homes and hardwoods with specific grain characteristics desired by furniture manufacturers. On a larger scale, product innovation has led to the creation of chipboard, OSB, and engineered wood products, such as glue-laminated lumber, trusses, and I-beams. All of these increase the utilization of wood fiber from the harvested log.

OSB, a composite made from small wooden fibers, has become a competitive substitute for plywood lumber.

Some of these new products compete with established forest products. For example, OSB, a composite made from small wooden fibers, has become a competitive substitute for plywood lumber. As such, it depends less on larger diameter logs or set species than the technology of other composite wood products, and continues to offer a way to use small material and previously under-used species.

Another potential area is engineered wood products. These can be designed to fit the design needs of specific applications and replace the use of soildwood products traditionally used for structural purposes. One example is the creation of parallel chord trusses (made from small-dimension lumber) and wood I-joists (made with OSB components) used to replace large-dimension lumber in many homes. Laminated strand lumber (created by reducing logs to smaller strands, then aligning and pressing them together) is being used for headers and core material in windows and doors.

An additional potential market is composites made from wood and non-wood materials. An example is filled plastics. These products may be used for many applications in which conventional plastic materials are used, not just in construction. According to the Society of the Plastics Industry, Inc., the United States produced 4.8 billion pounds (two million metric tons) of thermo-plastic products in 1992. A portion of the expensive plastic resin in these products could be replaced by cheaper wood fiber. See the online document Wood Products Technology Trends: Changing the Face of Forestry for more information (Skog et al., 1995).

Still another market is recycling of wood products material. Because many states have restricted the amount of wood and yard waste that may be landfilled or have banned it altogether, the market for recycling these materials has grown. The number of yard and wood waste processing facilities has grown from 700 to over 3,500 nationwide over the last 10 years (Olstad and Zerbe, 2000). Some California mills sell sawdust to dairies and nurseries for planting and other mixes. Bark can be sorted by size and used for golf course greens, potting soil, or decorative bark (Glaeseman, 2001).

Other new products are in the stage of technological development. One is expanded development of biorefineries. These are facilities that make cellulose into products such as ethanol, a product that can be used as an oxygenate in gasoline. Other biorefinery research includes:

(1) pretreatment of biomass inputs;

(2) more use of genetically-engineered organisms with improved ability to facilitate hydrolysis and fermentation of cellulose;

(3) integrating processing steps to lessen capital and operating costs; and

(4) actual production of ethanol from waste biomass in a biorefinery.

Another promising technology is the production of sugars from biomass. Biomass contains a number of six-carbon and five-carbon sugars such as glucose and xylose. Sugars are the synthetic building blocks of chemicals, additives, and other products and potentially have a value of carbon much higher than if it is used in fuel. President Bush's Executive Order on Biobased Products and Bioenergy is focused on speeding the development of enzyme technologies that will bring about more products and will increase competitiveness in the biofuels and chemicals industry (Federal Register, 2001).

Market strategies including forest certification

For a variety of reasons, market competition is forcing companies to develop business models that place the customer at the center of their business. Increasingly, successful forest products firms are using the Internet to attract, educate, and interact with consumers. This is consistent with better informed and Internet savvy consumers.

While this is true in all segments of the wood products business, the impact of e-business on the pulp and paper industry is most clear. According to PricewaterhouseCoopers, the pulp and paper industry is well situated to adapt to e-business but has been slow to do so. It is in the early stages of exploring with digital advertising, buying, and selling. However, it has not moved quickly to integrate with customers and suppliers, to restructure operations around the customer relationship, or to develop new service alliances with other industries (PricewaterhouseCoopers, 2000). However, in March 2000, International Paper, Georgia-Pacific, and Weyerhauser jointly created an independent, global on-line marketplace. Other companies have since joined this marketplace. Services include systems and trading partner integration, catalog content management, private trading exchanges, and professional services. The companies also operate an industry marketplace that brings application services to support forest products industry members. See the online document ForestExpress Partners with ICG Commerce to Deliver E-Procurement Capabilities and Cost Savings for more information (ForestExpress, 2001). Given this example and the traditional fragmentation in the industry, it is likely that similar ventures will develop between other firms in the pulp and paper industry, as well as others that are closely related.

Companies that can demonstrate sound management stand to gain competitive advantage both in the financial markets and the product marketplace.

Another aspect of the Internet and the global marketplace is the push toward marketing based on "sustainable" forest management. In many countries consumers increasingly demand responsible business practices, while mainstream investors such as pension funds and insurance companies are also beginning to take account of social and environmental performance. Companies that can demonstrate sound management stand to gain competitive advantage both in the financial markets and the product marketplace.

This has led to an international movement toward environmental certification, of which forest certification is a part. The intent is to encourage firms to practice sustainable forest management by strongly linking products purchased by consumers to specific types of forest management. This may require "chain of custody" certification that tracks movement of the wood fiber from the forest to the

customer as finished products. The notion is that many consumers, if they know that products come from forests managed with sustainable practices, will demand and purchase lumber or products using certified wood.

Environmental certification: Since the early 1990s, a number of governments and international and non-profit organizations have pushed programs that seek to reduce environmental impacts of industrial activities and land uses. This is seen in a series of international treaties and agreements related to such things as deforestation, reduction of carbon dioxide, and release of other gases into the atmosphere. Increasingly, multinational companies are also taking actions to reduce the impact of their activities on the global environment. This includes some resource-based companies such as oil, mining, and forestry firms. At the same time, the growth of world trade has increased the influence of big business substantially.

Five hundred of the world's largest companies are responsible for about half of global trade. Private investment in developing countries far exceeds that of governments. This has led to some skepticism about trade practices, management approaches, and business ethics by multinational corporations, especially in developing countries. Much of this criticism has been aimed at resource-based industries. Common issues relate to poverty, social and environmental justice, and sustainable resource management.

The mix of concerns related to trade and to the environment have led to increasing pressure on governments and multinational corporations to focus on sustainable environmental practices and social justice. This pressure can be seen in many ways: 1) demonstrations at the 1999 World Trade Conference in Seattle; 2) repeated surveys indicating widespread distrust of business; 3) the continued rise of watchdog groups; 4) preferences given by governments or public agencies to firms that are seen as more environmentally and socially responsible; and 5) increased shareholder activism in demanding investment only in firms that have a positive environmental or social record.

Business has responded in a variety of ways including: 1) changes in management and marketing practices regarding corporate disclosure about environmental or social performance; 2) increased use of non-regulatory standards and incentives; and 3) extended product responsibility and warranties. In 1999, the Dow Jones Industrial Index and Switzerland's SAM Sustainability Group started the Dow Jones Sustainability Group Index. The index includes more than 200 of the world's leading companies with positive environmental records. It focuses on rising investor interest in firms emphasizing corporate sustainability. According to one estimate, assets managed by socially responsible investment funds now exceed $2 trillion. These resources connect nearly one in eight dollars under management in the United States through screened portfolios, shareholder advocacy, and community investing (Business for Social Responsibility, 2002). See the online document Home Page of Business for Social Responsibility for more information.

The motivations of retailers for selling certified wood vary greatly. This can include going after a market advantage or the desire among employees and management to support sustainable forest management practices. More broadly, it may reflect the perception or recognition by business managers of the importance of global ecological concerns. The use of the certified products approach minimizes business risk and is consistent with the approach taken by many governments and international organizations emphasizing programs with less environmental risk. For example, some agencies have restricted use of tropical wood and have shown preferences for certified forest products.

Today, there are more than 25 national and international forest certification schemes at various stages of development. See the online documents Home Page of the United Nations Economic Commission for Europe, Press Office: Latest Press Releases, and Home Page of the International Tropical Timber Organization for more information. The Forest Stewardship Council is the most commonly used for forest management in Europe and the International Organization for Standardization (ISO 14001) is the most common for mills worldwide (PricewaterhouseCoopers, 1999).

The world market for certified forest products has remained small. Trade statistics do not differentiate between certified and non-certified wood, but it is probable that only a very small part of the world wood market deals in these kind of products. Still, in countries where environmental awareness among consumers is strong, demand for certified wood can be significant. In part, retailers have actually pushed the demand for certified wood. This is true in both Europe and the United States. For example, one buyers' group in the United Kingdom, the 1995+ Group, has over 85 members. See the online paper Certified Wood for more information (Bomersheim, William P, 2000). A few wood retailers in the United States such as Home Depot show a preference for FSC certified wood as part of their environmental policies. See the online document Build It Projects for more information (The Home Depot, 2002a).

California has been deeply involved in the forest certification movement. Two major certification systems are operating in California today: 1) the Forest Stewardship Council (FSC); and 2) the Sustainable Forest Initiative (SFI) sponsored by the American Forest and Paper Association (AF&PA). Each system has standards that must be met for certification. See the online documents Home Page of the Forest Stewardship Council and Home Page of the Sustainable Forest Initiative (Forest Stewardship Council, 2002; Sustainable Forest Initiative, 2002). Most industrial forest landowners and many non-industrial private landowners in California are covered by at least one of these systems.

Within California, forces for an increasing certification role are strong. International agencies and non-profit organizations are very interested in increasing the use of certification worldwide to improve forestry practices. Many of these agencies and non-profits have a presence or influence in California. A growing number of multinational firms, some of which do business in California, are endorsing and using "green label" certification systems. Furthermore, a number of AF&PA firms that subscribe to the SFI standards operate in California. Still, it is difficult to measure the pressure these forces have on change within the State.

However, it remains to be seen if a significant market advantage in California can be derived from use of a certification scheme in forestry. Firms such as The Collins Companies and The Home Depot place a strong emphasis on certified wood in their marketing (The Collins Companies, 2002; The Home Depot, 2002b). Other forestry firms such as Harwood Products extend certification-based consulting to smaller landowners (Harwood Products, 2002).

Much could happen in the next decade and it may be the case that certification becomes a common standard that is a requirement to do business in California. Only recently has a proposal for regulatory relief been developed (by the Forest Landowners of California), and its future is uncertain. Given the high regulatory costs now in effect, there is certainly strong incentive for the State to develop a regulatory system that provides some relief and cost savings to landowners who operate under a certified program.

Lessening regulatory cost

Landowners have sought to address long-run regulatory cost in a variety of ways. These include investment in improved information and monitoring, more planning and analysis, and pre-consultation with State agencies that review THPs. Landowners may also increase plan size or harvest volume to reduce future plan requirements. Some landowners are also taking advantage of options in the forest practice rules in order to develop long-term plans.

It is an option available to owners with land holdings of 5,000 acres or less. Under this approach, landowners can prepare long-term plans and operate under terms of approved plans with minimal additional permit costs. As shown in Table 14, over 440 Non-Industrial Timber Management Plans now exist on about 2,000 acres.

Table 14. Total approved Non-Industrial Timber Management Plans (NTMPs) by year and acres

Year	Number of NTMPs	Monitoring acres
1991	3	1,834
1992	10	7,413
1993	17	13,338
1994	22	10,253
1995	21	9,104
1996	37	15,829
1997	50	20,780
1998	42	22,454
1999	68	39,037
2000	84	33,947
2001	61	17,984
2002	27	6,629
Total NTMPs	442	198,602

Source: CDF, 2002b

For larger landowners, the most common is the Habitat Conservation Plans (HCP). This planning mechanism allows companies to meet concerns under the federal and California Endangered Species Acts. Simpson Timber Company and Pacific Lumber Company are operating under approved HCPs. Mendocino Redwoods is in the process of preparing an HCP (see the Assessment document Institutional Framework: Governance Shifts in the 1990s).

Alternate income streams

Given the variety of constraints on timber harvesting in California, increased emphasis is being placed on finding ways to remunerate landowners for forest uses of other than for growing and harvesting timber. Additional sources of return include:

- revenue from non-timber forest products;
- recreation and eco-tourism;
- conservation easements; and
- ecosystem services and related tools (Best et al., 1999).

In the case of income from non-timber forest products in California, sales of Christmas trees and greenery sales have exceeded $10 million a year over the last decade (California Agricultural Statistics Service, 2002). Other products can include mushrooms, herbal plants, mosses, ferns, ornamental plants, and cones.

In the case of recreation and eco-tourism, some industrial forest land owners in California have been leasing hunting and other recreational rights for many years. However, there is little information on income received, though it is undoubtedly nominal when compared to harvesting. Mendocino Redwoods, for example, reports one percent of its income from recreation uses. The USFS estimates that about eight percent of non-industrial forest lands in the United States. are leased for some recreational use. Types of additional sources of income are summarized in Table 15.

Table 15. Additional sources of income to forest landowners

Use	Kind of organization	Income source
Hunting	Hunting Clubs	Fees, leases
Camping	Campgrounds	Fees, leases
Hiking, fishing, horseback riding	Miscellaneous	Fees
Boating	Miscellaneous	Fees
Treks	Miscellaneous	Fees, leases

Forest lands produce much of the water that Californians drink. Water is being exported from forested regions without adequate compensation. Water rights that define the quantities of water being exported are not always available (TTCA, 1996). Water supplies are also being over-subscribed, which makes competition for water even greater. However, so far it has not been possible to establish a system whereby landowners can capture a portion of the value of water produced.

Remuneration to landowners for other ecosystem services also has been difficult to capture directly in the marketplace. Ecosystem services are actions taken to improve the ecosystem and are those that the public values. Five general kinds of forest land services are evident in California: 1) provision of wildlife habitat; 2) views and open space; 3) water quality and fish habitat improvement; 4) air quality improvement; and 5) carbon sequestration (Table 16).

Table 16. California forest land services

Ecosystem service	Form of landowner remuneration	Potential
Wildlife habitat	Land purchase, conservation easements, habitat improvement grants	Significant already, could become more
Views and open space	Land purchase, conservation easements, user fees	Limited in the case of forest lands
Water quality and fish habitat improvement	Land purchase, conservation easements, stream restoration grants	Significant already, could become more
Air quality improvement	None	Limited
Carbon sequestration	In development	Unknown, but could be great

The primary form of remuneration for these services seems to be evolving in the direction of conservation easements. Conservation easements are voluntary legal agreements that permanently restrict specified activities on a piece of property; furthermore, they are binding on future property owners. Property owners grant easements to conservation or other non-profit organizations as well as government agencies. The goals of such easements are to protect conservation values such as wildlife habitat and water quality while providing a source of income to the landowners. The use of such easements is more common in protection of agricultural lands, but other examples do occur in California. For example, The Pacific Forest Trust (PFT) has conservation easements on over 16,000 acres of forest land, with another 3,800 in negotiation. See the online document Home Page of The Pacific Forest Trust for more information (PFT, 2001a).

Example of the non-profit sector working to facilitate conservation of forest lands: The PFT has also worked with the Surdna Foundation in 2000 to create a Strategic Opportunities Conservation Fund that can be used to work with landowners and provide low-cost loans or equity investments. Examples include: 1) bridge loans to forest landowners while funds are raised to purchase a conservation easement; 2) lend working capital at below-market interest rates to refinance high cost loans; and 3) create loans for landowners who are moving to forest management certified by the Forest Stewardship Council. See the online paper Strategic Opportunities Conservation Fund for further discussion (PFT, 2001b). This addresses the issue that when landowners are facing cash crises, banks will seldom lend money for undeveloped ranch or timberland. Typically, landowners have had to harvest or subdivide parts of their property to obtain needed funds.

A variety of governmental programs seeks to facilitate conservation easements. See the Assessment documents Institutional Framework: Governance Shifts in the 1990s and Public Involvement, Information and Education for further discussions. One such program is the Forest Legacy Program (FLP). The FLP, as administered by CDF, is made up of two separate but complimentary programs: the federal FLP and the California FLP. See the online document The Forest Legacy Program for more information. Under these programs, the goal is to maintain forests intact and in private ownership. The intent is that landowners are able to manage forests for traditional uses, except for the restrictions on development or other uses provided by the conservation easement to the agency selected by the landowner. In both programs the participation by private landowners is voluntary. Federal funds are limited to 75 percent of the value of the conservation easement with the remaining portion contributed by non-federal matching funds (CDF, 2002a).

The federal program was complimented by the California Forest Legacy Act passed in 2000 (SB 1832, Chapter 790, 2000) (Legislative Council of California, 2000). This law allows CDF to acquire conservation easements. It also allows nonprofit land trust organizations and federal, State, and local agencies to hold conservation easements acquired pursuant to the California FLP. Money to fund the Program comes from gifts, donations, federal grants and loans, other appropriate funding sources, and $5 million from the sale of bonds pursuant to the Safe Neighborhood Parks, Clean Water, Clean Air, and Coastal Protection Bond Act of 2000.

Assessment of need for Forest Legacy in California: An assessment of need for California's FLP was first prepared in 1995 by CDF (CDF, 1995). This first assessment identified areas having forest resource values, high biological diversity, and other outstanding environmental resources. Six counties or parts of these counties were included as Forest Legacy Areas (FLAs): Mendocino, Sonoma, San Mateo, Santa Cruz, Riverside, and San Diego. An Amended Assessment of Need was completed in 2000 and 28 more counties were added to allow landowners to take advantage of the program (CDF, 2000).

Forest landowners who hold land in an FLA can apply to have conservation easements established on their property, or have other interests in their land purchased by the State or the USFS. Under the program, federal and State funds are made available for purchasing easements, or for covering costs associated with facilitating the donation of easements from willing forest landowners.

To be eligible, parcels must meet certain criteria such as having important fish and wildlife habitat, rare plants, oak stands, ecological old-growth, and other key forest types and seral stages that are poorly represented across California. In selecting parcels, CDF is guided by criteria such as the ability to monitor the environmental values proposed for protection and whether the parcels may become isolated by development from other areas maintained for key forest resources.

The assessments listed significant threats that existed in the 28 counties and developed a focus for each county's legacy program based on these threats (Tables 17 and 18).

Table 17. Threats based on California's Amended Assessment of Need

County	Threats
Butte	Residential development: Population expected to double by 2040. Growth occurring in unincorporated forested areas surrounding urban areas and foothills within commuting distance of urban areas. 25 percent of county within Timber Production Zone (TPZ) where low-density housing may occur. 170,000 acres of private land is TPZ. TPZ parcelization and development are possible and would create fire management problems. Watershed impairment: Resource extraction and mining and agriculture are primary sources of pollution.
El Dorado	Residential development: Population increase of 205 percent by 2040. Development centered around communities along Highway 50 and I-80 corridors. Land use regulations stipulate sliding percent canopy cover be retained. 150,000 acres private forest land TPZ (nearly all coniferous). TPZ parcelization and development is possible and would create fire management problems. Watershed Impairment: Heavenly Valley Creek siltation due to land development.
Humboldt	Residential development: Population increase of 14 percent by 2040. Chief growth areas around the communities of McKinleyville, Arcata, Fortuna, Garberville. Million acres private forest land TPZ, TPZ parcelization and development is possible. Watershed Impairment: Sedimentation and siltation widespread due to forest management practices, elevated temperatures due to removal of riparian vegetation.
Lake	Residential development: Population increase of 113 percent by 2040. Growth in urban areas, mostly on existing parcels and on larger lots in rural areas. Developments rising within commute distance to Napa and Sonoma. Agricultural Conversion and Forest Management: Small amount of conversion of oak woodlands into vineyards. No significant TPZ (Timberland Production Zone) conversion. Watershed Impairment: Resource extraction/toxicity are primary sources of pollution.
Lassen	Residential development: Population increase of 71 percent by 2040. Development centered around Susanville and Honey Lake Valley due to expansion of State Prison. Limited growth in forested areas. 310,000 acres private forest land TPZ. TPZ parcelization and development is possible and would create fire management problems. Watershed impairment: High coliform levels and toxicity in river segments. High dissolved oxygen in Eagle Lake watershed due to land development.
Los Angeles	Residential development: Population increase of 41 percent by 2040. Growth centered on urban fringe areas. County regulations require replacement of two trees for every one removed or payment for trees removed for development. Watershed impairment: Numerous segments impaired due to urban point and nonpoint source pollution.
Nevada	Residential development: Population increase of 70 percent by 2040. Grass Valley-Nevada City primary centers of growth. Eastern growth concentrated around Donner Lake. 100,000 acres (nearly all coniferous) of private land is TPZ. TPZ parcelization and development are possible and would create fire management problems. Watershed impairment: Bear River bacteria concentrations due to land development, Lower Truckee siltation due to residential development and silvicultural activities.
Placer	Residential development: Population increase of 214 percent by 2040. Majority of growth in south within non-forested and foothill communities. Dispersed development throughout county. Large conversions of "open space" into urban and rural developments. General plan designated 48,000 acres for development. 120,000 acres private forest land TPZ. TPZ parcelization and development possible. Watershed impairment: Lower American River polluted from urban runoff, Lower Truckee siltation due to forest management activities, Upper Truckee siltation due to land development, Lake Tahoe siltation due to land development.
Plumas	Residential development: Population increase of 18 percent by 2040. Minor development occurring in eastern portion due to recreational home building. Portola experiencing growth due to commuting distance from Reno. 80 percent private land is TPZ. TPZ parcelization and development are possible and would create fire management problems. Watershed impairment: Resource extraction and mining are the primary sources of pollution.
Shasta	Residential development: Population increase of 67 percent by 2040. Growth in non-forested areas along Sacramento River Valley and I-5 corridor. Growth in outlying communities within commute distance of Redding. 530, 000 acres private forest land TPZ. TPZ parcelization and development is possible and creates fire management problems. Watershed impairment: Pollution result of resource extraction/mining, agriculture, and sewage disposal. Upper Sacramento River polluted from 1991 herbicide spill.
Sierra	Residential development: Population stable. General plan allows 1.4 percent growth rate around existing communities. Current zoning precludes growth outside existing communities. 85,000 acres of private land is TPZ. TPZ parcelization and development are possible and would create fire management problems. Watershed impairment: Siltation due to urban development and silviculture practices in erosive watershed lands.
Siskiyou	Residential development: Population increase of 37 percent by 2040. Growth along the I-5 corridor around urban areas. Heavy development expected. 570,000 acres private forest land TPZ. TPZ parcelization and development possible. Watershed Impairment: Sedimentation, siltation, elevated temperatures due to forest management activities, undisclosed non-point source pollution, habitat modification and removal of riparian vegetation.
Trinity	Residential development: Population increase of 25 percent by 2040. Growth in Weaverville and recreation communities on west side due to retiree growth. 250,000 private forest land acres TPZ. TPZ parcelization and development possible. Watershed impairment: Sedimentation, siltation, elevated temperatures due to forest management activities and removal of riparian vegetation.
Tehama	Residential development: Population expected to double by 2040. Development centered along 1-5 corridor, Highway 99 and Southern Pacific Railroad. 245,000 acres private forest land TPZ. TPZ parcelization and development possible. Watershed impairment: Resource extraction and mining and agricultural activities are primary sources of pollution.
Yuba	Residential development: Population increase of 70 percent by 2040. General plan focuses growth on current population centers and unincorporated communities. 30,000 acres of private land is TPZ. TPZ parcelization and development is possible. Watershed impairment: Lower Feather River affected by urban runoff.

Source: CDF, 2000

Table 18. Threats based on California's Amended Assessments of Need

County	Threats
Amador	Residential development: Population increase of 24 percent by 2040. Limited growth in coniferous zones. Majority of growth east of Highway 49 and north of Highway 88. Limited growth on western side within commuting distance of Sacramento Valley due to agricultural zoning designations. No significant TPZ conversion. 38 percent private lands enrolled in Williamson Act contracts that preclude near-term residential development. Watershed impairment: No significant impairment.
Calaveras	Residential development: Population increase of 90 percent by 2040. Development occurring along major transportation corridors within commuting distance of Sacramento and Stockton (Highway 49, 4, 26). Growth resulting from conversion of summer homes to residences and infill on vacant parcels. Resource use and zoning: 75,000 acres private forest land TPZ. TPZ parcelization and development are possible and will create wildfire management problems. Large portion of undeveloped land currently unclassified. Watershed impairment: No significant impairment.
Fresno	Residential development: Population increase of 88 percent by 2040. Urban growth putting pressure on agricultural lands. Majority of growth occurring in non-forested areas. TPZ insignificant (one percent private forest land). Watershed impairment: Many streams impaired due to agriculture.
Mariposa	Residential development: Population increase of 71 percent by 2040. Limited growth scattered throughout rural areas. TPZ insignificant (five percent private forest land). Watershed impairment: Merced river impaired due to agricultural activities.
Madera	Residential development: Population increase of 274 percent by 2040. Growth fueled by retirees and commuters from Fresno. Low housing costs and recreational activities are major attractions. TPZ insignificant (five percent private forest land). Watershed impairment: San Joaquin river impaired due to agricultural activities.
Monterey	Residential development: Population increase of 113 percent by 2040. Growth proposals on Monterey peninsula threatens Monterey pine. Large recreational development proposed would remove 38,000 Monterey pine and thousands of oaks. Agricultural Conversion: Vineyard conversion growing rapidly on existing farmed and grazed lands. Watershed impairment: Salinas, Pajaro watersheds impaired due to siltation due to land development and habitat modifications.
Napa	Residential development: Population increase of 51 percent by 2040. In-fill development occurring around urban areas and dispersed rural residential growth on existing lots. Agricultural Conversion: Vineyard conversion growing rapidly throughout except driest portions of county. No regulations for removal of oak woodlands or individual oak trees. Watershed Impairment: Napa River impaired due to sedimentation from construction and land development. River segments of Putah Creek and Lower Sacramento watersheds impaired due to resource extraction and urban runoff.
Riverside	Residential development: Population increase of 40 percent between 1990 and 2005. Growth fragmenting forest lands. Third of county facing population, development pressure. Severe fire danger exists. Watershed impairment: Affected by point and non-point source pollution.
Sacramento	Residential development: Population increase of 75 percent by 2040. Growth centered along I-5, 80, Highway 99,50. Growth anticipated in oak woodland areas around Folsom, Highway 160. Expansion pressure in Southeast on oak woodland zone. Watershed impairment: Stream segments in Sacramento Delta, American River impaired due to agriculture, mining and urban runoff.
San Diego	Residential development: Population increase of 40 percent between 1990 and 2005. Continued development throughout county including forest lands. Ten percent of land enrolled as Agricultural Preserves under Williamson Act and currently in non-renewal. Watershed Impairment: Affected by point and non-point source pollution.
San Bernardino	Residential development: Population increase of 243 percent by 2040. Majority of growth occurring in non-forested west valley. Mountain regions designated resource conservation areas, thus limiting housing to one dwelling per 40 acres. Watershed impairment: Stream segments in Mojave-Santa Ana basins impaired due to agriculture, grazing, and land disposal.
Santa Barbara	Residential development: Population increase of 90 percent by 2040. Residential development throughout county including areas of oak woodland. Agricultural Conversion: Vineyard conversion growing rapidly. Removal of oaks for agriculture not regulated. Livestock Grazing: Grazing within valley oak woodlands not regenerating to maintain numbers. Watershed impairment: Santa Ynez watershed, creeks in Gaviota basin impaired due to urban runoff and agriculture.
San Luis Obispo	Residential development: Population increase of 110 percent by 2040. Residential growth concentrated in the north. Southern section growth more dispersed. All areas growing within oak woodland zone. Agricultural Conversion: Vineyard conversion growing rapidly east of Highway 101. Oak removal substantial. Watershed impairment: Salinas, Morro Bay watersheds impaired due to siltation from land development and erosion.
San Mateo Santa Cruz	Residential development: Population increase of 20 percent between 1990 and 2005. Encroachment of urban and residential development into forested areas. Proximity to Bay Area points to further parcelization and development conversions. Watershed impairment: Poor habitat resulting from past forest management practices (erosion, siltation). Development will impact soil and water quality.
Sonoma	Residential development: Population increase of 25 to 40 percent between 1990 and 2005. Housing encroachment into forest lands continuing. Northwest development increasing. Vineyard conversion growing. Watershed impairment: Poor road design from forest management practices and erosion affecting watersheds.
Tulare	Residential development: Population increase of 220 percent by 2040. Majority of growth occurring in non-forested areas within Valley communities. TPZ insignificant (three percent private forest land). Watershed impairment: Kings River impaired due to agricultural activities.
Tuolumne	Residential development: Population increase of 65 percent by 2040. Development occurring in center of county. Growth centered around urban areas. 85,000 acres TPZ (third of private forest land). TPZ lands located in northeast along Highway 108. TPZ land contains nearly all privately owned coniferous forests. TPZ parcelization and development are possible. Watershed impairment: Dunn Creek, Mantica-Merced-Turlock watersheds impaired due to mining and agriculture.

Source: CDF, 1995

Still another potential income source is carbon sequestration. Carbon sequestration is when the forests act as sinks or sources for carbon dioxide. At the international level, mechanisms for capturing and trading the value of forest management as carbon sinks have been in progress since the mid-1990s. The idea is that firms that create atmospheric carbon during the conduct of their business would reimburse landowners who do not cut trees, thus storing carbon to offset any increases.

Greenhouse gas trading: Greenhouse gas (GHG) trading has its origins in the United Nations Framework Convention on Climate Change and was later advanced by the Kyoto Protocol in December of 1997. The Kyoto Protocol includes three international trading mechanisms: 1) international emissions trading, 2) Joint Implementation; and 3) The Clean Development Mechanism. Emissions trading as an environmental economic instrument has been successfully used in the United States for sulfur oxide and nitric oxide emissions mitigation. The driver for the use of this mechanism is reduced cost due to increased flexibility in reduction measures. Companies or investors and developers of individual projects that can achieve emission reductions at a lower marginal abatement cost than others, can trade their surplus reductions with companies that face higher costs of achieving their reduction obligations.

Emissions trading schemes can be undertaken on a statewide, national, or regional basis. The European Union (EU) is now considering a European-wide scheme where each country can participate using its own programs, as long as reductions are "fungible" (ability to establish equivalency) with the EU system. Under emission trading schemes, emission levels are either mandated or voluntarily negotiated with the government for individual companies (or groups of companies). Prices for emission permits vary with market demand and supply.

Emissions trading can occur across national borders pursuant to the Kyoto agreement and the recent Marrakesh accord, when each Kyoto Protocol ratifying country implements a regulatory or voluntary system involving emissions trading to reduce their emissions. EU discussions about carbon trading are further along than in the United States. Talks are focusing on various principles for the new plan that would limit emissions of all six GHGs. They also have moved towards agreement on a mandatory system as opposed to a voluntary system within the EU.

GHG trading has seven common elements: 1) credible emissions baseline; 2) proof of the impacts that emissions have on the environment; 3) evidence that reductions are surplus to existing regulatory requirements; 4) permanence or durability of reductions; 5) emission-reducing project will not cause emissions to increase beyond project boundaries; 6) credible monitoring and verification; and 7) proof of ownership of reduction. Emission trading markets depend on forecasts from economic models and these models significantly influence people's expectations regarding the costs. See the online paper Greenhouse Gas Price Scenarios for 2000-2012: Impact of Different Policy Regimes for further discussion (Varilek and Marenzi, 2001).

In the United States, carbon emission trading is a practice that is just beginning. Most of the pilot programs that have been developed have difficulty in connecting the "credits" to the needs of new technology. The inclusion of lower cost forestry projects has driven prices down. Solid rules on "additionality" and eligibility of credits from sequestration as well as emission reduction projects is needed in order to maintain a system that drives towards real, permanent, and environmentally sound project investments. Furthermore, much care must be taken to ensure that projects are incremental to business as usual investments.

To further the sustainable development objectives of the international climate convention, the World Bank launched the Community Development Carbon Fund (CDCF) initiative at the World Summit on Sustainable Development in Johannesburg, South Africa. The $100 million fund will provide financing for reductions in GHG emissions, including small-scale projects in small, developing countries, and rural areas of all developing countries. The emphasis within CDCF will be on renewable energy, energy efficiency, solid waste to energy conversion, and agro-forestry projects. Participants in the fund will receive carbon emission reduction credits for reductions in carbon emissions.

As for the United States, developments have occurred on a national and state level regarding GHG emission registries. This has been mostly to ensure that companies voluntarily reducing emissions can obtain appropriate credit in any future regulatory scheme. More importantly, some states are implementing mandatory GHG emissions reduction programs for individual sectors and allowing for emissions trading. Massachusetts, among other northeastern States, has implemented such a scheme for the electricity sector. California has just passed legislation to control GHG emissions from motor vehicles under AB 1493 (AB 1493, Chapter 200, 2002) (Legislative Council of California, 2002a). This legislation contains provisions for the reporting of emissions reductions at the CA Climate Action Registry. Further developments at the State level can be expected in the near future.

On the federal level, the Bush Administration has directed that the current voluntary GHG registry (1605(b) Program at United States Department of Energy) identify and implement changes to improve the credibility of results reported to that program. A multi-agency effort is underway to identify potential means of improving the 1605(b) program. Sidebar sources include Point Carbon (2002) The Carbon Trader (2002), and Drummond (2002).

In California, the first sale of "carbon offsets" occurred in November 2000 between Green Mountain Energy and PFT. The agreement is designed to offset about half of Green Mountain's annual corporate carbon dioxide (CO_2) emissions with carbon stored in PFTs old-growth redwood forests, including those in the Butano Creek watershed in San Mateo County in Northern California (Environmental News Service, 2001).

More formal carbon emission trading in California is still in its infancy. California has enacted legislation creating the California Climate Registry and is now accepting volunteer members. The private, non-profit organization has appointed officers and developed the initial protocols for registering GHG emissions. There are currently 23 participants that have committed to join the Registry in its first year of operations. The California Environmental Protection Agency and the California Energy Commission have already committed to participate. There were two major additions to Registry mandates by the legislature in 2002, AB 1493 and SB 812 (AB 1493, Chapter 200, 2002; SB 812, Chapter 423, 2002) (Legislative Council of California, 2002a and 2002b).

Among other things, SB 812 directs the Registry to develop protocols for the quantification and certification of forest carbon emissions and storage. The legislation establishes a baseline that includes the concept of "surplus" and would include carbon storage projects that account for management practices over and above "business as usual" practices. The California Resources Agency is directed to assist the Registry in the development of these protocols.

Responding to constraints on timber profitability

A variety of government programs are possible in response to the major constraints, but it is very difficult to estimate the potential economic benefit from the programs (Table 19).

Table 19. Character of forest product industry constraints and potential responses

Profitability constraints	Seriousness of constraints	Class of opportunity for government programs	Subjective estimate of potential economic benefit
Natural factors (fire, disease)	Serious in places	Fire control, insect and disease prevention and research; increased cooperation in fuel reduction programs	Large
Legacies that hinder production	Serious in places	Restoration, policies favoring reforestation	Moderate
Loss of timberland base	Serious in places	Special zoning, conservation easements	Small, absent profitable product return
Fragmentation of timberland base	Serious in places	Special zoning, conservation easements	Small, absent profitable product return
Supply limitations on public land	Serious in past, limitations in future	Seemingly limited to fuel hazard reduction activities, small green sales program, and some salvage	Small given current policies; larger if policies change.
Restrictions on private timber growing	Serious because of impact on investment and timber supply	Lower or share compliance costs, programs to increase capacity to cooperate at watershed and regulatory levels	Large, if regulatory costs can be lessened, security given to private investment, and there is profitable product return
Sawmill considerations	Moderate, related to available timber supply and ability to invest in technological change	Preferential tax programs, loans and other financial relief	Large to smaller owners; small to others
Construction industry and residential considerations	Fluctuations affect demand for lumber	Mortgage rate programs and related programs	Large if construction continues use of lumber
Pulp and paper mill considerations	Small given diversity of remanufacturing sector	Improved product quality, market research and market development for existing products	Moderate, given industry self help efforts
Industry structure and market considerations	Large as significant competition comes from out-of-State	Direct payments or other forms of assistance in both domestic and international markets	Except for trade protection, small given international market pressure to keep prices low
Lack of remuneration in the marketplace for services and goods provided by forest lands	Large because forests provide significant habitat, open space, water, and other environmental services	Use of tax laws and conservation strategies to provide financial support to timber growers; development and use of carbon credits and trading	Large, if the values of goods and services can be captured for carbon and habitat

While qualitative, this table suggests that two areas have both large constraints and potentially large economic benefits of governmental programs in California. The first relates to maintenance of an efficient timber forest products industry with a reliable raw material supply and still capable of providing jobs in both rural and urban communities. The second relates to the lack of remuneration in the market place for services and goods provided by forest lands.

Conclusion

The forest products industry in California competes in a global market that influences prices and directs the flow of investment dollars toward plantations in other countries or regions of the United States that are less expensive. The industry also lives in California amidst a time of spontaneous change in political culture (Romm, 2000). Watershed organizations and other community groups with an interest in rural and urban forests are now found throughout the State. These groups possess a much wider diversity of values and efforts to protect their interests than the forest products industry has had to deal with before.

While still important to the economic base of several rural counties, the economic significance of the forest products industry has declined as economies have diversified and other sources of income such as transfer payments have grown. During the 1990s, actions of governmental agencies greatly reduced available timber supplies from public lands and increased regulation on privately owned lands. Yet, at the same time there has been a shift from site-specific to more regional or watershed-based regulatory approaches, such as habitat restoration or water quality goals. Some believe that there is the potential to give landowners more freedom of action under these approaches (Romm, 2000). There are also significant timber inventories on private lands that grow rapidly and generate considerable local economic opportunity.

With respect to lack of remuneration for goods and services provided by forest lands, the use of conservation easements is just now beginning to be applied to this resource. The next decade could well see a substantial expansion of this tool. In addition, there are hundreds of local watershed or other groups with an interest in forests and new agreements and ways to compensate landowners could well come from these citizen groups.

It remains to be seen if the mix of market considerations and public policies will encourage landowners to keep lands in production as well as allow the harvest of timber at a reasonable cost sometime in the future. It also remains to be seen if sufficient private investment will be made to reclaim underutilized forest land to conifer growing and provide sawmills and remanufacturing plants with up-to-date technology capable of competing in a global market.

Glossary

AF&PA: American Forest and Paper Association.

anadromous: Moving from the sea to fresh water for reproduction.

APHIS: Animal and Plant Health Inspection Service.

artificial cable anchors: Man-made objects used to secure cable yarders during logging.

BOE: California State Board of Equalization.

BOF: California State Board of Forestry and Fire Protection.

cable logging: Harvest of trees using wire rope remotely attacked to a power source that drags logs to the road.

carbon offsets: Agreement between two parties to sequester carbon as a condtion of allowing emission of carbon.

carbon sequestration: The ability of forests or other natural systems to "sink" or store carbon, thereby preventing it from collecting in the atmosphere as CO_2. Forests absorb carbon when they breakdown CO_2 during photosynthesis.

CDCF: Community Development Carbon Fund.

CDF: California Department of Forestry and Fire Protection.

CERES: California Environmental Resources Evaluation System.

CFIP: California Forest Improvement Program.

chipboard: A cheap hard material made from wood chips that are pressed together and bound with synthetic resin.

coliform: Of or relating to the bacilli that commonly inhabit the intestines of humans and other vertebrates, especially the colon bacillus.

EDD: California Employment Development Department.

ESA: Endangered Species Act.

EU: European Union.

even-aged stand: A forest stand or forest type in which relatively small (10-20 year) age differences exist between individual trees. Even-aged stands are often the result of fire, or a harvesting method such as clear-cutting or the shelterwood method; Forest stand where more than 70 percent of the tree stocking falls within three adjacent, decadal, age classes.

FAO: Food and Agriculture Organization of the United Nations

FAS: Foreign Agricultural Service.

FIP: Forestry Incentives Program.

FLA: Forest Legacy Area.

FLP: Forest Legacy Program.

FPR: Forest Practice Rule.

FRAP: Fire and Resource Assessment Program.

GDP: See **gross domestic product**.

GHG: Greenhouse gas.

glue-laminated lumber: Multiple smaller dimensioned slumber adhered together to create a composite wood product of greater engineering strength.

GPS: Global positioning system.

gross domestic product: Total market values of goods and services produced by workers and capital within the United States borders during a given period.

gross state product: Gross output (sales, receipts and other operating income, commodity taxes, and inventory changes) minus intermediate inputs (consumption of goods and services purchased from other United States industries or other nations).

GSP: See **gross state product**.

guyline tension monitors:

harvest block: An area of forest where trees are harvested.

I-beams: A steel joist or girder with short flanges and a cross section formed like the letter I.

laminated strand lumber: A composite of wood and glue where portions of wood fibers are glued together to create a structural wood product.

MBF: Thousand board feet.

MMBF: Million board feet.

NAICS: See **North American Industry Classification System**.

Nonpoint: Pollution whose source cannot be ascertained including runoff from storm water and agricultural, range, and forestry operations, as well as dust and air pollution that contaminate waterbodies.

North American Industry Classification System: A numerical system used to categorize industrial sectors. NAICS updates and replaces the old SIC system.

oriented strand board: A structural panel, usually 4’ x 8 feet in size, of glue and heat pressured wood flakes.

OSB: See **oriented strand board**.

overstory: The larger, taller trees of growth which occupies a forest area and shades young trees, hardwoods, brush, and other deciduous varieties which are growing beneath the larger trees (i.e., understory).

PFT: The Pacific Forest Trust.

phytosanitary: Plant or natural material handling methods to eliminate transported pest or disease.

PNW: Pacific Northwest Research Station.

point: Pollution coming from discrete sources, such as a discharge pipe from a factory or a sewage treatment plant.

pulpwood: Softwood, such as spruce, aspen, or pine, used in making paper.

RFFI: Redwood Forest Foundation, Inc.

riparian: Relating to or located on the banks of a river or stream.

roundwood: Logs, bolts, or other round sections cut from trees.

salmonids: Salmon species.

sawtimber: Live trees of commercial species containing at least one 12' sawlog or two noncontiguous 8' logs. Softwoods must be at least 9" in diameter and hardwoods at least 11" in diameter.

sedimentation: The act of causing the deposit of sediment, especially by the use of a centrifugal machine.

selection method: A silvcultural harvesting system indviual trees are removed while leaving others. seral of or relating to an ecological sere (a seral stage; a seral community).

SFI: Sustainable Forest Initiative.

shelterwood: A silvicultural method to establish seedling regeneration via a series of partial harvests, followed by the almost complete removal of overstory trees in a removal harvest once adequate numbers of seedlings are in place to permit the seedlings to grow in full sunlight.

SIC: Standard Industrial Classification.

siltation: Soil sedimentation deposits in a water body.

silviculture: Generally, the science and art of cultivating (such as with growing and tending) forest crops, based on the knowledge of silvics. More explicitly, the theory and practice of controlling the establishment, composition, constitution, and growth of forests.

SOD: Sudden Oak Death.

snags: Standing dead trees with a minimum DBH of 10 inches and a height of 10 feet.

stumpage: The value of the tree standing on the stump before it is harvested.

thin-kerf: Saw blades with thicknesses less than 1/8 inch.

timberlands: Forest land capable of growing 20 cubic feet or more of industrial wood/acre/year (mean increment at culmination in fully stocked, natural stands.) Timberland is not in a reserved status through removal of the area from timber utilization by statue, ordinance, or administrative order and is not in a withdrawn status pending consideration for reserved.

THP: Timber Harvesting Plan.

TMDL: See **Total Maximum Daily Load**.

Total Maximum Daily Load: A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, as well as an estimation of the percentage originating from each pollution source. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for State-designated purposes. The calculation must also account for seasonal variation in water quality.

TPZ: Timberland Production Zone.

tractor yarding: Transportation of fallen trees in the forest to roadside loading area using bulldozer type equipment.

transition method: Used when the forest manager wants to change an irregular or even-aged stand into an uneven-aged structure.

truss: A rigid framework, as of wooden beams or metal bars, designed to support a structure, such as a roof.

TTCA: California Technology, Trade and Commerce Agency.

UC: University of California.

understory: The trees and other woody species growing under a relatively continuous cover of branches and foliage formed by the overstory trees.

uneven-aged: Silvicultural system in which individual trees originate at different times and result in a forest with trees of many ages and sizes; stands where less than 70 percent of the tree stocking falls in three adjacent 10 year age classes.

USDA: U.S. Department of Agriculture.

USFS: U.S. Forest Service.

variable retention: A silvicutural approach to harvesting based on retention of structural elements or biological legacies from the harvested stand for integrations into a new stand to achieve various ecological objectives (Helm, 1998).

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